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
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Proved 153 of 164 verification conditions.

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

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

Condition defined at:

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

Given:

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

\$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)

invariant1(**heapIs** \$heap$_{funcstart\_724,1}$)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < $ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p1$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p1$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M1$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M2$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M3$))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$heap_{funcstart\_724,1}$.p1$) $ && $(\$heap_{funcstart\_724,1}$.p1$ <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M1$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M2$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M3$))$

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

[5.4] $(((((0 < \$heap_{funcstart\_724,1}$.p1$) $ && $(\$heap_{funcstart\_724,1}$.p1$ <$ **asType**$<$**integer**$>($\$heap_{init}$.M1$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M2$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M3$))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$heap_{funcstart\_724,1}$.p1$) $ && $(\$heap_{funcstart\_724,1}$.p1$ <$ **asType**$<$**integer**$>($**asType**$<$**short int**$>(($**int**$)30269)))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M2$))) $ && $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$)) $ && $($**asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}$.M3$))$

$\rightarrow$ *[simplify]*

[5.16] $((((\text{-}30269 < -\$heap_{funcstart\_724,1}$.p1$) \wedge (0 < \$heap_{funcstart\_724,1}$.p1$) \wedge (0 < \$heap_{funcstart\_724,1}$.p2$)) $ && $(\$heap_{funcstart\_724,1}$.p2$ <$

asType<integer>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<integer>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType<integer>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<integer>(heap_{init}.M2))) && (0 <
asType<integer>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType<integer>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<integer>(**asType<short int>**((**int**)30307)))) && (0 <
asType<integer>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType<integer>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType<integer>**($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType<integer>**(heap_{init}.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType<integer>**(**asType<short
int>**((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-\text{heap}_{funcstart\_724,1}$.p3) $\land$ (-30307 <
$-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 <
$\text{heap}_{funcstart\_724,1}$.p3)

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$heap_{funcstart\_724,1}.p1$

[Take goal term]

[1.0] $\mathbf{minof(int)} \leq \$heap_{funcstart\_724,1}.p1$

$\rightarrow$ *[simplify]*

[1.3] $-32769 < \$heap_{funcstart\_724,1}.p1$

$\rightarrow$ *[from term 8.0, literala $< \$heap_{funcstart\_724,1}.p1$ is true whenever (-1 + literala) < 0]*

    Proof of rule precondition:

    [1.3.0] $(-32769 + -1) < 0$

    $\rightarrow$ *[simplify]*

    [1.3.2] **true**

[1.4] **true**

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

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

Condition defined at:

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

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p1}))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.4] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{init}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30269))))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$

$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{init}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\textbf{asType}\textbf{<}\textbf{short int}\textbf{>}((\textbf{int})30307)))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\textbf{asType}\textbf{<}\textbf{short}$
$\textbf{int}\textbf{>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-\$\text{heap}_{funcstart\_724,1}.\text{p3}$) $\wedge$ (-30307 < $-\$\text{heap}_{funcstart\_724,1}.\text{p2}$) $\wedge$ (-30269 < $-\$\text{heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 < $\$\text{heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 < $\$\text{heap}_{funcstart\_724,1}.\text{p2}$) $\wedge$ (0 < $\$\text{heap}_{funcstart\_724,1}.\text{p3}$)

[Work on sub-term 3 of conjunction in term 5.40]

[7.0] -30269 < $-\$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_724,1}.\text{p1} \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] -32768 < $-\$\text{heap}_{funcstart\_724,1}.\text{p1}$

$\rightarrow$ *[from term 7.0, literala < $-\$heap_{funcstart\_724,1}.p1$ is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.9.0] (-32768 + -1) < -30269

$\rightarrow$ *[simplify]*

[1.9.2] **true**

[1.10] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (47,31)

Condition defined at:

To prove: minof(int) $\leq \$\text{heap}_{funcstart\_724,1}.\text{a1}$

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)

$\$heap_{init}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq \$heap_{funcstart\_724,1}$.a1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq \$heap_{funcstart\_724,1}$.a1

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

[1.2] -32768 $\leq \$heap_{init}$.a1

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

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

$\rightarrow$ *[simplify]*

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (47,31)

Condition defined at:

To prove: $\$heap_{funcstart\_724,1}$.a1 $\leq$ **maxof**(**int**)

Given:

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

$\$heap_{init}$.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)

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{funcstart\_724,1}.\text{a1} \leq \textbf{maxof}(\textbf{int})$

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

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

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

[1.2] $\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})177) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Precondition of 'div' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (47,18)

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

To prove: $0 < \textbf{asType}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{int}\textgreater(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

Proof:

[Take goal term]

[1.0] $0 < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

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

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

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

$\rightarrow$ *[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 (49,22)

Condition defined at:

To prove: minof(int) $\leq \$\text{heap}_{funcstart\_724,1}.\text{p2}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}))\ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}))\ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div1.rem}))\ ||\ !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot}))$

Proof:

[Take given term]

[5.0] $\text{invariant1}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1})$

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$

asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{init}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<integer>(**asType<short int>**((**int**)30307)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType<integer>**($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType<integer>**($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType<integer>**(**asType<short
int>**((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <
$-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $heap$_{funcstart_724,1}$.p2

$\rightarrow$ *[simplify]*

[1.3] -32769 < $heap$_{funcstart_724,1}$.p2

$\rightarrow$ *[from term 9.0, literala < $heap$_{funcstart_724,1}$.p2 is true whenever (-1 +
literala) < 0]*

Proof of rule precondition:

[1.3.0] (-32769 + -1) < 0

$\rightarrow$ *[simplify]*

[1.3.2] **true**

[1.4] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,22)

Condition defined at:

To prove: $\text{\$heap}_{funcstart\_724,1}.\text{p2} \leq \mathbf{maxof(int)}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

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

asType<integer>(div1.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p1)) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p1) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M1))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p2))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p2) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M2))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p3))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p3) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M3))$

$\rightarrow$ *[simplify]*

[5.3] $((((((0 < \$heap_{funcstart\_724,1}.p1) \&\& (\$heap_{funcstart\_724,1}.p1 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M1))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p2))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p2) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M2))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p3))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p3) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M3))$

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

[5.4] $((((((0 < \$heap_{funcstart\_724,1}.p1) \&\& (\$heap_{funcstart\_724,1}.p1 <$ **asType<integer>**$(\$heap_{init}.M1))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p2))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p2) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M2))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p3))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p3) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M3))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$heap_{funcstart\_724,1}.p1) \&\& (\$heap_{funcstart\_724,1}.p1 <$ **asType<integer>**(**asType<short int>**$((\textbf{int})30269)))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p2))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p2) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M2))) \&\& (0 <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.p3))) \&\&$ (**asType<integer>**$(\$heap_{funcstart\_724,1}.p3) <$ **asType<integer>**$(\$heap_{funcstart\_724,1}.M3))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M2}))) \&\& (0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)))) \&\& (0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$

$\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 2 of conjunction in term 5.40]

[6.0] $-30307 < -\text{\$heap}_{funcstart\_724,1}.\text{p2}$

[Take goal term]

[1.0] $\text{\$heap}_{funcstart\_724,1}.\text{p2} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.9] $-32768 < -\text{\$heap}_{funcstart\_724,1}.\text{p2}$

$\rightarrow$ *[from term 6.0, literala $< -\text{\$heap}_{funcstart\_724,1}.\text{p2}$ is true whenever (-1 + literala) < -30307]*

Proof of rule precondition:

[1.9.0] (-32768 + -1) < -30307

$\rightarrow$ *[simplify]*

[1.9.2] **true**

[1.10] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,31)

Condition defined at:

To prove: $\textbf{minof}(\textbf{int}) \leq \text{\$heap}_{funcstart\_724,1}.\text{a2}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

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

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq \text{\$heap}_{funcstart\_724,1}$.a2

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq \text{\$heap}_{funcstart\_724,1}$.a2

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

[1.2] -32768 $\leq \text{\$heap}_{init}$.a2

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[1.3] -32768 $\leq$ **asType<short int>**((**int**)176)

$\rightarrow$ *[simplify]*

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,31)

Condition defined at:

To prove: $\text{\$heap}_{funcstart\_724,1}$.a2 $\leq$ **maxof(int)**

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

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

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_724,1}.\text{a2} \leq \textbf{maxof}(\textbf{int})$

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

[1.1] $\$\text{heap}_{init}.\text{a2} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[1.2] **asType<short int>((int)176) ≤ maxof(int)**

→ *[simplify]*

[1.6] **true**

Proof of verification condition: Precondition of 'div' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (49,18)

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

To prove: $0 <$ **asType<integer>(asType<int>(\$heap**$_{funcstart\_724,1}$**.a2))**

Given:

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

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

$\$heap_{init}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>(asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(asType<int>($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>(asType<int>**($\$heap_{funcstart\_724,1}$.p1)) %
asType<integer>(asType<int>($\$heap_{funcstart\_724,1}$.a1))) ==

asType<**integer**>(div1.rem)

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

Proof:

[Take goal term]

[1.0] $0 <$ **asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.a2))

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

[1.1] $0 <$ **asType**<**integer**>(**asType**<**int**>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[1.2] $0 <$ **asType**<**integer**>(**asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[1.7] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,22)

Condition defined at:

To prove: minof(int) $\leq \$heap_{funcstart\_724,1}$.p3

Given:

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

$\$heap_{init}$.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)

invariant1(**heapIs** $heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType<**int**>($heap_{funcstart\_724,1}$.p1),
asType<**int**>($heap_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

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

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap_{funcstart\_724,1}$.p1)) &&
(**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) <
asType<**integer**>($heap_{funcstart\_724,1}$.M1))) && (0 <
asType<**integer**>($heap_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($heap_{funcstart\_724,1}$.p2) <
asType<**integer**>($heap_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($heap_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($heap_{funcstart\_724,1}$.p3) <
asType<**integer**>($heap_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M1})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**<**integer**>$(\$\text{heap}_{init}.\text{M1})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**<**integer**>$(\textbf{asType}<\textbf{short int}>((\textbf{int})30269))))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[simplify]*

[5.16] $(((((\text{-30269} < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.17] $(((((\text{-30269} < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**<**integer**>$(\$\text{heap}_{init}.\text{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30307)))) && $(0 <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$))) && (**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) $<$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$($\$\text{heap}_{init}.\text{M3}$))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take goal term]

[1.0] **minof**(**int**) $\leq \$\text{heap}_{funcstart\_724,1}.\text{p3}$

$\rightarrow$ *[simplify]*

[1.3] -32769 $< \$\text{heap}_{funcstart\_724,1}.\text{p3}$

$\rightarrow$ *[from term 10.0, literala $< \$\text{heap}_{funcstart\_724,1}.\text{p3}$ is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[1.3.0] (-32769 + -1) < 0

$\rightarrow$ [simplify]

[1.3.2] **true**

[1.4] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,22)

Condition defined at:

To prove: $\$\text{heap}_{funcstart\_724,1}.\text{p}3 \leq \textbf{maxof(int)}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %

asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) == **asType<integer>**(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p2), **asType<int>**($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a2))) == **asType<integer>**(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) % **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a2))) == **asType<integer>**(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 == **asType<integer>**(div2.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p1) < **asType<integer>**($heap$_{funcstart_724,1}$.M1))) && (0 < **asType<integer>**($heap$_{funcstart\_724,1}$.p2))) && (**asType<integer>**($heap$_{funcstart_724,1}$.p2) < **asType<integer>**($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($heap$_{funcstart_724,1}$.p3))) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p3) < **asType<integer>**($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType<integer>**($heap$_{funcstart_724,1}$.M1))) && (0 < **asType<integer>**($heap$_{funcstart\_724,1}$.p2))) && (**asType<integer>**($heap$_{funcstart_724,1}$.p2) < **asType<integer>**($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($heap$_{funcstart_724,1}$.p3))) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p3) < **asType<integer>**($heap$_{funcstart_724,1}$.M3))

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

[5.4] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType<integer>**($heap$_{init}$.M1))) && (0 <

asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M3}))$

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30323)))$

→ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

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

[5.41] $-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_724,1}.\text{p3} \leq \textbf{maxof}(\textbf{int})$

→ *[simplify]*

[1.9] $-32768 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}$

→ *[from term 5.41, literala $< -\$\text{heap}_{funcstart\_724,1}.\text{p3}$ is true whenever (-1 + literala) < -30323]*

Proof of rule precondition:

[1.9.0] $(-32768 + -1) < -30323$

→ *[simplify]*

[1.9.2] **true**

[1.10] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,31)

Condition defined at:

To prove: minof(int) $\leq \$\text{heap}_{funcstart\_724,1}.\text{a3}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}$.p1),
asType<**int**>($\$heap_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

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

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}$.a2))) ==

asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 == **asType<integer>**(div2.quot))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ \$heap$_{funcstart\_724,1}$.a3

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{funcstart\_724,1}$.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 (51,31)

Condition defined at:

To prove: \$heap$_{funcstart\_724,1}$.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)

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{funcstart\_724,1}.\text{a3} \leq$ **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 (51,18)

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

To prove: $0 < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a}3))$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \,/\,$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \,\%\,$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \,||\, !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$

asType\<int\>($\text{heap}_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

Proof:

[Take goal term]

[1.0] 0 < **asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))

→ *[const static or extern object]*

[1.1] 0 < **asType\<integer\>**(**asType\<int\>**(heap_{init}.a3))

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

[1.2] 0 < **asType\<integer\>**(**asType\<int\>**(**asType\<short
int\>**((**int**)178)))

→ *[simplify]*

[1.7] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)

Condition defined at:

To prove: minof(short int) ≤ div1.rem

Given:

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

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)

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1})$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$) /
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$) %
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$) ==
asType\<integer\>(div1.rem)

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

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$) /
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$) %
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})$) /
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})$) %
asType\<integer\>(**asType\<int\>**$(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$) ==

asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 == **asType<integer>**(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p1)) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p1) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 < $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 < **asType<integer>**($\text{\$heap}_{init}$.M1))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] ((((((0 < $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 < **asType<integer>**(**asType<short int>**((**int**)30269)))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p3))) &&

$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ [simplify]

[5.16] $((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ [const static or extern object]

[5.17] $((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ [expand definition of constant 'M2' at prang.c (19,20)]

[5.18] $((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ [simplify]

[5.30] $((\text{-}30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-}30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ [const static or extern object]

[5.31] $((\text{-}30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-}30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ [expand definition of constant 'M3' at prang.c (24,20)]

[5.32] $((\text{-}30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-}30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{int})30323)))$

$\rightarrow$ [simplify]

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType<int>($\$\text{heap}_{init}.\text{a1}$))

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) %
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem)

→ *[simplify]*

[15.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p1}$ % 177) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem)

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

[15.3] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) < 0]:
−(−**asType<integer>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) % 177), []:
asType<integer>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) % 177) ==
asType<integer>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)

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

[15.4] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) < 0]:
−(−**asType<integer>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) % 177),

[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

→ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177), [!(0 < −$heap$_{funcstart\_724,1}$.p1)]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

→ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!**false**]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.17] $0 == (-\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (\$heap_{funcstart\_724,1}.\text{p1} \% 177))$

[Assume known post-assertion, class invariant or type constraint for term 15.17]

[22.0] $\textbf{minof}(\textbf{int}) \leq \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem}$

$\rightarrow$ *[simplify]*

[22.3] $\text{-32769} < \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem}$

[Take goal term]

[1.0] $\textbf{minof}(\textbf{short int}) \leq \text{div1.rem}$

$\rightarrow$ *[simplify]*

[1.1] $\text{-32768} \leq \text{div1.rem}$

$\rightarrow$ *[from term 11.6, div1 is equal to div(*$\textbf{heapIs }$ *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177)]*

[1.2] $\text{-32768} \leq \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem}$

$\rightarrow$ *[simplify]*

[1.4] $\text{-32769} < \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem}$

$\rightarrow$ *[from term 22.3, literala < div(*$\textbf{heapIs }$ *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.4.0] $(\text{-32769} + \text{-1}) < \text{-32769}$

$\rightarrow$ *[simplify]*

[1.4.2] **true**

[1.5] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)

Condition defined at:

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

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 == **asType**<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3), **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3)) / **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3)) % **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 == **asType**<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p1)) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p1) < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] ((((((0 < $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.M3))

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

[5.4] ((((((0 < $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 < **asType**<**integer**>($\text{\$heap}_{init}$.M1))) && (0 < **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) <

asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>(**asType\<short int\>**((**int**)30269)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{init}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>(**asType\<short int\>**((**int**)30307)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType\<integer\>**($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

[11.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{a1}))$

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

[11.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1})\ \%$
$\textbf{asType}<\textbf{integer}>(177)) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[15.2] $(\$\text{heap}_{funcstart\_724,1}.\text{p1}\ \%\ 177) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}$

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)

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

[15.3] ([**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) % 177), []:
asType<**integer**>($heap_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)

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

[15.4] ([**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($heap_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[15.7] ([0 < $-$$heap_{funcstart_724,1}$.p1]:
$-(-$**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($heap_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[from term 8.0, literala < $-$$heap_{funcstart_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: $-(-$**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($heap_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[15.11] ([**false**]: $-(-$**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) % 177), [!(0
< $-$$heap_{funcstart_724,1}$.p1)]: **asType**<**integer**>($heap_{funcstart_724,1}$.p1) %
177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[from term 8.0, literala < $-$$heap_{funcstart_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($heap_{funcstart\_724,1}$.p1) % 177),
[!**false**]: **asType**$<$**integer**$>$($heap_{funcstart\_724,1}$.p1) % 177) ==
asType$<$**integer**$>$(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[15.17] 0 == ($-$div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem + ($heap_{funcstart\_724,1}$.p1 % 177))

*[Assume known post-assertion, class invariant or type constraint for term
15.17]*

[23.0] div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem $\leq$
maxof(**int**)

$\rightarrow$ *[simplify]*

[23.9] -32768 < $-$div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem

[Take goal term]

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

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177)]*

[1.1] div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem $\leq$
maxof(**short int**)

$\rightarrow$ *[simplify]*

[1.10] -32768 < $-$div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem

$\rightarrow$ *[from term 23.9, literala < $-$div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.10.0] (-32768 + -1) < -32768

$\rightarrow$ *[simplify]*

[1.10.2] **true**

[1.11] **true**

Proof of verification condition: Type constraint satisfied in implicit

conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)

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)

$\$heap_{init}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

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

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asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p1) <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&

($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}$.M1))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p2))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p2) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 $<$
$\textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short int>}$((**int**)30269)))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p2))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p2) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}$.M2))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short int>}$((**int**)30307)))) && (0 $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-\$heap_{funcstart\_724,1}.p2) \wedge$ (-30269 <
$-\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge (0 <$
$\$heap_{funcstart\_724,1}.p2) \wedge (0 < \$heap_{funcstart\_724,1}.p3))$ &&
($\$heap_{funcstart\_724,1}.p3 <$ **asType**<**integer**>($\$heap_{funcstart\_724,1}.$M3))

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

[5.31] ((-30307 < $-\$heap_{funcstart\_724,1}.p2) \wedge$ (-30269 <
$-\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge (0 <$
$\$heap_{funcstart\_724,1}.p2) \wedge (0 < \$heap_{funcstart\_724,1}.p3))$ &&
($\$heap_{funcstart\_724,1}.p3 <$ **asType**<**integer**>($\$heap_{init}.$M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-\$heap_{funcstart\_724,1}.p2) \wedge$ (-30269 <
$-\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge (0 <$
$\$heap_{funcstart\_724,1}.p2) \wedge (0 < \$heap_{funcstart\_724,1}.p3))$ &&
($\$heap_{funcstart\_724,1}.p3 <$ **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-\$heap_{funcstart\_724,1}.p3) \wedge$ (-30307 <
$-\$heap_{funcstart\_724,1}.p2) \wedge$ (-30269 < $-\$heap_{funcstart\_724,1}.p1) \wedge (0 <$
$\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p2) \wedge (0 <$
$\$heap_{funcstart\_724,1}.p3)$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $\$heap_{funcstart\_724,1}.p1$

[Take given term]

[11.0] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p1$),
asType<**int**>($\$heap_{funcstart\_724,1}.a1$))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,
asType<**int**>($\$heap_{funcstart\_724,1}.a1$))

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

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,
asType<**int**>($\$heap_{init}.a1$))

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

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

→ *[simplify]*

[15.2] ($\text{heap}_{funcstart\_724,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

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

[15.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177), []:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

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

[15.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$\text{heap}_{funcstart\_724,1}$.p1]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

→ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.11] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$, [!(0 $< -\$\text{heap}_{funcstart\_724,1}.\text{p1})$]: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \%$ 177) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$, [!**false**]: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177) ==$ $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem)

$\rightarrow$ *[simplify]*

[15.17] 0 == $(-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem + $(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))$

[Assume known post-assertion, class invariant or type constraint for term 15.17]

[22.0] $\textbf{minof}(\textbf{int}) \leq \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem

$\rightarrow$ *[simplify]*

[22.3] -32769 < $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq \textbf{asType}<\textbf{short int}>(\text{div1.rem})$

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq \textbf{asType}<\textbf{short int}>(\text{div1.rem})$

$\rightarrow$ *[from term 11.6, div1 is equal to div($\textbf{heapIs } \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p1, 177$)]*

[1.2] -32768 $\leq \textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[1.5] -32769 < $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem

$\rightarrow$ *[from term 22.3, literala $<$ div($\textbf{heapIs } \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p1, 177$).rem is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.5.0] (-32769 + -1) < -32769

$\rightarrow$ *[simplify]*

[1.5.2] **true**

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)

Condition defined at:

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

Given:

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

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

$\$heap_{init}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==

asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) % **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a1))) == **asType<integer>**(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p2), **asType<int>**($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a2))) == **asType<integer>**(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) % **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a2))) == **asType<integer>**(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 == **asType<integer>**(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p3), **asType<int>**($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a3))) == **asType<integer>**(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) % **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a3))) == **asType<integer>**(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 == **asType<integer>**(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p1) < **asType<integer>**($heap$_{funcstart_724,1}$.M1))) && (0 < **asType<integer>**($heap$_{funcstart\_724,1}$.p2))) && (**asType<integer>**($heap$_{funcstart_724,1}$.p2) < **asType<integer>**($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($heap$_{funcstart_724,1}$.p3))) &&

($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.3] ((((($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p1) && ($\$\mathrm{heap}_{funcstart\_724,1}$.p1 <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M1))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M2))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.4] ((((($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p1) && ($\$\mathrm{heap}_{funcstart\_724,1}$.p1 <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{init}$.M1))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M2))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [expand definition of constant 'M1' at prang.c (14,20)]

[5.5] ((((($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p1) && ($\$\mathrm{heap}_{funcstart\_724,1}$.p1 <
$\mathbf{asType}$<$\mathbf{integer}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(($\mathbf{int}$)30269)))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p2) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M2))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.16] ((((-30269 $< -\$\mathrm{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p1) $\wedge$
($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p2)) && ($\$\mathrm{heap}_{funcstart\_724,1}$.p2 <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M2))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.17] ((((-30269 $< -\$\mathrm{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p1) $\wedge$
($0 <$ $\$\mathrm{heap}_{funcstart\_724,1}$.p2)) && ($\$\mathrm{heap}_{funcstart\_724,1}$.p2 <
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{init}$.M2))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\$\mathrm{heap}_{funcstart\_724,1}$.p3))) &&

($\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \land (-30307 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType\<int\>($\$heap_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) %
asType\<integer\>(177)) == **asType\<integer\>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

→ *[simplify]*

[15.2] ($\$heap_{funcstart\_724,1}$.p1 % 177) == **asType\<integer\>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

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

[15.3] ([**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) < 0]:
−(−**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) % 177), []:
asType\<integer\>($\$heap_{funcstart\_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)

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

[15.4] ([**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) < 0]:
−(−**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) % 177),
[!(**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) < 0)]:
asType\<integer\>($\$heap_{funcstart\_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$\$heap_{funcstart\_724,1}$.p1]:
−(−**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) % 177),
[!(**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) < 0)]:
asType\<integer\>($\$heap_{funcstart\_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) % 177),
[!(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[15.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) % 177), [!(0
< $-\$\text{heap}_{funcstart\_724,1}$.p1)]: **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) %
177) == **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) % 177),
[!**false**]: **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p1) % 177) ==
asType$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[15.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem + ($\$\text{heap}_{funcstart\_724,1}$.p1 % 177))

*[Assume known post-assertion, class invariant or type constraint for term
15.17]*

[23.0] div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem $\leq$
maxof(int)

$\rightarrow$ *[simplify]*

[23.9] -32768 < $-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem

[Take goal term]

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

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177)]*

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[1.1] **asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem

$\rightarrow$ *[from term 23.9, literala* $< -div($**heapIs** *$\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.11.0] (-32768 + -1) < -32768

$\rightarrow$ *[simplify]*

[1.11.2] **true**

[1.12] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,10)

Condition defined at:

To prove: minof(**int**) $\leq \$\text{heap}_{funcstart\_724,1}$.r1

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)

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

invariant1(**heapIs** $heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType<**int**>($heap_{funcstart\_724,1}$.p1),
asType<**int**>($heap_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

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

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType<**int**>($heap_{funcstart\_724,1}$.p3),
asType<**int**>($heap_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $heap_{funcstart\_724,1}$.r1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{funcstart\_724,1}$.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 (56,10)

Condition defined at:

To prove: \$heap$_{funcstart\_724,1}$.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)

\$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)

invariant1(**heapIs** \$heap$_{funcstart\_724,1}$)

div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$,

asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take goal term]

[1.0] $heap$_{funcstart_724,1}$.r1 ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.1] $heap$_{init}$.r1 ≤ **maxof**(**int**)

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

[1.2] **asType<short int>((int)171) ≤ 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 (56,13)

Condition defined at:

To prove: minof(int) ≤ (asType<int>(asType<short int>(div1.rem)) * asType<int>($heap$_{funcstart_724,1}$.r1))

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)

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType<integer>(asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(asType<int>($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))$ % $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \;||\; !(0 ==$ $\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs}\; \$\text{heap}_{funcstart\_724,1},$ $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$ $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ / $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ % $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \;||\; !(0 ==$ $\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\; \$\text{heap}_{funcstart\_724,1},$ $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$ $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ / $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ % $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \;||\; !(0 ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))$ && $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \;\&\&\; (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \;\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

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

[5.4] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$ **asType**<**integer**>$(\$\mathrm{heap}_{init}.\mathrm{M1})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$ **asType**<**integer**>$(\mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30269))))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

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

[5.17] $(((((\text{-}30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$ **asType**<**integer**>$(\$\mathrm{heap}_{init}.\mathrm{M2})))$ && $(0 <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))$ && $(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} < \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)))) \&\& (0 < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<**int**>($\$heap_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Take goal term]

[1.0] **minof**(**int**) ≤ (**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\$heap_{funcstart\_724,1}$.r1))

→ *[simplify]*

[1.1] -32768 ≤ (**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\$heap_{funcstart\_724,1}$.r1))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177)]*

[1.2] -32768 ≤ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) *
asType<**int**>($\$heap_{funcstart\_724,1}$.r1))

→ *[simplify]*

[1.4] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1))

→ *[const static or extern object]*

[1.5] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem * **asType**<**int**>($\$heap_{init}$.r1))

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

[1.6] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171)))

→ *[simplify]*

[1.11] -32769 < (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)

→ *[literal comparison of product]*

[1.12] ([171 < 0]: (-32769 / -171) < −div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem, [0 < 171]: (-32769 / 171) < div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem, [0 == 171]: -32769 < 0)

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

[1.13] ([171 < 0]: (-32769 / -171) < −div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem, $[(0 < 171) \land !(171 < 0)]$: (-32769 / 171) < div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem, $[(0 == 171) \land !(0 < 171) \land !(171 < 0)]$: -32769 < 0)

→ [simplify]

[1.21] -192 < div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem

→ [negate goal and search for contradiction]

[1.22] !(-192 < div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

→ [simplify]

[1.24] 191 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

→ [simplify]

[15.2] ($\text{heap}_{funcstart\_724,1}.\text{p}1$ % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

→ [expand definition of operator '.%' in class 'int' at built in declaration]

[15.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) < 0]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177), []: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

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

[15.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) < 0]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

→ [simplify]

[15.7] ([0 < −$\text{heap}_{funcstart\_724,1}.\text{p}1$]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p}1$) % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p}1$, 177).rem)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.p1) \% 177)$, [!(**asType**<**integer**>($\$heap_{funcstart\_724,1}.p1$) < 0)]: **asType**<**integer**>($\$heap_{funcstart\_724,1}.p1$) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)

$\rightarrow$ *[simplify]*

[15.11] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.p1) \% 177)$, [!(0 < $-\$heap_{funcstart\_724,1}.p1$)]: **asType**<**integer**>($\$heap_{funcstart\_724,1}.p1$) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.p1) \% 177)$, [!**false**]: **asType**<**integer**>($\$heap_{funcstart\_724,1}.p1$) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)

$\rightarrow$ *[simplify]*

*[15.17] 0 == ($-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem + ($\$heap_{funcstart\_724,1}.p1$ % 177))*

[Create new term from terms 1.24, 15.17 using rule: transitivity 15]

[55.0] (0 + 191) < $-(\$heap_{funcstart\_724,1}.p1 \% 177)$

$\rightarrow$ *[simplify]*

[55.2] **false**

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

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

Condition defined at:

To prove: (asType<int>(asType<short int>(div1.rem)) * asType<int>($heap$_{funcstart_724,1}$.r1)) ≤ 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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType<**int**>($\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{p3}$)) %
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p1}$)) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p1}$) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{M1}$))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p2}$))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p2}$) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{M2}$))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p3}$) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{M3}$))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $\text{heap}_{funcstart\_724,1}.\text{p1}$) && ($\text{heap}_{funcstart\_724,1}.\text{p1}$ <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{M1}$))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p2}$))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p2}$) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{M2}$))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\text{p3}$) <

asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] $(((((0 < \$heap_{funcstart\_724,1}.p1)$ && $(\$heap_{funcstart\_724,1}.p1 <$
asType<integer>($heap$_{init}$.M1))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) $<$
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) $<$
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$heap_{funcstart\_724,1}.p1)$ && $(\$heap_{funcstart\_724,1}.p1 <$
asType<integer>(**asType<short int>**((**int**)30269)))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) $<$
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) $<$
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge$
$(0 < \$heap_{funcstart\_724,1}.p2))$ && $(\$heap_{funcstart\_724,1}.p2 <$
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) $<$
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] $(((((-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge$
$(0 < \$heap_{funcstart\_724,1}.p2))$ && $(\$heap_{funcstart\_724,1}.p2 <$
asType<integer>($heap$_{init}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) $<$
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge$
$(0 < \$heap_{funcstart\_724,1}.p2))$ && $(\$heap_{funcstart\_724,1}.p2 <$
asType<integer>(**asType<short int>**((**int**)30307)))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) $<$
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \land (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

[11.2] $\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{a1}))$

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

[11.3] $\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Take goal term]

[1.0] (**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) $\leq$ **maxof(int)**

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[1.1] (**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) $\leq$
maxof(int)

$\rightarrow$ *[simplify]*

[1.3] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) $\leq$ **maxof(int)**

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

[1.4] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) $\leq$ **maxof(int)**

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

[1.5] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>(**asType<short int>**((**int**)171))) $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.18] -32768 < (-171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)

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

[1.19] ([-171 < 0]: (-32768 / 171) < $-$div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem, [0 < -171]: (-32768 / -171) < div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem, [-171 == 0]: -32768 <
0)

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

[1.20] ([-171 < 0]: (-32768 / 171) < $-$div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem, [(0 < -171) $\wedge$!(-171 < 0)]: (-32768 / -171) <
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem, [(-171 ==
0) $\wedge$!(-171 < 0) $\wedge$!(0 < -171)]: -32768 < 0)

$\rightarrow$ *[simplify]*

[1.24] -192 < $-$div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem

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

[1.25] !(-192 < $-$div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[1.28] 191 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

→ *[simplify]*

[15.2] ($heap$_{funcstart_724,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

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

[15.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

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

[15.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

→ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177), [!(0 < $-\text{heap}_{funcstart\_724,1}$.p1)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[from term 8.0, literala < $-\text{heap}_{funcstart\_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177), [!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[15.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem + ($\text{heap}_{funcstart\_724,1}$.p1 % 177))

[Create new term from terms 1.28, 15.17 using rule: transitivity 16]

[55.0] (0 + 191) < ($\text{heap}_{funcstart\_724,1}$.p1 % 177)

$\rightarrow$ *[simplify]*

[55.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)

Condition defined at:

To prove: minof(short int) $\leq$ 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)

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType\<integer>**(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType\<integer>(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType\<integer>(div1.quot)

(**asType\<integer>**(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType\<integer>(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType\<integer>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType\<integer>**(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType\<integer>(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType\<integer>(div2.quot)

(**asType\<integer>**(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType\<integer>(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType\<integer>(div2.rem)

!(0 == **asType\<integer>**(div2.rem)) || !(0 ==
asType\<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType\<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType\<integer>**(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /
asType\<integer>(**asType\<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType\<integer>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1)) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M1))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M1))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>(heap_{init}.M1))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <

asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType\<integer\>(heap_{init}.M2))) && (0 <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType\<integer\>(**asType\<short int\>**((**int**)30307)))) && (0 <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**(heap_{init}.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**(**asType\<short
int\>**((**int**)30323)))

→ [simplify]

[5.40] (-30323 < −$\text{heap}_{funcstart\_724,1}$.p3) ∧ (-30307 <
−$\text{heap}_{funcstart\_724,1}$.p2) ∧ (-30269 < −$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 <
$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p2) ∧ (0 <
$\text{heap}_{funcstart\_724,1}$.p3)

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $\text{heap}_{funcstart\_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType\<int\>(heap_{init}.a1))

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

[11.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p1) /
asType\<integer\>(177)) == **asType\<integer\>**(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.2] ($\text{heap}_{funcstart\_724,1}$.p1 / 177) == **asType\<integer\>**(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p1) < 0]:
−(−**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p1) / 177), []:
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

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

[14.4] ([**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p1) < 0]:

$-(-$**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177),$
$[!($**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) < 0)]:$
asType$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177) ==$
asType$<$**integer**$>($div($**heapIs** \$heap$_{funcstart_724,1}$, \$heap$_{funcstart_724,1}$.p1,$
$177).$quot$)$

$\rightarrow$ *[simplify]*

[14.7] $([0 < -$\$heap$_{funcstart\_724,1}$.p1$]:$
$-(-$**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177),$
$[!($**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) < 0)]:$
asType$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177) ==$
asType$<$**integer**$>($div($**heapIs** \$heap$_{funcstart_724,1}$, \$heap$_{funcstart_724,1}$.p1,$
$177).$quot$)$

$\rightarrow$ *[from term 8.0, literala $< -$\$heap$_{funcstart\_724,1}$.p1 is false whenever -2 < (0 + literala)]*

> **Proof of rule precondition:**
>
> *[14.7.0]* -2 < (0 + 0)
>
> $\rightarrow$ *[simplify]*
>
> *[14.7.2]* **true**

[14.8] $([$**false**$]: -(-$**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177),$
$[!($**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) < 0)]:$
asType$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177) ==$
asType$<$**integer**$>($div($**heapIs** \$heap$_{funcstart_724,1}$, \$heap$_{funcstart_724,1}$.p1,$
$177).$quot$)$

$\rightarrow$ *[simplify]*

[14.11] $([$**false**$]: -(-$**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177), [!(0 <$
$-$\$heap$_{funcstart\_724,1}$.p1$)]:$ **asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177)$
$==$ **asType**$<$**integer**$>($div($**heapIs** \$heap$_{funcstart_724,1}$,$
\$heap$_{funcstart\_724,1}$.p1, $177).$quot$)$

$\rightarrow$ *[from term 8.0, literala $< -$\$heap$_{funcstart\_724,1}$.p1 is false whenever -2 < (0 + literala)]*

> **Proof of rule precondition:**
>
> *[14.11.0]* -2 < (0 + 0)
>
> $\rightarrow$ *[simplify]*
>
> *[14.11.2]* **true**

[14.12] $([$**false**$]: -(-$**asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177),$
$[!$**false**$]:$ **asType**$<$**integer**$>($\$heap$_{funcstart\_724,1}$.p1$) / 177) ==$
asType$<$**integer**$>($div($**heapIs** \$heap$_{funcstart_724,1}$, \$heap$_{funcstart_724,1}$.p1,$
$177).$quot$)$

$\rightarrow$ *[simplify]*

[14.17] $0 == (-\mathrm{div}(\textbf{heapIs } \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot} + (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} \ / \ 177))$

[Assume known post-assertion, class invariant or type constraint for term 14.17]

[20.0] $\textbf{minof}(\textbf{int}) \leq \mathrm{div}(\textbf{heapIs } \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot}$

$\rightarrow$ *[simplify]*

[20.3] $\text{-32769} < \mathrm{div}(\textbf{heapIs } \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot}$

[Take goal term]

[1.0] $\textbf{minof}(\textbf{short int}) \leq \mathrm{div1.quot}$

$\rightarrow$ *[simplify]*

[1.1] $\text{-32768} \leq \mathrm{div1.quot}$

$\rightarrow$ *[from term 11.6, div1 is equal to div(*$\textbf{heapIs }$ *$heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}.p1$, 177)]

[1.2] $\text{-32768} \leq \mathrm{div}(\textbf{heapIs } \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot}$

$\rightarrow$ *[simplify]*

[1.4] $\text{-32769} < \mathrm{div}(\textbf{heapIs } \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot}$

$\rightarrow$ *[from term 20.3, literala < div(*$\textbf{heapIs }$ *$heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}.p1$, 177).quot is true whenever (-1 + literala) < -32769]

Proof of rule precondition:

[1.4.0] $(\text{-32769} + \text{-1}) < \text{-32769}$

$\rightarrow$ *[simplify]*

[1.4.2] **true**

[1.5] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)

Condition defined at:

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

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p1$),
asType<int>($\$heap_{funcstart\_724,1}.a1$))

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_724,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_724,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.rem)

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

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

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_724,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_724,1}.p2$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==

asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 == **asType**<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3), **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3)) / **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3)) % **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 == **asType**<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1)) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M1))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M1))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 < **asType**<**integer**>(heap_{init}.M1))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&

($\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30269)))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.17] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M2}))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)))) \ \&\& \ (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((\text{-}30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-}30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

[11.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{init}.\text{a1}))$

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

[11.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] $(\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p1})\ /\ \textbf{asType}\!<\!\textbf{integer}\!>\!(177)) == \textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

$\rightarrow$ *[simplify]*

[14.2] ($heap$_{funcstart_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

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

[14.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

→ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177), [!(0 <
−$heap$_{funcstart_724,1}$.p1)]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p1) / 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0*

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+ literala)]

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

→ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177), [!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.17] 0 == (−div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot + ($\text{heap}_{funcstart\_724,1}$.p1 / 177))

[Assume known post-assertion, class invariant or type constraint for term 14.17]

[21.0] div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot ≤ **maxof**(**int**)

→ *[simplify]*

[21.9] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot

[Take goal term]

[1.0] div1.quot ≤ **maxof**(**short int**)

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[1.1] div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot ≤ **maxof**(**short int**)

→ *[simplify]*

[1.10] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot

→ *[from term 21.9, literala < −div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.10.0] (-32768 + -1) < -32768

→ *[simplify]*

[1.10.2] **true**

[1.11] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)

Condition defined at:

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p1) <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <

asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>(heap_{init}.M1))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] ((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>(heap_{init}.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <

asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType<integer>**($heap$_{funcstart_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType<integer>**($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType<integer>**(**asType<short int>**((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\wedge$ (-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $heap$_{funcstart_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p1), **asType<int>**($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>**($heap$_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>**($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>**(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.2] ($\$\mathrm{heap}_{funcstart\_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot)

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

[14.3] ([**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177), []:
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1,
177).quot)

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

[14.4] ([**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[14.7] ([0 < $-\$\mathrm{heap}_{funcstart\_724,1}$.p1]:
$-(-$**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[from term 8.0, literala < $-\$\mathrm{heap}_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: $-(-$**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[14.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) / 177), [!(0 $<$ $-\$$heap$_{funcstart\_724,1}$.p1)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) / 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[from term 8.0, literala $< -\$$heap$_{funcstart\_724,1}$.p1 is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[14.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) / 177), [!**false**]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) / 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.17] 0 $==$ ($-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot + ($\$$heap$_{funcstart\_724,1}$.p1 / 177))

[Assume known post-assertion, class invariant or type constraint for term 14.17]

[20.0] **minof**(**int**) $\leq$ div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot

$\rightarrow$ *[simplify]*

[20.3] -32769 $<$ div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot

[Take goal term]

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

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ **asType**$<$**short int**$>$(div1.quot)

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177)]*

[1.2] -32768 $\leq$ **asType**$<$**short int**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[1.5] -32769 $<$ div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot

→ *[from term 20.3, literala < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.5.0] (-32769 + -1) < -32769

→ *[simplify]*

[1.5.2] **true**

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)

Condition defined at:

To prove: asType<short int>(div1.quot) ≤ **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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType<int>**($\$heap_{funcstart\_724,1}$.p1), **asType<int>**($\$heap_{funcstart\_724,1}$.a1))

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(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <

asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((($-30269 < -$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$heap$_{funcstart\_724,1}$.p3) $\land$ (-30307 <
$-$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2) $\land$ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $heap$_{funcstart_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<**int**>($\$heap_{funcstart\_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<**int**>($\$heap_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.2] ($\$heap_{funcstart\_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177), []:
asType<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).quot)

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

[14.4] ([**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.7] ([0 < −$\$heap_{funcstart\_724,1}$.p1]:
−(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\$heap_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).quot)

→ *[from term 8.0, literala < −$\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0*

+ literala)]

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.11] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(0 < $-\$\text{heap}_{funcstart\_724,1}$.p1)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[from term 8.0, literala < $-\$\text{heap}_{funcstart\_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!**false**]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot + ($\$\text{heap}_{funcstart\_724,1}$.p1 / 177))

[Assume known post-assertion, class invariant or type constraint for term 14.17]

[21.0] div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[21.9] -32768 < $-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot

[Take goal term]

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

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[1.1] **asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot

$\rightarrow$ *[from term 21.9, literala $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot is true whenever (-1 + literala) < -32768]*

> **Proof of rule precondition:**
>
> *[1.11.0]* (-32768 + -1) < -32768
>
> $\rightarrow$ *[simplify]*
>
> *[1.11.2]* **true**

[1.12] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,35)

Condition defined at:

To prove: minof(int) $\leq \$heap_{funcstart\_724,1}$.b1

Given:

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

$\$heap_{init}$.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)

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

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

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

invariant1($\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}$)

div1 == div($\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p1})$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem}))\ ||\ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

div2 == div($\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p2})$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

div3 == div($\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p3})$,
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p3}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\text{\$heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem}))\ ||\ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ \$heap$_{funcstart\_724,1}$.b1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{funcstart\_724,1}$.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 (56,35)

Condition defined at:

To prove: \$heap$_{funcstart\_724,1}$.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)

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_724,1}$.b1 $\leq$ **maxof**(**int**)

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

[1.1] $heap_{init}$.b1 $\leq$ **maxof(int)**

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.2] **asType\<short int\>((int)2)** $\leq$ **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 (56,38)

Condition defined at:

To prove: minof(int) $\leq$ **(asType\<int\>(asType\<short int\>(div1.quot)) * asType\<int\>($heap$_{funcstart_724,1}$.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)**

invariant1(**heapIs** $heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p1),
asType\<int\>($heap$_{funcstart_724,1}$.a1))

(**asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p1))** /

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**asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a1))) ==
asType\<integer\>**(div1.quot)

**(asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p1)) %
asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a1))) ==
asType\<integer\>**(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p2),
asType\<int\>($heap$_{funcstart_724,1}$.a2))

**(asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p2)) /
asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>**(div2.quot)

**(asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p2)) %
asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>**(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p3),
asType\<int\>($heap$_{funcstart_724,1}$.a3))

**(asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p3)) /
asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>**(div3.quot)

**(asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.p3)) %
asType\<integer\>(asType\<int\>($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>**(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType\<integer\>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) <
asType\<integer\>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <

asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] ((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{init}$.M2))) && (0 <

asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-\$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p1) $\land$
(0 < $\$heap$_{funcstart_724,1}$.p2)) && ($\$heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($\$heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($\$heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($\$heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-\$heap$_{funcstart_724,1}$.p2) $\land$ (-30269 <
$-\$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$\$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p3)) &&
($\$heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($\$heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-\$heap$_{funcstart_724,1}$.p2) $\land$ (-30269 <
$-\$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$\$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p3)) &&
($\$heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($\$heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-\$heap$_{funcstart_724,1}$.p2) $\land$ (-30269 <
$-\$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$\$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p3)) &&
($\$heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-\$heap$_{funcstart_724,1}$.p3) $\land$ (-30307 <
$-\$heap$_{funcstart_724,1}$.p2) $\land$ (-30269 < $-\$heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$\$heap$_{funcstart_724,1}$.p1) $\land$ (0 < $\$heap$_{funcstart_724,1}$.p2) $\land$ (0 <
$\$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $\$heap$_{funcstart_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** $\$heap$_{funcstart_724,1}$,
asType<**int**>($\$heap$_{funcstart_724,1}$.p1),
asType<**int**>($\$heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$heap$_{funcstart_724,1}$, $\$heap$_{funcstart_724,1}$.p1,

asType<**int**>($\text{heap}_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>(heap_{init}.a1))

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

[11.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177)

[Take goal term]

[1.0] **minof**(**int**) $\leq$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.b1))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.b1))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177)]*

[1.2] -32768 $\leq$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.b1))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))

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

[1.5] -32768 $\leq$ (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot * **asType**<**int**>(heap_{init}.b1))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.6] -32768 $\leq$ (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))

$\rightarrow$ *[simplify]*

[1.11] -32769 < (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

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

[1.12] ([2 < 0]: (-32769 / -2) < $-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot, [0 < 2]: (-32769 / 2) < div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot, [0 == 2]: -32769 < 0)

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

[1.13] ([2 < 0]: (-32769 / -2) < −div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot, [(0 < 2) ∧ !(2 < 0)]: (-32769 / 2) < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot, [(0 == 2) ∧ !(0 < 2) ∧ !(2 < 0)]: -32769 < 0)

→ *[simplify]*

[1.21] -16385 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot

→ *[negate goal and search for contradiction]*

[1.22] !(-16385 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[1.24] 16384 < −div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.2] ($\$\text{heap}_{funcstart\_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]: −(−**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

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

[14.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]: −(−**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.7] ([0 < −$\$\text{heap}_{funcstart\_724,1}$.p1]: −(−**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]:

asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[14.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(0 <
$-\$heap_{funcstart\_724,1}$.p1)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177)
== **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177),
[!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

*[14.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot + ($\text{heap}_{funcstart\_724,1}$.p1 / 177))*

[Create new term from terms 1.24, 14.17 using rule: transitivity 15]

[55.0] (0 + 16384) < $-$($\text{heap}_{funcstart\_724,1}$.p1 / 177)

$\rightarrow$ *[simplify]*

[55.7] 2899968 < $-\$heap_{funcstart\_724,1}$.p1

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0*

+ literala)]

Proof of rule precondition:

[55.7.0] -2 < (0 + 2899968)

$\rightarrow$ *[simplify]*

[55.7.2] **true**

[55.8] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,38)

Condition defined at:

To prove: $(\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.quot}))$ * $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1})) \leq \textbf{maxof}(\textbf{int})$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ /$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \%$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})) \mathbin{||} !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ /$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \%$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})) \mathbin{||} !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ /$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ \%$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})) \mathbin{||} !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot}))$

Proof:

[Take given term]

[5.0] $\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$

asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269))))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.30] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 <
−$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 3 of conjunction in term 5.40]

[7.0] -30269 < −$heap$_{funcstart_724,1}$.p1

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] 0 < $heap$_{funcstart_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),

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

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
asType\<int\>($heap_{funcstart\_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
asType\<int\>($heap_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)

[Take goal term]

[1.0] (**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($heap_{funcstart\_724,1}$.b1)) ≤ **maxof(int)**

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177)]*

[1.1] (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType\<int\>**($heap_{funcstart\_724,1}$.b1))
≤ **maxof(int)**

→ *[simplify]*

[1.3] (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot *
asType\<int\>($heap_{funcstart\_724,1}$.b1)) ≤ **maxof(int)**

→ *[const static or extern object]*

[1.4] (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot *
asType\<int\>($heap_{init}$.b1)) ≤ **maxof(int)**

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.5] (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot *
asType\<int\>(**asType\<short int\>**((**int**)2))) ≤ **maxof(int)**

→ *[simplify]*

[1.18] -32768 < (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot)

→ *[literal comparison of product]*

[1.19] ([-2 < 0]: (-32768 / 2) < −div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot, [0 < -2]: (-32768 / -2) < div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot, [-2 == 0]: -32768 < 0)

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

[1.20] ([-2 < 0]: (-32768 / 2) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [(0 < -2) ∧ !(-2 < 0)]: (-32768 / -2) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [(-2 == 0) ∧ !(-2 < 0) ∧ !(0 < -2)]: -32768 < 0)

→ *[simplify]*

[1.24] -16384 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot

→ *[negate goal and search for contradiction]*

[1.25] !(-16384 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[1.28] 16383 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / **asType<integer>**(177)) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.2] ($\$heap_{funcstart\_724,1}$.p1 / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) < 0]: −(−**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / 177), []: **asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

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

[14.4] ([**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) < 0]: −(−**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / 177), [!(**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) < 0)]: **asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.7] ([0 < −$\$heap_{funcstart\_724,1}$.p1]: −(−**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) / 177), [!(**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) < 0)]:

asType<integer>($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).quot)

$\rightarrow$ *[from term 8.0, literala < $-\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177),
[!(**asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) < 0)]:
asType<integer>($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).quot)

$\rightarrow$ *[simplify]*

[14.11] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177), [!(0 <
$-\$heap_{funcstart\_724,1}.\text{p1}$)]: **asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177)
== **asType<integer>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot)

$\rightarrow$ *[from term 8.0, literala < $-\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177),
[!**false**]: **asType<integer>**($\text{heap}_{funcstart\_724,1}.\text{p1}$) / 177) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).quot)

$\rightarrow$ *[simplify]*

[14.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).quot + ($\text{heap}_{funcstart\_724,1}.\text{p1}$ / 177))

[Create new term from terms 1.28, 14.17 using rule: transitivity 16]

[55.0] (0 + 16383) < ($\text{heap}_{funcstart\_724,1}.\text{p1}$ / 177)

$\rightarrow$ *[simplify]*

[55.8] 2899967 < $\text{heap}_{funcstart\_724,1}.\text{p1}$

$\rightarrow$ *[from term 7.0, literala < $\$heap_{funcstart\_724,1}.p1$ is false whenever -2 <*

(-30269 + literala)]

Proof of rule precondition:

[55.8.0] -2 < (-30269 + 2899967)

$\rightarrow$ *[simplify]*

[55.8.2] **true**

[55.9] **false**

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

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

Condition defined at:

To prove: minof(short int) $\leq$ ((asType\<int\>(asType\<short int\>(div1.rem)) * asType\<int\>($heap$_{funcstart_724,1}$.r1)) $-$ (asType\<int\>(asType\<short int\>(div1.quot)) * asType\<int\>($heap$_{funcstart_724,1}$.b1)))

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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p1) <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <

asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{init}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.17] $(((((-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}))$ && $(\$heap_{funcstart\_724,1}.\mathrm{p2} <$ **asType$<$integer$>$**$(\$heap_{init}.\mathrm{M2}))) $ && $(0 <$ **asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{p3})))$ && $($**asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{p3}) <$ **asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}))$ && $(\$heap_{funcstart\_724,1}.\mathrm{p2} <$ **asType$<$integer$>$**$($**asType$<$short int$>$**$(($**int**$)30307)))) $ && $(0 <$ **asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{p3})))$ && $($**asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{p3}) <$ **asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p3}))$ && $(\$heap_{funcstart\_724,1}.\mathrm{p3} <$ **asType$<$integer$>$**$(\$heap_{funcstart\_724,1}.\mathrm{M3}))$

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

[5.31] $((-30307 < -\$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p3}))$ && $(\$heap_{funcstart\_724,1}.\mathrm{p3} <$ **asType$<$integer$>$**$(\$heap_{init}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p3}))$ && $(\$heap_{funcstart\_724,1}.\mathrm{p3} <$ **asType$<$integer$>$**$($**asType$<$short int$>$**$(($**int**$)30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$heap_{funcstart\_724,1}.\mathrm{p3}) \wedge (-30307 < -\$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p3})$

[Work on sub-term 3 of conjunction in term 5.40]

[7.0] $-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$heap_{funcstart\_724,1}.\mathrm{p1}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>($\$\text{heap}_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177)

[Take goal term]

[1.0] **minof(short int)** $\leq$ ((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ ((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177)]*

[1.2] -32768 $\leq$ ((**asType<int>**(**asType<short int>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.b1)))

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

[1.5] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem * **asType<int>**($\$\text{heap}_{init}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))

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

[1.6] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**(**asType\<short int\>**((**int**)171))) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.9] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[1.10] -32768 $\leq$ ((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.12] -32768 $\leq$ ((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))

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

[1.13] -32768 $\leq$ ((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**($\$heap_{init}$.b1)))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.14] -32768 $\leq$ ((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**(**asType\<short int\>**((**int**)2))))

$\rightarrow$ *[simplify]*

[1.21] -32769 $<$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))

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

[1.22] !(-32769 $<$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

$\rightarrow$ *[simplify]*

[1.27] 32768 $<$ ((2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[simplify]*

[14.2] ($heap$_{funcstart_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[14.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

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

[14.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

   Proof of rule precondition:

   [14.7.0] -2 < (0 + 0)

   → *[simplify]*

   [14.7.2] **true**

[14.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) / 177), [!(0 $<$ $-\$heap_{funcstart\_724,1}$.p1)]: **asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) / 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}$.p1 is false whenever -2 $< (0 + literala)]$*

Proof of rule precondition:

[14.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) / 177), [!**false**]: **asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) / 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.17] 0 $== (-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot + ($\$heap_{funcstart\_724,1}$.p1 / 177))

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) % **asType**$<$**integer**$>$(177)) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[15.2] ($\$heap_{funcstart\_724,1}$.p1 % 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

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

[15.3] ([**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) < 0]: $-(-$**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) % 177), []: **asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) % 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

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

[15.4] ([**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) < 0]: $-(-$**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) % 177), [!(**asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) < 0)]: **asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}$.p1) % 177) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[15.7] $([0 < -\$heap_{funcstart\_724,1}.\text{p1}]$:
$-(-\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem})$

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 $<$ (0*
+ literala)]

> **Proof of rule precondition:**
>
> *[15.7.0]* -2 $< (0 + 0)$
>
> $\rightarrow$ *[simplify]*
>
> *[15.7.2]* **true**

[15.8] $([\textbf{false}]: -(-\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem})$

$\rightarrow$ *[simplify]*

[15.11] $([\textbf{false}]: -(-\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177), [!(0$
$< -\$heap_{funcstart\_724,1}.\text{p1})]$: $\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \%$
$177) == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 $<$ (0*
+ literala)]

> **Proof of rule precondition:**
>
> *[15.11.0]* -2 $< (0 + 0)$
>
> $\rightarrow$ *[simplify]*
>
> *[15.11.2]* **true**

[15.12] $([\textbf{false}]: -(-\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!\textbf{false}]$: $\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem})$

$\rightarrow$ *[simplify]*

[15.17] $0 == (-\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem} + (\$heap_{funcstart\_724,1}.\text{p1} \% 177))$

[Copy term 1.27]

[58.0] $32768 < ((\text{-171} * \text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs} \ \$heap_{funcstart\_724,1},$

$\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))$

→ *[from term 15.17, div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem is equal to $\text{\$heap}_{funcstart\_724,1}.p1$ % 177]*

[58.1] $32768 < ((-171 * (\text{\$heap}_{funcstart\_724,1}.\text{p1} \% 177)) + (2 * \text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))$

[Create new term from term 14.17 using rule: condition for equality of division]

[62.0] $((177 * (0 + -(-\text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))) < (1 + \text{\$heap}_{funcstart\_724,1}.\text{p1})) \wedge$ $(\text{\$heap}_{funcstart\_724,1}.\text{p1} < (177 * (0 + 1 + -(-\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))))$

→ *[simplify]*

[62.15] $(-1 < ((-177 * \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}) + \text{\$heap}_{funcstart\_724,1}.\text{p1})) \wedge (-177 < (-\text{\$heap}_{funcstart\_724,1}.\text{p1} +$ $(177 * \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))$

[Work on sub-term 2 of conjunction in term 62.15]

[63.0] $-1 < ((-177 * \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}) + \text{\$heap}_{funcstart\_724,1}.\text{p1})$

[Create new term from terms 63.0, 7.0 using rule: transitivity 2]

[77.0] $(-30269 + -1 + 1) < (-177 * \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

→ *[simplify]*

[77.1] $-30269 < (-177 * \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

→ *[literal comparison of product]*

[77.2] $([-177 < 0]: (-30269 / 177) < -\text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 < -177]: (-30269 / -177) < \text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [-177 == 0]: -30269 <$ $0)$

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

[77.3] $([-177 < 0]: (-30269 / 177) < -\text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [(0 < -177) \wedge !(-177 < 0)]: (-30269 / -177)$ $< \text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [(-177$ $== 0) \wedge !(-177 < 0) \wedge !(0 < -177)]: -30269 < 0)$

→ *[simplify]*

[77.7] $-172 < -\text{div}(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}$

[Create new term from terms 77.7, 58.1 using rule: transitivity 5]

[81.0] $32768 < ((-171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177)) + (2 * -(-172 + 1)))$

$\rightarrow$ *[simplify]*

[81.5] $32426 < (-171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))$

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

[81.6] $([-171 < 0]: (32426 / 171) < -(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 < -171]: (32426 / -171) < (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [-171 == 0]: 32426 < 0)$

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

[81.7] $([-171 < 0]: (32426 / 171) < -(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(0 < -171) \wedge !(-171 < 0)]: (32426 / -171) < (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(-171 == 0) \wedge !(-171 < 0) \wedge !(0 < -171)]: 32426 < 0)$

$\rightarrow$ *[simplify]*

[81.12] **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 (56,33)

Condition defined at:

To prove: $((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div1.rem})) * \mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div1.quot})) * \mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))) \leq \mathbf{maxof(short\ int)}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < $ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p1$))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p1$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M1$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M2$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M3$))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < $\$heap_{funcstart\_724,1}.$p1$) $\&\&$ ($\$heap_{funcstart\_724,1}.$p1 $<$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M1$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M2$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M3$))$

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

[5.4] $(((((0 < $\$heap_{funcstart\_724,1}.$p1$) $\&\&$ ($\$heap_{funcstart\_724,1}.$p1 $<$ **asType**$<$**integer**$>($\$heap_{init}.$M1$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M2$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M3$))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < $\$heap_{funcstart\_724,1}.$p1$) $\&\&$ ($\$heap_{funcstart\_724,1}.$p1 $<$ **asType**$<$**integer**$>($**asType**$<$**short int**$>((\textbf{int})30269))))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p2$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M2$)))$ $\&\&$ $(0 <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$)))$ $\&\&$ (**asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$p3$) <$ **asType**$<$**integer**$>($\$heap_{funcstart_724,1}.$M3$))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$ (**asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

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

[5.17] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{init}.\mathrm{M2}))) \&\& (0 <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$ (**asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$ **asType**$<$**integer**$>($**asType**$<$**short int**$>(($**int**$)30307)))) \&\& (0 <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$ (**asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$ $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

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

[5.31] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$ $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} <$ **asType**$<$**integer**$>(\$\mathrm{heap}_{init}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$ $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} <$ **asType**$<$**integer**$>($**asType**$<$**short int**$>(($**int**$)30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \wedge (-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 <$ \$heap$_{funcstart\_724,1}$.p1

[Take given term]

[11.0] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p1),
asType<int>(\$heap$_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(\$heap$_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(\$heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take goal term]

[1.0] ((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))) $\leq$ **maxof**(**short
int**)

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177)]*

[1.1] ((**asType<int>**(**asType<short int>**(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.r1)) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>(\$heap$_{funcstart\_724,1}$.b1))) $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[1.3] ((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))) $\leq$ **maxof**(**short
int**)

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

[1.4] ((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{init}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))) $\leq$ **maxof**(**short
int**)

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

[1.5] $((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})171))) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.8] $((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * 171)$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[1.9] $((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1})))$
$\leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.11] $((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) - (\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot} * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))) \leq \textbf{maxof}(\textbf{short int})$

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

[1.12] $((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) - (\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot} * \textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{b1}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.13] $((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) - (\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})2)))) \leq \textbf{maxof}(\textbf{short}$
$\textbf{int})$

$\rightarrow$ *[simplify]*

[1.32] $-32768 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))$

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

[1.33] $!(-32768 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[simplify]*

[1.38] $32767 < ((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$

177).rem) + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.2] ($\$\text{heap}_{funcstart\_724,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

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

[14.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

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

[14.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}$.p1]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[from term 8.0, literala < $-\$heap_{funcstart\_724,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,

177).quot)

→ *[simplify]*

[14.11] ([**false**]: $-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$, [!(0 < $-\$\text{heap}_{funcstart\_724,1}.\text{p1})$]: $\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$ == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

→ *[from term 8.0, literala < $-\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

→ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: $-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$, [!**false**]: $\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$ == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).quot)

→ *[simplify]*

[14.17] 0 == $(-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).quot + $(\$\text{heap}_{funcstart\_724,1}.\text{p1} / 177))$

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] $(\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % $\textbf{asType}\!<\!\textbf{integer}\!>(177))$ == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

→ *[simplify]*

[15.2] $(\$\text{heap}_{funcstart\_724,1}.\text{p1}$ % 177) == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

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

[15.3] ([$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0$]: $-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177), []: $\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177) == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ 177).rem)

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

[15.4] ([$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0$]: $-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177), [!($\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0$)]: $\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177) == $\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$

177).rem)

→ *[simplify]*

[15.7] ($[0 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}]$:
$-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem)

→ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[15.7.0] -2 $<$ (0 + 0)

→ *[simplify]*

[15.7.2] **true**

[15.8] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem)

→ *[simplify]*

[15.11] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$, $[!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p1})]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177) == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$

→ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 $<$ (0 + 0)

→ *[simplify]*

[15.11.2] **true**

[15.12] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177)$,
$[!\textbf{false}]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) \% 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem)

→ *[simplify]*

[15.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem} + (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))$

[Take given term]

[24.0] !(0 == **asType**<**integer**>(div1.rem)) || !(0 == **asType**<**integer**>(div1.quot))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[24.1] !(0 == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) || !(0 == **asType**<**integer**>(div1.quot))

→ *[simplify]*

[24.2] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) || !(0 == **asType**<**integer**>(div1.quot))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[24.3] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) || !(0 == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

→ *[simplify]*

[24.5] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

[Branch on disjunction or conditional in term 24.5]

[53.0] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) ∨ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

[Copy term 1.38]

[58.0] 32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))

→ *[from term 15.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem is equal to $\$heap_{funcstart\_724,1}$.p1 % 177]*

[58.1] 32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * ($\$heap_{funcstart\_724,1}$.p1 % 177)))

[Copy term 53.0]

[59.0] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) ∨ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[from term 14.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot is equal to $\$heap_{funcstart\_724,1}$.p1 / 177]*

[59.1] !(0 == ($heap$_{funcstart_724,1}$.p1 / 177)) ∨ ...

[Create new term from term 14.17 using rule: condition for equality of division]

[61.0] ((177 * (0 + −(−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))) < (1 + $heap$_{funcstart_724,1}$.p1)) ∧ ($heap$_{funcstart\_724,1}$.p1 < (177 * (0 + 1 + −(−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))))

→ *[simplify]*

[61.15] (-1 < ((-177 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + $heap$_{funcstart_724,1}$.p1)) ∧ (-177 < (−$heap$_{funcstart\_724,1}$.p1 + (177 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)))

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

[61.16] -177 < (−$heap$_{funcstart_724,1}$.p1 + (177 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))

[Create new term from term 59.1 using rule: condition for inequality of division]

[65.0] (!((0 * 177) < (1 + $heap$_{funcstart_724,1}$.p1)) ∨ !($heap$_{funcstart\_724,1}$.p1 < (177 * (0 + 1)))) ∨ !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) ∨ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[simplify]*

[65.3] (!(-1 < $heap$_{funcstart_724,1}$.p1) ∨ !($heap$_{funcstart\_724,1}$.p1 < (177 * (0 + 1)))) ∨ ...

→ *[from term 8.0, literala < $heap$_{funcstart_724,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[65.3.0] (-1 + -1) < 0

→ *[simplify]*

[65.3.2] **true**

[65.4] (!**true** ∨ !($heap$_{funcstart_724,1}$.p1 < (177 * (0 + 1)))) ∨ ...

→ *[simplify]*

[65.14] (176 < $heap$_{funcstart_724,1}$.p1) ∨ ...

[Create new term from terms 65.14, 61.16 using rule: transitivity 3]

[66.0] ((-177 + 1 + 176) < (177 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) ∨ !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) ∨ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[simplify]*

[66.1] $(0 < (177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot})) \lor ...$

$\rightarrow$ *[product is positive]*

[66.2] $(((0 < 177) \land (0 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \lor ((177 < 0) \land (\text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} < 0))) \lor ...$

$\rightarrow$ *[simplify]*

[66.7] $(0 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$ $\lor ...$

[Create new term from terms 66.7, 58.1 using rule: transitivity 11]

[68.0] $((1 + 32767 + (0 * 2)) < (171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))) \lor !(0$ $== \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \lor (0$ $== \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

$\rightarrow$ *[simplify]*

[68.2] $(32768 < (171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))) \lor ...$

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

[68.3] $([171 < 0]: (32768 / \text{-}171) < -(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 < 171]:$ $(32768 / 171) < (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 == 171]: 32768 < 0) \lor ...$

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

[68.4] $([171 < 0]: (32768 / \text{-}171) < -(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(0 <$ $171) \land !(171 < 0)]: (32768 / 171) < (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(0 ==$ $171) \land !(0 < 171) \land !(171 < 0)]: 32768 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[68.13] **false** $\lor ...$

[Remove 'false' term 68.13 and fetch new term from containing clause]

[71.0] $0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}$

[Copy term 1.38]

[58.1] $32767 < ((\text{-}2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}) + (171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177)))$

$\rightarrow$ *[from term 71.0, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,* *177).quot is equal to 0]*

[58.2] $32767 < ((\text{-}2 * 0) + (171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177)))$

$\rightarrow$ *[simplify]*

[58.4] $32767 < (171 * (\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))$

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

[58.5] $([171 < 0]: (32767 / \text{-}171) < -(\$\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 < 171]:$

$(32767 \ / \ 171) < (\$heap_{funcstart\_724,1}.p1 \ \% \ 177), [0 == 171]: 32767 < 0)$

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

[58.6] $([171 < 0]: (32767 \ / \ -171) < -(\$heap_{funcstart\_724,1}.p1 \ \% \ 177), [(0 < 171) \land !(171 < 0)]: (32767 \ / \ 171) < (\$heap_{funcstart\_724,1}.p1 \ \% \ 177), [(0 == 171) \land !(0 < 171) \land !(171 < 0)]: 32767 < 0)$

$\rightarrow$ *[simplify]*

[58.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (57,31)

**To prove: asType$<$integer$>$($\$heap_{724,1;740,8}.$p1$) <$
asType$<$integer$>$($\$heap_{724,1;740,8}.$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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 $==$ div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType$<$int$>$($\$heap_{funcstart\_724,1}.$p1),
asType$<$int$>$($\$heap_{funcstart\_724,1}.$a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_724,1}.$p1)) /

asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a1))) == **asType\<integer\>**(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p1)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_724,1}$.a1))) == **asType\<integer\>**(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType\<int\>**($heap$_{funcstart\_724,1}$.p2), **asType\<int\>**($heap$_{funcstart_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) / **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_724,1}$.a2))) == **asType\<integer\>**(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_724,1}$.a2))) == **asType\<integer\>**(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 == **asType\<integer\>**(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType\<int\>**($heap$_{funcstart\_724,1}$.p3), **asType\<int\>**($heap$_{funcstart_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) / **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 == **asType\<integer\>**(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($heap$_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_724,1}$.b1))))

−**asType\<integer const\>**($heap$_{724,1;740,8}$.M1) < **asType\<integer\>**($heap$_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($heap$_{724,1;740,8}$.p1))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{init}.\text{M1}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\textbf{asType}\texttt{<}\textbf{short int}\texttt{>}((\textbf{int})30269)))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\& (\textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 < \textbf{asType}\texttt{<}\textbf{integer}\texttt{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$

($\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.p3) <$
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.M3))$

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

[5.17] $(((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land$
$(0 < \$heap_{funcstart\_724,1}.p2))\ \&\&\ (\$heap_{funcstart\_724,1}.p2 <$
$\textbf{asType}\textbf{<integer>}(\$heap_{init}.M2)))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.p3)))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.p3) <$
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.M3))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land$
$(0 < \$heap_{funcstart\_724,1}.p2))\ \&\&\ (\$heap_{funcstart\_724,1}.p2 <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307))))\ \&\&\ (0 <$
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.p3)))\ \&\&$
$(\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.p3) <$
$\textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.M3))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <$
$-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 <$
$\$heap_{funcstart\_724,1}.p2) \land (0 < \$heap_{funcstart\_724,1}.p3))\ \&\&$
$(\$heap_{funcstart\_724,1}.p3 < \textbf{asType}\textbf{<integer>}(\$heap_{funcstart\_724,1}.M3))$

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

[5.31] $((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <$
$-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 <$
$\$heap_{funcstart\_724,1}.p2) \land (0 < \$heap_{funcstart\_724,1}.p3))\ \&\&$
$(\$heap_{funcstart\_724,1}.p3 < \textbf{asType}\textbf{<integer>}(\$heap_{init}.M3))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <$
$-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 <$
$\$heap_{funcstart\_724,1}.p2) \land (0 < \$heap_{funcstart\_724,1}.p3))\ \&\&$
$(\$heap_{funcstart\_724,1}.p3 < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 <$
$-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <$
$\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p2) \land (0 <$
$\$heap_{funcstart\_724,1}.p3)$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$heap_{funcstart\_724,1}.p1$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>($\$\text{heap}_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) /
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[14.2] ($\$\text{heap}_{funcstart\_724,1}$.p1 / 177) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)

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

[14.3] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) / 177), []:
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

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

[14.4] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) < 0]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) / 177),
[!(**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) < 0)]:
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[14.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}$.p1]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) / 177),

[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

→ *[simplify]*

[14.7.2] **true**

[14.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

[14.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177), [!(0 <
−$heap$_{funcstart_724,1}$.p1)]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p1) / 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

→ *[simplify]*

[14.11.2] **true**

[14.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177),
[!**false**]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot)

→ *[simplify]*

*[14.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot + ($heap$_{funcstart_724,1}$.p1 / 177))*

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[15.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

→ *[simplify]*

[15.2] ($heap$_{funcstart_724,1}$.p1 % 177) == **asType\<integer\>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

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

[15.3] ([**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) % 177), []:
asType\<integer\>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

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

[15.4] ([**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) < 0)]:
asType\<integer\>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) < 0)]:
asType\<integer\>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

> **Proof of rule precondition:**
>
> *[15.7.0]* -2 < (0 + 0)
>
> → *[simplify]*
>
> *[15.7.2]* **true**

[15.8] ([**false**]: −(−**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) < 0)]:
asType\<integer\>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType\<integer\>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.11] ([**false**]: −(−**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) % 177), [!(0
< −$heap$_{funcstart_724,1}$.p1)]: **asType\<integer\>**($heap$_{funcstart\_724,1}$.p1) %
177) == **asType\<integer\>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0*

+ literala)]

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177),
[!**false**]: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177) ==
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem)

$\rightarrow$ *[simplify]*

[15.17] $0 == (-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem + ($\$\text{heap}_{funcstart\_724,1}.\text{p1}$ % 177))

[Take given term]

[24.0] !(0 == $\textbf{asType}\textbf{<integer>}$(div1.rem)) || !(0 ==
$\textbf{asType}\textbf{<integer>}$(div1.quot))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p1, 177)]

[24.1] !(0 == $\textbf{asType}\textbf{<integer>}$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}$)) || !(0 == $\textbf{asType}\textbf{<integer>}$(div1.quot))

$\rightarrow$ *[simplify]*

[24.2] !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem) || !(0 == $\textbf{asType}\textbf{<integer>}$(div1.quot))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p1, 177)]

[24.3] !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem) || !(0 == $\textbf{asType}\textbf{<integer>}$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}$))

$\rightarrow$ *[simplify]*

[24.5] !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).quot) $\vee$!(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{r1}$)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{b1}$))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}$.p1, 177)]

[53.1] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**($heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [simplify]

[53.3] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [const static or extern object]

[53.4] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [expand definition of constant 'r1' at prang.c (15,20)]

[53.5] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [simplify]

[53.8] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]

[53.9] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [simplify]

[53.11] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

→ [const static or extern object]

[53.12] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → **asType<short int>**((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → **asType<short int>**((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[53.19] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.M1)

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.1] **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).p1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.M1)

→ *[simplify]*

[1.3] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.M1)

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.4] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).M1)

→ *[const member of object with modified fields]*

[1.5] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) <

asType<integer>($heap$_{funcstart_724,1}$.M1)

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

[1.6] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)) < **asType<integer>**($heap$_{init}$.M1)

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.7] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)) < **asType<integer>**(**asType<short int>**((**int**)30269))

$\rightarrow$ *[simplify]*

[1.17] -30269 < ((-171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))

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

[1.18] !(-30269 < ((-171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)))

$\rightarrow$ *[simplify]*

[1.23] 30268 < ((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))

[Branch on disjunction or conditional in term 24.5]

[56.0] !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) $\lor$!(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $\lor$ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)

[Copy term 1.23]

[61.0] 30268 < ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))

$\rightarrow$ *[from term 15.17, div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem is equal to $heap$_{funcstart_724,1}$.p1 % 177]*

[61.1] 30268 < ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * ($heap$_{funcstart\_724,1}$.p1 % 177)))

[Copy term 56.0]

[62.0] !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) $\lor$!(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $\lor$ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,

177).quot)

→ *[from term 14.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot is equal to $\$heap_{funcstart\_724,1}$.p1 / 177]*

[62.1] !(0 == ($\$heap_{funcstart\_724,1}$.p1 / 177)) ∨ ...

[Create new term from term 14.17 using rule: condition for equality of division]

[64.0] ((177 * (0 + −(−div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))) < (1 + $\$heap_{funcstart\_724,1}$.p1)) ∧ ($\$heap_{funcstart\_724,1}$.p1 < (177 * (0 + 1 + −(−div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))))

→ *[simplify]*

[64.15] (-1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + $\$heap_{funcstart\_724,1}$.p1)) ∧ (-177 < (−$\$heap_{funcstart\_724,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)))

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

[64.16] -177 < (−$\$heap_{funcstart\_724,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

[Create new term from term 62.1 using rule: condition for inequality of division]

[68.0] (!((0 * 177) < (1 + $\$heap_{funcstart\_724,1}$.p1)) ∨ !($\$heap_{funcstart\_724,1}$.p1 < (177 * (0 + 1)))) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) ∨ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[68.3] (!(-1 < $\$heap_{funcstart\_724,1}$.p1) ∨ !($\$heap_{funcstart\_724,1}$.p1 < (177 * (0 + 1)))) ∨ ...

→ *[from term 8.0, literala < $\$heap_{funcstart\_724,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[68.3.0] (-1 + -1) < 0

→ *[simplify]*

[68.3.2] **true**

[68.4] (!**true** ∨ !($\$heap_{funcstart\_724,1}$.p1 < (177 * (0 + 1)))) ∨ ...

→ *[simplify]*

[68.14] (176 < $\$heap_{funcstart\_724,1}$.p1) ∨ ...

[Create new term from terms 68.14, 64.16 using rule: transitivity 3]

[69.0] ((-177 + 1 + 176) < (177 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \lor !(0 == \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \lor (0 == \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

$\rightarrow$ *[simplify]*

[69.1] $(0 < (177 * \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \lor ...$

$\rightarrow$ *[product is positive]*

[69.2] $(((0 < 177) \land (0 < \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \lor ((177 < 0) \land (\text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} < 0))) \lor ...$

$\rightarrow$ *[simplify]*

[69.7] $(0 < \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$
$\lor ...$

[Create new term from terms 69.7, 61.1 using rule: transitivity 11]

[71.0] $((1 + 30268 + (0 * 2)) < (171 * (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))) \lor !(0$
$== \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \lor (0$
$== \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

$\rightarrow$ *[simplify]*

[71.2] $(30269 < (171 * (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177))) \lor ...$

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

[71.3] $([171 < 0]: (30269 / \text{-}171) < -(\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 < 171]:$
$(30269 / 171) < (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 == 171]: 30269 < 0) \lor ...$

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

[71.4] $([171 < 0]: (30269 / \text{-}171) < -(\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(0 <$
$171) \land !(171 < 0)]: (30269 / 171) < (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177), [(0 ==$
$171) \land !(0 < 171) \land !(171 < 0)]: 30269 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[71.13] **false** $\lor ...$

[Remove 'false' term 71.13 and fetch new term from containing clause]

[74.0] $0 == \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}$

[Copy term 1.23]

[61.1] $30268 < ((\text{-}2 * \text{div}(\textbf{heapIs} \ \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}) + (171 * (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177)))$

$\rightarrow$ *[from term 74.0, div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot is equal to 0]*

[61.2] $30268 < ((\text{-}2 * 0) + (171 * (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177)))$

$\rightarrow$ *[simplify]*

[61.4] $30268 < (171 * (\$heap_{funcstart\_724,1}.p1 \% 177))$

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

[61.5] $([171 < 0]: (30268 / -171) < -(\$heap_{funcstart\_724,1}.p1 \% 177), [0 < 171]: (30268 / 171) < (\$heap_{funcstart\_724,1}.p1 \% 177), [0 == 171]: 30268 < 0)$

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

[61.6] $([171 < 0]: (30268 / -171) < -(\$heap_{funcstart\_724,1}.p1 \% 177), [(0 < 171) \wedge !(171 < 0)]: (30268 / 171) < (\$heap_{funcstart\_724,1}.p1 \% 177), [(0 == 171) \wedge !(0 < 171) \wedge !(171 < 0)]: 30268 < 0)$

$\rightarrow$ *[simplify]*

[61.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (57,12)

To prove: $-$**asType$<$integer const$>$**$(\$heap_{724,1;740,8}.M1) <$ **asType$<$integer$>$**$(\$heap_{724,1;740,8}.p1)$

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**$)30323)$

$\$heap_{init}.r3 ==$ **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**$)3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

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

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < $ **asType**<**integer**>$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M1}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M2}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p3}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

→ *[simplify]*

[5.3] $(((((0 < \$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1}) \,\&\&\, (\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1} < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M1}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M2}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p3}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

→ *[const static or extern object]*

[5.4] $(((((0 < \$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1}) \,\&\&\, (\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1} < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{init}.\mathrm{M1}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M2}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p3}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1}) \,\&\&\, (\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p1} < $
$\mathbf{asType}<\mathbf{integer}>(\mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30269)))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{M2}))) \,\&\&\, (0 < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \,\&\&\,$
$(\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p3}) < $
$\mathbf{asType}<\mathbf{integer}>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

→ *[simplify]*

[5.16] $((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2})) \,\&\&\, (\$\mathrm{heap}_{funcstart_724,1}.\mathrm{p2} < $

asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <
$-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 3 of conjunction in term 5.40]

[7.0] $-30269 < -\$\text{heap}_{funcstart\_724,1}.p1$

[Work on sub-term 4 of conjunction in term 5.40]

[8.0] $0 < \$\text{heap}_{funcstart\_724,1}.p1$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.p1$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.a1$))

$\to$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.a1$))

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

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$,
asType<**int**>($\$\text{heap}_{init}.a1$))

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\to$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$, 177)

[Assume known post-assertion, class invariant or type constraint for term 11.6]

[14.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$, 177).quot)

$\to$ *[simplify]*

[14.2] ($\$\text{heap}_{funcstart\_724,1}.p1$ / 177) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$, 177).quot)

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

[14.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) / 177), []:
asType<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) / 177) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$,
177).quot)

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

[14.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) / 177),
[!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) < 0)]:
asType<**integer**>($\$\text{heap}_{funcstart\_724,1}.p1$) / 177) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1$,

177).quot)

$\rightarrow$ *[simplify]*

[14.7] ($[0 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}]$:
$-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).quot)

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.7.2] **true**

[14.8] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).quot)

$\rightarrow$ *[simplify]*

[14.11] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$, $[!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p1})]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$
$== \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})$

$\rightarrow$ *[from term 8.0, literala $< -\$heap_{funcstart\_724,1}.p1$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[14.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[14.11.2] **true**

[14.12] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177)$,
$[!\textbf{false}]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) / 177) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).quot)

$\rightarrow$ *[simplify]*

[14.17] $0 == (-\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p1} / 177))$

[Assume known post-assertion, class invariant or type constraint for term 11.6]

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[15.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

→ *[simplify]*

[15.2] ($heap$_{funcstart_724,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)

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

[15.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

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

[15.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.7] ([0 < −$heap$_{funcstart_724,1}$.p1]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[from term 8.0, literala < −$heap$_{funcstart_724,1}$.p1 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[15.7.0] -2 < (0 + 0)

→ *[simplify]*

[15.7.2] **true**

[15.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)

→ *[simplify]*

[15.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) % 177), [!(0

$< -\$\text{heap}_{funcstart\_724,1}.\text{p1})]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem)

→ *[from term 8.0, literala $< -\$\text{heap}_{funcstart\_724,1}.\text{p1}$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[15.11.0] -2 < (0 + 0)

→ *[simplify]*

[15.11.2] **true**

[15.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p1})$ % 177), [**!false**]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$) % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem)

→ *[simplify]*

[15.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem + ($\$\text{heap}_{funcstart\_724,1}.\text{p1}$ % 177))

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)]*

[53.1] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

→ *[simplify]*

[53.3] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

→ *[const static or extern object]*

[53.4] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

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

[53.5] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($heap_{funcstart\_724,1}$.b1))))

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

[53.12] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($heap_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] −**asType**<**integer const**>($heap_{724,1;740,8}$.M1) <

asType<integer>($heap$_{724,1;740,8}$.p1)

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.1] $-$**asType<integer const>**($heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).M1) < **asType<integer>**($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[const member of object with modified fields]*

[1.2] $-$**asType<integer const>**($heap_{funcstart\_724,1}$.M1) < **asType<integer>**($heap_{724,1;740,8}$.p1)

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

[1.3] $-$**asType<integer const>**($heap_{init}$.M1) < **asType<integer>**($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.4] $-$**asType<integer const>**(**asType<short int>**((**int**)30269)) < **asType<integer>**($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[simplify]*

[1.8] -30269 < **asType<integer>**($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.9] -30269 < **asType<integer>**($heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p1)

$\rightarrow$ *[simplify]*

[1.11] -30269 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))

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

[1.12] !(-30269 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

$\rightarrow$ *[simplify]*

[1.17] 30268 < ((2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,

177).rem))

[Copy term 1.17]

[59.0] 30268 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

→ *[from term 15.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem is equal to $\$heap_{funcstart\_724,1}$.p1 % 177]*

[59.1] 30268 < ((-171 * ($\$heap_{funcstart\_724,1}$.p1 % 177)) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

[Create new term from term 14.17 using rule: condition for equality of division]

[63.0] ((177 * (0 + −(−div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))) < (1 + $\$heap_{funcstart\_724,1}$.p1)) ∧ ($\$heap_{funcstart\_724,1}$.p1 < (177 * (0 + 1 + −(−div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))))

→ *[simplify]*

[63.15] (-1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + $\$heap_{funcstart\_724,1}$.p1)) ∧ (-177 < (−$\$heap_{funcstart\_724,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)))

[Work on sub-term 2 of conjunction in term 63.15]

[64.0] -1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + $\$heap_{funcstart\_724,1}$.p1)

[Create new term from terms 64.0, 7.0 using rule: transitivity 2]

[78.0] (-30269 + -1 + 1) < (-177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[simplify]*

[78.1] -30269 < (-177 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)

→ *[literal comparison of product]*

[78.2] ([-177 < 0]: (-30269 / 177) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [0 < -177]: (-30269 / -177) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [-177 == 0]: -30269 < 0)

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

[78.3] ([-177 < 0]: (-30269 / 177) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-30269 / -177) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -30269 < 0)

→ *[simplify]*

[78.7] -172 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot

[Create new term from terms 78.7, 59.1 using rule: transitivity 5]

[82.0] 30268 < ((-171 * ($\$heap_{funcstart\_724,1}$.p1 % 177)) + (2 * −(-172 + 1)))

→ *[simplify]*

[82.5] 29926 < (-171 * ($\$heap_{funcstart\_724,1}$.p1 % 177))

→ *[literal comparison of product]*

[82.6] ([-171 < 0]: (29926 / 171) < −($\$heap_{funcstart\_724,1}$.p1 % 177), [0 < -171]: (29926 / -171) < ($\$heap_{funcstart\_724,1}$.p1 % 177), [-171 == 0]: 29926 < 0)

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

[82.7] ([-171 < 0]: (29926 / 171) < −($\$heap_{funcstart\_724,1}$.p1 % 177), [(0 < -171) ∧ !(-171 < 0)]: (29926 / -171) < ($\$heap_{funcstart\_724,1}$.p1 % 177), [(-171 == 0) ∧ !(-171 < 0) ∧ !(0 < -171)]: 29926 < 0)

→ *[simplify]*

[82.12] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)

Condition defined at:

To prove: minof(short int) ≤ 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)

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p1})) \ / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p1})) \ \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \ || \ !(0 == $
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p2})) \ / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p2})) \ \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \ || \ !(0 == $
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p3})) \ / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{p3})) \ \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_724,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \ || \ !(0 == $

asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) < **asType\<integer\>**($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) < **asType\<integer\>**($\$heap_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1)) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M1))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M2))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] ((((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M1))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M2))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.4] ((((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < **asType\<integer\>**($\$heap_{init}$.M1))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.M2))) && (0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3) <

asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $\text{heap}_{funcstart\_724,1}$.p1) && ($\text{heap}_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.16] (((((-30269 < −$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p1) ∧
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.17] (((((-30269 < −$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p1) ∧
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>(heap_{init}.M2))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < −$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p1) ∧
(0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.30] ((-30307 < −$\text{heap}_{funcstart\_724,1}$.p2) ∧ (-30269 <
−$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] ((-30307 < −$\text{heap}_{funcstart\_724,1}$.p2) ∧ (-30269 <
−$\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p1) ∧ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) ∧ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>(heap_{init}.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 $< -$\$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $<$
$-$\$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$ \$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$
\$heap$_{funcstart\_724,1}$.p2) $\land$ (0 $<$ \$heap$_{funcstart\_724,1}$.p3)) &&
(\$heap$_{funcstart\_724,1}$.p3 $<$ **asType$<$integer$>$(asType$<$short
int$>$((int)**30323))))

$\rightarrow$ *[simplify]*

[5.40] (-30323 $< -$\$heap$_{funcstart\_724,1}$.p3) $\land$ (-30307 $<$
$-$\$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $< -$\$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$
\$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$ \$heap$_{funcstart\_724,1}$.p2) $\land$ (0 $<$
\$heap$_{funcstart\_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 $<$ \$heap$_{funcstart\_724,1}$.p2

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.p2),
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a2))

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

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(**asType$<$short int$>$((int)**176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType$<$integer$>$**(\$heap$_{funcstart\_724,1}$.p2) %
asType$<$integer$>$(176)) == **asType$<$integer$>$**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] (\$heap$_{funcstart\_724,1}$.p2 % 176) == **asType$<$integer$>$**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)

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

[29.3] ([**asType$<$integer$>$**(\$heap$_{funcstart\_724,1}$.p2) $<$ 0]:

$-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176), []:
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).rem)

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

[29.4] ([**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$ 0]:
$-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$ 0)]:
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 $< -\text{\$heap}_{funcstart\_724,1}$.p2]:
$-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$ 0)]:
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\text{\$heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$ 0)]:
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176), [!(0 $< -\text{\$heap}_{funcstart\_724,1}$.p2)]: **asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\text{\$heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($heap_{funcstart\_724,1}$.p2) % 176),
[**!false**]: **asType**$<$**integer**$>$($heap_{funcstart\_724,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.17] 0 == ($-$div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem + ($heap_{funcstart\_724,1}$.p2 % 176))

*[Assume known post-assertion, class invariant or type constraint for term
29.17]*

[36.0] **minof**(**int**) $\leq$ div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem

$\rightarrow$ *[simplify]*

[36.3] -32769 $<$ div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div2.rem

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ div2.rem

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[1.2] -32768 $\leq$ div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem

$\rightarrow$ *[simplify]*

[1.4] -32769 $<$ div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem

$\rightarrow$ *[from term 36.3, literala $<$ div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem is true whenever (-1 + literala) $<$ -32769]*

Proof of rule precondition:

[1.4.0] (-32769 + -1) $<$ -32769

$\rightarrow$ *[simplify]*

[1.4.2] **true**

[1.5] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)

Condition defined at:

To prove: div2.rem $\leq$ **maxof(short int)**

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType\<integer\>(div1.rem)

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

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1)))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&

$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{init}.\text{M1}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})30269)))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$
$(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{init}.\text{M2}))) \;\&\&\; (0 <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$

$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30307)))) \ \&\& \ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] $\text{div2} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \ \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

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

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, **asType**<**int**>($\$\text{heap}_{init}.\text{a}2$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p}2$ % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176).rem)

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

[29.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176).rem)

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

[29.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}.\text{p}2$]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p}2$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p}2$, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\$\text{heap}_{funcstart\_724,1}.\text{p}2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) < 0)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!(0 < $-\$$heap$_{funcstart\_724,1}$.p2)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!**false**]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.17] 0 == ($-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem + ($\$$heap$_{funcstart\_724,1}$.p2 % 176))

[Assume known post-assertion, class invariant or type constraint for term 29.17]

[37.0] div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

*[37.9] -32768 < $-$*div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem

[Take goal term]

[1.0] div2.rem $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176)]*

[1.1] div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[1.10] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem

$\rightarrow$ *[from term 37.9, literala $< -div($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.10.0] (-32768 + -1) < -32768

$\rightarrow$ *[simplify]*

[1.10.2] **true**

[1.11] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)

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)

177

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

invariant1($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$)

div1 == div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p1})$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p1}))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p1}))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})) \;||\; !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot}))$

div2 == div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p2})$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p2}))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p2}))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})) \;||\; !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot}))$

div3 == div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p3})$,
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p3}))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})) \;||\; !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot}))$

$\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short int}\rangle((\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.rem}))$ *
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.quot}))$ * $\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$-$**asType**$<$**integer const**$>$($\text{\$heap}_{724,1;740,8}$.M1) $<$
asType$<$**integer**$>$($\text{\$heap}_{724,1;740,8}$.p1)

!(0 == **asType**$<$**integer**$>$($\text{\$heap}_{724,1;740,8}$.p1))

asType$<$**integer**$>$($\text{\$heap}_{724,1;740,8}$.p1) $<$
asType$<$**integer**$>$($\text{\$heap}_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 $<$ **asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p1)) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p1) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] ((((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M1))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

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

[5.4] ((((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\text{\$heap}_{init}$.M1))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] ((((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30269)))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&

($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p2) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((($-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 < $\$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] (((($-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 < $\$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}$.M2))) && (0 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((($-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$
(0 < $\$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 <
$\textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short int>}$((**int**)30307)))) && (0 <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] (($-30307 < -\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 <
-\$\text{heap}_{funcstart_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p3)) &&
($\$\text{heap}_{funcstart\_724,1}$.p3 < $\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.31] (($-30307 < -\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 <
-\$\text{heap}_{funcstart_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p3)) &&
($\$\text{heap}_{funcstart\_724,1}$.p3 < $\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] (($-30307 < -\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 <
-\$\text{heap}_{funcstart_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 <
$\$\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\$\text{heap}_{funcstart\_724,1}$.p3)) &&
($\$\text{heap}_{funcstart\_724,1}$.p3 < $\textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short}$

int$>$((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 $< -\$\text{heap}_{funcstart\_724,1}.\text{p3}$) $\wedge$ (-30307 $< -\$\text{heap}_{funcstart\_724,1}.\text{p2}$) $\wedge$ (-30269 $< -\$\text{heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}.\text{p2}$) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}.\text{p3}$)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 $< \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[25.0] div2 $==$ div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p2}$), **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

$\rightarrow$ *[simplify]*

[25.1] div2 $==$ div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

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

[25.2] div2 $==$ div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**$<$**int**$>$($\$\text{heap}_{init}.\text{a2}$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 $==$ div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 $==$ div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p2}$) % **asType**$<$**integer**$>$(176)) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p2}$ % 176) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

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

[29.3] ([**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p2}$) < 0]: $-(-$**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176), []: **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

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

[29.4] ([**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p2) % 176) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 < $-\text{heap}_{funcstart\_724,1}$.p2]:
$-(-$**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p2) % 176) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176),
[!(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p2) % 176) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(0
< $-\text{heap}_{funcstart\_724,1}$.p2)]: **asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) %
176) == **asType\<integer\>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176),
[!**false**]: **asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p2) % 176) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (\$\text{heap}_{funcstart\_724,1}.\text{p2} \% 176))$

[Assume known post-assertion, class invariant or type constraint for term 29.17]

[36.0] $\textbf{minof}(\textbf{int}) \leq \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}$

$\rightarrow$ *[simplify]*

[36.3] $\text{-32769} < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}$

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq \textbf{asType}\langle\textbf{short int}\rangle(\text{div2.rem})$

$\rightarrow$ *[simplify]*

[1.1] $\text{-32768} \leq \textbf{asType}\langle\textbf{short int}\rangle(\text{div2.rem})$

$\rightarrow$ *[from term 25.6, div2 is equal to div(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176)]*

[1.2] $\text{-32768} \leq \textbf{asType}\langle\textbf{short int}\rangle(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[1.5] $\text{-32769} < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}$

$\rightarrow$ *[from term 36.3, literala < div(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.5.0] $(\text{-32769} + \text{-1}) < \text{-32769}$

$\rightarrow$ *[simplify]*

[1.5.2] **true**

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)

Condition defined at:

To prove: $\textbf{asType}\langle\textbf{short int}\rangle(\text{div2.rem}) \leq \textbf{maxof}(\textbf{int})$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \$heap_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{p1})) \; / $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{a1}))) == $
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{p1})) \; \% $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{a1}))) == $
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div1.rem})) \; || \; !(0 == $
$\textbf{asType}<\textbf{integer}>(\text{div1.quot}))$

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

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{p2})) \; / $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{a2}))) == $
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{p2})) \; \% $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart_724,1}.\text{a2}))) == $

asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 == **asType**<**integer**>(div2.quot))

div3 == div(**heapIs** $heap_{funcstart\_724,1}$, **asType**<**int**>($heap_{funcstart\_724,1}$.p3), **asType**<**int**>($heap_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p3)) / **asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.p3)) % **asType**<**integer**>(**asType**<**int**>($heap_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 == **asType**<**integer**>(div3.quot))

$heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart\_724,1}$.b1)))))

−**asType**<**integer const**>($heap_{724,1;740,8}$.M1) < **asType**<**integer**>($heap_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap_{724,1;740,8}$.p1))

asType<**integer**>($heap_{724,1;740,8}$.p1) < **asType**<**integer**>($heap_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap_{funcstart\_724,1}$.p1)) && (**asType**<**integer**>($heap_{funcstart\_724,1}$.p1) < **asType**<**integer**>($heap_{funcstart\_724,1}$.M1))) && (0 < **asType**<**integer**>($heap_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($heap_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $heap_{funcstart\_724,1}$.p1) && ($heap_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap_{funcstart\_724,1}$.M1))) && (0 <

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asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p2}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M2}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M3}$))

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

[5.4] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}$) && ($\text{\$heap}_{funcstart\_724,1}.\text{p1}$ $<$
asType$<$integer$>$($\text{\$heap}_{init}.\text{M1}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p2}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M2}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M3}$))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}$) && ($\text{\$heap}_{funcstart\_724,1}.\text{p1}$ $<$
asType$<$integer$>$(**asType$<$short int$>$**((**int**)30269)))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p2}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M2}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M3}$))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) && ($\text{\$heap}_{funcstart\_724,1}.\text{p2}$ $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M2}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M3}$))

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

[5.17] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) && ($\text{\$heap}_{funcstart\_724,1}.\text{p2}$ $<$
asType$<$integer$>$($\text{\$heap}_{init}.\text{M2}$))) && (0 $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{p3}$))) &&
(**asType$<$integer$>$**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$) $<$
asType$<$integer$>$($\text{\$heap}_{funcstart\_724,1}.\text{M3}$))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p1}$) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) && ($\text{\$heap}_{funcstart\_724,1}.\text{p2}$ $<$

asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.30] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 <
−$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<**int**>($heap$_{funcstart_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType$<$int$>$(**asType$<$short int$>$**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) %
asType$<$integer$>$(176)) == **asType$<$integer$>$**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$heap_{funcstart\_724,1}$.p2 % 176) == **asType$<$integer$>$**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)

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

[29.3] ([**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) % 176), []:
asType$<$integer$>$($\$heap_{funcstart\_724,1}$.p2) % 176) ==
asType$<$integer$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem)

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

[29.4] ([**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) % 176),
[!(**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) < 0)]:
asType$<$integer$>$($\$heap_{funcstart\_724,1}$.p2) % 176) ==
asType$<$integer$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 < $-\$heap_{funcstart\_724,1}$.p2]:
$-(-$**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) % 176),
[!(**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) < 0)]:
asType$<$integer$>$($\$heap_{funcstart\_724,1}$.p2) % 176) ==
asType$<$integer$>$(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\$heap_{funcstart\_724,1}$.p2 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType$<$integer$>$**($\$heap_{funcstart\_724,1}$.p2) % 176),

[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) % 176) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

→ *[simplify]*

[29.11] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(0 < −$\text{heap}_{funcstart\_724,1}$.p2)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

→ *[from term 9.0, literala < −$heap_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

→ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) % 176), [!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

→ *[simplify]*

[29.17] 0 == (−div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem + ($\text{heap}_{funcstart\_724,1}$.p2 % 176))

[Assume known post-assertion, class invariant or type constraint for term 29.17]

[37.0] div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem ≤ **maxof**(**int**)

→ *[simplify]*

[37.9] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem

[Take goal term]

[1.0] **asType**<**short int**>(div2.rem) ≤ **maxof**(**int**)

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[1.1] **asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) ≤ **maxof**(**int**)

→ *[simplify]*

[1.11] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,

176).rem

$\rightarrow$ *[from term 37.9, literala < −div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176).rem is true whenever (-1 + literala) < -32768]

Proof of rule precondition:

[1.11.0] (-32768 + -1) < -32768

$\rightarrow$ *[simplify]*

[1.11.2] **true**

[1.12] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,10)

Condition defined at:

To prove: minof(int) $\leq$ $\$heap_{724,1;740,8}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

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

asType\<int\>($\text{heap}_{funcstart\_724,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p2),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\text{heap}_{724,1;740,8}$.M1) <
asType\<integer\>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;740,8}$.p1))

asType\<integer\>($heap$_{724,1;740,8}$.p1) <
asType\<integer\>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p1),
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($heap$_{funcstart_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType\<int\>**($heap$_{funcstart\_724,1}$.r1)) −
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType\<short
int\>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType\<int\>($heap$_{funcstart_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType\<short
int\>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *

asType$<$int$>$($\text{\$heap}_{init}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

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

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**(**asType$<$short int$>$**((**int**)171))) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

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

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**(**asType$<$short int$>$**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof**(**int**) $\leq$ \$heap$_{724,1;740,8}$.r2

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{724,1;740,8}$.r2

$\rightarrow$ *[from term 53.19, \$heap$_{724,1;740,8}$ is equal to \$heap$_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]*

[1.2] -32768 $\leq$ \$heap$_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).r2

$\rightarrow$ *[const member of object with modified fields]*

[1.3] -32768 $\leq$ \$heap$_{funcstart\_724,1}$.r2

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

[1.4] -32768 $\leq$ \$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 (58,10)

Condition defined at:

To prove: \$heap$_{724,1;740,8}$.r2 $\leq$ **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)

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3)) %

asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType<short

int>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

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

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)

− (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] $\$heap_{724,1;740,8}$.r2 ≤ **maxof**(**int**)

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.1] $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2 ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.2] $\$heap_{funcstart\_724,1}$.r2 ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.3] $\$heap_{init}$.r2 ≤ **maxof**(**int**)

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.4] **asType**<**short int**>((**int**)172) ≤ **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 (58,13)

Condition defined at:

To prove: minof(**int**) ≤ (**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$heap_{724,1;740,8}$.r2))

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType<int>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}$),
asType<int>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}$))

(**asType<integer>**(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}$)) /
asType<integer>(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}$)) %
asType<integer>(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}$))) ==
asType<integer>(div1.rem)

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

div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType<int>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}$),
asType<int>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}$))

(**asType<integer>**(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}$)) /
asType<integer>(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}$)) %
asType<integer>(**asType<int>**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}$))) ==

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asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 == **asType\<integer\>**(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p3), **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p3)) / **asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p3)) % **asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 == **asType\<integer\>**(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$\text{heap}_{724,1;740,8}$.M1) < **asType\<integer\>**($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$\text{heap}_{724,1;740,8}$.p1))

asType\<integer\>($\$\text{heap}_{724,1;740,8}$.p1) < **asType\<integer\>**($\$\text{heap}_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p1)) && (**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p1) < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p2))) && (**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p2) < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.p3) < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $\$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 < **asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 <

asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\text{\$heap}_{init}$.M1))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30269)))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

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

[5.17] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\text{\$heap}_{init}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$

asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <
$-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{funcstart_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Take given term]

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

$\rightarrow$ *[simplify]*

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

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

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType\<int\>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) %
asType\<integer\>(176)) == **asType\<integer\>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$heap_{funcstart\_724,1}$.p2 % 176) == **asType\<integer\>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)

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

[29.3] ([**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) % 176), []:
asType\<integer\>($\$heap_{funcstart\_724,1}$.p2) % 176) ==
asType\<integer\>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem)

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

[29.4] ([**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) % 176),
[!(**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p2) < 0)]:
asType\<integer\>($\$heap_{funcstart\_724,1}$.p2) % 176) ==

asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}$.p2]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\$\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(0 < $-\$\text{heap}_{funcstart\_724,1}$.p2)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-\$\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), [!**false**]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem + ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176))

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.rem)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(*$\textbf{heapIs}$ *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

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

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * \textbf{asType}<\textbf{int}>(\$heap_{init}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

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

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})171))) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(*$\textbf{heapIs}$ *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.b1))))$

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

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}\textbf{<int>}(\$heap_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem})))$

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2}.\text{rem})) * \textbf{asType}\textbf{<int>}(\$heap_{724,1;740,8}.r2))$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2}.\text{rem})) * \textbf{asType}\textbf{<int>}(\$heap_{724,1;740,8}.r2))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(\textbf{heapIs} $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176)]*

[1.2] $-32768 \leq (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem})) * \textbf{asType}\textbf{<int>}(\$heap_{724,1;740,8}.r2))$

$\rightarrow$ *[simplify]*

[1.4] $-32768 \leq (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem} * \textbf{asType}\textbf{<int>}(\$heap_{724,1;740,8}.r2))$

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart_724,1}.\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs} $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]*

[1.5] $-32768 \leq (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$

176).rem * **asType**<**int**>($heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2))

→ *[const member of object with modified fields]*

[1.6] -32768 ≤ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem * **asType**<**int**>($heap$_{funcstart_724,1}$.r2))

→ *[const static or extern object]*

[1.7] -32768 ≤ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem * **asType**<**int**>($heap$_{init}$.r2))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.8] -32768 ≤ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem * **asType**<**int**>(**asType**<**short int**>((**int**)172)))

→ *[simplify]*

[1.13] -32769 < (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem)

→ *[literal comparison of product]*

[1.14] ([172 < 0]: (-32769 / -172) < −div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem, [0 < 172]: (-32769 / 172) < div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem, [0 == 172]: -32769 < 0)

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

[1.15] ([172 < 0]: (-32769 / -172) < −div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem, [(0 < 172) ∧ !(172 < 0)]: (-32769 / 172) <
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem, [(0 == 172)
∧ !(0 < 172) ∧ !(172 < 0)]: -32769 < 0)

→ *[simplify]*

[1.23] -191 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem

→ *[negate goal and search for contradiction]*

[1.24] !(-191 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem)

→ *[simplify]*

[1.26] 190 < −div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem

[Create new term from terms 1.26, 29.17 using rule: transitivity 15]

[59.0] (0 + 190) < −($heap$_{funcstart_724,1}$.p2 % 176)

→ *[simplify]*

[59.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,13)

Condition defined at:

To prove: $(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.rem})) * \textbf{asType<int>}(\$\text{heap}_{724,1;740,8}.\text{r2})) \leq \textbf{maxof(int)}$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$, $\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1})$)

$(\textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) / \textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType<integer>}(\text{div1.quot})$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \% \textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType<integer>}(\text{div1.rem})) || !(0 == \textbf{asType<integer>}(\text{div1.quot}))$

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

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) <
asType\<integer\>($\$heap_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1)) &&
(**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p1) <
asType\<integer\>($\$heap_{funcstart\_724,1}$.M1))) && (0 <
asType\<integer\>($\$heap_{funcstart\_724,1}$.p2))) &&

($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M2))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M1))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M2))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M3))

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

[5.4] (((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < $\mathbf{asType\langle integer\rangle}$($\$heap_{init}$.M1))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M2))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < $\mathbf{asType\langle integer\rangle}$($\mathbf{asType\langle short\ int\rangle}$((int)30269)))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p2) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M2))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-\$heap_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\$heap_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\$heap_{funcstart\_724,1}$.p2)) && ($\$heap_{funcstart\_724,1}$.p2 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M2))) && (0 < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3))) && ($\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.p3) < $\mathbf{asType\langle integer\rangle}$($\$heap_{funcstart\_724,1}$.M3))

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

[5.17] (((((-30269 < $-\$heap_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\$heap_{funcstart\_724,1}$.p1) $\wedge$

$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**<**integer**>($\$\text{heap}_{init}.\text{M2}$))) && $(0 <$ **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$))) && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**<**integer**>(**asType**<**short int**>((**int**)30307)))) && $(0 <$ **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$))) && $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

→ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M3}))$

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30323)))$

→ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$), **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>($\$\text{heap}_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

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

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>($\$\text{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) %
asType<**integer**>(176)) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

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

[29.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), []:

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asType<integer>($heap$_{funcstart_724,1}$.p2) % 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)

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

[29.4] ([**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) % 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) % 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 < $-$$heap$_{funcstart\_724,1}$.p2]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) % 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) % 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) % 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) % 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) % 176), [!(0 < $-$$heap$_{funcstart\_724,1}$.p2)]: **asType<integer>**($heap$_{funcstart_724,1}$.p2) % 176) == **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala < $-$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!**false**]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.17] $0 ==$ ($-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem + ($\$$heap$_{funcstart\_724,1}$.p2 % 176))

[Take given term]

[53.0] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.3] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

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

[53.4] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$($\$$heap$_{init}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

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

[53.5] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)171))) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * 171)

− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[53.9] $heap_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $heap_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $heap_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] (**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap_{724,1;740,8}$.r2)) ≤ **maxof**(**int**)

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p2, 176)]

[1.1] (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap_{724,1;740,8}$.r2)) ≤
maxof(**int**)

→ *[simplify]*

[1.3] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>($heap_{724,1;740,8}$.r2)) ≤ **maxof**(**int**)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
$heap_{funcstart\_724,1}$.__replace__($p1 \rightarrow$ (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[1.4] (div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
__asType__<__int__>($heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) ≤ __maxof__(__int__)

→ *[const member of object with modified fields]*

[1.5] (div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
__asType__<__int__>($heap_{funcstart\_724,1}$.r2)) ≤ __maxof__(__int__)

→ *[const static or extern object]*

[1.6] (div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
__asType__<__int__>($heap_{init}$.r2)) ≤ __maxof__(__int__)

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.7] (div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
__asType__<__int__>(__asType__<__short int__>((__int__)172))) ≤ __maxof__(__int__)

→ *[simplify]*

[1.20] -32768 < (-172 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem)

→ *[literal comparison of product]*

[1.21] ([-172 < 0]: (-32768 / 172) < −div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem, [0 < -172]: (-32768 / -172) < div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem, [-172 == 0]: -32768 <
0)

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

[1.22] ([-172 < 0]: (-32768 / 172) < −div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem, [(0 < -172) ∧ !(-172 < 0)]: (-32768 / -172) <
div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem, [(-172 ==
0) ∧ !(-172 < 0) ∧ !(0 < -172)]: -32768 < 0)

→ *[simplify]*

[1.26] -191 < −div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem

→ *[negate goal and search for contradiction]*

[1.27] !(-191 < −div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem)

→ *[simplify]*

[1.30] 190 < div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem

[Create new term from terms 1.30, 29.17 using rule: transitivity 16]

[59.0] $(0 + 190) < (\$heap_{funcstart\_724,1}.p2 \% 176)$

$\rightarrow$ *[simplify]*

[59.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)

Condition defined at:

To prove: minof(short int) $\leq$ div2.quot

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType$\langle$**int**$\rangle$($\$heap_{funcstart\_724,1}.p1$),
asType$\langle$**int**$\rangle$($\$heap_{funcstart\_724,1}.a1$))

(**asType**$\langle$**integer**$\rangle$(**asType**$\langle$**int**$\rangle$($\$heap_{funcstart\_724,1}.p1$)) /
asType$\langle$**integer**$\rangle$(**asType**$\langle$**int**$\rangle$($\$heap_{funcstart\_724,1}.a1$))) ==
asType$\langle$**integer**$\rangle$(div1.quot)

$(\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \%$
$\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div1.rem})$

$!(0 == \textbf{asType}{<}\textbf{integer}{>}(\text{div1.rem}))\ ||\ !(0 ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ /$
$\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div2.quot})$

$(\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \%$
$\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div2.rem})$

$!(0 == \textbf{asType}{<}\textbf{integer}{>}(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ /$
$\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div3.quot})$

$(\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ \%$
$\textbf{asType}{<}\textbf{integer}{>}(\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div3.rem})$

$!(0 == \textbf{asType}{<}\textbf{integer}{>}(\text{div3.rem}))\ ||\ !(0 ==$
$\textbf{asType}{<}\textbf{integer}{>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}((\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short int}{>}(\text{div1.rem}))\ *$
$\textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}(\text{div1.quot})\ *\ \textbf{asType}{<}\textbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}{<}\textbf{integer const}{>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}{<}\textbf{integer}{>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}{<}\textbf{integer}{>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}{<}\textbf{integer}{>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}{<}\textbf{integer}{>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M1}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M2}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart_724,1}.\text{p1}) $ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M1}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M2}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.4] $(((((0 < \$\text{heap}_{funcstart_724,1}.\text{p1}) $ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M1}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M2}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$\text{heap}_{funcstart_724,1}.\text{p1}) $ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30269)))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M2}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart_724,1}.\text{p2})) $ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{M2}))) $ && $(0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart_724,1}.\text{p3}))) $ &&

($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.p3) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}.\text{M2})))$ \&\& $(0 <$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$))) \&\&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short int>}$((**int**)30307)))) \&\& $(0 <$
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$))) \&\&
($\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) <
$\textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

→ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}$($\$\text{heap}_{funcstart\_724,1}.\text{M3}$))

→ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}$($\$\text{heap}_{init}.\text{M3}$))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}$($\textbf{asType}\textbf{<short}$
$\textbf{int>}$((**int**)30323)))

→ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[25.0] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p2),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a2))

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

[25.2] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
asType<int>($\text{\$heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) /
asType<integer>(176)) == **asType<integer>**(div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\text{\$heap}_{funcstart\_724,1}$.p2 / 176) == **asType<integer>**(div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

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

[28.3] ([**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) / 176), []:
asType<integer>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot)

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

[28.4] ([**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) / 176),
[!(**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) < 0)]:
asType<integer>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < $-\text{\$heap}_{funcstart\_724,1}$.p2]:
$-(-$**asType<integer>**($\text{\$heap}_{funcstart\_724,1}$.p2) / 176),

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[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < $-\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(0 < $-\text{heap}_{funcstart\_724,1}$.p2)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < $-\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176),
[!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot + ($\text{heap}_{funcstart\_724,1}$.p2 / 176))

[Assume known post-assertion, class invariant or type constraint for term 28.17]

[34.0] **minof**(**int**) $\leq$ div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot

$\rightarrow$ *[simplify]*

[34.3] -32769 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot

[Take goal term]

[1.0] **minof(short int)** ≤ div2.quot

→ *[simplify]*

[1.1] -32768 ≤ div2.quot

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[1.2] -32768 ≤ div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot

→ *[simplify]*

[1.4] -32769 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot

→ *[from term 34.3, literala < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot is true whenever (-1 + literala) < -32769]*

> **Proof of rule precondition:**
>
> *[1.4.0]* (-32769 + -1) < -32769
>
> → *[simplify]*
>
> *[1.4.2]* **true**

[1.5] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)

Condition defined at:

To prove: div2.quot ≤ **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)

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ % $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \,||\, !(0 == $ $\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$ $\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) *$ $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$ $\textbf{int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \,\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \,\&\&\, (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \,\&\&\, (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&$ $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M1}))) \,\&\&\, (0 <$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&$

$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30269)))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)))) \&\& (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\&$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}), \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] $\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

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

[25.2] $\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{init}.\text{a2}))$

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] $\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, \textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})176)))$

$\rightarrow$ *[simplify]*

[25.6] $\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176)$

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] $(\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) / \textbf{asType}\text{<}\textbf{integer}\text{>}(176)) == \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

$\rightarrow$ *[simplify]*

[28.2] ($heap$_{funcstart_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[28.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

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

[28.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

→ *[simplify]*

[28.7] ([0 < −$heap$_{funcstart_724,1}$.p2]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

→ *[from term 9.0, literala < −$heap$_{funcstart_724,1}$.p2 is false whenever -2 < (0
+ literala)]*

> **Proof of rule precondition:**
>
> *[28.7.0]* -2 < (0 + 0)
>
> → *[simplify]*
>
> *[28.7.2]* **true**

[28.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

→ *[simplify]*

[28.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176), [!(0 <
−$heap$_{funcstart_724,1}$.p2)]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) / 176)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[from term 9.0, literala < −$heap$_{funcstart_724,1}$.p2 is false whenever -2 < (0

+ literala)]

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

→ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176), [!**false**]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[simplify]*

[28.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot + ($heap$_{funcstart\_724,1}$.p2 / 176))

[Assume known post-assertion, class invariant or type constraint for term 28.17]

[35.0] div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot ≤ **maxof**(**int**)

→ *[simplify]*

[35.9] -32768 < −div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot

[Take goal term]

[1.0] div2.quot ≤ **maxof**(**short int**)

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[1.1] div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot ≤ **maxof**(**short int**)

→ *[simplify]*

[1.10] -32768 < −div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot

→ *[from term 35.9, literala < −div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.10.0] (-32768 + -1) < -32768

→ *[simplify]*

[1.10.2] **true**

[1.11] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)

Condition defined at:

To prove: minof(int) $\leq$ asType\<short int\>(div2.quot)

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,

asType\<int\>($heap$_{funcstart_724,1}$.p2),
asType\<int\>($heap$_{funcstart_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p3),
asType\<int\>($heap$_{funcstart_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($heap$_{funcstart_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_724,1}$.b1)))))

−**asType\<integer const\>**($heap$_{724,1;740,8}$.M1) <
asType\<integer\>($heap$_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($heap$_{724,1;740,8}$.p1))

asType\<integer\>($heap$_{724,1;740,8}$.p1) <
asType\<integer\>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType\<integer\>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p1) <
asType\<integer\>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <

asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>($heap$_{init}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>(**asType\<short int\>**((**int**)30269)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.30] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 <
−$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 <
−$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 <
$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType**<**int**>($\text{\$heap}_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[25.6] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[28.2] ($\text{\$heap}_{funcstart\_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[28.3] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < 0]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176), []: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

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

[28.4] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < 0]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[28.7] ([0 < −$\text{\$heap}_{funcstart\_724,1}$.p2]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[from term 9.0, literala < −$heap_{funcstart\_724,1}$.p2 is false whenever -2 < (0*

+ literala)]

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

→ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[28.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(0 < $-\text{heap}_{funcstart\_724,1}$.p2)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[from term 9.0, literala < $-\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

→ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176), [!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[28.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot + ($\text{heap}_{funcstart\_724,1}$.p2 / 176))

[Assume known post-assertion, class invariant or type constraint for term 28.17]

[34.0] **minof**(**int**) ≤ div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot

→ *[simplify]*

[34.3] -32769 < div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot

[Take goal term]

[1.0] **minof**(**int**) ≤ **asType**<**short int**>(div2.quot)

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ **asType**<**short int**>(div2.quot)

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176)]*

[1.2] -32768 $\leq$ **asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot)

$\rightarrow$ *[simplify]*

[1.5] -32769 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot

$\rightarrow$ *[from term 34.3, literala < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.5.0] (-32769 + -1) < -32769

$\rightarrow$ *[simplify]*

[1.5.2] **true**

[1.6] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)

Condition defined at:

To prove: asType<**short int**>(div2.quot) $\leq$ **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)

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p1),$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a1))$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p1))\ /$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}\text{<integer>}(\text{div1.quot})$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p1))\ \%$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}\text{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\text{<integer>}(\text{div1.rem}))\ ||\ !(0 ==$
$\textbf{asType}\text{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p2),$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a2))$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p2))\ /$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}\text{<integer>}(\text{div2.quot})$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p2))\ \%$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}\text{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\text{<integer>}(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}\text{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p3),$
$\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a3))$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p3))\ /$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}\text{<integer>}(\text{div3.quot})$

$(\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.p3))\ \%$
$\textbf{asType}\text{<integer>}(\textbf{asType}\text{<int>}(\$\text{heap}_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}\text{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\text{<integer>}(\text{div3.rem}))\ ||\ !(0 ==$

asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1)) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $\$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.4] (((((0 < $\$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 < **asType<integer>**($\$\text{heap}_{init}$.M1))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p2) < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) <

asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}$.p1) && ($\$\text{heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30269)))) && (0 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\$\text{heap}_{init}$.M2))) && (0 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $< \$\text{heap}_{funcstart\_724,1}$.p2)) && ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30307)))) && (0 $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 $<$
$-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$
$\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p3)) &&
($\$\text{heap}_{funcstart\_724,1}$.p3 $<$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}$.M3))

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

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 $<$
$-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$
$\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 $< \$\text{heap}_{funcstart\_724,1}$.p3)) &&
($\$\text{heap}_{funcstart\_724,1}$.p3 $<$ **asType**$<$**integer**$>$($\$\text{heap}_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p2) \wedge (0 < \$heap_{funcstart\_724,1}.p3))$ && $(\$heap_{funcstart\_724,1}.p3 < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$heap_{funcstart\_724,1}.p3) \wedge (-30307 < -\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p1) \wedge (0 < \$heap_{funcstart\_724,1}.p2) \wedge (0 < \$heap_{funcstart\_724,1}.p3)$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$heap_{funcstart\_724,1}.p2$

[Take given term]

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

$\rightarrow$ *[simplify]*

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

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

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, **asType**<**int**>($\$heap_{init}.a2$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($\$heap_{funcstart\_724,1}.p2$) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\$heap_{funcstart\_724,1}.p2$ / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot)

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

[28.3] ([**asType**<**integer**>($\$heap_{funcstart\_724,1}.p2$) < 0]:

$-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176),\;[]:$
$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176)\;==$
$\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},\;\$\text{heap}_{funcstart\_724,1}.\text{p2},\;176).\text{quot})$

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

[28.4] $([\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;<\;0]:$
$-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176),$
$[!(\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;<\;0)]:$
$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176)\;==$
$\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},\;\$\text{heap}_{funcstart\_724,1}.\text{p2},\;176).\text{quot})$

$\rightarrow$ *[simplify]*

[28.7] $([0\;<\;-\$\text{heap}_{funcstart\_724,1}.\text{p2}]:$
$-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176),$
$[!(\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;<\;0)]:$
$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176)\;==$
$\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},\;\$\text{heap}_{funcstart\_724,1}.\text{p2},\;176).\text{quot})$

$\rightarrow$ *[from term 9.0, literala $<\;-\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] $([\textbf{false}]:\;-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176),$
$[!(\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;<\;0)]:$
$\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176)\;==$
$\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},\;\$\text{heap}_{funcstart\_724,1}.\text{p2},\;176).\text{quot})$

$\rightarrow$ *[simplify]*

[28.11] $([\textbf{false}]:\;-(-\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176),\;[!(0\;<\;$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2})]:\;\textbf{asType}\!<\!\textbf{integer}\!>(\$\text{heap}_{funcstart\_724,1}.\text{p2})\;/\;176)$
$==\;\textbf{asType}\!<\!\textbf{integer}\!>(\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2},\;176).\text{quot})$

$\rightarrow$ *[from term 9.0, literala $<\;-\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) / 176),
[**!false**]: **asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) / 176) ==
asType$<$**integer**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[28.17] 0 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot + ($\text{\$heap}_{funcstart\_724,1}$.p2 / 176))

[Assume known post-assertion, class invariant or type constraint for term 28.17]

[35.0] div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot $\leq$
maxof(int)

$\rightarrow$ *[simplify]*

[35.9] -32768 $<$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot

[Take goal term]

[1.0] **asType**$<$**short int**$>$(div2.quot) $\leq$ **maxof(int)**

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[1.1] **asType**$<$**short int**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.11] -32768 $<$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).quot

$\rightarrow$ *[from term 35.9, literala $< -$div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot is true whenever (-1 + literala) < -32768]*

> **Proof of rule precondition:**
>
> *[1.11.0]* (-32768 + -1) $<$ -32768
>
> $\rightarrow$ *[simplify]*
>
> *[1.11.2]* **true**

[1.12] **true**

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

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

Condition defined at:

To prove: minof(int) $\leq$ $\$heap_{724,1;740,8}.b2$

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p1$),
asType<int>($\$heap_{funcstart\_724,1}.a1$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.rem)

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

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

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{p3}$)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{p3}$)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}.$**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{r1}$)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}.\text{b1}$))))

−**asType\<integer const\>**($\text{heap}_{724,1;740,8}.\text{M1}$) <
asType\<integer\>($\text{heap}_{724,1;740,8}.\text{p1}$)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;740,8}.\text{p1}$))

asType\<integer\>($\text{heap}_{724,1;740,8}.\text{p1}$) <
asType\<integer\>($\text{heap}_{724,1;740,8}.\text{M1}$)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{a1}$))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}.\text{a1}$))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType\<int\>($\text{heap}_{init}.\text{a1}$))

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

[11.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}$,

asType<int>(asType<short int>((int)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

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

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((int)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short**

int>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).quot)) *
asType<**int**>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>(\$heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ \$heap$_{724,1;740,8}$.b2

→ *[simplify]*

[1.1] -32768 ≤ \$heap$_{724,1;740,8}$.b2

→ *[from term 53.19, \$heap$_{724,1;740,8}$ is equal to
\$heap$_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem))]*

[1.2] -32768 ≤ \$heap$_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).b2

→ *[const member of object with modified fields]*

[1.3] -32768 ≤ \$heap$_{funcstart\_724,1}$.b2

→ *[const static or extern object]*

[1.4] -32768 ≤ \$heap$_{init}$.b2

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.5] -32768 $\leq$ **asType<short int>**((**int**)35)

$\rightarrow$ *[simplify]*

[1.8] **true**

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

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

Condition defined at:

To prove: $\text{\$heap}_{724,1;740,8}.\text{b2} \leq$ **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)

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p2),
asType\<int\>($heap$_{funcstart_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p3),
asType\<int\>($heap$_{funcstart_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($heap$_{funcstart_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($heap$_{funcstart_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_724,1}$.b1))))

−**asType\<integer const\>**($heap$_{724,1;740,8}$.M1) <
asType\<integer\>($heap$_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($heap$_{724,1;740,8}$.p1))

asType\<integer\>($heap$_{724,1;740,8}$.p1) <
asType\<integer\>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

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

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

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

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *

asType\<int\>(asType\<short int\>((int)171))) −
(**asType\<int\>(asType\<short int\>**(div1.quot)) *
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171) − (**asType\<int\>(asType\<short int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (**asType\<int\>(asType\<short int\>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) * **asType\<int\>**($heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType\<int\>**($heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType\<int\>**($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType\<int\>(asType\<short int\>**((int)2)))))

→ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] $heap$_{724,1;740,8}$.b2 ≤ **maxof(int)**

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*

$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[1.1] $\$heap_{funcstart\_724,1}.$**replace**(p1 $\to$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem))).b2 $\le$ **maxof(int)**

$\to$ *[const member of object with modified fields]*

[1.2] $\$heap_{funcstart\_724,1}.$b2 $\le$ **maxof(int)**

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

[1.3] $\$heap_{init}.$b2 $\le$ **maxof(int)**

$\to$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.4] **asType<short int>**((**int**)35) $\le$ **maxof(int)**

$\to$ *[simplify]*

[1.8] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,38)

Condition defined at:

To prove: minof(int) $\le$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}.$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)

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

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

$\text{invariant1}(\textbf{heapIs } \$heap_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.p1),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p1)) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p1)) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \; || \; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

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

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p2)) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p2)) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \; || \; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.p3),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p3)) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart_724,1}.p3)) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \; || \; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \; * $
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$-$**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{init}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <

asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.17] ((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 <
$heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) &&

($heap$_{funcstart_724,1}$.p3 < **asType<integer>(asType<short int>((int)30323)))**

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 < −$heap$_{funcstart\_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p1), **asType<int>**($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>**($heap$_{funcstart\_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>**($heap$_{init}$.a1))

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

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, **asType<int>(asType<short int>((int)177)))**

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p2), **asType<int>**($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, **asType<int>**($heap$_{funcstart\_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, **asType<int>**($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,

asType<int>(asType<short int>((int)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) /
asType<integer>(176)) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\$heap_{funcstart\_724,1}$.p2 / 176) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

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

[28.3] ([**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) / 176), []:
asType<integer>($\$heap_{funcstart\_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).quot)

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

[28.4] ([**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) / 176),
[!(**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < 0)]:
asType<integer>($\$heap_{funcstart\_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < $-\$heap_{funcstart\_724,1}$.p2]:
$-(-$**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) / 176),
[!(**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < 0)]:
asType<integer>($\$heap_{funcstart\_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).quot)

$\rightarrow$ *[from term 9.0, literala < $-\$heap_{funcstart\_724,1}$.p2 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) / 176),
[!(**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < 0)]:

asType<integer>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

→ *[simplify]*

[28.11] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176), [!(0 <
−$heap$_{funcstart_724,1}$.p2)]: **asType<integer>**($heap$_{funcstart\_724,1}$.p2) / 176)
== **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[from term 9.0, literala < −$heap$_{funcstart_724,1}$.p2 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

→ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176),
[!**false**]: **asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

→ *[simplify]*

[28.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot + ($heap$_{funcstart_724,1}$.p2 / 176))

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\text{\$heap}_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b1)))))

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

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\text{\$heap}_{init}$.b1)))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

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[53.19] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))$

[Take goal term]

[1.0] $\textbf{minof(int)} \leq (\textbf{asType<int>}(\textbf{asType<short int>}(div2.quot)) *$
$\textbf{asType<int>}(\$heap_{724,1;740,8}.b2))$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq (\textbf{asType<int>}(\textbf{asType<short int>}(div2.quot)) *$
$\textbf{asType<int>}(\$heap_{724,1;740,8}.b2))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p2, 176)]

[1.2] $-32768 \leq (\textbf{asType<int>}(\textbf{asType<short int>}(div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot)) *$
$\textbf{asType<int>}(\$heap_{724,1;740,8}.b2))$

$\rightarrow$ *[simplify]*

[1.4] $-32768 \leq (div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot * \textbf{asType<int>}(\$heap_{724,1;740,8}.b2))$

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart_724,1}.p1, 177).rem))]

[1.5] $-32768 \leq (div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot * \textbf{asType<int>}(\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).b2))$

$\rightarrow$ *[const member of object with modified fields]*

[1.6] $-32768 \leq (div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot * \textbf{asType<int>}(\$heap_{funcstart\_724,1}.b2))$

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

[1.7] $-32768 \leq (div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot * \textbf{asType<int>}(\$heap_{init}.b2))$

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.8] $-32768 \leq (div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot * \textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})35)))$

$\rightarrow$ *[simplify]*

[1.13] $-32769 < (35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot)$

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

[1.14] ([35 < 0]: (-32769 / -35) < −div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot, [0 < 35]: (-32769 / 35) < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot, [0 == 35]: -32769 < 0)

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

[1.15] ([35 < 0]: (-32769 / -35) < −div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot, [(0 < 35) ∧ !(35 < 0)]: (-32769 / 35) < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot, [(0 == 35) ∧ !(0 < 35) ∧ !(35 < 0)]: -32769 < 0)

→ *[simplify]*

[1.23] -937 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot

→ *[negate goal and search for contradiction]*

[1.24] !(-937 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[1.26] 936 < −div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot

[Create new term from terms 1.26, 28.17 using rule: transitivity 15]

[59.0] (0 + 936) < −($\$\text{heap}_{funcstart\_724,1}$.p2 / 176)

→ *[simplify]*

[59.7] 164736 < −$\$\text{heap}_{funcstart\_724,1}$.p2

→ *[from term 9.0, literala < −$\$\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[59.7.0] -2 < (0 + 164736)

→ *[simplify]*

[59.7.2] **true**

[59.8] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,38)

Condition defined at:

To prove: (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)) ≤ **maxof**(**int**)

Given:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_724,1}.\text{p1})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_724,1}.\text{p1})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \;||\; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_724,1}.\text{p2})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$

asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 == **asType<integer>**(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType<int>**($\$heap_{funcstart\_724,1}$.p3), **asType<int>**($\$heap_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) / **asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) == **asType<integer>**(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) % **asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) == **asType<integer>**(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 == **asType<integer>**(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType<integer const>**($\$heap_{724,1;740,8}$.M1) < **asType<integer>**($\$heap_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$heap_{724,1;740,8}$.p1))

asType<integer>($\$heap_{724,1;740,8}$.p1) < **asType<integer>**($\$heap_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType<integer>**($\$heap_{funcstart\_724,1}$.p1)) && (**asType<integer>**($\$heap_{funcstart\_724,1}$.p1) < **asType<integer>**($\$heap_{funcstart\_724,1}$.M1))) && (0 < **asType<integer>**($\$heap_{funcstart\_724,1}$.p2))) && (**asType<integer>**($\$heap_{funcstart\_724,1}$.p2) < **asType<integer>**($\$heap_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($\$heap_{funcstart\_724,1}$.p3))) && (**asType<integer>**($\$heap_{funcstart\_724,1}$.p3) < **asType<integer>**($\$heap_{funcstart\_724,1}$.M3))

→ *[simplify]*

[5.3] ((((((0 < $\$heap_{funcstart\_724,1}$.p1) && ($\$heap_{funcstart\_724,1}$.p1 < **asType<integer>**($\$heap_{funcstart\_724,1}$.M1))) && (0 <

asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

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

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{init}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

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

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <
$-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p2) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 2 of conjunction in term 5.40]

[6.0] -30307 < $-$$heap$_{funcstart\_724,1}$.p2

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] 0 < $heap$_{funcstart_724,1}$.p2

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{funcstart_724,1}$.a1))

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

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,

asType<**int**>(heap_{init}.a1))

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

[11.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>($\text{heap}_{funcstart\_724,1}$.a2))

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

[25.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>(heap_{init}.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) /
asType<**integer**>(176)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\text{heap}_{funcstart\_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

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

[28.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176), []:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
176).quot)

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

[28.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p2) < 0]:

$-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$,
$[!($**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ $< 0)]$:
asType$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$ ==
asType$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}.$p2,
176$)$.quot$)$

$\rightarrow$ *[simplify]*

[28.7] $([0 < -$$heap$_{funcstart\_724,1}.$p2$]$:
$-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$,
$[!($**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ $< 0)]$:
asType$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$ ==
asType$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}.$p2,
176$)$.quot$)$

$\rightarrow$ *[from term 9.0, literala $< -$$heap$_{funcstart\_724,1}.$p2 is false whenever -2 $< (0$
+ literala)]*

Proof of rule precondition:

[28.7.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] $([$**false**$]$: $-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$,
$[!($**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ $< 0)]$:
asType$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$ ==
asType$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}.$p2,
176$)$.quot$)$

$\rightarrow$ *[simplify]*

[28.11] $([$**false**$]$: $-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$, $[!(0 <$
$-$$heap$_{funcstart\_724,1}.$p2$)]$: **asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$
== **asType**$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}.$p2, 176$)$.quot$)$

$\rightarrow$ *[from term 9.0, literala $< -$$heap$_{funcstart\_724,1}.$p2 is false whenever -2 $< (0$
+ literala)]*

Proof of rule precondition:

[28.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] $([$**false**$]$: $-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$,
$[!$**false**$]$: **asType**$<$**integer**$>$($heap$_{funcstart_724,1}.$p2$)$ / 176$)$ ==
asType$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}.$p2,
176$)$.quot$)$

$\rightarrow$ *[simplify]*

[28.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p2} / 176))$

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177)]*

[53.1] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.3] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

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

[53.4] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType<int>}(\$\text{heap}_{init}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

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

[53.5] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})171))) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.8] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * 171) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177)]*

[53.9] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$

int>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ [simplify]

[53.11] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ [const static or extern object]

[53.12] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>($\$\text{heap}_{init}$.b1))))

→ [expand definition of constant 'b1' at prang.c (17,20)]

[53.13] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ [simplify]

[53.19] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)) ≤ **maxof**(**int**)

→ [from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176)]

[1.1] (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)) ≤
maxof(**int**)

→ [simplify]

[1.3] (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)) ≤ **maxof**(**int**)

→ [from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[1.4] (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *

asType<**int**>($heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[const member of object with modified fields]*

[1.5] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<**int**>($heap$_{funcstart_724,1}$.b2)) $\leq$ **maxof**(**int**)

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

[1.6] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<**int**>($heap$_{init}$.b2)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.7] (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.20] -32768 < (-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

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

[1.21] ([-35 < 0]: (-32768 / 35) < $-$div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot, [0 < -35]: (-32768 / -35) < div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot, [-35 == 0]: -32768 < 0)

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

[1.22] ([-35 < 0]: (-32768 / 35) < $-$div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot, [(0 < -35) $\wedge$!(-35 < 0)]: (-32768 / -35) <
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot, [(-35 == 0)
$\wedge$!(-35 < 0) $\wedge$!(0 < -35)]: -32768 < 0)

$\rightarrow$ *[simplify]*

[1.26] -937 < $-$div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot

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

[1.27] !(-937 < $-$div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[1.30] 936 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot

[Create new term from terms 1.30, 28.17 using rule: transitivity 16]

[59.0] (0 + 936) < ($heap$_{funcstart_724,1}$.p2 / 176)

$\rightarrow$ *[simplify]*

[59.8] 164911 < $heap$_{funcstart_724,1}$.p2

$\rightarrow$ *[from term 6.0, literala $<$ \$heap$_{funcstart\_724,1}$.p2 is false whenever -2 $<$ (-30307 + literala)]*

Proof of rule precondition:

[59.8.0] -2 $<$ (-30307 + 164911)

$\rightarrow$ *[simplify]*

[59.8.2] **true**

[59.9] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,33)

Condition defined at:

To prove: minof(short int) $\leq$ ((asType$<$int$>$(asType$<$short int$>$(div2.rem)) * asType$<$int$>$(\$heap$_{724,1;740,8}$.r2)) $-$ (asType$<$int$>$(asType$<$short int$>$(div2.quot)) * asType$<$int$>$(\$heap$_{724,1;740,8}$.b2)))

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)

invariant1(**heapIs** \$heap$_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

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

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

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

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

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{init}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <

asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ [simplify]

[5.16] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 < **asType\<integer\>**($heap$_{funcstart_724,1}$.M2))) && (0 < **asType\<integer\>**($heap$_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) < **asType\<integer\>**($heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.17] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 < **asType\<integer\>**($heap$_{init}$.M2))) && (0 < **asType\<integer\>**($heap$_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) < **asType\<integer\>**($heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ [expand definition of constant 'M2' at prang.c (19,20)]

[5.18] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 < **asType\<integer\>**(**asType\<short int\>**((**int**)30307)))) && (0 < **asType\<integer\>**($heap$_{funcstart_724,1}$.p3))) && (**asType\<integer\>**($heap$_{funcstart\_724,1}$.p3) < **asType\<integer\>**($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ [simplify]

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType\<integer\>**($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.31] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType\<integer\>**($heap$_{init}$.M3))

$\rightarrow$ [expand definition of constant 'M3' at prang.c (24,20)]

[5.32] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p2) $\land$ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType\<integer\>**(**asType\<short int\>**((**int**)30323)))

$\rightarrow$ [simplify]

[5.40] (-30323 < $-$$heap$_{funcstart\_724,1}$.p3) $\land$ (-30307 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 2 of conjunction in term 5.40]

[6.0] -30307 $< -\$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

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

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType\<int\>$(\$\text{heap}_{init}.\text{a1}))$

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

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
asType\<int\>(**asType\<short int\>**$((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
asType\<int\>$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

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

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
asType\<int\>$(\$\text{heap}_{init}.\text{a2}))$

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
asType\<int\>(**asType\<short int\>**$((\textbf{int})176)))$

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\$\text{heap}_{funcstart\_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

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

[28.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

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

[28.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}$.p2]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < $-\$\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.11] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176), [!(0 < $-\$\text{heap}_{funcstart\_724,1}.\text{p2})$]: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

$\rightarrow$ *[from term 9.0, literala* $< -\$heap_{funcstart\_724,1}.p2$ *is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176), [!**false**]: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

$\rightarrow$ *[simplify]*

[28.17] 0 == $(-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p2}$ / 176))

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] ($\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % $\textbf{asType}<\textbf{integer}>(176)) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p2}$ % 176) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

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

[29.3] ([$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ < 0]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176), []: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

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

[29.4] ([$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ < 0]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176), [!($\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ < 0)]: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) == $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.7] ($[0 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}]$:
$-(-\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176),
$[!(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0)]$:
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) ==
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176),
$[!(\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0)]$:
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) ==
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
176).rem)

$\rightarrow$ *[simplify]*

[29.11] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176), $[!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p2})]$: $\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) == $\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[from term 9.0, literala $< -\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176),
$[!\textbf{false}]$: $\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) ==
$\textbf{asType}\textbf{<}\textbf{integer}\textbf{>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
176).rem)

$\rightarrow$ *[simplify]*

[29.17] $0 == (-\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
176).rem + (\$\text{heap}_{funcstart_724,1}.\text{p2} % 176))

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<}\textbf{short}$

int>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to* **div**(**heapIs** *$heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(**div**(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.r1)) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((**div**(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((**div**(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>($heap$_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

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

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((**div**(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>(**asType**<**short int**>((**int**)171))) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((**div**(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to* **div**(**heapIs** *$heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * **div**(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(**div**(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**

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int>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof**(**short int**) ≤ ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.b2)))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.b2)))

→ *[from term 25.6, div2 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)]*

[1.2] -32768 ≤ ((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.b2)))

→ *[simplify]*

[1.4] -32768 ≤ ((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>(\$heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{724,1;740,8}$.b2)))

→ *[from term 53.19, \$heap$_{724,1;740,8}$ is equal to \$heap$_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*

$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[1.5] $-32768 \leq ((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).r2)) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[const member of object with modified fields]*

[1.6] $-32768 \leq ((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{funcstart\_724,1}.r2)) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

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

[1.7] $-32768 \leq ((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{init}.r2)) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.8] $-32768 \leq ((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem * \textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})172))) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[simplify]*

[1.11] $-32768 \leq ((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem * 172) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176)]*

[1.12] $-32768 \leq ((172 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot)) * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[simplify]*

[1.14] $-32768 \leq ((172 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot * \textbf{asType}\textless\textbf{int}\textgreater(\$heap_{724,1;740,8}.b2)))$

$\rightarrow$ *[from term 53.19, \$heap_{724,1;740,8} is equal to \$heap_{funcstart_724,1}._\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).rem))]*

[1.15] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2)))

→ *[const member of object with modified fields]*

[1.16] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b2)))

→ *[const static or extern object]*

[1.17] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{init}$.b2)))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.18] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**(**asType\<short int\>**((**int**)35))))

→ *[simplify]*

[1.25] -32769 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))

→ *[negate goal and search for contradiction]*

[1.26] !(-32769 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

→ *[simplify]*

[1.31] 32768 < ((35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))

[Copy term 1.31]

[62.0] 32768 < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot))

→ *[from term 29.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem is equal to $\$heap_{funcstart\_724,1}$.p2 % 176]*

[62.1] 32768 < ((-172 * ($\$heap_{funcstart\_724,1}$.p2 % 176)) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot))

[Create new term from term 28.17 using rule: condition for equality of division]

[79.0] ((176 * (0 + −(−div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot))) < (1 + $\text{\$heap}_{funcstart\_724,1}$.p2)) ∧ ($\text{\$heap}_{funcstart\_724,1}$.p2 < (176 * (0 + 1 + −(−div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot))))

→ *[simplify]*

[79.15] (-1 < ((-176 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + $\text{\$heap}_{funcstart\_724,1}$.p2)) ∧ (-176 < (−$\text{\$heap}_{funcstart\_724,1}$.p2 + (176 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)))

[Work on sub-term 2 of conjunction in term 79.15]

[80.0] -1 < ((-176 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + $\text{\$heap}_{funcstart\_724,1}$.p2)

[Create new term from terms 80.0, 6.0 using rule: transitivity 2]

[92.0] (-30307 + -1 + 1) < (-176 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[92.1] -30307 < (-176 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)

→ *[literal comparison of product]*

[92.2] ([-176 < 0]: (-30307 / 176) < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot, [0 < -176]: (-30307 / -176) < div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot, [-176 == 0]: -30307 < 0)

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

[92.3] ([-176 < 0]: (-30307 / 176) < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot, [(0 < -176) ∧ !(-176 < 0)]: (-30307 / -176) < div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot, [(-176 == 0) ∧ !(-176 < 0) ∧ !(0 < -176)]: -30307 < 0)

→ *[simplify]*

[92.7] -173 < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot

[Create new term from terms 92.7, 62.1 using rule: transitivity 5]

[94.0] 32768 < ((-172 * ($\text{\$heap}_{funcstart\_724,1}$.p2 % 176)) + (35 * −(-173 + 1)))

→ *[simplify]*

[94.5] 26748 < (-172 * ($\text{\$heap}_{funcstart\_724,1}$.p2 % 176))

→ *[literal comparison of product]*

[94.6] ([-172 < 0]: (26748 / 172) < −($\text{\$heap}_{funcstart\_724,1}$.p2 % 176), [0 < -172]: (26748 / -172) < ($\text{\$heap}_{funcstart\_724,1}$.p2 % 176), [-172 == 0]: 26748 <

0)

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

[94.7] ([-172 < 0]: (26748 / 172) < $-(\$heap_{funcstart\_724,1}.p2 \% 176)$, [(0 < -172) $\wedge$!(-172 < 0)]: (26748 / -172) < ($\$heap_{funcstart\_724,1}.p2 \% 176$), [(-172 == 0) $\wedge$!(-172 < 0) $\wedge$!(0 < -172)]: 26748 < 0)

$\rightarrow$ *[simplify]*

[94.12] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (58,33)

Condition defined at:

To prove: ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$heap_{724,1;740,8}.r2$)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}.b2$))) $\leq$ **maxof**(**short int**)

Given:

$\$heap_{init}.LIMIT == (\textbf{int})80$

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{init}.\mathrm{M1}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})30269)))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$

asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.16] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.17] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>(heap_{init}.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [expand definition of constant 'M2' at prang.c (19,20)]

[5.18] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.30] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.31] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>(heap_{init}.M3))

$\rightarrow$ [expand definition of constant 'M3' at prang.c (24,20)]

[5.32] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\land$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\land$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>(**asType**<**short int**>((**int**)30323)))

$\rightarrow$ [simplify]

[5.40] (-30323 < $-\text{heap}_{funcstart\_724,1}$.p3) $\land$ (-30307 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$), **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType<int>**($\$\text{heap}_{init}.\text{a1}$))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType<int>**(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$), **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType<int>**($\$\text{heap}_{init}.\text{a2}$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType<int>**(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) /
asType<**integer**>(176)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($heap$_{funcstart_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[28.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0]:
$-(-$**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[28.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0]:
$-(-$**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < $-$$heap$_{funcstart\_724,1}$.p2]:
$-(-$**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

$\rightarrow$ *[from term 9.0, literala < $-$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0
+ literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[28.11] ([**false**]: $-(-$**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) / 176), [!(0 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p2})$]: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176) $==$ $\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

$\rightarrow$ *[from term 9.0, literala $< -\$\text{heap}_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176), [**!false**]: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ / 176) $==$ $\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

$\rightarrow$ *[simplify]*

[28.17] 0 $==$ ($-\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p2}$ / 176))

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] $(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % $\textbf{asType}\textbf{<integer>}(176)) == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.2] $(\$\text{heap}_{funcstart\_724,1}.\text{p2}$ % 176) $== \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[29.3] ([$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0$]: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176), []: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) $==$ $\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[29.4] ([$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0$]: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176), [!($\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0$)]: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$ % 176) $==$ $\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.7] ([0 $< -\$\text{heap}_{funcstart\_724,1}.\text{p2}$]:

$-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem})$

$\rightarrow$ *[from term 9.0, literala $< -\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] $-2 < (0 + 0)$

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176)$,
$[!(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < 0)]$:
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.11] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176)$, $[!(0$
$< -\$\text{heap}_{funcstart\_724,1}.\text{p2})]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%$
$176) == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2},\ 176).\text{rem})$

$\rightarrow$ *[from term 9.0, literala $< -\$heap_{funcstart\_724,1}.p2$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] $-2 < (0 + 0)$

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ($[\textbf{false}]$: $-(-\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176)$,
$[!\textbf{false}]$: $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})\ \%\ 176) ==$
$\textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem})$

$\rightarrow$ *[simplify]*

[29.17] $0 == (-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem} + (\$\text{heap}_{funcstart\_724,1}.\text{p2}\ \%\ 176))$

[Take given term]

[38.0] $!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p2, 176)]$

[38.1] !(0 == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem)) || !(0 == **asType**<**integer**>(div2.quot))

→ *[simplify]*

[38.2] !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem) || !(0 == **asType**<**integer**>(div2.quot))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176)]*

[38.3] !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem) || !(0 == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).quot))$

→ *[simplify]*

[38.5] !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) ∨ !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem)

[Take given term]

[53.0] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap_{funcstart\_724,1}.r1$)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart\_724,1}.b1$))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177)]*

[53.1] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem)) * **asType**<**int**>($heap_{funcstart_724,1}.r1$)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart_724,1}.b1$))))

→ *[simplify]*

[53.3] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem * **asType**<**int**>($heap_{funcstart_724,1}.r1$)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart_724,1}.b1$))))

→ *[const static or extern object]*

[53.4] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem * **asType**<**int**>($heap_{init}.r1$)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap_{funcstart_724,1}.b1$))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take goal term]

[1.0] ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2))) ≤ **maxof**(**short int**)

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[1.1] ((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType\<int\>**($heap_{724,1;740,8}$.r2)) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.3] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**($heap_{724,1;740,8}$.r2)) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.__replace(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.4] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**($heap_{funcstart\_724,1}$.__replace(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[const member of object with modified fields]*

[1.5] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**($heap_{funcstart\_724,1}$.r2)) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[const static or extern object]*

[1.6] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**($heap_{init}$.r2)) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.7] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**(**asType\<short int\>**((**int**)172))) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.10] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * 172) $-$ (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))) $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[1.11] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.13] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{724,1;740,8}$.b2))) ≤ **maxof**(**short int**)

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.14] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))) ≤ **maxof**(**short int**)

→ *[const member of object with modified fields]*

[1.15] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_724,1}$.b2))) ≤ **maxof**(**short int**)

→ *[const static or extern object]*

[1.16] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{init}$.b2))) ≤ **maxof**(**short int**)

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.17] ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((**int**)35)))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.36] -32768 < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot))

→ *[negate goal and search for contradiction]*

[1.37] !(-32768 < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)))

→ *[simplify]*

[1.42] $32767 < ((172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) + (-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}))$

[Branch on disjunction or conditional in term 38.5]

[58.0] $!(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) \lor !(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) \lor (0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

[Copy term 1.42]

[62.0] $32767 < ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))$

→ *[from term 29.17, div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem is equal to \$heap$_{funcstart\_724,1}$.p2 % 176]*

[62.1] $32767 < ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * (\$\text{heap}_{funcstart\_724,1}.\text{p2} \% 176)))$

[Copy term 58.0]

[78.0] $!(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) \lor !(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) \lor (0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})$

→ *[from term 28.17, div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot is equal to \$heap$_{funcstart\_724,1}$.p2 / 176]*

[78.1] $!(0 == (\$\text{heap}_{funcstart\_724,1}.\text{p2} / 176)) \lor ...$

[Create new term from term 28.17 using rule: condition for equality of division]

[79.0] $((176 * (0 + -(-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}))) < (1 + \$\text{heap}_{funcstart\_724,1}.\text{p2})) \land (\$\text{heap}_{funcstart\_724,1}.\text{p2} < (176 * (0 + 1 + -(-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}))))$

→ *[simplify]*

[79.15] $(-1 < ((-176 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + \$\text{heap}_{funcstart\_724,1}.\text{p2})) \land (-176 < (-\$\text{heap}_{funcstart\_724,1}.\text{p2} + (176 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})))$

→ *[separate conjunction and work on first sub-term]*

[79.16] $-176 < (-\$\text{heap}_{funcstart\_724,1}.\text{p2} + (176 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}))$

[Create new term from term 78.1 using rule: condition for inequality of

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division]

[84.0] (!((0 * 176) < (1 + $heap_{funcstart\_724,1}$.p2)) ∨ !($heap_{funcstart\_724,1}$.p2 < (176 * (0 + 1)))) ∨ !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[84.3] (!(-1 < $heap_{funcstart\_724,1}$.p2) ∨ !($heap_{funcstart\_724,1}$.p2 < (176 * (0 + 1)))) ∨ ...

→ *[from term 9.0, literala < $heap_{funcstart\_724,1}$.p2 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[84.3.0] (-1 + -1) < 0

→ *[simplify]*

[84.3.2] **true**

[84.4] (!**true** ∨ !($heap_{funcstart\_724,1}$.p2 < (176 * (0 + 1)))) ∨ ...

→ *[simplify]*

[84.14] (175 < $heap_{funcstart\_724,1}$.p2) ∨ ...

[Create new term from terms 84.14, 79.16 using rule: transitivity 3]

[85.0] ((-176 + 1 + 175) < (176 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) ∨ !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)

→ *[simplify]*

[85.1] (0 < (176 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) ∨ ...

→ *[product is positive]*

[85.2] (((0 < 176) ∧ (0 < div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) ∨ ((176 < 0) ∧ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot < 0))) ∨ ...

→ *[simplify]*

[85.7] (0 < div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) ∨ ...

[Create new term from terms 85.7, 62.1 using rule: transitivity 11]

[87.0] ((1 + 32767 + (0 * 35)) < (172 * ($heap_{funcstart\_724,1}$.p2 % 176))) ∨ !(0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[87.2] $(32768 < (172 * (\$\text{heap}_{funcstart\_724,1}.p2 \% 176))) \vee ...$

$\rightarrow$ *[literal comparison of product]*

[87.3] $([172 < 0]: (32768 / -172) < -(\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [0 < 172]:$
$(32768 / 172) < (\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [0 == 172]: 32768 < 0) \vee ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[87.4] $([172 < 0]: (32768 / -172) < -(\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [(0 <$
$172) \wedge !(172 < 0)]: (32768 / 172) < (\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [(0 ==$
$172) \wedge !(0 < 172) \wedge !(172 < 0)]: 32768 < 0) \vee ...$

$\rightarrow$ *[simplify]*

[87.13] **false** $\vee$ ...

[Remove 'false' term 87.13 and fetch new term from containing clause]

[90.0] $0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).\text{quot}$

[Copy term 1.42]

[62.1] $32767 < ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2,$
$176).\text{quot}) + (172 * (\$\text{heap}_{funcstart\_724,1}.p2 \% 176)))$

$\rightarrow$ *[from term 90.0, div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,*
176).quot is equal to 0]

[62.2] $32767 < ((-35 * 0) + (172 * (\$\text{heap}_{funcstart\_724,1}.p2 \% 176)))$

$\rightarrow$ *[simplify]*

[62.4] $32767 < (172 * (\$\text{heap}_{funcstart\_724,1}.p2 \% 176))$

$\rightarrow$ *[literal comparison of product]*

[62.5] $([172 < 0]: (32767 / -172) < -(\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [0 < 172]:$
$(32767 / 172) < (\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [0 == 172]: 32767 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[62.6] $([172 < 0]: (32767 / -172) < -(\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [(0 <$
$172) \wedge !(172 < 0)]: (32767 / 172) < (\$\text{heap}_{funcstart\_724,1}.p2 \% 176), [(0 ==$
$172) \wedge !(0 < 172) \wedge !(172 < 0)]: 32767 < 0)$

$\rightarrow$ *[simplify]*

[62.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (59,31)

To prove: asType\<integer\>$(\$\text{heap}_{724,1;742,8}.p2) <$
asType\<integer\>$(\$\text{heap}_{724,1;742,8}.M2)$

Given:

$\$heap_{init}.LIMIT == (\textbf{int})80$

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1})$

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1)$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}<\textbf{integer}>(div1.quot)$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1))$ %
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}<\textbf{integer}>(div1.rem)$

$!(0 == \textbf{asType}<\textbf{integer}>(div1.rem)) \;||\; !(0 ==$
$\textbf{asType}<\textbf{integer}>(div1.quot))$

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2)$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a2))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}<\textbf{integer}>(div2.quot)$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2))$ %

asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p1) <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && (0 <

asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M1))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$
asType$<$integer$>$($\$$heap$_{init}$.M1))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$
asType$<$integer$>$(**asType$<$short int$>$**((**int**)30269)))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 $<$ $-\$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\$$heap$_{funcstart\_724,1}$.p2)) && ($\$$heap$_{funcstart\_724,1}$.p2 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$integer$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M2})))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $($**asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**$($**asType<short int>**$((\textbf{int})30307))))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $($**asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$($**asType<short int>**$((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$, **asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<**int**>(\$heap$_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<**int**>(\$heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<**int**>(\$heap$_{funcstart\_724,1}$.p2),
asType<**int**>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<**int**>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<**int**>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p2) /
asType<**integer**>(176)) == **asType**<**integer**>(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] (\$heap$_{funcstart\_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[28.3] ([**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p2) < 0]:
$-(-$**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p2) / 176), []:

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asType<integer>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[28.4] ([**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < $-$$heap$_{funcstart\_724,1}$.p2]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < $-$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p2) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.11] ([**false**]: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176), [!(0 < $-$$heap$_{funcstart\_724,1}$.p2)]: **asType<integer>**($heap$_{funcstart_724,1}$.p2) / 176)
== **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < $-$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) / 176), [!**false**]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) / 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot)

$\rightarrow$ *[simplify]*

[28.17] $0 ==$ ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot $+$ ($\text{heap}_{funcstart\_724,1}.\text{p2}$ / 176))

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % **asType**$<$**integer**$>$(176)) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\text{heap}_{funcstart\_724,1}.\text{p2}$ % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[29.3] ([**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) $<$ 0]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176), []: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[29.4] ([**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) $<$ 0]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176), [!(**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) $<$ 0)]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[29.7] ([0 $<$ $-\text{heap}_{funcstart\_724,1}.\text{p2}$]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176), [!(**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) $<$ 0)]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}.\text{p2}$) % 176) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\text{heap}_{funcstart\_724,1}.\text{p2}$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) < 0)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!(0 $< -\$$heap$_{funcstart\_724,1}$.p2)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[from term 9.0, literala $< -\$$heap$_{funcstart\_724,1}$.p2 is false whenever -2 $< (0$ + literala)]*

Proof of rule precondition:

[29.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176), [!**false**]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) % 176) $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.17] 0 $==$ ($-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem + ($\$$heap$_{funcstart\_724,1}$.p2 % 176))

[Take given term]

[38.0] !(0 $==$ **asType**$<$**integer**$>$(div2.rem)) || !(0 $==$ **asType**$<$**integer**$>$(div2.quot))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176)]*

[38.1] !(0 $==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem)) || !(0 $==$ **asType**$<$**integer**$>$(div2.quot))

$\rightarrow$ *[simplify]*

[38.2] !(0 $==$ div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem) || !(0 $==$ **asType**$<$**integer**$>$(div2.quot))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176)]*

[38.3] !(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem) || !(0 == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot))

→ *[simplify]*

[38.5] !(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) ∨ !(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)

[Take given term]

[53.0] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.3] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.4] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**(\$heap$_{init}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**(**asType\<short int\>**((**int**)171))) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.8] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.b1$)))))

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}.b1$)))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot * **asType**<**int**>($\$heap_{init}.b1$)))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}.$**replace**(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$heap_{724,1;740,8}.r2$)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}.b2$)))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *

asType<**int**>($\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.4] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\$heap_{init}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>(**asType**<**short int**>((**int**)172))) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
$\$heap_{funcstart\_724,1}$.**replace**$(p1 \rightarrow$ *(-2 * div(***heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

$\rightarrow$ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.p2$, 176).rem)))

[Take goal term]

[1.0] **asType**<**integer**>($\text{heap}_{724,1;742,8}.p2$) <
asType<**integer**>($\text{heap}_{724,1;742,8}.M2$)

→ *[from term 57.24, $\text{heap}_{724,1;742,8}$ is equal to*
*$\text{heap}_{funcstart\_724,1}.\_$**replace***(p1 → ((-2 * div(***heapIs** $\text{heap}_{funcstart\_724,1}$,*
*$\text{heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(***heapIs** $\text{heap}_{funcstart\_724,1}$,*
*$\text{heap}_{funcstart\_724,1}.p1$, 177).rem)))._***replace***(p2 → (-35 * div(***heapIs***
*$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(***heapIs***
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).rem))]

[1.1] **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.p2$, 176).rem))).p2) <
asType<**integer**>($\text{heap}_{724,1;742,8}.M2$)

→ *[simplify]*

[1.3] ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$,
176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$,
176).rem)) < **asType**<**integer**>($\text{heap}_{724,1;742,8}.M2$)

→ *[from term 57.24, $\text{heap}_{724,1;742,8}$ is equal to*
*$\text{heap}_{funcstart\_724,1}.\_$**replace***(p1 → ((-2 * div(***heapIs** $\text{heap}_{funcstart\_724,1}$,*
*$\text{heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(***heapIs** $\text{heap}_{funcstart\_724,1}$,*
*$\text{heap}_{funcstart\_724,1}.p1$, 177).rem)))._***replace***(p2 → (-35 * div(***heapIs***
*$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(***heapIs***
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).rem))]

[1.4] ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).quot)
+ (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).rem)) <
asType<**integer**>($\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 → ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).quot) + (172 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$, 176).rem))).M2)

→ *[const member of object with modified fields]*

[1.6] ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$,
176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$,
176).rem)) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}.M2$)

→ *[const static or extern object]*

[1.7] ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.p2$,

176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) < **asType**<**integer**>($\$heap_{init}$.M2)

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.8] ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) < **asType**<**integer**>(**asType**<**short int**>((**int**)30307))

→ *[simplify]*

[1.18] -30307 < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot))

→ *[negate goal and search for contradiction]*

[1.19] !(-30307 < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)))

→ *[simplify]*

[1.24] 30306 < ((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot))

[Branch on disjunction or conditional in term 38.5]

[61.0] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

[Copy term 1.24]

[65.0] 30306 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))

→ *[from term 29.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem is equal to $\$heap_{funcstart\_724,1}$.p2 % 176]*

[65.1] 30306 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * ($\$heap_{funcstart\_724,1}$.p2 % 176)))

[Copy term 61.0]

[81.0] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) ∨ !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

→ *[from term 28.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot is equal to $\$heap_{funcstart\_724,1}$.p2 / 176]*

[81.1] !(0 == ($heap$_{funcstart_724,1}$.p2 / 176)) ∨ ...

[Create new term from term 28.17 using rule: condition for equality of division]

[82.0] ((176 * (0 + −(−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot))) < (1 + $heap$_{funcstart_724,1}$.p2)) ∧ ($heap$_{funcstart\_724,1}$.p2 < (176 * (0 + 1 + −(−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot))))

→ *[simplify]*

[82.15] (-1 < ((-176 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + $heap$_{funcstart_724,1}$.p2)) ∧ (-176 < (−$heap$_{funcstart\_724,1}$.p2 + (176 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)))

→ *[separate conjunction and work on first sub-term]*

[82.16] -176 < (−$heap$_{funcstart_724,1}$.p2 + (176 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot))

[Create new term from term 81.1 using rule: condition for inequality of division]

[87.0] (!((0 * 176) < (1 + $heap$_{funcstart_724,1}$.p2)) ∨ !($heap$_{funcstart\_724,1}$.p2 < (176 * (0 + 1)))) ∨ !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[simplify]*

[87.3] (!(-1 < $heap$_{funcstart_724,1}$.p2) ∨ !($heap$_{funcstart\_724,1}$.p2 < (176 * (0 + 1)))) ∨ ...

→ *[from term 9.0, literala < $heap$_{funcstart_724,1}$.p2 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[87.3.0] (-1 + -1) < 0

→ *[simplify]*

[87.3.2] **true**

[87.4] (!**true** ∨ !($heap$_{funcstart_724,1}$.p2 < (176 * (0 + 1)))) ∨ ...

→ *[simplify]*

[87.14] (175 < $heap$_{funcstart_724,1}$.p2) ∨ ...

[Create new term from terms 87.14, 82.16 using rule: transitivity 3]

[88.0] ((-176 + 1 + 175) < (176 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)) ∨ !(0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)

→ *[simplify]*

[88.1] (0 < (176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) ∨ ...

→ [product is positive]

[88.2] (((0 < 176) ∧ (0 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) ∨ ((176 < 0) ∧ (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot < 0))) ∨ ...

→ [simplify]

[88.7] (0 < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) ∨ ...

[Create new term from terms 88.7, 65.1 using rule: transitivity 11]

[90.0] ((1 + 30306 + (0 * 35)) < (172 * ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176))) ∨ !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) ∨ (0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

→ [simplify]

[90.2] (30307 < (172 * ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176))) ∨ ...

→ [literal comparison of product]

[90.3] ([172 < 0]: (30307 / -172) < −($\$\text{heap}_{funcstart\_724,1}$.p2 % 176), [0 < 172]: (30307 / 172) < ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176), [0 == 172]: 30307 < 0) ∨ ...

→ [explicitly assert falsehood of skipped guards in subsequent guards]

[90.4] ([172 < 0]: (30307 / -172) < −($\$\text{heap}_{funcstart\_724,1}$.p2 % 176), [(0 < 172) ∧ !(172 < 0)]: (30307 / 172) < ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176), [(0 == 172) ∧ !(0 < 172) ∧ !(172 < 0)]: 30307 < 0) ∨ ...

→ [simplify]

[90.13] **false** ∨ ...

[Remove 'false' term 90.13 and fetch new term from containing clause]

[93.0] 0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot

[Copy term 1.24]

[65.1] 30306 < ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176)))

→ [from term 93.0, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot is equal to 0]

[65.2] 30306 < ((-35 * 0) + (172 * ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176)))

→ [simplify]

[65.4] 30306 < (172 * ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176))

→ [literal comparison of product]

[65.5] ([172 < 0]: (30306 / -172) < −($\$\text{heap}_{funcstart\_724,1}$.p2 % 176), [0 < 172]:

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$(30306 \ / \ 172) < (\$\text{heap}_{funcstart\_724,1}.\text{p2} \ \% \ 176), [0 == 172]: 30306 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[65.6] $([172 < 0]: (30306 \ / \ \text{-}172) < -(\$\text{heap}_{funcstart\_724,1}.\text{p2} \ \% \ 176), [(0 < 172) \wedge \ !(172 < 0)]: (30306 \ / \ 172) < (\$\text{heap}_{funcstart\_724,1}.\text{p2} \ \% \ 176), [(0 == 172) \wedge \ !(0 < 172) \wedge \ !(172 < 0)]: 30306 < 0)$

$\rightarrow$ *[simplify]*

[65.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (59,12)

To prove: $-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;742,8}.\text{M2}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1})$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /

asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType**<**short

int>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p1) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.3] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[const static or extern object]*

[5.4] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap$_{init}$.M1))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p3))) &&

($\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{init}.\mathrm{M2}))) \&\& (0 <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \&\& (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)))) \&\& (0 <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))) \&\&$
$(\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $(((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 <$
$-\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 <$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$
$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} < \mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $(((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 <$
$-\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 <$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$
$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} < \mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{init}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $(((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 <$
$-\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 <$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \&\&$
$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} < \mathbf{asType{<}integer{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \land (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 2 of conjunction in term 5.40]

[6.0] -30307 $< -\$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Work on sub-term 5 of conjunction in term 5.40]

[9.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$), **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType**<**int**>($\$\text{heap}_{init}.\text{a1}$))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$), **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**<**int**>($\$\text{heap}_{init}.\text{a2}$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[28.0] (**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.2] ($\$heap_{funcstart\_724,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[28.3] ([**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) < 0]: −(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176), []: **asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[28.4] ([**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) < 0]: −(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.7] ([0 < −$\$heap_{funcstart\_724,1}$.p2]: −(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala < −$\$heap_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.7.2] **true**

[28.8] ([**false**]: −(−**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176), [!(**asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$heap_{funcstart\_724,1}$.p2) / 176) ==

asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.11] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), [!(0 < $-\$\text{heap}_{funcstart\_724,1}$.p2)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[from term 9.0, literala $< -\$\text{heap}_{funcstart\_724,1}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[28.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[28.11.2] **true**

[28.12] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176), [!**false**]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[28.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot + ($\$\text{heap}_{funcstart\_724,1}$.p2 / 176))

[Assume known post-assertion, class invariant or type constraint for term 25.6]

[29.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[29.2] ($\$\text{heap}_{funcstart\_724,1}$.p2 % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[29.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[29.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.p2) % 176) ==

asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem)

→ *[simplify]*

[29.7] ([0 < −\$heap$_{funcstart\_724,1}$·p2]:
−(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176),
[!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) < 0)]:
asType<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem)

→ *[from term 9.0, literala < −\$heap$_{funcstart\_724,1}$·p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.7.0] -2 < (0 + 0)

→ *[simplify]*

[29.7.2] **true**

[29.8] ([**false**]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176),
[!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) < 0)]:
asType<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem)

→ *[simplify]*

[29.11] ([**false**]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176), [!(0 < −\$heap$_{funcstart\_724,1}$·p2)]: **asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem)

→ *[from term 9.0, literala < −\$heap$_{funcstart\_724,1}$·p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[29.11.0] -2 < (0 + 0)

→ *[simplify]*

[29.11.2] **true**

[29.12] ([**false**]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176),
[!**false**]: **asType**<**integer**>(\$heap$_{funcstart\_724,1}$·p2) % 176) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem)

→ *[simplify]*

[29.17] 0 == (−div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$·p2, 176).rem + (\$heap$_{funcstart\_724,1}$·p2 % 176))

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}.$r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType**<**int**>($\$heap_{init}.$r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * 171) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}<\textbf{int}>(\$heap_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem})))$

[Take given term]

[57.0] $\$heap_{724,1;742,8} ==$ $\$heap_{724,1;740,8}.\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart_724,1}.\textbf{replace}(p1 \rightarrow (-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).\text{rem}))]*

[57.1] $\$heap_{724,1;742,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 25.6, div2 is equal to $\text{div}(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176)]*

[57.2] $\$heap_{724,1;742,8} ==$ $\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$

177).rem))). **replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.4] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$. **replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{init}$.r2)) − (**asType<int>**(**asType<short**

int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176)]*

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to
$heap$_{funcstart_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[57.24] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] −**asType<integer const>**($\text{\$heap}_{724,1;742,8}$.M2) <
asType<integer>($\text{\$heap}_{724,1;742,8}$.p2)

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._replace(p2 → (-35 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.1] −**asType**<**integer const**>($heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).M2) <
asType<**integer**>($heap_{724,1;742,8}$.p2)

→ *[const member of object with modified fields]*

[1.3] −**asType**<**integer const**>($heap_{funcstart\_724,1}$.M2) <
asType<**integer**>($heap_{724,1;742,8}$.p2)

→ *[const static or extern object]*

[1.4] −**asType**<**integer const**>($heap_{init}$.M2) <
asType<**integer**>($heap_{724,1;742,8}$.p2)

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.5] −**asType**<**integer const**>(**asType**<**short int**>((int)30307)) <
asType<**integer**>($heap_{724,1;742,8}$.p2)

→ *[simplify]*

[1.9] -30307 < **asType**<**integer**>($heap_{724,1;742,8}$.p2)

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._replace(p2 → (-35 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.10] -30307 < **asType**<**integer**>($heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).p2)

→ *[simplify]*

[1.12] -30307 < ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem))

$\rightarrow$ *[negate goal and search for contradiction]*

[1.13] !(-30307 < ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)))

$\rightarrow$ *[simplify]*

[1.18] 30306 < ((35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot) + (-172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem))

[Copy term 1.18]

[63.0] 30306 < ((-172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) + (35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot))

$\rightarrow$ *[from term 29.17, div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p2$, 176).rem is equal to $\$\text{heap}_{funcstart\_724,1}.p2 \% 176$]*

[63.1] 30306 < ((-172 * ($\$\text{heap}_{funcstart\_724,1}.\text{p2} \% 176$)) + (35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot))

[Create new term from term 28.17 using rule: condition for equality of division]

[80.0] ((176 * (0 + $-(-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot))) < (1 + $\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) $\wedge$ ($\$\text{heap}_{funcstart\_724,1}.\text{p2}$ < (176 * (0 + 1 + $-(-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot))))

$\rightarrow$ *[simplify]*

[80.15] (-1 < ((-176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot) + $\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) $\wedge$ (-176 < ($-\$\text{heap}_{funcstart\_724,1}.\text{p2}$ + (176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot)))

[Work on sub-term 2 of conjunction in term 80.15]

[81.0] -1 < ((-176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot) + $\$\text{heap}_{funcstart\_724,1}.\text{p2}$)

[Create new term from terms 81.0, 6.0 using rule: transitivity 2]

[93.0] (-30307 + -1 + 1) < (-176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot)

$\rightarrow$ *[simplify]*

[93.1] -30307 < (-176 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot)

$\rightarrow$ *[literal comparison of product]*

[93.2] ([-176 < 0]: (-30307 / 176) < $-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot, [0 < -176]: (-30307 / -176) < div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot, [-176 == 0]: -30307 <

0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[93.3] ([-176 < 0]: (-30307 / 176) < $-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot, [(0 < -176) $\wedge$!(-176 < 0)]: (-30307 / -176) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot, [(-176 == 0) $\wedge$!(-176 < 0) $\wedge$!(0 < -176)]: -30307 < 0)

$\rightarrow$ *[simplify]*

[93.7] -173 < $-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot

[Create new term from terms 93.7, 63.1 using rule: transitivity 5]

[95.0] 30306 < ((-172 * ($\$heap_{funcstart\_724,1}$.p2 % 176)) + (35 * $-$(-173 + 1)))

$\rightarrow$ *[simplify]*

[95.5] 24286 < (-172 * ($\$heap_{funcstart\_724,1}$.p2 % 176))

$\rightarrow$ *[literal comparison of product]*

[95.6] ([-172 < 0]: (24286 / 172) < $-$($\$heap_{funcstart\_724,1}$.p2 % 176), [0 < -172]: (24286 / -172) < ($\$heap_{funcstart\_724,1}$.p2 % 176), [-172 == 0]: 24286 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[95.7] ([-172 < 0]: (24286 / 172) < $-$($\$heap_{funcstart\_724,1}$.p2 % 176), [(0 < -172) $\wedge$!(-172 < 0)]: (24286 / -172) < ($\$heap_{funcstart\_724,1}$.p2 % 176), [(-172 == 0) $\wedge$!(-172 < 0) $\wedge$!(0 < -172)]: 24286 < 0)

$\rightarrow$ *[simplify]*

[95.12] **false**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)

Condition defined at:

To prove: minof(short int) $\leq$ div3.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)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p1),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p2),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}$.p3),
asType<int>($\text{\$heap}_{funcstart\_724,1}$.a3))

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \,||\, !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \,\&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**$<$**integer**$>(\$\text{heap}_{init}.\text{M1})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType**$<$**integer**$>($**asType**$<$**short int**$>((\text{int})30269))))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.17] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>(\$\text{heap}_{init}.\text{M2})))\ \&\&\ (0 <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$ (**asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2 <$ **asType$<$integer$>$**(**asType$<$short int$>$**((**int**)30307)))) && $(0 <$ **asType$<$integer$>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3$))) && (**asType$<$integer$>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3$) $<$ **asType$<$integer$>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3$))

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3 <$ **asType$<$integer$>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3$))

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3 <$ **asType$<$integer$>$**($\$\mathrm{heap}_{init}.\mathrm{M}3$))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))$ && $(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3 <$ **asType$<$integer$>$**(**asType$<$short int$>$**((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) \wedge (-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3)$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3$

[Take given term]

[39.0] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, **asType$<int>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3$), **asType$<int>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a}3$))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3$, **asType$<int>$**($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a}3$))

$\rightarrow$ *[const static or extern object]*

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[39.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, **asType**<**int**>($\text{\$heap}_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % **asType**<**integer**>(178)) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.2] ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < 0]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178), []: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < 0]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.7] ([0 < −$\text{\$heap}_{funcstart\_724,1}$.p3]: −(−**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[from term 10.0, literala < −$\text{\$heap}_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

→ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(0 $< -$$\text{heap}_{funcstart_724,1}$.p3)]: **asType**$<$**integer**$>$($\text{heap}_{funcstart_724,1}$.p3) % 178) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[from term 10.0, literala $< -$heap$_{funcstart\_724,1}$.p3 is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 $<$ (0 + 0)

→ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!**false**]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem + ($\text{heap}_{funcstart\_724,1}$.p3 % 178))

[Assume known post-assertion, class invariant or type constraint for term 43.17]

[50.0] **minof**(**int**) $\leq$ div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem

→ *[simplify]*

[50.3] -32769 $<$ div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div3.rem

→ *[simplify]*

[1.1] -32768 $\leq$ div3.rem

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p3, 178)]$

[1.2] -32768 $\leq$ div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem

$\rightarrow$ *[simplify]*

[1.4] -32769 < div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem

$\rightarrow$ *[from term 50.3, literala < div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}.p3$, 178).rem is true whenever (-1 + literala) < -32769]

> **Proof of rule precondition:**
>
> *[1.4.0]* (-32769 + -1) < -32769
>
> $\rightarrow$ *[simplify]*
>
> *[1.4.2]* **true**

[1.5] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)

Condition defined at:

To prove: div3.rem $\leq$ **maxof**(**short int**)

Given:

$heap_{init}.LIMIT == (\mathbf{int})80$

$heap_{init}.M1 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})30269)$

$heap_{init}.r1 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})171)$

$heap_{init}.a1 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})177)$

$heap_{init}.b1 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})2)$

$heap_{init}.M2 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})30307)$

$heap_{init}.r2 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})172)$

$heap_{init}.a2 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})176)$

$heap_{init}.b2 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})35)$

$heap_{init}.M3 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})30323)$

$heap_{init}.r3 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})170)$

$heap_{init}.a3 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})178)$

$heap_{init}.b3 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})63)$

$heap_{init}.p1 == \mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{r1}$)) − (**asType<int>**(**asType<short**

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) < **asType**<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) < **asType**<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

−**asType**<**integer const**>($heap$_{724,1;742,8}$.M2) < **asType**<**integer**>($heap$_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

asType<**integer**>($heap$_{724,1;742,8}$.p2) < **asType**<**integer**>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p1) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[const static or extern object]*

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <

asType\<integer\>($heap$_{init}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>(**asType\<short int\>**((**int**)30269)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{init}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>(**asType\<short int\>**((**int**)30307)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&

($heap$_{funcstart_724,1}$.p3 < **asType**<**integer**>($heap$_{funcstart\_724,1}$.M3))

→ *[const static or extern object]*

[5.31] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType**<**integer**>($heap$_{init}$.M3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType**<**integer**>(**asType**<**short int**>((**int**)30323)))

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 < −$heap$_{funcstart\_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] 0 < $heap$_{funcstart_724,1}$.p3

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType**<**int**>($heap$_{funcstart\_724,1}$.p3), **asType**<**int**>($heap$_{funcstart_724,1}$.a3))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType**<**int**>($heap$_{funcstart\_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType**<**int**>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) % **asType**<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**

$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.2] ($\text{heap}_{funcstart\_724,1}$.p3 % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178), []: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.7] ([0 < $-$$\text{heap}_{funcstart_724,1}$.p3]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[from term 10.0, literala < $-$$heap_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(0 < $-$$\text{heap}_{funcstart_724,1}$.p3)]: **asType**<**integer**>($\text{heap}_{funcstart_724,1}$.p3) % 178) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,

$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.\text{p3}) \% 178)$, [!**false**]: $\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.\text{p3}) \% 178) ==$ $\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.17] $0 == (-\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (\$heap_{funcstart\_724,1}.\text{p3} \% 178))$

[Assume known post-assertion, class invariant or type constraint for term 43.17]

[51.0] $\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[51.9] $-32768 < -\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}$

[Take goal term]

[1.0] div3.rem $\leq$ **maxof**(**short int**)

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p3, 178)]*

[1.1] $\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem} \leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[1.10] $-32768 < -\text{div}(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}$

$\rightarrow$ *[from term 51.9, literala $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3, 178).rem$ is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.10.0] (-32768 + -1) < -32768

$\rightarrow$ *[simplify]*

[1.10.2] **true**

[1.11] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)

Condition defined at:

To prove: minof(int) $\leq$ asType\<short int\>(div3.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

!(0 == **asType\<integer\>**(div1.rem)) || !(0 ==

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asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 <$ **asType<integer>**($heap$_{funcstart_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p1) <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] $(((((0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{funcstart_724,1}$.M1))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>($heap$_{init}$.M1))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(**asType<short int>**((**int**)30269)))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && $(0 <$
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(**asType<integer>**($heap$_{funcstart_724,1}$.p3) <

asType<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.16] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.17] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>(heap_{init}.M2))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [expand definition of constant 'M2' at prang.c (19,20)]

[5.18] (((((-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2)) && ($\text{heap}_{funcstart\_724,1}$.p2 < **asType**<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3))) && (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [simplify]

[5.30] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ [const static or extern object]

[5.31] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>(heap_{init}.M3))

$\rightarrow$ [expand definition of constant 'M3' at prang.c (24,20)]

[5.32] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) && ($\text{heap}_{funcstart\_724,1}$.p3 < **asType**<**integer**>(**asType**<**short int**>((**int**)30323)))

$\rightarrow$ [simplify]

[5.40] (-30323 < $-\text{heap}_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[39.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
asType\<int\>($\$\text{heap}_{init}.\text{a3}$))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) %
asType\<integer\>(178)) == **asType\<integer\>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[43.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p3}$ % 178) == **asType\<integer\>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0]:
$-(-$**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178), []:
asType\<integer\>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178) ==
asType\<integer\>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0]:
$-(-$**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178),
[!(**asType\<integer\>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0)]:

asType<integer>($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.7] ([0 < −$heap$_{funcstart_724,1}$.p3]:
−(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

→ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.11] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178), [!(0 < −$heap$_{funcstart\_724,1}$.p3)]: **asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178) == **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 < (0 + 0)

→ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178),
[!**false**]: **asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,

178).rem + ($heap$_{funcstart_724,1}$.p3 % 178))

[Assume known post-assertion, class invariant or type constraint for term 43.17]

[50.0] **minof(int)** $\leq$ div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem

$\rightarrow$ *[simplify]*

[50.3] -32769 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem

[Take goal term]

[1.0] **minof(int)** $\leq$ **asType<short int>**(div3.rem)

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ **asType<short int>**(div3.rem)

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)]*

[1.2] -32768 $\leq$ **asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[1.5] -32769 < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem

$\rightarrow$ *[from term 50.3, literala < div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem is true whenever (-1 + literala) < -32769]*

Proof of rule precondition:

[1.5.0] (-32769 + -1) < -32769

$\rightarrow$ *[simplify]*

[1.5.2] **true**

[1.6] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)

Condition defined at:

To prove: asType<short int>(div3.rem) $\leq$ **maxof(int)**

Given:

$heap$_{init}$.LIMIT == (**int**)80

$heap$_{init}$.M1 == **asType<short int>**((**int**)30269)

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==

asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2)))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\$\text{heap}_{724,1;742,8}$.p2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1)) &&
(**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) <
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 <
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p2))) &&

$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}2))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \;\&\&\; (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}1))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}2))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \;\&\&\; (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{init}.\mathrm{M}1))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}2))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \;\&\&\; (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\mathbf{asType}\langle\mathbf{short\ int}\rangle((\mathbf{int})30269)))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}2))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2)) \;\&\&\; (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}2))) \;\&\&\; (0 <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3))) \;\&\&\;$
$(\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3) <$
$\mathbf{asType}\langle\mathbf{integer}\rangle(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M}3))$

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1) \wedge$

$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
asType$<$**integer**$>$($\$\text{heap}_{init}.\text{M2}))) \ \&\& \ (0 <$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
($\textbf{asType}<\textbf{integer}>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \ \&\& \ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30307)))) \ \&\& \ (0 <$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \ \&\&$
($\textbf{asType}<\textbf{integer}>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>$($\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \&\&$
($\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>$(**asType**$<$**short**
int$>$((**int**)30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[39.0] $\text{div3} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_724,1},$
asType$<$**int**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
asType$<$**int**$>$($\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<**int**>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<**int**>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) %
asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.2] (\$heap$_{funcstart\_724,1}$.p3 % 178) == **asType**<**integer**>(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178), []:
asType<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178),
[!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).rem)

$\rightarrow$ *[simplify]*

[43.7] ([0 < $-$\$heap$_{funcstart\_724,1}$.p3]:
$-(-$**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178),
[!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>(\$heap$_{funcstart\_724,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).rem)

→ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

→ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: $-(-$**asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178), [!(**asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3) < 0)$]: **asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178) == **asType**$<$**integer**$>($**div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)

→ *[simplify]*

[43.11] ([**false**]: $-(-$**asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178), [!(0 $< -\$heap_{funcstart\_724,1}.p3$)]: **asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178) == **asType**$<$**integer**$>($**div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)

→ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 < (0 + 0)

→ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-$**asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178), [!**false**]: **asType**$<$**integer**$>(\$heap_{funcstart\_724,1}.p3)$ % 178) == **asType**$<$**integer**$>($**div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)

→ *[simplify]*

[43.17] 0 == ($-$**div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem + ($\$heap_{funcstart\_724,1}.p3$ % 178))

[Assume known post-assertion, class invariant or type constraint for term 43.17]

[51.0] **div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem $\leq$ **maxof**(**int**)

→ *[simplify]*

[51.9] -32768 $< -$**div**(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem

[Take goal term]

[1.0] **asType<short int>**(div3.rem) ≤ **maxof(int)**

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[1.1] **asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) ≤ **maxof(int)**

→ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem

→ *[from term 51.9, literala $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem is true whenever (-1 + literala) < -32768]*

Proof of rule precondition:

[1.11.0] (-32768 + -1) < -32768

→ *[simplify]*

[1.11.2] **true**

[1.12] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,10)

Condition defined at:

To prove: minof(int) ≤ $\$heap_{724,1;742,8}$.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)

$\$heap_{init}.b3 == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p1$),
asType<int>($\$heap_{funcstart\_724,1}.a1$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p2$),
asType<int>($\$heap_{funcstart\_724,1}.a2$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p2$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p3$),
asType<int>($\$heap_{funcstart\_724,1}.a3$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p3$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a3$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p3$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a3$))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;740,8}.\text{M1}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;740,8}.\text{M1})$

$\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;742,8}.\text{M2}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}),$

asType<int>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, **asType<int>**($heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, **asType<int>**($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, **asType<int>**(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($heap$_{funcstart_724,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{init}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) $-$

(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171)
$-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
$-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
$-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
$-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
$-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*

$heap_{funcstart\_724,1}$._**replace**_(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]_

[57.1] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.4] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-}2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem} *$
$\textbf{asType<int>}(\$heap_{funcstart\_724,1}.r2)) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType<int>}(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-}2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem} *$
$\textbf{asType<int>}(\$heap_{init}.r2)) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType<int>}(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-}2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem} *$
$\textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})172))) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.quot})) *$
$\textbf{asType<int>}(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[simplify]*

[57.11] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-}2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem} * 172) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.quot})) *$
$\textbf{asType<int>}(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}.p2$, 176)]*

[57.12] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-}2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow \textbf{asType<short int>}((172 * \text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem}) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{quot})) * \textbf{asType<int>}(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType$<$int$>$(asType$<$short int$>$((int)35)))))

$\rightarrow$ *[simplify]*

[57.24] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(int)** $\leq$ $heap_{724,1;742,8}$.r3

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $heap_{724,1;742,8}$.r3

$\rightarrow$ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
*$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ (-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.2] -32768 $\leq$ $heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).r3

$\rightarrow$ *[const member of object with modified fields]*

[1.4] -32768 $\leq$ $heap_{funcstart\_724,1}$.r3

$\rightarrow$ *[const static or extern object]*

[1.5] -32768 $\leq$ $heap_{init}$.r3

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.6] -32768 $\leq$ **asType$<$short int$>$((int)170)**

$\rightarrow$ *[simplify]*

[1.9] **true**

Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,10)

Condition defined at:

365

To prove: $\text{\$heap}_{724,1;742,8}.\text{r3} \leq \textbf{maxof(int)}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1)))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2)))))

−**asType**<**integer const**>($heap$_{724,1;742,8}$.M2) <
asType<**integer**>($heap$_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

asType<**integer**>($heap$_{724,1;742,8}$.p2) <
asType<**integer**>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, **asType**$<$**int**$>$($\$\mathrm{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.p2), **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, **asType**$<$**int**$>$($\$\mathrm{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176)

[Take given term]

[53.0] $\$\mathrm{heap}_{724,1;740,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) * **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$\mathrm{heap}_{724,1;740,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)) * **asType**$<$**int**$>$($\$\mathrm{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) *

asType<int>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{init}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) * **asType<int>**($heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType<int>**($heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType<int>**($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((171 * \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))$

[Take given term]

[57.0] $\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\_\mathbf{replace}(\text{p2} \rightarrow \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short\ int}{>}(\text{div2.rem})) *$
$\mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}(\text{div2.quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{b2})))))$

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \rightarrow (-2 * div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$*
*$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$*
$heap_{funcstart_724,1}.p1, 177).rem))]

[57.1] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\mathbf{replace}(\text{p2} \rightarrow \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short\ int}{>}(\text{div2.rem})) *$
$\mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}(\text{div2.quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{b2})))))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(\mathbf{heapIs}\ $heap_{funcstart_724,1},*
$heap_{funcstart_724,1}.p2, 176)]

[57.2] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\mathbf{replace}(\text{p2} \rightarrow \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short\ int}{>}(\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.\text{p2}, 176).\text{rem})) * \mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{r2})) -$
$(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short\ int}{>}(\text{div2.quot})) *$
$\mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;740,8}.\text{b2})))))$

$\rightarrow$ *[simplify]*

[57.4] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\mathbf{replace}(\text{p2} \rightarrow \mathbf{asType}{<}\mathbf{short\ int}{>}((\text{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *$

asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.__replace__(p1 → (-2 * div(__heapIs__ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{init}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>(**asType**<**short int**>((**int**)172))) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] $\$heap_{724,1;742,8}$.r3 ≤ **maxof**(**int**)

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.1] $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3 ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.3] $\$heap_{funcstart\_724,1}$.r3 ≤ **maxof**(**int**)

$\rightarrow$ *[const static or extern object]*

[1.4] $\$\text{heap}_{init}.\text{r3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.5] $\textbf{asType}\textbf{<short int>}((\textbf{int})170) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.9] **true**

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,13)

Condition defined at:

To prove: minof(int) $\leq$ **(asType<int>(asType<short int>(div3.rem)) * asType<int>($\$\text{heap}_{724,1;742,8}.\text{r3}$))**

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

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$\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short}$ $\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) *$ $\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$ $\textbf{int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}<\textbf{integer const}>(\text{\$heap}_{724,1;742,8}.\text{M2}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{\$heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}<\textbf{integer}>(\text{\$heap}_{724,1;742,8}.\text{p2}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p1})) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& (\text{\$heap}_{funcstart\_724,1}.\text{p1} <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{init}.\text{M1}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}))) \&\&$ $(\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{p3}) <$ $\textbf{asType}<\textbf{integer}>(\text{\$heap}_{funcstart\_724,1}.\text{M3}))$

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p1} <$ **asType<integer>(asType<short int>((int)30269))))** && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p2})))$ && $(\textbf{asType<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M2})))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M2})))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>(asType<short int>((int)30307))))** && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $(\textbf{asType<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

→ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M3}))$

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((\text{-30307} < -\$heap_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} <$
$-\$heap_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$heap_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$heap_{funcstart\_724,1}.\text{p3}))$ &&
$(\$heap_{funcstart\_724,1}.\text{p3} < \textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(\text{-30323} < -\$heap_{funcstart\_724,1}.\text{p3}) \wedge (\text{-30307} <$
$-\$heap_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} < -\$heap_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$heap_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$heap_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$heap_{funcstart\_724,1}.\text{p3}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177)$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] $\text{div2} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p2},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[const static or extern object]*

[25.2] $\text{div2} == \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p2},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$heap_{init}.\text{a2}))$

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType\<int\>**(**asType\<short int\>**((**int**)176)))

→ *[simplify]*

[25.6] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.a3))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3,
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3,
asType\<int\>($\text{\$heap}_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) %
asType\<integer\>(178)) == **asType\<integer\>**(div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.2] ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178) == **asType\<integer\>**(div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) < 0]:
−(−**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) % 178), []:
asType\<integer\>($\text{\$heap}_{funcstart\_724,1}$.p3) % 178) ==
asType\<integer\>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3,
178).rem)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) < 0]:
−(−**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) % 178),
[!(**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) < 0)]:

asType<integer>($\text{heap}_{funcstart\_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.7] ([0 < $-\text{heap}_{funcstart\_724,1}$.p3]:
$-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178),
[!(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>($\text{heap}_{funcstart\_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[from term 10.0, literala < $-\text{heap}_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178),
[!(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>($\text{heap}_{funcstart\_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.11] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178), [!(0 < $-\text{heap}_{funcstart\_724,1}$.p3)]: **asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178) == **asType<integer>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[from term 10.0, literala < $-\text{heap}_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178),
[!**false**]: **asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,

178).rem + ($heap$_{funcstart_724,1}$.p3 % 178))

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**($heap$_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) *

asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ [simplify]

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ [const static or extern object]

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{init}$.b1))))

$\rightarrow$ [expand definition of constant 'b1' at prang.c (17,20)]

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**(**asType$<$short int$>$**((**int**)2)))))

$\rightarrow$ [simplify]

[53.19] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.r2)) − (**asType$<int>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.b2))))

$\rightarrow$ [from term 53.19, $\text{\$heap}_{724,1;740,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))]

[57.1] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.r2)) − (**asType$<int>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.b2))))

$\rightarrow$ [from term 25.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176)]

[57.2] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$. **replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *

asType<int>($heap$_{init}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType<int>**(**asType<short int>**((**int**)172))) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * 172) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *

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div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ (**asType**<**int**>(**asType**<**short int**>(div3.rem)) *

asType<int>($heap$_{724,1;742,8}$.r3))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{724,1;742,8}$.r3))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[1.2] -32768 ≤ (**asType<int>**(**asType<short int>**(div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)) *
asType<int>($heap$_{724,1;742,8}$.r3))

→ *[simplify]*

[1.4] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem * **asType<int>**($heap$_{724,1;742,8}$.r3))

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[1.5] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem * **asType<int>**($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).r3))

→ *[const member of object with modified fields]*

[1.7] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem * **asType<int>**($heap_{funcstart\_724,1}$.r3))

→ *[const static or extern object]*

[1.8] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem * **asType<int>**($heap_{init}$.r3))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.9] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem * **asType<int>**(**asType<short int>**((int)170)))

→ *[simplify]*

[1.14] -32769 < (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)

→ *[literal comparison of product]*

[1.15] ([170 < 0]: (-32769 / -170) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem, [0 < 170]: (-32769 / 170) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem, [0 == 170]: -32769 < 0)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.16] ([170 < 0]: (-32769 / -170) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem, [(0 < 170) ∧ !(170 < 0)]: (-32769 / 170) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem, [(0 == 170) ∧ !(0 < 170) ∧ !(170 < 0)]: -32769 < 0)

→ *[simplify]*

[1.24] -193 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem

→ *[negate goal and search for contradiction]*

[1.25] !(-193 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[1.27] 192 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem

[Create new term from terms 1.27, 43.17 using rule: transitivity 15]

[63.0] (0 + 192) < −($\$heap_{funcstart\_724,1}$.p3 % 178)

→ *[simplify]*

[63.2] **false**

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,13)

Condition defined at:

To prove: (**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\$heap_{724,1;742,8}$.r3)) ≤ **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)

$\$\mathrm{heap}_{init}.\mathrm{a2} == $ **asType**$<$**short int**$>((\textbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == $ **asType**$<$**short int**$>((\textbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == $ **asType**$<$**short int**$>((\textbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == $ **asType**$<$**short int**$>((\textbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == $ **asType**$<$**short int**$>((\textbf{int})178)$

$\$\mathrm{heap}_{init}.\mathrm{b3} == $ **asType**$<$**short int**$>((\textbf{int})63)$

$\$\mathrm{heap}_{init}.\mathrm{p1} == $ **asType**$<$**short int**$>((\textbf{int})1)$

$\$\mathrm{heap}_{init}.\mathrm{p2} == $ **asType**$<$**short int**$>((\textbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{p3} == $ **asType**$<$**short int**$>((\textbf{int})3)$

invariant1(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==$
asType$<$**integer**$>(\mathrm{div1.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==$
asType$<$**integer**$>(\mathrm{div1.rem})$

!(0 == **asType**$<$**integer**$>(\mathrm{div1.rem}))$ || !(0 ==
asType$<$**integer**$>(\mathrm{div1.quot}))$

div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==$
asType$<$**integer**$>(\mathrm{div2.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==$
asType$<$**integer**$>(\mathrm{div2.rem})$

!(0 == **asType**$<$**integer**$>(\mathrm{div2.rem}))$ || !(0 ==
asType$<$**integer**$>(\mathrm{div2.quot}))$

div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})$,
asType$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==$
asType$<$**integer**$>(\mathrm{div3.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ \%$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem}))\ ||\ !(0 ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.rem})) *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle(\text{div1.quot})) * \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\langle\textbf{integer const}\rangle(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div2.rem})) *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle(\text{div2.quot})) * \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\langle\textbf{integer const}\rangle(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M1})))\ \&\&\ (0 <$

asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[const static or extern object]*

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{init}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.16] (((((-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[const static or extern object]*

[5.17] (((((-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<**integer**>($heap$_{init}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <

asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 $< -$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $<$
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p1) $\land$ (0 $<$
$heap$_{funcstart_724,1}$.p2) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 $<$ **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.31] ((-30307 $< -$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $<$
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p1) $\land$ (0 $<$
$heap$_{funcstart_724,1}$.p2) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 $<$ **asType**<**integer**>($heap$_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 $< -$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $<$
$-$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p1) $\land$ (0 $<$
$heap$_{funcstart_724,1}$.p2) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 $<$ **asType**<**integer**>(**asType**<**short
int**>((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 $< -$$heap$_{funcstart\_724,1}$.p3) $\land$ (-30307 $<$
$-$$heap$_{funcstart\_724,1}$.p2) $\land$ (-30269 $< -$$heap$_{funcstart\_724,1}$.p1) $\land$ (0 $<$
$heap$_{funcstart_724,1}$.p1) $\land$ (0 $<$ $heap$_{funcstart_724,1}$.p2) $\land$ (0 $<$
$heap$_{funcstart_724,1}$.p3)

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] 0 $<$ $heap$_{funcstart_724,1}$.p3

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType\<int\>(\$heap$_{funcstart\_724,1}$.p2),
asType\<int\>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType\<int\>(\$heap$_{funcstart\_724,1}$.p3),
asType\<int\>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) %

asType\<integer\>(178)) == **asType\<integer\>**(div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.2] ($heap_{funcstart\_724,1}$.p3 % 178) == **asType\<integer\>**(div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) < 0]:
−(−**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) % 178), []:
asType\<integer\>($heap_{funcstart\_724,1}$.p3) % 178) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) < 0]:
−(−**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) % 178),
[!(**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) < 0)]:
asType\<integer\>($heap_{funcstart\_724,1}$.p3) % 178) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)

→ *[simplify]*

[43.7] ([0 < −$heap_{funcstart\_724,1}$.p3]:
−(−**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) % 178),
[!(**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) < 0)]:
asType\<integer\>($heap_{funcstart\_724,1}$.p3) % 178) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)

→ *[from term 10.0, literala < −$heap_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 < (0 + 0)

→ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: −(−**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) % 178),
[!(**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) < 0)]:
asType\<integer\>($heap_{funcstart\_724,1}$.p3) % 178) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)

→ *[simplify]*

[43.11] ([**false**]: −(−**asType\<integer\>**($heap_{funcstart\_724,1}$.p3) % 178), [!(0
< −$heap_{funcstart\_724,1}$.p3)]: **asType\<integer\>**($heap_{funcstart\_724,1}$.p3) %

178) == **asType\<integer\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}$.p3 is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-$**asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3) % 178), [!**false**]: **asType\<integer\>**($\$heap_{funcstart\_724,1}$.p3) % 178) == **asType\<integer\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.17] 0 == ($-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem + ($\$heap_{funcstart\_724,1}$.p3 % 178))

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{init}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)171))) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem * 171) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot)) * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_724,1}.$b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot * **asType**$<$**int**$>$($\text{\$heap}_{init}.$b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem)))

[Take given term]

[57.0] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{724,1;740,8}.\_$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\text{\$heap}_{724,1;740,8}.$r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short**

int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short**
int>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p2, 176)]

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short**
int>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) −

(**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) *
asType$<$int$>$($\text{\$heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType$<$short int$>$**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.r2)) − (**asType$<int>$**(**asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType$<$short int$>$**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType$<$int$>$($\text{\$heap}_{init}$.r2)) − (**asType$<int>$**(**asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType$<$short int$>$**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType$<$int$>$(**asType$<$short int$>$**((**int**)172))) −
(**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) *
asType$<$int$>$($\text{\$heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType$<$short int$>$**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) *
asType$<$int$>$($\text{\$heap}_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType$<$short int$>$**((172 * div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) $-$
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType\<int\>**($\text{\$heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, \$heap$_{724,1;740,8}$ is equal to*
*\$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{init}$.b2))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] (**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{724,1;742,8}$.r3)) ≤ **maxof(int)**

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178)]*

[1.1] (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{724,1;742,8}$.r3)) ≤
maxof(int)

→ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($\$heap_{724,1;742,8}$.r3)) ≤ **maxof(int)**

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to
$\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[1.4] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) ≤
maxof(int)

→ *[const member of object with modified fields]*

[1.6] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($\$heap_{funcstart\_724,1}$.r3)) ≤ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.7] (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(\$heap$_{init}$.r3)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.8] (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.21] -32768 < (-170 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[literal comparison of product]*

[1.22] ([-170 < 0]: (-32768 / 170) < $-$div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem, [0 < -170]: (-32768 / -170) < div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem, [-170 == 0]: -32768 <
0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.23] ([-170 < 0]: (-32768 / 170) < $-$div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem, [(0 < -170) $\wedge$!(-170 < 0)]: (-32768 / -170) <
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem, [(-170 ==
0) $\wedge$!(-170 < 0) $\wedge$!(0 < -170)]: -32768 < 0)

$\rightarrow$ *[simplify]*

[1.27] -193 < $-$div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.28] !(-193 < $-$div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).rem)

$\rightarrow$ *[simplify]*

[1.31] 192 < div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem

[Create new term from terms 1.31, 43.17 using rule: transitivity 16]

[63.0] (0 + 192) < (\$heap$_{funcstart\_724,1}$.p3 % 178)

$\rightarrow$ *[simplify]*

[63.2] **false**

Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)

Condition defined at:

400

To prove: minof(short int) $\leq$ div3.quot

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

($\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2})))$ ==
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 ==$ $\textbf{asType}\textbf{<integer>}(\text{div2.rem})) || !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} ==$ div($\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

($\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3})))$ ==
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

($\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3})))$ ==
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.rem})) || !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} ==$ $\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))$ *
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot}))$ * $\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 ==$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} ==$ $\$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem}))$ *
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot}))$ * $\textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 ==$ $\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[5.0] invariant1($\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $((((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $((((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{init}.\text{M1}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((\text{-}30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \&\& (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \&\& (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \&\&$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$

asType\<integer\>($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] (((($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 < **asType\<integer\>**($\text{\$heap}_{init}$.M2))) && ($0 <$ **asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 < **asType\<integer\>**(**asType\<short int\>**(**(int)**30307)))) && ($0 <$ **asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3))) && (**asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.p3) < **asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] (($-30307 < -\text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p3)) && ($\text{\$heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.31] (($-30307 < -\text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p3)) && ($\text{\$heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**($\text{\$heap}_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] (($-30307 < -\text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p3)) && ($\text{\$heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**(**asType\<short int\>**(**(int)**30323)))

$\rightarrow$ *[simplify]*

[5.40] ($-30323 < -\text{\$heap}_{funcstart\_724,1}$.p3) $\land$ ($-30307 < -\text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($-30269 < -\text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p1) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p2) $\land$ ($0 < \text{\$heap}_{funcstart\_724,1}$.p3)

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \text{\$heap}_{funcstart\_724,1}$.p3

[Take given term]

[39.0] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\$\mathrm{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3,
asType\<int\>($\$\mathrm{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3,
asType\<int\>($\$\mathrm{heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) /
asType\<integer\>(178)) == **asType\<integer\>**(div(**heapIs**
$\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] ($\$\mathrm{heap}_{funcstart\_724,1}$.p3 / 178) == **asType\<integer\>**(div(**heapIs**
$\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) / 178), []:
asType\<integer\>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType\<integer\>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType\<integer\>($\$\mathrm{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType\<integer\>(div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.7] ([0 < $-\$\mathrm{heap}_{funcstart\_724,1}$.p3]:
$-(-$**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType\<integer\>**($\$\mathrm{heap}_{funcstart\_724,1}$.p3) < 0)]:

asType<integer>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}$.p3 is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178), [!(**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) $<$ 0)]: **asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.11] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178), [!(0 $<$ $-\$heap_{funcstart\_724,1}$.p3)]: **asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}$.p3 is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: $-(-$**asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178), [!**false**]: **asType<integer>**($\text{heap}_{funcstart\_724,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.17] 0 == ($-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot + ($\text{heap}_{funcstart\_724,1}$.p3 / 178))

[Assume known post-assertion, class invariant or type constraint for term 42.17]

[48.0] **minof(int)** $\leq$ div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot

$\rightarrow$ *[simplify]*

[48.3] -32769 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

[Take goal term]

[1.0] **minof(short int)** ≤ div3.quot

→ *[simplify]*

[1.1] -32768 ≤ div3.quot

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[1.2] -32768 ≤ div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

→ *[simplify]*

[1.4] -32769 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

→ *[from term 48.3, literala < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot is true whenever (-1 + literala) < -32769]*

> **Proof of rule precondition:**
>
> *[1.4.0]* (-32769 + -1) < -32769
>
> → *[simplify]*
>
> *[1.4.2]* **true**

[1.5] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)

Condition defined at:

To prove: div3.quot ≤ **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)

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

($\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ % $\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$ $\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \;||\; !(0 == \textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;740,8}.\text{M1}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \to \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.quot})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;742,8}.\text{M2}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;742,8}.\text{M2})$

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

$\to$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \;\&\&\; (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \;\&\&\; (0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \;\&\&\; (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\; (\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\to$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p1} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \;\&\&\; (0 <$

asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\text{\$heap}_{init}$.M1))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) && ($\text{\$heap}_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30269)))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$
asType$<$**integer**$>$($\text{\$heap}_{init}$.M2))) && (0 $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\text{\$heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((-30269 $<$ $-\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p1) $\wedge$
(0 $<$ $\text{\$heap}_{funcstart\_724,1}$.p2)) && ($\text{\$heap}_{funcstart\_724,1}$.p2 $<$

$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)))) \mathbin{\&\&} (0 <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \mathbin{\&\&}$
$(\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((\text{-30307} < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \mathbin{\&\&}$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((\text{-30307} < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \mathbin{\&\&}$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((\text{-30307} < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \mathbin{\&\&}$
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(\text{-30323} < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (\text{-30307} <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (\text{-30269} < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[39.0] $\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$\rightarrow$ *[simplify]*

[39.1] $\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$\rightarrow$ *[const static or extern object]*

[39.2] $\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{init}.\text{a3}))$

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(asType<short int>((int)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) /
asType<integer>(178)) == **asType<integer>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.2] (\$heap$_{funcstart\_724,1}$.p3 / 178) == **asType<integer>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0]:
−(−**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178), []:
asType<integer>(\$heap$_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0]:
−(−**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178),
[!(**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>(\$heap$_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.7] ([0 < −\$heap$_{funcstart\_724,1}$.p3]:
−(−**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178),
[!(**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>(\$heap$_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)

→ *[from term 10.0, literala < −\$heap$_{funcstart\_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

→ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: −(−**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178),

[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.11] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178), [!(0 <
−$\text{heap}_{funcstart\_724,1}$.p3)]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178)
== **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap_{funcstart\_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 < (0 + 0)

→ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: −(−**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!**false**]: **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.17] 0 == (−div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot + ($\text{heap}_{funcstart\_724,1}$.p3 / 178))

*[Assume known post-assertion, class invariant or type constraint for term
42.17]*

[49.0] div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot ≤
maxof(**int**)

→ *[simplify]*

[49.9] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot

[Take goal term]

[1.0] div3.quot ≤ **maxof**(**short int**)

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[1.1] div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot ≤
maxof(**short int**)

→ *[simplify]*

[1.10] -32768 < −div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,

178).quot

→ *[from term 49.9, literala < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot is true whenever (-1 + literala) < -32768]*

> **Proof of rule precondition:**

> *[1.10.0]* (-32768 + -1) < -32768

> → *[simplify]*

> *[1.10.2]* **true**

[1.11] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)

Condition defined at:

To prove: minof(int) ≤ asType<short int>(div3.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 == **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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.\_**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

−**asType**<**integer const**>($heap$_{724,1;742,8}$.M2) <
asType<**integer**>($heap$_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

asType<**integer**>($heap$_{724,1;742,8}$.p2) <
asType<**integer**>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 < **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p1) <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.3] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) <
asType<**integer**>($heap$_{funcstart_724,1}$.M3))

→ *[const static or extern object]*

[5.4] ((((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<**integer**>($heap$_{init}$.M1))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p2))) &&
(**asType**<**integer**>($heap$_{funcstart_724,1}$.p2) <
asType<**integer**>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<**integer**>($heap$_{funcstart_724,1}$.p3))) &&

($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] ((((($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\&\&$ ($\$\text{heap}_{funcstart\_724,1}$.p1 $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\textbf{asType}\!<\!\textbf{short int}\!>$((int)30269)))) $\&\&$ ($0 <$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p2))) $\&\&$
($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p2) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M2))) $\&\&$ ($0 <$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3))) $\&\&$
($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((($-30269 <$ $-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p2)) $\&\&$ ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M2))) $\&\&$ ($0 <$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3))) $\&\&$
($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] ((((($-30269 <$ $-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p2)) $\&\&$ ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{init}$.M2))) $\&\&$ ($0 <$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3))) $\&\&$
($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] ((((($-30269 <$ $-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$
($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p2)) $\&\&$ ($\$\text{heap}_{funcstart\_724,1}$.p2 $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\textbf{asType}\!<\!\textbf{short int}\!>$((int)30307)))) $\&\&$ ($0 <$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3))) $\&\&$
($\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.p3) $<$
$\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] (($-30307 <$ $-\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ ($-30269 <$
$-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$
$\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p3)) $\&\&$
($\$\text{heap}_{funcstart\_724,1}$.p3 $<$ $\textbf{asType}\!<\!\textbf{integer}\!>$($\$\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.31] (($-30307 <$ $-\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ ($-30269 <$
$-\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ ($0 <$
$\$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ ($0 <$ $\$\text{heap}_{funcstart\_724,1}$.p3)) $\&\&$

($heap$_{funcstart_724,1}$.p3 < **asType\<integer\>**($heap$_{init}$.M3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < −$heap$_{funcstart_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart\_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)) && ($heap$_{funcstart\_724,1}$.p3 < **asType\<integer\>**(**asType\<short int\>**((**int**)30323)))

→ *[simplify]*

[5.40] (-30323 < −$heap$_{funcstart_724,1}$.p3) ∧ (-30307 < −$heap$_{funcstart\_724,1}$.p2) ∧ (-30269 < −$heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p1) ∧ (0 < $heap$_{funcstart_724,1}$.p2) ∧ (0 < $heap$_{funcstart_724,1}$.p3)

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] 0 < $heap$_{funcstart_724,1}$.p3

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType\<int\>**($heap$_{funcstart\_724,1}$.p3), **asType\<int\>**($heap$_{funcstart_724,1}$.a3))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType\<int\>**($heap$_{funcstart\_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType\<int\>**($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, **asType\<int\>**(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) / **asType\<integer\>**(178)) == **asType\<integer\>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.2] ($heap$_{funcstart_724,1}$.p3 / 178) == **asType\<integer\>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] (**[asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178), []:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] (**[asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.7] ([0 < $-$$heap$_{funcstart\_724,1}$.p3]:
$-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[from term 10.0, literala < $-$$heap$_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[42.7.2] **true**

[42.8] (**[false]**: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.11] (**[false]**: $-(-$**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178), [!(0 <
$-$$heap$_{funcstart\_724,1}$.p3)]: **asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178)
== **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 10.0, literala < $-$$heap$_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($heap$_{funcstart_724,1}$.p3) / 178),
[!**false**]: **asType**$<$**integer**$>$($heap$_{funcstart_724,1}$.p3) / 178) ==
asType$<$**integer**$>$(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.17] 0 == ($-$div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot + ($heap$_{funcstart_724,1}$.p3 / 178))

*[Assume known post-assertion, class invariant or type constraint for term
42.17]*

[48.0] **minof**(**int**) $\leq$ div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot

$\rightarrow$ *[simplify]*

[48.3] -32769 $<$ div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot

[Take goal term]

[1.0] **minof**(**int**) $\leq$ **asType**$<$**short int**$>$(div3.quot)

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ **asType**$<$**short int**$>$(div3.quot)

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178)]*

[1.2] -32768 $\leq$ **asType**$<$**short int**$>$(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[1.5] -32769 $<$ div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot

$\rightarrow$ *[from term 48.3, literala $<$ div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot is true whenever (-1 + literala) $<$ -32769]*

Proof of rule precondition:

[1.5.0] (-32769 + -1) $<$ -32769

$\rightarrow$ *[simplify]*

[1.5.2] **true**

[1.6] **true**

Proof of verification condition: Type constraint satisfied in implicit

conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)

Condition defined at:

To prove: asType<short int>(div3.quot) $\leq$ **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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p2),

asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] $(((((0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p1}))$ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p1}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M1}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M2}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$heap_{funcstart_724,1}.\mathrm{p1}) $ && $(\$heap_{funcstart_724,1}.\mathrm{p1} < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M1}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M2}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \$heap_{funcstart_724,1}.\mathrm{p1}) $ && $(\$heap_{funcstart_724,1}.\mathrm{p1} < $**asType**$<$**integer**$>(\$heap_{init}.\mathrm{M1}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M2}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $((((((0 < \$heap_{funcstart_724,1}.\mathrm{p1}) $ && $(\$heap_{funcstart_724,1}.\mathrm{p1} < $**asType**$<$**integer**$>($**asType**$<$**short int**$>(($**int**$)30269)))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p2}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M2}))) $ && $(0 < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}))) $ && $($**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{p3}) < $**asType**$<$**integer**$>(\$heap_{funcstart_724,1}.\mathrm{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$heap_{funcstart\_724,1}.\mathrm{p1}) \wedge$

$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \;\&\&\; (0 <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$ $(\textbf{asType\<integer\>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land$ $(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType\<integer\>**$(\$\text{heap}_{init}.\text{M2}))) \;\&\&\; (0 <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$ $(\textbf{asType\<integer\>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land$ $(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \;\&\&\; (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType\<integer\>**$(\textbf{asType\<short int\>}((\textbf{int})30307)))) \;\&\&\; (0 <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \;\&\&\;$ $(\textbf{asType\<integer\>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$ $-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$ $\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \;\&\&\;$ $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType\<integer\>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$ $-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$ $\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \;\&\&\;$ $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType\<integer\>**$(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 <$ $-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$ $\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \;\&\&\;$ $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType\<integer\>**$(\textbf{asType\<short int\>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \land (-30307 <$ $-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 <$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \land (0 <$ $\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 <$ \$heap$_{funcstart\_724,1}$.p3

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p3),
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(**asType<short int>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) /
asType<integer>(178)) == **asType<integer>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] (\$heap$_{funcstart\_724,1}$.p3 / 178) == **asType<integer>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178), []:
asType<integer>(\$heap$_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) / 178),
[!(**asType<integer>**(\$heap$_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>(\$heap$_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.7] $([0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}]:$
$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178),$
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]:$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{quot})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$
(0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[42.7.2] **true**

[42.8] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178),$
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]:$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{quot})$

$\rightarrow$ *[simplify]*

[42.11] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178), [!(0 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p3})]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178)$
$== \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$
(0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[42.11.2] **true**

[42.12] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178),$
$[!\textbf{false}]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) / 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{quot})$

$\rightarrow$ *[simplify]*

[42.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p3} / 178))$

*[Assume known post-assertion, class invariant or type constraint for term
42.17]*

[49.0] div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[49.9] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

[Take goal term]

[1.0] **asType<short int>**(div3.quot) $\leq$ **maxof(int)**

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[1.1] **asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

$\rightarrow$ *[from term 49.9, literala $< -$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot is true whenever (-1 + literala) < -32768]*

   Proof of rule precondition:

   [1.11.0] (-32768 + -1) < -32768

   $\rightarrow$ *[simplify]*

   [1.11.2] **true**

[1.12] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,35)

Condition defined at:

To prove: minof(int) $\leq$ $\$heap_{724,1;742,8}$.b3

Given:

$\$heap_{init}$.LIMIT $==$ **(int)**80

$\$heap_{init}$.M1 $==$ **asType<short int>((int)**30269)

$\$heap_{init}$.r1 $==$ **asType<short int>((int)**171)

$\$heap_{init}$.a1 $==$ **asType<short int>((int)**177)

$\$heap_{init}$.b1 $==$ **asType<short int>((int)**2)

$\$heap_{init}$.M2 $==$ **asType<short int>((int)**30307)

$\$heap_{init}$.r2 $==$ **asType<short int>((int)**172)

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

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[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p2),
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(\$heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

→ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[53.0] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.3] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.4] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{init}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**($\$heap_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.__replace__(p2 $\rightarrow$ **asType<short**

int>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**

$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const member of object with modified fields]*

[57.6] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const static or extern object]*

[57.7] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[simplify]*

[57.11] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$
(**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{\$heap}_{724,1;742,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}$(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).$\textbf{replace}$(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35))))))

→ *[simplify]*

[57.24] $\text{\$heap}_{724,1;742,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}$(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).$\textbf{replace}$(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ $\text{\$heap}_{724,1;742,8}.$b3

→ *[simplify]*

[1.1] -32768 ≤ $\text{\$heap}_{724,1;742,8}.$b3

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart_724,1}.\textbf{replace}(p1 → ((-2 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).rem))).\textbf{replace}(p2 → (-35 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem))]*

[1.2] -32768 ≤ $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}$(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).$\textbf{replace}$(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).b3

→ *[const member of object with modified fields]*

[1.4] -32768 ≤ $\text{\$heap}_{funcstart\_724,1}.$b3

→ *[const static or extern object]*

[1.5] -32768 ≤ $\text{\$heap}_{init}.$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 (60,35)

Condition defined at:

To prove: $\$\text{heap}_{724,1;742,8}.\text{b3} \leq \mathbf{maxof(int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>($\$\text{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>($\$\text{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176)

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177)$]*

[53.1] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$)) * **asType<int>**($heap_{funcstart\_724,1}.r1$)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[simplify]*

[53.3] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$ * **asType<int>**($heap_{funcstart\_724,1}.r1$)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[const static or extern object]*

[53.4] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$ * **asType<int>**($heap_{init}.r1$)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$ * **asType<int>**(**asType<short int>**((**int**)171))) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[simplify]*

[53.8] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$ * 171) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177)$]*

[53.9] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).quot$)) * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[simplify]*

[53.11] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem$) $-$ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).quot$ * **asType<int>**($heap_{funcstart\_724,1}.b1$))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).rem)$
$- ($div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).$quot $*$
asType$<$**int**$>(\$\text{heap}_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).rem)$
$- ($div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).$quot $*$
asType$<$**int**$>($**asType**$<$**short int**$>(($**int**$)2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow ((-2 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).$quot$) + (171 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).rem)))$

[Take given term]

[57.0] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}.\_$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>(($**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.rem$)) *$
asType$<$**int**$>(\$\text{heap}_{724,1;740,8}.r2)) - ($**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.quot$)) *$ **asType**$<$**int**$>(\$\text{heap}_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\_$**replace***$(p1 \rightarrow (-2 *$ *div(***heapIs** *$\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$ div(***heapIs** *$\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p1, 177).rem))]

[57.1] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow ((-2 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).$quot$) + (171 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1,$
$177).$rem$))).\_$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>(($**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.rem$)) *$
asType$<$**int**$>(\$\text{heap}_{724,1;740,8}.r2)) - ($**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.quot$)) *$ **asType**$<$**int**$>(\$\text{heap}_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(***heapIs** *$\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p2, 176)]

[57.2] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**$(p1 \rightarrow ((-2 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1, 177).$quot$) + (171 *$
div$($**heapIs** $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p1,$
$177).$rem$))).\_$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>(($**asType**$<$**int**$>($**asType**$<$**short int**$>($div$($**heapIs** $\$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.p2, 176).rem)) *$ **asType**$<$**int**$>(\$\text{heap}_{724,1;740,8}.r2)) -$
$($**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.quot$)) *$
asType$<$**int**$>(\$\text{heap}_{724,1;740,8}.b2))))$

$\rightarrow$ *[simplify]*

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[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((div(**heapIs**

$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType\<int\>(asType\<short int\>((int)172))) −
(**asType\<int\>(asType\<short int\>**(div2.quot)) *
asType\<int\>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType\<int\>(asType\<short int\>**(div2.quot)) *
asType\<int\>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) −
(**asType\<int\>(asType\<short int\>**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType\<int\>**($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.14] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] $\$heap_{724,1;742,8}$.b3 ≤ **maxof**(**int**)

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[1.1] $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\text{b3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const member of object with modified fields]*

[1.3] $\text{\$heap}_{funcstart\_724,1}.\text{b3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const static or extern object]*

[1.4] $\text{\$heap}_{init}.\text{b3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.5] $\textbf{asType}\text{<short int>}((\textbf{int})63) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.9] **true**

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,38)

Condition defined at:

To prove: minof(int) $\leq$ (**asType**<int>(**asType**<short int>(div3.quot)) * **asType**<int>($\text{\$heap}_{724,1;742,8}.\text{b3}$))

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\text{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\text{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\text{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\text{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\text{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\text{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\text{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\text{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\text{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\text{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\text{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\text{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\text{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\text{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \$heap_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1),$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1)) \ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p1)) \ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a1))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div1.rem})) \ || \ !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2),$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a2))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2)) \ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p2)) \ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a2))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div2.rem})) \ || \ !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p3),$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a3))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p3)) \ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p3)) \ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a3))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div3.rem})) \ || \ !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

$\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \to \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) \ *$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div1.quot})) \ * \ \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;740,8}$.M1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1))

asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.M1)

$\$$heap$_{724,1;742,8}$ == $\$$heap$_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;740,8}$.r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;740,8}$.b2))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;742,8}$.M2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$$heap$_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1)) &&
(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M1))) && (0 $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M1))) && (0 $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2))) &&
(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3))) &&
(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] ((((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$
asType$<$**integer**$>$($\$$heap$_{init}$.M1))) && (0 $<$

asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p2))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p2) <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>($heap$_{init}$.M2))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] (((((-30269 < $-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType<integer>($heap$_{funcstart_724,1}$.p3))) &&
(asType<integer>($heap$_{funcstart_724,1}$.p3) <
asType<integer>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-$$heap$_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-$$heap$_{funcstart\_724,1}$.p1) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p1) $\wedge$ (0 <
$heap$_{funcstart_724,1}$.p2) $\wedge$ (0 < $heap$_{funcstart_724,1}$.p3)) &&
($heap$_{funcstart_724,1}$.p3 < asType<integer>($heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType\<int\>(\$heap$_{funcstart\_724,1}$.p3),
asType\<int\>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) /
asType\<integer\>(178)) == **asType\<integer\>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] (\$heap$_{funcstart\_724,1}$.p3 / 178) == **asType\<integer\>**(div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) < 0]:
$-$($-$**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178), []:

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asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0]:
−(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.7] ([0 < −$heap$_{funcstart_724,1}$.p3]:
−(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

→ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType<integer>**($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<integer>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.11] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178), [!(0 < −$heap$_{funcstart\_724,1}$.p3)]: **asType<integer>**($heap$_{funcstart_724,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 < (0 + 0)

→ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!**false**]: **asType**$<$**integer**$>$($\text{heap}_{funcstart\_724,1}$.p3) / 178) $==$
asType$<$**integer**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.17] $0 == (-$div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot $+$ ($\text{heap}_{funcstart\_724,1}$.p3 / 178))

[Take given term]

[53.0] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.3] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$(heap_{init}.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)171))) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\text{heap}_{724,1;740,8} ==$ $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * 171)

$- (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.quot})) *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p1$, 177)]

[53.9] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.11] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{init}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))$

[Take given term]

[57.0] $\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle((\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div2.rem})) *$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short}$
$\textbf{int}\rangle(\text{div2.quot})) * \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\_$**replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p1$, 177).rem))]

[57.1] $\$\text{heap}_{724,1;742,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$

177).rem))). **_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to* **div**(**heapIs** *$heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p2, 176)]

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))). **_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))). **_replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$. **_replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))). **_replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))). **_replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *

453

asType<**int**>($\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>(heap_{init}.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>(**asType**<**short int**>((**int**)172))) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**

$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ (-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).b2)))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.b2)))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{init}$.b2)))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

$\rightarrow$ *[simplify]*

[57.24] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178)]*

[1.2] -32768 ≤ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))

→ *[simplify]*

[1.4] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($heap_{724,1;742,8}$.b3))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[1.5] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).b3))

→ *[const member of object with modified fields]*

[1.7] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($heap_{funcstart\_724,1}$.b3))

→ *[const static or extern object]*

[1.8] -32768 ≤ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($heap_{init}$.b3))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.9] -32768 $\leq$ (div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(**asType\<short int\>**((**int**)63)))

$\rightarrow$ *[simplify]*

[1.14] -32769 < (63 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[literal comparison of product]*

[1.15] ([63 < 0]: (-32769 / -63) < $-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot, [0 < 63]: (-32769 / 63) < div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot, [0 == 63]: -32769 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.16] ([63 < 0]: (-32769 / -63) < $-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot, [(0 < 63) $\wedge$!(63 < 0)]: (-32769 / 63) < div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot, [(0 == 63) $\wedge$!(0 < 63) $\wedge$!(63 < 0)]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.24] -521 < div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.25] !(-521 < div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[1.27] 520 < $-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot

[Create new term from terms 1.27, 42.17 using rule: transitivity 15]

[63.0] (0 + 520) < $-$($\$$heap$_{funcstart\_724,1}$.p3 / 178)

$\rightarrow$ *[simplify]*

[63.7] 92560 < $-\$$heap$_{funcstart\_724,1}$.p3

$\rightarrow$ *[from term 10.0, literala < $-\$$heap$_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[63.7.0] -2 < (0 + 92560)

$\rightarrow$ *[simplify]*

[63.7.2] **true**

[63.8] **false**

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,38)

Condition defined at:

To prove: $(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) * \textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3})) \leq \textbf{maxof(int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType<short int>}((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \, / \, \textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType<integer>}(\text{div1.quot})$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \, \% \, \textbf{asType<integer>}(\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType<integer>}(\text{div1.rem})) \, || \, !(0 == \textbf{asType<integer>}(\text{div1.quot}))$

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p2),
asType\<int\>($\$heap_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) <
asType\<integer\>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$._**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2)))))

−**asType\<integer const\>**($\$heap_{724,1;742,8}$.M2) <
asType\<integer\>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$heap_{724,1;742,8}$.p2))

asType\<integer\>($\$heap_{724,1;742,8}$.p2) <

asType<**integer**>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $heap$_{funcstart_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p1)) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p1) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M2))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] ((((($0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap$_{funcstart_724,1}$.M1))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M2))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] ((((($0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>($heap$_{init}$.M1))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M2))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] ((((($0 <$ $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType**<**integer**>(**asType**<**short int**>((**int**)30269)))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p2))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p2) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M2))) && ($0 <$ **asType**<**integer**>($heap$_{funcstart_724,1}$.p3))) && (**asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) < **asType**<**integer**>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$ (**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>$($\$\text{heap}_{init}.\text{M2}))) \,\&\&\, (0 <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$ (**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType**$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30307)))) \,\&\&\, (0 <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$ (**asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\&\&\,$ ($\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\&\&\,$ ($\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$($\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\&\&\,$ ($\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType**$<$**integer**$>$(**asType**$<$**short int**$>$((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$

$\text{\$heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \text{\$heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \text{\$heap}_{funcstart\_724,1}.\mathrm{p3})$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[5.41] $-30323 < -\text{\$heap}_{funcstart\_724,1}.\mathrm{p3}$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \text{\$heap}_{funcstart\_724,1}.\mathrm{p3}$

[Take given term]

[11.0] $\mathrm{div1} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{p1}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\mathrm{div1} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\mathrm{div1} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\mathrm{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\mathrm{div1} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p1},$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\mathrm{div1} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p1}, 177)$

[Take given term]

[25.0] $\mathrm{div2} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{p2}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{a2}))$

$\rightarrow$ *[simplify]*

[25.1] $\mathrm{div2} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p2},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\mathrm{a2}))$

$\rightarrow$ *[const static or extern object]*

[25.2] $\mathrm{div2} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p2},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\mathrm{a2}))$

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] $\mathrm{div2} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p2},$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})176)))$

$\rightarrow$ *[simplify]*

[25.6] $\mathrm{div2} == \mathrm{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\mathrm{p2}, 176)$

[Take given term]

[39.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3,
asType<int>($\$\text{heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3,
asType<int>(**asType<short int>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) /
asType<integer>(178)) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] ($\$\text{heap}_{funcstart\_724,1}$.p3 / 178) == **asType<integer>**(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) / 178), []:
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.7] ([0 < $-\$\text{heap}_{funcstart\_724,1}$.p3]:
$-(-$**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p3) / 178),

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[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

→ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178), [!(0 <
−$heap$_{funcstart_724,1}$.p3)]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) / 178)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 < (0 + 0)

→ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!**false**]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot + ($heap$_{funcstart_724,1}$.p3 / 178))

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.1] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$(($**asType<int>**$($**asType<short int>**$($div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.r1)) -$ $($**asType<int>**$($**asType<short int>**$($div1.quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$(($div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType<int>**$(\$heap_{funcstart\_724,1}.r1)) - ($**asType<int>**$($**asType<short int>**$($div1.quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$(($div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType<int>**$(\$heap_{init}.r1)) - ($**asType<int>**$($**asType<short int>**$($div1.quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$(($div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * **asType<int>**$($**asType<short int>**$(($**int**$)171))) - ($**asType<int>**$($**asType<short int>**$($div1.quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.8] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$(($div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem * 171$) - ($**asType<int>**$($**asType<short int>**$($div1.quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.9] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$((171$ * div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem$) - ($**asType<int>**$($**asType<short int>**$(div($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot$))$ * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ **asType<short int>**$((171$ * div$($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem$) - (div($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot * **asType<int>**$(\$heap_{funcstart\_724,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}<\textbf{int}>(\$heap_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}) - (\text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem})))$

[Take given term]

[57.0] $\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\_\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart_724,1}._\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs}\ heap_{funcstart_724,1}, heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}\ heap_{funcstart_724,1}, heap_{funcstart_724,1}.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[from term 25.6, div2 is equal to div(\textbf{heapIs} $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176)]*

[57.2] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).\text{rem})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$\rightarrow$ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<int>(asType<short int>((int)172))) −
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) −
(asType<int>(asType<short int>(div(heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)) ***asType<int>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)) ≤ **maxof**(**int**)

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[1.1] (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)) ≤ **maxof**(**int**)

→ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{724,1;742,8}$.b3)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.4] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3)) $\leq$
maxof(**int**)

$\rightarrow$ *[const member of object with modified fields]*

[1.6] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.b3)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[const static or extern object]*

[1.7] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{init}$.b3)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.8] (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.21] -32768 < (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[literal comparison of product]*

[1.22] ([-63 < 0]: (-32768 / 63) < $-$div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot, [0 < -63]: (-32768 / -63) < div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [-63 == 0]: -32768 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.23] ([-63 < 0]: (-32768 / 63) < $-$div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot, [(0 < -63) $\wedge$!(-63 < 0)]: (-32768 / -63) <
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [(-63 == 0)
$\wedge$!(-63 < 0) $\wedge$!(0 < -63)]: -32768 < 0)

$\rightarrow$ *[simplify]*

[1.27] -521 < $-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
178).quot

→ *[negate goal and search for contradiction]*

[1.28] !(-521 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[1.31] 520 < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

[Create new term from terms 1.31, 42.17 using rule: transitivity 16]

[63.0] (0 + 520) < ($\$heap_{funcstart\_724,1}$.p3 / 178)

→ *[simplify]*

[63.8] 92737 < $\$heap_{funcstart\_724,1}$.p3

→ *[from term 5.41, literala < $\$heap_{funcstart\_724,1}$.p3 is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[63.8.0] -2 < (-30323 + 92737)

→ *[simplify]*

[63.8.2] **true**

[63.9] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,33)

Condition defined at:

To prove: minof(short int) ≤ ((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))

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)

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) %

asType<integer>(asType<int>($heap$_{funcstart_724,1}$.a3))) == asType<integer>(div3.rem)

!(0 == asType<integer>(div3.rem)) || !(0 == asType<integer>(div3.quot))

$\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace(p1 → asType<short int>((asType<int>(asType<short int>(div1.rem)) * asType<int>($heap$_{funcstart_724,1}$.r1)) − (asType<int>(asType<short int>(div1.quot)) * asType<int>($heap$_{funcstart\_724,1}$.b1))))**

−asType<integer const>($heap$_{724,1;740,8}$.M1) < asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == asType<integer>($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) < asType<integer>($heap$_{724,1;740,8}$.M1)

$\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{724,1;740,8}$.**_replace(p2 → asType<short int>((asType<int>(asType<short int>(div2.rem)) * asType<int>($heap$_{724,1;740,8}$.r2)) − (asType<int>(asType<short int>(div2.quot)) * asType<int>($heap$_{724,1;740,8}$.b2))))**

−asType<integer const>($heap$_{724,1;742,8}$.M2) < asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == asType<integer>($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) < asType<integer>($heap$_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($heap$_{funcstart_724,1}$.p1)) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p1) < **asType<integer>**($heap$_{funcstart_724,1}$.M1))) && (0 < **asType<integer>**($heap$_{funcstart\_724,1}$.p2))) && (**asType<integer>**($heap$_{funcstart_724,1}$.p2) < **asType<integer>**($heap$_{funcstart\_724,1}$.M2))) && (0 < **asType<integer>**($heap$_{funcstart_724,1}$.p3))) && (**asType<integer>**($heap$_{funcstart\_724,1}$.p3) < **asType<integer>**($heap$_{funcstart_724,1}$.M3))

→ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 < **asType<integer>**($heap$_{funcstart_724,1}$.M1))) && (0 < **asType<integer>**($heap$_{funcstart\_724,1}$.p2))) &&

$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M1})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1})\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30269))))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M2})))\ \&\&\ (0 <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})))\ \&\&$
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \&\&\ (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30307))))\ \&\&\ (0 <$

asType\<integer\>($\text{heap}_{funcstart\_724,1}$.p3))) &&
(**asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.p3) <
asType\<integer\>($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.30] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**($\text{heap}_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.31] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**(heap_{init}.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] ((-30307 < $-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 <
$-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p3)) &&
($\text{heap}_{funcstart\_724,1}$.p3 < **asType\<integer\>**(**asType\<short
int\>**((**int**)30323)))

$\rightarrow$ *[simplify]*

[5.40] (-30323 < $-\text{heap}_{funcstart\_724,1}$.p3) $\wedge$ (-30307 <
$-\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (-30269 < $-\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p1) $\wedge$ (0 < $\text{heap}_{funcstart\_724,1}$.p2) $\wedge$ (0 <
$\text{heap}_{funcstart\_724,1}$.p3)

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[5.41] -30323 < $-\text{heap}_{funcstart\_724,1}$.p3

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] 0 < $\text{heap}_{funcstart\_724,1}$.p3

[Take given term]

[11.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
asType\<int\>(heap_{init}.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType$<$int$>$(**asType$<$short int$>$**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.p2),
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(**asType$<$short int$>$**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.p3),
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(**asType$<$short int$>$**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) /
asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] ($\text{heap}_{funcstart\_724,1}$.p3 / 178) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178), []:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.7] ([0 < $-$$\text{heap}_{funcstart_724,1}$.p3]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[from term 10.0, literala < $-$$\text{heap}_{funcstart_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.11] ([**false**]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.p3) / 178), [!(0 <

$-\$\text{heap}_{funcstart\_724,1}.\text{p3})]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) / 178)
== **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot)

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) / 178),
[!**false**]: **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) / 178) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
178).quot)

$\rightarrow$ *[simplify]*

[42.17] 0 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
178).quot + ($\$\text{heap}_{funcstart\_724,1}.\text{p3}$ / 178))

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) %
asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[43.2] ($\$\text{heap}_{funcstart\_724,1}.\text{p3}$ % 178) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178), []:
asType<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178),
[!(**asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) < 0)]:
asType<**integer**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$) % 178) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$,
178).rem)

$\rightarrow$ *[simplify]*

[43.7] ([0 $< -\$\text{heap}_{funcstart\_724,1}.\text{p3}$]:

$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.7.0] $-2 < (0 + 0)$

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.11] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$, $[!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3})]$: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.11.0] $-2 < (0 + 0)$

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!\textbf{false}]$: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem} + (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178))$

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.r1)) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short**
int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>($heap$_{init}$.r1)) − (**asType**<**int**>(**asType**<**short**
int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<**int**>(**asType**<**short int**>((**int**)171))) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177)]

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)) *
asType<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short**
int>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot *

asType<int>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType<int>**($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\$heap_{724,1;740,8}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType**<**int**>($\$heap_{init}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.14] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ [const member of object with modified fields]

[57.16] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.b2))))

→ [const static or extern object]

[57.17] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\text{\$heap}_{init}$.b2))))

→ [expand definition of constant 'b2' at prang.c (22,20)]

[57.18] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

→ [simplify]

[57.24] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof**(**short int**) ≤ ((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))

→ [simplify]

[1.1] -32768 ≤ ((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)]*

[1.2] -32768 $\leq$ ((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)) * **asType<int>**($\$heap_{724,1;742,8}.r3$)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($\$heap_{724,1;742,8}.r3$)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))]*

[1.5] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[const member of object with modified fields]*

[1.7] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}.r3$)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[const static or extern object]*

[1.8] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($\$heap_{init}.r3$)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.9] -32768 $\leq$ ((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**(**asType<short int>**((**int**)170))) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3$)))

$\rightarrow$ *[simplify]*

[1.12] -32768 $\leq$ ((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem * 170) $-$ (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**(\$heap$_{724,1;742,8}$.b3)))

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)]*

[1.13] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)) * **asType\<int\>**(\$heap$_{724,1;742,8}$.b3)))

$\rightarrow$ *[simplify]*

[1.15] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(\$heap$_{724,1;742,8}$.b3)))

$\rightarrow$ *[from term 57.24, \$heap$_{724,1;742,8}$ is equal to \$heap$_{funcstart\_724,1}$.__replace(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).__replace(p2 $\rightarrow$ (-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))]*

[1.16] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.__replace(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).__replace(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))).b3)))

$\rightarrow$ *[const member of object with modified fields]*

[1.18] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(\$heap$_{funcstart\_724,1}$.b3)))

$\rightarrow$ *[const static or extern object]*

[1.19] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(\$heap$_{init}$.b3)))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.20] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot * **asType\<int\>**(**asType\<short int\>**((**int**)63))))

$\rightarrow$ *[simplify]*

[1.27] -32769 < ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))

→ *[negate goal and search for contradiction]*

[1.28] !(-32769 < ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))

→ *[simplify]*

[1.33] 32768 < ((63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))

[Copy term 1.33]

[66.0] 32768 < ((-170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot))

→ *[from term 43.17, div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem is equal to $heap_{funcstart\_724,1}$.p3 % 178]*

[66.1] 32768 < ((-170 * ($heap_{funcstart\_724,1}$.p3 % 178)) + (63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot))

[Create new term from term 42.17 using rule: condition for equality of division]

[97.0] ((178 * (0 + −(−div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot))) < (1 + $heap_{funcstart\_724,1}$.p3)) ∧ ($heap_{funcstart\_724,1}$.p3 < (178 * (0 + 1 + −(−div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot))))

→ *[simplify]*

[97.15] (-1 < ((-178 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + $heap_{funcstart\_724,1}$.p3)) ∧ (-178 < (−$heap_{funcstart\_724,1}$.p3 + (178 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot)))

[Work on sub-term 2 of conjunction in term 97.15]

[98.0] -1 < ((-178 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + $heap_{funcstart\_724,1}$.p3)

[Create new term from terms 98.0, 5.41 using rule: transitivity 2]

[109.0] (-30323 + -1 + 1) < (-178 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[109.1] -30323 < (-178 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot)

→ *[literal comparison of product]*

[109.2] ([-178 < 0]: (-30323 / 178) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [0 < -178]: (-30323 / -178) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [-178 == 0]: -30323 < 0)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[109.3] ([-178 < 0]: (-30323 / 178) < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [(0 < -178) ∧ !(-178 < 0)]: (-30323 / -178) < div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot, [(-178 == 0) ∧ !(-178 < 0) ∧ !(0 < -178)]: -30323 < 0)

→ *[simplify]*

[109.7] -171 < −div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot

[Create new term from terms 109.7, 66.1 using rule: transitivity 5]

[111.0] 32768 < ((-170 * ($\$heap_{funcstart\_724,1}$.p3 % 178)) + (63 * −(-171 + 1)))

→ *[simplify]*

[111.5] 22058 < (-170 * ($\$heap_{funcstart\_724,1}$.p3 % 178))

→ *[literal comparison of product]*

[111.6] ([-170 < 0]: (22058 / 170) < −($\$heap_{funcstart\_724,1}$.p3 % 178), [0 < -170]: (22058 / -170) < ($\$heap_{funcstart\_724,1}$.p3 % 178), [-170 == 0]: 22058 < 0)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[111.7] ([-170 < 0]: (22058 / 170) < −($\$heap_{funcstart\_724,1}$.p3 % 178), [(0 < -170) ∧ !(-170 < 0)]: (22058 / -170) < ($\$heap_{funcstart\_724,1}$.p3 % 178), [(-170 == 0) ∧ !(-170 < 0) ∧ !(0 < -170)]: 22058 < 0)

→ *[simplify]*

[111.12] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,33)

Condition defined at:

To prove: ((**asType**<int>(**asType**<short int>(div3.rem)) * **asType**<int>($\$heap_{724,1;742,8}$.r3)) − (**asType**<int>(**asType**<short int>(div3.quot)) * **asType**<int>($\$heap_{724,1;742,8}$.b3))) ≤ **maxof**(**short int**)

Given:

$\$heap_{init}$.LIMIT == (**int**)80

$\$heap_{init}$.M1 == **asType**<short int>((**int**)30269)

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$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==

asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\$\text{heap}_{724,1;742,8}$.p2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.M2)

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 < **asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1)) &&
(**asType<integer>**($\$\text{heap}_{funcstart\_724,1}$.p1) <
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.M1))) && (0 <
asType<integer>($\$\text{heap}_{funcstart\_724,1}$.p2))) &&

$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.3] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M1}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.4] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{init}.\text{M1}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p1} <$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30269)))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.16] $((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2})) \,\&\&\, (\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M2}))) \,\&\&\, (0 <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))) \,\&\&\,$
$(\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.17] $((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$

$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
asType<**integer**>$(\$\text{heap}_{init}.\text{M2})))$ && $(0 <$
asType<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
asType<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge$
$(0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$
asType<**integer**>(**asType**<**short int**>$((\textbf{int})30307))))$ && $(0 <$
asType<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ &&
$(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$
asType<**integer**>$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ &&
$(\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 <$
$-\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 <$
$\$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
asType<**int**>$(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
asType<**int**>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, **asType<int>**(\$heap$_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, **asType<int>**(\$heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, **asType<int>**(**asType<short int>**(**(int)**177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p2),
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, **asType<int>**(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, **asType<int>**(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, **asType<int>**(**asType<short int>**(**(int)**176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p3),
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, **asType<int>**(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, **asType<int>**(\$heap$_{init}$.a3))

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→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / **asType**<**integer**>(178)) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.2] (\$heap$_{funcstart\_724,1}$.p3 / 178) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178), []: **asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178), [!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[42.7] ([0 < −\$heap$_{funcstart\_724,1}$.p3]: −(−**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178), [!(**asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) < 0)]: **asType**<**integer**>(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −\$heap$_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

→ *[simplify]*

[42.7.2] **true**

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[42.8] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178),
[!(**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ 0)]:
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178) $==$
asType$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.11] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178), [!(0 $<$
$-\$$heap$_{funcstart\_724,1}$.p3)]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178)
$==$ **asType**$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$,
$\$$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 10.0, literala $< -\$$heap$_{funcstart\_724,1}$.p3 is false whenever -2 $<$
(0 + literala)]*

Proof of rule precondition:

[42.11.0] -2 $<$ (0 + 0)

$\rightarrow$ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: $-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178),
[!**false**]: **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) / 178) $==$
asType$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.17] 0 $==$ ($-$div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3,
178).quot + ($\$$heap$_{funcstart\_724,1}$.p3 / 178))

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) %
asType$<$**integer**$>$(178)) $==$ **asType**$<$**integer**$>$(div(**heapIs**
$\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[43.2] ($\$$heap$_{funcstart\_724,1}$.p3 % 178) $==$ **asType**$<$**integer**$>$(div(**heapIs**
$\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ 0]:
$-(-$**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) % 178), []:
asType$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) % 178) $==$
asType$<$**integer**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3,
178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ 0]:

$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.7] $([0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}]$:
$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] $([\textbf{false}]$: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.11] $([\textbf{false}]$: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178)$, $[!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3})]$: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] $([\textbf{false}]$: $-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178)$,
$[!\textbf{false}]$: $\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})$ % $178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem})$

→ *[simplify]*

[43.17] $0 == (-\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (\$heap_{funcstart\_724,1}.\text{p3} \% 178))$

[Take given term]

[52.0] $!(0 == \textbf{asType}<\textbf{integer}>(\text{div3.rem})) \;||\; !(0 == \textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)]*

[52.1] $!(0 == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem})) \;||\; !(0 == \textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

→ *[simplify]*

[52.2] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \;||\; !(0 == \textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)]*

[52.3] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \;||\; !(0 == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{quot}))$

→ *[simplify]*

[52.5] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) \lor !(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

[Take given term]

[53.0] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{b1}))))$

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.1] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{b1}))))$

→ *[simplify]*

[53.3] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType**<**int**>($heap$_{init}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.__replace__(p2 → __asType<short int>__((__asType<int>__(__asType<short int>__(div2.rem)) * __asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → __asType<short int>__((__asType<int>__(__asType<short int>__(div2.rem)) * __asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p2, 176)]

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → __asType<short int>__((__asType<int>__(__asType<short int>__(div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * __asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → __asType<short int>__((div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * __asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*

$\$heap_{funcstart\_724,1}.p1,\ 177).rem))]$

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}.$b2))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_724,1}.$r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}.$b2))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem *
asType<**int**>($\$heap_{init}.$r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}.$b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}.$b2))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem * 172) −

(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\text{heap}_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((int)35)))))

→ *[simplify]*

[57.24] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take goal term]

[1.0] ((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 39.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178)]*

[1.1] ((**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($\text{\$heap}_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[simplify]*

[1.3] ((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 57.24, \$heap$_{724,1;742,8}$ is equal to
\$heap$_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[1.4] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[const member of object with modified fields]*

[1.6] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[const static or extern object]*

[1.7] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{init}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.8] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>(**asType<short int>**((int)170))) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[simplify]*

[1.11] ((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
170) − (**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[1.12] ((170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot)) *
asType<int>($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[simplify]*

[1.14] ((170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).quot * **asType<int>**($heap_{724,1;742,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs***

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]

*[1.15] ((170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))) ≤ **maxof(short int)***

→ *[const member of object with modified fields]*

*[1.17] ((170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\text{\$heap}_{funcstart\_724,1}$.b3))) ≤ **maxof(short int)***

→ *[const static or extern object]*

*[1.18] ((170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\text{\$heap}_{init}$.b3))) ≤ **maxof(short int)***

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

*[1.19] ((170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>(asType<short int>((int)63))))** ≤ **maxof(short int)***

→ *[simplify]*

*[1.38] -32768 < ((-170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot))*

→ *[negate goal and search for contradiction]*

*[1.39] !(-32768 < ((-170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot)))*

→ *[simplify]*

*[1.44] 32767 < ((170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) + (-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot))*

[Branch on disjunction or conditional in term 52.5]

*[63.0] !(0 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) ∨ !(0 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) ∨ (0 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3,*

178).quot)

[Copy term 1.44]

[66.0] 32767 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))

$\rightarrow$ *[from term 43.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem is equal to $\$heap_{funcstart\_724,1}$.p3 % 178]*

[66.1] 32767 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * ($\$heap_{funcstart\_724,1}$.p3 % 178)))

[Copy term 63.0]

[96.0] !(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) $\lor$!(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $\lor$ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 42.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot is equal to $\$heap_{funcstart\_724,1}$.p3 / 178]*

[96.1] !(0 == ($\$heap_{funcstart\_724,1}$.p3 / 178)) $\lor$ ...

[Create new term from term 42.17 using rule: condition for equality of division]

[97.0] ((178 * (0 + $-$($-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot))) < (1 + $\$heap_{funcstart\_724,1}$.p3)) $\land$ ($\$heap_{funcstart\_724,1}$.p3 < (178 * (0 + 1 + $-$($-$div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot))))

$\rightarrow$ *[simplify]*

[97.15] (-1 < ((-178 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + $\$heap_{funcstart\_724,1}$.p3)) $\land$ (-178 < ($-\$heap_{funcstart\_724,1}$.p3 + (178 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)))

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[97.16] -178 < ($-\$heap_{funcstart\_724,1}$.p3 + (178 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot))

[Create new term from term 96.1 using rule: condition for inequality of division]

[99.0] (!((0 * 178) < (1 + $\$heap_{funcstart\_724,1}$.p3)) $\lor$!($\$heap_{funcstart\_724,1}$.p3 < (178 * (0 + 1)))) $\lor$!(0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $\lor$ (0 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[99.3] (!(-1 < $\$heap_{funcstart\_724,1}$.p3) $\lor$!($\$heap_{funcstart\_724,1}$.p3 < (178 * (0 + 1)))) $\lor$ ...

$\rightarrow$ *[from term 10.0, literala $<$ \$heap$_{funcstart\_724,1}$.p3 is true whenever (-1 + literala) $<$ 0]*

Proof of rule precondition:

[99.3.0] (-1 + -1) $<$ 0

$\rightarrow$ *[simplify]*

[99.3.2] **true**

[99.4] (!**true** $\vee$!(\$heap$_{funcstart\_724,1}$.p3 $<$ (178 * (0 + 1)))) $\vee$ ...

$\rightarrow$ *[simplify]*

[99.14] (177 $<$ \$heap$_{funcstart\_724,1}$.p3) $\vee$ ...

[Create new term from terms 99.14, 97.16 using rule: transitivity 3]

[100.0] ((-178 + 1 + 177) $<$ (178 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)) $\vee$!(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $\vee$ (0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[100.1] (0 $<$ (178 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)) $\vee$ ...

$\rightarrow$ *[product is positive]*

[100.2] (((0 $<$ 178) $\wedge$ (0 $<$ div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)) $\vee$ ((178 $<$ 0) $\wedge$ (div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot $<$ 0)))) $\vee$ ...

$\rightarrow$ *[simplify]*

[100.7] (0 $<$ div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) $\vee$ ...

[Create new term from terms 100.7, 66.1 using rule: transitivity 11]

[103.0] ((1 + 32767 + (0 * 63)) $<$ (170 * (\$heap$_{funcstart\_724,1}$.p3 % 178))) $\vee$!(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) $\vee$ (0 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[103.2] (32768 $<$ (170 * (\$heap$_{funcstart\_724,1}$.p3 % 178))) $\vee$ ...

$\rightarrow$ *[literal comparison of product]*

[103.3] ([170 $<$ 0]: (32768 / -170) $<$ $-$(\$heap$_{funcstart\_724,1}$.p3 % 178), [0 $<$ 170]: (32768 / 170) $<$ (\$heap$_{funcstart\_724,1}$.p3 % 178), [0 == 170]: 32768 $<$ 0) $\vee$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[103.4] ([170 $<$ 0]: (32768 / -170) $<$ $-$(\$heap$_{funcstart\_724,1}$.p3 % 178), [(0 $<$

170) $\wedge$!(170 < 0)]: (32768 / 170) < ($heap$_{funcstart_724,1}$.p3 % 178), [(0 == 170) $\wedge$!(0 < 170) $\wedge$!(170 < 0)]: 32768 < 0) $\vee$ ...

$\rightarrow$ *[simplify]*

[103.13] **false** $\vee$ ...

[Remove 'false' term 103.13 and fetch new term from containing clause]

[106.0] 0 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot

[Copy term 1.44]

[66.1] 32767 < ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * ($heap$_{funcstart\_724,1}$.p3 % 178)))

$\rightarrow$ *[from term 106.0, div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot is equal to 0]*

[66.2] 32767 < ((-63 * 0) + (170 * ($heap$_{funcstart_724,1}$.p3 % 178)))

$\rightarrow$ *[simplify]*

[66.4] 32767 < (170 * ($heap$_{funcstart_724,1}$.p3 % 178))

$\rightarrow$ *[literal comparison of product]*

[66.5] ([170 < 0]: (32767 / -170) < $-$($heap$_{funcstart_724,1}$.p3 % 178), [0 < 170]: (32767 / 170) < ($heap$_{funcstart\_724,1}$.p3 % 178), [0 == 170]: 32767 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[66.6] ([170 < 0]: (32767 / -170) < $-$($heap$_{funcstart_724,1}$.p3 % 178), [(0 < 170) $\wedge$!(170 < 0)]: (32767 / 170) < ($heap$_{funcstart_724,1}$.p3 % 178), [(0 == 170) $\wedge$!(0 < 170) $\wedge$!(170 < 0)]: 32767 < 0)

$\rightarrow$ *[simplify]*

[66.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (61,31)

To prove: asType<integer>($heap$_{724,1;744,8}$.p3) < **asType<integer>**($heap$_{724,1;744,8}$.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)

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1})$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) /

**asType$<$integer$>$(asType$<$int$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$integer$>$**(div3.quot)

**(asType$<$integer$>$(asType$<$int$>$($\$$heap$_{funcstart\_724,1}$.p3)) %
asType$<$integer$>$(asType$<$int$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$integer$>$**(div3.rem)

!(0 == asType$<$integer$>$(div3.rem)) || !(0 ==
asType$<$integer$>$(div3.quot))

$\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**_replace(p1 $\rightarrow$ asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**($\$$heap$_{funcstart\_724,1}$.b1))))

$-$**asType$<$integer const$>$**($\$$heap$_{724,1;740,8}$.M1) $<$
asType$<$integer$>$($\$$heap$_{724,1;740,8}$.p1)

!(0 == asType$<$integer$>$($\$$heap$_{724,1;740,8}$.p1))

asType$<$integer$>$($\$$heap$_{724,1;740,8}$.p1) $<$
asType$<$integer$>$($\$$heap$_{724,1;740,8}$.M1)

$\$$heap$_{724,1;742,8}$ == $\$$heap$_{724,1;740,8}$.**_replace(p2 $\rightarrow$ asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div2.rem)) *
asType$<$int$>$($\$$heap$_{724,1;740,8}$.r2)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\$$heap$_{724,1;740,8}$.b2))))

$-$**asType$<$integer const$>$**($\$$heap$_{724,1;742,8}$.M2) $<$
asType$<$integer$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == asType$<$integer$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$integer$>$($\$$heap$_{724,1;742,8}$.p2) $<$
asType$<$integer$>$($\$$heap$_{724,1;742,8}$.M2)

$\$$heap$_{724,1;744,8}$ == $\$$heap$_{724,1;742,8}$.**_replace(p3 $\rightarrow$ asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div3.rem)) *
asType$<$int$>$($\$$heap$_{724,1;742,8}$.r3)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div3.quot)) * **asType$<$int$>$**($\$$heap$_{724,1;742,8}$.b3))))

$-$**asType$<$integer const$>$**($\$$heap$_{724,1;744,8}$.M3) $<$
asType$<$integer$>$($\$$heap$_{724,1;744,8}$.p3)

!(0 == asType$<$integer$>$($\$$heap$_{724,1;744,8}$.p3))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$$heap$_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] ((((((0 $<$ **asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p1)) &&
(**asType$<$integer$>$**($\$$heap$_{funcstart\_724,1}$.p1) $<$

asType\<integer\>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>($heap$_{funcstart_724,1}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>($heap$_{init}$.M1))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] (((((0 < $heap$_{funcstart_724,1}$.p1) && ($heap$_{funcstart\_724,1}$.p1 <
asType\<integer\>(**asType\<short int\>**((**int**)30269)))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p2))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p2) <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.16] ((((-30269 < $-$heap$_{funcstart\_724,1}$.p1) $\land$ (0 < $heap$_{funcstart_724,1}$.p1) $\land$
(0 < $heap$_{funcstart_724,1}$.p2)) && ($heap$_{funcstart\_724,1}$.p2 <
asType\<integer\>($heap$_{funcstart_724,1}$.M2))) && (0 <
asType\<integer\>($heap$_{funcstart_724,1}$.p3))) &&
(**asType\<integer\>**($heap$_{funcstart_724,1}$.p3) <
asType\<integer\>($heap$_{funcstart_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M2})))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $($**asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p2} <$ **asType<integer>**(**asType<short int>**$((\text{int})30307))))$ && $(0 <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})))$ && $($**asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3}) <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{funcstart\_724,1}.\text{M3}))$

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**$(\$\text{heap}_{init}.\text{M3}))$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}))$ && $(\$\text{heap}_{funcstart\_724,1}.\text{p3} <$ **asType<integer>**(**asType<short int>**$((\text{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$, **asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(\$heap$_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(\$heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p2),
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p3),
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, **asType\<int\>(asType\<short int\>((int)**178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / **asType\<integer\>**(178)) == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.2] (\$heap$_{funcstart\_724,1}$.p3 / 178) == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) < 0]: $-(-$**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178), []: **asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) < 0]: $-(-$**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178), [!(**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) < 0)]: **asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[42.7] ([0 < $-$\$heap$_{funcstart\_724,1}$.p3]: $-(-$**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178), [!(**asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) < 0)]: **asType\<integer\>**(\$heap$_{funcstart\_724,1}$.p3) / 178) == **asType\<integer\>**(div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 10.0, literala < $-$\$heap$_{funcstart\_724,1}$.p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[42.7.0] -2 < (0 + 0)

$\rightarrow$ *[simplify]*

[42.7.2] **true**

[42.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178), [!(0 <
−$heap$_{funcstart_724,1}$.p3)]: **asType**<**integer**>($heap$_{funcstart\_724,1}$.p3) / 178)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 <*
(0 + literala)]

Proof of rule precondition:

[42.11.0] -2 < (0 + 0)

→ *[simplify]*

[42.11.2] **true**

[42.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!**false**]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot + ($heap$_{funcstart_724,1}$.p3 / 178))

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] (**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) %
asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[simplify]*

[43.2] ($heap$_{funcstart_724,1}$.p3 % 178) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) % 178), []:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).rem)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0]:

$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.7] $([0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}$:
$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.7.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]$:
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.11] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178), [!(0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3})]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$heap_{funcstart\_724,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[43.11.2] **true**

[43.12] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178)$,
$[!\textbf{false}]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.17] $0 == (-\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (\$heap_{funcstart\_724,1}.\text{p3 \% 178}))$

[Take given term]

[52.0] $!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \;||\; !(0 == \textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\rightarrow$ *[from term 39.6, div3 is equal to div(*$\textbf{heapIs } \$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)]*

[52.1] $!(0 == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem})) \;||\; !(0 == \textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\rightarrow$ *[simplify]*

[52.2] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \;||\; !(0 == \textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\rightarrow$ *[from term 39.6, div3 is equal to div(*$\textbf{heapIs } \$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)]*

[52.3] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \;||\; !(0 == \textbf{asType}\textbf{<integer>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{quot}))$

$\rightarrow$ *[simplify]*

[52.5] $!(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) \lor !(0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

[Take given term]

[53.0] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(*$\textbf{heapIs } \$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177)]*

[53.1] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short})$

int>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(heap_{init}.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(heap_{init}.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ [simplify]

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

→ [from term 53.19, $heap_{724,1;740,8}$ is equal to
*$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

*→ [from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176)]

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType\<int\>**($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

→ [simplify]

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType\<int\>**($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

→ [from term 53.19, $heap_{724,1;740,8}$ is equal to
*$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p1, 177).rem))]$

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap_{724,1;740,8}.b2$))))

→ [const member of object with modified fields]

[57.6] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{funcstart\_724,1}.r2$)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}.b2$))))

→ [const static or extern object]

[57.7] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{init}.r2$)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}.b2$))))

→ [expand definition of constant 'r2' at prang.c (20,20)]

[57.8] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap_{724,1;740,8}.b2$))))

→ [simplify]

[57.11] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem * 172) −

(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType\<int\>**($heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**(**asType\<short int\>**((int)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3, 178).rem)) * **asType<int>**($\$heap_{724,1;742,8}.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3)))))

→ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3, 178).rem * **asType<int>**($\$heap_{724,1;742,8}.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3, 178).rem * **asType<int>**($\$heap_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$\text{heap}_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
*$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow ((\text{-63} * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{M3})$

$\rightarrow$ *[from term 61.26, $heap_{724,1;744,8}$ is equal to*
*$heap_{funcstart\_724,1}.\textbf{\_replace}(p1 \rightarrow ((\text{-2} * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{\_replace}(p2 \rightarrow ((\text{-35} * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → (-63 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]

[1.1] **asType**<**integer**>($heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).p3) <
asType<**integer**>($heap_{724,1;744,8}$.M3)

→ [simplify]

[1.3] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)) < **asType**<**integer**>($heap_{724,1;744,8}$.M3)

→ [from term 61.26, $heap_{724,1;744,8}$ is equal to
$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → (-63 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]

[1.4] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)) < **asType**<**integer**>($heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).M3)

→ [const member of object with modified fields]

[1.7] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)) < **asType**<**integer**>($heap_{funcstart\_724,1}$.M3)

→ [const static or extern object]

[1.8] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)) < **asType**<**integer**>($heap_{init}$.M3)

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.9] ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem)) < **asType\<integer\>**(**asType\<short int\>**((**int**)30323))

$\rightarrow$ *[simplify]*

[1.19] -30323 < ((-170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot))

$\rightarrow$ *[negate goal and search for contradiction]*

[1.20] !(-30323 < ((-170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)))

$\rightarrow$ *[simplify]*

[1.25] 30322 < ((170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) + (-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot))

[Branch on disjunction or conditional in term 52.5]

[66.0] !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) $\lor$!(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) $\lor$ (0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

[Copy term 1.25]

[69.0] 30322 < ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))

$\rightarrow$ *[from term 43.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem is equal to $\$heap_{funcstart\_724,1}$.p3 % 178]*

[69.1] 30322 < ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * ($\$\text{heap}_{funcstart\_724,1}$.p3 % 178)))

[Copy term 66.0]

[99.0] !(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) $\lor$!(0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) $\lor$ (0 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)

$\rightarrow$ *[from term 42.17, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot is equal to $\$heap_{funcstart\_724,1}$.p3 / 178]*

[99.1] !(0 == ($\$\text{heap}_{funcstart\_724,1}$.p3 / 178)) $\lor$ ...

[Create new term from term 42.17 using rule: condition for equality of division]

[100.0] ((178 * (0 + −(−div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).quot))) < (1 + \$heap$_{funcstart\_724,1}$.p3)) ∧
(\$heap$_{funcstart\_724,1}$.p3 < (178 * (0 + 1 + −(−div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot))))

→ *[simplify]*

[100.15] (-1 < ((-178 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot) + \$heap$_{funcstart\_724,1}$.p3)) ∧ (-178 < (−\$heap$_{funcstart\_724,1}$.p3 +
(178 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot)))

→ *[separate conjunction and work on first sub-term]*

[100.16] -178 < (−\$heap$_{funcstart\_724,1}$.p3 + (178 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot))

*[Create new term from term 99.1 using rule: condition for inequality of
division]*

[102.0] (!((0 * 178) < (1 + \$heap$_{funcstart\_724,1}$.p3)) ∨ !(\$heap$_{funcstart\_724,1}$.p3
< (178 * (0 + 1)))) ∨ !(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem) ∨ (0 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[102.3] (!(-1 < \$heap$_{funcstart\_724,1}$.p3) ∨ !(\$heap$_{funcstart\_724,1}$.p3 < (178 * (0
+ 1)))) ∨ ...

→ *[from term 10.0, literala < \$heap$_{funcstart\_724,1}$.p3 is true whenever (-1 +
literala) < 0]*

    Proof of rule precondition:

    [102.3.0] (-1 + -1) < 0

    → *[simplify]*

    [102.3.2] **true**

[102.4] (!**true** ∨ !(\$heap$_{funcstart\_724,1}$.p3 < (178 * (0 + 1)))) ∨ ...

→ *[simplify]*

[102.14] (177 < \$heap$_{funcstart\_724,1}$.p3) ∨ ...

[Create new term from terms 102.14, 100.16 using rule: transitivity 3]

[103.0] ((-178 + 1 + 177) < (178 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).quot)) ∨ !(0 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem) ∨ (0 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).quot)

→ *[simplify]*

[103.1] (0 < (178 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
178).quot)) ∨ ...

$\rightarrow$ *[product is positive]*

[103.2] $(((0 < 178) \wedge (0 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) \vee ((178 < 0) \wedge (\text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} < 0))) \vee ...$

$\rightarrow$ *[simplify]*

[103.7] $(0 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$ $178).\text{quot}) \vee ...$

[Create new term from terms 103.7, 69.1 using rule: transitivity 11]

[106.0] $((1 + 30322 + (0 * 63)) < (170 * (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178))) \vee$ $!(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \vee (0$ $== \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})$

$\rightarrow$ *[simplify]*

[106.2] $(30323 < (170 * (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178))) \vee ...$

$\rightarrow$ *[literal comparison of product]*

[106.3] $([170 < 0]: (30323 / \text{-}170) < -(\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 <$ $170]: (30323 / 170) < (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 == 170]: 30323 < 0)$ $\vee ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[106.4] $([170 < 0]: (30323 / \text{-}170) < -(\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [(0 <$ $170) \wedge !(170 < 0)]: (30323 / 170) < (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [(0 ==$ $170) \wedge !(0 < 170) \wedge !(170 < 0)]: 30323 < 0) \vee ...$

$\rightarrow$ *[simplify]*

[106.13] **false** $\vee ...$

[Remove 'false' term 106.13 and fetch new term from containing clause]

[109.0] $0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}$

[Copy term 1.25]

[69.1] $30322 < ((\text{-}63 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$ $178).\text{quot}) + (170 * (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178)))$

$\rightarrow$ *[from term 109.0, div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot is equal to 0]*

[69.2] $30322 < ((\text{-}63 * 0) + (170 * (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178)))$

$\rightarrow$ *[simplify]*

[69.4] $30322 < (170 * (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178))$

$\rightarrow$ *[literal comparison of product]*

[69.5] $([170 < 0]: (30322 / \text{-}170) < -(\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 < 170]:$ $(30322 / 170) < (\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 == 170]: 30322 < 0)$

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[69.6] ([170 < 0]: (30322 / -170) < −($heap$_{funcstart_724,1}$.p3 % 178), [(0 < 170) ∧ !(170 < 0)]: (30322 / 170) < ($heap$_{funcstart\_724,1}$.p3 % 178), [(0 == 170) ∧ !(0 < 170) ∧ !(170 < 0)]: 30322 < 0)

→ *[simplify]*

[69.15] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (61,12)

To prove: −**asType<integer const>**($heap$_{724,1;744,8}$.M3) < **asType<integer>**($heap$_{724,1;744,8}$.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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p1), **asType<int>**($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_724,1}$.a1))) == **asType<integer>**(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p1)) % **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a1))) == **asType**<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 == **asType**<**integer**>(div1.quot))

div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p2), **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p2)) / **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a2))) == **asType**<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p2)) % **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a2))) == **asType**<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 == **asType**<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3), **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3)) / **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.p3)) % **asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}$.a3))) == **asType**<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 == **asType**<**integer**>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b1))))

−**asType**<**integer const**>($\text{heap}_{724,1;740,8}$.M1) < **asType**<**integer**>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($\text{heap}_{724,1;740,8}$.p1))

asType<**integer**>($\text{heap}_{724,1;740,8}$.p1) < **asType**<**integer**>($\text{heap}_{724,1;740,8}$.M1)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;742,8}$.M2) $<$ **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2) $<$ **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.M2)

$\$$heap$_{724,1;744,8}$ == $\$$heap$_{724,1;742,8}$.**_replace**(p3 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) * **asType**$<$**int**$>$($\$$heap$_{724,1;742,8}$.r3)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;742,8}$.b3))))

Proof:

[Take given term]

[5.0] invariant1(**heapIs** $\$$heap$_{funcstart\_724,1}$)

$\rightarrow$ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[5.1] (((((0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1)) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p1) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M1))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[5.3] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M1))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[5.4] (((((0 $<$ $\$$heap$_{funcstart\_724,1}$.p1) && ($\$$heap$_{funcstart\_724,1}$.p1 $<$ **asType**$<$**integer**$>$($\$$heap$_{init}$.M1))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p2) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M2))) && (0 $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3))) && (**asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.p3) $<$ **asType**$<$**integer**$>$($\$$heap$_{funcstart\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[5.5] $(((((0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \,\&\&\, (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} <$
asType<**integer**>(**asType**<**short int**>((**int**)30269)))) && (0 <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}$))) &&
(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}$) <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}$))) && (0 <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$))) &&
(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$) <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}$))

$\rightarrow$ *[simplify]*

[5.16] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \,\&\&\, (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2}$))) && (0 <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$))) &&
(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$) <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}$))

$\rightarrow$ *[const static or extern object]*

[5.17] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \,\&\&\, (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
asType<**integer**>($\$\mathrm{heap}_{init}.\mathrm{M2}$))) && (0 <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$))) &&
(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$) <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}$))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[5.18] $(((((-30269 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge$
$(0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})) \,\&\&\, (\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} <$
asType<**integer**>(**asType**<**short int**>((**int**)30307)))) && (0 <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$))) &&
(**asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}$) <
asType<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}$))

$\rightarrow$ *[simplify]*

[5.30] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 <$
$-\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 <$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \,\&\&\,$
$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} <$ **asType**<**integer**>($\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}$))

$\rightarrow$ *[const static or extern object]*

[5.31] $((-30307 < -\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (-30269 <$
$-\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \wedge (0 <$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \wedge (0 < \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})) \,\&\&\,$
$(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} <$ **asType**<**integer**>($\$\mathrm{heap}_{init}.\mathrm{M3}$))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[5.32] $((-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})) \, \&\& \, (\$\text{heap}_{funcstart\_724,1}.\text{p3} < \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)))$

$\rightarrow$ *[simplify]*

[5.40] $(-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}) \wedge (-30307 < -\$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (-30269 < -\$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p1}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p2}) \wedge (0 < \$\text{heap}_{funcstart\_724,1}.\text{p3})$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[5.41] $-30323 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Work on sub-term 6 of conjunction in term 5.40]

[10.0] $0 < \$\text{heap}_{funcstart\_724,1}.\text{p3}$

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}), \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\text{div1} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\text{div1} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, \textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}), \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] $\text{div2} == \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$,
asType<int>($\$heap_{init}.a2$))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$,
asType<int>(**asType<short int>**((**int**)176)))

→ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p3$),
asType<int>($\$heap_{funcstart\_724,1}.a3$))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$,
asType<int>($\$heap_{funcstart\_724,1}.a3$))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$,
asType<int>($\$heap_{init}.a3$))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$,
asType<int>(**asType<short int>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178)

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[42.0] (**asType<integer>**($\$heap_{funcstart\_724,1}.p3$) /
asType<integer>(178)) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot)

→ *[simplify]*

[42.2] ($\$heap_{funcstart\_724,1}.p3$ / 178) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[42.3] ([**asType<integer>**($\$heap_{funcstart\_724,1}.p3$) < 0]:
−(−**asType<integer>**($\$heap_{funcstart\_724,1}.p3$) / 178), []:
asType<integer>($\$heap_{funcstart\_724,1}.p3$) / 178) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$,
178).quot)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[42.4] ([**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.7] ([0 < −$heap$_{funcstart_724,1}$.p3]:
−(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

> **Proof of rule precondition:**
>
> *[42.7.0]* -2 < (0 + 0)
>
> → *[simplify]*
>
> *[42.7.2]* **true**

[42.8] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!(**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) < 0)]:
asType<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

→ *[simplify]*

[42.11] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178), [!(0 < −$heap$_{funcstart\_724,1}$.p3)]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 < (0 + literala)]*

> **Proof of rule precondition:**
>
> *[42.11.0]* -2 < (0 + 0)
>
> → *[simplify]*
>
> *[42.11.2]* **true**

[42.12] ([**false**]: −(−**asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178),
[!**false**]: **asType**<**integer**>($heap$_{funcstart_724,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[42.17] $0 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (\$\text{heap}_{funcstart\_724,1}.\text{p3} / 178))$

[Assume known post-assertion, class invariant or type constraint for term 39.6]

[43.0] $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% \textbf{asType}<\textbf{integer}>(178)) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.2] $(\$\text{heap}_{funcstart\_724,1}.\text{p3} \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[43.3] $([\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178), []: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[43.4] $([\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178), [!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[43.7] $([0 < -\$\text{heap}_{funcstart\_724,1}.\text{p3}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178), [!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[from term 10.0, literala $< -\$\text{heap}_{funcstart\_724,1}.\text{p3}$ is false whenever -2 $< (0 + literala)$]*

Proof of rule precondition:

[43.7.0] -2 $< (0 + 0)$

$\rightarrow$ *[simplify]*

[43.7.2] **true**

[43.8] $([\textbf{false}]: -(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) \% 178), [!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}) < 0)]:$

asType<integer>($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).rem)

→ *[simplify]*

[43.11] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178), [!(0
< −$heap$_{funcstart_724,1}$.p3)]: **asType<integer>**($heap$_{funcstart\_724,1}$.p3) %
178) == **asType<integer>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).rem)

→ *[from term 10.0, literala < −$heap$_{funcstart_724,1}$.p3 is false whenever -2 <
(0 + literala)]*

Proof of rule precondition:

[43.11.0] -2 < (0 + 0)

→ *[simplify]*

[43.11.2] **true**

[43.12] ([**false**]: −(−**asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178),
[!**false**]: **asType<integer>**($heap$_{funcstart_724,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).rem)

→ *[simplify]*

[43.17] 0 == (−div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
178).rem + ($heap$_{funcstart_724,1}$.p3 % 178))

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{init}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType\<int\>**(**asType\<short int\>**((**int**)171))) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**($\$heap_{init}$.b1)))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**(**asType\<short int\>**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.__replace__(p2 → __asType<short__
__int>__((__asType<int>__(__asType<short int>__(div2.rem)) *
__asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short__
__int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → __asType<short__
__int>__((__asType<int>__(__asType<short int>__(div2.rem)) *
__asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short__
__int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p2, 176)]

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → __asType<short__
__int>__((__asType<int>__(__asType<short int>__(div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)) * __asType<int>__($\$heap_{724,1;740,8}$.r2)) −
(__asType<int>__(__asType<short int>__(div2.quot)) *
__asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → __asType<short int>__((div(__heapIs__
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
__asType<int>__($\$heap_{724,1;740,8}$.r2)) − (__asType<int>__(__asType<short__
__int>__(div2.quot)) * __asType<int>__($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 → (-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.5] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *

asType<int>($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) $-$ (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($heap$_{funcstart_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

$\rightarrow$ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p3, 178)]$

[61.2] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}.p3, 178).rem)) * **asType<int>**($heap_{724,1;742,8}.r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}.b3)))))

→ [simplify]

[61.4] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem *
asType<int>($heap_{724,1;742,8}.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}.b3)))))

→ [from term 57.24, $heap_{724,1;742,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))]

[61.5] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))).r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}.b3)))))

→ [const member of object with modified fields]

[61.7] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).␣**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).␣**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.␣**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).␣**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).␣**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.␣**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).␣**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).␣**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.␣**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).␣**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).␣**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.␣**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$*$ div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
(div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{heap}_{funcstart\_724,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$*$ div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
(div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$*$ div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
(div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[61.26] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
div($\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$ $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((\text{-63} * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $-\textbf{asType}\textbf{<integer const>}(\text{heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType}\textbf{<integer>}(\text{heap}_{724,1;744,8}.\text{p3})$

$\rightarrow$ *[from term 61.26, $heap_{724,1;744,8}$ is equal to*
$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2} * div(\textbf{heapIs} \, heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \, heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((\text{-35} * div(\textbf{heapIs}$
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow (\text{-63} *$

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div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.*p3, 178).quot) + (170 ***
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.*p3, 178).rem))]*

[1.1] −**asType<integer const>**($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).M3) <
asType<integer>($\$heap_{724,1;744,8}$.p3)

→ *[const member of object with modified fields]*

[1.4] −**asType<integer const>**($\$heap_{funcstart\_724,1}$.M3) <
asType<integer>($\$heap_{724,1;744,8}$.p3)

→ *[const static or extern object]*

[1.5] −**asType<integer const>**($\$heap_{init}$.M3) <
asType<integer>($\$heap_{724,1;744,8}$.p3)

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.6] −**asType<integer const>**(**asType<short int>**((**int**)30323)) <
asType<integer>($\$heap_{724,1;744,8}$.p3)

→ *[simplify]*

[1.10] -30323 < **asType<integer>**($\$heap_{724,1;744,8}$.p3)

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 **
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.11] -30323 < **asType<integer>**($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p3)

→ *[simplify]*

[1.13] -30323 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,

178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem))

→ *[negate goal and search for contradiction]*

[1.14] !(-30323 < ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem)))

→ *[simplify]*

[1.19] 30322 < ((63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot) + (-170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem))

[Copy term 1.19]

[67.0] 30322 < ((-170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).rem) + (63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot))

→ *[from term 43.17, div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p3$, 178).rem is equal to $\$\text{heap}_{funcstart\_724,1}.p3$ % 178]*

[67.1] 30322 < ((-170 * ($\$\text{heap}_{funcstart\_724,1}.\text{p3}$ % 178)) + (63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot))

[Create new term from term 42.17 using rule: condition for equality of division]

[98.0] ((178 * (0 + −(−div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot))) < (1 + $\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) ∧ ($\$\text{heap}_{funcstart\_724,1}.\text{p3}$ < (178 * (0 + 1 + −(−div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot))))

→ *[simplify]*

[98.15] (-1 < ((-178 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot) + $\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) ∧ (-178 < (−$\$\text{heap}_{funcstart\_724,1}.\text{p3}$ + (178 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot)))

[Work on sub-term 2 of conjunction in term 98.15]

[99.0] -1 < ((-178 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot) + $\$\text{heap}_{funcstart\_724,1}.\text{p3}$)

[Create new term from terms 99.0, 5.41 using rule: transitivity 2]

[110.0] (-30323 + -1 + 1) < (-178 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot)

→ *[simplify]*

[110.1] -30323 < (-178 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}$, 178).quot)

→ *[literal comparison of product]*

[110.2] ([-178 < 0]: (-30323 / 178) < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot, [0 < -178]: (-30323 / -178) < div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot, [-178 == 0]: -30323 < 0)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[110.3] ([-178 < 0]: (-30323 / 178) < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot, [(0 < -178) ∧ !(-178 < 0)]: (-30323 / -178) < div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot, [(-178 == 0) ∧ !(-178 < 0) ∧ !(0 < -178)]: -30323 < 0)

→ *[simplify]*

[110.7] -171 < −div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot

[Create new term from terms 110.7, 67.1 using rule: transitivity 5]

[112.0] 30322 < ((-170 * ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178)) + (63 * −(-171 + 1)))

→ *[simplify]*

[112.5] 19612 < (-170 * ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178))

→ *[literal comparison of product]*

[112.6] ([-170 < 0]: (19612 / 170) < −($\text{\$heap}_{funcstart\_724,1}$.p3 % 178), [0 < -170]: (19612 / -170) < ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178), [-170 == 0]: 19612 < 0)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[112.7] ([-170 < 0]: (19612 / 170) < −($\text{\$heap}_{funcstart\_724,1}$.p3 % 178), [(0 < -170) ∧ !(-170 < 0)]: (19612 / -170) < ($\text{\$heap}_{funcstart\_724,1}$.p3 % 178), [(-170 == 0) ∧ !(-170 < 0) ∧ !(0 < -170)]: 19612 < 0)

→ *[simplify]*

[112.12] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,27)

Condition defined at:

To prove: minof(int) ≤ $\text{\$heap}_{724,1;744,8}$.M1

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)

$heap_{init}$.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)

invariant1(**heapIs** $heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType<int>($heap_{funcstart\_724,1}$.p1),
asType<int>($heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType<int>($heap_{funcstart\_724,1}$.p2),
asType<int>($heap_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) <
asType\<integer\>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

−**asType\<integer const\>**($\$heap_{724,1;742,8}$.M2) <
asType\<integer\>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$heap_{724,1;742,8}$.p2))

asType\<integer\>($\$heap_{724,1;742,8}$.p2) <
asType\<integer\>($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

−**asType\<integer const\>**($\$heap_{724,1;744,8}$.M3) <
asType\<integer\>($\$heap_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($\$heap_{724,1;744,8}$.p3))

asType\<integer\>($\$heap_{724,1;744,8}$.p3) <
asType\<integer\>($\$heap_{724,1;744,8}$.M3)

Proof:

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[Take given term]

[11.0] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<int>($\$heap_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<int>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p2),
asType<int>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType<int>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType<int>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p3),
asType<int>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,

asType<int>($heap$_{funcstart_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>(**asType<short int>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1)))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>(**asType<short int>**((**int**)171))) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1)))))

→ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}.$b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_724,1}.$b1))))

→ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot * **asType<int>**($\$heap_{funcstart\_724,1}.$b1))))

→ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot * **asType<int>**($\$heap_{init}.$b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}.$**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}.$b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}.$**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 *

div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to* div(**heapIs** *$\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.4] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$\text{heap}_{724,1;740,8}$ is equal to
$\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,

177).rem))). **replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r2)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.7] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{init}$.r2)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) $-$
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.11] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) $-$
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) $-$
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to* $\$heap_{funcstart\_724,1}$.**_replace***(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[57.24] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{724,1;742,8}$._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.4] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.* **replace***(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).* **replace***(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div3.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})170))) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[simplify]*

[61.12] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} * 170)$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p3, 178)]

[61.13] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[simplify]*

[61.15] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$

$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[from term 57.24, $\$\text{heap}_{724,1;742,8}$ is equal to*
*$\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \to ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \to (-35 * \text{div}(\textbf{heapIs}$*
*$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs}$*
$\$\text{heap}_{funcstart_724,1}, \$\text{heap}_{funcstart_724,1}.p2, 176).rem))]

[61.16] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((-35 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((-35 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\text{b3}))))$

$\to$ *[const member of object with modified fields]*

[61.18] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((-35 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b3}))))$

$\to$ *[const static or extern object]*

[61.19] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((-35 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType<int>}(\$\text{heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>(**asType**<**short int**>((**int**)63)))))

$\rightarrow$ *[simplify]*

[61.26] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $\$heap_{724,1;744,8}$.M1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $\$heap_{724,1;744,8}$.M1

$\rightarrow$ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.2] -32768 $\leq$ $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).M1

$\rightarrow$ *[const member of object with modified fields]*

[1.5] -32768 $\leq$ $\$heap_{funcstart\_724,1}$.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 (63,27)

Condition defined at:

To prove: \$heap$_{724,1;744,8}$.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)

\$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)

invariant1(**heapIs** \$heap$_{funcstart\_724,1}$)

div1 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<**int**>(\$heap$_{funcstart\_724,1}$.p1),
asType<**int**>(\$heap$_{funcstart\_724,1}$.a1))

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(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.__**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{M2})$

$\text{\$heap}_{724,1;744,8} == \text{\$heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem})) *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{M3})$

Proof:

[Take given term]

[11.0] $\text{div1} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] $\text{div1} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] $\text{div1} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] $\text{div1} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] $\text{div1} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177)$

[Take given term]

[25.0] $\text{div2} == \text{div}(\textbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\text{p2}),$

asType\<int\>($\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType\<int\>(heap_{init}.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
asType\<int\>(heap_{init}.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem)) * }\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{r1)) }-$
$(\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short int}\text{>(div1.quot)) * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[simplify]*

[53.3] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{r1)) }- (\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>(div1.quot)) * }\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{init}.\text{r1)) }- (\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>(div1.quot)) * }\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short int}\text{>((}\textbf{int}\text{)171))) }-$
$(\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short int}\text{>(div1.quot)) * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem * 171)}$
$- (\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short int}\text{>(div1.quot)) * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart_724,1}.p1, 177)]

[53.9] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((171 * div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem)}$
$- (\textbf{asType}\text{<}\textbf{int}\text{>(}\textbf{asType}\text{<}\textbf{short int}\text{>(div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p1, 177).quot)) * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((171 * div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem)}$
$- (\text{div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).quot * }$
$\textbf{asType}\text{<}\textbf{int}\text{>(\$heap}_{funcstart\_724,1}.\text{b1))))}$

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}\text{(p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>((171 * div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem)}$
$- (\text{div(}\textbf{heapIs}\text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1, 177).quot * }$

asType<int>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.* **replace***(p1 → (-2 * div(***heapIs** *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs** *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($heap_{init}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**(**asType<short int>**((**int**)172))) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.11] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8} == \$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**($\$\text{heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType\<int\>**(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[57.24] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$\text{heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\$\text{heap}_{724,1;742,8}$ is equal to $\$\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(__heapIs__ $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__ $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType\<int\>**($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{init}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**(**asType<short int>**((**int**)170))) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType}\textbf{<short}$
$\textbf{int>}((\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{rem} * 170)$
$- (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) *$
$\textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.$p3, 178)]

[61.13] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170$
$* \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{rem}) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{quot})) * \textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[simplify]*

[61.15] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170$
$* \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{rem}) -$
$(\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{quot} *$
$\textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.$**replace***(p1 $\to$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 $\to$ (-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))]

[61.16] $\$\text{heap}_{724,1;744,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType<short int>}((170$
$* \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{rem}) -$
$(\text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3, 178}).\text{quot} *$
$\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35}$
$* \text{div}(\textbf{heapIs} \, \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2, 176}).\text{quot}) + (172 *$

div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\$\mathrm{heap}_{724,1;744,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>($\$\mathrm{heap}_{funcstart\_724,1}$.b3))))

→ *[const static or extern object]*

[61.19] $\$\mathrm{heap}_{724,1;744,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>($\$\mathrm{heap}_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\$\mathrm{heap}_{724,1;744,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[61.26] $\$\mathrm{heap}_{724,1;744,8}$ == $\$\mathrm{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] $\$heap_{724,1;744,8}.M1 \leq$ **maxof(int)**

$\rightarrow$ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.$***replace**$(p1 \rightarrow ((-2 * div($**heapIs** *$\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div($**heapIs** *$\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).$***replace**$(p2 \rightarrow ((-35 * div($**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div($**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).rem))).$***replace**$(p3 \rightarrow (-63 *$*
*$div($**heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *$*
*$div($**heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p3, 178).rem))]*

[1.1] $\$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow ((-2 * div($**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div($**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1, 177).rem))).$**replace**$(p2 \rightarrow ((-35$
$* div($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 *$
$div($**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2,$
$176).rem))).$**replace**$(p3 \rightarrow ((-63 * div($**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div($**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p3, 178).rem))).M1 \leq$ **maxof(int)**

$\rightarrow$ *[const member of object with modified fields]*

[1.4] $\$heap_{funcstart\_724,1}.M1 \leq$ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.5] $\$heap_{init}.M1 \leq$ **maxof(int)**

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.6] **asType**$<$**short int**$>((\text{int})30269) \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.10] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,17)

Condition defined at:

To prove: minof(int) $\leq \$heap_{724,1;744,8}.p1$

Given:

$\$heap_{init}.LIMIT ==$ **(int)**80

$\$heap_{init}.M1 ==$ **asType**$<$**short int**$>((\text{int})30269)$

$\$heap_{init}.r1 ==$ **asType**$<$**short int**$>((\text{int})171)$

$\$heap_{init}.a1 ==$ **asType**$<$**short int**$>((\text{int})177)$

$\$heap_{init}.b1 ==$ **asType**$<$**short int**$>((\text{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.__**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.__**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.__**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) <
asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) <
asType<integer>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{funcstart_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType<int>**($\$heap_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType<int>**(**asType<short int>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) *

asType\<int\>($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**(heap_{init}.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot * **asType\<int\>**(**asType\<short int\>**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[54.0] −**asType\<integer const\>**($\text{heap}_{724,1;740,8}$.M1) < **asType\<integer\>**($\text{heap}_{724,1;740,8}$.p1)

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[54.1] −**asType\<integer const\>**($\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).M1) < **asType\<integer\>**($\text{heap}_{724,1;740,8}$.p1)

$\rightarrow$ *[const member of object with modified fields]*

[54.2] −**asType**<**integer const**>($heap$_{funcstart_724,1}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

→ *[const static or extern object]*

[54.3] −**asType**<**integer const**>($heap$_{init}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[54.4] −**asType**<**integer const**>(**asType**<**short int**>((int)30269)) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

→ *[simplify]*

[54.8] -30269 < **asType**<**integer**>($heap$_{724,1;740,8}$.p1)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[54.9] -30269 < **asType**<**integer**>($heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).p1)

→ *[simplify]*

[54.11] -30269 < ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))

[Take given term]

[57.0] $heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$,
177).rem))).$\textbf{replace}$(p2 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.\text{p2}$, 176).rem)) * **asType<int>**($\text{\$heap}_{724,1;740,8}.\text{r2})$) $-$
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}.\text{b2})))$)

$\rightarrow$ *[simplify]*

[57.4] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$,
177).rem))).$\textbf{replace}$(p2 $\rightarrow$ **asType<short int>**((div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p2}$, 176).rem *
asType<int>($\text{\$heap}_{724,1;740,8}.\text{r2})$) $-$ (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}.\text{b2})))$)

$\rightarrow$ *[from term 53.19, $\text{\$heap}_{724,1;740,8}$ is equal to*
*$\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow (\text{-2} * div(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$*
*$\text{\$heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \text{\$heap}_{funcstart\_724,1},$*
$\text{\$heap}_{funcstart_724,1}.p1, 177).rem))]

[57.5] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$,
177).rem))).$\textbf{replace}$(p2 $\rightarrow$ **asType<short int>**((div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p2}$, 176).rem *
asType<int>($\text{\$heap}_{funcstart\_724,1}.\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).rem))).r2)) $-$
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}.\text{b2})))$)

$\rightarrow$ *[const member of object with modified fields]*

[57.6] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$,
177).rem))).$\textbf{replace}$(p2 $\rightarrow$ **asType<short int>**((div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p2}$, 176).rem *
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{r2})$) $-$ (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}.\text{b2})))$)

$\rightarrow$ *[const static or extern object]*

[57.7] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.\text{p1}$,

177).rem))). **replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{init}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$. **replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\$\text{heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{724,1;742,8}$.__**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.4] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__**replace**(p3 → **asType<short int>**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{init}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} *$
$\textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})170))) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) *$
$\textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[simplify]*

[61.12] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} * 170)$
$- (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) *$
$\textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart_724,1}.p3, 178)]

[61.13] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) * \textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[simplify]*

[61.15] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
*$heap_{funcstart\_724,1}.\underline{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
$heap_{funcstart\_724,1}.p1, 177).rem))).\underline{replace}(p2 \rightarrow (-35 * div(\textbf{heapIs}$
*$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ __asType__<__short int__>((170
* div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
__asType__<__int__>($\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(__heapIs__
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ ((-35
* div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ __asType__<__short int__>((170
* div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
__asType__<__int__>($\$heap_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ __asType__<__short int__>((170
* div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
__asType__<__int__>($\$heap_{init}$.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ __asType__<__short int__>((170
* div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(__heapIs__ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
__asType__<__int__>(__asType__<__short int__>((__int__)63)))))

→ *[simplify]*

[61.26] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ $\$heap_{724,1;744,8}$.p1

→ *[simplify]*

[1.1] -32768 ≤ $\$heap_{724,1;744,8}$.p1

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.2] -32768 ≤ $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p1

→ *[simplify]*

[1.7] -32769 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))

→ *[from term 54.11, literala < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.7.0] (-32769 + -1) < -30269

→ *[simplify]*

[1.7.2] **true**

[1.8] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,17)

Condition defined at:

To prove: $\$\text{heap}_{724,1;744,8}.\text{p1} \leq$ **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**$)3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$)) /
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1})))$ ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$)) %
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1})))$ ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==

592

asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType\<integer\>($heap$_{724,1;742,8}$.p2) <
asType\<integer\>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.\_**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($heap$_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap$_{724,1;742,8}$.b3))))

−**asType\<integer const\>**($heap$_{724,1;744,8}$.M3) <
asType\<integer\>($heap$_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($heap$_{724,1;744,8}$.p3))

asType\<integer\>($heap$_{724,1;744,8}$.p3) <
asType\<integer\>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p1),
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p2),
asType\<int\>($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType\<int\>($heap$_{funcstart_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType\<int\>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2,
asType$<$int$>$(**asType$<$short int$>$**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.p3),
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType$<$int$>$(**asType$<$short int$>$**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**(\$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType$<$int$>$**(\$heap$_{funcstart\_724,1}$.r1)) $-$
(**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) *
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short
int$>$**((div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType$<$int$>$(\$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**(\$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**($\text{\$heap}_{init}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**(**asType$<$short int$>$**((**int**)171))) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**($\text{\$heap}_{init}$.b1)))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot * **asType$<$int$>$**(**asType$<$short int$>$**((**int**)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[56.0] **asType**<**integer**>($\$heap_{724,1;740,8}$.p1) < **asType**<**integer**>($\$heap_{724,1;740,8}$.M1)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[56.1] **asType**<**integer**>($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1) < **asType**<**integer**>($\$heap_{724,1;740,8}$.M1)

→ *[simplify]*

[56.3] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>($\$heap_{724,1;740,8}$.M1)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[56.4] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).M1)

→ *[const member of object with modified fields]*

[56.5] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>($\$heap_{funcstart\_724,1}$.M1)

→ *[const static or extern object]*

[56.6] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>($\$heap_{init}$.M1)

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[56.7] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>(**asType**<**short int**>((**int**)30269))

→ [simplify]

[56.17] -30269 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

*→ [from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

*→ [from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ [simplify]

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

*→ [from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p1, 177).rem))]$

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap_{724,1;740,8}.b2))))

→ [const member of object with modified fields]

[57.6] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{funcstart\_724,1}.r2$)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}.b2))))

→ [const static or extern object]

[57.7] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>($heap_{init}.r2$)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}.b2))))

→ [expand definition of constant 'r2' at prang.c (20,20)]

[57.8] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap_{724,1;740,8}.b2))))

→ [simplify]

[57.11] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem * 172) −

(**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($heap_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$._**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._**replace***(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace***(p2 → (-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)]

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 39.6, div3 is equal to div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}$<$\textbf{short int}$>(($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) * $\textbf{asType}$<$\textbf{int}$>($\$heap_{724,1;742,8}$.r3)) $-$ ($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div3.quot)) * $\textbf{asType}$<$\textbf{int}$>($\$heap_{724,1;742,8}$.b3)))))

$\rightarrow$ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}$<$\textbf{short int}$>((div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * $\textbf{asType}$<$\textbf{int}$>($\$heap_{724,1;742,8}$.r3)) $-$ ($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div3.quot)) * $\textbf{asType}$<$\textbf{int}$>($\$heap_{724,1;742,8}$.b3)))))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ (-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}$<$\textbf{short int}$>((div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * $\textbf{asType}$<$\textbf{int}$>($\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) $-$ ($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div3.quot)) * $\textbf{asType}$<$\textbf{int}$>($\$heap_{724,1;742,8}$.b3)))))

$\rightarrow$ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.15] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to*
*$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.16] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs }$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs }$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\text{\$heap}_{724,1;744,8}.\text{p1} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 61.26, \$heap$_{724,1;744,8}$ is equal to*
*\$heap$_{funcstart\_724,1}$._\textbf{replace}(p1 → ((-2 * div(\textbf{heapIs} \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).rem)))._\textbf{replace}(p2 → ((-35 * div(\textbf{heapIs}*
*\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(\textbf{heapIs}*
*\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)))._\textbf{replace}(p3 → (-63 **

*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.1] $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem))).p1 ≤ **maxof(int)**

→ *[simplify]*

[1.18] -32768 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot))

→ *[from term 56.17, literala < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot)) is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.18.0] (-32768 + -1) < -30269

→ *[simplify]*

[1.18.2] **true**

[1.19] **true**

Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,11)

Condition defined at:

To prove: minof(int) ≤
static_cast<integer>(asType<int>($heap_{724,1;744,8}.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)

$\$\text{heap}_{init}.\text{a2} ==$ **asType<short int>**$((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} ==$ **asType<short int>**$((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} ==$ **asType<short int>**$((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} ==$ **asType<short int>**$((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} ==$ **asType<short int>**$((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} ==$ **asType<short int>**$((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} ==$ **asType<short int>**$((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} ==$ **asType<short int>**$((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} ==$ **asType<short int>**$((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$) /
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1})$)) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p1})$) %
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a1})$)) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$) /
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a2})$)) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p2})$) %
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a2})$)) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{p3})$,
asType<int>$(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

(**asType<integer>**(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{p3})$) /
asType<integer>(**asType<int>**$(\$\text{heap}_{funcstart\_724,1}.\text{a3})$)) ==
asType<integer>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\text{heap}_{724,1;740,8}$.M1) <
asType\<integer\>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;740,8}$.p1))

asType\<integer\>($\text{heap}_{724,1;740,8}$.p1) <
asType\<integer\>($\text{heap}_{724,1;740,8}$.M1)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{724,1;740,8}$.b2))))

−**asType\<integer const\>**($\text{heap}_{724,1;742,8}$.M2) <
asType\<integer\>($\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;742,8}$.p2))

asType\<integer\>($\text{heap}_{724,1;742,8}$.p2) <
asType\<integer\>($\text{heap}_{724,1;742,8}$.M2)

$\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{heap}_{724,1;742,8}$.b3))))

−**asType\<integer const\>**($\text{heap}_{724,1;744,8}$.M3) <
asType\<integer\>($\text{heap}_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;744,8}$.p3))

asType\<integer\>($\text{heap}_{724,1;744,8}$.p3) <
asType\<integer\>($\text{heap}_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, **asType**<**int**>($\$heap_{funcstart\_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, **asType**<**int**>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType**<**int**>($\$heap_{funcstart\_724,1}$.p2), **asType**<**int**>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, **asType**<**int**>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, **asType**<**int**>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType**<**int**>($\$heap_{funcstart\_724,1}$.p3), **asType**<**int**>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType**<**int**>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType**<**int**>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,
asType<int>(asType<short int>((int)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((asType<int>(asType<short int>(div1.rem)) ***
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((asType<int>(asType<short int>**(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>(asType<short int>**(div1.quot)) *
asType<int>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.3] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((**div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((**div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(\$heap$_{init}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((**div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem *
asType<int>(asType<short int>((int)171))) −
(**asType<int>(asType<short int>**(div1.quot)) *
asType<int>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] \$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>((**div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem * 171)
− (**asType<int>(asType<short int>**(div1.quot)) *
asType<int>(\$heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short int}{>}(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{init}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short int}{>}((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))$

[Take given term]

[55.0] $!(0 == \textbf{asType}{<}\textbf{integer}{>}(\text{\$heap}_{724,1;740,8}.\text{p1}))$

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart_724,1}.\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart_724,1},*
*$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart_724,1},*
$heap_{funcstart_724,1}.p1, 177).rem))]

[55.1] $!(0 == \textbf{asType}{<}\textbf{integer}{>}(\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\text{p1}))$

$\rightarrow$ *[simplify]*

[55.3] $!(0 == ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem})))$

[Take given term]

[57.0] $\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType}{<}\textbf{short}$

int>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.__replace(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)]*

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to $heap$_{funcstart_724,1}$.__replace(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).__replace(p2 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * **asType**<**int**>($heap$_{funcstart\_724,1}$.__replace(p1 → ((-2 * div(**heapIs**

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$heap_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → **asType<short int>**((172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType<int>(asType<short int>((int)35)))))**

→ *[simplify]*

[57.24] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$.__replace__(p3 → **asType<short int>**((**asType<int>(asType<short int>**(div3.rem)) * **asType<int>**($\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>(asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((**asType<int>(asType<short int>**(div3.rem)) * **asType<int>**($\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>(asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,

$heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)) * **asType<int>**($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.4] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * **asType<int>**($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))]*

[61.5] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * **asType<int>**($heap$_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem *

asType<int>($heap$_{funcstart_724,1}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[const static or extern object]*

[61.8] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * **asType<int>**($heap$_{init}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * **asType<int>**(**asType<short int>**((**int**)170))) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.12] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)]*

[61.13] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem) −

($\textbf{asType}\textbf{<int>}$($\textbf{asType}\textbf{<short int>}$(div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) * $\textbf{asType}\textbf{<int>}$($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}\textbf{<short int>}$((170 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * $\textbf{asType}\textbf{<int>}$($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ (-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}\textbf{<short int>}$((170 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * $\textbf{asType}\textbf{<int>}$($\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 $\rightarrow$ ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 $\rightarrow$ $\textbf{asType}\textbf{<short int>}$((170 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * $\textbf{asType}\textbf{<int>}$($\$heap_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**(heap_{init}.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**(**asType<short int>**((**int**)63)))))

→ *[simplify]*

[61.26] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ **static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) < (**int**)0)

→ *[simplify]*

[1.1] -32768 ≤ **static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) < (**int**)0)

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))]*

[1.2] -32768 $\leq$
static_cast<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$
((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).p1) < (**int**)0)

$\rightarrow$ *[simplify]*

[1.14] -32768 $\leq$ ([0 < ((-171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, []: 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.15] -32768 $\leq$ ([0 < ((-171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot)))]: 0)

$\rightarrow$ *[simplify]*

[1.20] -32768 $\leq$ ([0 < ((-171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [-1 < ((171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (-2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 0)

$\rightarrow$ *[from term 55.3, -1 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)) is true if and only if 0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.21] -32768 $\leq$ ([0 < ((-171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0)

$\rightarrow$ *[simplify]*

[1.23] -32769 < ([0 < ((-171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0)

$\rightarrow$ *[move guard outside expression]*

[1.24] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: -32769 < 1, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.26] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: **true**)

$\rightarrow$ *[all guards have equal guarded terms]*

[1.27] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,11)

Condition defined at:

To prove: static_cast<integer>(asType<int>(\$heap$_{724,1;744,8}$.p1) < (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)

$\$heap_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \$heap_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p1}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p1}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \;||\; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p2}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p2}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \;||\; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p3}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{p3}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \;||\; !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\;*$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

−**asType**<**integer const**>($heap$_{724,1;742,8}$.M2) <
asType<**integer**>($heap$_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

asType<**integer**>($heap$_{724,1;742,8}$.p2) <
asType<**integer**>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$._**replace**(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($heap$_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap$_{724,1;742,8}$.b3))))

−**asType**<**integer const**>($heap$_{724,1;744,8}$.M3) <
asType<**integer**>($heap$_{724,1;744,8}$.p3)

!(0 == **asType**<**integer**>($heap$_{724,1;744,8}$.p3))

asType<**integer**>($heap$_{724,1;744,8}$.p3) <
asType<**integer**>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,

asType<int>(asType<short int>((int)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{funcstart_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>(asType<short int>((int)176)))

→ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{funcstart_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>(asType<short int>((int)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short int>((asType<int>(asType<short int>**(div1.rem)) *

asType$<$int$>$($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.3] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**($\$\text{heap}_{init}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**(**asType$<$short int$>$**((**int**)171))) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)

− (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot *
asType<int>($\$heap_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot *
asType<int>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot *
asType<int>(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[55.0] !(0 == **asType<integer>**($\$heap_{724,1;740,8}$.p1))

→ *[from term 53.19, \$heap_{724,1;740,8} is equal to
\$heap_{funcstart_724,1}.**replace**(p1 → (-2 * div(**heapIs** \$heap_{funcstart_724,1},
\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** \$heap_{funcstart_724,1},
\$heap_{funcstart_724,1}.p1, 177).rem))]*

[55.1] !(0 == **asType<integer>**($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1))

→ *[simplify]*

[55.3] !(0 == ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, \$heap_{724,1;740,8} is equal to
\$heap_{funcstart_724,1}.**replace**(p1 → (-2 * div(**heapIs** \$heap_{funcstart_724,1},
\$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** \$heap_{funcstart_724,1},
\$heap_{funcstart_724,1}.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *

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div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($heap_{724,1;740,8}$.r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\text{\$heap}_{init}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))). **_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot * **asType\<int\>**($\$heap_{724,1;740,8}.b2$))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))]*

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))). **_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))). **_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot * **asType\<int\>**($\$heap_{funcstart\_724,1}.b2$))))

→ *[const static or extern object]*

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))). **_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot * **asType\<int\>**($\$heap_{init}.b2$))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))). **_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot * **asType\<int\>**(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem * **asType$<int>$**($\text{\$heap}_{724,1;742,8}$.r3)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to*
$\text{\$heap}_{funcstart\_724,1}$. **replace***(p1 $\rightarrow$ ((-2 * div(***heapIs*** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\text{\$heap}_{funcstart\_724,1}$,*
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace***(p2 $\rightarrow$ (-35 * div(***heapIs***
*$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs***
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]

[61.5] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem * **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).r3)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;742,8}$.b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.7] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem * **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.r3)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;742,8}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.8] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} * \textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\text{\$heap}_{724,1;744,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} * \textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})170))) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[simplify]*

[61.12] $\text{\$heap}_{724,1;744,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} * 170) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[from term 39.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\text{\$heap}_{724,1;744,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \to \textbf{asType}\textbf{<short int>}((170 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\to$ *[simplify]*

[61.15] $\text{\$heap}_{724,1;744,8} ==$ $\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$

$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \to \mathbf{asType}<\mathbf{short\ int}>((170$
$* \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem) -$
$(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot *$
$\mathbf{asType}<\mathbf{int}>(\$heap_{724,1;742,8}.b3))))$

$\to$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
$\$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to ((-2 * div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \to (-35 * div(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))]$

[61.16] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to ((-2 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\mathbf{replace}(p2 \to ((-35 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \to \mathbf{asType}<\mathbf{short\ int}>((170$
$* \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem) -$
$(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot *$
$\mathbf{asType}<\mathbf{int}>(\$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to ((-2 * \mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \to ((-35$
$* \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).b3))))$

$\to$ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to ((-2 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\mathbf{replace}(p2 \to ((-35 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \to \mathbf{asType}<\mathbf{short\ int}>((170$
$* \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem) -$
$(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot *$
$\mathbf{asType}<\mathbf{int}>(\$heap_{funcstart\_724,1}.b3))))$

$\to$ *[const static or extern object]*

[61.19] $\$heap_{724,1;744,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to ((-2 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\mathbf{replace}(p2 \to ((-35 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \to \mathbf{asType}<\mathbf{short\ int}>((170$
$* \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem) -$
$(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot *$
$\mathbf{asType}<\mathbf{int}>(\$heap_{init}.b3))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$\text{* div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow ((\text{-63 * div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0) \le$
$\textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 61.26, $\text{\$heap}_{724,1;744,8}$ is equal to*
*$\text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(p1 \rightarrow ((\text{-2 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$*
*$\text{\$heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$*
*$\text{\$heap}_{funcstart\_724,1}.p1, 177).rem))).\textbf{\_replace}(p2 \rightarrow ((\text{-35 * div}(\textbf{heapIs}$*
*$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs}$*
*$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))).\textbf{\_replace}(p3 \rightarrow (\text{-63 *}$*
*$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3, 178).quot) + (170 *$*
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3, 178).rem))]$

[1.1] $\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1}$
$\rightarrow ((\text{-2 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +$
$(171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((\text{-35 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow ((\text{-63 * div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\text{p1}) < (\textbf{int})0) \le$
$\textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.13] $([0 < ((\text{-171 * div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$

177).quot))]: 1, []: 0) $\leq$ **maxof**(**int**)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.14] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot)))]: 0) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.19] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 1, [-1 < ((171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 0) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 55.3, -1 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)) is true if and only if 0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]*

[1.20] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: 0) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.22] (-1 + ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: 0)) < 32767

$\rightarrow$ *[move guard outside expression]*

[1.23] ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: -1 + 1, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: -1 + 0) < 32767

$\rightarrow$ *[simplify]*

[1.26] 0 < (32767 + $-$([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot))]: 0, [0 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))]: -1))

→ *[move guard outside expression]*

[1.27] $0 < (32767 + ([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: -0, [0 < ((\text{-2} * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: --1))$

→ *[simplify]*

[1.29] $0 < (32767 + ([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: 0, [0 < ((\text{-2} * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 1))$

→ *[move guard outside expression]*

[1.30] $0 < ([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: 0 + 32767, [0 < ((\text{-2} * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 1 + 32767)$

→ *[simplify]*

[1.32] $0 < ([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: 32767, [0 < ((\text{-2} * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 32768)$

→ *[move guard outside expression]*

[1.33] $([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}))]: 0 < 32767, [0 < ((\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 0 < 32768)$

→ *[simplify]*

[1.35] $([0 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}))]: \textbf{true}, [0 < ((\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: \textbf{true})$

→ *[all guards have equal guarded terms]*

[1.36] **true**

Proof of verification condition: Arithmetic result of operator '*' is within

limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,25)

Condition defined at:

To prove: minof(int) $\leq$ (**asType\<int\>**($heap_{724,1;744,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{724,1;744,8}$.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)

$heap_{init}$.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)

invariant1(**heapIs** $heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $heap_{funcstart\_724,1}$,
asType\<int\>($heap_{funcstart\_724,1}$.p1),
asType\<int\>($heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

!(0 == **asType\<integer\>**(div1.rem)) || !(0 ==
asType\<integer\>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_724,1}$.b1)))))

−**asType\<integer const\>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType\<integer\>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$\text{heap}_{724,1;740,8}$.p1))

asType\<integer\>($\$\text{heap}_{724,1;740,8}$.p1) <
asType\<integer\>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$\text{heap}_{724,1;740,8}$.b2)))))

−**asType\<integer const\>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType\<integer\>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$\text{heap}_{724,1;742,8}$.p2))

asType\<integer\>($\$\text{heap}_{724,1;742,8}$.p2) <

asType$<$integer$>$($\text{\$heap}_{724,1;742,8}$.M2)

$\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{724,1;742,8}$.**replace**(p3 → **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div3.rem)) * **asType$<$int$>$**($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType$<int>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;742,8}$.b3))))

$-$**asType$<$integer const$>$**($\text{\$heap}_{724,1;744,8}$.M3) $<$ **asType$<$integer$>$**($\text{\$heap}_{724,1;744,8}$.p3)

!(0 == **asType$<$integer$>$**($\text{\$heap}_{724,1;744,8}$.p3))

asType$<$integer$>$($\text{\$heap}_{724,1;744,8}$.p3) $<$ **asType$<$integer$>$**($\text{\$heap}_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.p1), **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, **asType$<int>$**($\text{\$heap}_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, **asType$<int>$**(**asType$<$short int$>$**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.p2), **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, **asType$<int>$**($\text{\$heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType**<**int**>($\$heap_{funcstart\_724,1}$.p3), **asType**<**int**>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType**<**int**>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType**<**int**>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.8] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1)))))

→ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1)))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2))))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[55.0] !(0 == **asType**<**integer**>($\$heap_{724,1;740,8}$.p1))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[55.1] !(0 == **asType**<**integer**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1))

→ *[simplify]*

[55.3] !(0 == ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>($\$heap_{724,1;740,8}$.r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *

asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short**
int>(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_724,1}$.r2)) − (**asType<int>**(**asType<short**
int>(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{init}$.r2)) − (**asType<int>**(**asType<short**
int>(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType\<int\>(**asType\<short int\>**((**int**)172))) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *

asType<int>($heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * **asType<int>**($heap$_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * **asType<int>**($heap$_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[57.24] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.**_replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*

$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

$\rightarrow$ *[simplify]*

[61.12] $\$heap_{724,1;744,8} ==\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 \text{ *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow ((\text{-35 * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 \text{ * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{rem}))).\textbf{replace}(p3 \rightarrow \textbf{asType<short}$
$\textbf{int>}((\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).\text{rem * 170})$
$- (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) \text{ *}$
$\textbf{asType<int>}(\$heap_{724,1;742,8}.b3))))$

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart_724,1}.p3, 178)]

[61.13] $\$heap_{724,1;744,8} ==\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 \text{ *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow ((\text{-35 * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 \text{ * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{rem}))).\textbf{replace}(p3 \rightarrow \textbf{asType<short int>}((170$
$\text{* div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).\text{rem}) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p3, 178).\text{quot})) \text{ * asType<int>}(\$heap_{724,1;742,8}.b3))))$

$\rightarrow$ *[simplify]*

[61.15] $\$heap_{724,1;744,8} ==\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 \text{ *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow ((\text{-35 * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 \text{ * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{rem}))).\textbf{replace}(p3 \rightarrow \textbf{asType<short int>}((170$
$\text{* div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).\text{quot } \text{*}$
$\textbf{asType<int>}(\$heap_{724,1;742,8}.b3))))$

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-2 * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 \text{ * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \rightarrow (\text{-35 * div}(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 \text{ * div}(\textbf{heapIs}$*
$\$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8} ==\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((\text{-2 *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 \text{ *}$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\textbf{replace}(p2 \rightarrow ((\text{-35 * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 \text{ * div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).\text{rem}))).\textbf{replace}(p3 \rightarrow \textbf{asType<short int>}((170$

* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{funcstart\_724,1}$.b3))))

→ *[const static or extern object]*

[61.19] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<int>(**asType<short int>**((int)63)))))

→ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,

$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] **minof(int)** $\leq$ (**asType<int>**($\text{heap}_{724,1;744,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) <
(int)0)))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ (**asType<int>**($\text{heap}_{724,1;744,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) <
(int)0)))

$\rightarrow$ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow (-63 *$*
*$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *$*
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))]$

[1.2] -32768 $\leq$ (**asType<int>**($\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
div(**heapIs** $\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
div(**heapIs** $\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\text{M1}) *$
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) <
(int)0)))

$\rightarrow$ *[const member of object with modified fields]*

[1.5] -32768 $\leq$ (**asType<int>**($\text{heap}_{funcstart\_724,1}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) <
(int)0)))

$\rightarrow$ *[const static or extern object]*

[1.6] -32768 $\leq$ (**asType<int>**(heap_{init}.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;744,8}$.p1) <
(int)0)))

$\rightarrow$ *[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>**($\text{heap}_{724,1;744,8}$.p1) <

(**int**)0)))

→ [simplify]

[1.10] -32768 ≤ (30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) <
(**int**)0)))

→ *[from term 61.26, $heap$_{724,1;744,8}$ is equal to*
*$heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(__heapIs__*
*$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(__heapIs__*
*$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))).__replace__(p3 → (-63 **
*div(__heapIs__ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 **
div(__heapIs__ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))]

[1.11] -32768 ≤ (30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.__replace__(p1
→ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).__replace__(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))).p1) < (**int**)0)))

→ [simplify]

[1.23] -32768 ≤ (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))]: 1, []: 0)))

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.24] -32768 ≤ (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)))]: 0)))

→ [simplify]

[1.29] -32768 ≤ (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))]: 1, [-1 < ((171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))]: 0)))

→ *[from term 55.3, -1 < ((-2 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).rem)) is true if and only if 0 < ((-2 * div(__heapIs__*

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.30] -32768 ≤ (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)))

→ *[simplify]*

[1.31] -32768 ≤ (30269 * ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0))

→ *[move guard outside expression]*

[1.32] -32768 ≤ ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 1 * 30269, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0 * 30269)

→ *[simplify]*

[1.36] -32769 < ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)

→ *[move guard outside expression]*

[1.37] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: -32769 < 30269, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: -32769 < 0)

→ *[simplify]*

[1.39] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: **true**)

→ *[all guards have equal guarded terms]*

[1.40] **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 (63,25)

Condition defined at:

To prove: (asType<int>($heap$_{724,1;744,8}$.M1) * asType<int>(static_cast<integer>(asType<int>($heap$_{724,1;744,8}$.p1) < (int)0))) ≤ 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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$, **asType<int>**($heap$_{funcstart\_724,1}$.p1), **asType<int>**($heap$_{funcstart_724,1}$.a1))

(**asType<integer>(asType<int>**($heap$_{funcstart_724,1}$.p1)) / **asType<integer>(asType<int>**($heap$_{funcstart\_724,1}$.a1))) == **asType<integer>**(div1.quot)

(**asType<integer>(asType<int>**($heap$_{funcstart_724,1}$.p1)) % **asType<integer>(asType<int>**($heap$_{funcstart\_724,1}$.a1))) == **asType<integer>**(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==

asType$<$integer$>$(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.p2),
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType$<$integer$>$(div2.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p2)) %
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a2))) ==
asType$<$integer$>$(div2.rem)

!(0 == **asType$<$integer$>$**(div2.rem)) || !(0 ==
asType$<$integer$>$(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.p3),
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.a3))

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p3)) /
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a3))) ==
asType$<$integer$>$(div3.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p3)) %
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a3))) ==
asType$<$integer$>$(div3.rem)

!(0 == **asType$<$integer$>$**(div3.rem)) || !(0 ==
asType$<$integer$>$(div3.quot))

$\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.r1)) − (**asType$<int>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1))))

−**asType$<$integer const$>$**($\text{\$heap}_{724,1;740,8}$.M1) $<$
asType$<$integer$>$($\text{\$heap}_{724,1;740,8}$.p1)

!(0 == **asType$<$integer$>$**($\text{\$heap}_{724,1;740,8}$.p1))

asType$<$integer$>$($\text{\$heap}_{724,1;740,8}$.p1) $<$
asType$<$integer$>$($\text{\$heap}_{724,1;740,8}$.M1)

$\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{724,1;740,8}$.**replace**(p2 → **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) *
asType$<$int$>$($\text{\$heap}_{724,1;740,8}$.r2)) − (**asType$<int>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{724,1;740,8}$.b2))))

−**asType$<$integer const$>$**($\text{\$heap}_{724,1;742,8}$.M2) $<$
asType$<$integer$>$($\text{\$heap}_{724,1;742,8}$.p2)

!(0 == **asType$<$integer$>$**($\text{\$heap}_{724,1;742,8}$.p2))

asType\<integer\>($heap$_{724,1;742,8}$.p2) <
asType\<integer\>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($heap$_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap$_{724,1;742,8}$.b3)))))

−**asType\<integer const\>**($heap$_{724,1;744,8}$.M3) <
asType\<integer\>($heap$_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($heap$_{724,1;744,8}$.p3))

asType\<integer\>($heap$_{724,1;744,8}$.p3) <
asType\<integer\>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p1),
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType\<int\>($heap$_{funcstart_724,1}$.p2),
asType\<int\>($heap$_{funcstart_724,1}$.a2))

→ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType\<int\>($heap$_{funcstart_724,1}$.a2))

→ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType\<int\>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3), **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, **asType**<**int**>($\$\text{heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem} * \textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})171))) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem} * 171) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem}) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem}) - (\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{quot} * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem}) - (\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{quot} * \textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{rem}) - (\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1},\ \text{\$heap}_{funcstart\_724,1}.\text{p1},\ 177).\text{quot} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[53.19] $heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[55.0] !(0 == **asType**<**integer**>($heap_{724,1;740,8}$.p1))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[55.1] !(0 == **asType**<**integer**>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p1))

→ *[simplify]*

[55.3] !(0 == ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)))

[Take given term]

[57.0] $heap_{724,1;742,8}$ == $heap_{724,1;740,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap_{724,1;740,8}$.r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *

asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to
$heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_724,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<int>($heap$_{init}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>(asType<short int>((int)172))) −
(**asType<int>(asType<short int>**(div2.quot)) *
asType<int>($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType<int>(asType<short int>**(div2.quot)) *
asType<int>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) −
(**asType<int>(asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.14] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<int>($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *

asType<int>($heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<int>($heap$_{funcstart_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<int>($heap$_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((int)35)))))

→ *[simplify]*

[57.24] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$._**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to
$heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*

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$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.1] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ [from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178)]

[61.2] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ [simplify]

[61.4] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). _**replace**(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ [from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))). _**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.5] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$. **_replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **_replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{init}$.r3)) − (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{724,1;742,8}.$b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p3, 178)]*

[61.13] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p3, 178).quot)) * **asType**<**int**>($\text{\$heap}_{724,1;742,8}.$b3)))))

→ *[simplify]*

[61.15] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).quot *
asType<**int**>($\text{\$heap}_{724,1;742,8}.$b3)))))

→ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to
$\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))]*

[61.16] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170

* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{init}$.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

$\rightarrow$ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,

$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem)))

[Take goal term]

[1.0] (**asType**<**int**>($heap_{724,1;744,8}.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;744,8}.p1) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to*
*$heap_{funcstart_724,1}._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart_724,1}.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem)))._**replace**(p3 → (-63 ***
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 ***
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem))]*

[1.1] (**asType**<**int**>($heap_{funcstart_724,1}._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p3, 178).rem))).M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;744,8}.p1) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.4] (**asType**<**int**>($heap_{funcstart_724,1}.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;744,8}.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_{724,1;744,8}.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_{724,1;744,8}.p1) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.9] (30269 *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;744,8}.p1) <

(**int**)0))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.$**replace***(p1 \rightarrow ((-2 * div($**heapIs** *$\$heap_{funcstart_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div($**heapIs** *$\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).rem)))$.**replace***(p2 \rightarrow ((-35 * div($**heapIs**
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div($**heapIs**
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2, 176).rem)))$.**replace***(p3 \rightarrow (-63 *
*div($**heapIs** *$\$heap_{funcstart_724,1}$, $\$heap_{funcstart_724,1}.p3, 178).quot) + (170 *
*div($**heapIs** *$\$heap_{funcstart_724,1}$, $\$heap_{funcstart_724,1}.p3, 178).rem)))]*

[1.10] (30269 *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.$**replace**(p1
$\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) +
(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).$\_$**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).rem))).$\_$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).rem))).p1) < (**int**)0))) $\leq$
maxof(**int**)

$\rightarrow$ *[simplify]*

[1.22] (30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot))]: 1, []: 0))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.23] (30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) + (2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot))]: 0))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.28] (30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot))]: 1, [-1 < ((171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem) + (-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot))]: 0))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 55.3, -1 < ((-2 * div($**heapIs** *$\$heap_{funcstart_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div($**heapIs** *$\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).rem)) is true if and only if 0 < ((-2 * div($**heapIs**
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div($**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart_724,1}.p1, 177).rem))]

[1.29] (30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0))) ≤ **maxof(int)**

→ *[simplify]*

[1.30] (30269 * ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)) ≤ **maxof(int)**

→ *[move guard outside expression]*

[1.31] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1 * 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0 * 30269) ≤ **maxof(int)**

→ *[simplify]*

[1.35] (-1 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)) < 32767

→ *[move guard outside expression]*

[1.36] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: -1 + 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: -1 + 0) < 32767

→ *[simplify]*

[1.39] 0 < (32767 + −([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 30268, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: -1))

→ *[move guard outside expression]*

[1.40] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: −30268, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: −-1))

→ *[simplify]*

[1.42] $0 < (32767 + ([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: -30268, [0 < ((-2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 1))$

→ *[move guard outside expression]*

[1.43] $0 < ([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: -30268 + 32767, [0 < ((-2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 1 + 32767)$

→ *[simplify]*

[1.45] $0 < ([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]: 2499, [0 < ((-2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 32768)$

→ *[move guard outside expression]*

[1.46] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}))]: 0 < 2499, [0 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: 0 < 32768)$

→ *[simplify]*

[1.48] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$ $177).\text{quot}))]: \textbf{true}, [0 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$ $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]: \textbf{true})$

→ *[all guards have equal guarded terms]*

[1.49] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,5)

Condition defined at:

To prove: minof(int) $\leq \$\text{heap}_{724,1;744,8}.\text{p1}$

Given:

$\$heap_{init}.LIMIT == (\textbf{int})80$

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p1$),
asType<**int**>($\$heap_{funcstart\_724,1}.a1$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p2$),
asType<**int**>($\$heap_{funcstart\_724,1}.a2$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==

asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p3),
asType<int>($\$heap_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType<integer const>**($\$heap_{724,1;740,8}$.M1) <
asType<integer>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$heap_{724,1;740,8}$.p1))

asType<integer>($\$heap_{724,1;740,8}$.p1) <
asType<integer>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

−**asType<integer const>**($\$heap_{724,1;742,8}$.M2) <
asType<integer>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$heap_{724,1;742,8}$.p2))

asType<integer>($\$heap_{724,1;742,8}$.p2) <
asType<integer>($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

−**asType<integer const>**($\$heap_{724,1;744,8}$.M3) <
asType<integer>($\$heap_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($\$heap_{724,1;744,8}$.p3))

asType$<$integer$>$($heap$_{724,1;744,8}$.p3) $<$
asType$<$integer$>$($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType$<$int$>$($heap$_{funcstart_724,1}$.p1),
asType$<$int$>$($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType$<$int$>$($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType$<$int$>$($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType$<$int$>$(**asType$<$short int$>$**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType$<$int$>$($heap$_{funcstart_724,1}$.p2),
asType$<$int$>$($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType$<$int$>$($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType$<$int$>$($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType$<$int$>$(**asType$<$short int$>$**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType$<$int$>$($heap$_{funcstart_724,1}$.p3),

asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, **asType$<int>$**($\text{\$heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, **asType$<int>$**(**asType$<$short int$>$**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div1.rem)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**($\text{\$heap}_{funcstart\_724,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**($\text{\$heap}_{init}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem * **asType$<int>$**(**asType$<$short int$>$**((**int**)171))) $-$

($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div1.quot)) *
$\textbf{asType}$<$\textbf{int}$>($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.8] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ $\textbf{asType}$<$\textbf{short}$
$\textbf{int}$>((div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * 171)
$-$ ($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div1.quot)) *
$\textbf{asType}$<$\textbf{int}$>($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177)]

[53.9] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ $\textbf{asType}$<$\textbf{short}$
$\textbf{int}$>((171 * div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)
$-$ ($\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>(div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$,
$\$$heap$_{funcstart\_724,1}$.p1, 177).quot)) *
$\textbf{asType}$<$\textbf{int}$>($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.11] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ $\textbf{asType}$<$\textbf{short}$
$\textbf{int}$>((171 * div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)
$-$ (div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot *
$\textbf{asType}$<$\textbf{int}$>($\$$heap$_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.12] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ $\textbf{asType}$<$\textbf{short}$
$\textbf{int}$>((171 * div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)
$-$ (div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot *
$\textbf{asType}$<$\textbf{int}$>($\$$heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ $\textbf{asType}$<$\textbf{short}$
$\textbf{int}$>((171 * div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)
$-$ (div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot *
$\textbf{asType}$<$\textbf{int}$>($\textbf{asType}$<$\textbf{short int}$>((int)2)))))

$\rightarrow$ *[simplify]*

[53.19] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ ((-2 *
div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div($\textbf{heapIs}$ $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[54.0] $-\textbf{asType}$<$\textbf{integer const}$>($\$$heap$_{724,1;740,8}$.M1) <
$\textbf{asType}$<$\textbf{integer}$>($\$$heap$_{724,1;740,8}$.p1)

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 $\rightarrow$ (-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$,

$\$heap_{funcstart\_724,1}.p1,\ 177).rem))]$

[54.1] $-$**asType**$<$**integer const**$>$($\$heap_{funcstart\_724,1}.$_**replace**(p1 $\to$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem))).M1) $<$
asType$<$**integer**$>$($\$heap_{724,1;740,8}.$p1)

$\to$ *[const member of object with modified fields]*

[54.2] $-$**asType**$<$**integer const**$>$($\$heap_{funcstart\_724,1}.$M1) $<$
asType$<$**integer**$>$($\$heap_{724,1;740,8}.$p1)

$\to$ *[const static or extern object]*

[54.3] $-$**asType**$<$**integer const**$>$($\$heap_{init}.$M1) $<$
asType$<$**integer**$>$($\$heap_{724,1;740,8}.$p1)

$\to$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[54.4] $-$**asType**$<$**integer const**$>$(**asType**$<$**short int**$>$((int)30269)) $<$
asType$<$**integer**$>$($\$heap_{724,1;740,8}.$p1)

$\to$ *[simplify]*

[54.8] -30269 $<$ **asType**$<$**integer**$>$($\$heap_{724,1;740,8}.$p1)

$\to$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}.$_**replace**(p1 $\to$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))]*

[54.9] -30269 $<$ **asType**$<$**integer**$>$($\$heap_{funcstart\_724,1}.$_**replace**(p1 $\to$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem))).p1)

$\to$ *[simplify]*

[54.11] -30269 $<$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}.$_**replace**(p2 $\to$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) *
asType$<$**int**$>$($\$heap_{724,1;740,8}.$r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{724,1;740,8}.$b2))))

$\to$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to
$\$heap_{funcstart\_724,1}.$_**replace**(p1 $\to$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}.$_**replace**(p1 $\to$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType\<int\>($\text{\$heap}_{funcstart\_724,1}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[const static or extern object]*

[57.7] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType\<int\>($\text{\$heap}_{init}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem *
asType\<int\>(**asType\<short int\>**((**int**)172))) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) −
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot)) * **asType\<int\>**($\text{\$heap}_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))).b2)))))

→ *[const member of object with modified fields]*

[57.16] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($heap_{funcstart\_724,1}$.b2)))))

→ *[const static or extern object]*

[57.17] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($heap_{init}$.b2)))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $heap_{724,1;742,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{724,1;742,8}$.r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($\$heap_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.4] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,

177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short**

int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType**<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * **asType**<**int**>(**asType**<**short int**>((**int**)170))) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * 170) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170

* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
$\$heap_{funcstart\_724,1}$. **replace***(p1 $\rightarrow$ ((-2 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace***(p2 $\rightarrow$ (-35 * div(***heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{init}$.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>(asType<short int>((int)63)))))**

→ *[simplify]*

[61.26] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ $\$heap_{724,1;744,8}$.p1

→ *[simplify]*

[1.1] -32768 ≤ $\$heap_{724,1;744,8}$.p1

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.2] -32768 ≤ $\$heap_{funcstart\_724,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p1

→ *[simplify]*

[1.7] -32769 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,

177).rem))

$\rightarrow$ *[from term 54.11, literala < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)) is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.7.0] (-32769 + -1) < -30269

$\rightarrow$ *[simplify]*

[1.7.2] **true**

[1.8] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,5)

Condition defined at:

To prove: \$heap$_{724,1;744,8}$.p1 $\leq$ **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)

invariant1(**heapIs** \$heap$_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

!(0 == **asType\<integer\>**(div1.rem)) || !(0 ==
asType\<integer\>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p2),
asType\<int\>($\$heap_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$._**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) <
asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) <
asType<integer>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

→ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p2),
asType\<int\>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType\<int\>($\$heap_{funcstart\_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType\<int\>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{r1})) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.3] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[53.4] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})171))) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.8] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} * 171)$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[from term 11.6, div1 is equal to div($\textbf{heapIs }$ \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p1, 177)]

[53.9] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[53.11] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[53.12] $\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$

int>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[56.0] **asType**<**integer**>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<**integer**>($\$\text{heap}_{724,1;740,8}$.M1)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace***(p1 → (-2 * div(**heapIs** *$heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** *$heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[56.1] **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).p1) <
asType<**integer**>($\$\text{heap}_{724,1;740,8}$.M1)

→ *[simplify]*

[56.3] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\$\text{heap}_{724,1;740,8}$.M1)

→ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace***(p1 → (-2 * div(**heapIs** *$heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** *$heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[56.4] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).M1)

→ *[const member of object with modified fields]*

[56.5] ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\$\text{heap}_{funcstart\_724,1}$.M1)

$\rightarrow$ *[const static or extern object]*

[56.6] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>($\$heap_{init}$.M1)

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[56.7] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType**<**integer**>(**asType**<**short int**>((**int**)30269))

$\rightarrow$ *[simplify]*

[56.17] -30269 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$._**replace**(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$heap_{724,1;740,8}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$heap_{724,1;740,8}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType**<**int**>($\$heap_{724,1;740,8}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *

asType\<int\>(asType\<short int\>((int)172))) −
(asType\<int\>(asType\<short int\>(div2.quot)) *
**asType\<int\>($heap$_{724,1;740,8}$.b2)))))

$\rightarrow$ *[simplify]*

[57.11] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType\<short int\>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * 172) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap$_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176)]

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) −
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot)) * **asType\<int\>**($heap$_{724,1;740,8}$.b2)))))

$\rightarrow$ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType\<int\>($heap$_{724,1;740,8}$.b2)))))

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType\<int\>($heap$_{funcstart_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2)))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_724,1}$.b2))))

→ [const static or extern object]

[57.17] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

→ [expand definition of constant 'b2' at prang.c (22,20)]

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ [simplify]

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$._**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\$heap_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

→ [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
$\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.1] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.4] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → **asType<short**

int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short**
int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((int)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.15] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$\text{heap}_{724,1;742,8}$ is equal to $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → (-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[61.16] $\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($heap_{funcstart\_724,1}$.b3))))

→ *[const static or extern object]*

[61.19] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($heap_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[61.26] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] $\$heap_{724,1;744,8}$.p1 $\leq$ **maxof(int)**

$\rightarrow$ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ (-63 **
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.1] $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem))).p1 $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.18] -32768 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot))

$\rightarrow$ *[from term 56.17, literala < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot)) is true whenever (-1 + literala) < -30269]

> **Proof of rule precondition:**
>
> *[1.18.0]* (-32768 + -1) < -30269
>
> $\rightarrow$ *[simplify]*
>
> *[1.18.2]* **true**

[1.19] **true**

Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,8)

Condition defined at:

To prove: minof(short int) $\leq$ ((**asType**<**int**>($\$heap_{724,1;744,8}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\$heap_{724,1;744,8}$.p1))

Given:

$\$heap_{init}.\text{LIMIT} == (\textbf{int})80$

$\$heap_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p1})$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p1}))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p1}))$ %
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div1.rem})) \;||\; !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot}))$

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p2})$,
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p2}))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.\text{p2}))$ %

asType$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a2))) ==
asType$<$**integer**$>$(div2.rem)

!(0 == **asType**$<$**integer**$>$(div2.rem)) || !(0 ==
asType$<$**integer**$>$(div2.quot))

div3 == div(**heapIs** $\$$heap$_{funcstart\_724,1}$,
asType$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.p3),
asType$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a3))

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.p3)) /
asType$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$**integer**$>$(div3.quot)

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.p3)) %
asType$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$**integer**$>$(div3.rem)

!(0 == **asType**$<$**integer**$>$(div3.rem)) || !(0 ==
asType$<$**integer**$>$(div3.quot))

$\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) *
asType$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;740,8}$.M1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1))

asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.M1)

$\$$heap$_{724,1;742,8}$ == $\$$heap$_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;740,8}$.r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;740,8}$.b2)))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;742,8}$.M2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.M2)

$\$$heap$_{724,1;744,8}$ == $\$$heap$_{724,1;742,8}$.**replace**(p3 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;742,8}$.r3)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div3.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;742,8}$.b3)))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;744,8}$.M3) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3)

!(0 == **asType**<**integer**>($heap$_{724,1;744,8}$.p3))

asType<**integer**>($heap$_{724,1;744,8}$.p3) < **asType**<**integer**>($heap$_{724,1;744,8}$.M3)

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p1),
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<**int**>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$,

asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

→ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{funcstart_724,1}$.a3))

→ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>(**asType<short int>**((**int**)178)))

→ *[simplify]*

[39.6] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178)

[Take given term]

[53.0] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.1] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_724,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.3] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.4] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem *

asType\<int\>(asType\<short int\>((int)171))) −
(**asType\<int\>(asType\<short int\>(div1.quot)) ***
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171)
− (**asType\<int\>(asType\<short int\>(div1.quot)) ***
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (**asType\<int\>(asType\<short int\>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot)) ***
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot ***
asType\<int\>($heap$_{funcstart_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot ***
asType\<int\>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType\<short
int\>**((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)
− (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot ***
asType\<int\>(asType\<short int\>((int)2)))))

→ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take given term]

[54.0] −**asType\<integer const\>**($heap$_{724,1;740,8}$.M1) <
asType\<integer\>($heap$_{724,1;740,8}$.p1)

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to
$heap$_{funcstart_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*

$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]

[54.1] −**asType**<**integer const**>($heap_{funcstart_724,1}._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))).M1) < **asType**<**integer**>($heap_{724,1;740,8}.p1)

→ [const member of object with modified fields]

[54.2] −**asType**<**integer const**>($heap_{funcstart\_724,1}.M1) < **asType**<**integer**>($heap_{724,1;740,8}.p1)

→ [const static or extern object]

[54.3] −**asType**<**integer const**>($heap_{init}.M1) < **asType**<**integer**>($heap_{724,1;740,8}.p1)

→ [expand definition of constant 'M1' at prang.c (14,20)]

[54.4] −**asType**<**integer const**>(**asType**<**short int**>((**int**)30269)) < **asType**<**integer**>($heap_{724,1;740,8}.p1)

→ [simplify]

[54.8] -30269 < **asType**<**integer**>($heap_{724,1;740,8}.p1)

→ [from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart_724,1}._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]

[54.9] -30269 < **asType**<**integer**>($heap_{funcstart_724,1}._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))).p1)

→ [simplify]

[54.11] -30269 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))

[Take given term]

[55.0] !(0 == **asType**<**integer**>($heap_{724,1;740,8}.p1))

→ [from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart_724,1}._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]

[55.1] !(0 == **asType**<**integer**>($heap_{funcstart_724,1}._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))).p1))

→ [simplify]

[55.3] !(0 == ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.5] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\$\text{heap}_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *

asType<int>($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div($\mathbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).$\mathbf{_replace}$(p2 $\rightarrow$ $\mathbf{asType{<}short\ int{>}}$((172 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) $-$ ($\mathbf{asType{<}int{>}}$($\mathbf{asType{<}short\ int{>}}$(div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)) * $\mathbf{asType{<}int{>}}$($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).$\mathbf{_replace}$(p2 $\rightarrow$ $\mathbf{asType{<}short\ int{>}}$((172 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) $-$ (div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * $\mathbf{asType{<}int{>}}$($heap$_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to $heap_{funcstart\_724,1}$.$\mathbf{\_replace}$(p1 $\rightarrow$ (-2 * div($\mathbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).$\mathbf{_replace}$(p2 $\rightarrow$ $\mathbf{asType{<}short\ int{>}}$((172 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) $-$ (div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * $\mathbf{asType{<}int{>}}$($heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).$\mathbf{_replace}$(p2 $\rightarrow$ $\mathbf{asType{<}short\ int{>}}$((172 * div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) $-$ (div($\mathbf{heapIs}$ $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot * $\mathbf{asType{<}int{>}}$($heap$_{funcstart_724,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[57.17] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.$\mathbf{_replace}$(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot *
asType\<int\>(**asType\<short int\>**((int)35)))))

→ *[simplify]*

[57.24] $\text{\$heap}_{724,1;742,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{724,1;742,8}$.**_replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to*
*$\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs***
*$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]

[61.1] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{\$heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p3, 178)]$

[61.2] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem)) * **asType<int>**($heap_{724,1;742,8}.r3$)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}.b3$)))))

→ [simplify]

[61.4] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($heap_{724,1;742,8}.r3$)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}.b3$)))))

→ [from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))]

[61.5] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem * **asType<int>**($heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}.b3$)))))

→ [const member of object with modified fields]

[61.7] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *

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div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_724,1}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>($heap_{init}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem *
asType<int>(**asType<short int>**((**int**)170))) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem * 170)
− (**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $heap_{724,1;744,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{724,1;742,8}$.b3))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\text{\_replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[61.26] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\textbf{\_replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\textbf{minof}(\textbf{short int}) \leq ((\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{M1}) * \textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{p1}))$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq ((\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{M1}) * \textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;744,8}.\text{p1}))$

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._replace(p1 → ((-2 * div(heapIs $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._replace(p2 → ((-35 * div(heapIs*
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(heapIs*
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._replace(p3 → (-63 ***
*div(heapIs $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 ***
div(heapIs $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]

[1.2] -32768 ≤ ((**asType<int>**($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1))

→ *[const member of object with modified fields]*

[1.5] -32768 ≤ ((**asType<int>**($\$heap_{funcstart\_724,1}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1))

→ *[const static or extern object]*

[1.6] -32768 ≤ ((**asType<int>**($\$heap_{init}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1))

→ *[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>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1))

→ *[simplify]*

[1.10] -32768 ≤ ((30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1))

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 ***
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 ***

*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.11] -32768 ≤ ((30269 *
asType<int>(static_cast<integer>(asType<int>($heap_{funcstart\_724,1}$._**replace**(p1
→ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).p1) < (**int**)0))) +
asType<int>($heap_{724,1;744,8}$.p1))

→ *[simplify]*

[1.23] -32768 ≤ ((30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, []: 0))) +
asType<int>($heap_{724,1;744,8}$.p1))

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.24] -32768 ≤ ((30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)))]: 0))) +
asType<int>($heap_{724,1;744,8}$.p1))

→ *[simplify]*

[1.29] -32768 ≤ ((30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [-1 < ((171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 0))) +
asType<int>($heap_{724,1;744,8}$.p1))

→ *[from term 55.3, -1 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)) is true if and only if 0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.30] -32768 ≤ ((30269 * **asType<int>**(([0 < ((-171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0))) +
asType<int>($heap_{724,1;744,8}$.p1))

→ *[simplify]*

[1.31] -32768 ≤ ((30269 * ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)) +
asType<**int**>($heap_{724,1;744,8}$.p1))

→ *[move guard outside expression]*

[1.32] -32768 ≤ (([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot))]: 1 * 30269, [0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0 * 30269) +
asType<**int**>($heap_{724,1;744,8}$.p1))

→ *[simplify]*

[1.34] -32768 ≤ (([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0) +
asType<**int**>($heap_{724,1;744,8}$.p1))

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to
$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[1.35] -32768 ≤ (([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: 0) +
asType<**int**>($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem))).p1))

→ *[simplify]*

[1.40] -32768 ≤ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0))

→ *[move guard outside expression]*

[1.41] -32768 ≤ ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem), [0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))

→ *[simplify]*

[1.44] -32769 < ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem), [0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))

→ *[move guard outside expression]*

[1.45] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: -32769 < (30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)), [0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]: -32769 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

→ *[simplify]*

[1.47] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))]: -63038 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,

$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)), [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: -32769 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

$\rightarrow$ *[from term 54.11, literala < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)) is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.47.0] (-63038 + -1) < -30269

$\rightarrow$ *[simplify]*

[1.47.2] **true**

[1.48] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: -32769 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

$\rightarrow$ *[from term 54.11, literala < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)) is true whenever (-1 + literala) < -30269]*

Proof of rule precondition:

[1.48.0] (-32769 + -1) < -30269

$\rightarrow$ *[simplify]*

[1.48.2] **true**

[1.49] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: **true**)

$\rightarrow$ *[all guards have equal guarded terms]*

[1.50] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,8)

Condition defined at:

To prove: $((\mathbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{M1})\ *$
$\mathbf{asType<int>}(\mathbf{static\_cast<integer>}(\mathbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{p1}) <$
$(\mathbf{int})0))) + \mathbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{p1})) \leq \mathbf{maxof(short\ int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \mathbf{asType<short\ int>}((\mathbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \mathbf{asType<short\ int>}((\mathbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \mathbf{asType<short\ int>}((\mathbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \mathbf{asType<short\ int>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \mathbf{asType<short\ int>}((\mathbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \mathbf{asType<short\ int>}((\mathbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \mathbf{asType<short\ int>}((\mathbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \mathbf{asType<short\ int>}((\mathbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \mathbf{asType<short\ int>}((\mathbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \mathbf{asType<short\ int>}((\mathbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \mathbf{asType<short\ int>}((\mathbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \mathbf{asType<short\ int>}((\mathbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \mathbf{asType<short\ int>}((\mathbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \mathbf{asType<short\ int>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \mathbf{asType<short\ int>}((\mathbf{int})3)$

$\text{invariant1}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\mathbf{asType<integer>}(\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ /$
$\mathbf{asType<integer>}(\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\mathbf{asType<integer>}(\text{div1.quot})$

$(\mathbf{asType<integer>}(\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \%$
$\mathbf{asType<integer>}(\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\mathbf{asType<integer>}(\text{div1.rem})$

$!(0 == \mathbf{asType<integer>}(\text{div1.rem}))\ ||\ !(0 ==$
$\mathbf{asType<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\mathbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ %
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div2.rem})) \;||\; !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs} \; \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ /
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div3.rem})) \;||\; !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem}))$ *
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div1.quot}))$ * $\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem}))$ *
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div2.quot}))$ * $\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.rem}))$ *

$\textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}\textbf{<integer const>}(\$\text{heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType}\textbf{<integer>}(\$\text{heap}_{724,1;744,8}.\text{M3})$

Proof:

[Take given term]

[11.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})177)))$

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{a2}))$

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$,
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})176)))$

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) $-$
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[simplify]*

[53.3] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem *
asType\<int\>($\$heap_{init}$.r1)) $-$ (**asType\<int\>**(**asType\<short

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.8] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)]*

[53.9] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot)) * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>($heap$_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))

[Take given term]

[55.0] !(0 == **asType**<**integer**>($\text{heap}_{724,1;740,8}$.p1))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._replace(p1 $\rightarrow$ (-2 * div(heapIs $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[55.1] !(0 == **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$._**replace**_(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).p1))

$\rightarrow$ *[simplify]*

[55.3] !(0 == ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)))

[Take given term]

[56.0] **asType**<**integer**>($\text{heap}_{724,1;740,8}$.p1) <
asType<**integer**>($\text{heap}_{724,1;740,8}$.M1)

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._replace(p1 $\rightarrow$ (-2 * div(heapIs $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[56.1] **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$._**replace**_(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).p1) <
asType<**integer**>($\text{heap}_{724,1;740,8}$.M1)

$\rightarrow$ *[simplify]*

[56.3] ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\text{heap}_{724,1;740,8}$.M1)

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$._replace(p1 $\rightarrow$ (-2 * div(heapIs $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[56.4] ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$._**replace**_(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).M1)

$\rightarrow$ *[const member of object with modified fields]*

[56.5] ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem)) < **asType**<**integer**>($\text{heap}_{funcstart\_724,1}$.M1)

$\rightarrow$ *[const static or extern object]*

[56.6] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType<integer>**($\$heap_{init}$.M1)

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[56.7] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) < **asType<integer>**(**asType<short int>**((**int**)30269))

$\rightarrow$ *[simplify]*

[56.17] -30269 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))

[Take given term]

[57.0] $\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**_replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$._replace(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[57.1] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[from term 25.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176)]*

[57.2] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

$\rightarrow$ *[simplify]*

[57.4] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]

[57.5] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_724,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *
asType<int>($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem *

asType\<int\>(asType\<short int\>((int)172))) −
(**asType\<int\>(asType\<short int\>(div2.quot)) ***
**asType\<int\>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.11] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem * 172) −
(**asType\<int\>(asType\<short int\>**(div2.quot)) *
asType\<int\>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176)]*

[57.12] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) −
(**asType\<int\>(asType\<short int\>**(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot)) * **asType\<int\>**($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.14] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType\<int\>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to
$heap$_{funcstart_724,1}$.**_replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem))]*

[57.15] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot *
asType\<int\>($heap$_{funcstart_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[57.16] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>($\text{heap}_{funcstart\_724,1}$.b2))))

→ *[const static or extern object]*

[57.17] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(heap_{init}.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[61.0] $\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$._**replace**(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\text{heap}_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\text{heap}_{724,1;742,8}$.b3))))

→ *[from term 57.24, $heap_{724,1;742,8}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.1] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3)))))

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178)]*

[61.2] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3)))))

$\rightarrow$ *[simplify]*

[61.4] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType<short int>**((div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem * **asType<int>**($\text{\$heap}_{724,1;742,8}$.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{\$heap}_{724,1;742,8}$.b3)))))

$\rightarrow$ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[61.5] $\text{\$heap}_{724,1;744,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ **asType<short**

int>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const member of object with modified fields]*

[61.7] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_724,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[const static or extern object]*

[61.8] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.12] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178)]*

[61.13] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[simplify]*

[61.15] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\$heap_{724,1;742,8}$.b3)))))

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot * **asType<int>**($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs**

$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\text{heap}_{724,1;744,8} == \text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\text{heap}_{724,1;744,8} == \text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(heap_{init}.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\text{heap}_{724,1;744,8} == \text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ **asType**<**short int**>((170
* div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

$\rightarrow$ *[simplify]*

[61.26] $\text{heap}_{724,1;744,8} == \text{heap}_{funcstart\_724,1}$. **replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)))

[Take goal term]

[1.0] ((**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1)) ≤ **maxof**(**short int**)

→ *[from term 61.26, $\text{\$heap}_{724,1;744,8}$ is equal to*
$\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).__**replace**(p3 → (-63 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))]*

[1.1] ((**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).__**replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2,
176).rem))).__**replace**(p3 → ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))).M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1)) ≤ **maxof**(**short int**)

→ *[const member of object with modified fields]*

[1.4] ((**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1)) ≤ **maxof**(**short int**)

→ *[const static or extern object]*

[1.5] ((**asType**<**int**>($\text{\$heap}_{init}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.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**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1)) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.9] ((30269 *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<**int**>($\text{\$heap}_{724,1;744,8}$.p1)) ≤ **maxof**(**short int**)

→ *[from term 61.26, $\text{\$heap}_{724,1;744,8}$ is equal to*

$heap_{funcstart\_724,1}.$**replace**$(p1 \rightarrow$ $((-2$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).quot) + (171$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).rem))).$**replace**$(p2 \rightarrow ((-35$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))).$**replace**$(p3 \rightarrow (-63$ *
$div($**heapIs** $heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170$ *
$div($**heapIs** $heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))]$

[1.10] $((30269$ *
asType<int>(static_cast<integer>(asType<int>$(heap_{funcstart\_724,1}.$**replace**$(p1$
$\rightarrow ((-2$ * $div($**heapIs** $heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) +$
$(171$ * $div($**heapIs** $heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,$
$177).rem))).$**replace**$(p2 \rightarrow ((-35$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p2, 176).quot) + (172$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p2, 176).rem))).$**replace**$(p3 \rightarrow ((-63$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))).p1) <$ **(int)**$0)))) +$
asType<int>$(heap_{724,1;744,8}.p1)) \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.22] $((30269$ * **asType<int>**$(([0 < ((-171$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).rem) + (2$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).quot))]: 1, []: 0))) +$
asType<int>$(heap_{724,1;744,8}.p1)) \leq$ **maxof(short int)**

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.23] $((30269$ * **asType<int>**$(([0 < ((-171$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).rem) + (2$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).quot))]: 1, [!(0 < ((-171$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem) + (2$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot)))]: 0))) +$
asType<int>$(heap_{724,1;744,8}.p1)) \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.28] $((30269$ * **asType<int>**$(([0 < ((-171$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).rem) + (2$ * $div($**heapIs** $heap_{funcstart\_724,1},$
$heap_{funcstart\_724,1}.p1, 177).quot))]: 1, [-1 < ((171$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem) + (-2$ * $div($**heapIs**
$heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot)]: 0))) +$
asType<int>$(heap_{724,1;744,8}.p1)) \leq$ **maxof(short int)**

$\rightarrow$ *[from term 55.3, -1 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1},$*
*$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1},$*
*$heap_{funcstart_724,1}.p1, 177).rem)) is true if and only if 0 < ((-2 * div(**heapIs***
*$heap_{funcstart_724,1}, heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs***
$heap_{funcstart_724,1}, heap_{funcstart_724,1}.p1, 177).rem))]

[1.29] $((30269$ * **asType<int>**$(([0 < ((-171$ * $div($**heapIs** $heap_{funcstart\_724,1},$

$heap_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))]: 0))) + **asType**<**int**>($heap_{724,1;744,8}.p1)) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.30] ((30269 * ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$ $heap_{funcstart_724,1}.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))]: 0)) + **asType**<**int**>($heap_{724,1;744,8}.p1)) ≤ **maxof**(**short int**)

→ *[move guard outside expression]*

[1.31] ((([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot))]: 1 * 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))]: 0 * 30269) + **asType**<**int**>($heap_{724,1;744,8}.p1)) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.33] ((([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))]: 0) + **asType**<**int**>($heap_{724,1;744,8}.p1)) ≤ **maxof**(**short int**)

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to $heap_{funcstart\_724,1}$.*_**replace***(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))).*_**replace***(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))).*_**replace***(p3 → (-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem)))]*

[1.34] ((([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot))]: 30269, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))]: 0) + **asType**<**int**>($heap_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))))._**replace**(p2 → ((-35

* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p1)) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.39] ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)]: 30269, [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0)) ≤ **maxof**(**short int**)

→ *[move guard outside expression]*

[1.40] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem), [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: 0 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.43] (-1 + ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem), [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))) < 32767

→ *[move guard outside expression]*

[1.44] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))]: -1 + (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)), [0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]: -1 + ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))) < 32767

$\rightarrow$ *[simplify]*

[1.48] 0 < (32767 + −([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot))]: 30268 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem), [0 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))]: -1 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem)))

$\rightarrow$ *[move guard outside expression]*

[1.49] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot))]: −(30268 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem)), [0 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))]: −(-1 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))))

$\rightarrow$ *[simplify]*

[1.61] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot))]: -30268 + (-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot), [0 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))]: 1 + (-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot)))

$\rightarrow$ *[move guard outside expression]*

[1.62] 0 < ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot))]: 32767 + (-30268 + (-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot)), [0 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem))]: 32767 + (1 + (-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.p1$, 177).quot)))

$\rightarrow$ *[simplify]*

[1.66] $0 < ([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}))]: 2499 + (-171 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}), [0 < ((-2 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}))]: 32768 + (-171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}))$

$\rightarrow$ *[move guard outside expression]*

[1.67] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}))]: 0 < (2499 + (-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot})), [0 < ((-2 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}))]: 0 < (32768 + (-171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot})))$

$\rightarrow$ *[simplify]*

[1.69] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}))]: -2499 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot})), [0 < ((-2 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}))]: 0 < (32768 + (-171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}) + (2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot})))$

$\rightarrow$ *[from guard, literala < ((-171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p1, 177).quot)) is true whenever (-1 + literala) < 0]

    Proof of rule precondition:

    [1.69.0] $(-2499 + -1) < 0$

    $\rightarrow$ *[simplify]*

    [1.69.2] **true**

[1.70] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}))]: \textbf{true}, [0 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1, 177}).\text{rem}))]: 0 < (32768 + (-171 * \text{div}(\textbf{heapIs }$

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)))

→ *[simplify]*

[1.72] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: -32768 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)))

→ *[from term 56.17, literala < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot)) is true whenever (-1 + literala) < -30269]*

> **Proof of rule precondition:**
>
> *[1.72.0]* (-32768 + -1) < -30269
>
> → *[simplify]*
>
> *[1.72.2]* **true**

[1.73] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]: **true**, [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]: **true**)

→ *[all guards have equal guarded terms]*

[1.74] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,27)

Condition defined at:

To prove: minof(int) ≤ $heap_{724,1;747,8}$.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)

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$)) /

asType$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$**integer**$>$(div3.quot)

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.p3)) %
asType$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.a3))) ==
asType$<$**integer**$>$(div3.rem)

!(0 == **asType**$<$**integer**$>$(div3.rem)) || !(0 ==
asType$<$**integer**$>$(div3.quot))

$\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**_replace**(p1 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) *
asType$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;740,8}$.M1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1))

asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.M1)

$\$$heap$_{724,1;742,8}$ == $\$$heap$_{724,1;740,8}$.**_replace**(p2 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;740,8}$.r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;740,8}$.b2))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;742,8}$.M2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.M2)

$\$$heap$_{724,1;744,8}$ == $\$$heap$_{724,1;742,8}$.**_replace**(p3 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;742,8}$.r3)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short
int**$>$(div3.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;742,8}$.b3))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;744,8}$.M3) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3))

asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.M3)

$\$$heap$_{724,1;747,8}$ == $\$$heap$_{724,1;744,8}$.**_replace**(p1 $\rightarrow$ **asType**$<$**short
int**$>$((**asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.M1) *
asType$<$**int**$>$(**static_cast**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.p1) $<$
(**int**)0))) + **asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] $\mathbf{minof(int)} \leq \$heap_{724,1;747,8}.M2$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq \$heap_{724,1;747,8}.M2$

$\rightarrow$ *[const static or extern object]*

[1.2] $-32768 \leq \$heap_{init}.M2$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] $-32768 \leq \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\rightarrow$ *[simplify]*

[1.6] $\mathbf{true}$

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,27)

Condition defined at:

To prove: $\$heap_{724,1;747,8}.M2 \leq \mathbf{maxof(int)}$

Given:

$\$heap_{init}.LIMIT == (\mathbf{int})80$

$\$heap_{init}.M1 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$heap_{init}.r1 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$heap_{init}.a1 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$heap_{init}.b1 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$heap_{init}.M2 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$heap_{init}.r2 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\$heap_{init}.a2 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\$heap_{init}.b2 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\$heap_{init}.M3 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\$heap_{init}.r3 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\$heap_{init}.a3 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

$\$heap_{init}.b3 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})63)$

$\$heap_{init}.p1 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$heap_{init}.p3 == \mathbf{asType{<}short\ int{>}}((\mathbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p1),
asType\<int\>($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType\<integer\>(div1.rem)

!(0 == **asType\<integer\>**(div1.rem)) || !(0 ==
asType\<integer\>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p2),
asType\<int\>($\$heap_{funcstart\_724,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

$!(0 == \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.rem})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textless\textbf{integer const}\textgreater(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div3.rem})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater(\text{div3.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}\textless\textbf{integer const}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M3})$

$\$\text{heap}_{724,1;747,8} == \$\text{heap}_{724,1;744,8}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M1}) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\textbf{static\_cast}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p1}) <$
$(\textbf{int})0))) + \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p1})))$

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{724,1;747,8}.\text{M2} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const static or extern object]*

[1.1] $\$\text{heap}_{init}.\text{M2} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.2] $\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})30307) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,17)

Condition defined at:

To prove: minof(int) $\leq$ $\text{\$heap}_{724,1;747,8}.\text{p2}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \,/$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \,\%$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.rem})$

$!(0 =\!= \textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.rem})) \,||\, !(0 =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.quot}))$

$\text{div3} =\!= \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \,/$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \,\%$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.rem})$

$!(0 =\!= \textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.rem})) \,||\, !(0 =\!=$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} =\!= \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div1.rem})) \,*$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!(\text{div1.quot})) \,* \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{b1})))))$

$-\textbf{asType}\!<\!\textbf{integer const}\!>\!(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 =\!= \textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} =\!= \$\text{heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div2.rem})) \,*$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!(\text{div2.quot})) \,* \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;740,8}.\text{b2})))))$

$-\textbf{asType}\!<\!\textbf{integer const}\!>\!(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 =\!= \textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} =\!= \$\text{heap}_{724,1;742,8}.\textbf{replace}(\text{p3} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div3.rem})) \,*$

asType<int>($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) < **asType<integer>**($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) < **asType<integer>**($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$.**_replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) < **(int)**0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ $heap$_{724,1;747,8}$.p2

→ *[simplify]*

[1.3] -32769 < $heap$_{724,1;747,8}$.p2

→ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $heap$_{724,1;747,8}$.p2)

→ *[simplify]*

[1.6] 32768 < −$heap$_{724,1;747,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[66.0] **minof(short int)** ≤ $heap$_{724,1;747,8}$.p2

→ *[simplify]*

[66.3] -32769 < $heap$_{724,1;747,8}$.p2

→ *[from term 1.6, literala < $heap$_{724,1;747,8}$.p2 is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[66.3.0]* -2 < (-32769 + 32768)
>
> → *[simplify]*
>
> *[66.3.2]* **true**

[66.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,17)

Condition defined at:

To prove: $\text{\$heap}_{724,1;747,8}.\text{p2} \leq \textbf{maxof}(\textbf{int})$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1})) /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p1})) \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div1.rem})) \ || \ !(0 ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_724,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{p2})) /$

asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1)))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2)))))

−**asType**<**integer const**>($heap$_{724,1;742,8}$.M2) <
asType<**integer**>($heap$_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

asType<**integer**>($heap$_{724,1;742,8}$.p2) <
asType<**integer**>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($heap$_{724,1;742,8}$.r3)) − (**asType**<**int**>(**asType**<**short

int>(div3.quot)) * **asType**<**int**>($heap$_{724,1;742,8}$.b3))))

−**asType**<**integer const**>($heap$_{724,1;744,8}$.M3) < **asType**<**integer**>($heap$_{724,1;744,8}$.p3)

!(0 == **asType**<**integer**>($heap$_{724,1;744,8}$.p3))

asType<**integer**>($heap$_{724,1;744,8}$.p3) < **asType**<**integer**>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$.**_replace**(p1 → **asType**<**short int**>((**asType**<**int**>($heap$_{724,1;744,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{724,1;744,8}$.p1) < (**int**)0))) + **asType**<**int**>($heap$_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] $heap$_{724,1;747,8}$.p2 ≤ **maxof**(**int**)

→ *[simplify]*

[1.9] -32768 < −$heap$_{724,1;747,8}$.p2

→ *[negate goal and search for contradiction]*

[1.10] !(-32768 < −$heap$_{724,1;747,8}$.p2)

→ *[simplify]*

[1.13] 32767 < $heap$_{724,1;747,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[66.0] $heap$_{724,1;747,8}$.p2 ≤ **maxof**(**short int**)

→ *[simplify]*

[66.9] -32768 < −$heap$_{724,1;747,8}$.p2

→ *[from term 1.13, literala < −$heap$_{724,1;747,8}$.p2 is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [66.9.0] -2 < (-32768 + 32767)

    → *[simplify]*

    [66.9.2] **true**

[66.10] **false**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,11)

Condition defined at:

**To prove: minof(int) $\leq$
static_cast$<$integer$>$(asType$<$int$>$($heap$_{724,1;747,8}$.p2) $<$ (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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType$<$int$>$($heap$_{funcstart_724,1}$.p1),
asType$<$int$>$($heap$_{funcstart_724,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**$heap$_{funcstart_724,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($heap$_{funcstart_724,1}$.a1))) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**$heap$_{funcstart_724,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($heap$_{funcstart_724,1}$.a1))) ==
asType$<$integer$>$(div1.rem)

!(0 == **asType$<$integer$>$**(div1.rem)) || !(0 ==
asType$<$integer$>$(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType$<$int$>$($heap$_{funcstart_724,1}$.p2),
asType$<$int$>$($heap$_{funcstart_724,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**$heap$_{funcstart_724,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($heap$_{funcstart_724,1}$.a2))) ==

750

asType<integer>(div2.quot)

(asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.p2)) %
asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType<int>($\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\text{heap}_{funcstart\_724,1}$.a3))

(asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(asType<int>($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>(asType<short int>**(div1.rem)) *
asType<int>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**($\text{heap}_{funcstart\_724,1}$.b1)))))

−**asType<integer const>**($\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\text{heap}_{724,1;740,8}$.M1)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>(asType<short int>**(div2.rem)) *
asType<int>($\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>(asType<short
int>**(div2.quot)) * **asType<int>**($\text{heap}_{724,1;740,8}$.b2)))))

−**asType<integer const>**($\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\text{heap}_{724,1;742,8}$.p2) <
asType<integer>($\text{heap}_{724,1;742,8}$.M2)

$\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>(asType<short int>**(div3.rem)) *
asType<int>($\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>(asType<short
int>**(div3.quot)) * **asType<int>**($\text{heap}_{724,1;742,8}$.b3)))))

$-$**asType$<$integer const$>$**($\$heap_{724,1;744,8}$.M3) $<$
asType$<$integer$>$($\$heap_{724,1;744,8}$.p3)

!(0 == **asType$<$integer$>$**($\$heap_{724,1;744,8}$.p3))

asType$<$integer$>$($\$heap_{724,1;744,8}$.p3) $<$
asType$<$integer$>$($\$heap_{724,1;744,8}$.M3)

$\$heap_{724,1;747,8}$ == $\$heap_{724,1;744,8}$._**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**($\$heap_{724,1;744,8}$.M1) *
asType$<$int$>$(**static_cast$<$integer$>$**(**asType$<$int$>$**($\$heap_{724,1;744,8}$.p1) $<$
(**int**)0))) + **asType$<$int$>$**($\$heap_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ **static_cast$<$integer$>$**(**asType$<$int$>$**($\$heap_{724,1;747,8}$.p2)
$<$ (**int**)0)

$\rightarrow$ *[simplify]*

[1.6] -32768 $\leq$ ([0 $<$ $-\$heap_{724,1;747,8}$.p2]: 1, []: 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.7] -32768 $\leq$ ([0 $<$ $-\$heap_{724,1;747,8}$.p2]: 1, [!(0 $<$ $-\$heap_{724,1;747,8}$.p2)]: 0)

$\rightarrow$ *[simplify]*

[1.12] -32769 $<$ ([0 $<$ $-\$heap_{724,1;747,8}$.p2]: 1, [-1 $<$ $\$heap_{724,1;747,8}$.p2]: 0)

$\rightarrow$ *[move guard outside expression]*

[1.13] ([0 $<$ $-\$heap_{724,1;747,8}$.p2]: -32769 $<$ 1, [-1 $<$ $\$heap_{724,1;747,8}$.p2]: -32769
$<$ 0)

$\rightarrow$ *[simplify]*

[1.15] ([0 $<$ $-\$heap_{724,1;747,8}$.p2]: **true**, [-1 $<$ $\$heap_{724,1;747,8}$.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 (64,11)

Condition defined at:

To prove: static_cast$<$integer$>$(**asType$<$int$>$**($\$heap_{724,1;747,8}$.p2) $<$
(**int**)0) $\leq$ **maxof(int)**

Given:

$\$heap_{init}$.LIMIT == (**int**)80

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p1$),
asType<**int**>($\$heap_{funcstart\_724,1}.a1$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p2$),
asType<**int**>($\$heap_{funcstart\_724,1}.a2$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 == **asType\<integer\>**(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType\<int\>**($\$heap_{funcstart\_724,1}$.p3), **asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) / **asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) % **asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) == **asType\<integer\>**(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 == **asType\<integer\>**(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) < **asType\<integer\>**($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) < **asType\<integer\>**($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2)))))

−**asType\<integer const\>**($\$heap_{724,1;742,8}$.M2) < **asType\<integer\>**($\$heap_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$heap_{724,1;742,8}$.p2))

asType\<integer\>($\$heap_{724,1;742,8}$.p2) < **asType\<integer\>**($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3)))))

−**asType\<integer const\>**($\$heap_{724,1;744,8}$.M3) < **asType\<integer\>**($\$heap_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($\$heap_{724,1;744,8}$.p3))

asType\<integer\>($\$heap_{724,1;744,8}$.p3) <

asType<integer>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$._**replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] **static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) < (**int**)0) ≤ **maxof**(**int**)

→ *[simplify]*

[1.5] ([0 < −$heap$_{724,1;747,8}$.p2]: 1, []: 0) ≤ **maxof**(**int**)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.6] ([0 < −$heap$_{724,1;747,8}$.p2]: 1, [!(0 < −$heap$_{724,1;747,8}$.p2)]: 0) ≤ **maxof**(**int**)

→ *[simplify]*

[1.11] (-1 + ([0 < −$heap$_{724,1;747,8}$.p2]: 1, [-1 < $heap$_{724,1;747,8}$.p2]: 0)) < 32767

→ *[move guard outside expression]*

[1.12] ([0 < −$heap$_{724,1;747,8}$.p2]: -1 + 1, [-1 < $heap$_{724,1;747,8}$.p2]: -1 + 0) < 32767

→ *[simplify]*

[1.15] 0 < (32767 + −([0 < −$heap$_{724,1;747,8}$.p2]: 0, [-1 < $heap$_{724,1;747,8}$.p2]: -1))

→ *[move guard outside expression]*

[1.16] 0 < (32767 + ([0 < −$heap$_{724,1;747,8}$.p2]: −0, [-1 < $heap$_{724,1;747,8}$.p2]: −-1))

→ *[simplify]*

[1.18] 0 < (32767 + ([0 < −$heap$_{724,1;747,8}$.p2]: 0, [-1 < $heap$_{724,1;747,8}$.p2]: 1))

→ *[move guard outside expression]*

[1.19] 0 < ([0 < −$heap$_{724,1;747,8}$.p2]: 0 + 32767, [-1 < $heap$_{724,1;747,8}$.p2]: 1 + 32767)

→ *[simplify]*

[1.21] 0 < ([0 < −$heap$_{724,1;747,8}$.p2]: 32767, [-1 < $heap$_{724,1;747,8}$.p2]: 32768)

→ *[move guard outside expression]*

[1.22] ([0 < −$heap$_{724,1;747,8}$.p2]: 0 < 32767, [-1 < $heap$_{724,1;747,8}$.p2]: 0 <

32768)

$\rightarrow$ *[simplify]*

[1.24] ($[0 < -\$\text{heap}_{724,1;747,8}.\text{p2}]$: **true**, $[-1 < \$\text{heap}_{724,1;747,8}.\text{p2}]$: **true**)

$\rightarrow$ *[all guards have equal guarded terms]*

[1.25] **true**

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,25)

Condition defined at:

To prove: minof(int) $\leq$ (**asType**<**int**>($\$\text{heap}_{724,1;747,8}.\text{M2}$) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$\text{heap}_{724,1;747,8}.\text{p2}$) < (**int**)0)))

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)

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$), **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p2),
asType<**int**>($heap$_{funcstart_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<**int**>($heap$_{funcstart_724,1}$.p3),
asType<**int**>($heap$_{funcstart_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_724,1}$.b1))))

−**asType**<**integer const**>($heap$_{724,1;740,8}$.M1) <
asType<**integer**>($heap$_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($heap$_{724,1;740,8}$.p1))

asType<**integer**>($heap$_{724,1;740,8}$.p1) <
asType<**integer**>($heap$_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.rem})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div3.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{M3})$

$\$\text{heap}_{724,1;747,8} == \$\text{heap}_{724,1;744,8}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{M1}) *$
$\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{p1}) <$
$(\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{p1})))$

Proof:

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq (\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{M2}) *$
$\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{p2}) <$
$(\textbf{int})0)))$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq (\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{M2}) *$
$\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{p2}) <$
$(\textbf{int})0)))$

$\rightarrow$ *[const static or extern object]*

[1.2] $-32768 \leq (\textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{M2}) *$
$\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{p2}) <$
$(\textbf{int})0)))$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] $-32768 \leq (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30307)) *$
$\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;747,8}.\text{p2}) <$

(**int**)0)))

→ [simplify]

[1.11] -32768 ≤ (30307 * **asType**<**int**>((([0 < −$heap_{724,1;747,8}$.p2]: 1, []: 0)))

→ [explicitly assert falsehood of skipped guards in subsequent guards]

[1.12] -32768 ≤ (30307 * **asType**<**int**>((([0 < −$heap_{724,1;747,8}$.p2]: 1, [!(0 < −$heap_{724,1;747,8}$.p2)]: 0)))

→ [simplify]

[1.16] -32768 ≤ (30307 * ([0 < −$heap_{724,1;747,8}$.p2]: 1, [-1 < $heap_{724,1;747,8}$.p2]: 0))

→ [move guard outside expression]

[1.17] -32768 ≤ ([0 < −$heap_{724,1;747,8}$.p2]: 1 * 30307, [-1 < $heap_{724,1;747,8}$.p2]: 0 * 30307)

→ [simplify]

[1.21] -32769 < ([0 < −$heap_{724,1;747,8}$.p2]: 30307, [-1 < $heap_{724,1;747,8}$.p2]: 0)

→ [move guard outside expression]

[1.22] ([0 < −$heap_{724,1;747,8}$.p2]: -32769 < 30307, [-1 < $heap_{724,1;747,8}$.p2]: -32769 < 0)

→ [simplify]

[1.24] ([0 < −$heap_{724,1;747,8}$.p2]: **true**, [-1 < $heap_{724,1;747,8}$.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 (64,25)

Condition defined at:

To prove: (**asType**<**int**>($heap_{724,1;747,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;747,8}$.p2) < (**int**)0))) ≤ **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)

$\$heap_{init}.M2 == \textbf{asType<short int>}((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType<short int>}((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType<short int>}((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType<short int>}((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType<short int>}((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType<short int>}((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType<short int>}((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType<short int>}((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p1$),
asType<int>($\$heap_{funcstart\_724,1}.a1$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a1$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p2$),
asType<int>($\$heap_{funcstart\_724,1}.a2$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}.p2$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}.a2$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}.p3$),
asType<int>($\$heap_{funcstart\_724,1}.a3$))

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p3))$ / $\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a3))) ==$ $\textbf{asType}<\textbf{integer}>(div3.quot)$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.p3))$ % $\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.a3))) ==$ $\textbf{asType}<\textbf{integer}>(div3.rem)$

$!(0 == \textbf{asType}<\textbf{integer}>(div3.rem)) \;||\; !(0 == \textbf{asType}<\textbf{integer}>(div3.quot))$

$\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$ $\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.rem)) *$ $\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$ $\textbf{int}>(div1.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_724,1}.b1))))$

$-\textbf{asType}<\textbf{integer const}>(\$heap_{724,1;740,8}.M1) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;740,8}.p1)$

$!(0 == \textbf{asType}<\textbf{integer}>(\$heap_{724,1;740,8}.p1))$

$\textbf{asType}<\textbf{integer}>(\$heap_{724,1;740,8}.p1) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;740,8}.M1)$

$\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\_\textbf{replace}(p2 \rightarrow \textbf{asType}<\textbf{short}$ $\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div2.rem)) *$ $\textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$ $\textbf{int}>(div2.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;740,8}.b2))))$

$-\textbf{asType}<\textbf{integer const}>(\$heap_{724,1;742,8}.M2) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.p2)$

$!(0 == \textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.p2))$

$\textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.p2) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.M2)$

$\$heap_{724,1;744,8} == \$heap_{724,1;742,8}.\_\textbf{replace}(p3 \rightarrow \textbf{asType}<\textbf{short}$ $\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div3.rem)) *$ $\textbf{asType}<\textbf{int}>(\$heap_{724,1;742,8}.r3)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$ $\textbf{int}>(div3.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{724,1;742,8}.b3))))$

$-\textbf{asType}<\textbf{integer const}>(\$heap_{724,1;744,8}.M3) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;744,8}.p3)$

$!(0 == \textbf{asType}<\textbf{integer}>(\$heap_{724,1;744,8}.p3))$

$\textbf{asType}<\textbf{integer}>(\$heap_{724,1;744,8}.p3) <$ $\textbf{asType}<\textbf{integer}>(\$heap_{724,1;744,8}.M3)$

$\$heap_{724,1;747,8} == \$heap_{724,1;744,8}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$ $\textbf{int}>((\textbf{asType}<\textbf{int}>(\$heap_{724,1;744,8}.M1) *$ $\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$heap_{724,1;744,8}.p1) <$ $(\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$heap_{724,1;744,8}.p1)))$

Proof:

[Take goal term]

[1.0] (**asType<int>**($\text{heap}_{724,1;747,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;747,8}$.p2) <
(**int**)0))) ≤ **maxof(int)**

→ *[const static or extern object]*

[1.1] (**asType<int>**(heap_{init}.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($\text{heap}_{724,1;747,8}$.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>**($\text{heap}_{724,1;747,8}$.p2) <
(**int**)0))) ≤ **maxof(int)**

→ *[simplify]*

[1.10] (30307 * **asType<int>**(([0 < $-\text{heap}_{724,1;747,8}$.p2]: 1, []: 0))) ≤
maxof(int)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] (30307 * **asType<int>**(([0 < $-\text{heap}_{724,1;747,8}$.p2]: 1, [!(0 <
$-\text{heap}_{724,1;747,8}$.p2)]: 0))) ≤ **maxof(int)**

→ *[simplify]*

[1.15] (30307 * ([0 < $-\text{heap}_{724,1;747,8}$.p2]: 1, [-1 < $\text{heap}_{724,1;747,8}$.p2]: 0)) ≤
maxof(int)

→ *[move guard outside expression]*

[1.16] ([0 < $-\text{heap}_{724,1;747,8}$.p2]: 1 * 30307, [-1 < $\text{heap}_{724,1;747,8}$.p2]: 0 *
30307) ≤ **maxof(int)**

→ *[simplify]*

[1.20] (-1 + ([0 < $-\text{heap}_{724,1;747,8}$.p2]: 30307, [-1 < $\text{heap}_{724,1;747,8}$.p2]: 0)) <
32767

→ *[move guard outside expression]*

[1.21] ([0 < $-\text{heap}_{724,1;747,8}$.p2]: -1 + 30307, [-1 < $\text{heap}_{724,1;747,8}$.p2]: -1 +
0) < 32767

→ *[simplify]*

[1.24] 0 < (32767 + $-$([0 < $-\text{heap}_{724,1;747,8}$.p2]: 30306, [-1 <
$\text{heap}_{724,1;747,8}$.p2]: -1))

→ *[move guard outside expression]*

[1.25] 0 < (32767 + ([0 < $-\text{heap}_{724,1;747,8}$.p2]: $-$30306, [-1 <

$\$heap_{724,1;747,8}.p2$: −-1))

→ [simplify]

[1.27] $0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]$: -30306, [-1 < $\$heap_{724,1;747,8}.p2]$: 1))

→ [move guard outside expression]

[1.28] $0 < ([0 < -\$heap_{724,1;747,8}.p2]$: -30306 + 32767, [-1 < $\$heap_{724,1;747,8}.p2]$: 1 + 32767)

→ [simplify]

[1.30] $0 < ([0 < -\$heap_{724,1;747,8}.p2]$: 2461, [-1 < $\$heap_{724,1;747,8}.p2]$: 32768)

→ [move guard outside expression]

[1.31] $([0 < -\$heap_{724,1;747,8}.p2]$: 0 < 2461, [-1 < $\$heap_{724,1;747,8}.p2]$: 0 < 32768)

→ [simplify]

[1.33] $([0 < -\$heap_{724,1;747,8}.p2]$: **true**, [-1 < $\$heap_{724,1;747,8}.p2]$: **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 (64,5)

Condition defined at:

To prove: minof(int) $\leq \$heap_{724,1;747,8}.p2$

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 == $ **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>**$((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p1)$,
asType<int>$(\$heap_{funcstart\_724,1}.a1))$

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p1))$ /
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a1)))$ ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p1))$ %
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a1)))$ ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p2)$,
asType<int>$(\$heap_{funcstart\_724,1}.a2))$

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p2))$ /
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a2)))$ ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p2))$ %
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a2)))$ ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p3)$,
asType<int>$(\$heap_{funcstart\_724,1}.a3))$

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p3))$ /
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a3)))$ ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p3))$ %
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a3)))$ ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==

asType<integer>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}.\_$**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_724,1}.$r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}.$b1))))

−**asType<integer const>**($\$heap_{724,1;740,8}.$M1) < **asType<integer>**($\$heap_{724,1;740,8}.$p1)

!(0 == **asType<integer>**($\$heap_{724,1;740,8}.$p1))

asType<integer>($\$heap_{724,1;740,8}.$p1) < **asType<integer>**($\$heap_{724,1;740,8}.$M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}.\_$**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}.$b2))))

−**asType<integer const>**($\$heap_{724,1;742,8}.$M2) < **asType<integer>**($\$heap_{724,1;742,8}.$p2)

!(0 == **asType<integer>**($\$heap_{724,1;742,8}.$p2))

asType<integer>($\$heap_{724,1;742,8}.$p2) < **asType<integer>**($\$heap_{724,1;742,8}.$M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}.\_$**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{724,1;742,8}.$r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}.$b3))))

−**asType<integer const>**($\$heap_{724,1;744,8}.$M3) < **asType<integer>**($\$heap_{724,1;744,8}.$p3)

!(0 == **asType<integer>**($\$heap_{724,1;744,8}.$p3))

asType<integer>($\$heap_{724,1;744,8}.$p3) < **asType<integer>**($\$heap_{724,1;744,8}.$M3)

$\$heap_{724,1;747,8}$ == $\$heap_{724,1;744,8}.\_$**replace**(p1 → **asType<short int>**((**asType<int>**($\$heap_{724,1;744,8}.$M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}.$p1) < (**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}.$p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ $\$heap_{724,1;747,8}.$p2

→ *[simplify]*

[1.3] -32769 < $\$heap_{724,1;747,8}.$p2

→ *[negate goal and search for contradiction]*

[1.4] !(-32769 < \$heap$_{724,1;747,8}$.p2)

→ *[simplify]*

[1.6] 32768 < −\$heap$_{724,1;747,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[66.0] **minof(short int)** ≤ \$heap$_{724,1;747,8}$.p2

→ *[simplify]*

[66.3] -32769 < \$heap$_{724,1;747,8}$.p2

→ *[from term 1.6, literala < \$heap$_{724,1;747,8}$.p2 is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[66.3.0]* -2 < (-32769 + 32768)
>
> → *[simplify]*
>
> *[66.3.2]* **true**

[66.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,5)

Condition defined at:

To prove: \$heap$_{724,1;747,8}$.p2 ≤ **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**$>((\mathbf{int})63)$

$\$heap_{init}.p1 == $ **asType**$<$**short int**$>((\mathbf{int})1)$

$\$heap_{init}.p2 == $ **asType**$<$**short int**$>((\mathbf{int})2)$

$\$heap_{init}.p3 == $ **asType**$<$**short int**$>((\mathbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 $==$ div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p1})$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a1}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p1}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
asType$<$**integer**$>(\text{div1.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p1}))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a1}))) ==$
asType$<$**integer**$>(\text{div1.rem})$

!(0 $==$ **asType**$<$**integer**$>(\text{div1.rem})) ||$!(0 $==$
asType$<$**integer**$>(\text{div1.quot}))$

div2 $==$ div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p2})$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a2}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p2}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a2}))) ==$
asType$<$**integer**$>(\text{div2.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p2}))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a2}))) ==$
asType$<$**integer**$>(\text{div2.rem})$

!(0 $==$ **asType**$<$**integer**$>(\text{div2.rem})) ||$!(0 $==$
asType$<$**integer**$>(\text{div2.quot}))$

div3 $==$ div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p3})$,
asType$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a3}))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p3}))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a3}))) ==$
asType$<$**integer**$>(\text{div3.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{p3}))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_724,1}.\text{a3}))) ==$
asType$<$**integer**$>(\text{div3.rem})$

!(0 $==$ **asType**$<$**integer**$>(\text{div3.rem})) ||$!(0 $==$
asType$<$**integer**$>(\text{div3.quot}))$

$\text{\$heap}_{724,1;740,8} == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) * \textbf{asType<int>}(\text{\$heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) * \textbf{asType<int>}(\text{\$heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType<integer const>}(\text{\$heap}_{724,1;740,8}.\text{M1}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType<integer>}(\text{\$heap}_{724,1;740,8}.\text{p1}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;740,8}.\text{M1})$

$\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.rem})) * \textbf{asType<int>}(\text{\$heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.quot})) * \textbf{asType<int>}(\text{\$heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType<integer const>}(\text{\$heap}_{724,1;742,8}.\text{M2}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;742,8}.\text{M2})$

$\text{\$heap}_{724,1;744,8} == \text{\$heap}_{724,1;742,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.rem})) * \textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.quot})) * \textbf{asType<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType<integer const>}(\text{\$heap}_{724,1;744,8}.\text{M3}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}) < \textbf{asType<integer>}(\text{\$heap}_{724,1;744,8}.\text{M3})$

$\text{\$heap}_{724,1;747,8} == \text{\$heap}_{724,1;744,8}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short int>}((\textbf{asType<int>}(\text{\$heap}_{724,1;744,8}.\text{M1}) * \textbf{asType<int>}(\textbf{static\_cast<integer>}(\textbf{asType<int>}(\text{\$heap}_{724,1;744,8}.\text{p1}) < (\text{int})0))) + \textbf{asType<int>}(\text{\$heap}_{724,1;744,8}.\text{p1})))$

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{724,1;747,8}.\text{p2} \leq \textbf{maxof(int)}$

$\rightarrow$ *[simplify]*

[1.9] $-32768 < -\text{\$heap}_{724,1;747,8}.\text{p2}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] $!(-32768 < -\text{\$heap}_{724,1;747,8}.\text{p2})$

$\rightarrow$ *[simplify]*

[1.13] $32767 < \$heap_{724,1;747,8}.p2$

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[66.0] $\$heap_{724,1;747,8}.p2 \leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[66.9] $-32768 < -\$heap_{724,1;747,8}.p2$

$\rightarrow$ *[from term 1.13, literala $< -\$heap_{724,1;747,8}.p2$ is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[66.9.0] $-2 < (-32768 + 32767)$

$\rightarrow$ *[simplify]*

[66.9.2] **true**

[66.10] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,8)

Condition defined at:

To prove: minof(**short int**) $\leq$ ((**asType**<**int**>($\$heap_{724,1;747,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;747,8}$.p2) < (**int**)0))) + **asType**<**int**>($\$heap_{724,1;747,8}$.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)

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \ || \ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \ || \ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \ || \ !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) \text{ *}$
$\textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})) \text{ * } \textbf{asType<int>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType<integer const>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType<integer>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.rem})) \text{ *}$
$\textbf{asType<int>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div2.quot})) \text{ * } \textbf{asType<int>}(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType<integer const>}(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType<integer>}(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.rem})) \text{ *}$
$\textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div3.quot})) \text{ * } \textbf{asType<int>}(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType<integer const>}(\$\text{heap}_{724,1;744,8}.\text{M3}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType<integer>}(\$\text{heap}_{724,1;744,8}.\text{p3}) <$
$\textbf{asType<integer>}(\$\text{heap}_{724,1;744,8}.\text{M3})$

$\$\text{heap}_{724,1;747,8} == \$\text{heap}_{724,1;744,8}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{M1}) \text{ *}$
$\textbf{asType<int>}(\textbf{static\_cast<integer>}(\textbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{p1}) <$
$(\textbf{int})0))) + \textbf{asType<int>}(\$\text{heap}_{724,1;744,8}.\text{p1})))$

Proof:

[Take goal term]

[1.0] $\textbf{minof}(\text{short int}) \leq ((\textbf{asType<int>}(\$\text{heap}_{724,1;747,8}.\text{M2}) \text{ *}$
$\textbf{asType<int>}(\textbf{static\_cast<integer>}(\textbf{asType<int>}(\$\text{heap}_{724,1;747,8}.\text{p2}) <$
$(\textbf{int})0))) + \textbf{asType<int>}(\$\text{heap}_{724,1;747,8}.\text{p2}))$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq ((\textbf{asType<int>}(\$\text{heap}_{724,1;747,8}.\text{M2}) \text{ *}$

asType<int>(static_cast<integer>(asType<int>($heap$_{724,1;747,8}$.p2) < (int)0))) + asType<int>($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[const static or extern object]*

[1.2] -32768 $\leq$ ((**asType<int>**($heap$_{init}$.M2) *
asType<int>(static_cast<integer>(asType<int>($heap$_{724,1;747,8}$.p2) <
(int)0))) + asType<int>($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] -32768 $\leq$ ((**asType<int>(asType<short int>((int)30307)) *
asType<int>(static_cast<integer>(asType<int>**($heap$_{724,1;747,8}$.p2) <
(int)0))) + asType<int>($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[simplify]*

[1.11] -32768 $\leq$ ((30307 * **asType<int>**((([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, []: 0)))
+ **asType<int>**($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.12] -32768 $\leq$ ((30307 * **asType<int>**((([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, [!(0 <
$-$$heap$_{724,1;747,8}$.p2)]: 0))) + **asType<int>**($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[simplify]*

[1.16] -32768 $\leq$ ((30307 * ([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, [-1 <
$heap$_{724,1;747,8}$.p2]: 0)) + **asType<int>**($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[move guard outside expression]*

[1.17] -32768 $\leq$ (([0 < $-$$heap$_{724,1;747,8}$.p2]: 1 * 30307, [-1 <
$heap$_{724,1;747,8}$.p2]: 0 * 30307) + **asType<int>**($heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[simplify]*

[1.20] -32768 $\leq$ (([0 < $-$$heap$_{724,1;747,8}$.p2]: 30307, [-1 < $heap$_{724,1;747,8}$.p2]:
0) + $heap$_{724,1;747,8}$.p2)

$\rightarrow$ *[move guard outside expression]*

[1.21] -32768 $\leq$ ([0 < $-$$heap$_{724,1;747,8}$.p2]: 30307 + $heap$_{724,1;747,8}$.p2, [-1 <
$heap$_{724,1;747,8}$.p2]: 0 + $heap$_{724,1;747,8}$.p2)

$\rightarrow$ *[simplify]*

[1.24] -32769 < ([0 < $-$$heap$_{724,1;747,8}$.p2]: 30307 + $heap$_{724,1;747,8}$.p2, [-1 <
$heap$_{724,1;747,8}$.p2]: $heap$_{724,1;747,8}$.p2)

$\rightarrow$ *[move guard outside expression]*

[1.25] ([0 < $-$$heap$_{724,1;747,8}$.p2]: -32769 < (30307 + $heap$_{724,1;747,8}$.p2), [-1 <
$heap$_{724,1;747,8}$.p2]: -32769 < $heap$_{724,1;747,8}$.p2)

$\rightarrow$ *[simplify]*

[1.27] ([0 < $-$$heap$_{724,1;747,8}$.p2]: -63076 < $heap$_{724,1;747,8}$.p2, [-1 <

$\$heap_{724,1;747,8}.p2]$: -32769 < $\$heap_{724,1;747,8}.p2$)

→ *[from guard, literala < $\$heap_{724,1;747,8}.p2$ is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[1.27.0] (-32769 + -1) < -1

→ *[simplify]*

[1.27.2] **true**

[1.28] ([0 < −$\$heap_{724,1;747,8}.p2]$: -63076 < $\$heap_{724,1;747,8}.p2$, [-1 < $\$heap_{724,1;747,8}.p2]$: **true**)

→ *[negate goal and search for contradiction]*

[1.29] !([0 < −$\$heap_{724,1;747,8}.p2]$: -63076 < $\$heap_{724,1;747,8}.p2$, [-1 < $\$heap_{724,1;747,8}.p2]$: **true**)

→ *[move guard outside expression]*

[1.30] ([0 < −$\$heap_{724,1;747,8}.p2]$: !(-63076 < $\$heap_{724,1;747,8}.p2$), [-1 < $\$heap_{724,1;747,8}.p2]$: !**true**)

→ *[simplify]*

[1.35] (0 < −$\$heap_{724,1;747,8}.p2$) ∧ (63075 < −$\$heap_{724,1;747,8}.p2$)

[Work on sub-term 2 of conjunction in term 1.35]

[66.0] 63075 < −$\$heap_{724,1;747,8}.p2$

[Assume known post-assertion, class invariant or type constraint for term 1.35]

[67.0] **minof**(**short int**) ≤ $\$heap_{724,1;747,8}.p2$

→ *[simplify]*

[67.3] -32769 < $\$heap_{724,1;747,8}.p2$

→ *[from term 66.0, literala < $\$heap_{724,1;747,8}.p2$ is false whenever -2 < (63075 + literala)]*

Proof of rule precondition:

[67.3.0] -2 < (-32769 + 63075)

→ *[simplify]*

[67.3.2] **true**

[67.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,8)

Condition defined at:

To prove: $((\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;747,8}.\text{M2}) *$ $\textbf{asType}\langle\textbf{int}\rangle(\textbf{static\_cast}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;747,8}.\text{p2}) <$ $(\textbf{int})0))) + \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{724,1;747,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ /$ $\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$ $\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1}))\ \%$ $\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$ $\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem}))\ ||\ !(0 ==$ $\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$ $\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ /$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.quot})$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}))\ \%$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.rem})$

$!(0 == \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ /$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.quot})$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ \%$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.rem})$

$!(0 == \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.rem}))\ ||\ !(0 ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}((\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}(\text{div1.rem}))\ *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}(\text{div1.quot})) * \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\text{<}\textbf{integer const}\text{>}(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\_\textbf{replace}(\text{p2} \to \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}((\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}(\text{div2.rem}))\ *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}(\text{div2.quot})) * \textbf{asType}\text{<}\textbf{int}\text{>}(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\text{<}\textbf{integer const}\text{>}(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \to \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}((\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}(\text{div3.rem}))\ *$

asType\<int\>($heap$_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap$_{724,1;742,8}$.b3)))))

−**asType\<integer const\>**($heap$_{724,1;744,8}$.M3) < **asType\<integer\>**($heap$_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($heap$_{724,1;744,8}$.p3))

asType\<integer\>($heap$_{724,1;744,8}$.p3) < **asType\<integer\>**($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$.**\_replace**(p1 → **asType\<short int\>**((**asType\<int\>**($heap$_{724,1;744,8}$.M1) * **asType\<int\>**(**static_cast\<integer\>**(**asType\<int\>**($heap$_{724,1;744,8}$.p1) < **(int)**0))) + **asType\<int\>**($heap$_{724,1;744,8}$.p1)))

Proof:

[Take goal term]

[1.0] ((**asType\<int\>**($heap$_{724,1;747,8}$.M2) * **asType\<int\>**(**static\_cast\<integer\>**(**asType\<int\>**($heap$_{724,1;747,8}$.p2) < **(int)**0))) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

→ *[const static or extern object]*

[1.1] ((**asType\<int\>**($heap$_{init}$.M2) * **asType\<int\>**(**static\_cast\<integer\>**(**asType\<int\>**($heap$_{724,1;747,8}$.p2) < **(int)**0))) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short 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\>**($heap$_{724,1;747,8}$.p2) < **(int)**0))) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

→ *[simplify]*

[1.10] ((30307 * **asType\<int\>**(([0 < −$heap$_{724,1;747,8}$.p2]: 1, []: 0))) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] ((30307 * **asType\<int\>**(([0 < −$heap$_{724,1;747,8}$.p2]: 1, [!(0 < −$heap$_{724,1;747,8}$.p2)]: 0))) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

→ *[simplify]*

[1.15] ((30307 * ([0 < −$heap$_{724,1;747,8}$.p2]: 1, [-1 < $heap$_{724,1;747,8}$.p2]: 0)) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

→ *[move guard outside expression]*

[1.16] (([0 < −$heap$_{724,1;747,8}$.p2]: 1 * 30307, [-1 < $heap$_{724,1;747,8}$.p2]: 0 * 30307) + **asType\<int\>**($heap$_{724,1;747,8}$.p2)) ≤ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.19] $(([0 < -\$heap_{724,1;747,8}.p2]: 30307, [-1 < \$heap_{724,1;747,8}.p2]: 0) + \$heap_{724,1;747,8}.p2) \leq$ **maxof(short int)**

$\rightarrow$ *[move guard outside expression]*

[1.20] $([0 < -\$heap_{724,1;747,8}.p2]: 30307 + \$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: 0 + \$heap_{724,1;747,8}.p2) \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.23] $(-1 + ([0 < -\$heap_{724,1;747,8}.p2]: 30307 + \$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: \$heap_{724,1;747,8}.p2)) < 32767$

$\rightarrow$ *[move guard outside expression]*

[1.24] $([0 < -\$heap_{724,1;747,8}.p2]: -1 + (30307 + \$heap_{724,1;747,8}.p2), [-1 < \$heap_{724,1;747,8}.p2]: -1 + \$heap_{724,1;747,8}.p2) < 32767$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + -([0 < -\$heap_{724,1;747,8}.p2]: 30306 + \$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: -1 + \$heap_{724,1;747,8}.p2))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]: -(30306 + \$heap_{724,1;747,8}.p2), [-1 < \$heap_{724,1;747,8}.p2]: -(-1 + \$heap_{724,1;747,8}.p2)))$

$\rightarrow$ *[simplify]*

[1.32] $0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]: -30306 + -\$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: 1 + -\$heap_{724,1;747,8}.p2))$

$\rightarrow$ *[move guard outside expression]*

[1.33] $0 < ([0 < -\$heap_{724,1;747,8}.p2]: 32767 + (-30306 + -\$heap_{724,1;747,8}.p2), [-1 < \$heap_{724,1;747,8}.p2]: 32767 + (1 + -\$heap_{724,1;747,8}.p2))$

$\rightarrow$ *[simplify]*

[1.37] $0 < ([0 < -\$heap_{724,1;747,8}.p2]: 2461 + -\$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: 32768 + -\$heap_{724,1;747,8}.p2)$

$\rightarrow$ *[move guard outside expression]*

[1.38] $([0 < -\$heap_{724,1;747,8}.p2]: 0 < (2461 + -\$heap_{724,1;747,8}.p2), [-1 < \$heap_{724,1;747,8}.p2]: 0 < (32768 + -\$heap_{724,1;747,8}.p2))$

$\rightarrow$ *[simplify]*

[1.40] $([0 < -\$heap_{724,1;747,8}.p2]: -2461 < -\$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]: 0 < (32768 + -\$heap_{724,1;747,8}.p2))$

$\rightarrow$ *[from guard, literala $< -\$heap_{724,1;747,8}.p2$ is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[1.40.0] (-2461 + -1) < 0

→ *[simplify]*

[1.40.2] **true**

[1.41] ([0 < −$heap_{724,1;747,8}$.p2]: **true**, [-1 < $heap_{724,1;747,8}$.p2]: 0 < (32768 + −$heap_{724,1;747,8}$.p2))

→ *[simplify]*

[1.43] ([0 < −$heap_{724,1;747,8}$.p2]: **true**, [-1 < $heap_{724,1;747,8}$.p2]: -32768 < −$heap_{724,1;747,8}$.p2)

→ *[negate goal and search for contradiction]*

[1.44] !([0 < −$heap_{724,1;747,8}$.p2]: **true**, [-1 < $heap_{724,1;747,8}$.p2]: -32768 < −$heap_{724,1;747,8}$.p2)

→ *[move guard outside expression]*

[1.45] ([0 < −$heap_{724,1;747,8}$.p2]: !**true**, [-1 < $heap_{724,1;747,8}$.p2]: !(-32768 < −$heap_{724,1;747,8}$.p2))

→ *[simplify]*

[1.51] (-1 < $heap_{724,1;747,8}$.p2) ∧ (32767 < $heap_{724,1;747,8}$.p2)

[Work on sub-term 2 of conjunction in term 1.51]

[66.0] 32767 < $heap_{724,1;747,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.51]

[67.0] $heap_{724,1;747,8}$.p2 ≤ **maxof**(**short int**)

→ *[simplify]*

[67.9] -32768 < −$heap_{724,1;747,8}$.p2

→ *[from term 66.0, literala < −$heap_{724,1;747,8}$.p2 is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[67.9.0] -2 < (-32768 + 32767)

→ *[simplify]*

[67.9.2] **true**

[67.10] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,27)

Condition defined at:

To prove: minof(int) $\leq$ $heap$_{724,1;748,8}$.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)

invariant1(**heapIs** $heap$_{funcstart_724,1}$)

div1 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p1),
asType<int>($heap$_{funcstart_724,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p2}))$ %
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.rem})$

$!(0 == \textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.rem}))\ ||\ !(0 ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3}))\ /$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{p3}))$ %
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.rem})$

$!(0 == \textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.rem}))\ ||\ !(0 ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div1.rem}))\ *$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!(\text{div1.quot}))\ *\ \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_724,1}.\text{b1})))))$

$-\textbf{asType}\!<\!\textbf{integer const}\!>\!(\$\text{heap}_{724,1;740,8}.\text{M1}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{p1}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div2.rem}))\ *$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!(\text{div2.quot}))\ *\ \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;740,8}.\text{b2})))))$

$-\textbf{asType}\!<\!\textbf{integer const}\!>\!(\$\text{heap}_{724,1;742,8}.\text{M2}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{p2}) <$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\textbf{replace}(\text{p3} \to \textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!((\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!(\text{div3.rem}))\ *$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\!<\!\textbf{int}\!>\!(\textbf{asType}\!<\!\textbf{short}$
$\textbf{int}\!>\!(\text{div3.quot}))\ *\ \textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{724,1;742,8}.\text{b3})))))$

$-\textbf{asType}\!<\!\textbf{integer const}\!>\!(\$\text{heap}_{724,1;744,8}.\text{M3}) <$

asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) < **asType<integer>**($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$._**replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

$heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**($heap$_{724,1;747,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) < (**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ $heap$_{724,1;748,8}$.M3

→ *[simplify]*

[1.1] -32768 ≤ $heap$_{724,1;748,8}$.M3

→ *[const static or extern object]*

[1.2] -32768 ≤ $heap$_{init}$.M3

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.3] -32768 ≤ **asType<short int>**((**int**)30323)

→ *[simplify]*

[1.6] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,27)

Condition defined at:

To prove: $heap$_{724,1;748,8}$.M3 ≤ **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>**$((\textbf{int})30307)$

$\$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>**$((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p1)$,
asType<int>$(\$heap_{funcstart\_724,1}.a1))$

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p1)$)) /
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a1)$)) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p1)$)) %
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a1)$)) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p2)$,
asType<int>$(\$heap_{funcstart\_724,1}.a2))$

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p2)$)) /
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a2)$)) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**$(\$heap_{funcstart\_724,1}.p2)$)) %
asType<integer>(**asType<int>**$(\$heap_{funcstart\_724,1}.a2)$)) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>$(\$heap_{funcstart\_724,1}.p3)$,
asType<int>$(\$heap_{funcstart\_724,1}.a3))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \ / \ \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) == \textbf{asType}<\textbf{integer}>(\text{div3.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \ \% \ \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) == \textbf{asType}<\textbf{integer}>(\text{div3.rem})$

$!(0 == \textbf{asType}<\textbf{integer}>(\text{div3.rem})) \ || \ !(0 == \textbf{asType}<\textbf{integer}>(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;740,8}.\text{M1}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{p1}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\$\text{heap}_{724,1;742,8} == \$\text{heap}_{724,1;740,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;742,8}.\text{M2}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{p2}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.rem})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot})) \ * \ \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}<\textbf{integer const}>(\$\text{heap}_{724,1;744,8}.\text{M3}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{p3}) < \textbf{asType}<\textbf{integer}>(\$\text{heap}_{724,1;744,8}.\text{M3})$

$\$\text{heap}_{724,1;747,8} == \$\text{heap}_{724,1;744,8}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{M1}) \ * \ \textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{724,1;744,8}.\text{p1})))$

$\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{724,1;747,8}$.**replace**(p2 → **asType**<**short int**>((**asType**<**int**>($\$\text{heap}_{724,1;747,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$\text{heap}_{724,1;747,8}$.p2) < (**int**)0))) + **asType**<**int**>($\$\text{heap}_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{724,1;748,8}$.M3 ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.1] $\$\text{heap}_{init}$.M3 ≤ **maxof**(**int**)

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.2] **asType**<**short int**>((**int**)30323) ≤ **maxof**(**int**)

→ *[simplify]*

[1.6] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,17)

Condition defined at:

To prove: minof(**int**) ≤ $\$\text{heap}_{724,1;748,8}$.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)

$\$\text{heap}_{init}$.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)

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1})$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div1.rem})) \text{ || } !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div2.rem})) \text{ || } !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{div3.rem})) \text{ || } !(0 ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \text{ * }$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;740,8}$.M1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1))

asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.p1) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;740,8}$.M1)

$\$$heap$_{724,1;742,8}$ == $\$$heap$_{724,1;740,8}$.**_replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;740,8}$.r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;740,8}$.b2))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;742,8}$.M2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2))

asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.p2) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;742,8}$.M2)

$\$$heap$_{724,1;744,8}$ == $\$$heap$_{724,1;742,8}$.**_replace**(p3 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) *
asType$<$**int**$>$($\$$heap$_{724,1;742,8}$.r3)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.quot)) * **asType**$<$**int**$>$($\$$heap$_{724,1;742,8}$.b3))))

$-$**asType**$<$**integer const**$>$($\$$heap$_{724,1;744,8}$.M3) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3)

!(0 == **asType**$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3))

asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.p3) $<$
asType$<$**integer**$>$($\$$heap$_{724,1;744,8}$.M3)

$\$$heap$_{724,1;747,8}$ == $\$$heap$_{724,1;744,8}$.**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.M1) *
asType$<$**int**$>$(**static_cast**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.p1) $<$
(**int**)0))) + **asType**$<$**int**$>$($\$$heap$_{724,1;744,8}$.p1)))

$\$$heap$_{724,1;748,8}$ == $\$$heap$_{724,1;747,8}$.**_replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$($\$$heap$_{724,1;747,8}$.M2) *
asType$<$**int**$>$(**static_cast**$<$**integer**$>$(**asType**$<$**int**$>$($\$$heap$_{724,1;747,8}$.p2) $<$
(**int**)0))) + **asType**$<$**int**$>$($\$$heap$_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $\$$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[simplify]*

[1.3] -32769 $<$ $\$$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(−32769 < $heap$_{724,1;748,8}$.p3)

→ *[simplify]*

[1.6] 32768 < −$heap$_{724,1;748,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[69.0] **minof(short int)** ≤ $heap$_{724,1;748,8}$.p3

→ *[simplify]*

[69.3] -32769 < $heap$_{724,1;748,8}$.p3

→ *[from term 1.6, literala < $heap$_{724,1;748,8}$.p3 is false whenever -2 < (32768 + literala)]*

    Proof of rule precondition:

    [69.3.0] -2 < (-32769 + 32768)

    → *[simplify]*

    [69.3.2] **true**

[69.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,17)

Condition defined at:

To prove: $heap$_{724,1;748,8}$.p3 ≤ **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)

$\$heap_{init}.b3 == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p2),
asType<int>($\$heap_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p3),
asType<int>($\$heap_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$heap_{724,1;740,8}$.M1) < **asType<integer>**($\$heap_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$heap_{724,1;740,8}$.p1))

asType<integer>($\$heap_{724,1;740,8}$.p1) < **asType<integer>**($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$heap_{724,1;742,8}$.M2) < **asType<integer>**($\$heap_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$heap_{724,1;742,8}$.p2))

asType<integer>($\$heap_{724,1;742,8}$.p2) < **asType<integer>**($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{724,1;742,8}$.b3))))

−**asType<integer const>**($\$heap_{724,1;744,8}$.M3) < **asType<integer>**($\$heap_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($\$heap_{724,1;744,8}$.p3))

asType<integer>($\$heap_{724,1;744,8}$.p3) < **asType<integer>**($\$heap_{724,1;744,8}$.M3)

$\$heap_{724,1;747,8}$ == $\$heap_{724,1;744,8}$.**replace**(p1 → **asType<short int>**((**asType<int>**($\$heap_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1)))

$\$heap_{724,1;748,8}$ == $\$heap_{724,1;747,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**($\$heap_{724,1;747,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;747,8}$.p2) < (**int**)0))) + **asType<int>**($\$heap_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] $\$heap_{724,1;748,8}$.p3 ≤ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -$$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -$$heap$_{724,1;748,8}$.p3)

$\rightarrow$ *[simplify]*

[1.13] 32767 $<$ $heap$_{724,1;748,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[69.0] $heap$_{724,1;748,8}$.p3 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[69.9] -32768 $< -$$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[from term 1.13, literala $< -$$heap$_{724,1;748,8}$.p3 is false whenever -2 $<$ (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[69.9.0]* -2 $<$ (-32768 + 32767)
>
> $\rightarrow$ *[simplify]*
>
> *[69.9.2]* **true**

[69.10] **false**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,11)

Condition defined at:

To prove: minof(**int**) $\leq$ **static_cast**<**integer**>(**asType**<**int**>($heap$_{724,1;748,8}$.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)

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p1$),
asType<**int**>($\$heap_{funcstart\_724,1}.a1$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p1$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a1$))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p2$),
asType<**int**>($\$heap_{funcstart\_724,1}.a2$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p2$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a2$))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<**int**>($\$heap_{funcstart\_724,1}.p3$),
asType<**int**>($\$heap_{funcstart\_724,1}.a3$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p3$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.a3$))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_724,1}.p3$)) %

asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{a3}$))) == **asType**<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 == **asType**<**integer**>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}.$**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{r1}$)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_724,1}.\text{b1}$))))

−**asType**<**integer const**>($\text{heap}_{724,1;740,8}.\text{M1}$) < **asType**<**integer**>($\text{heap}_{724,1;740,8}.\text{p1}$)

!(0 == **asType**<**integer**>($\text{heap}_{724,1;740,8}.\text{p1}$))

asType<**integer**>($\text{heap}_{724,1;740,8}.\text{p1}$) < **asType**<**integer**>($\text{heap}_{724,1;740,8}.\text{M1}$)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}.$**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{heap}_{724,1;740,8}.\text{r2}$)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}.\text{b2}$))))

−**asType**<**integer const**>($\text{heap}_{724,1;742,8}.\text{M2}$) < **asType**<**integer**>($\text{heap}_{724,1;742,8}.\text{p2}$)

!(0 == **asType**<**integer**>($\text{heap}_{724,1;742,8}.\text{p2}$))

asType<**integer**>($\text{heap}_{724,1;742,8}.\text{p2}$) < **asType**<**integer**>($\text{heap}_{724,1;742,8}.\text{M2}$)

$\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}.$**replace**(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\text{heap}_{724,1;742,8}.\text{r3}$)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\text{heap}_{724,1;742,8}.\text{b3}$))))

−**asType**<**integer const**>($\text{heap}_{724,1;744,8}.\text{M3}$) < **asType**<**integer**>($\text{heap}_{724,1;744,8}.\text{p3}$)

!(0 == **asType**<**integer**>($\text{heap}_{724,1;744,8}.\text{p3}$))

asType<**integer**>($\text{heap}_{724,1;744,8}.\text{p3}$) < **asType**<**integer**>($\text{heap}_{724,1;744,8}.\text{M3}$)

$\text{heap}_{724,1;747,8}$ == $\text{heap}_{724,1;744,8}.$**replace**(p1 → **asType**<**short int**>((**asType**<**int**>($\text{heap}_{724,1;744,8}.\text{M1}$) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{724,1;744,8}.\text{p1}$) < (**int**)0))) + **asType**<**int**>($\text{heap}_{724,1;744,8}.\text{p1}$)))

$\text{heap}_{724,1;748,8}$ == $\text{heap}_{724,1;747,8}.$**replace**(p2 → **asType**<**short int**>((**asType**<**int**>($\text{heap}_{724,1;747,8}.\text{M2}$) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{724,1;747,8}.\text{p2}$) < (**int**)0))) + **asType**<**int**>($\text{heap}_{724,1;747,8}.\text{p2}$)))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ **static_cast<integer>(asType<int>**($\text{heap}_{724,1;748,8}$.p3)
$<$ **(int)**0)

$\rightarrow$ *[simplify]*

[1.6] -32768 $\leq$ ([0 $<$ $-\text{heap}_{724,1;748,8}$.p3]: 1, []: 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.7] -32768 $\leq$ ([0 $<$ $-\text{heap}_{724,1;748,8}$.p3]: 1, [!(0 $<$ $-\text{heap}_{724,1;748,8}$.p3)]: 0)

$\rightarrow$ *[simplify]*

[1.12] -32769 $<$ ([0 $<$ $-\text{heap}_{724,1;748,8}$.p3]: 1, [-1 $<$ $\text{heap}_{724,1;748,8}$.p3]: 0)

$\rightarrow$ *[move guard outside expression]*

[1.13] ([0 $<$ $-\text{heap}_{724,1;748,8}$.p3]: -32769 $<$ 1, [-1 $<$ $\text{heap}_{724,1;748,8}$.p3]: -32769 $<$ 0)

$\rightarrow$ *[simplify]*

[1.15] ([0 $<$ $-\text{heap}_{724,1;748,8}$.p3]: **true**, [-1 $<$ $\text{heap}_{724,1;748,8}$.p3]: **true**)

$\rightarrow$ *[all guards have equal guarded terms]*

[1.16] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,11)

Condition defined at:

To prove: static_cast<integer>(asType<int>($\text{heap}_{724,1;748,8}$.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)

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==

asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 == **asType<integer>**(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**_replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) < **asType<integer>**($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) < **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\$\text{heap}_{724,1;742,8}$.p2) < **asType<integer>**($\$\text{heap}_{724,1;742,8}$.M2)

$\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{724,1;742,8}$.**_replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3))))

−**asType<integer const>**($\$\text{heap}_{724,1;744,8}$.M3) < **asType<integer>**($\$\text{heap}_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;744,8}$.p3))

asType<integer>($\$\text{heap}_{724,1;744,8}$.p3) < **asType<integer>**($\$\text{heap}_{724,1;744,8}$.M3)

$\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{724,1;744,8}$.**_replace**(p1 → **asType<short int>**((**asType<int>**($\$\text{heap}_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$\text{heap}_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($\$\text{heap}_{724,1;744,8}$.p1)))

$\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{724,1;747,8}$.**_replace**(p2 → **asType<short int>**((**asType<int>**($\$\text{heap}_{724,1;747,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$\text{heap}_{724,1;747,8}$.p2) < (**int**)0))) + **asType<int>**($\$\text{heap}_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] **static_cast<integer>(asType<int>**($heap$_{724,1;748,8}$.p3) < (**int**)0) ≤ **maxof(int)**

→ *[simplify]*

[1.5] ([0 < −$heap$_{724,1;748,8}$.p3]: 1, []: 0) ≤ **maxof(int)**

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.6] ([0 < −$heap$_{724,1;748,8}$.p3]: 1, [!(0 < −$heap$_{724,1;748,8}$.p3)]: 0) ≤ **maxof(int)**

→ *[simplify]*

[1.11] (-1 + ([0 < −$heap$_{724,1;748,8}$.p3]: 1, [-1 < $heap$_{724,1;748,8}$.p3]: 0)) < 32767

→ *[move guard outside expression]*

[1.12] ([0 < −$heap$_{724,1;748,8}$.p3]: -1 + 1, [-1 < $heap$_{724,1;748,8}$.p3]: -1 + 0) < 32767

→ *[simplify]*

[1.15] 0 < (32767 + −([0 < −$heap$_{724,1;748,8}$.p3]: 0, [-1 < $heap$_{724,1;748,8}$.p3]: -1))

→ *[move guard outside expression]*

[1.16] 0 < (32767 + ([0 < −$heap$_{724,1;748,8}$.p3]: −0, [-1 < $heap$_{724,1;748,8}$.p3]: −-1))

→ *[simplify]*

[1.18] 0 < (32767 + ([0 < −$heap$_{724,1;748,8}$.p3]: 0, [-1 < $heap$_{724,1;748,8}$.p3]: 1))

→ *[move guard outside expression]*

[1.19] 0 < ([0 < −$heap$_{724,1;748,8}$.p3]: 0 + 32767, [-1 < $heap$_{724,1;748,8}$.p3]: 1 + 32767)

→ *[simplify]*

[1.21] 0 < ([0 < −$heap$_{724,1;748,8}$.p3]: 32767, [-1 < $heap$_{724,1;748,8}$.p3]: 32768)

→ *[move guard outside expression]*

[1.22] ([0 < −$heap$_{724,1;748,8}$.p3]: 0 < 32767, [-1 < $heap$_{724,1;748,8}$.p3]: 0 < 32768)

→ *[simplify]*

[1.24] ([0 < −$heap$_{724,1;748,8}$.p3]: **true**, [-1 < $heap$_{724,1;748,8}$.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 (65,25)

Condition defined at:

To prove: minof(int) $\leq$ (**asType\<int\>**($\$heap_{724,1;748,8}$.M3) * **asType\<int\>**(**static_cast\<integer\>**(**asType\<int\>**($\$heap_{724,1;748,8}$.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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$, **asType\<int\>**($\$heap_{funcstart\_724,1}$.p1), **asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) / **asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) == **asType\<integer\>**(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p1)) % **asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a1))) == **asType\<integer\>**(div1.rem)

!(0 == **asType\<integer\>**(div1.rem)) || !(0 ==

asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==
asType<**integer**>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.b1))))

−**asType**<**integer const**>($\$\text{heap}_{724,1;740,8}$.M1) <
asType<**integer**>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType**<**integer**>($\$\text{heap}_{724,1;740,8}$.p1))

asType<**integer**>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<**integer**>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{724,1;740,8}$.b2))))

−**asType**<**integer const**>($\$\text{heap}_{724,1;742,8}$.M2) <
asType<**integer**>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType**<**integer**>($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.**_replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) <
asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) <
asType<integer>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

$heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**($heap$_{724,1;747,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ (**asType<int>**($heap$_{724,1;748,8}$.M3) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.p3) <
(**int**)0)))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**($heap$_{724,1;748,8}$.M3) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.p3) <
(**int**)0)))

→ *[const static or extern object]*

[1.2] -32768 ≤ (**asType<int>**($heap$_{init}$.M3) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.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>**($heap$_{724,1;748,8}$.p3) <
(**int**)0)))

→ *[simplify]*

[1.11] -32768 ≤ (30323 * **asType<int>**(((0 < −$heap$_{724,1;748,8}$.p3]: 1, []: 0)))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.12] -32768 $\leq$ (30323 * **asType$<$int$>$**((([0 $< -\$heap_{724,1;748,8}$.p3]: 1, [!(0 $<$ $-\$heap_{724,1;748,8}$.p3)]: 0)))

$\rightarrow$ *[simplify]*

[1.16] -32768 $\leq$ (30323 * ([0 $< -\$heap_{724,1;748,8}$.p3]: 1, [-1 $<$ $\$heap_{724,1;748,8}$.p3]: 0))

$\rightarrow$ *[move guard outside expression]*

[1.17] -32768 $\leq$ ([0 $< -\$heap_{724,1;748,8}$.p3]: 1 * 30323, [-1 $<$ $\$heap_{724,1;748,8}$.p3]: 0 * 30323)

$\rightarrow$ *[simplify]*

[1.21] -32769 $<$ ([0 $< -\$heap_{724,1;748,8}$.p3]: 30323, [-1 $<$ $\$heap_{724,1;748,8}$.p3]: 0)

$\rightarrow$ *[move guard outside expression]*

[1.22] ([0 $< -\$heap_{724,1;748,8}$.p3]: -32769 $<$ 30323, [-1 $<$ $\$heap_{724,1;748,8}$.p3]: -32769 $<$ 0)

$\rightarrow$ *[simplify]*

[1.24] ([0 $< -\$heap_{724,1;748,8}$.p3]: **true**, [-1 $<$ $\$heap_{724,1;748,8}$.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 (65,25)

Condition defined at:

To prove: (asType$<$int$>$($\$heap_{724,1;748,8}$.M3) * asType$<int>$(static_cast$<$integer$>$(asType$<int>$($\$heap_{724,1;748,8}$.p3) $<$ (int)0))) $\leq$ 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)

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %

asType<integer>(**asType**<int>($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType**<integer>(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType**<short
int>((**asType**<int>(**asType**<short int>(div1.rem)) *
asType<int>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType**<int>(**asType**<short
int>(div1.quot)) * **asType**<int>($\text{heap}_{funcstart\_724,1}$.b1))))

−**asType**<integer const>($\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType**<integer>($\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\text{heap}_{724,1;740,8}$.M1)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType**<short
int>((**asType**<int>(**asType**<short int>(div2.rem)) *
asType<int>($\text{heap}_{724,1;740,8}$.r2)) − (**asType**<int>(**asType**<short
int>(div2.quot)) * **asType**<int>($\text{heap}_{724,1;740,8}$.b2))))

−**asType**<integer const>($\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType**<integer>($\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\text{heap}_{724,1;742,8}$.p2) <
asType<integer>($\text{heap}_{724,1;742,8}$.M2)

$\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType**<short
int>((**asType**<int>(**asType**<short int>(div3.rem)) *
asType<int>($\text{heap}_{724,1;742,8}$.r3)) − (**asType**<int>(**asType**<short
int>(div3.quot)) * **asType**<int>($\text{heap}_{724,1;742,8}$.b3))))

−**asType**<integer const>($\text{heap}_{724,1;744,8}$.M3) <
asType<integer>($\text{heap}_{724,1;744,8}$.p3)

!(0 == **asType**<integer>($\text{heap}_{724,1;744,8}$.p3))

asType<integer>($\text{heap}_{724,1;744,8}$.p3) <
asType<integer>($\text{heap}_{724,1;744,8}$.M3)

$\text{heap}_{724,1;747,8}$ == $\text{heap}_{724,1;744,8}$.**replace**(p1 → **asType**<short
int>((**asType**<int>($\text{heap}_{724,1;744,8}$.M1) *
asType<int>(**static_cast**<integer>(**asType**<int>($\text{heap}_{724,1;744,8}$.p1) <
(**int**)0))) + **asType**<int>($\text{heap}_{724,1;744,8}$.p1)))

$\text{heap}_{724,1;748,8}$ == $\text{heap}_{724,1;747,8}$.**replace**(p2 → **asType**<short
int>((**asType**<int>($\text{heap}_{724,1;747,8}$.M2) *
asType<int>(**static_cast**<integer>(**asType**<int>($\text{heap}_{724,1;747,8}$.p2) <
(**int**)0))) + **asType**<int>($\text{heap}_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] (**asType**<**int**>($heap_{724,1;748,8}$.M3) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;748,8}$.p3) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.1] (**asType**<**int**>($heap_{init}$.M3) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{724,1;748,8}$.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**>($heap_{724,1;748,8}$.p3) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.10] (30323 * **asType**<**int**>(([0 < −$heap_{724,1;748,8}$.p3]: 1, []: 0))) ≤
maxof(**int**)

→ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] (30323 * **asType**<**int**>(([0 < −$heap_{724,1;748,8}$.p3]: 1, [!(0 <
−$heap_{724,1;748,8}$.p3)]: 0))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.15] (30323 * ([0 < −$heap_{724,1;748,8}$.p3]: 1, [-1 < $heap_{724,1;748,8}$.p3]: 0)) ≤
maxof(**int**)

→ *[move guard outside expression]*

[1.16] ([0 < −$heap_{724,1;748,8}$.p3]: 1 * 30323, [-1 < $heap_{724,1;748,8}$.p3]: 0 *
30323) ≤ **maxof**(**int**)

→ *[simplify]*

[1.20] (-1 + ([0 < −$heap_{724,1;748,8}$.p3]: 30323, [-1 < $heap_{724,1;748,8}$.p3]: 0)) <
32767

→ *[move guard outside expression]*

[1.21] ([0 < −$heap_{724,1;748,8}$.p3]: -1 + 30323, [-1 < $heap_{724,1;748,8}$.p3]: -1 +
0) < 32767

→ *[simplify]*

[1.24] 0 < (32767 + −([0 < −$heap_{724,1;748,8}$.p3]: 30322, [-1 <
$heap_{724,1;748,8}$.p3]: -1))

→ *[move guard outside expression]*

[1.25] 0 < (32767 + ([0 < −$heap_{724,1;748,8}$.p3]: −30322, [-1 <

$\text{\$heap}_{724,1;748,8}.\text{p3}]: --1))$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + ([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: \text{-30322}, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 1))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < ([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: \text{-30322} + 32767, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 1 + 32767)$

$\rightarrow$ *[simplify]*

[1.30] $0 < ([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: 2445, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 32768)$

$\rightarrow$ *[move guard outside expression]*

[1.31] $([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: 0 < 2445, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 0 < 32768)$

$\rightarrow$ *[simplify]*

[1.33] $([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]:$ **true**, $[\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]:$ **true**$)$

$\rightarrow$ *[all guards have equal guarded terms]*

[1.34] **true**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,5)

Condition defined at:

To prove: minof(int) $\leq \text{\$heap}_{724,1;748,8}.\text{p3}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==
asType<**integer**>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a2))) ==
asType<**integer**>(div2.rem)

!(0 == **asType**<**integer**>(div2.rem)) || !(0 ==
asType<**integer**>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<**integer**>(div3.rem)

!(0 == **asType**<**integer**>(div3.rem)) || !(0 ==

asType<integer>(div3.quot))

$heap_{724,1;740,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($heap_{724,1;740,8}$.M1) < **asType<integer>**($heap_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap_{724,1;740,8}$.p1))

asType<integer>($heap_{724,1;740,8}$.p1) < **asType<integer>**($heap_{724,1;740,8}$.M1)

$heap_{724,1;742,8}$ == $heap_{724,1;740,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap_{724,1;742,8}$.M2) < **asType<integer>**($heap_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap_{724,1;742,8}$.p2))

asType<integer>($heap_{724,1;742,8}$.p2) < **asType<integer>**($heap_{724,1;742,8}$.M2)

$heap_{724,1;744,8}$ == $heap_{724,1;742,8}$.**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap_{724,1;744,8}$.M3) < **asType<integer>**($heap_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap_{724,1;744,8}$.p3))

asType<integer>($heap_{724,1;744,8}$.p3) < **asType<integer>**($heap_{724,1;744,8}$.M3)

$heap_{724,1;747,8}$ == $heap_{724,1;744,8}$.**replace**(p1 → **asType<short int>**((**asType<int>**($heap_{724,1;744,8}$.M1) * **asType<int>**(static_cast**<integer>**(**asType<int>**($heap_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($heap_{724,1;744,8}$.p1)))

$heap_{724,1;748,8}$ == $heap_{724,1;747,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**($heap_{724,1;747,8}$.M2) * **asType<int>**(static_cast**<integer>**(**asType<int>**($heap_{724,1;747,8}$.p2) < (**int**)0))) + **asType<int>**($heap_{724,1;747,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ \$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[simplify]*

[1.3] -32769 < \$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(-32769 < \$heap$_{724,1;748,8}$.p3)

$\rightarrow$ *[simplify]*

[1.6] 32768 < $-$\$heap$_{724,1;748,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[69.0] **minof(short int)** $\leq$ \$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[simplify]*

[69.3] -32769 < \$heap$_{724,1;748,8}$.p3

$\rightarrow$ *[from term 1.6, literala < \$heap$_{724,1;748,8}$.p3 is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[69.3.0]* -2 < (-32769 + 32768)
>
> $\rightarrow$ *[simplify]*
>
> *[69.3.2]* **true**

[69.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'short int' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,5)

Condition defined at:

To prove: \$heap$_{724,1;748,8}$.p3 $\leq$ **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)

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}.\text{p3}$)) %

$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{funcstart\_724,1}.a3))) ==$
$\mathbf{asType{<}integer{>}}(div3.rem)$

$!(0 == \mathbf{asType{<}integer{>}}(div3.rem)) \,||\, !(0 ==$
$\mathbf{asType{<}integer{>}}(div3.quot))$

$\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\mathbf{\_replace}(p1 \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(div1.rem)) *$
$\mathbf{asType{<}int{>}}(\$heap_{funcstart\_724,1}.r1)) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(div1.quot)) * \mathbf{asType{<}int{>}}(\$heap_{funcstart\_724,1}.b1))))$

$-\mathbf{asType{<}integer\ const{>}}(\$heap_{724,1;740,8}.M1) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;740,8}.p1)$

$!(0 == \mathbf{asType{<}integer{>}}(\$heap_{724,1;740,8}.p1))$

$\mathbf{asType{<}integer{>}}(\$heap_{724,1;740,8}.p1) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;740,8}.M1)$

$\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\mathbf{\_replace}(p2 \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(div2.rem)) *$
$\mathbf{asType{<}int{>}}(\$heap_{724,1;740,8}.r2)) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(div2.quot)) * \mathbf{asType{<}int{>}}(\$heap_{724,1;740,8}.b2))))$

$-\mathbf{asType{<}integer\ const{>}}(\$heap_{724,1;742,8}.M2) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;742,8}.p2)$

$!(0 == \mathbf{asType{<}integer{>}}(\$heap_{724,1;742,8}.p2))$

$\mathbf{asType{<}integer{>}}(\$heap_{724,1;742,8}.p2) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;742,8}.M2)$

$\$heap_{724,1;744,8} == \$heap_{724,1;742,8}.\mathbf{\_replace}(p3 \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(div3.rem)) *$
$\mathbf{asType{<}int{>}}(\$heap_{724,1;742,8}.r3)) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(div3.quot)) * \mathbf{asType{<}int{>}}(\$heap_{724,1;742,8}.b3))))$

$-\mathbf{asType{<}integer\ const{>}}(\$heap_{724,1;744,8}.M3) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;744,8}.p3)$

$!(0 == \mathbf{asType{<}integer{>}}(\$heap_{724,1;744,8}.p3))$

$\mathbf{asType{<}integer{>}}(\$heap_{724,1;744,8}.p3) <$
$\mathbf{asType{<}integer{>}}(\$heap_{724,1;744,8}.M3)$

$\$heap_{724,1;747,8} == \$heap_{724,1;744,8}.\mathbf{\_replace}(p1 \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$heap_{724,1;744,8}.M1) *$
$\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{724,1;744,8}.p1) <$
$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;744,8}.p1)))$

$\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\mathbf{\_replace}(p2 \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$heap_{724,1;747,8}.M2) *$
$\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{724,1;747,8}.p2) <$
$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;747,8}.p2)))$

Proof:

[Take goal term]

[1.0] $\$heap_{724,1;748,8}.p3 \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] $-32768 < -\$heap_{724,1;748,8}.p3$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] $!(-32768 < -\$heap_{724,1;748,8}.p3)$

$\rightarrow$ *[simplify]*

[1.13] $32767 < \$heap_{724,1;748,8}.p3$

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[69.0] $\$heap_{724,1;748,8}.p3 \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[69.9] $-32768 < -\$heap_{724,1;748,8}.p3$

$\rightarrow$ *[from term 1.13, literala $< -\$heap_{724,1;748,8}.p3$ is false whenever -2 < (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[69.9.0]* $-2 < (-32768 + 32767)$
>
> $\rightarrow$ *[simplify]*
>
> *[69.9.2]* **true**

[69.10] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,8)

Condition defined at:

To prove: minof(short int) $\leq$ ((**asType**<**int**>($\$heap_{724,1;748,8}$.M3) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;748,8}$.p3) < (**int**)0))) + **asType**<**int**>($\$heap_{724,1;748,8}$.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)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a3}$))

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))$ /
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==$
$\mathbf{asType{<}integer{>}}(\mathrm{div3.quot})$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}))$ %
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==$
$\mathbf{asType{<}integer{>}}(\mathrm{div3.rem})$

$!(0 == \mathbf{asType{<}integer{>}}(\mathrm{div3.rem})) \,||\, !(0 ==$
$\mathbf{asType{<}integer{>}}(\mathrm{div3.quot}))$

$\$\mathrm{heap}_{724,1;740,8} == \$\mathrm{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\mathrm{p1} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div1.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\mathrm{div1.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))$

$-\mathbf{asType{<}integer\ const{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})$

$!(0 == \mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1}))$

$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})$

$\$\mathrm{heap}_{724,1;742,8} == \$\mathrm{heap}_{724,1;740,8}.\_\mathbf{replace}(\mathrm{p2} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div2.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\mathrm{div2.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))$

$-\mathbf{asType{<}integer\ const{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})$

$!(0 == \mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2}))$

$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})$

$\$\mathrm{heap}_{724,1;744,8} == \$\mathrm{heap}_{724,1;742,8}.\_\mathbf{replace}(\mathrm{p3} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div3.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\mathrm{div3.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))$

$-\mathbf{asType{<}integer\ const{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})$

$!(0 == \mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3}))$

$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3}) <$
$\mathbf{asType{<}integer{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})$

$\$\mathrm{heap}_{724,1;747,8} == \$\mathrm{heap}_{724,1;744,8}.\_\mathbf{replace}(\mathrm{p1} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M1})\ *$
$\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1}) <$
$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})))$

$\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\_$**replace**$(p2 \to$ **asType**$<$**short int**$>(($**asType**$<$**int**$>(\$heap_{724,1;747,8}.$M2$) *$ **asType**$<$**int**$>($**static_cast**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{724,1;747,8}.$p2$) <$ **(int)**$0))) +$ **asType**$<$**int**$>(\$heap_{724,1;747,8}.$p2$)))$

Proof:

[Take goal term]

[1.0] **minof**(**short int**) $\leq ((\textbf{asType}<\textbf{int}>(\$heap_{724,1;748,8}.$M3$) *$ **asType**$<$**int**$>($**static_cast**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$) <$ **(int)**$0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[simplify]*

[1.1] -32768 $\leq ((\textbf{asType}<\textbf{int}>(\$heap_{724,1;748,8}.$M3$) *$ **asType**$<$**int**$>($**static_cast**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$) <$ **(int)**$0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[const static or extern object]*

[1.2] -32768 $\leq ((\textbf{asType}<\textbf{int}>(\$heap_{init}.$M3$) *$ **asType**$<$**int**$>($**static_cast**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$) <$ **(int)**$0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.3] -32768 $\leq ((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\textbf{(int)}30323)) *$ **asType**$<$**int**$>($**static_cast**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$) <$ **(int)**$0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[simplify]*

[1.11] -32768 $\leq ((30323 *$ **asType**$<$**int**$>(([0 < -\$heap_{724,1;748,8}.$p3$]: 1, []: 0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.12] -32768 $\leq ((30323 *$ **asType**$<$**int**$>(([0 < -\$heap_{724,1;748,8}.$p3$]: 1, [!(0 < -\$heap_{724,1;748,8}.$p3$)]: 0))) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[simplify]*

[1.16] -32768 $\leq ((30323 * ([0 < -\$heap_{724,1;748,8}.$p3$]: 1, [-1 < \$heap_{724,1;748,8}.$p3$]: 0)) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[move guard outside expression]*

[1.17] -32768 $\leq ((([0 < -\$heap_{724,1;748,8}.$p3$]: 1 * 30323, [-1 < \$heap_{724,1;748,8}.$p3$]: 0 * 30323) +$ **asType**$<$**int**$>(\$heap_{724,1;748,8}.$p3$))$

$\to$ *[simplify]*

[1.20] -32768 $\leq ((([0 < -\$heap_{724,1;748,8}.$p3$]: 30323, [-1 < \$heap_{724,1;748,8}.$p3$]: 0) + \$heap_{724,1;748,8}.$p3$)$

$\to$ *[move guard outside expression]*

[1.21] -32768 ≤ ([0 < −$heap$_{724,1;748,8}$.p3]: 30323 + $heap$_{724,1;748,8}$.p3, [-1 < $heap$_{724,1;748,8}$.p3]: 0 + $heap$_{724,1;748,8}$.p3)

→ *[simplify]*

[1.24] -32769 < ([0 < −$heap$_{724,1;748,8}$.p3]: 30323 + $heap$_{724,1;748,8}$.p3, [-1 < $heap$_{724,1;748,8}$.p3]: $heap$_{724,1;748,8}$.p3)

→ *[move guard outside expression]*

[1.25] ([0 < −$heap$_{724,1;748,8}$.p3]: -32769 < (30323 + $heap$_{724,1;748,8}$.p3), [-1 < $heap$_{724,1;748,8}$.p3]: -32769 < $heap$_{724,1;748,8}$.p3)

→ *[simplify]*

[1.27] ([0 < −$heap$_{724,1;748,8}$.p3]: -63092 < $heap$_{724,1;748,8}$.p3, [-1 < $heap$_{724,1;748,8}$.p3]: -32769 < $heap$_{724,1;748,8}$.p3)

→ *[from guard, literala < $heap$_{724,1;748,8}$.p3 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[1.27.0] (-32769 + -1) < -1

→ *[simplify]*

[1.27.2] **true**

[1.28] ([0 < −$heap$_{724,1;748,8}$.p3]: -63092 < $heap$_{724,1;748,8}$.p3, [-1 < $heap$_{724,1;748,8}$.p3]: **true**)

→ *[negate goal and search for contradiction]*

[1.29] !([0 < −$heap$_{724,1;748,8}$.p3]: -63092 < $heap$_{724,1;748,8}$.p3, [-1 < $heap$_{724,1;748,8}$.p3]: **true**)

→ *[move guard outside expression]*

[1.30] ([0 < −$heap$_{724,1;748,8}$.p3]: !(-63092 < $heap$_{724,1;748,8}$.p3), [-1 < $heap$_{724,1;748,8}$.p3]: !**true**)

→ *[simplify]*

[1.35] (0 < −$heap$_{724,1;748,8}$.p3) ∧ (63091 < −$heap$_{724,1;748,8}$.p3)

[Work on sub-term 2 of conjunction in term 1.35]

[69.0] 63091 < −$heap$_{724,1;748,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.35]

[70.0] **minof**(**short int**) ≤ $heap$_{724,1;748,8}$.p3

→ *[simplify]*

[70.3] -32769 < $heap$_{724,1;748,8}$.p3

→ *[from term 69.0, literala < $heap$_{724,1;748,8}$.p3 is false whenever -2 < (63091 + literala)]*

Proof of rule precondition:

[70.3.0] -2 < (-32769 + 63091)

$\rightarrow$ *[simplify]*

[70.3.2] **true**

[70.4] **false**

Proof of verification condition: Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,8)

Condition defined at:

To prove: $((\textbf{asType}\texttt{<int>}(\$\text{heap}_{724,1;748,8}.\text{M3})$ * $\textbf{asType}\texttt{<int>}(\textbf{static\_cast}\texttt{<integer>}(\textbf{asType}\texttt{<int>}(\$\text{heap}_{724,1;748,8}.\text{p3}) <$ $(\textbf{int})0))) + \textbf{asType}\texttt{<int>}(\$\text{heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof(short int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\texttt{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\texttt{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\texttt{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\texttt{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\texttt{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\texttt{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\texttt{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\texttt{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\texttt{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\texttt{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\texttt{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\texttt{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\texttt{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\texttt{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\texttt{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\textbf{asType}\texttt{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{p1})$, $\textbf{asType}\texttt{<int>}(\$\text{heap}_{funcstart\_724,1}.\text{a1}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \:/\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p1})) \:\%\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a1}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})) \:||\: !(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot}))$

$\text{div2} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2}),$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \:/\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p2})) \:\%\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a2}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})) \:||\: !(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot}))$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3}),$
$\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \:/\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{p3})) \:\%\: \textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{a3}))) == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})) \:||\: !(0 == \textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot}))$

$\$\text{heap}_{724,1;740,8} == \$\text{heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \to \textbf{asType}\langle\textbf{short int}\rangle((\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.rem})) * \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{r1})) - (\textbf{asType}\langle\textbf{int}\rangle(\textbf{asType}\langle\textbf{short int}\rangle(\text{div1.quot})) * \textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_724,1}.\text{b1}))))$

$-\textbf{asType}\langle\textbf{integer const}\rangle(\$\text{heap}_{724,1;740,8}.\text{M1}) < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1})$

$!(0 == \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1}))$

$\textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{p1}) < \textbf{asType}\langle\textbf{integer}\rangle(\$\text{heap}_{724,1;740,8}.\text{M1})$

$\text{\$heap}_{724,1;742,8} == \text{\$heap}_{724,1;740,8}.\textbf{\_replace}(p2 \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;740,8}.\text{b2}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;742,8}.\text{M2}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{p2}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;742,8}.\text{M2})$

$\text{\$heap}_{724,1;744,8} == \text{\$heap}_{724,1;742,8}.\textbf{\_replace}(p3 \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}\textbf{<integer const>}(\text{\$heap}_{724,1;744,8}.\text{M3}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{p3}) < \textbf{asType}\textbf{<integer>}(\text{\$heap}_{724,1;744,8}.\text{M3})$

$\text{\$heap}_{724,1;747,8} == \text{\$heap}_{724,1;744,8}.\textbf{\_replace}(p1 \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;744,8}.\text{M1}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;744,8}.\text{p1})))$

$\text{\$heap}_{724,1;748,8} == \text{\$heap}_{724,1;747,8}.\textbf{\_replace}(p2 \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;747,8}.\text{M2}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;747,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;747,8}.\text{p2})))$

Proof:

[Take goal term]

[1.0] $((\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{M3}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[const static or extern object]*

[1.1] $((\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{M3}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.2] $((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30323)) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

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$\rightarrow$ *[simplify]*

[1.10] $((30323 * \textbf{asType<int>}(([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 1, []: 0))) +$
$\textbf{asType<int>}(\$\text{heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] $((30323 * \textbf{asType<int>}(([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 1, [!(0 <$
$-\$\text{heap}_{724,1;748,8}.\text{p3})]: 0))) + \textbf{asType<int>}(\$\text{heap}_{724,1;748,8}.\text{p3})) \leq$
$\textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.15] $((30323 * ([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 1, [-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: 0)) +$
$\textbf{asType<int>}(\$\text{heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[move guard outside expression]*

[1.16] $((([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 1 * 30323, [-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: 0 *$
$30323) + \textbf{asType<int>}(\$\text{heap}_{724,1;748,8}.\text{p3})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.19] $((([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 30323, [-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: 0) +$
$\$\text{heap}_{724,1;748,8}.\text{p3}) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[move guard outside expression]*

[1.20] $([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 30323 + \$\text{heap}_{724,1;748,8}.\text{p3}, [-1 <$
$\$\text{heap}_{724,1;748,8}.\text{p3}]: 0 + \$\text{heap}_{724,1;748,8}.\text{p3}) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.23] $(-1 + ([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 30323 + \$\text{heap}_{724,1;748,8}.\text{p3}, [-1 <$
$\$\text{heap}_{724,1;748,8}.\text{p3}]: \$\text{heap}_{724,1;748,8}.\text{p3})) < 32767$

$\rightarrow$ *[move guard outside expression]*

[1.24] $([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: -1 + (30323 + \$\text{heap}_{724,1;748,8}.\text{p3}), [-1 <$
$\$\text{heap}_{724,1;748,8}.\text{p3}]: -1 + \$\text{heap}_{724,1;748,8}.\text{p3}) < 32767$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + -([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 30322 + \$\text{heap}_{724,1;748,8}.\text{p3},$
$[-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: -1 + \$\text{heap}_{724,1;748,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < (32767 + ([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: -(30322 +$
$\$\text{heap}_{724,1;748,8}.\text{p3}), [-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: -(-1 + \$\text{heap}_{724,1;748,8}.\text{p3})))$

$\rightarrow$ *[simplify]*

[1.32] $0 < (32767 + ([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: -30322 + -\$\text{heap}_{724,1;748,8}.\text{p3},$
$[-1 < \$\text{heap}_{724,1;748,8}.\text{p3}]: 1 + -\$\text{heap}_{724,1;748,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[1.33] $0 < ([0 < -\$\text{heap}_{724,1;748,8}.\text{p3}]: 32767 + (-30322 + -\$\text{heap}_{724,1;748,8}.\text{p3}),$

[-1 < $\$heap_{724,1;748,8}.p3$]: 32767 + (1 + $-\$heap_{724,1;748,8}.p3$))

→ [simplify]

[1.37] 0 < ([0 < $-\$heap_{724,1;748,8}.p3$]: 2445 + $-\$heap_{724,1;748,8}.p3$, [-1 < $\$heap_{724,1;748,8}.p3$]: 32768 + $-\$heap_{724,1;748,8}.p3$)

→ [move guard outside expression]

[1.38] ([0 < $-\$heap_{724,1;748,8}.p3$]: 0 < (2445 + $-\$heap_{724,1;748,8}.p3$), [-1 < $\$heap_{724,1;748,8}.p3$]: 0 < (32768 + $-\$heap_{724,1;748,8}.p3$))

→ [simplify]

[1.40] ([0 < $-\$heap_{724,1;748,8}.p3$]: -2445 < $-\$heap_{724,1;748,8}.p3$, [-1 < $\$heap_{724,1;748,8}.p3$]: 0 < (32768 + $-\$heap_{724,1;748,8}.p3$))

→ [from guard, literala < $-\$heap_{724,1;748,8}.p3$ is true whenever (-1 + literala) < 0]

Proof of rule precondition:

[1.40.0] (-2445 + -1) < 0

→ [simplify]

[1.40.2] **true**

[1.41] ([0 < $-\$heap_{724,1;748,8}.p3$]: **true**, [-1 < $\$heap_{724,1;748,8}.p3$]: 0 < (32768 + $-\$heap_{724,1;748,8}.p3$))

→ [simplify]

[1.43] ([0 < $-\$heap_{724,1;748,8}.p3$]: **true**, [-1 < $\$heap_{724,1;748,8}.p3$]: -32768 < $-\$heap_{724,1;748,8}.p3$)

→ [negate goal and search for contradiction]

[1.44] !([0 < $-\$heap_{724,1;748,8}.p3$]: **true**, [-1 < $\$heap_{724,1;748,8}.p3$]: -32768 < $-\$heap_{724,1;748,8}.p3$)

→ [move guard outside expression]

[1.45] ([0 < $-\$heap_{724,1;748,8}.p3$]: !**true**, [-1 < $\$heap_{724,1;748,8}.p3$]: !(-32768 < $-\$heap_{724,1;748,8}.p3$))

→ [simplify]

[1.51] (-1 < $\$heap_{724,1;748,8}.p3$) ∧ (32767 < $\$heap_{724,1;748,8}.p3$)

[Work on sub-term 2 of conjunction in term 1.51]

[69.0] 32767 < $\$heap_{724,1;748,8}.p3$

[Assume known post-assertion, class invariant or type constraint for term 1.51]

[70.0] $\$heap_{724,1;748,8}.p3$ ≤ **maxof**(**short int**)

→ [simplify]

[70.9] -32768 < $-\$heap_{724,1;748,8}.p3$

$\rightarrow$ *[from term 69.0, literala $< -\$heap_{724,1;748,8}.p3$ is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[70.9.0] -2 < (-32768 + 32767)

$\rightarrow$ *[simplify]*

[70.9.2] **true**

[70.10] **false**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (71,12)

To prove: invariant1(**heapIs** $\$heap_{funcend\_724,1}$)

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)

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==

asType<integer>(div1.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

(asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

(asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$heap$_{724,1;740,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_724,1}$.b1))))

−**asType<integer const>**($heap$_{724,1;740,8}$.M1) <
asType<integer>($heap$_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($heap$_{724,1;740,8}$.p1))

asType<integer>($heap$_{724,1;740,8}$.p1) <
asType<integer>($heap$_{724,1;740,8}$.M1)

$heap$_{724,1;742,8}$ == $heap$_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *

asType<int>($heap$_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{724,1;740,8}$.b2))))

−**asType<integer const>**($heap$_{724,1;742,8}$.M2) <
asType<integer>($heap$_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($heap$_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$.__replace__(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) <
asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) <
asType<integer>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$.__replace__(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) <
(int)0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

$heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$.__replace__(p2 → **asType<short int>**((**asType<int>**($heap$_{724,1;747,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) <
(int)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$.__replace__(p3 → **asType<short int>**((**asType<int>**($heap$_{724,1;748,8}$.M3) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.p3) <
(int)0))) + **asType<int>**($heap$_{724,1;748,8}$.p3)))

Proof:

[Take goal term]

[1.0] invariant1(**heapIs** $heap$_{funcend_724,1}$)

→ *[expand definition of function 'invariant1' at prang.c (34,1)]*

[1.1] (((((0 < **asType<integer>**($heap$_{funcend_724,1}$.p1)) &&
(**asType<integer>**($heap$_{funcend_724,1}$.p1) <
asType<integer>($heap$_{funcend_724,1}$.M1))) && (0 <
asType<integer>($heap$_{funcend_724,1}$.p2))) &&
(**asType<integer>**($heap$_{funcend_724,1}$.p2) <
asType<integer>($heap$_{funcend_724,1}$.M2))) && (0 <
asType<integer>($heap$_{funcend_724,1}$.p3))) &&

($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M3}$))

$\rightarrow$ *[simplify]*

[1.3] ((((($0 <$ $\text{\$heap}_{funcend\_724,1}.\text{p1}$) && ($\text{\$heap}_{funcend\_724,1}.\text{p1} <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M1}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M2}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M3}$))

$\rightarrow$ *[const static or extern object]*

[1.4] (((((($0 <$ $\text{\$heap}_{funcend\_724,1}.\text{p1}$) && ($\text{\$heap}_{funcend\_724,1}.\text{p1} <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{init}.\text{M1}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M2}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M3}$))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.5] (((((($0 <$ $\text{\$heap}_{funcend\_724,1}.\text{p1}$) && ($\text{\$heap}_{funcend\_724,1}.\text{p1} <$
$\mathbf{asType}$<$\mathbf{integer}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(($\mathbf{int}$)30269)))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p2}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M2}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M3}$))

$\rightarrow$ *[simplify]*

[1.16] (((((-30269 $< -\text{\$heap}_{funcend\_724,1}.\text{p1}$) $\wedge$ ($0 <$ $\text{\$heap}_{funcend\_724,1}.\text{p1}$) $\wedge$ (0
$<$ $\text{\$heap}_{funcend\_724,1}.\text{p2}$)) && ($\text{\$heap}_{funcend\_724,1}.\text{p2} <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M2}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$))) &&
($\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$) <
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{M3}$))

$\rightarrow$ *[const static or extern object]*

[1.17] (((((-30269 $< -\text{\$heap}_{funcend\_724,1}.\text{p1}$) $\wedge$ ($0 <$ $\text{\$heap}_{funcend\_724,1}.\text{p1}$) $\wedge$ (0
$<$ $\text{\$heap}_{funcend\_724,1}.\text{p2}$)) && ($\text{\$heap}_{funcend\_724,1}.\text{p2} <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{init}.\text{M2}$))) && ($0 <$
$\mathbf{asType}$<$\mathbf{integer}$>($\text{\$heap}_{funcend\_724,1}.\text{p3}$))) &&

($\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.p3) <
$\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.M3))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.18] (((((-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0
< $\$\text{heap}_{funcend\_724,1}$.p2)) && ($\$\text{heap}_{funcend\_724,1}$.p2 <
$\textbf{asType}$<$\textbf{integer}$>($\textbf{asType}$<$\textbf{short int}$>(($\textbf{int}$)30307)))) && (0 <
$\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.p3))) &&
($\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.p3) <
$\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.M3))

$\rightarrow$ *[simplify]*

[1.30] ((-30307 < $-\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1)
$\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (0 <
$\$\text{heap}_{funcend\_724,1}$.p3)) && ($\$\text{heap}_{funcend\_724,1}$.p3 <
$\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{funcend\_724,1}$.M3))

$\rightarrow$ *[const static or extern object]*

[1.31] ((-30307 < $-\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1)
$\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (0 <
$\$\text{heap}_{funcend\_724,1}$.p3)) && ($\$\text{heap}_{funcend\_724,1}$.p3 <
$\textbf{asType}$<$\textbf{integer}$>($\$\text{heap}_{init}$.M3))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.32] ((-30307 < $-\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1)
$\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (0 <
$\$\text{heap}_{funcend\_724,1}$.p3)) && ($\$\text{heap}_{funcend\_724,1}$.p3 <
$\textbf{asType}$<$\textbf{integer}$>($\textbf{asType}$<$\textbf{short int}$>(($\textbf{int}$)30323)))

$\rightarrow$ *[simplify]*

[1.40] (-30323 < $-\$\text{heap}_{funcend\_724,1}$.p3) $\land$ (-30307 < $-\$\text{heap}_{funcend\_724,1}$.p2)
$\land$ (-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\land$ (0 <
$\$\text{heap}_{funcend\_724,1}$.p2) $\land$ (0 < $\$\text{heap}_{funcend\_724,1}$.p3)

$\rightarrow$ *[negate goal and search for contradiction]*

[1.41] !(-30323 < $-\$\text{heap}_{funcend\_724,1}$.p3) $\lor$!(-30307 < $-\$\text{heap}_{funcend\_724,1}$.p2)
$\lor$!(-30269 < $-\$\text{heap}_{funcend\_724,1}$.p1) $\lor$!(0 < $\$\text{heap}_{funcend\_724,1}$.p1) $\lor$!(0 <
$\$\text{heap}_{funcend\_724,1}$.p2) $\lor$!(0 < $\$\text{heap}_{funcend\_724,1}$.p3)

$\rightarrow$ *[simplify]*

[1.56] (30322 < $\$\text{heap}_{funcend\_724,1}$.p3) $\lor$ (30306 < $\$\text{heap}_{funcend\_724,1}$.p2) $\lor$
(30268 < $\$\text{heap}_{funcend\_724,1}$.p1) $\lor$ (-1 < $-\$\text{heap}_{funcend\_724,1}$.p1) $\lor$ (-1 <
$-\$\text{heap}_{funcend\_724,1}$.p2) $\lor$ (-1 < $-\$\text{heap}_{funcend\_724,1}$.p3)

[Take given term]

[11.0] div1 == div($\textbf{heapIs}$ $\$\text{heap}_{funcstart\_724,1}$,
$\textbf{asType}$<$\textbf{int}$>($\$\text{heap}_{funcstart\_724,1}$.p1),

asType<int>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[simplify]*

[11.1] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{funcstart_724,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[11.2] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[11.3] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[11.6] div1 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177)

[Take given term]

[25.0] div2 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p2),
asType<int>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[simplify]*

[25.1] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{funcstart_724,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[25.2] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[25.3] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[25.6] div2 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176)

[Take given term]

[39.0] div3 == div(**heapIs** $heap$_{funcstart_724,1}$,
asType<int>($heap$_{funcstart_724,1}$.p3),
asType<int>($heap$_{funcstart_724,1}$.a3))

$\rightarrow$ *[simplify]*

[39.1] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,
asType<int>($heap$_{funcstart_724,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[39.2] div3 == div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3,

asType$<$**int**$>$($\$$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[39.3] div3 == div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)178)))

$\rightarrow$ *[simplify]*

[39.6] div3 == div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178)

[Take given term]

[53.0] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[from term 11.6, div1 is equal to div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177)]*

[53.1] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.3] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[53.4] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$($\$$heap$_{init}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[53.5] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)171))) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

$\rightarrow$ *[simplify]*

[53.8] $\$$heap$_{724,1;740,8}$ == $\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem * 171) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$$heap$_{funcstart\_724,1}$.b1)))))

→ *[from term 11.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177)]*

[53.9] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[simplify]*

[53.11] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_724,1}$.b1))))

→ *[const static or extern object]*

[53.12] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[53.13] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[53.19] $\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Take given term]

[54.0] −**asType**<**integer const**>($\$heap_{724,1;740,8}$.M1) < **asType**<**integer**>($\$heap_{724,1;740,8}$.p1)

→ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[54.1] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).M1) < **asType**<**integer**>($\$heap_{724,1;740,8}$.p1)

→ *[const member of object with modified fields]*

[54.2] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$.M1) <

827

asType<integer>($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[const static or extern object]*

[54.3] $-$**asType<integer const>**($heap_{init}$.M1) <
asType<integer>($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[54.4] $-$**asType<integer const>**(**asType<short int>**((int)30269)) <
asType<integer>($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[simplify]*

[54.8] -30269 < **asType<integer>**($heap_{724,1;740,8}$.p1)

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[54.9] -30269 < **asType<integer>**($heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p1)

$\rightarrow$ *[simplify]*

[54.11] -30269 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))

[Take given term]

[55.0] !(0 == **asType<integer>**($heap_{724,1;740,8}$.p1))

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[55.1] !(0 == **asType<integer>**($heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p1))

$\rightarrow$ *[simplify]*

[55.3] !(0 == ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)))

[Take given term]

[56.0] **asType<integer>**($heap_{724,1;740,8}$.p1) <
asType<integer>($heap_{724,1;740,8}$.M1)

$\rightarrow$ *[from term 53.19, $heap_{724,1;740,8}$ is equal to
$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$,*

$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[56.1] **asType**<**integer**>($heap$_{funcstart_724,1}._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).rem))).p1) <
asType<**integer**>($heap$_{724,1;740,8}.M1)

→ *[simplify]*

[56.3] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).rem)) < **asType**<**integer**>($heap$_{724,1;740,8}.M1)

→ *[from term 53.19, $heap$_{724,1;740,8} is equal to*
$\$heap_{funcstart\_724,1}._\textbf{replace}(p1 → (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[56.4] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).rem)) < **asType**<**integer**>($heap$_{funcstart_724,1}._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).rem))).M1)

→ *[const member of object with modified fields]*

[56.5] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).rem)) < **asType**<**integer**>($heap$_{funcstart_724,1}.M1)

→ *[const static or extern object]*

[56.6] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).rem)) < **asType**<**integer**>($heap$_{init}.M1)

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[56.7] ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1,
177).rem)) < **asType**<**integer**>(**asType**<**short int**>((**int**)30269))

→ *[simplify]*

[56.17] -30269 < ((-171 * div(**heapIs** $heap$_{funcstart_724,1},
$heap$_{funcstart_724,1}.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_724,1},
$heap$_{funcstart_724,1}.p1, 177).quot))

[Take given term]

[57.0] $heap$_{724,1;742,8} == $heap$_{724,1;740,8}._**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}.r2)) − (**asType**<**int**>(**asType**<**short**

int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$.__replace(p1 → (-2 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.1] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).__replace__(p2 → **asType**<**short**
int>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 25.6, div2 is equal to div(__heapIs__ $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p2, 176)]

[57.2] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).__replace__(p2 → **asType**<**short**
int>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)) * **asType**<**int**>($heap$_{724,1;740,8}$.r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[simplify]*

[57.4] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>($heap$_{724,1;740,8}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{724,1;740,8}$.b2))))

→ *[from term 53.19, $heap$_{724,1;740,8}$ is equal to*
*$heap$_{funcstart_724,1}$.__replace(p1 → (-2 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap$_{funcstart_724,1}$,*
$heap$_{funcstart_724,1}$.p1, 177).rem))]

[57.5] $heap$_{724,1;742,8}$ == $heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).__replace__(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_724,1}$.__replace__(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).r2)) −

(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[const member of object with modified fields]*

[57.6] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>($\text{heap}_{funcstart\_724,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[const static or extern object]*

[57.7] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(heap_{init}.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[57.8] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[simplify]*

[57.11] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{heap}_{724,1;740,8}$.b2)))))

→ *[from term 25.6, div2 is equal to div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176)]*

[57.12] $\text{heap}_{724,1;742,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**

$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) $-$
(**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot)) * **asType\<int\>**($\$\text{heap}_{724,1;740,8}.\text{b2}$))))

$\rightarrow$ *[simplify]*

[57.14] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)))._**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot *
asType\<int\>($\$\text{heap}_{724,1;740,8}.\text{b2}$))))

$\rightarrow$ *[from term 53.19, $\$heap_{724,1;740,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\_$**replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p1$, 177).rem))]

[57.15] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)))._**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot *
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[57.16] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)))._**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot *
asType\<int\>($\$\text{heap}_{funcstart\_724,1}.\text{b2}$))))

$\rightarrow$ *[const static or extern object]*

[57.17] $\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{funcstart\_724,1}.\_$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}$,
177).rem)))._**replace**(p2 $\rightarrow$ **asType\<short int\>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).rem) $-$ (div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}$, 176).quot *
asType\<int\>($\$\text{heap}_{init}.\text{b2}$))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[57.18] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[57.24] $\$heap_{724,1;742,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem)))

[Take given term]

[58.0] −**asType**<**integer const**>($\$heap_{724,1;742,8}$.M2) <
asType<**integer**>($\$heap_{724,1;742,8}$.p2)

→ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to
$\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[58.1] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).M2) <
asType<**integer**>($\$heap_{724,1;742,8}$.p2)

→ *[const member of object with modified fields]*

[58.3] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$.M2) <
asType<**integer**>($\$heap_{724,1;742,8}$.p2)

→ *[const static or extern object]*

[58.4] −**asType**<**integer const**>($\$heap_{init}$.M2) <
asType<**integer**>($\$heap_{724,1;742,8}$.p2)

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[58.5] −**asType**<**integer const**>(**asType**<**short int**>((**int**)30307)) <
asType<**integer**>($\$heap_{724,1;742,8}$.p2)

→ *[simplify]*

[58.9] -30307 < **asType**<**integer**>($heap$_{724,1;742,8}$.p2)

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))]

[58.10] -30307 < **asType**<**integer**>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2
* div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).p2)

→ *[simplify]*

[58.12] -30307 < ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))

[Take given term]

[59.0] !(0 == **asType**<**integer**>($heap$_{724,1;742,8}$.p2))

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,*
*$heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))]

[59.1] !(0 == **asType**<**integer**>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).p2))

→ *[simplify]*

[59.3] !(0 == ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem)))

[Take given term]

[60.0] **asType**<**integer**>($heap$_{724,1;742,8}$.p2) <
asType<**integer**>($heap$_{724,1;742,8}$.M2)

→ *[from term 57.24, $heap$_{724,1;742,8}$ is equal to*
*$heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,*

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$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))]$

[60.1] $\textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 *$
div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).p2) <$
$\textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.M2)$

$\rightarrow$ *[simplify]*

[60.3] $((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).rem)) < \textbf{asType}<\textbf{integer}>(\$heap_{724,1;742,8}.M2)$

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
$\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))]$

[60.4] $((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).rem)) < \textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 *$
div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).M2)$

$\rightarrow$ *[const member of object with modified fields]*

[60.6] $((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).rem)) < \textbf{asType}<\textbf{integer}>(\$heap_{funcstart\_724,1}.M2)$

$\rightarrow$ *[const static or extern object]*

[60.7] $((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).rem)) < \textbf{asType}<\textbf{integer}>(\$heap_{init}.M2)$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[60.8] $((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
$176).rem)) < \textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30307))$

$\rightarrow$ *[simplify]*

[60.18] -30307 < ((-172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).quot))

[Take given term]

[61.0] \$heap$_{724,1;744,8}$ == \$heap$_{724,1;742,8}$.**replace**(p3 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>(\$heap$_{724,1;742,8}$.r3)) $-$ (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**(\$heap$_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, \$heap$_{724,1;742,8}$ is equal to*
*\$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs***
*\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))]

[61.1] \$heap$_{724,1;744,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>(\$heap$_{724,1;742,8}$.r3)) $-$ (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**(\$heap$_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 39.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p3, 178)]

[61.2] \$heap$_{724,1;744,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p3, 178).rem)) * **asType<int>**(\$heap$_{724,1;742,8}$.r3)) $-$
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>(\$heap$_{724,1;742,8}$.b3))))

$\rightarrow$ *[simplify]*

[61.4] \$heap$_{724,1;744,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div3.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[from term 57.24, $\text{\$heap}_{724,1;742,8}$ is equal to*
*$\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2 * div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$*
*$\text{\$heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$*
*$\text{\$heap}_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (\text{-35 * div}(\textbf{heapIs}$*
*$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))]$

[61.5] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{rem}))).\_\textbf{replace}(p3 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1, 177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow ((\text{-35}$
$* \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2, 176).\text{rem}))).\text{r3})) -$
$(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot})) *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[const member of object with modified fields]*

[61.7] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{rem}))).\_\textbf{replace}(p3 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_724,1}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div3.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{724,1;742,8}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[61.8] $\text{\$heap}_{724,1;744,8} == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,$
$177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1},$
$\text{\$heap}_{funcstart\_724,1}.p2, 176).\text{rem}))).\_\textbf{replace}(p3 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3, 178).\text{rem} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$

int>(div3.quot)) * **asType**<**int**>($heap$_{724,1;742,8}$.b3))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[61.9] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($heap$_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.12] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($heap$_{724,1;742,8}$.b3))))

→ *[from term 39.6, div3 is equal to div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178)]*

[61.13] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot)) * **asType**<**int**>($heap$_{724,1;742,8}$.b3))))

→ *[simplify]*

[61.15] $heap$_{724,1;744,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem) −
(div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot *

asType$<$int$>$($\$heap_{724,1;742,8}$.b3))))

$\rightarrow$ *[from term 57.24, $\$heap_{724,1;742,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ (-35 * div(__heapIs__*
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(__heapIs__*
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]

[61.16] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).b3))))

$\rightarrow$ *[const member of object with modified fields]*

[61.18] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{funcstart\_724,1}$.b3))))

$\rightarrow$ *[const static or extern object]*

[61.19] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).__replace__(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).__replace__(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{init}$.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[61.20] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.__replace__(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[61.26] $\$heap_{724,1;744,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take given term]

[62.0] −**asType**<**integer const**>($\$heap_{724,1;744,8}$.M3) <
asType<**integer**>($\$heap_{724,1;744,8}$.p3)

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → (-63 ***
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 ***
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[62.1] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).M3) <
asType<**integer**>($\$heap_{724,1;744,8}$.p3)

→ *[const member of object with modified fields]*

[62.4] −**asType**<**integer const**>($\$heap_{funcstart\_724,1}$.M3) <
asType<**integer**>($\$heap_{724,1;744,8}$.p3)

→ *[const static or extern object]*

[62.5] −**asType**<**integer const**>($heap$_{init}$.M3) <
asType<**integer**>($heap$_{724,1;744,8}$.p3)

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[62.6] −**asType**<**integer const**>(**asType**<**short int**>((**int**)30323)) <
asType<**integer**>($heap$_{724,1;744,8}$.p3)

→ *[simplify]*

[62.10] -30323 < **asType**<**integer**>($heap$_{724,1;744,8}$.p3)

→ *[from term 61.26, $heap$_{724,1;744,8}$ is equal to
$heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))]*

[62.11] -30323 < **asType**<**integer**>($heap$_{funcstart_724,1}$._**replace**(p1 → ((-2
* div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))).p3)

→ *[simplify]*

[62.13] -30323 < ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).rem))

[Take given term]

[63.0] !(0 == **asType**<**integer**>($heap$_{724,1;744,8}$.p3))

→ *[from term 61.26, $heap$_{724,1;744,8}$ is equal to
$heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))]*

[63.1] !(0 == **asType**<**integer**>($heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,

$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).p3))

→ *[simplify]*

[63.3] !(0 == ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))

[Take given term]

[64.0] **asType**<**integer**>($heap_{724,1;744,8}$.p3) < **asType**<**integer**>($heap_{724,1;744,8}$.M3)

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to $heap_{funcstart\_724,1}$._replace(p1 → ((-2 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._replace(p2 → ((-35 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._replace(p3 → (-63 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[64.1] **asType**<**integer**>($heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).p3) < **asType**<**integer**>($heap_{724,1;744,8}$.M3)

→ *[simplify]*

[64.3] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)) < **asType**<**integer**>($heap_{724,1;744,8}$.M3)

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to $heap_{funcstart\_724,1}$._replace(p1 → ((-2 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._replace(p2 → ((-35 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._replace(p3 → (-63 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[64.4] ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,

178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)) < **asType**<**integer**>(\$heap$_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)))).M3)

→ *[const member of object with modified fields]*

[64.7] ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)) < **asType**<**integer**>(\$heap$_{funcstart\_724,1}$.M3)

→ *[const static or extern object]*

[64.8] ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)) < **asType**<**integer**>(\$heap$_{init}$.M3)

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[64.9] ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)) < **asType**<**integer**>(**asType**<**short int**>((**int**)30323))

→ *[simplify]*

[64.19] -30323 < ((-170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot))

[Take given term]

[65.0] \$heap$_{724,1;747,8}$ == \$heap$_{724,1;744,8}$._**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(\$heap$_{724,1;744,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>(\$heap$_{724,1;744,8}$.p1) < (**int**)0))) + **asType**<**int**>(\$heap$_{724,1;744,8}$.p1)))

→ *[from term 61.26, \$heap$_{724,1;744,8}$ is equal to \$heap$_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → (-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)))]*

[65.2] \$heap$_{724,1;747,8}$ == \$heap$_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 →
asType<short int>((**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2
* div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$\text{heap}_{724,1;744,8}$.p1) <
(int)0))) + **asType<int>**($\$\text{heap}_{724,1;744,8}$.p1)))

→ *[const member of object with modified fields]*

[65.5] $\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 →
asType<short int>((**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$\text{heap}_{724,1;744,8}$.p1) <
(int)0))) + **asType<int>**($\$\text{heap}_{724,1;744,8}$.p1)))

→ *[const static or extern object]*

[65.6] $\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
$\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 →
asType<short int>((**asType<int>**($\$\text{heap}_{init}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$\text{heap}_{724,1;744,8}$.p1) <
(int)0))) + **asType<int>**($\$\text{heap}_{724,1;744,8}$.p1)))

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[65.7] $\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1,

177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 →
asType<short int>((**asType<int>**(**asType<short int>**((**int**)30269)) *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1)))

→ *[simplify]*

[65.10] $\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 →
asType<short int>((30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{724,1;744,8}$.p1) <
(**int**)0))) + **asType<int>**($\$heap_{724,1;744,8}$.p1)))

→ *[from term 61.26, $\$heap_{724,1;744,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → (-63 ***
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 ***
*div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[65.11] $\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 →
asType<short int>((30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$. **replace**(p1
→ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**

$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p3}, 178).\text{rem}))).\text{p1}) < (\textbf{int})0))) + $
asType<**int**>($\text{heap}_{724,1;744,8}.\text{p1})))

$\rightarrow$ *[simplify]*

[65.23] $\text{heap}_{724,1;747,8} == \text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$**replace**(p1 $\rightarrow$
asType<**short int**>((30269 * **asType**<**int**>((([0 < ((-171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})]: 1, []: 0))) +$
asType<**int**>($\text{heap}_{724,1;744,8}.\text{p1})))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[65.24] $\text{heap}_{724,1;747,8} == \text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$**replace**(p1 $\rightarrow$
asType<**short int**>((30269 * **asType**<**int**>((([0 < ((-171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot})]: 1, [!(0 < ((-171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{rem}) + (2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))]: 0))) +$
asType<**int**>($\text{heap}_{724,1;744,8}.\text{p1})))

$\rightarrow$ *[simplify]*

[65.29] $\text{heap}_{724,1;747,8} == \text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1},$
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{heap}_{funcstart\_724,1},$
$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$**replace**(p1 $\rightarrow$
asType<**short int**>((30269 * **asType**<**int**>((([0 < ((-171 * div(**heapIs**
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot})]: 1, [-1 < ((171 *
div(**heapIs** $\text{heap}_{funcstart\_724,1}$, $\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{rem}) + (-2 *

div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot))]: 0))) +
asType<**int**>($\text{\$heap}_{724,1;744,8}$.p1)))

→ *[from term 55.3, -1 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)) is true if and only if 0 < ((-2 * div(**heapIs***
*$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs***
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))]

[65.30] $\text{\$heap}_{724,1;747,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 →
asType<**short int**>((30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0))) +
asType<**int**>($\text{\$heap}_{724,1;744,8}$.p1)))

→ *[simplify]*

[65.31] $\text{\$heap}_{724,1;747,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 →
asType<**short int**>((30269 * ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot))]: 1, [0 < ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))]: 0)) +
asType<**int**>($\text{\$heap}_{724,1;744,8}$.p1)))

→ *[move guard outside expression]*

[65.32] $\text{\$heap}_{724,1;747,8}$ == $\text{\$heap}_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → **asType**<**short int**>((\[0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))\]: 1 * 30269, \[0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))\]: 0 * 30269) + **asType**<**int**>($heap_{724,1;744,8}$.p1)))

→ *[simplify]*

[65.34] $heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → **asType**<**short int**>((\[0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))\]: 30269, \[0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))\]: 0) + **asType**<**int**>($heap_{724,1;744,8}$.p1)))

→ *[from term 61.26, $heap_{724,1;744,8}$ is equal to $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → (-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[65.35] $heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → **asType**<**short int**>((\[0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))\]: 30269, \[0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))\]: 0) +

asType<**int**>($heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2,
176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p3, 178).rem))).p1)))

→ [simplify]

[65.40] $heap$_{724,1;747,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))).**replace**(p1 →
asType<**short int**>((-2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem) + ([0 < ((-171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot))]: 30269, [0 < ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]: 0)))

→ [move guard outside expression]

[65.41] $heap$_{724,1;747,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))).**replace**(p1 →
asType<**short int**>(([0 < ((-171 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem), [0 < ((-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]: 0 + (-2 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))))

→ [simplify]

[65.43] $heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ([0 <
((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) +
(2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))]:
30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem), [0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))]: (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)))

→ *[move guard outside expression]*

[65.45] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).quot))]: $heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269
+ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))), [0
< ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]:
$heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))))

[Take given term]

[66.0] $heap_{724,1;748,8}$ == $heap_{724,1;747,8}$.**replace**(p2 → **asType**<**short**

int>((**asType<int>**($heap$_{724,1;747,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[const static or extern object]*

[66.1] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**((**asType<int>**($heap$_{init}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[66.2] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**((**int**)30307)) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[simplify]*

[66.10] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**((30307 * **asType<int>**(([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, []: 0))) +
asType<int>($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[66.11] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**((30307 * **asType<int>**(([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, [!(0 <
$-$$heap$_{724,1;747,8}$.p2)]: 0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[simplify]*

[66.15] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**((30307 * ([0 < $-$$heap$_{724,1;747,8}$.p2]: 1, [-1 < $heap$_{724,1;747,8}$.p2]: 0)) +
asType<int>($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[move guard outside expression]*

[66.16] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**(([0 < $-$$heap$_{724,1;747,8}$.p2]: 1 * 30307, [-1 < $heap$_{724,1;747,8}$.p2]: 0 *
30307) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[simplify]*

[66.19] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**(([0 < $-$$heap$_{724,1;747,8}$.p2]: 30307, [-1 < $heap$_{724,1;747,8}$.p2]: 0) +
$heap$_{724,1;747,8}$.p2))

$\rightarrow$ *[move guard outside expression]*

[66.20] $heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 $\rightarrow$ **asType<short
int>**(([0 < $-$$heap$_{724,1;747,8}$.p2]: 30307 + $heap$_{724,1;747,8}$.p2, [-1 <
$heap$_{724,1;747,8}$.p2]: 0 + $heap$_{724,1;747,8}$.p2)))

$\rightarrow$ *[simplify]*

[66.22] $\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\_\mathbf{replace}(p2 \to ([0 <$ $-\$heap_{724,1;747,8}.p2]: 30307 + \$heap_{724,1;747,8}.p2, [-1 < \$heap_{724,1;747,8}.p2]:$ $\$heap_{724,1;747,8}.p2))$

$\to$ *[move guard outside expression]*

[66.24] $([0 < -\$heap_{724,1;747,8}.p2]: \$heap_{724,1;748,8} ==$ $\$heap_{724,1;747,8}.\_\mathbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)), [-1 <$ $\$heap_{724,1;747,8}.p2]: \$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\_\mathbf{replace}(p2 \to$ $\$heap_{724,1;747,8}.p2))$

[Take given term]

[69.0] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.M3) *$ $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3) <$ $(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[const static or extern object]*

[69.1] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$heap_{init}.M3) *$ $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3) <$ $(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[69.2] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)) *$ $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3) <$ $(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[simplify]*

[69.10] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((30323 * \mathbf{asType{<}int{>}}(([0 < -\$heap_{724,1;748,8}.p3]: 1, []: 0))) +$ $\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[69.11] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((30323 * \mathbf{asType{<}int{>}}(([0 < -\$heap_{724,1;748,8}.p3]: 1, [!(0 <$ $-\$heap_{724,1;748,8}.p3)]: 0))) + \mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[simplify]*

[69.15] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}((30323 * ([0 < -\$heap_{724,1;748,8}.p3]: 1, [-1 < \$heap_{724,1;748,8}.p3]: 0)) +$ $\mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\to$ *[move guard outside expression]*

[69.16] $\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3 \to \mathbf{asType{<}short}$ $\mathbf{int{>}}(([0 < -\$heap_{724,1;748,8}.p3]: 1 * 30323, [-1 < \$heap_{724,1;748,8}.p3]: 0 *$ $30323) + \mathbf{asType{<}int{>}}(\$heap_{724,1;748,8}.p3)))$

$\rightarrow$ *[simplify]*

[69.19] $\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}(([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: 30323, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 0) + \text{\$heap}_{724,1;748,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[69.20] $\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}(([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: 30323 + \text{\$heap}_{724,1;748,8}.\text{p3}, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: 0 + \text{\$heap}_{724,1;748,8}.\text{p3})))$

$\rightarrow$ *[simplify]*

[69.22] $\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow ([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: 30323 + \text{\$heap}_{724,1;748,8}.\text{p3}, [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: \text{\$heap}_{724,1;748,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[69.24] $([0 < -\text{\$heap}_{724,1;748,8}.\text{p3}]: \text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow (30323 + \text{\$heap}_{724,1;748,8}.\text{p3})), [\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}]: \text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3}))$

[Branch on disjunction or conditional in term 69.24]

[72.0] $(\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow (30323 + \text{\$heap}_{724,1;748,8}.\text{p3}))) \vee (\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3})) \vee (\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3})$

[Branch on disjunction or conditional in term 69.24]

[73.0] $(0 < -\text{\$heap}_{724,1;748,8}.\text{p3}) \vee (\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3})) \vee (\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3})$

[Copy term 1.56]

[74.0] $((\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})) \vee (\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3})) \vee (\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3})$

$\rightarrow$ *[from term 72.0, $\text{\$heap}_{funcend\_724,1}$ is equal to $\text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow 30323 + \text{\$heap}_{724,1;748,8}.\text{p3})$]*

[74.1] $((\text{-1} < -\text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow (30323 + \text{\$heap}_{724,1;748,8}.\text{p3})).\text{p1}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.2] $((\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} <$

$-\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[from term 72.0, $\$\mathrm{heap}_{funcend\_724,1}$ is equal to $\$\mathrm{heap}_{724,1;748,8}.$**replace***(p3 $\rightarrow$ 30323 + $\$\mathrm{heap}_{724,1;748,8}.p3)]*

[74.3] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.$**replace**$(\mathrm{p3} \rightarrow (30323 + \$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})).\mathrm{p2}) \vee (-1 < -\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.4] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (-1 < -\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[from term 72.0, $\$\mathrm{heap}_{funcend\_724,1}$ is equal to $\$\mathrm{heap}_{724,1;748,8}.$**replace***(p3 $\rightarrow$ 30323 + $\$\mathrm{heap}_{724,1;748,8}.p3)]*

[74.5] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.$**replace**$(\mathrm{p3} \rightarrow (30323 + \$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})).\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.10] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (30322 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[from term 72.0, $\$\mathrm{heap}_{funcend\_724,1}$ is equal to $\$\mathrm{heap}_{724,1;748,8}.$**replace***(p3 $\rightarrow$ 30323 + $\$\mathrm{heap}_{724,1;748,8}.p3)]*

[74.11] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (30322 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{724,1;748,8}.$**replace**$(\mathrm{p3} \rightarrow (30323 + \$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})).\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.12] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (30322 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[from term 72.0, $\$\mathrm{heap}_{funcend\_724,1}$ is equal to $\$\mathrm{heap}_{724,1;748,8}.$**replace***(p3 $\rightarrow$ 30323 + $\$\mathrm{heap}_{724,1;748,8}.p3)]*

[74.13] $((-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (-1 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p2}) \vee (30322 < -\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3}) \vee (30268 < \$\mathrm{heap}_{724,1;748,8}.\mathrm{p1}) \vee (30306 < \$\mathrm{heap}_{724,1;748,8}.$**replace**$(\mathrm{p3} \rightarrow (30323 + \$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})).\mathrm{p2}) \vee (30322 < \$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.14] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{funcend\_724,1}.\text{p3})) \lor ...$

$\rightarrow$ *[from term 72.0, $\$\text{heap}_{funcend\_724,1}$ is equal to $\$\text{heap}_{724,1;748,8}.$ **replace**(p3 $\rightarrow$ 30323 + $\$\text{heap}_{724,1;748,8}.$p3)]*

[74.15] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{724,1;748,8}.$ **replace**(p3 $\rightarrow$ (30323 + $\$\text{heap}_{724,1;748,8}.$p3)).p3)) $\lor ...$

$\rightarrow$ *[simplify]*

[74.18] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (-1 < \$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

$\rightarrow$ *[from term 73.0, literala < $\$\text{heap}_{724,1;748,8}.$p3 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[74.18.0] $-2 < (-1 + 0)$

$\rightarrow$ *[simplify]*

[74.18.2] **true**

[74.19] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor$ **false**$) \lor ...$

$\rightarrow$ *[simplify]*

[74.20] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

[Branch on disjunction or conditional in term 66.24]

[75.0] $(\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.$ **replace**(p2 $\rightarrow$ (30307 + $\$\text{heap}_{724,1;747,8}.$p2))) $\lor (\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.$ **replace**(p2 $\rightarrow \$\text{heap}_{724,1;747,8}.$p2)) $\lor (-1 < \$\text{heap}_{724,1;747,8}.$p2)

[Branch on disjunction or conditional in term 66.24]

[76.0] $(0 < -\$\text{heap}_{724,1;747,8}.$p2$) \lor (\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.$ **replace**(p2 $\rightarrow \$\text{heap}_{724,1;747,8}.$p2)) $\lor (-1 < \$\text{heap}_{724,1;747,8}.$p2)

[Copy term 74.20]

[83.0] $((-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\$\text{heap}_{724,1;748,8}.\text{p3})) \lor (\$\text{heap}_{funcend\_724,1} == \$\text{heap}_{724,1;748,8}.$ **replace**(p3 $\rightarrow \$\text{heap}_{724,1;748,8}.$p3)) $\lor (-1 < \$\text{heap}_{724,1;748,8}.$p3$) \lor (\$\text{heap}_{724,1;748,8} ==$

$\$heap_{724,1;747,8}.\textbf{replace}(p2 \to \$heap_{724,1;747,8}.p2)) \lor (\text{-}1 < \$heap_{724,1;747,8}.p2)$

$\to$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \to 30307 + \$heap_{724,1;747,8}.p2)]$*

[83.1] $((\text{-}1 < -\$heap_{724,1;747,8}.\textbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)).p1) \lor (\text{-}1 < -\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[simplify]*

[83.2] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (\text{-}1 < -\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \to 30307 + \$heap_{724,1;747,8}.p2)]$*

[83.3] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (\text{-}1 < -\$heap_{724,1;747,8}.\textbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)).p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[simplify]*

[83.8] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \to 30307 + \$heap_{724,1;747,8}.p2)]$*

[83.9] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.\textbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)).p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[simplify]*

[83.10] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \to 30307 + \$heap_{724,1;747,8}.p2)]$*

[83.11] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (30306 < \$heap_{724,1;747,8}.\textbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)).p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

$\to$ *[simplify]*

[83.14] $((\text{-}1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (\text{-}1 < \$heap_{724,1;747,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor ...$

→ *[from term 76.0, literala < $\$heap_{724,1;747,8}$.p2 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[83.14.0] -2 < (-1 + 0)

→ *[simplify]*

[83.14.2] **true**

[83.15] $((\text{-}1 < -\$heap_{724,1;747,8}.\text{p1}) \lor (30306 < -\$heap_{724,1;747,8}.\text{p2}) \lor (30268 < \$heap_{724,1;747,8}.\text{p1}) \lor$ **false** $\lor (30322 < -\$heap_{724,1;748,8}.\text{p3})) \lor ...$

→ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.* **replace***(p2 → 30307 + $\$heap_{724,1;747,8}$.p2)]*

[83.16] $((\text{-}1 < -\$heap_{724,1;747,8}.\text{p1}) \lor (30306 < -\$heap_{724,1;747,8}.\text{p2}) \lor (30268 < \$heap_{724,1;747,8}.\text{p1}) \lor$ **false** $\lor (30322 < -\$heap_{724,1;747,8}.$**replace**$(p2 → (30307 + \$heap_{724,1;747,8}.\text{p2})).\text{p3})) \lor ...$

→ *[simplify]*

[83.18] $((\text{-}1 < -\$heap_{724,1;747,8}.\text{p1}) \lor (30268 < \$heap_{724,1;747,8}.\text{p1}) \lor (30306 < -\$heap_{724,1;747,8}.\text{p2}) \lor (30322 < -\$heap_{724,1;747,8}.\text{p3})) \lor ...$

[Branch on disjunction or conditional in term 65.45]

[84.0] ($\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))) ∨ ($\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Branch on disjunction or conditional in term 65.45]

[85.0] (0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot))) ∨ ($\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

[Copy term 75.0]

[86.0] ($\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{724,1;747,8}$.**replace**(p2 → (30307 + $\$\text{heap}_{724,1;747,8}$.p2))) ∨ ($\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{724,1;747,8}$.**replace**(p2 → $\$\text{heap}_{724,1;747,8}$.p2)) ∨ (-1 < $\$\text{heap}_{724,1;747,8}$.p2) ∨ ($\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 84.0, $\$\text{heap}_{724,1;747,8}$ is equal to $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → 30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))]*

[86.2] ($\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,

$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \rightarrow$
$(30269 + (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow (30307 + \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2$
$* div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \rightarrow$
$(30269 + (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).p2))) \lor ...$

$\rightarrow$ *[simplify]*

[86.6] $(\$heap_{724,1;748,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \rightarrow$
$(30269 + (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow (30307 + (-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem)))) \lor ...$

[Copy term 76.0]

[88.0] $(0 < -\$heap_{724,1;747,8}.p2) \lor (\$heap_{724,1;748,8} ==$
$\$heap_{724,1;747,8}.\_\textbf{replace}(p2 \rightarrow \$heap_{724,1;747,8}.p2)) \lor (-1 <$
$\$heap_{724,1;747,8}.p2) \lor (\$heap_{724,1;747,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow$
$((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +$
$(171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \rightarrow ((-2 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))) \lor (0 <$

$((-2 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +$
$(171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))$

$\rightarrow$ *[from term 84.0, $\$\text{heap}_{724,1;747,8}$ is equal to $\$\text{heap}_{funcstart\_724,1}.$ **replace***(p1*
$\rightarrow$ *((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p1, 177).quot) +*
*(171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p1,*
177).rem))). **replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,*
*$\$\text{heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,*
$\$\text{heap}_{funcstart\_724,1}.$p2, 176).rem))). **replace***(p3 $\rightarrow$ ((-63 * div(**heapIs***
*$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs***
$\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p3, 178).rem))). **replace***(p1 $\rightarrow$ 30269*
*+ (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p1, 177).quot) +*
*(171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.$p1, 177).rem))]*

[88.1] $(0 < -\$\text{heap}_{funcstart\_724,1}.$ **replace**$(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$ **replace**$(\text{p2} \rightarrow ((-35$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem}))).$ **replace**$(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$ **replace**$(\text{p1} \rightarrow (30269 + (-2 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\text{p2}) \vee ...$

$\rightarrow$ *[simplify]*

[88.7] $(0 < ((35 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{quot}) + (-172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem}))) \vee ...$

[Copy term 83.18]

[90.0] $((-1 < -\$\text{heap}_{724,1;747,8}.\text{p1}) \vee (30268 < \$\text{heap}_{724,1;747,8}.\text{p1}) \vee (30306 <$
$-\$\text{heap}_{724,1;747,8}.\text{p2}) \vee (30322 < -\$\text{heap}_{724,1;747,8}.\text{p3})) \vee (\$\text{heap}_{funcend\_724,1}$
$== \$\text{heap}_{724,1;748,8}.$ **replace**$(\text{p3} \rightarrow \$\text{heap}_{724,1;748,8}.\text{p3})) \vee (-1 <$
$\$\text{heap}_{724,1;748,8}.\text{p3}) \vee (\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.$ **replace**$(\text{p2} \rightarrow$
$\$\text{heap}_{724,1;747,8}.\text{p2})) \vee (-1 < \$\text{heap}_{724,1;747,8}.\text{p2}) \vee (\$\text{heap}_{724,1;747,8} ==$
$\$\text{heap}_{funcstart\_724,1}.$ **replace**$(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$ **replace**$(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$ **replace**$(\text{p3} \rightarrow ((-63$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem}))).$ **replace**$(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \vee (0 < ((-2 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 84.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 → 30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[90.1] ((-1 < −$\$heap_{funcstart\_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < −$\$heap_{724,1;747,8}$.p2) ∨ (30322 < −$\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[simplify]*

[90.10] ((30268 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < −$\$heap_{724,1;747,8}$.p2) ∨ (30322 < −$\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 54.11, literala < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot)) is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[90.10.0] -2 < (-30269 + 30268)

→ *[simplify]*

[90.10.2] **true**

[90.11] (**false** ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < −$\$heap_{724,1;747,8}$.p2) ∨ (30322 < −$\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 84.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.__replace(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*

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$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\mathbf{\_replace}(p3 \rightarrow ((-63 * div(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\mathbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\mathbf{\_replace}(p1 \rightarrow 30269$
$+ (-2 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +$
$(171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]$

[90.12] (**false** ∨ (30268 < $\$heap_{funcstart\_724,1}.\mathbf{\_replace}(p1 \rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p2$, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))).**_replace**(p1 → (30269
+ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) +
(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).p1)
∨ (30306 < −$\$heap_{724,1;747,8}.p2$) ∨ (30322 < −$\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[simplify]*

[90.15] (**false** ∨ (-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p1$, 177).rem))) ∨ (30306 < −$\$heap_{724,1;747,8}.p2$) ∨ (30322
< −$\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[from term 85.0, literala < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p1$, 177).rem)) is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[90.15.0] -2 < (-1 + 0)

→ *[simplify]*

[90.15.2] **true**

[90.16] (**false** ∨ **false** ∨ (30306 < −$\$heap_{724,1;747,8}.p2$) ∨ (30322 <
−$\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[from term 84.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}.\mathbf{\_replace}(p1$*
*→ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) +*
*(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,*
*177).rem)))._replace(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p2$, 176).rem)))._replace(p3 → ((-63 * div(**heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)))._replace(p1 → 30269
*+ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) +*
*(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))]*

[90.17] (**false** ∨ **false** ∨ (30306 < −$heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).p2) ∨ (30322 < −$heap$_{724,1;747,8}$.p3)) ∨ ...

→ *[simplify]*

[90.23] (**false** ∨ **false** ∨ (30306 < ((35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (-172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem))) ∨ (30322 < −$heap$_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 58.12, literala < ((-172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[90.23.0] -2 < (-30307 + 30306)

→ *[simplify]*

[90.23.2] **true**

[90.24] (**false** ∨ **false** ∨ **false** ∨ (30322 < −$heap$_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 84.0, $heap$_{724,1;747,8}$ is equal to $heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 → 30269 + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))]*

[90.25] (**false** ∨ **false** ∨ **false** ∨ (30322 < −$heap$_{funcstart_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 →

(30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p3)) ∨ ...

→ *[simplify]*

[90.30] (**false** ∨ **false** ∨ **false** ∨ (30322 < ((63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 62.13, literala < ((-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[90.30.0] -2 < (-30323 + 30322)

→ *[simplify]*

[90.30.2] **true**

[90.31] (**false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[90.32] **false** ∨ ...

[Remove 'false' term 90.32 and fetch new term from containing clause]

[91.0] ($\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))) ∨ ($\$heap_{funcend\_724,1}$ == $\$heap_{724,1;748,8}$.**_replace**(p3 → $\$heap_{724,1;748,8}$.p3)) ∨ (-1 < $\$heap_{724,1;748,8}$.p3) ∨ ($\$heap_{724,1;748,8}$ == $\$heap_{724,1;747,8}$.**_replace**(p2 → $\$heap_{724,1;747,8}$.p2)) ∨ (-1 < $\$heap_{724,1;747,8}$.p2)

[Remove 'false' term 90.32 and fetch new term from containing clause]

[92.0] (0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))) ∨ ($\$heap_{funcend\_724,1}$ == $\$heap_{724,1;748,8}$.**_replace**(p3 → $\$heap_{724,1;748,8}$.p3)) ∨ (-1 < $\$heap_{724,1;748,8}$.p3) ∨ ($\$heap_{724,1;748,8}$ == $\$heap_{724,1;747,8}$.**_replace**(p2 → $\$heap_{724,1;747,8}$.p2)) ∨ (-1 < $\$heap_{724,1;747,8}$.p2)

[Copy term 74.20]

[83.18] ((-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 <

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$-\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2}) \vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p3})) \vee (\$\mathrm{heap}_{funcend\_724,1}$
$== \$\mathrm{heap}_{724,1;748,8}.\textbf{replace}(\mathrm{p3} \to \$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})) \vee (\text{-1} <$
$\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3}) \vee (\$\mathrm{heap}_{724,1;748,8} == \$\mathrm{heap}_{724,1;747,8}.\textbf{replace}(\mathrm{p2} \to$
$\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2})) \vee (\text{-1} < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p2})$

$\to$ *[from term 91.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}.\textbf{replace}(p1$*
*$\to ((\text{-2} * div(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +$*
*$(171 * div(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$*
*$177).rem))).\textbf{replace}(p2 \to ((\text{-35} * div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \to ((\text{-63} * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\textbf{replace}(p1 \to (\text{-2} *$*
*$div(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$*
$div(\textbf{heapIs}\ \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]$

[83.19] $((\text{-1} < -\$\mathrm{heap}_{funcstart\_724,1}.\textbf{replace}(\mathrm{p1} \to ((\text{-2} * div(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 177).\mathrm{quot}) + (171 * div(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 177).\mathrm{rem}))).\textbf{replace}(\mathrm{p2} \to ((\text{-35}$
$* div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, 176).\mathrm{quot}) + (172 *$
$div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},$
$176).\mathrm{rem}))).\textbf{replace}(\mathrm{p3} \to ((\text{-63} * div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, 178).\mathrm{quot}) + (170 * div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, 178).\mathrm{rem}))).\textbf{replace}(\mathrm{p1} \to ((\text{-2} * div(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 177).\mathrm{quot}) + (171 * div(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 177).\mathrm{rem}))).\mathrm{p1}) \vee (30268 <$
$\$\mathrm{heap}_{724,1;747,8}.\mathrm{p1}) \vee (30306 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2}) \vee (30322 <$
$-\$\mathrm{heap}_{724,1;747,8}.\mathrm{p3})) \vee ...$

$\to$ *[simplify]*

[83.23] $((\text{-1} < ((2 * div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{quot}) + (\text{-171} * div(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},$
$177).\mathrm{rem}))) \vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p1}) \vee (30306 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2}) \vee$
$(30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p3})) \vee ...$

$\to$ *[from term 92.0, literala < ((-171 * div(\textbf{heapIs}\ \$heap_{funcstart_724,1},*
*$\$heap_{funcstart\_724,1}.p1, 177).rem) + (2 * div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart\_724,1}.p1, 177).quot))$ is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[83.23.0] -2 < (-1 + 0)

$\to$ *[simplify]*

[83.23.2] **true**

[83.24] (**false** $\vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p1}) \vee (30306 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2})$
$\vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p3})) \vee ...$

$\to$ *[from term 91.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}.\textbf{replace}(p1$*

$\rightarrow$ *((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._ **replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._ **replace***(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))._ **replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[83.25] (**false** $\vee$ (30268 < $\$heap_{funcstart\_724,1}$._ **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._ **replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._ **replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))._ **replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1) $\vee$ (30306 < $-\$heap_{724,1;747,8}$.p2) $\vee$ (30322 < $-\$heap_{724,1;747,8}$.p3)) $\vee$ ...

$\rightarrow$ *[simplify]*

[83.26] (**false** $\vee$ (30268 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))) $\vee$ (30306 < $-\$heap_{724,1;747,8}$.p2) $\vee$ (30322 < $-\$heap_{724,1;747,8}$.p3)) $\vee$ ...

$\rightarrow$ *[from term 56.17, literala < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)) is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[83.26.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[83.26.2] **true**

[83.27] (**false** $\vee$ **false** $\vee$ (30306 < $-\$heap_{724,1;747,8}$.p2) $\vee$ (30322 < $-\$heap_{724,1;747,8}$.p3)) $\vee$ ...

$\rightarrow$ *[from term 91.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$._ **replace***(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))._ **replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))._ **replace***(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3, 178).rem)))$. __replace__*(p1 → (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]*

[83.28] (**false** ∨ **false** ∨ (30306 < −$heap_{funcstart\_724,1}$. __replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))). __replace__(p2 → ((-35 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))). __replace__(p3 → ((-63 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem))). __replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))).p2) ∨ (30322 < −$heap_{724,1;747,8}.p3)) ∨ ...

→ *[simplify]*

[83.34] (**false** ∨ **false** ∨ (30306 < ((35 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (-172 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).rem))) ∨ (30322 < −$heap_{724,1;747,8}.p3)) ∨ ...

→ *[from term 58.12, literala < ((-172 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem) + (35 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[83.34.0] -2 < (-30307 + 30306)

→ *[simplify]*

[83.34.2] **true**

[83.35] (**false** ∨ **false** ∨ **false** ∨ (30322 < −$heap_{724,1;747,8}.p3)) ∨ ...

→ *[from term 91.0, $heap_{724,1;747,8}$ is equal to $heap_{funcstart\_724,1}$. __replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))). __replace__(p2 → ((-35 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))). __replace__(p3 → ((-63 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).rem))). __replace__(p1 → (-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))]*

[83.36] (**false** ∨ **false** ∨ **false** ∨ (30322 < −$heap_{funcstart\_724,1}$. __replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).rem))). __replace__(p2 → ((-35 * div(__heapIs__ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(__heapIs__ $heap_{funcstart\_724,1}$,

$heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p3)) ∨ ...

→ *[simplify]*

[83.41] (**false** ∨ **false** ∨ **false** ∨ (30322 < ((63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 62.13, literala < ((-170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[83.41.0] -2 < (-30323 + 30322)

→ *[simplify]*

[83.41.2] **true**

[83.42] (**false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[83.43] **false** ∨ ...

[Remove 'false' term 83.43 and fetch new term from containing clause]

[95.0] ($heap_{724,1;748,8}$ == $heap_{724,1;747,8}$. **replace**(p2 → $heap_{724,1;747,8}$.p2))
∨ ($heap_{funcend\_724,1}$ == $heap_{724,1;748,8}$. **replace**(p3 → $heap_{724,1;748,8}$.p3))
∨ (-1 < $heap_{724,1;748,8}$.p3)

[Copy term 1.56]

[74.20] ((-1 < −$heap_{724,1;748,8}$.p1) ∨ (-1 < −$heap_{724,1;748,8}$.p2) ∨ (30268 <
$heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 <
−$heap_{724,1;748,8}$.p3)) ∨ ($heap_{funcend\_724,1}$ == $heap_{724,1;748,8}$. **replace**(p3
→ $heap_{724,1;748,8}$.p3)) ∨ (-1 < $heap_{724,1;748,8}$.p3)

→ *[from term 95.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}$. **replace**(p2 →
$heap_{724,1;747,8}$.p2)]*

[74.21] ((-1 < −$heap_{724,1;747,8}$. **replace**(p2 → $heap_{724,1;747,8}$.p2).p1) ∨ (-1 <
−$heap_{724,1;748,8}$.p2) ∨ (30268 < $heap_{724,1;748,8}$.p1) ∨ (30306 <
$heap_{724,1;748,8}$.p2) ∨ (30322 < −$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[simplify]*

[74.22] ((-1 < −$heap_{724,1;747,8}$.p1) ∨ (-1 < −$heap_{724,1;748,8}$.p2) ∨ (30268 <
$heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 <
−$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 95.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}$. **replace**(p2 →*

$heap_{724,1;747,8}$.p2)]

[74.23] ((-1 < −$heap_{724,1;747,8}$.p1) ∨ (-1 < −$heap_{724,1;747,8}$.**replace**(p2 → $heap_{724,1;747,8}$.p2).p2) ∨ (30268 < $heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 < −$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[simplify]*

[74.24] ((-1 < −$heap_{724,1;747,8}$.p1) ∨ (-1 < −$heap_{724,1;747,8}$.p2) ∨ (30268 < $heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 < −$heap_{724,1;748,8}$.p3)) ∨ ...

[Remove 'false' term 83.43 and fetch new term from containing clause]

[96.0] (-1 < $heap_{724,1;747,8}$.p2) ∨ ($heap_{funcend\_724,1}$ == $heap_{724,1;748,8}$.**replace**(p3 → $heap_{724,1;748,8}$.p3)) ∨ (-1 < $heap_{724,1;748,8}$.p3)

[Copy term 95.0]

[98.0] ($heap_{724,1;748,8}$ == $heap_{724,1;747,8}$.**replace**(p2 → $heap_{724,1;747,8}$.p2)) ∨ ($heap_{funcend\_724,1}$ == $heap_{724,1;748,8}$.**replace**(p3 → $heap_{724,1;748,8}$.p3)) ∨ (-1 < $heap_{724,1;748,8}$.p3) ∨ ($heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))))) ∨ (0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 84.0, $heap_{724,1;747,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → 30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[98.2] ($heap_{724,1;748,8}$ == $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,

$heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem))).p2)) $\vee$ ...

$\rightarrow$ *[simplify]*

[98.5] ($heap$_{724,1;748,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))) $\vee$ ...

[Copy term 96.0]

[99.0] (-1 < $heap$_{724,1;747,8}$.p2) $\vee$ ($heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$._**replace**(p3 $\rightarrow$ $heap$_{724,1;748,8}$.p3)) $\vee$ (-1 < $heap$_{724,1;748,8}$.p3) $\vee$ ($heap$_{724,1;747,8}$ == $heap$_{funcstart_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))) $\vee$ (0 < ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) +

(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 84.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.* **replace***(p1 → ((-2 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))*.* **replace***(p2 → ((-35 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))*.* **replace***(p3 → ((-63 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))*.* **replace***(p1 → 30269 + (-2 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[99.1] (-1 < $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))**.** **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)))**.** **replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))**.** **replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p2) ∨ ...

→ *[simplify]*

[99.4] (-1 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))) ∨ ...

→ *[from term 59.3, -1 < ((-35 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) is true if and only if 0 < ((-35 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs** *$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[99.5] (0 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))) ∨ ...

[Copy term 74.20]

[102.0] ((-1 < −$\$heap_{724,1;748,8}$.p1) ∨ (-1 < −$\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < −$\$heap_{724,1;748,8}$.p3)) ∨ ($\$heap_{funcend\_724,1}$ == $\$heap_{724,1;748,8}$.**replace**(p3 → $\$heap_{724,1;748,8}$.p3)) ∨ (-1 < $\$heap_{724,1;748,8}$.p3) ∨ ($\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))**.** **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**

$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 98.5, $heap_{724,1;748,8}$ is equal to $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))]*

[102.1] ((-1 < −$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))).p1) ∨ (-1 < −$heap_{724,1;748,8}$.p2) ∨ (30268 < $heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 < −$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[simplify]*

[102.11] ((30268 < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot))) ∨ (-1 < −$heap_{724,1;748,8}$.p2) ∨ (30268 < $heap_{724,1;748,8}$.p1) ∨ (30306 < $heap_{724,1;748,8}$.p2) ∨ (30322 < −$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 54.11, literala < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,*

$\$heap_{funcstart\_724,1}.p1, 177).quot))$ *is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[102.11.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[102.11.2] **true**

[102.12] (**false** $\lor$ (-1 < $-\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor$
$(30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor$ ...

$\rightarrow$ *[from term 98.5, $\$heap_{724,1;748,8}$ is equal to $\$heap_{funcstart\_724,1}.$***replace***(p1*
$\rightarrow$ *((-2 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) +*
*(171 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,*
177).rem))).***replace***(p2 $\rightarrow$ ((-35 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p2$, 176).rem))).***replace***(p3 $\rightarrow$ ((-63 * div(***heapIs***
*$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(***heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))).***replace***(p1 $\rightarrow$
*(30269 + (-2 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,*
*177).quot) + (171 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$,*
177).rem))).***replace***(p2 $\rightarrow$ (-35 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}.p2$, 176).rem))]

[102.13] (**false** $\lor$ (-1 < $-\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))**.replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$,
176).rem)))**.replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p3$, 178).rem)))**.replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))**.replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).p2) $\lor$
$(30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 <$
$-\$heap_{724,1;748,8}.p3)) \lor$ ...

$\rightarrow$ *[simplify]*

[102.17] (**false** $\lor$ (-1 < ((35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p2$, 176).quot) + (-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p2$, 176).rem))) $\lor$ (30268 < $\$heap_{724,1;748,8}.p1) \lor (30306 <$
$\$heap_{724,1;748,8}.p2) \lor (30322 < -\$heap_{724,1;748,8}.p3)) \lor$ ...

$\rightarrow$ *[from term 99.5, literala < ((-172 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p2$, 176).rem) + (35 * div(***heapIs*** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart_724,1}.p2, 176).quot)) is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[102.17.0] -2 < (-1 + 0)

→ *[simplify]*

[102.17.2] **true**

[102.18] (**false** ∨ **false** ∨ (30268 < $heap_{724,1;748,8}.p1$) ∨ (30306 < $heap_{724,1;748,8}.p2$) ∨ (30322 < −$heap_{724,1;748,8}.p3$)) ∨ ...

→ *[from term 98.5, $heap_{724,1;748,8}$ is equal to $heap_{funcstart_724,1}._\textbf{replace}(p1 → ((-2 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).rem)))._\textbf{replace}(p2 → ((-35 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem)))._\textbf{replace}(p3 → ((-63 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p3, 178).rem)))._\textbf{replace}(p1 → (30269 + (-2 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).rem)))._\textbf{replace}(p2 → (-35 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p2, 176).rem))]*

[102.19] (**false** ∨ **false** ∨ (30268 < $heap_{funcstart\_724,1}._$**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3$, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2$, 176).rem))).p1) ∨ (30306 < $heap_{724,1;748,8}.p2$) ∨ (30322 < −$heap_{724,1;748,8}.p3$)) ∨ ...

→ *[simplify]*

[102.23] (**false** ∨ **false** ∨ (-1 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1$, 177).rem))) ∨ (30306 < $heap_{724,1;748,8}.p2$) ∨ (30322 < −$heap_{724,1;748,8}.p3$)) ∨ ...

→ *[from term 85.0, literala < ((-2 * div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart_724,1},*

$\$heap_{funcstart\_724,1}.$p1, 177).rem)) is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[102.23.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[102.23.2] **true**

[102.24] (**false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < $\$heap_{724,1;748,8}.$p2) $\lor$ (30322 < $-\$heap_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[from term 98.5, $\$heap_{724,1;748,8}$ is equal to $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem)))._**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))]*

[102.25] (**false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < $\$heap_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))).p2) $\lor$ (30322 < $-\$heap_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[simplify]*

[102.26] (**false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))) $\lor$ (30322 < $-\$heap_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[from term 60.18, literala < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[102.26.0] -2 < (-30307 + 30306)

$\rightarrow$ *[simplify]*

[102.26.2] **true**

[102.27] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30322 < $-\$\text{heap}_{724,1;748,8}$.p3)) $\lor$ ...

$\rightarrow$ *[from term 98.5, $\$heap_{724,1;748,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace***(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace***(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace***(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace***(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[102.28] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30322 < $-\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).p3)) $\lor$ ...

$\rightarrow$ *[simplify]*

[102.34] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30322 < ((63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))) $\lor$ ...

$\rightarrow$ *[from term 62.13, literala < ((-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[102.34.0] -2 < (-30323 + 30322)

$\rightarrow$ *[simplify]*

[102.34.2] **true**

[102.35] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ [simplify]

[102.36] **false** ∨ ...

[Remove 'false' term 102.36 and fetch new term from containing clause]

[103.0] ($heap$_{724,1;747,8}$ == $heap$_{funcstart_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}$,
$heap$_{funcstart_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1, 177).rem)))) ∨
($heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$.**replace**(p3 → $heap$_{724,1;748,8}$.p3)) ∨
(-1 < $heap$_{724,1;748,8}$.p3)

[Remove 'false' term 102.36 and fetch new term from containing clause]

[104.0] (0 < ((-2 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}$, $heap$_{funcstart_724,1}$.p1,
177).rem))) ∨ ($heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$.**replace**(p3 →
$heap$_{724,1;748,8}$.p3)) ∨ (-1 < $heap$_{724,1;748,8}$.p3)

[Copy term 1.56]

[74.24] ((-1 < −$heap$_{724,1;747,8}$.p1) ∨ (-1 < −$heap$_{724,1;747,8}$.p2) ∨ (30268 <
$heap$_{724,1;748,8}$.p1) ∨ (30306 < $heap$_{724,1;748,8}$.p2) ∨ (30322 <
−$heap$_{724,1;748,8}$.p3)) ∨ ($heap$_{funcend\_724,1}$ == $heap$_{724,1;748,8}$.**replace**(p3
→ $heap$_{724,1;748,8}$.p3)) ∨ (-1 < $heap$_{724,1;748,8}$.p3)

→ *[from term 96.0, -1 < −$heap$_{724,1;747,8}$.p2 is true if and only if 0 ==
$heap$_{724,1;747,8}$.p2]*

[74.25] ((-1 < −$heap$_{724,1;747,8}$.p1) ∨ (0 == $heap$_{724,1;747,8}$.p2) ∨ (30268 <
$heap$_{724,1;748,8}$.p1) ∨ (30306 < $heap$_{724,1;748,8}$.p2) ∨ (30322 <
−$heap$_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 95.0, $heap$_{724,1;748,8}$ is equal to $heap$_{724,1;747,8}$.**replace**(p2 →
$heap$_{724,1;747,8}$.p2)]*

[74.26] ((-1 < −$heap$_{724,1;747,8}$.p1) ∨ (0 == $heap$_{724,1;747,8}$.p2) ∨ (30268 <
$heap$_{724,1;747,8}$.**replace**(p2 → $heap$_{724,1;747,8}$.p2).p1) ∨ (30306 <
$heap$_{724,1;748,8}$.p2) ∨ (30322 < −$heap$_{724,1;748,8}$.p3)) ∨ ...

→ [simplify]

[74.27] ((-1 < −$heap$_{724,1;747,8}$.p1) ∨ (0 == $heap$_{724,1;747,8}$.p2) ∨ (30268 <

$\text{\$heap}_{724,1;747,8}.\text{p1}) \vee (30306 < \text{\$heap}_{724,1;748,8}.\text{p2}) \vee (30322 < -\text{\$heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[from term 95.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.__**replace**(p2 → $\$heap_{724,1;747,8}.p2)]$*

[74.28] $((\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \vee (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \vee (30306 < \text{\$heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow \text{\$heap}_{724,1;747,8}.\text{p2}).\text{p2}) \vee (30322 < -\text{\$heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.29] $((\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \vee (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \vee (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30322 < -\text{\$heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[from term 95.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.__**replace**(p2 → $\$heap_{724,1;747,8}.p2)]$*

[74.30] $((\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \vee (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \vee (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30322 < -\text{\$heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow \text{\$heap}_{724,1;747,8}.\text{p2}).\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[74.31] $((\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \vee (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \vee (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \vee (30322 < -\text{\$heap}_{724,1;747,8}.\text{p3})) \vee ...$

$\rightarrow$ *[from term 103.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).__**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))).__**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))]*

[74.32] $((0 == \text{\$heap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((\text{-63} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\text{p2}) \vee (\text{-1} <$

$-\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30306 <$
$\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}2) \vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}3)) \vee ...$

$\rightarrow$ *[simplify]*

[74.35] $((0 == ((\text{-35} * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2,$
$176).\mathrm{quot}) + (172 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2,$
$176).\mathrm{rem}))) \vee (\text{-1} < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee$
$(30306 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}2) \vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}3)) \vee ...$

$\rightarrow$ *[from term 59.3, 0 == ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p2, 176).rem)) is false]

[74.36] $(\mathbf{false} \vee (\text{-1} < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee$
$(30306 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}2) \vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}3)) \vee ...$

$\rightarrow$ *[from term 103.0, $heap_{724,1;747,8}$ is equal to*
*$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63*
** div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,*
*178).rem))).**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[74.37] $(\mathbf{false} \vee (\text{-1} < -\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p}1 \rightarrow ((\text{-2} * \mathrm{div}(\mathbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{quot}) + (171 * \mathrm{div}(\mathbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{rem}))).\mathbf{\_replace}(\mathrm{p}2 \rightarrow ((\text{-35}$
$* \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2, 176).\mathrm{quot}) + (172 *$
$\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}2,$
$176).\mathrm{rem}))).\mathbf{\_replace}(\mathrm{p}3 \rightarrow ((\text{-63} * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3, 178).\mathrm{quot}) + (170 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}3, 178).\mathrm{rem}))).\mathbf{\_replace}(\mathrm{p}1 \rightarrow ((\text{-2} * \mathrm{div}(\mathbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{quot}) + (171 * \mathrm{div}(\mathbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_724,1}, \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{rem}))).\mathrm{p}1) \vee (30268 <$
$\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30306 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}2) \vee (30322 <$
$-\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}3)) \vee ...$

$\rightarrow$ *[simplify]*

[74.41] $(\mathbf{false} \vee (\text{-1} < ((2 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{quot}) + (\text{-171} * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},$
$\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p}1, 177).\mathrm{rem}))) \vee (30268 < \$\mathrm{heap}_{724,1;747,8}.\mathrm{p}1) \vee (30306 <$
$\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}2) \vee (30322 < -\$\mathrm{heap}_{724,1;747,8}.\mathrm{p}3)) \vee ...$

$\rightarrow$ *[from term 104.0, literala < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_724,1}$,*

$\text{\$heap}_{funcstart\_724,1}.p1, 177).quot))$ *is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[74.41.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[74.41.2] **true**

[74.42] (**false** $\lor$ **false** $\lor$ (30268 < \$heap$_{724,1;747,8}$.p1) $\lor$ (30306 < \$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $-$\$heap$_{724,1;747,8}$.p3)) $\lor$ ...

$\rightarrow$ *[from term 103.0, \$heap$_{724,1;747,8}$ is equal to*
*\$heap$_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs***
*\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
*\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63*
** div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 **
*div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3,*
*178).rem)))._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p1, 177).rem))]

[74.43] (**false** $\lor$ **false** $\lor$ (30268 < \$heap$_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
\$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).p1) $\lor$
(30306 < \$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $-$\$heap$_{724,1;747,8}$.p3)) $\lor$ ...

$\rightarrow$ *[simplify]*

[74.44] (**false** $\lor$ **false** $\lor$ (30268 < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,
\$heap$_{funcstart\_724,1}$.p1, 177).rem))) $\lor$ (30306 < \$heap$_{724,1;747,8}$.p2) $\lor$ (30322 <
$-$\$heap$_{724,1;747,8}$.p3)) $\lor$ ...

$\rightarrow$ *[from term 56.17, literala < ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
*\$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$,*
\$heap$_{funcstart\_724,1}$.p1, 177).rem)) is false whenever -2 < (-30269 + literala)]

Proof of rule precondition:

[74.44.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[74.44.2] **true**

[74.45] (**false** ∨ **false** ∨ **false** ∨ (30306 < $\$heap_{724,1;747,8}.p2$) ∨ (30322 < $-\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[from term 103.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace***(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).**replace***(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).**replace***(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))).**replace***(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))]*

[74.46] (**false** ∨ **false** ∨ **false** ∨ (30306 < $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem))).p2) ∨ (30322 < $-\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[simplify]*

[74.49] (**false** ∨ **false** ∨ **false** ∨ (30306 < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))) ∨ (30322 < $-\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[from term 60.18, literala < ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[74.49.0] -2 < (-30307 + 30306)

→ *[simplify]*

[74.49.2] **true**

[74.50] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < $-\$heap_{724,1;747,8}.p3$)) ∨ ...

→ *[from term 103.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.**replace***(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*

$heap_{funcstart\_724,1}.p1, 177).rem)))._$\mathbf{replace}$(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).rem)))._$\mathbf{replace}$(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p3,
178).rem)))._$\mathbf{replace}$(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart_724,1}.p1, 177).rem))]*

[74.51] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 <
−$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)))._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))).p3)) ∨ ...

→ *[simplify]*

[74.56] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < ((63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 62.13, literala < ((-170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[74.56.0] -2 < (-30323 + 30322)

→ *[simplify]*

[74.56.2] **true**

[74.57] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[74.58] **false** ∨ ...

[Remove 'false' term 74.58 and fetch new term from containing clause]

[106.0] $heap_{funcend\_724,1}$ == $heap_{724,1;748,8}$._**replace**(p3 →
$heap_{724,1;748,8}$.p3)

[Take goal term]

[1.56] (30322 < $heap_{funcend\_724,1}$.p3) ∨ (30306 < $heap_{funcend\_724,1}$.p2) ∨
(30268 < $heap_{funcend\_724,1}$.p1) ∨ (-1 < −$heap_{funcend\_724,1}$.p1) ∨ (-1 <

$-\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}$.__replace(p3 $\rightarrow$ $heap_{724,1;748,8}$.p3)]*

[1.57] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3}).\text{p1}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[simplify]*

[1.58] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}$.__replace(p3 $\rightarrow$ $heap_{724,1;748,8}$.p3)]*

[1.59] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3}).\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[simplify]*

[1.60] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}$.__replace(p3 $\rightarrow$ $heap_{724,1;748,8}$.p3)]*

[1.61] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\textbf{replace}(\text{p3} \rightarrow \text{\$heap}_{724,1;748,8}.\text{p3}).\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[simplify]*

[1.62] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

[Remove 'false' term 74.58 and fetch new term from containing clause]

[107.0] $\text{-1} < \text{\$heap}_{724,1;748,8}.\text{p3}$

[Take goal term]

[1.62] $(\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p1}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p2}) \vee (\text{-1} < -\text{\$heap}_{724,1;748,8}.\text{p3}) \vee (30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \vee (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{\$heap}_{funcend\_724,1}.\text{p3})$

$\rightarrow$ *[from term 107.0, -1 < $-$heap$_{724,1;748,8}$.p3 is true if and only if 0 ==*

$heap_{724,1;748,8}.p3]$

[1.63] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)$

$\to$ *[from term 106.0, $\$heap_{funcend\_724,1}$ is equal to $\$heap_{724,1;748,8}.$* **replace***(p3 $\to \$heap_{724,1;748,8}.p3)]$*

[1.64] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.$**replace**$(p3 \to \$heap_{724,1;748,8}.p3).p1) \lor (30306 < \$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)$

$\to$ *[simplify]*

[1.65] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)$

$\to$ *[from term 106.0, $\$heap_{funcend\_724,1}$ is equal to $\$heap_{724,1;748,8}.$* **replace***(p3 $\to \$heap_{724,1;748,8}.p3)]$*

[1.66] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.$**replace**$(p3 \to \$heap_{724,1;748,8}.p3).p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)$

$\to$ *[simplify]*

[1.67] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)$

$\to$ *[from term 106.0, $\$heap_{funcend\_724,1}$ is equal to $\$heap_{724,1;748,8}.$* **replace***(p3 $\to \$heap_{724,1;748,8}.p3)]$*

[1.68] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.$**replace**$(p3 \to \$heap_{724,1;748,8}.p3).p3)$

$\to$ *[simplify]*

[1.69] $(-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 == \$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)$

[Copy term 106.0]

[109.0] $(\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.$**replace**$(p3 \to \$heap_{724,1;748,8}.p3)) \lor (\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.$**replace**$(p2 \to \$heap_{724,1;747,8}.p2)) \lor (-1 < \$heap_{724,1;747,8}.p2) \lor (\$heap_{724,1;747,8} == \$heap_{funcstart\_724,1}.$**replace**$(p1 \to ((-2 *$ div(**heapIs** $\$heap_{funcstart\_724,1},$

$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \to ((-63$
$* div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *$
$div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,$
$178).rem))).\_\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem)))) \lor (0 < ((-2 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))$

$\to$ *[from term 86.6, $\$heap_{724,1;748,8}$ is equal to $\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1$*
*$\to ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +$*
*$(171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$*
*$177).rem))).\_\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \to ((-63 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$*
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \to$
*$(30269 + (-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$*
*$177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$*
*$177).rem))).\_\textbf{replace}(p2 \to 30307 + (-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart\_724,1}.p2, 176).rem))]$

[109.2] ($\$heap_{funcend\_724,1} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \to ((-2 *$
$div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \to ((-63 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \to$
$(30269 + (-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\_\textbf{replace}(p2 \to (30307 + (-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \to$
$\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \to ((-63$
$* div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *$
$div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,$
$178).rem))).\_\textbf{replace}(p1 \to (30269 + (-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$

$\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → (30307 + (-35 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).p3)) ∨ ...

→ *[simplify]*

[109.5] ($\text{\$heap}_{funcend\_724,1}$ == $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 →
(30269 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → (30307 + (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

[Copy term 107.0]

[110.0] (-1 < $\text{\$heap}_{724,1;748,8}$.p3) ∨ ($\text{\$heap}_{724,1;748,8}$ ==
$\text{\$heap}_{724,1;747,8}$. **replace**(p2 → $\text{\$heap}_{724,1;747,8}$.p2)) ∨ (-1 <
$\text{\$heap}_{724,1;747,8}$.p2) ∨ ($\text{\$heap}_{724,1;747,8}$ == $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1 →
((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 <
((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) +
(171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 86.6, $\text{\$heap}_{724,1;748,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}$. **replace**(p1*
*→ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) +*
*(171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1,*
*177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,*
*$\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs***
*$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs***
*$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 →*

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*(30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → 30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))]*

[110.1] (-1 < $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → (30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem))).p3) ∨ ...

→ *[simplify]*

[110.4] (-1 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))) ∨ ...

→ *[from term 63.3, -1 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)) is true if and only if 0 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))]*

[110.5] (0 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem))) ∨ ...

[Copy term 1.56]

[111.0] ((-1 < −$\$heap_{funcend\_724,1}.p1$) ∨ (-1 < −$\$heap_{funcend\_724,1}.p2$) ∨ (-1 < −$\$heap_{funcend\_724,1}.p3$) ∨ (30268 < $\$heap_{funcend\_724,1}.p1$) ∨ (30306 < $\$heap_{funcend\_724,1}.p2$) ∨ (30322 < $\$heap_{funcend\_724,1}.p3$)) ∨ ($\$heap_{724,1;748,8}$ == $\$heap_{724,1;747,8}$._**replace**(p2 → $\$heap_{724,1;747,8}.p2$)) ∨ (-1 < $\$heap_{724,1;747,8}.p2$) ∨ ($\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p1$, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p2$, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.p3$, 178).rem)))._**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 109.5, $\$heap_{funcend\_724,1}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[111.1] ((-1 < −$\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p1) ∨ (-1 < −$\$heap_{funcend\_724,1}$.p2) ∨ (-1 < −$\$heap_{funcend\_724,1}$.p3) ∨ (30268 < $\$heap_{funcend\_724,1}$.p1) ∨ (30306 < $\$heap_{funcend\_724,1}$.p2) ∨ (30322 < $\$heap_{funcend\_724,1}$.p3)) ∨ ...

→ *[simplify]*

[111.12] ((30268 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))) ∨ (-1 < −$\$heap_{funcend\_724,1}$.p2) ∨ (-1 < −$\$heap_{funcend\_724,1}$.p3) ∨ (30268 < $\$heap_{funcend\_724,1}$.p1) ∨ (30306 < $\$heap_{funcend\_724,1}$.p2) ∨ (30322 < $\$heap_{funcend\_724,1}$.p3)) ∨ ...

$\rightarrow$ *[from term 54.11, literala < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot)) is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[111.12.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[111.12.2] **true**

[111.13] (**false** $\vee$ (-1 < $-\$heap_{funcend\_724,1}$.p2) $\vee$ (-1 <
$-\$heap_{funcend\_724,1}$.p3) $\vee$ (30268 < $\$heap_{funcend\_724,1}$.p1) $\vee$ (30306 <
$\$heap_{funcend\_724,1}$.p2) $\vee$ (30322 < $\$heap_{funcend\_724,1}$.p3)) $\vee$ ...

$\rightarrow$ *[from term 109.5, $\$heap_{funcend\_724,1}$ is equal to*
$\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,*
178).rem))).**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (30307 + (-35 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,*
176).rem))).**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[111.14] (**false** $\vee$ (-1 < $-\$heap_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$
(30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem))).p2) $\vee$ (-1 < $-\$heap_{funcend\_724,1}$.p3) $\vee$
(30268 < $\$heap_{funcend\_724,1}$.p1) $\vee$ (30306 < $\$heap_{funcend\_724,1}$.p2) $\vee$ (30322 <
$\$heap_{funcend\_724,1}$.p3)) $\vee$ ...

$\rightarrow$ *[simplify]*

[111.24] (**false** $\lor$ (30306 < ((-172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot))) $\lor$ (-1 < $-heap_{funcend\_724,1}$.p3) $\lor$ (30268 < $heap_{funcend\_724,1}$.p1) $\lor$ (30306 < $heap_{funcend\_724,1}$.p2) $\lor$ (30322 < $heap_{funcend\_724,1}$.p3)) $\lor$ ...

$\rightarrow$ *[from term 58.12, literala < ((-172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem) + (35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[111.24.0] -2 < (-30307 + 30306)

$\rightarrow$ *[simplify]*

[111.24.2] **true**

[111.25] (**false** $\lor$ **false** $\lor$ (-1 < $-heap_{funcend\_724,1}$.p3) $\lor$ (30268 < $heap_{funcend\_724,1}$.p1) $\lor$ (30306 < $heap_{funcend\_724,1}$.p2) $\lor$ (30322 < $heap_{funcend\_724,1}$.p3)) $\lor$ ...

$\rightarrow$ *[from term 109.5, $heap_{funcend\_724,1}$ is equal to $heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ (30307 + (-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))]*

[111.26] (**false** $\lor$ **false** $\lor$ (-1 < $-heap_{funcstart\_724,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,

177).rem))).**replace**(p2 → (30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).p3) ∨ (30268 < $\$heap_{funcend\_724,1}$.p1) ∨ (30306 < $\$heap_{funcend\_724,1}$.p2) ∨ (30322 < $\$heap_{funcend\_724,1}$.p3)) ∨ ...

→ *[simplify]*

[111.30] (**false** ∨ **false** ∨ (-1 < ((63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))) ∨ (30268 < $\$heap_{funcend\_724,1}$.p1) ∨ (30306 < $\$heap_{funcend\_724,1}$.p2) ∨ (30322 < $\$heap_{funcend\_724,1}$.p3)) ∨ ...

→ *[from term 110.5, literala < ((-170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot)) is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[111.30.0] -2 < (-1 + 0)

→ *[simplify]*

[111.30.2] **true**

[111.31] (**false** ∨ **false** ∨ **false** ∨ (30268 < $\$heap_{funcend\_724,1}$.p1) ∨ (30306 < $\$heap_{funcend\_724,1}$.p2) ∨ (30322 < $\$heap_{funcend\_724,1}$.p3)) ∨ ...

→ *[from term 109.5, $\$heap_{funcend\_724,1}$ is equal to $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (30307 + (-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))]*

[111.32] (**false** ∨ **false** ∨ **false** ∨ (30268 < $\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,

$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\_\textbf{replace}(\text{p1} \rightarrow$
$(30269 + (-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow (30307 + (-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\text{p1}) \vee (30306 <$
$\$\text{heap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \$\text{heap}_{funcend\_724,1}.\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[111.37] (**false** $\vee$ **false** $\vee$ **false** $\vee$ (-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))) \vee (30306 < \$heap_{funcend\_724,1}.p2) \vee$
$(30322 < \$heap_{funcend\_724,1}.p3)) \vee ...$

$\rightarrow$ *[from term 85.0, literala < ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart\_724,1}.p1, 177).rem))$ is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[111.37.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[111.37.2] **true**

[111.38] (**false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ (30306 < $\$heap_{funcend\_724,1}.p2$) $\vee$
$(30322 < \$heap_{funcend\_724,1}.p3)) \vee ...$

$\rightarrow$ *[from term 109.5, $\$heap_{funcend\_724,1}$ is equal to*
*$\$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow ((-63$
$ div(\textbf{heapIs } \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p3, 178).quot) + (170 *$*
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,$
*$178).rem))).\_\textbf{replace}(p1 \rightarrow (30269 + (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (30307 + (-35 *$*
*$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 *$*
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$
*$176).rem))).\_\textbf{replace}(p3 \rightarrow (-63 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart_724,1}.p3, 178).rem))]

[111.39] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30306 <
$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).rem)))._**replace**(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p3,
178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p1, 177).rem)))._**replace**(p2 → (30307 + (-35 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$·p3, 178).rem))).p2) ∨ (30322 < $heap_{funcend\_724,1}$·p3)) ∨
...

→ *[simplify]*

[111.43] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (-1 < ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).rem))) ∨ (30322 <
$heap_{funcend\_724,1}$·p3)) ∨ ...

→ *[from term 88.7, literala < ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$·p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$·p2, 176).rem)) is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[111.43.0] -2 < (-1 + 0)

→ *[simplify]*

[111.43.2] **true**

[111.44] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 <
$heap_{funcend\_724,1}$·p3)) ∨ ...

→ *[from term 109.5, $heap_{funcend\_724,1}$ is equal to*
*$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$·p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$·p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).quot) + (172 * div(**heapIs***
*$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p2, 176).rem)))._**replace**(p3 → ((-63*
** div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p3, 178).quot) + (170 ***
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$·p3,*
*178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$·p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$·p1, 177).rem)))._**replace**(p2 → (30307 + (-35 ***

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*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 **
*div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,*
*176).rem)))._**replace**(p3 → (-63 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p3, 178).rem))]

[111.45] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 <
$heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → (30307 + (-35 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p3, 178).rem))).p3)) ∨ ...

→ *[simplify]*

[111.46] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 64.19, literala < ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$,*
*$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$,*
$heap_{funcstart\_724,1}$.p3, 178).rem)) is false whenever -2 < (-30323 + literala)]

> **Proof of rule precondition:**
>
> *[111.46.0]* -2 < (-30323 + 30322)
>
> → *[simplify]*
>
> *[111.46.2]* **true**

[111.47] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[111.48] **false** ∨ ...

[Remove 'false' term 111.48 and fetch new term from containing clause]

[112.0] ($heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,

$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \vee$
$(\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow \$\text{heap}_{724,1;747,8}.\text{p2})) \vee (-1$
$< \$\text{heap}_{724,1;747,8}.\text{p2})$

[Remove 'false' term 111.48 and fetch new term from containing clause]

[113.0] $(0 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},$
$177).\text{rem}))) \vee (\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow$
$\$\text{heap}_{724,1;747,8}.\text{p2})) \vee (-1 < \$\text{heap}_{724,1;747,8}.\text{p2})$

[Copy term 1.69]

[114.0] $((0 == \$\text{heap}_{724,1;748,8}.\text{p3}) \vee (-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \vee (-1 <$
$-\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \vee (30306 <$
$\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \vee (\$\text{heap}_{724,1;748,8} ==$
$\$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow \$\text{heap}_{724,1;747,8}.\text{p2})) \vee (-1 < \$\text{heap}_{724,1;747,8}.\text{p2})$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\_\textbf{replace}(p2 \rightarrow$*
$30307 + \$heap_{724,1;747,8}.p2)]$

[114.1] $((0 == \$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow (30307 +$
$\$\text{heap}_{724,1;747,8}.\text{p2})).\text{p3}) \vee (-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \vee (-1 <$
$-\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \vee (30306 <$
$\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[114.2] $((0 == \$\text{heap}_{724,1;747,8}.\text{p3}) \vee (-1 < -\$\text{heap}_{724,1;748,8}.\text{p1}) \vee (-1 <$
$-\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \vee (30306 <$
$\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\_\textbf{replace}(p2 \rightarrow$*
$30307 + \$heap_{724,1;747,8}.p2)]$

[114.3] $((0 == \$\text{heap}_{724,1;747,8}.\text{p3}) \vee (-1 < -\$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow$
$(30307 + \$\text{heap}_{724,1;747,8}.\text{p2})).\text{p1}) \vee (-1 < -\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30268 <$
$\$\text{heap}_{724,1;748,8}.\text{p1}) \vee (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 <$
$\$\text{heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[simplify]*

[114.4] $((0 == \$\text{heap}_{724,1;747,8}.\text{p3}) \vee (-1 < -\$\text{heap}_{724,1;747,8}.\text{p1}) \vee (-1 <$
$-\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \vee (30306 <$
$\$\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \vee ...$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\_\textbf{replace}(p2 \rightarrow$*
$30307 + \$heap_{724,1;747,8}.p2)]$

[114.5] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (\text{-}1 < -\$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow (30307 + \$heap_{724,1;747,8}.p2)).p2) \vee (30268 < \$heap_{724,1;748,8}.p1) \vee (30306 < \$heap_{724,1;748,8}.p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[simplify]*

[114.10] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;748,8}.p1) \vee (30306 < \$heap_{724,1;748,8}.p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow 30307 + \$heap_{724,1;747,8}.p2)]$*

[114.11] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow (30307 + \$heap_{724,1;747,8}.p2)).p1) \vee (30306 < \$heap_{724,1;748,8}.p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[simplify]*

[114.12] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < \$heap_{724,1;748,8}.p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow 30307 + \$heap_{724,1;747,8}.p2)]$*

[114.13] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < \$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow (30307 + \$heap_{724,1;747,8}.p2)).p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[simplify]*

[114.16] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (\text{-}1 < \$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[from term 76.0, literala $< \$heap_{724,1;747,8}.p2$ is false whenever -2 $< (0 +$ literala)]*

Proof of rule precondition:

[114.16.0] -2 $< (\text{-}1 + 0)$

$\rightarrow$ *[simplify]*

[114.16.2] **true**

[114.17] $((0 == \$heap_{724,1;747,8}.p3) \vee (\text{-}1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee \textbf{false} \vee (30322 < \$heap_{724,1;748,8}.p3)) \vee ...$

$\rightarrow$ *[from term 75.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}.\textbf{replace}(p2 \rightarrow$*

$30307 + \$heap_{724,1;747,8}.p2)]$

[114.18] $((0 == \$heap_{724,1;747,8}.p3) \vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee$ **false** $\vee (30322 < \$heap_{724,1;747,8}.\textbf{replace}(p2 \to (30307 + \$heap_{724,1;747,8}.p2)).p3)) \vee ...$

$\to$ *[simplify]*

[114.20] $((0 == \$heap_{724,1;747,8}.p3) \vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)) \vee ...$

$\to$ *[from term 112.0, $\$heap_{724,1;747,8}$ is equal to*
*$\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \to ((-63$
$ div(\textbf{heapIs} \$heap_{funcstart_724,1}, \$heap_{funcstart_724,1}.p3, 178).quot) + (170 *$*
$div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,$
*$178).rem))).\textbf{replace}(p1 \to (-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[114.21] $((0 == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs}$ $\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$ $\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \to ((-35$ $* div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 *$ $div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,$ $176).rem))).\textbf{replace}(p3 \to ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p3, 178).rem))).\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs}$ $\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$ $\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).p3) \vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)) \vee ...$

$\to$ *[simplify]*

[114.23] $((0 == ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$ $\$heap_{funcstart\_724,1}.p3, 178).rem))) \vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)) \vee ...$

$\to$ *[from term 63.3, $0 == ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
*$\$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},$*
$\$heap_{funcstart\_724,1}.p3, 178).rem))$ is false]

[114.24] (**false** $\vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30268 < \$heap_{724,1;747,8}.p1) \vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)) \vee ...$

→ *[from term 112.0, $\$heap_{724,1;747,8}$ is equal to*
$\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3,
178).rem))).**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[114.25] (**false** ∨ (-1 < −$\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2,
176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p1) ∨ (30268 <
$\$heap_{724,1;747,8}$.p1) ∨ (30306 < −$\$heap_{724,1;747,8}$.p2) ∨ (30322 <
$\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[simplify]*

[114.29] (**false** ∨ (-1 < ((2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}$.p1, 177).rem))) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 <
−$\$heap_{724,1;747,8}$.p2) ∨ (30322 < $\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 113.0, literala < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
$\$heap_{funcstart\_724,1}$.p1, 177).quot)) is false whenever -2 < (0 + literala)]

Proof of rule precondition:

[114.29.0] -2 < (-1 + 0)

→ *[simplify]*

[114.29.2] **true**

[114.30] (**false** ∨ **false** ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 <
−$\$heap_{724,1;747,8}$.p2) ∨ (30322 < $\$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 112.0, $\$heap_{724,1;747,8}$ is equal to*
*$\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,*
*$\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs***

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$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem))).**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))]

[114.31] (**false** ∨ **false** ∨ (30268 < $heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p1) ∨
(30306 < −$heap_{724,1;747,8}$.p2) ∨ (30322 < $heap_{724,1;747,8}$.p3)) ∨ ...

→ *[simplify]*

[114.32] (**false** ∨ **false** ∨ (30268 < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))) ∨ (30306 < −$heap_{724,1;747,8}$.p2) ∨ (30322
< $heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 56.17, literala < ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem)) is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[114.32.0] -2 < (-30269 + 30268)

→ *[simplify]*

[114.32.2] **true**

[114.33] (**false** ∨ **false** ∨ **false** ∨ (30306 < −$heap_{724,1;747,8}$.p2) ∨ (30322 <
$heap_{724,1;747,8}$.p3)) ∨ ...

→ *[from term 112.0, $heap_{724,1;747,8}$ is equal to
$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,
$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63
* div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3,
178).rem))).**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_724,1}$,

$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))]

[114.34] (**false** ∨ **false** ∨ **false** ∨ (30306 < −$\$heap_{funcstart\_724,1}.$**replace**(p1
→ ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) +
(171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).rem))).**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p1, 177).rem))).p2) ∨
(30322 < $\$heap_{724,1;747,8}.$p3)) ∨ ...

→ *[simplify]*

[114.40] (**false** ∨ **false** ∨ **false** ∨ (30306 < ((35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (-172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))) ∨ (30322 <
$\$heap_{724,1;747,8}.$p3)) ∨ ...

→ *[from term 58.12, literala < ((-172 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).rem) + (35 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p2, 176).quot)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[114.40.0] -2 < (-30307 + 30306)

→ *[simplify]*

[114.40.2] **true**

[114.41] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < $\$heap_{724,1;747,8}.$p3)) ∨ ...

→ *[from term 112.0, $\$heap_{724,1;747,8}$ is equal to
$\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 → ((-63
* div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3, 178).quot) + (170 *
div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}.$p3,
178).rem))).**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))]*

[114.42] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 <
$\$heap_{funcstart\_724,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$,
$\$heap_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**

$\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p3)) ∨ ...

→ *[simplify]*

[114.44] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 64.19, literala < ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[114.44.0] -2 < (-30323 + 30322)

→ *[simplify]*

[114.44.2] **true**

[114.45] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[114.46] **false** ∨ ...

[Remove 'false' term 114.46 and fetch new term from containing clause]

[117.0] $\$heap_{724,1;748,8}$ == $\$heap_{724,1;747,8}$.**replace**(p2 → $\$heap_{724,1;747,8}$.p2)

[Take goal term]

[1.69] (-1 < −$\$heap_{724,1;748,8}$.p1) ∨ (-1 < −$\$heap_{724,1;748,8}$.p2) ∨ (0 == $\$heap_{724,1;748,8}$.p3) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)

→ *[from term 117.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.**replace**(p2 → $\$heap_{724,1;747,8}$.p2)]*

[1.70] (0 == $\$heap_{724,1;747,8}$.**replace**(p2 → $\$heap_{724,1;747,8}$.p2).p3) ∨ (-1 < −$\$heap_{724,1;748,8}$.p1) ∨ (-1 < −$\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)

→ *[simplify]*

[1.71] (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;748,8}$.p1) ∨ (-1 < −$\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)

→ *[from term 117.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.**replace**(p2 →*

$heap_{724,1;747,8}.p2)]$

[1.72] $(0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.\textbf{replace}(p2 \to \$heap_{724,1;747,8}.p2).p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)$

$\to$ *[simplify]*

[1.73] $(0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)$

$\to$ *[from term 117.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}.\textbf{replace}(p2 \to \$heap_{724,1;747,8}.p2)]$*

[1.74] $(0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.p1) \lor (-1 < -\$heap_{724,1;747,8}.\textbf{replace}(p2 \to \$heap_{724,1;747,8}.p2).p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)$

$\to$ *[simplify]*

[1.75] $(0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.p1) \lor (-1 < -\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)$

[Remove 'false' term 114.46 and fetch new term from containing clause]

[118.0] $-1 < \$heap_{724,1;747,8}.p2$

[Copy term 117.0]

[120.0] $(\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\textbf{replace}(p2 \to \$heap_{724,1;747,8}.p2)) \lor (\$heap_{724,1;747,8} == \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \to ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \to ((-35 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \to ((-63 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\textbf{replace}(p1 \to ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))) \lor (0 < ((-2 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))$

$\to$ *[from term 84.0, $heap_{724,1;747,8}$ is equal to $heap_{funcstart\_724,1}.\textbf{replace}(p1 \to ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \to ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \to ((-63 * div(\textbf{heapIs}$*

*$heap$_{*funcstart*_724,1}, *$heap$_{*funcstart*_724,1}.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).* **replace**(p1 → 30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[120.2] ($heap_{724,1;748,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))).p2)) ∨ ...

→ *[simplify]*

[120.5] ($heap_{724,1;748,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**(p1 → (30269 + (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))))) ∨ ...

[Copy term 118.0]

[121.0] (-1 < $heap_{724,1;747,8}$.p2) ∨ ($heap_{724,1;747,8}$ == $heap_{funcstart\_724,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$,

$\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))) ∨ (0 < ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)))

→ *[from term 84.0, $\$\mathrm{heap}_{724,1;747,8}$ is equal to $\$\mathrm{heap}_{funcstart\_724,1}$.* **replace**(*p1 → ((-2 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem)).* **replace**(*p2 → ((-35 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))).* **replace**(*p3 → ((-63 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem))).* **replace**(*p1 → 30269 + (-2 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem))]*

[121.1] (-1 < $\$\mathrm{heap}_{funcstart\_724,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p3, 178).rem))). **replace**(p1 → (30269 + (-2 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p1, 177).rem))).p2) ∨ ...

→ *[simplify]*

[121.4] (-1 < ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))) ∨ ...

→ *[from term 59.3, -1 < ((-35 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem)) is true if and only if 0 < ((-35 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[121.5] (0 < ((-35 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\mathrm{heap}_{funcstart\_724,1}$, $\$\mathrm{heap}_{funcstart\_724,1}$.p2, 176).rem))) ∨ ...

[Copy term 1.69]

[123.0] $((0 == \$\text{heap}_{724,1;748,8}.\text{p3}) \lor (\text{-1} < -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (\text{-1} <$
$-\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 <$
$\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \lor (\$\text{heap}_{724,1;747,8} ==$
$\$\text{heap}_{funcstart\_724,1}.$**replace**$(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$**replace**$(\text{p2} \to ((\text{-35} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$**replace**$(\text{p3} \to ((\text{-63}$
$* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p3},$
$178).\text{rem}))).$**replace**$(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \lor (0 < ((\text{-2} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))$

$\to$ *[from term 120.5, $\$\text{heap}_{724,1;748,8}$ is equal to*
*$\$\text{heap}_{funcstart\_724,1}.$**replace***$(p1 \to ((\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).rem))).$**replace***$(p2 \to ((\text{-35} * \text{div}(\textbf{heapIs}$*
*$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs}$*
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).rem))).$**replace***$(p3 \to ((\text{-63}$
$ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart_724,1}, \$\text{heap}_{funcstart_724,1}.p3, 178).quot) + (170 *$*
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p3,$
*$178).rem))).$**replace***$(p1 \to (30269 + (\text{-2} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$*
*$\$\text{heap}_{funcstart\_724,1}.p1, 177).rem))).$**replace***$(p2 \to (\text{-35} * \text{div}(\textbf{heapIs}$*
*$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs}$*
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p2, 176).rem))]$

[123.1] $((0 == \$\text{heap}_{funcstart\_724,1}.$**replace**$(\text{p1} \to ((\text{-2} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$**replace**$(\text{p2} \to ((\text{-35}$
$* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2},$
$176).\text{rem}))).$**replace**$(\text{p3} \to ((\text{-63} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1},$
$\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$**replace**$(\text{p1} \to (30269 + (\text{-2} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$**replace**$(\text{p2} \to ((\text{-35}$
$* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\text{p3}) \lor (\text{-1}$
$< -\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (\text{-1} < -\$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30268 <$
$\$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 <$
$\$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

$\to$ *[simplify]*

[123.4] ((0 == ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))) ∨ (-1 < $-\$heap_{724,1;748,8}$.p1) ∨ (-1 < $-\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 63.3, 0 == ((-63 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) is false]*

[123.5] (**false** ∨ (-1 < $-\$heap_{724,1;748,8}$.p1) ∨ (-1 < $-\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 120.5, $\$heap_{724,1;748,8}$ is equal to $\$heap_{funcstart\_724,1}$.***replace***(p1 → ((-2 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).***replace***(p2 → ((-35 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).***replace***(p3 → ((-63 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).***replace***(p1 → (30269 + (-2 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).***replace***(p2 → (-35 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))]*

[123.6] (**false** ∨ (-1 < $-\$heap_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).p1) ∨ (-1 < $-\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)) ∨ ...

→ *[simplify]*

[123.16] (**false** ∨ (30268 < ((-171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot))) ∨ (-1 < $-\$heap_{724,1;748,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 <

$heap_{724,1;748,8}.p3)) \lor ...$

$\rightarrow$ *[from term 54.11, literala < ((-171 * div($\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem) + (2 * div($\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p1, 177).quot)) is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[123.16.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[123.16.2] **true**

[123.17] (**false** $\lor$ **false** $\lor$ (-1 < $-$\$heap$_{724,1;748,8}.$p2) $\lor$ (30268 < \$heap$_{724,1;748,8}.$p1) $\lor$ (30306 < \$heap$_{724,1;748,8}.$p2) $\lor$ (30322 < \$heap$_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[from term 120.5, \$heap$_{724,1;748,8}$ is equal to*
$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3, 178).rem))).\textbf{replace}(p1 \rightarrow (30269 + (-2 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \rightarrow (-35 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$ $heap_{funcstart\_724,1}$, $heap_{funcstart_724,1}.p2, 176).rem))]*

[123.18] (**false** $\lor$ **false** $\lor$ (-1 < $-$\$heap$_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p3, 178).rem))).**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p2, 176).rem))).p2) $\lor$ (30268 < \$heap$_{724,1;748,8}.$p1) $\lor$ (30306 < \$heap$_{724,1;748,8}.$p2) $\lor$ (30322 < \$heap$_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[simplify]*

[123.22] (**false** $\lor$ **false** $\lor$ (-1 < ((35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}.$p2, 176).quot) + (-172 * div(**heapIs** \$heap$_{funcstart\_724,1}$,

$\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))) \lor (30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

$\rightarrow$ *[from term 121.5, literala < ((-172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p2, 176).\text{rem}) + (35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p2, 176).\text{quot})) is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[123.22.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[123.22.2] **true**

[123.23] (**false** $\lor$ **false** $\lor$ **false** $\lor$ $(30268 < \$\text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

$\rightarrow$ *[from term 120.5, $\$\text{heap}_{724,1;748,8}$ is equal to $\$\text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p1, 177).\text{quot}) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1, 177).\text{rem}))).$**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p2, 176).\text{quot}) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p2, 176).\text{rem}))).$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p3, 178).\text{quot}) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p3, 178).\text{rem}))).$**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p1, 177).\text{quot}) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.p1, 177).\text{rem}))).$**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p2, 176).\text{quot}) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.p2, 176).\text{rem}))]*

[123.24] (**false** $\lor$ **false** $\lor$ **false** $\lor$ $(30268 < \$\text{heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p2}, 176).\text{quot}) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).$**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p3}, 178).\text{quot}) + (170 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).$**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).$**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p2}, 176).\text{quot}) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))).\text{p1}) \lor (30306 < \$\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \$\text{heap}_{724,1;748,8}.\text{p3})) \lor ...$

$\rightarrow$ *[simplify]*

[123.28] (**false** $\lor$ **false** $\lor$ **false** $\lor$ (-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$, $\$\text{heap}_{funcstart_724,1}.\text{p1}, 177).\text{quot}) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,

$\text{\$heap}_{funcstart\_724,1}.\text{p1, 177).rem)))} \lor (30306 < \text{\$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;748,8}.\text{p3})) \lor \ldots$

$\rightarrow$ *[from term 85.0, literala < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).rem)) is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[123.28.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[123.28.2] **true**

[123.29] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < $\text{\$heap}_{724,1;748,8}.\text{p2}$) $\lor$ (30322 < $\text{\$heap}_{724,1;748,8}.\text{p3}$)) $\lor$ ...

$\rightarrow$ *[from term 120.5, $\text{\$heap}_{724,1;748,8}$ is equal to $\text{\$heap}_{funcstart\_724,1}.$* **replace***(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).rem))).* **replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p2, 176).rem))).* **replace***(p3 $\rightarrow$ ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p3, 178).rem))).* **replace***(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p1, 177).rem))).* **replace***(p2 $\rightarrow$ (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart_724,1}.p2, 176).rem))]*

[123.30] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < $\text{\$heap}_{funcstart\_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p3, 178).rem))).**replace**(p1 $\rightarrow$ (30269 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).rem))).p2) $\lor$ (30322 < $\text{\$heap}_{724,1;748,8}.$p3)) $\lor$ ...

$\rightarrow$ *[simplify]*

[123.31] (**false** $\lor$ **false** $\lor$ **false** $\lor$ **false** $\lor$ (30306 < ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}.$p2, 176).quot) + (172 * div(**heapIs**

$\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))) ∨ (30322 < $\text{\$heap}_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 60.18, literala < ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[123.31.0] -2 < (-30307 + 30306)

→ *[simplify]*

[123.31.2] **true**

[123.32] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < $\text{\$heap}_{724,1;748,8}$.p3)) ∨ ...

→ *[from term 120.5, $\text{\$heap}_{724,1;748,8}$ is equal to* $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))]*

[123.33] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < $\text{\$heap}_{funcstart\_724,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 → (30269 + (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p2, 176).rem))).p3)) ∨ ...

→ *[simplify]*

[123.36] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, $\text{\$heap}_{funcstart\_724,1}$.p3, 178).rem)))) ∨ ...

→ *[from term 64.19, literala < ((-63 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[123.36.0] -2 < (-30323 + 30322)

→ *[simplify]*

[123.36.2] **true**

[123.37] (**false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**) ∨ ...

→ *[simplify]*

[123.38] **false** ∨ ...

[Remove 'false' term 123.38 and fetch new term from containing clause]

[124.0] $\$heap_{724,1;747,8}$ == $\$heap_{funcstart\_724,1}$.$\textbf{replace}$(p1 → ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).$\textbf{replace}$(p2 → ((-35 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).$\textbf{replace}$(p3 → ((-63 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).$\textbf{replace}$(p1 → ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem)))

[Remove 'false' term 123.38 and fetch new term from containing clause]

[125.0] 0 < ((-2 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($\textbf{heapIs}$ $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))

[Take goal term]

[1.75] (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (-1 < −$\$heap_{724,1;747,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)

→ *[from term 118.0, -1 < −$\$heap_{724,1;747,8}$.p2 is true if and only if 0 == $\$heap_{724,1;747,8}$.p2]*

[1.76] (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (0 == $\$heap_{724,1;747,8}$.p2) ∨ (30268 < $\$heap_{724,1;748,8}$.p1) ∨ (30306 < $\$heap_{724,1;748,8}$.p2) ∨ (30322 < $\$heap_{724,1;748,8}$.p3)

→ *[from term 117.0, $\$heap_{724,1;748,8}$ is equal to $\$heap_{724,1;747,8}$.$\textbf{replace}$(p2 → $\$heap_{724,1;747,8}$.p2)]*

[1.77] (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (0 == $\$heap_{724,1;747,8}$.p2) ∨ (30268 < $\$heap_{724,1;747,8}$.$\textbf{replace}$(p2 →

$\text{\$heap}_{724,1;747,8}.\text{p2}).\text{p1}) \lor (30306 < \text{\$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;748,8}.\text{p3})$

$\rightarrow$ *[simplify]*

[1.78] $(0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{\$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;748,8}.\text{p3})$

$\rightarrow$ *[from term 117.0, $heap$_{724,1;748,8}$ is equal to $heap$_{724,1;747,8}.$**replace**(p2 $\rightarrow$ $heap$_{724,1;747,8}.p2)]*

[1.79] $(0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{\$heap}_{724,1;747,8}.\textbf{replace}(\text{p2} \rightarrow \text{\$heap}_{724,1;747,8}.\text{p2}).\text{p2}) \lor (30322 < \text{\$heap}_{724,1;748,8}.\text{p3})$

$\rightarrow$ *[simplify]*

[1.80] $(0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;748,8}.\text{p3})$

$\rightarrow$ *[from term 117.0, $heap$_{724,1;748,8}$ is equal to $heap$_{724,1;747,8}.$**replace**(p2 $\rightarrow$ $heap$_{724,1;747,8}.p2)]*

[1.81] $(0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;747,8}.\textbf{replace}(\text{p2} \rightarrow \text{\$heap}_{724,1;747,8}.\text{p2}).\text{p3})$

$\rightarrow$ *[simplify]*

[1.82] $(0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (\text{-1} < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (0 == \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{\$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{\$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{\$heap}_{724,1;747,8}.\text{p3})$

$\rightarrow$ *[from term 124.0, $heap$_{724,1;747,8}$ is equal to $heap$_{funcstart_724,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p3, 178).rem))).**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_724,1}, $heap$_{funcstart_724,1}.p1, 177).rem))]*

[1.83] $(0 == \text{\$heap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 *$

div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p2) ∨ (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < $\$heap_{724,1;747,8}$.p2) ∨ (30322 < $\$heap_{724,1;747,8}$.p3)

→ *[simplify]*

[1.86] (0 == ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))) ∨ (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < $\$heap_{724,1;747,8}$.p2) ∨ (30322 < $\$heap_{724,1;747,8}$.p3)

→ *[from term 59.3, 0 == ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem)) is false]*

[1.87] **false** ∨ (0 == $\$heap_{724,1;747,8}$.p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 < $\$heap_{724,1;747,8}$.p2) ∨ (30322 < $\$heap_{724,1;747,8}$.p3)

→ *[from term 124.0, $\$heap_{724,1;747,8}$ is equal to $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.88] **false** ∨ (0 == $\$heap_{funcstart\_724,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p3, 178).rem))).**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_724,1}$, $\$heap_{funcstart\_724,1}$.p1, 177).rem))).p3) ∨ (-1 < −$\$heap_{724,1;747,8}$.p1) ∨ (30268 < $\$heap_{724,1;747,8}$.p1) ∨ (30306 <

$\$$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $\$$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[simplify]*

[1.90] **false** $\lor$ (0 == ((-63 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).rem))) $\lor$ (-1 < $-\$$heap$_{724,1;747,8}$.p1) $\lor$ (30268 < $\$$heap$_{724,1;747,8}$.p1) $\lor$ (30306 < $\$$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $\$$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 63.3, 0 == ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)) is false]*

[1.91] **false** $\lor$ **false** $\lor$ (-1 < $-\$$heap$_{724,1;747,8}$.p1) $\lor$ (30268 < $\$$heap$_{724,1;747,8}$.p1) $\lor$ (30306 < $\$$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $\$$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 124.0, $heap_{724,1;747,8}$ is equal to $heap_{funcstart\_724,1}$.***replace***(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).***replace***(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem))).***replace***(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem))).***replace***(p1 $\rightarrow$ (-2 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]*

[1.92] **false** $\lor$ **false** $\lor$ (-1 < $-\$$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem))).p1) $\lor$ (30268 < $\$$heap$_{724,1;747,8}$.p1) $\lor$ (30306 < $\$$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $\$$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[simplify]*

[1.96] **false** $\lor$ **false** $\lor$ (-1 < ((2 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).quot) + (-171 * div(**heapIs** $\$$heap$_{funcstart\_724,1}$, $\$$heap$_{funcstart\_724,1}$.p1, 177).rem))) $\lor$ (30268 < $\$$heap$_{724,1;747,8}$.p1) $\lor$ (30306 < $\$$heap$_{724,1;747,8}$.p2) $\lor$ (30322 < $\$$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 125.0, literala < ((-171 * div(**heapIs** $heap_{funcstart\_724,1}$,*

$\$heap_{funcstart\_724,1}.p1, 177).rem) + (2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot))$ *is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[1.96.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[1.96.2] **true**

[1.97] **false** $\vee$ **false** $\vee$ **false** $\vee$ $(30268 < \$heap_{724,1;747,8}.p1) \vee (30306 <$
$\$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)$

$\rightarrow$ *[from term 124.0, $\$heap_{724,1;747,8}$ is equal to*
$\$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))).\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs }$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs }$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \rightarrow ((-63$
$* div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,$
$178).rem))).\textbf{replace}(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))]$

[1.98] **false** $\vee$ **false** $\vee$ **false** $\vee$ $(30268 < \$heap_{funcstart\_724,1}.\textbf{replace}(p1 \rightarrow$
$((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +$
$(171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,$
$177).rem))).\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p2, 176).rem))).\textbf{replace}(p3 \rightarrow ((-63 * div(\textbf{heapIs }$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs }$
$\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\textbf{replace}(p1 \rightarrow ((-2 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 *$
$div(\textbf{heapIs } \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).p1) \vee$
$(30306 < \$heap_{724,1;747,8}.p2) \vee (30322 < \$heap_{724,1;747,8}.p3)$

$\rightarrow$ *[simplify]*

[1.99] **false** $\vee$ **false** $\vee$ **false** $\vee$ $(30268 < ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))) \vee (30306 < \$heap_{724,1;747,8}.p2) \vee (30322 <$
$\$heap_{724,1;747,8}.p3)$

$\rightarrow$ *[from term 56.17, literala < ((-2 * div(\textbf{heapIs } \$heap_{funcstart_724,1},*
$\$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},$
$\$heap_{funcstart\_724,1}.p1, 177).rem))$ *is false whenever -2 < (-30269 + literala)]*

Proof of rule precondition:

[1.99.0] -2 < (-30269 + 30268)

$\rightarrow$ *[simplify]*

[1.99.2] **true**

[1.100] **false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ (30306 < \$heap$_{724,1;747,8}$.p2) $\vee$ (30322 < \$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 124.0, \$heap$_{724,1;747,8}$ is equal to \$heap$_{funcstart\_724,1}$.***replace***(p1 $\rightarrow$ ((-2 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).***replace***(p2 $\rightarrow$ ((-35 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))).***replace***(p3 $\rightarrow$ ((-63 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem))).***replace***(p1 $\rightarrow$ (-2 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(***heapIs*** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem)))]*

[1.101] **false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ (30306 < \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p3, 178).rem))).**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p1, 177).rem))).p2) $\vee$ (30322 < \$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[simplify]*

[1.104] **false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ (30306 < ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem))) $\vee$ (30322 < \$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 60.18, literala < ((-35 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_724,1}$, \$heap$_{funcstart\_724,1}$.p2, 176).rem)) is false whenever -2 < (-30307 + literala)]*

Proof of rule precondition:

[1.104.0] -2 < (-30307 + 30306)

$\rightarrow$ *[simplify]*

[1.104.2] **true**

[1.105] **false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ **false** $\vee$ (30322 < \$heap$_{724,1;747,8}$.p3)

$\rightarrow$ *[from term 124.0, \$heap$_{724,1;747,8}$ is equal to

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$heap_{funcstart\_724,1}$._**replace**$(p1 \rightarrow ((-2 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**$(p2 \rightarrow ((-35 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**$(p3 \rightarrow ((-63 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**$(p1 \rightarrow (-2 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))]

[1.106] **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < $heap_{funcstart\_724,1}$._**replace**$(p1 \rightarrow ((-2 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem)))._**replace**$(p2 \rightarrow ((-35 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).quot) + (172 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2, 176).rem)))._**replace**$(p3 \rightarrow ((-63 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))._**replace**$(p1 \rightarrow ((-2 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).quot) + (171 * div($**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1, 177).rem))).p3)

→ *[simplify]*

[1.108] **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ (30322 < ((-63 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)))

→ *[from term 64.19, literala < ((-63 * div(*__heapIs__ *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).quot) + (170 * div(*__heapIs__ *$heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p3, 178).rem)) is false whenever -2 < (-30323 + literala)]*

Proof of rule precondition:

[1.108.0] -2 < (-30323 + 30322)

→ *[simplify]*

[1.108.2] **true**

[1.109] **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false** ∨ **false**

→ *[simplify]*

[1.110] **false**

Proof of verification condition: Precondition of 'operator /' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (75,34)

Condition defined at: built in declaration

To prove: $!(0.0 ==$
asType$<$double$>$(static_cast$<$real$>$($\text{\$heap}_{funcend\_724,1}$.M1)))

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)

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 $==$ div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.p1),
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a1))) $==$
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a1))) $==$
asType$<$integer$>$(div1.rem)

$!(0 ==$ **asType$<$integer$>$**(div1.rem)) || $!(0 ==$
asType$<$integer$>$(div1.quot))

div2 $==$ div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.p2),
asType$<$int$>$($\text{\$heap}_{funcstart\_724,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($\text{\$heap}_{funcstart\_724,1}$.a2))) $==$

asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a2))) ==
asType\<integer\>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\text{heap}_{funcstart\_724,1}$,
asType\<int\>($\text{heap}_{funcstart\_724,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\text{heap}_{724,1;740,8}$ == $\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\text{heap}_{724,1;740,8}$.M1) <
asType\<integer\>($\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;740,8}$.p1))

asType\<integer\>($\text{heap}_{724,1;740,8}$.p1) <
asType\<integer\>($\text{heap}_{724,1;740,8}$.M1)

$\text{heap}_{724,1;742,8}$ == $\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{724,1;740,8}$.b2))))

−**asType\<integer const\>**($\text{heap}_{724,1;742,8}$.M2) <
asType\<integer\>($\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\text{heap}_{724,1;742,8}$.p2))

asType\<integer\>($\text{heap}_{724,1;742,8}$.p2) <
asType\<integer\>($\text{heap}_{724,1;742,8}$.M2)

$\text{heap}_{724,1;744,8}$ == $\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{heap}_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{heap}_{724,1;742,8}$.b3))))

$-$**asType$<$integer const$>$**($\$\text{heap}_{724,1;744,8}$.M3) $<$
asType$<$integer$>$($\$\text{heap}_{724,1;744,8}$.p3)

!(0 == **asType$<$integer$>$**($\$\text{heap}_{724,1;744,8}$.p3))

asType$<$integer$>$($\$\text{heap}_{724,1;744,8}$.p3) $<$
asType$<$integer$>$($\$\text{heap}_{724,1;744,8}$.M3)

$\$\text{heap}_{724,1;747,8}$ == $\$\text{heap}_{724,1;744,8}$.**replace**(p1 $\to$ **asType$<$short int$>$**((**asType$<$int$>$**($\$\text{heap}_{724,1;744,8}$.M1) *
asType$<$int$>$(**static_cast$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{724,1;744,8}$.p1) $<$
(**int**)0))) + **asType$<$int$>$**($\$\text{heap}_{724,1;744,8}$.p1)))

$\$\text{heap}_{724,1;748,8}$ == $\$\text{heap}_{724,1;747,8}$.**replace**(p2 $\to$ **asType$<$short int$>$**((**asType$<$int$>$**($\$\text{heap}_{724,1;747,8}$.M2) *
asType$<$int$>$(**static_cast$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{724,1;747,8}$.p2) $<$
(**int**)0))) + **asType$<$int$>$**($\$\text{heap}_{724,1;747,8}$.p2)))

$\$\text{heap}_{funcend\_724,1}$ == $\$\text{heap}_{724,1;748,8}$.**replace**(p3 $\to$ **asType$<$short int$>$**((**asType$<$int$>$**($\$\text{heap}_{724,1;748,8}$.M3) *
asType$<$int$>$(**static_cast$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{724,1;748,8}$.p3) $<$
(**int**)0))) + **asType$<$int$>$**($\$\text{heap}_{724,1;748,8}$.p3)))

invariant1(**heapIs** $\$\text{heap}_{funcend\_724,1}$)

Proof:

[Take goal term]

[1.0] !(0.0 ==
asType$<$double$>$(**static_cast$<$real$>$**($\$\text{heap}_{funcend\_724,1}$.M1)))

$\to$ *[const static or extern object]*

[1.1] !(0.0 == **asType$<$double$>$**(**static_cast$<$real$>$**($\$\text{heap}_{init}$.M1)))

$\to$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.2] !(0.0 == **asType$<$double$>$**(**static_cast$<$real$>$**(**asType$<$short int$>$**((**int**)30269))))

$\to$ *[simplify]*

[1.9] **true**

Proof of verification condition: Precondition of 'operator /' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (76,34)

Condition defined at: built in declaration

To prove: !(0.0 ==
asType$<$double$>$(**static_cast$<$real$>$**($\$\text{heap}_{funcend\_724,1}$.M2)))

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType\<integer\>**(div2.rem)) || !(0 ==
asType\<integer\>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1)))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) <
asType\<integer\>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2)))))

−**asType\<integer const\>**($\$heap_{724,1;742,8}$.M2) <
asType\<integer\>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$heap_{724,1;742,8}$.p2))

asType\<integer\>($\$heap_{724,1;742,8}$.p2) <
asType\<integer\>($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3)))))

−**asType\<integer const\>**($\$heap_{724,1;744,8}$.M3) <
asType\<integer\>($\$heap_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($\$heap_{724,1;744,8}$.p3))

asType\<integer\>($\$heap_{724,1;744,8}$.p3) <

asType<integer>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$._**replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) < (**int**)0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

$heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**($heap$_{724,1;747,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) < (**int**)0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$._**replace**(p3 → **asType<short int>**((**asType<int>**($heap$_{724,1;748,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.p3) < (**int**)0))) + **asType<int>**($heap$_{724,1;748,8}$.p3)))

invariant1(**heapIs** $heap$_{funcend_724,1}$)

raux1 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.p1)) / **asType<double>**(**static_cast<real>**($heap$_{funcend\_724,1}$.M1))

Proof:

[Take goal term]

[1.0] !(0.0 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.M2)))

→ *[const static or extern object]*

[1.1] !(0.0 == **asType<double>**(**static_cast<real>**($heap$_{init}$.M2)))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.2] !(0.0 == **asType<double>**(**static_cast<real>**(**asType<short int>**((**int**)30307))))

→ *[simplify]*

[1.9] **true**

Proof of verification condition: Precondition of 'operator /' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (77,34)

Condition defined at: built in declaration

To prove: !(0.0 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.M3)))

Given:

$heap$_{init}$.LIMIT == (**int**)80

$heap$_{init}$.M1 == **asType<short int>**((**int**)30269)

$\$heap_{init}.r1 == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\$heap_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p1),
asType<int>($\$heap_{funcstart\_724,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a1))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p2),
asType<int>($\$heap_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==

asType<integer>(div2.quot))

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType<int>($\$\text{heap}_{funcstart\_724,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$\text{heap}_{724,1;740,8}$ == $\$\text{heap}_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_724,1}$.b1)))))

−**asType<integer const>**($\$\text{heap}_{724,1;740,8}$.M1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;740,8}$.p1))

asType<integer>($\$\text{heap}_{724,1;740,8}$.p1) <
asType<integer>($\$\text{heap}_{724,1;740,8}$.M1)

$\$\text{heap}_{724,1;742,8}$ == $\$\text{heap}_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$\text{heap}_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{724,1;740,8}$.b2)))))

−**asType<integer const>**($\$\text{heap}_{724,1;742,8}$.M2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;742,8}$.p2))

asType<integer>($\$\text{heap}_{724,1;742,8}$.p2) <
asType<integer>($\$\text{heap}_{724,1;742,8}$.M2)

$\$\text{heap}_{724,1;744,8}$ == $\$\text{heap}_{724,1;742,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$\text{heap}_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{724,1;742,8}$.b3)))))

−**asType<integer const>**($\$\text{heap}_{724,1;744,8}$.M3) <
asType<integer>($\$\text{heap}_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($\$\text{heap}_{724,1;744,8}$.p3))

asType<integer>($\$\text{heap}_{724,1;744,8}$.p3) <
asType<integer>($\$\text{heap}_{724,1;744,8}$.M3)

$\$heap_{724,1;747,8} == \$heap_{724,1;744,8}$.__replace__(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{724,1;744,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;744,8}$.p1) < (**int**)0))) + **asType**<**int**>($\$heap_{724,1;744,8}$.p1)))

$\$heap_{724,1;748,8} == \$heap_{724,1;747,8}$.__replace__(p2 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{724,1;747,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;747,8}$.p2) < (**int**)0))) + **asType**<**int**>($\$heap_{724,1;747,8}$.p2)))

$\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}$.__replace__(p3 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{724,1;748,8}$.M3) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{724,1;748,8}$.p3) < (**int**)0))) + **asType**<**int**>($\$heap_{724,1;748,8}$.p3)))

invariant1(**heapIs** $\$heap_{funcend\_724,1}$)

raux1 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_724,1}$.p1)) / **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_724,1}$.M1))

raux2 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_724,1}$.p2)) / **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_724,1}$.M2))

Proof:

[Take goal term]

[1.0] !(0.0 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_724,1}$.M3)))

$\rightarrow$ *[const static or extern object]*

[1.1] !(0.0 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{init}$.M3)))

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.2] !(0.0 == **asType**<**double**>(**static_cast**<**real**>(**asType**<**short int**>((**int**)30323))))

$\rightarrow$ *[simplify]*

[1.9] **true**

Proof of verification condition: Assertion valid

Condition generated at: C:\Escher\Customers\prang\prang.c (81,30)

To prove: asType<**real**>((**double**)0.0) < ((**asType**<**real**>(raux2) + **asType**<**real**>(raux1)) + **asType**<**real**>(raux3))

Given:

$\$heap_{init}$.LIMIT == (**int**)80

$\$heap_{init}$.M1 == **asType**<**short int**>((**int**)30269)

$\$heap_{init}$.r1 == **asType**<**short int**>((**int**)171)

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

!(0 == **asType<integer>**(div1.rem)) || !(0 ==
asType<integer>(div1.quot))

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$,
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_724,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType\<int\>($\$heap_{funcstart\_724,1}$.p3),
asType\<int\>($\$heap_{funcstart\_724,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_724,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType\<integer\>(div3.rem)

!(0 == **asType\<integer\>**(div3.rem)) || !(0 ==
asType\<integer\>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$._**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_724,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType\<integer const\>**($\$heap_{724,1;740,8}$.M1) <
asType\<integer\>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType\<integer\>**($\$heap_{724,1;740,8}$.p1))

asType\<integer\>($\$heap_{724,1;740,8}$.p1) <
asType\<integer\>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$._**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$heap_{724,1;740,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{724,1;740,8}$.b2))))

−**asType\<integer const\>**($\$heap_{724,1;742,8}$.M2) <
asType\<integer\>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType\<integer\>**($\$heap_{724,1;742,8}$.p2))

asType\<integer\>($\$heap_{724,1;742,8}$.p2) <
asType\<integer\>($\$heap_{724,1;742,8}$.M2)

$\$heap_{724,1;744,8}$ == $\$heap_{724,1;742,8}$._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$heap_{724,1;742,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{724,1;742,8}$.b3))))

−**asType\<integer const\>**($\$heap_{724,1;744,8}$.M3) <
asType\<integer\>($\$heap_{724,1;744,8}$.p3)

!(0 == **asType\<integer\>**($\$heap_{724,1;744,8}$.p3))

asType\<integer\>($\$heap_{724,1;744,8}$.p3) <
asType\<integer\>($\$heap_{724,1;744,8}$.M3)

$\$heap_{724,1;747,8}$ == $\$heap_{724,1;744,8}$._**replace**(p1 → **asType\<short**

$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M1})$ *
$\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{static\_cast}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})<$
$(\mathbf{int})0))) + \mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})))$

$\$\mathrm{heap}_{724,1;748,8} == \$\mathrm{heap}_{724,1;747,8}.\_\mathbf{replace}(\mathrm{p2} \to \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;747,8}.\mathrm{M2})$ *
$\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{static\_cast}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2})<$
$(\mathbf{int})0))) + \mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;747,8}.\mathrm{p2})))$

$\$\mathrm{heap}_{funcend\_724,1} == \$\mathrm{heap}_{724,1;748,8}.\_\mathbf{replace}(\mathrm{p3} \to \mathbf{asType}{<}\mathbf{short}$
$\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;748,8}.\mathrm{M3})$ *
$\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{static\_cast}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})<$
$(\mathbf{int})0))) + \mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})))$

invariant1(**heapIs** $\$\mathrm{heap}_{funcend\_724,1}$)

raux1 $== \mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}))$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M1}))$

raux2 $== \mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}))$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M2}))$

raux3 $== \mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}))$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))$

$\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\mathrm{raux1})$

$\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\mathrm{raux2})$

$\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\mathrm{raux3})$

Proof:

[Take given term]

[78.0] $(\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1}))$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M1}))) ==$ raux1

$\to$ *[simplify]*

[78.2] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1})$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M1}))) ==$ raux1

$\to$ *[const static or extern object]*

[78.3] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1})$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathrm{heap}_{init}.\mathrm{M1}))) ==$ raux1

$\to$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[78.4] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1})$ /
$\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})30269))))$
$==$ raux1

$\to$ *[simplify]*

[78.10] $0.0 == (-\mathrm{raux1} + (\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p1})$ / 30269.0))

[Take given term]

[79.0] $(\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}))$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M2}))) == \mathrm{raux2}$

$\rightarrow$ *[simplify]*

[79.2] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M2}))) == \mathrm{raux2}$

$\rightarrow$ *[const static or extern object]*

[79.3] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{init}.\mathrm{M2}))) == \mathrm{raux2}$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[79.4] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30307)))) == \mathrm{raux2}$

$\rightarrow$ *[simplify]*

[79.10] $0.0 == (-\mathrm{raux2} + (\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2})$ / $30307.0))$

[Take given term]

[80.0] $(\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}))$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))) == \mathrm{raux3}$

$\rightarrow$ *[simplify]*

[80.2] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))) == \mathrm{raux3}$

$\rightarrow$ *[const static or extern object]*

[80.3] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\$\mathrm{heap}_{init}.\mathrm{M3}))) == \mathrm{raux3}$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[80.4] $(\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})$ / $\mathbf{asType}<\mathbf{double}>(\mathbf{static\_cast}<\mathbf{real}>(\mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30323)))) == \mathrm{raux3}$

$\rightarrow$ *[simplify]*

[80.10] $0.0 == (-\mathrm{raux3} + (\mathbf{real}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3})$ / $30323.0))$

[Take goal term]

[1.0] $\mathbf{asType}<\mathbf{real}>((\mathbf{double})0.0) < ((\mathbf{asType}<\mathbf{real}>(\mathrm{raux2}) + \mathbf{asType}<\mathbf{real}>(\mathrm{raux1})) + \mathbf{asType}<\mathbf{real}>(\mathrm{raux3}))$

$\rightarrow$ *[simplify]*

[1.2] $0.0 < ((\mathbf{asType}<\mathbf{real}>(\mathrm{raux2}) + \mathbf{asType}<\mathbf{real}>(\mathrm{raux1})) + \mathbf{asType}<\mathbf{real}>(\mathrm{raux3}))$

$\rightarrow$ *[from term 79.10, raux2 is equal to **real**($\$heap_{funcend\_724,1}.p2$) / 30307.0]*

[1.3] $0.0 < ((\mathbf{asType}\mathbf{<real>}(\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) + \mathbf{asType}\mathbf{<real>}(raux1)) + \mathbf{asType}\mathbf{<real>}(raux3))$

$\rightarrow$ *[simplify]*

[1.4] $0.0 < (((\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) + \mathbf{asType}\mathbf{<real>}(raux1)) + \mathbf{asType}\mathbf{<real>}(raux3))$

$\rightarrow$ *[from term 78.10, raux1 is equal to **real**($\$heap_{funcend\_724,1}.p1$) / 30269.0]*

[1.5] $0.0 < (((\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) + \mathbf{asType}\mathbf{<real>}(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)) + \mathbf{asType}\mathbf{<real>}(raux3))$

$\rightarrow$ *[simplify]*

[1.6] $0.0 < (((\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)) + \mathbf{asType}\mathbf{<real>}(raux3))$

$\rightarrow$ *[from term 80.10, raux3 is equal to **real**($\$heap_{funcend\_724,1}.p3$) / 30323.0]*

[1.7] $0.0 < (((\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0)) + \mathbf{asType}\mathbf{<real>}(\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0))$

$\rightarrow$ *[simplify]*

[1.9] $0.0 < ((\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0))$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] $!(0.0 < ((\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0) + (\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0)))$

$\rightarrow$ *[simplify]*

[1.17] $0.0 \leq (-(\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0) + -(\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) + -(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0))$

[Take given term]

[81.0] $\mathbf{asType}\mathbf{<real>}((\mathbf{double})0.0) < \mathbf{asType}\mathbf{<real>}(raux1)$

$\rightarrow$ *[simplify]*

[81.2] $0.0 < \mathbf{asType}\mathbf{<real>}(raux1)$

$\rightarrow$ *[from term 78.10, raux1 is equal to **real**($\$heap_{funcend\_724,1}.p1$) / 30269.0]*

[81.3] $0.0 < \mathbf{asType}\mathbf{<real>}(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)$

$\rightarrow$ *[simplify]*

[81.4] $0.0 < (\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)$

[Take given term]

[82.0] $\mathbf{asType}<\mathbf{real}>((\mathbf{double})0.0) < \mathbf{asType}<\mathbf{real}>(raux2)$

$\rightarrow$ *[simplify]*

[82.2] $0.0 < \mathbf{asType}<\mathbf{real}>(raux2)$

$\rightarrow$ *[from term 79.10, raux2 is equal to $\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0$]*

[82.3] $0.0 < \mathbf{asType}<\mathbf{real}>(\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0)$

$\rightarrow$ *[simplify]*

[82.4] $0.0 < (\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0)$

[Take given term]

[83.0] $\mathbf{asType}<\mathbf{real}>((\mathbf{double})0.0) < \mathbf{asType}<\mathbf{real}>(raux3)$

$\rightarrow$ *[simplify]*

[83.2] $0.0 < \mathbf{asType}<\mathbf{real}>(raux3)$

$\rightarrow$ *[from term 80.10, raux3 is equal to $\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0$]*

[83.3] $0.0 < \mathbf{asType}<\mathbf{real}>(\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0)$

$\rightarrow$ *[simplify]*

[83.4] $0.0 < (\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0)$

[Create new term from terms 1.17, 83.4 using rule: transitivity 2b]

[140.0] $(0.0 + 0.0) < (-(\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) +$
$-(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0))$

$\rightarrow$ *[simplify]*

[140.1] $0.0 < (-(\mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0) +$
$-(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0))$

[Create new term from terms 140.1, 82.4 using rule: transitivity 2a]

[150.0] $(0.0 + 0.0) < -(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)$

$\rightarrow$ *[simplify]*

[150.1] $0.0 < -(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)$

$\rightarrow$ *[from term 81.4, literala $< -(\mathbf{real}(\$heap_{funcend\_724,1}.p1) / 30269.0)$ is false whenever -0.0 $\leq$ literala]*

Proof of rule precondition:

[150.1.0] -0.0 $\leq$ 0.0

$\rightarrow$ *[simplify]*

[150.1.1] **true**

[150.2] **false**

Proof of verification condition: Precondition of 'fmod' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (82,25)

Condition defined at: C:\Escher\ecv\standard\math.h (84,16)

To prove: !(**asType**<**real**>((**double**)1.0) == **asType**<**real**>((**double**)0.0))

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

invariant1(**heapIs** $\text{\$heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_724,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$), **asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) / **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) == **asType**<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{p1}$)) % **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_724,1}.\text{a1}$))) == **asType**<**integer**>(div1.rem)

!(0 == **asType**<**integer**>(div1.rem)) || !(0 ==

asType<integer>(div1.quot))

div2 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p2),
asType<int>($\$heap_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

!(0 == **asType<integer>**(div2.rem)) || !(0 ==
asType<integer>(div2.quot))

div3 == div(**heapIs** $\$heap_{funcstart\_724,1}$,
asType<int>($\$heap_{funcstart\_724,1}$.p3),
asType<int>($\$heap_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

!(0 == **asType<integer>**(div3.rem)) || !(0 ==
asType<integer>(div3.quot))

$\$heap_{724,1;740,8}$ == $\$heap_{funcstart\_724,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_724,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_724,1}$.b1))))

−**asType<integer const>**($\$heap_{724,1;740,8}$.M1) <
asType<integer>($\$heap_{724,1;740,8}$.p1)

!(0 == **asType<integer>**($\$heap_{724,1;740,8}$.p1))

asType<integer>($\$heap_{724,1;740,8}$.p1) <
asType<integer>($\$heap_{724,1;740,8}$.M1)

$\$heap_{724,1;742,8}$ == $\$heap_{724,1;740,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{724,1;740,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{724,1;740,8}$.b2))))

−**asType<integer const>**($\$heap_{724,1;742,8}$.M2) <
asType<integer>($\$heap_{724,1;742,8}$.p2)

!(0 == **asType<integer>**($\$heap_{724,1;742,8}$.p2))

asType<integer>($heap$_{724,1;742,8}$.p2) <
asType<integer>($heap$_{724,1;742,8}$.M2)

$heap$_{724,1;744,8}$ == $heap$_{724,1;742,8}$._**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap$_{724,1;742,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{724,1;742,8}$.b3))))

−**asType<integer const>**($heap$_{724,1;744,8}$.M3) <
asType<integer>($heap$_{724,1;744,8}$.p3)

!(0 == **asType<integer>**($heap$_{724,1;744,8}$.p3))

asType<integer>($heap$_{724,1;744,8}$.p3) <
asType<integer>($heap$_{724,1;744,8}$.M3)

$heap$_{724,1;747,8}$ == $heap$_{724,1;744,8}$._**replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{724,1;744,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;744,8}$.p1) < **(int)**0))) + **asType<int>**($heap$_{724,1;744,8}$.p1)))

$heap$_{724,1;748,8}$ == $heap$_{724,1;747,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**($heap$_{724,1;747,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;747,8}$.p2) < **(int)**0))) + **asType<int>**($heap$_{724,1;747,8}$.p2)))

$heap$_{funcend_724,1}$ == $heap$_{724,1;748,8}$._**replace**(p3 → **asType<short int>**((**asType<int>**($heap$_{724,1;748,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{724,1;748,8}$.p3) < **(int)**0))) + **asType<int>**($heap$_{724,1;748,8}$.p3)))

invariant1(**heapIs** $heap$_{funcend_724,1}$)

raux1 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.p1)) / **asType<double>**(**static_cast<real>**($heap$_{funcend\_724,1}$.M1))

raux2 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.p2)) / **asType<double>**(**static_cast<real>**($heap$_{funcend\_724,1}$.M2))

raux3 == **asType<double>**(**static_cast<real>**($heap$_{funcend_724,1}$.p3)) / **asType<double>**(**static_cast<real>**($heap$_{funcend\_724,1}$.M3))

asType<real>(**(double)**0.0) < **asType<real>**(raux1)

asType<real>(**(double)**0.0) < **asType<real>**(raux2)

asType<real>(**(double)**0.0) < **asType<real>**(raux3)

asType<real>(**(double)**0.0) < ((**asType<real>**(raux2) + **asType<real>**(raux1)) + **asType<real>**(raux3))

Proof:

[Take goal term]

[1.0] !(**asType<real>**(**(double)**1.0) == **asType<real>**(**(double)**0.0))

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Postcondition satisfied when function 'WHprang' returns

Condition generated at: C:\Escher\Customers\prang\prang.c (84,9)

Condition defined at: C:\Escher\Customers\prang\prang.c (43,25)

To prove: asType$<$real$>$(result) $<$ asType$<$real$>$((double)1.0)

Given:

$\$\text{heap}_{init}$.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)

invariant1(**heapIs** $\$\text{heap}_{funcstart\_724,1}$)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_724,1}$,
asType$<$int$>$($\$\text{heap}_{funcstart\_724,1}$.p1),
asType$<$int$>$($\$\text{heap}_{funcstart\_724,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_724,1}$.a1))) ==
asType$<$integer$>$(div1.rem)

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$!(0 ==$ **asType<integer>**(div1.rem)$)$ || $!(0 ==$
asType<integer>(div1.quot)$)$

div2 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p2),
asType<int>(\$heap$_{funcstart\_724,1}$.a2))

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_724,1}$.p2)) /
asType<integer>(**asType<int>**(\$heap$_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_724,1}$.p2)) %
asType<integer>(**asType<int>**(\$heap$_{funcstart\_724,1}$.a2))) ==
asType<integer>(div2.rem)

$!(0 ==$ **asType<integer>**(div2.rem)$)$ || $!(0 ==$
asType<integer>(div2.quot)$)$

div3 == div(**heapIs** \$heap$_{funcstart\_724,1}$,
asType<int>(\$heap$_{funcstart\_724,1}$.p3),
asType<int>(\$heap$_{funcstart\_724,1}$.a3))

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_724,1}$.p3)) /
asType<integer>(**asType<int>**(\$heap$_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_724,1}$.p3)) %
asType<integer>(**asType<int>**(\$heap$_{funcstart\_724,1}$.a3))) ==
asType<integer>(div3.rem)

$!(0 ==$ **asType<integer>**(div3.rem)$)$ || $!(0 ==$
asType<integer>(div3.quot)$)$

\$heap$_{724,1;740,8}$ == \$heap$_{funcstart\_724,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>(\$heap$_{funcstart\_724,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**(\$heap$_{funcstart\_724,1}$.b1))))

$-$**asType<integer const>**(\$heap$_{724,1;740,8}$.M1) <
asType<integer>(\$heap$_{724,1;740,8}$.p1)

$!(0 ==$ **asType<integer>**(\$heap$_{724,1;740,8}$.p1)$)$

asType<integer>(\$heap$_{724,1;740,8}$.p1) <
asType<integer>(\$heap$_{724,1;740,8}$.M1)

\$heap$_{724,1;742,8}$ == \$heap$_{724,1;740,8}$.**replace**(p2 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>(\$heap$_{724,1;740,8}$.r2)) $-$ (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**(\$heap$_{724,1;740,8}$.b2))))

$-$**asType<integer const>**(\$heap$_{724,1;742,8}$.M2) <
asType<integer>(\$heap$_{724,1;742,8}$.p2)

$!(0 == \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{p2}))$

$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{p2}) < \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;742,8}.\text{M2})$

$\$\text{heap}_{724,1;744,8} == \$\text{heap}_{724,1;742,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div3.rem})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;742,8}.\text{r3})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div3.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;742,8}.\text{b3}))))$

$-\textbf{asType}\textless\textbf{integer const}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M3}) < \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3})$

$!(0 == \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3}))$

$\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p3}) < \textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M3})$

$\$\text{heap}_{724,1;747,8} == \$\text{heap}_{724,1;744,8}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{M1}) * \textbf{asType}\textless\textbf{int}\textgreater(\textbf{static\_cast}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;744,8}.\text{p1})))$

$\$\text{heap}_{724,1;748,8} == \$\text{heap}_{724,1;747,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;747,8}.\text{M2}) * \textbf{asType}\textless\textbf{int}\textgreater(\textbf{static\_cast}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;747,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;747,8}.\text{p2})))$

$\$\text{heap}_{funcend\_724,1} == \$\text{heap}_{724,1;748,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;748,8}.\text{M3}) * \textbf{asType}\textless\textbf{int}\textgreater(\textbf{static\_cast}\textless\textbf{integer}\textgreater(\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;748,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{724,1;748,8}.\text{p3})))$

$\text{invariant1}(\textbf{heapIs } \$\text{heap}_{funcend\_724,1})$

$\text{raux1} == \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{p1})) / \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{M1}))$

$\text{raux2} == \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{p2})) / \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{M2}))$

$\text{raux3} == \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{p3})) / \textbf{asType}\textless\textbf{double}\textgreater(\textbf{static\_cast}\textless\textbf{real}\textgreater(\$\text{heap}_{funcend\_724,1}.\text{M3}))$

$\textbf{asType}\textless\textbf{real}\textgreater((\textbf{double})0.0) < \textbf{asType}\textless\textbf{real}\textgreater(\text{raux1})$

$\textbf{asType}\textless\textbf{real}\textgreater((\textbf{double})0.0) < \textbf{asType}\textless\textbf{real}\textgreater(\text{raux2})$

$\textbf{asType}\textless\textbf{real}\textgreater((\textbf{double})0.0) < \textbf{asType}\textless\textbf{real}\textgreater(\text{raux3})$

$\textbf{asType}\textless\textbf{real}\textgreater((\textbf{double})0.0) < ((\textbf{asType}\textless\textbf{real}\textgreater(\text{raux2}) + \textbf{asType}\textless\textbf{real}\textgreater(\text{raux1})) + \textbf{asType}\textless\textbf{real}\textgreater(\text{raux3}))$

$\text{result} == \text{fmod}(\textbf{heapIs } \$\text{heap}_{funcend\_724,1}, (\text{raux1} + \text{raux2}) + \text{raux3}, (\textbf{double})1.0)$

$((\textbf{asType}\!<\!\textbf{real}\!>\!((\textbf{double})0.0) \leq \textbf{asType}\!<\!\textbf{real}\!>\!((\text{raux1} + \text{raux2}) +$
$\text{raux3})) \,\&\&\, (\textbf{asType}\!<\!\textbf{real}\!>\!((\textbf{double})0.0) \leq \textbf{asType}\!<\!\textbf{real}\!>\!((\textbf{double})1.0)))$
$=> ((\textbf{asType}\!<\!\textbf{real}\!>\!((\textbf{double})0.0) \leq \textbf{asType}\!<\!\textbf{real}\!>\!(\text{result})) \,\&\&$
$(\textbf{asType}\!<\!\textbf{real}\!>\!(\text{result}) < \textbf{asType}\!<\!\textbf{real}\!>\!((\textbf{double})1.0)))$

Proof:

[Take given term]

[78.0] $(\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{p1})) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{M1}))) == \text{raux1}$

$\rightarrow$ *[simplify]*

[78.2] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p1}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{M1}))) == \text{raux1}$

$\rightarrow$ *[const static or extern object]*

[78.3] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p1}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{init}.\text{M1}))) == \text{raux1}$

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[78.4] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p1}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})30269))))$
$== \text{raux1}$

$\rightarrow$ *[simplify]*

[78.10] $0.0 == (-\text{raux1} + (\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p1}) \,/\, 30269.0))$

[Take given term]

[79.0] $(\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{p2})) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{M2}))) == \text{raux2}$

$\rightarrow$ *[simplify]*

[79.2] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p2}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{funcend\_724,1}.\text{M2}))) == \text{raux2}$

$\rightarrow$ *[const static or extern object]*

[79.3] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p2}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\$\text{heap}_{init}.\text{M2}))) == \text{raux2}$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[79.4] $(\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p2}) \,/$
$\textbf{asType}\!<\!\textbf{double}\!>\!(\textbf{static\_cast}\!<\!\textbf{real}\!>\!(\textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})30307))))$
$== \text{raux2}$

$\rightarrow$ *[simplify]*

[79.10] $0.0 == (-\text{raux2} + (\textbf{real}(\$\text{heap}_{funcend\_724,1}.\text{p2}) \,/\, 30307.0))$

[Take given term]

[80.0] (**asType**<**double**>(**static_cast**<**real**>($\text{heap}_{funcend\_724,1}$.p3)) /
asType<**double**>(**static_cast**<**real**>($\text{heap}_{funcend\_724,1}$.M3))) == raux3

$\rightarrow$ *[simplify]*

[80.2] (**real**($\text{heap}_{funcend\_724,1}$.p3) /
asType<**double**>(**static_cast**<**real**>($\text{heap}_{funcend\_724,1}$.M3))) == raux3

$\rightarrow$ *[const static or extern object]*

[80.3] (**real**($\text{heap}_{funcend\_724,1}$.p3) /
asType<**double**>(**static_cast**<**real**>(heap_{init}.M3))) == raux3

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[80.4] (**real**($\text{heap}_{funcend\_724,1}$.p3) /
asType<**double**>(**static_cast**<**real**>(**asType**<**short int**>((**int**)30323))))
== raux3

$\rightarrow$ *[simplify]*

[80.10] 0.0 == (−raux3 + (**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0))

[Take given term]

[84.0] **asType**<**real**>((**double**)0.0) < ((**asType**<**real**>(raux2) +
asType<**real**>(raux1)) + **asType**<**real**>(raux3))

$\rightarrow$ *[simplify]*

[84.2] 0.0 < ((**asType**<**real**>(raux2) + **asType**<**real**>(raux1)) +
asType<**real**>(raux3))

$\rightarrow$ *[from term 79.10, raux2 is equal to **real**($heap_{funcend\_724,1}$.p2) / 30307.0]*

[84.3] 0.0 < ((**asType**<**real**>(**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) +
asType<**real**>(raux1)) + **asType**<**real**>(raux3))

$\rightarrow$ *[simplify]*

[84.4] 0.0 < (((**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) +
asType<**real**>(raux1)) + **asType**<**real**>(raux3))

$\rightarrow$ *[from term 78.10, raux1 is equal to **real**($heap_{funcend\_724,1}$.p1) / 30269.0]*

[84.5] 0.0 < (((**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) +
asType<**real**>(**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0)) +
asType<**real**>(raux3))

$\rightarrow$ *[simplify]*

[84.6] 0.0 < (((**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) +
(**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0)) + **asType**<**real**>(raux3))

$\rightarrow$ *[from term 80.10, raux3 is equal to **real**($heap_{funcend\_724,1}$.p3) / 30323.0]*

[84.7] 0.0 < (((**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0) +
(**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0)) +

asType<**real**>(**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0))

$\rightarrow$ *[simplify]*

[84.9] $0.0 <$ ((**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0))

[Take given term]

[85.0] result == fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, (raux1 + raux2) + raux3, (**double**)1.0)

$\rightarrow$ *[from term 78.10, raux1 is equal to **real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0]*

[85.1] result == fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, ((**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0) + raux2) + raux3, (**double**)1.0)

$\rightarrow$ *[from term 79.10, raux2 is equal to **real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0]*

[85.2] result == fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, ((**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0)) + raux3, (**double**)1.0)

$\rightarrow$ *[from term 80.10, raux3 is equal to **real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0]*

[85.3] result == fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, ((**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0)) + (**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0), (**double**)1.0)

$\rightarrow$ *[simplify]*

[85.6] $0.0 ==$ ($-$fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, (**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0) + result)

[Assume known post-assertion, class invariant or type constraint for term 85.6]

[88.0] ((**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>((**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0))) && (**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(1.0))) => ((**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, (**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0))) && (**asType**<**real**>(fmod(**heapIs** $\text{heap}_{funcend\_724,1}$, (**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)) < **asType**<**real**>(1.0)))

$\rightarrow$ *[simplify]*

[88.3] ((0.0 $\leq$ ((**real**($\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\text{heap}_{funcend\_724,1}$.p1) / 30269.0))) && (**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(1.0))) => ((**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(fmod(**heapIs**

$\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0))) && (**asType**<**real**>(fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)) < **asType**<**real**>(1.0)))

$\rightarrow$ *[from term 84.9, literala $\leq$ ((**real**($\$heap_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$heap_{funcend\_724,1}$.p1) / 30269.0) + (**real**($\$heap_{funcend\_724,1}$.p2) / 30307.0)) is true whenever literala $\leq$ 0.0]*

Proof of rule precondition:

[88.3.0] $0.0 \leq 0.0$

$\rightarrow$ *[simplify]*

[88.3.1] **true**

[88.4] (**true** && (**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(1.0))) => ((**asType**<**real**>((**double**)0.0) $\leq$ **asType**<**real**>(fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0))) && (**asType**<**real**>(fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)) < **asType**<**real**>(1.0)))

$\rightarrow$ *[simplify]*

[88.21] (-1.0 < $-$fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)) $\land$ (0.0 $\leq$ fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0))

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[88.22] -1.0 < $-$fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)

[Take goal term]

[1.0] **asType**<**real**>(result) < **asType**<**real**>((**double**)1.0)

$\rightarrow$ *[from term 85.6, result is equal to fmod(**heapIs** $\$heap_{funcend\_724,1}$, (**real**($\$heap_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$heap_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$heap_{funcend\_724,1}$.p1) / 30269.0), 1.0)]*

[1.1] **asType**<**real**>(fmod(**heapIs** $\$\text{heap}_{funcend\_724,1}$, (**real**($\$\text{heap}_{funcend\_724,1}$.p3) / 30323.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p2) / 30307.0) + (**real**($\$\text{heap}_{funcend\_724,1}$.p1) / 30269.0), 1.0)) <

asType$<$real$>$((double)1.0)

$\rightarrow$ *[simplify]*

[1.7] -1.0 $<$ $-$fmod(**heapIs** \$heap$_{funcend\_724,1}$, (**real**(\$heap$_{funcend\_724,1}$.p3) / 30323.0) + (**real**(\$heap$_{funcend\_724,1}$.p2) / 30307.0) + (**real**(\$heap$_{funcend\_724,1}$.p1) / 30269.0), 1.0)

$\rightarrow$ *[from term 88.22, literala $<$ $-$fmod(**heapIs** \$heap$_{funcend\_724,1}$, (**real**(\$heap$_{funcend\_724,1}$.p3) / 30323.0) + (**real**(\$heap$_{funcend\_724,1}$.p2) / 30307.0) + (**real**(\$heap$_{funcend\_724,1}$.p1) / 30269.0), 1.0) is true whenever literala $\leq$ -1.0]*

> **Proof of rule precondition:**
>
> *[1.7.0]* -1.0 $\leq$ -1.0
>
> $\rightarrow$ *[simplify]*
>
> *[1.7.1]* **true**

[1.8] **true**

Proof of verification condition: Loop initialisation establishes end condition or a valid variant

Condition generated at: C:\Escher\Customers\prang\prang.c (101,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (103,20)

To prove: $0 \leq$ (**asType$<$integer const$>$**(limit) $-$ **asType$<$integer$>$**(count))

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)

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\text{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\text{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\text{<short int>}((\textbf{int})3)$

$\text{limit} == \text{\$heap}_{funcstart\_775,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \leq \text{limit}$

$\text{limit} \leq \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \leq \text{count}$

$\text{count} \leq \textbf{maxof}(\textbf{int})$

$\text{\$heap}_{775,1;780,5} ==$
$\text{\$heap}_{funcstart\_775,1}.\textbf{replace}((\&\text{\$heap}_{funcstart\_775,1}.\_\text{ecv\_files}[1]).\text{\$r} \to$
$\text{writes\_780\_5})$

$\text{count} < \text{limit}$

Proof:

[Take given term]

[5.0] $\text{\$heap}_{funcstart\_775,1}.\text{LIMIT} == \text{limit}$

$\to$ *[const static or extern object]*

[5.1] $\text{\$heap}_{init}.\text{LIMIT} == \text{limit}$

$\to$ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] $(\textbf{int})80 == \text{limit}$

$\to$ *[simplify]*

[5.3] $80 == \text{limit}$

[Take given term]

[6.0] $(\textbf{int})0 == \text{count}$

$\to$ *[simplify]*

[6.1] $0 == \text{count}$

[Take goal term]

[1.0] $0 \leq (\textbf{asType}\text{<integer const>}(\text{limit}) - \textbf{asType}\text{<integer>}(\text{count}))$

$\to$ *[from term 5.3, limit is equal to 80]*

[1.1] $0 \leq (\textbf{asType}\text{<integer const>}(80) - \textbf{asType}\text{<integer>}(\text{count}))$

$\to$ *[simplify]*

[1.2] $0 \leq (80 - \textbf{asType}\text{<integer>}(\text{count}))$

$\to$ *[from term 6.1, count is equal to 0]*

[1.3] $0 \leq (80 - \textbf{asType}\textbf{<integer>}(0))$

$\rightarrow$ *[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 (104,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (103,5)

To prove: $(\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}_{loopend})) < (\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_782,5}))$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{limit} == \$\text{heap}_{funcstart\_775,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \leq \text{limit}$

$\text{limit} \leq \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \leq \text{count}$

count $\leq$ **maxof**(**int**)

$\text{\$heap}_{775,1;780,5}$ ==
$\text{\$heap}_{funcstart\_775,1}$._**replace**((&$\text{\$heap}_{funcstart\_775,1}$._ecv_files[1]).\$r $\rightarrow$
writes_780_5)

$\text{\$heap}_{loopstart\_782,5}$ == $\text{\$heap}_{775,1;780,5}$._**replace**(p1 $\rightarrow$
writes_783_12)._**replace**(p2 $\rightarrow$ writes_783_12)._**replace**(p3 $\rightarrow$
writes_783_12)._**replace**(_ecv_files $\rightarrow$ writes_783_12)

#writes_783_12 == #$\text{\$heap}_{775,1;780,5}$._ecv_files

minof(**int**) $\leq$ count$_{loopstart\_782,5}$

count$_{loopstart\_782,5}$ $\leq$ **maxof**(**int**)

count$_{loopstart\_782,5}$ < limit

$0 \leq$ (**asType**<**integer const**>(limit) $-$
asType<**integer**>(count$_{loopstart\_782,5}$))

(**asType**<**integer const**>(limit) $-$ **asType**<**integer**>(count$_{loopstart\_782,5}$))
$\leq$ (**asType**<**integer const**>(limit) $-$ **asType**<**integer**>(count))

(++count$_{loopstart\_782,5}$ == count$_{loopend}$) $\wedge$ ($\text{\$heap}_{786,16}$ ==
$\text{\$heap}_{loopstart\_782,5}$._**replace**(p1 $\rightarrow$ writes_786_25)._**replace**(p2 $\rightarrow$
writes_786_25)._**replace**(p3 $\rightarrow$ writes_786_25)) $\wedge$ ($\text{\$heap}_{loopend}$ ==
$\text{\$heap}_{786,16}$._**replace**((&$\text{\$heap}_{786,16}$._ecv_files[1]).\$r $\rightarrow$ writes_786_9)) $\wedge$
(**asType**<**real**>((**double**)0.0) < **asType**<**real**>(\$result_786_25)) $\wedge$
(**asType**<**real**>(\$result_786_25) < **asType**<**real**>((**double**)1.0)))

count$_{loopend}$ < limit

Proof:

[Take given term]

[5.0] $\text{\$heap}_{funcstart\_775,1}$.LIMIT == limit

$\rightarrow$ *[const static or extern object]*

[5.1] $\text{\$heap}_{init}$.LIMIT == limit

$\rightarrow$ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] (**int**)80 == limit

$\rightarrow$ *[simplify]*

[5.3] 80 == limit

[Take given term]

[7.0] $\text{\$heap}_{775,1;780,5}$ ==
$\text{\$heap}_{funcstart\_775,1}$._**replace**((&$\text{\$heap}_{funcstart\_775,1}$._ecv_files[1]).\$r $\rightarrow$
writes_780_5)

$\rightarrow$ *[simplify]*

[7.1] $\$heap_{775,1;780,5}$ == $\$heap_{funcstart\_775,1}.$**replace**$((\&\$heap.\_ecv\_files[1]).\$r$ $\to$ writes_780_5)

$\to$ *[attribute value is known from postcondition]*

[7.2] $\$heap_{775,1;780,5}$ == $\$heap_{funcstart\_775,1}.$**replace**$(\&\$heap.\_ecv\_files[1] \to$ writes_780_5)

[Take given term]

[8.0] $\$heap_{loopstart\_782,5}$ == $\$heap_{775,1;780,5}.$**replace**$(p1 \to$ writes_783_12)$.$**replace**$(p2 \to$ writes_783_12)$.$**replace**$(p3 \to$ writes_783_12)$.$**replace**$(\_ecv\_files \to$ writes_783_12)

$\to$ *[from term 7.2, $\$heap_{775,1;780,5}$ is equal to $\$heap_{funcstart\_775,1}.$**replace**$(\&\$heap.\_ecv\_files[1] \to$ writes_780_5)]*

[8.1] $\$heap_{loopstart\_782,5}$ == $\$heap_{funcstart\_775,1}.$**replace**$((\&\$heap.\_ecv\_files[1]) \to$ writes_780_5)$.$**replace**$(p1 \to$ writes_783_12)$.$**replace**$(p2 \to$ writes_783_12)$.$**replace**$(p3 \to$ writes_783_12)$.$**replace**$(\_ecv\_files \to$ writes_783_12)

[Take given term]

[20.0] $(++count_{loopstart\_782,5}$ == $count_{loopend}) \wedge (\$heap_{786,16}$ == $\$heap_{loopstart\_782,5}.$**replace**$(p1 \to$ writes_786_25)$.$**replace**$(p2 \to$ writes_786_25)$.$**replace**$(p3 \to$ writes_786_25)) \wedge (\$heap_{loopend}$ == $\$heap_{786,16}.$**replace**$((\&\$heap_{786,16}.\_ecv\_files[1]).\$r \to$ writes_786_9)) \wedge ($**asType**$<$**real**$>((\textbf{double})0.0) <$ **asType**$<$**real**$>(\$result\_786\_25)) \wedge ($**asType**$<$**real**$>(\$result\_786\_25) <$ **asType**$<$**real**$>((\textbf{double})1.0))$

$\to$ *[simplify]*

[20.8] $(1$ == $(count_{loopend} + -count_{loopstart\_782,5})) \wedge (\$heap_{786,16}$ == $\$heap_{loopstart\_782,5}.$**replace**$(p1 \to$ writes_786_25)$.$**replace**$(p2 \to$ writes_786_25)$.$**replace**$(p3 \to$ writes_786_25)) \wedge (\$heap_{loopend}$ == $\$heap_{786,16}.$**replace**$((\&\$heap_{786,16}.\_ecv\_files[1]).\$r \to$ writes_786_9)) \wedge ($**asType**$<$**real**$>((\textbf{double})0.0) <$ **asType**$<$**real**$>(\$result\_786\_25)) \wedge ($**asType**$<$**real**$>(\$result\_786\_25) <$ **asType**$<$**real**$>((\textbf{double})1.0))$

$\to$ *[from term 8.1, $\$heap_{loopstart\_782,5}$ is equal to $\$heap_{funcstart\_775,1}.$**replace**$((\&\$heap.\_ecv\_files[1]) \to$ writes_780_5)$.$**replace**$(p1 \to$ writes_783_12)$.$**replace**$(p2 \to$ writes_783_12)$.$**replace**$(p3 \to$ writes_783_12)$.$**replace**$(\_ecv\_files \to$ writes_783_12)]*

[20.9] $(1$ == $(-count_{loopstart\_782,5} + count_{loopend})) \wedge (\$heap_{786,16}$ == $\$heap_{funcstart\_775,1}.$**replace**$((\&\$heap.\_ecv\_files[1]) \to$ writes_780_5)$.$**replace**$(p1 \to$ writes_783_12)$.$**replace**$(p2 \to$ writes_783_12)$.$**replace**$(p3 \to$ writes_783_12)$.$**replace**$(\_ecv\_files \to$ writes_783_12)$.$**replace**$(p1 \to$ writes_786_25)$.$**replace**$(p2 \to$ writes_786_25)$.$**replace**$(p3 \to$ writes_786_25)) \wedge (\$heap_{loopend}$ ==

$\$\mathrm{heap}_{786,16}.\_\mathbf{replace}((\&\$\mathrm{heap}_{786,16}.\_\mathrm{ecv\_files}[1]).\$r \to \mathrm{writes\_786\_9})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25}) < \mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})1.0))$

$\to$ *[simplify]*

[20.10] $(1 == (-\mathrm{count}_{loopstart\_782,5} + \mathrm{count}_{loopend})) \wedge (\$\mathrm{heap}_{786,16} ==$
$\$\mathrm{heap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1]) \to$
$\mathrm{writes\_780\_5}).\_\mathbf{replace}(p1 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p3 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(\_\mathrm{ecv\_files} \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p1 \to \mathrm{writes\_786\_25}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_786\_25}).\_\mathbf{replace}(p3 \to \mathrm{writes\_786\_25})) \wedge (\$\mathrm{heap}_{loopend} ==$
$\$\mathrm{heap}_{786,16}.\_\mathbf{replace}((\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1]).\$r \to \mathrm{writes\_786\_9})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25}) < \mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})1.0))$

$\to$ *[attribute value is known from postcondition]*

[20.11] $(1 == (-\mathrm{count}_{loopstart\_782,5} + \mathrm{count}_{loopend})) \wedge (\$\mathrm{heap}_{786,16} ==$
$\$\mathrm{heap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1]) \to$
$\mathrm{writes\_780\_5}).\_\mathbf{replace}(p1 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p3 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(\_\mathrm{ecv\_files} \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p1 \to \mathrm{writes\_786\_25}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_786\_25}).\_\mathbf{replace}(p3 \to \mathrm{writes\_786\_25})) \wedge (\$\mathrm{heap}_{loopend} ==$
$\$\mathrm{heap}_{786,16}.\_\mathbf{replace}(\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1] \to \mathrm{writes\_786\_9})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25})) \wedge$
$(\mathbf{asType}{<}\mathbf{real}{>}(\$\mathrm{result\_786\_25}) < \mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})1.0))$

$\to$ *[simplify]*

[20.20] $(1 == (-\mathrm{count}_{loopstart\_782,5} + \mathrm{count}_{loopend})) \wedge (\$\mathrm{heap}_{786,16} ==$
$\$\mathrm{heap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1]) \to$
$\mathrm{writes\_780\_5}).\_\mathbf{replace}(p1 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p3 \to \mathrm{writes\_783\_12}).\_\mathbf{replace}(\_\mathrm{ecv\_files} \to$
$\mathrm{writes\_783\_12}).\_\mathbf{replace}(p1 \to \mathrm{writes\_786\_25}).\_\mathbf{replace}(p2 \to$
$\mathrm{writes\_786\_25}).\_\mathbf{replace}(p3 \to \mathrm{writes\_786\_25})) \wedge (\$\mathrm{heap}_{loopend} ==$
$\$\mathrm{heap}_{786,16}.\_\mathbf{replace}(\&\$\mathrm{heap}.\_\mathrm{ecv\_files}[1] \to \mathrm{writes\_786\_9})) \wedge (0.0 <$
$\$\mathrm{result\_786\_25}) \wedge (\text{-}1.0 < -\$\mathrm{result\_786\_25})$

$\to$ *[separate conjunction and work on first sub-term]*

[20.21] $1 == (-\mathrm{count}_{loopstart\_782,5} + \mathrm{count}_{loopend})$

[Take goal term]

[1.0] $(\mathbf{asType}{<}\mathbf{integer\ const}{>}(\mathrm{limit}) - \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{count}_{loopend})) <$
$(\mathbf{asType}{<}\mathbf{integer\ const}{>}(\mathrm{limit}) - \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{count}_{loopstart\_782,5}))$

$\to$ *[from term 5.3, limit is equal to 80]*

[1.1] $(\mathbf{asType}{<}\mathbf{integer\ const}{>}(80) - \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{count}_{loopend})) <$
$(\mathbf{asType}{<}\mathbf{integer\ const}{>}(\mathrm{limit}) - \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{count}_{loopstart\_782,5}))$

$\rightarrow$ *[simplify]*

[1.2] $(80 - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopend})) < (\mathbf{asType{<}integer\ const{>}}(\mathrm{limit}) - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopstart\_782,5}))$

$\rightarrow$ *[from term 20.21, $\mathrm{count}_{loopend}$ is equal to $1 + \mathrm{count}_{loopstart\_782,5}$]*

[1.3] $(80 - \mathbf{asType{<}integer{>}}(1 + \mathrm{count}_{loopstart\_782,5})) < (\mathbf{asType{<}integer\ const{>}}(\mathrm{limit}) - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopstart\_782,5}))$

$\rightarrow$ *[simplify]*

[1.9] $(79 + -\mathrm{count}_{loopstart\_782,5}) < (\mathbf{asType{<}integer\ const{>}}(\mathrm{limit}) - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopstart\_782,5}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.10] $(79 + -\mathrm{count}_{loopstart\_782,5}) < (\mathbf{asType{<}integer\ const{>}}(80) - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopstart\_782,5}))$

$\rightarrow$ *[simplify]*

[1.22] **true**

Proof of verification condition: Loop body establishes end condition or preserves validity of variant

Condition generated at: C:\Escher\Customers\prang\prang.c (104,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (103,20)

To prove: $0 \leq (\mathbf{asType{<}integer\ const{>}}(\mathrm{limit}) - \mathbf{asType{<}integer{>}}(\mathrm{count}_{loopend}))$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{limit} == \text{\$heap}_{funcstart\_775,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \leq \text{limit}$

$\text{limit} \leq \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \leq \text{count}$

$\text{count} \leq \textbf{maxof}(\textbf{int})$

$\text{\$heap}_{775,1;780,5} ==$
$\text{\$heap}_{funcstart\_775,1}.\textbf{\_replace}((\&\text{\$heap}_{funcstart\_775,1}.\text{\_ecv\_files}[1]).\text{\$r} \rightarrow$
$\text{writes\_780\_5})$

$\text{\$heap}_{loopstart\_782,5} == \text{\$heap}_{775,1;780,5}.\textbf{\_replace}(\text{p1} \rightarrow$
$\text{writes\_783\_12}).\textbf{\_replace}(\text{p2} \rightarrow \text{writes\_783\_12}).\textbf{\_replace}(\text{p3} \rightarrow$
$\text{writes\_783\_12}).\textbf{\_replace}(\text{\_ecv\_files} \rightarrow \text{writes\_783\_12})$

$\#\text{writes\_783\_12} == \#\text{\$heap}_{775,1;780,5}.\text{\_ecv\_files}$

$\textbf{minof}(\textbf{int}) \leq \text{count}_{loopstart\_782,5}$

$\text{count}_{loopstart\_782,5} \leq \textbf{maxof}(\textbf{int})$

$\text{count}_{loopstart\_782,5} < \text{limit}$

$0 \leq (\textbf{asType}\textbf{<integer const>}(\text{limit}) -$
$\textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_782,5}))$

$(\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_782,5}))$
$\leq (\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}))$

$(++\text{count}_{loopstart\_782,5} == \text{count}_{loopend}) \wedge (\text{\$heap}_{786,16} ==$
$\text{\$heap}_{loopstart\_782,5}.\textbf{\_replace}(\text{p1} \rightarrow \text{writes\_786\_25}).\textbf{\_replace}(\text{p2} \rightarrow$
$\text{writes\_786\_25}).\textbf{\_replace}(\text{p3} \rightarrow \text{writes\_786\_25})) \wedge (\text{\$heap}_{loopend} ==$
$\text{\$heap}_{786,16}.\textbf{\_replace}((\&\text{\$heap}_{786,16}.\text{\_ecv\_files}[1]).\text{\$r} \rightarrow \text{writes\_786\_9})) \wedge$
$(\textbf{asType}\textbf{<real>}((\textbf{double})0.0) < \textbf{asType}\textbf{<real>}(\text{\$result\_786\_25})) \wedge$
$(\textbf{asType}\textbf{<real>}(\text{\$result\_786\_25}) < \textbf{asType}\textbf{<real>}((\textbf{double})1.0))$

$\text{count}_{loopend} < \text{limit}$

Proof:

[Take given term]

[5.0] $\text{\$heap}_{funcstart\_775,1}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[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]

[7.0] $\$\text{heap}_{775,1;780,5} ==$
$\$\text{heap}_{funcstart\_775,1}.\textbf{\_replace}((\&\$\text{heap}_{funcstart\_775,1}.\_\text{ecv\_files}[1]).\$r \rightarrow$
$\text{writes\_780\_5})$

$\rightarrow$ *[simplify]*

[7.1] $\$\text{heap}_{775,1;780,5} == \$\text{heap}_{funcstart\_775,1}.\textbf{\_replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]).\$r$
$\rightarrow \text{writes\_780\_5})$

$\rightarrow$ *[attribute value is known from postcondition]*

[7.2] $\$\text{heap}_{775,1;780,5} == \$\text{heap}_{funcstart\_775,1}.\textbf{\_replace}(\&\$\text{heap}.\_\text{ecv\_files}[1] \rightarrow$
$\text{writes\_780\_5})$

[Take given term]

[8.0] $\$\text{heap}_{loopstart\_782,5} == \$\text{heap}_{775,1;780,5}.\textbf{\_replace}(p1 \rightarrow$
$\text{writes\_783\_12}).\textbf{\_replace}(p2 \rightarrow \text{writes\_783\_12}).\textbf{\_replace}(p3 \rightarrow$
$\text{writes\_783\_12}).\textbf{\_replace}(\_\text{ecv\_files} \rightarrow \text{writes\_783\_12})$

$\rightarrow$ *[from term 7.2, $\$\text{heap}_{775,1;780,5}$ is equal to*
$\$\text{heap}_{funcstart_775,1}.\textbf{_replace}(\&\$\text{heap}._\text{ecv_files}[1] \rightarrow \text{writes_780_5})]

[8.1] $\$\text{heap}_{loopstart\_782,5} ==$
$\$\text{heap}_{funcstart\_775,1}.\textbf{\_replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]) \rightarrow$
$\text{writes\_780\_5}).\textbf{\_replace}(p1 \rightarrow \text{writes\_783\_12}).\textbf{\_replace}(p2 \rightarrow$
$\text{writes\_783\_12}).\textbf{\_replace}(p3 \rightarrow \text{writes\_783\_12}).\textbf{\_replace}(\_\text{ecv\_files} \rightarrow$
$\text{writes\_783\_12})$

[Take given term]

[20.0] $(++\text{count}_{loopstart\_782,5} == \text{count}_{loopend}) \land (\$\text{heap}_{786,16} ==$
$\$\text{heap}_{loopstart\_782,5}.\textbf{\_replace}(p1 \rightarrow \text{writes\_786\_25}).\textbf{\_replace}(p2 \rightarrow$
$\text{writes\_786\_25}).\textbf{\_replace}(p3 \rightarrow \text{writes\_786\_25})) \land (\$\text{heap}_{loopend} ==$
$\$\text{heap}_{786,16}.\textbf{\_replace}((\&\$\text{heap}_{786,16}.\_\text{ecv\_files}[1]).\$r \rightarrow \text{writes\_786\_9})) \land$
$(\textbf{asType}<\textbf{real}>((\textbf{double})0.0) < \textbf{asType}<\textbf{real}>(\$\text{result\_786\_25})) \land$
$(\textbf{asType}<\textbf{real}>(\$\text{result\_786\_25}) < \textbf{asType}<\textbf{real}>((\textbf{double})1.0))$

$\rightarrow$ *[simplify]*

[20.8] $(1 == (\text{count}_{loopend} + -\text{count}_{loopstart\_782,5})) \land (\$\text{heap}_{786,16} ==$
$\$\text{heap}_{loopstart\_782,5}.\textbf{\_replace}(p1 \rightarrow \text{writes\_786\_25}).\textbf{\_replace}(p2 \rightarrow$
$\text{writes\_786\_25}).\textbf{\_replace}(p3 \rightarrow \text{writes\_786\_25})) \land (\$\text{heap}_{loopend} ==$
$\$\text{heap}_{786,16}.\textbf{\_replace}((\&\$\text{heap}_{786,16}.\_\text{ecv\_files}[1]).\$r \rightarrow \text{writes\_786\_9})) \land$
$(\textbf{asType}<\textbf{real}>((\textbf{double})0.0) < \textbf{asType}<\textbf{real}>(\$\text{result\_786\_25})) \land$

($\textbf{asType}\textbf{<real>}$($result\_786\_25$) < $\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$1.0$))

$\rightarrow$ *[from term 8.1, $\$heap_{loopstart\_782,5}$ is equal to $\$heap_{funcstart_775,1}.\textbf{_replace}((\&\$heap._ecv_files[1]) \rightarrow writes_780_5).\textbf{_replace}(p1 \rightarrow writes_783_12).\textbf{_replace}(p2 \rightarrow writes_783_12).\textbf{_replace}(p3 \rightarrow writes_783_12).\textbf{_replace}(_ecv_files \rightarrow writes_783_12)]*

[20.9] $(1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \wedge (\$heap_{786,16} ==$ $\$heap_{funcstart\_775,1}.\textbf{\_replace}((\&\$heap.\_ecv\_files[1]) \rightarrow$ $writes\_780\_5).\textbf{\_replace}(p1 \rightarrow writes\_783\_12).\textbf{\_replace}(p2 \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p3 \rightarrow writes\_783\_12).\textbf{\_replace}(\_ecv\_files \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p1 \rightarrow writes\_786\_25).\textbf{\_replace}(p2 \rightarrow$ $writes\_786\_25).\textbf{\_replace}(p3 \rightarrow writes\_786\_25)) \wedge (\$heap_{loopend} ==$ $\$heap_{786,16}.\textbf{\_replace}((\&\$heap_{786,16}.\_ecv\_files[1]).\$r \rightarrow writes\_786\_9)) \wedge$ ($\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$0.0$) < $\textbf{asType}\textbf{<real>}$($result\_786\_25$)) $\wedge$ ($\textbf{asType}\textbf{<real>}$($result\_786\_25$) < $\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$1.0$))

$\rightarrow$ *[simplify]*

[20.10] $(1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \wedge (\$heap_{786,16} ==$ $\$heap_{funcstart\_775,1}.\textbf{\_replace}((\&\$heap.\_ecv\_files[1]) \rightarrow$ $writes\_780\_5).\textbf{\_replace}(p1 \rightarrow writes\_783\_12).\textbf{\_replace}(p2 \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p3 \rightarrow writes\_783\_12).\textbf{\_replace}(\_ecv\_files \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p1 \rightarrow writes\_786\_25).\textbf{\_replace}(p2 \rightarrow$ $writes\_786\_25).\textbf{\_replace}(p3 \rightarrow writes\_786\_25)) \wedge (\$heap_{loopend} ==$ $\$heap_{786,16}.\textbf{\_replace}((\&\$heap.\_ecv\_files[1]).\$r \rightarrow writes\_786\_9)) \wedge$ ($\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$0.0$) < $\textbf{asType}\textbf{<real>}$($result\_786\_25$)) $\wedge$ ($\textbf{asType}\textbf{<real>}$($result\_786\_25$) < $\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$1.0$))

$\rightarrow$ *[attribute value is known from postcondition]*

[20.11] $(1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \wedge (\$heap_{786,16} ==$ $\$heap_{funcstart\_775,1}.\textbf{\_replace}((\&\$heap.\_ecv\_files[1]) \rightarrow$ $writes\_780\_5).\textbf{\_replace}(p1 \rightarrow writes\_783\_12).\textbf{\_replace}(p2 \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p3 \rightarrow writes\_783\_12).\textbf{\_replace}(\_ecv\_files \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p1 \rightarrow writes\_786\_25).\textbf{\_replace}(p2 \rightarrow$ $writes\_786\_25).\textbf{\_replace}(p3 \rightarrow writes\_786\_25)) \wedge (\$heap_{loopend} ==$ $\$heap_{786,16}.\textbf{\_replace}(\&\$heap.\_ecv\_files[1] \rightarrow writes\_786\_9)) \wedge$ ($\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$0.0$) < $\textbf{asType}\textbf{<real>}$($result\_786\_25$)) $\wedge$ ($\textbf{asType}\textbf{<real>}$($result\_786\_25$) < $\textbf{asType}\textbf{<real>}$(($\textbf{double}$)$1.0$))

$\rightarrow$ *[simplify]*

[20.20] $(1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \wedge (\$heap_{786,16} ==$ $\$heap_{funcstart\_775,1}.\textbf{\_replace}((\&\$heap.\_ecv\_files[1]) \rightarrow$ $writes\_780\_5).\textbf{\_replace}(p1 \rightarrow writes\_783\_12).\textbf{\_replace}(p2 \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p3 \rightarrow writes\_783\_12).\textbf{\_replace}(\_ecv\_files \rightarrow$ $writes\_783\_12).\textbf{\_replace}(p1 \rightarrow writes\_786\_25).\textbf{\_replace}(p2 \rightarrow$ $writes\_786\_25).\textbf{\_replace}(p3 \rightarrow writes\_786\_25)) \wedge (\$heap_{loopend} ==$

$heap_{786,16}$.**replace**($\&$heap._ecv_files[1] $\rightarrow$ writes_786_9)) $\wedge$ (0.0 < $result_786_25) $\wedge$ (-1.0 < $-$$result_786_25)

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[20.21] 1 == ($-$count$_{loopstart\_782,5}$ + count$_{loopend}$)

[Take given term]

[33.0] count$_{loopend}$ < limit

$\rightarrow$ *[from term 20.21, count$_{loopend}$ is equal to 1 + count$_{loopstart\_782,5}$]*

[33.1] (1 + count$_{loopstart\_782,5}$) < limit

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[33.2] (1 + count$_{loopstart\_782,5}$) < 80

$\rightarrow$ *[simplify]*

[33.9] -79 < $-$count$_{loopstart\_782,5}$

[Take goal term]

[1.0] 0 $\leq$ (**asType**<**integer const**>(limit) $-$ **asType**<**integer**>(count$_{loopend}$))

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.1] 0 $\leq$ (**asType**<**integer const**>(80) $-$ **asType**<**integer**>(count$_{loopend}$))

$\rightarrow$ *[simplify]*

[1.2] 0 $\leq$ (80 $-$ **asType**<**integer**>(count$_{loopend}$))

$\rightarrow$ *[from term 20.21, count$_{loopend}$ is equal to 1 + count$_{loopstart\_782,5}$]*

[1.3] 0 $\leq$ (80 $-$ **asType**<**integer**>(1 + count$_{loopstart\_782,5}$))

$\rightarrow$ *[simplify]*

[1.13] -80 < $-$count$_{loopstart\_782,5}$

$\rightarrow$ *[from term 33.9, literala < $-$count$_{loopstart\_782,5}$ is true whenever (-1 + literala) < -79]*

  Proof of rule precondition:

  [1.13.0] (-80 + -1) < -79

  $\rightarrow$ *[simplify]*

  [1.13.2] **true**

[1.14] **true**

Proof of verification condition: Arithmetic result of operator '++' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (106,9)

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Condition defined at:

To prove: minof(int) $\leq$ ++count$_{loopstart\_782,5}$

Given:

$\$heap_{init}.LIMIT == (\textbf{int})80$

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$heap_{init}.a3 == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$heap_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$limit == \$heap_{funcstart\_775,1}.LIMIT$

minof(int const) $\leq$ limit

limit $\leq$ **maxof(int const)**

count $== (\textbf{int})0$

minof(int) $\leq$ count

count $\leq$ **maxof(int)**

$\$heap_{775,1;780,5} ==$
$\$heap_{funcstart\_775,1}.\textbf{replace}((\&\$heap_{funcstart\_775,1}.\_ecv\_files[1]).\$r \rightarrow$
writes$\_780\_5)$

$\$heap_{loopstart\_782,5} == \$heap_{775,1;780,5}.\textbf{replace}(p1 \rightarrow$
writes$\_783\_12).\textbf{replace}(p2 \rightarrow$ writes$\_783\_12).\textbf{replace}(p3 \rightarrow$
writes$\_783\_12).\textbf{replace}(\_ecv\_files \rightarrow$ writes$\_783\_12)$

$\#writes\_783\_12 == \#\$heap_{775,1;780,5}.\_ecv\_files$

minof(int) $\leq$ count$_{loopstart\_782,5}$

$\text{count}_{loopstart\_782,5} \leq \mathbf{maxof(int)}$

$\text{count}_{loopstart\_782,5} < \text{limit}$

$0 \leq (\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}_{loopstart\_782,5}))$

$(\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}_{loopstart\_782,5})) \leq (\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}))$

$\text{\$heap}_{786,16} == \text{\$heap}_{loopstart\_782,5}.\mathbf{\_replace}(\text{p1} \rightarrow \text{writes\_786\_25}).\mathbf{\_replace}(\text{p2} \rightarrow \text{writes\_786\_25}).\mathbf{\_replace}(\text{p3} \rightarrow \text{writes\_786\_25})$

$\text{\$heap}_{loopend} == \text{\$heap}_{786,16}.\mathbf{\_replace}((\&\text{\$heap}_{786,16}.\_\text{ecv\_files}[1]).\text{\$r} \rightarrow \text{writes\_786\_9})$

$\mathbf{asType{<}real{>}}((\mathbf{double})0.0) < \mathbf{asType{<}real{>}}(\text{\$result\_786\_25})$

$\mathbf{asType{<}real{>}}(\text{\$result\_786\_25}) < \mathbf{asType{<}real{>}}((\mathbf{double})1.0)$

Proof:

[Take given term]

[5.0] $\text{\$heap}_{funcstart\_775,1}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[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 given term]

[19.0] $(\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}_{loopstart\_782,5})) \leq (\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[19.1] $(\mathbf{asType{<}integer\ const{>}}(80) - \mathbf{asType{<}integer{>}}(\text{count}_{loopstart\_782,5})) \leq (\mathbf{asType{<}integer\ const{>}}(\text{limit}) - \mathbf{asType{<}integer{>}}(\text{count}))$

$\rightarrow$ *[simplify]*

[19.4] $(80 + -\text{count}_{loopstart\_782,5}) \leq (\mathbf{asType{<}integer\ const{>}}(\text{limit}) -$

asType<integer>(count))

→ *[from term 5.3, limit is equal to 80]*

[19.5] $(80 + -\text{count}_{loopstart\_782,5}) \leq (\textbf{asType<integer const>}(80) -$ **asType<integer>**(count))

→ *[simplify]*

[19.6] $(80 + -\text{count}_{loopstart\_782,5}) \leq (80 - \textbf{asType<integer>}(\text{count}))$

→ *[from term 6.1, count is equal to 0]*

[19.7] $(80 + -\text{count}_{loopstart\_782,5}) \leq (80 - \textbf{asType<integer>}(0))$

→ *[simplify]*

[19.20] $-1 < \text{count}_{loopstart\_782,5}$

[Take goal term]

[1.0] $\textbf{minof(int)} \leq ++\text{count}_{loopstart\_782,5}$

→ *[simplify]*

[1.6] $-32770 < \text{count}_{loopstart\_782,5}$

→ *[from term 19.20, literala < $\text{count}_{loopstart\_782,5}$ is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[1.6.0] $(-32770 + -1) < -1$

→ *[simplify]*

[1.6.2] **true**

[1.7] **true**

Proof of verification condition: Arithmetic result of operator '++' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (106,9)

Condition defined at:

To prove: $++\text{count}_{loopstart\_782,5} \leq \textbf{maxof(int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{limit} == \text{\$heap}_{funcstart\_775,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \le \text{limit}$

$\text{limit} \le \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \le \text{count}$

$\text{count} \le \textbf{maxof}(\textbf{int})$

$\text{\$heap}_{775,1;780,5} ==$
$\text{\$heap}_{funcstart\_775,1}.\_\textbf{replace}((\&\text{\$heap}_{funcstart\_775,1}.\_\text{ecv\_files}[1]).\text{\$r} \rightarrow$
$\text{writes\_780\_5})$

$\text{\$heap}_{loopstart\_782,5} == \text{\$heap}_{775,1;780,5}.\_\textbf{replace}(\text{p1} \rightarrow$
$\text{writes\_783\_12}).\_\textbf{replace}(\text{p2} \rightarrow \text{writes\_783\_12}).\_\textbf{replace}(\text{p3} \rightarrow$
$\text{writes\_783\_12}).\_\textbf{replace}(\_\text{ecv\_files} \rightarrow \text{writes\_783\_12})$

$\#\text{writes\_783\_12} == \#\text{\$heap}_{775,1;780,5}.\_\text{ecv\_files}$

$\textbf{minof}(\textbf{int}) \le \text{count}_{loopstart\_782,5}$

$\text{count}_{loopstart\_782,5} \le \textbf{maxof}(\textbf{int})$

$\text{count}_{loopstart\_782,5} < \text{limit}$

$0 \le (\textbf{asType}\textbf{<integer const>}(\text{limit}) -$
$\textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_782,5}))$

$(\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_782,5}))$
$\le (\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}))$

$\text{\$heap}_{786,16} == \text{\$heap}_{loopstart\_782,5}.\_\textbf{replace}(\text{p1} \rightarrow \text{writes\_786\_25}).\_\textbf{replace}(\text{p2}$
$\rightarrow \text{writes\_786\_25}).\_\textbf{replace}(\text{p3} \rightarrow \text{writes\_786\_25})$

$\text{\$heap}_{loopend} == \text{\$heap}_{786,16}.\_\textbf{replace}((\&\text{\$heap}_{786,16}.\_\text{ecv\_files}[1]).\text{\$r} \rightarrow$
$\text{writes\_786\_9})$

asType<real>((double)0.0) < asType<real>($result_786_25)

asType<real>($result_786_25) < asType<real>((double)1.0)

Proof:

[Take given term]

[5.0] $\$heap_{funcstart\_775,1}.LIMIT == limit$

$\rightarrow$ *[const static or extern object]*

[5.1] $\$heap_{init}.LIMIT == limit$

$\rightarrow$ *[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] $count_{loopstart\_782,5} < limit$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[18.1] $count_{loopstart\_782,5} < 80$

$\rightarrow$ *[simplify]*

[18.4] $-80 < -count_{loopstart\_782,5}$

[Take goal term]

[1.0] $++count_{loopstart\_782,5} \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] $-32767 < -count_{loopstart\_782,5}$

$\rightarrow$ *[from term 18.4, literala $< -count_{loopstart\_782,5}$ is true whenever (-1 + literala) < -80]*

Proof of rule precondition:

[1.9.0] $(-32767 + -1) < -80$

$\rightarrow$ *[simplify]*

[1.9.2] **true**

[1.10] **true**

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)

$\$heap_{init}$.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)

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: (int)3 $\leq$ 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)

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)

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ **(int)2**

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (30,19)

Condition defined at:

To prove: $(\textbf{int})2 \leq \textbf{maxof(short int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

Proof:

[Take goal term]

[1.0] $(\textbf{int})2 \leq \textbf{maxof(short int)}$

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (29,19)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)**1

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)

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:

$\$heap_{init}$.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)

Proof:

[Take goal term]

[1.0] (**int**)1 ≤ **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 (27,29)

Condition defined at:

To prove: minof(short int) ≤ (int)63

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)

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

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: **(int)**63 $\leq$ **maxof(short int)**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

Proof:

[Take goal term]

[1.0] **(int)**63 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (26,29)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)178**

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)

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 == **(int)**80

$\$\text{heap}_{init}$.M1 == **asType<short int>((int)**30269)

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$heap_{init}.r3 == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

Proof:

[Take goal term]

[1.0] $(\textbf{int})178 \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[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 (25,29)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)170**

Given:

$\$heap_{init}.\text{LIMIT} == (\textbf{int})80$

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$heap_{init}.a2 == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$heap_{init}.b2 == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$heap_{init}.M3 == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

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)

$\$heap_{init}$.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] **(int)**170 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (24,29)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)**30323

Given:

$\$heap_{init}$.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)

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ (**int**)30323

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (24,29)

Condition defined at:

To prove: (**int**)30323 $\leq$ **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)

$\text{\$heap}_{init}$.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)

Proof:

[Take goal term]

[1.0] (**int**)30323 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (22,29)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)35**

Given:

\$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)

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:

\$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)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

Proof:

[Take goal term]

[1.0] $(\textbf{int})35 \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[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 (21,29)

Condition defined at:

To prove: $\textbf{minof}(\textbf{short int}) \leq (\textbf{int})176$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

Proof:

[Take goal term]

[1.0] $\textbf{minof}(\textbf{short int}) \leq (\textbf{int})176$

$\rightarrow$ *[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: $(\textbf{int})176 \leq \textbf{maxof}(\textbf{short int})$

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)

Proof:

[Take goal term]

[1.0] (**int**)176 ≤ **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 (20,29)

Condition defined at:

To prove: minof(short int) ≤ (**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)** ≤ (**int**)172

→ *[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 ≤ 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 ≤ 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 (19,29)

Condition defined at:

To prove: minof(short int) ≤ (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) ≤ (int)30307**

→ *[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: $(\mathbf{int})30307 \leq \mathbf{maxof(short\ int)}$

Given:

$\$heap_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$heap_{init}.\text{M1} == \mathbf{asType<short\ int>}((\mathbf{int})30269)$

$\$heap_{init}.\text{r1} == \mathbf{asType<short\ int>}((\mathbf{int})171)$

$\$heap_{init}.\text{a1} == \mathbf{asType<short\ int>}((\mathbf{int})177)$

$\$heap_{init}.\text{b1} == \mathbf{asType<short\ int>}((\mathbf{int})2)$

Proof:

[Take goal term]

[1.0] $(\mathbf{int})30307 \leq \mathbf{maxof(short\ int)}$

$\rightarrow$ *[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 (17,29)

Condition defined at:

To prove: $\mathbf{minof(short\ int)} \leq (\mathbf{int})2$

Given:

$\$heap_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$heap_{init}.\text{M1} == \mathbf{asType<short\ int>}((\mathbf{int})30269)$

$\$heap_{init}.\text{r1} == \mathbf{asType<short\ int>}((\mathbf{int})171)$

$\$heap_{init}.\text{a1} == \mathbf{asType<short\ int>}((\mathbf{int})177)$

Proof:

[Take goal term]

[1.0] $\mathbf{minof(short\ int)} \leq (\mathbf{int})2$

$\rightarrow$ *[simplify]*

[1.3] **true**

Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (17,29)

Condition defined at:

To prove: $(\mathbf{int})2 \leq \mathbf{maxof(short\ int)}$

Given:

$\$heap_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$heap_{init}.\text{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$heap_{init}.\text{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$heap_{init}.\text{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

Proof:

[Take goal term]

[1.0] $(\mathbf{int})2 \leq \mathbf{maxof(short\ int)}$

$\rightarrow$ *[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 (16,29)

Condition defined at:

To prove: $\mathbf{minof(short\ int)} \leq (\mathbf{int})177$

Given:

$\$heap_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$heap_{init}.\text{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$heap_{init}.\text{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

Proof:

[Take goal term]

[1.0] $\mathbf{minof(short\ int)} \leq (\mathbf{int})177$

$\rightarrow$ *[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 ≤ 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 ≤ 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 (15,29)

Condition defined at:

To prove: minof(short int) ≤ (int)171

Given:

$\$heap_{init}$.LIMIT == **(int)80**

$\$heap_{init}$.M1 == **asType<short int>((int)30269)**

Proof:

[Take goal term]

[1.0] **minof(short int) ≤ (int)171**

→ *[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 ≤ maxof(short int)

Given:

$\$heap_{init}$.LIMIT == **(int)80**

$heap_{init}$.M1 == **asType<short int>**((**int**)30269)

Proof:

[Take goal term]

[1.0] (**int**)171 ≤ **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 (14,29)

Condition defined at:

To prove: minof(short int) ≤ (**int**)30269

Given:

$heap_{init}$.LIMIT == (**int**)80

Proof:

[Take goal term]

[1.0] **minof(short int)** ≤ (**int**)30269

→ *[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 ≤ **maxof(short int)**

Given:

$heap_{init}$.LIMIT == (**int**)80

Proof:

[Take goal term]

[1.0] (**int**)30269 ≤ **maxof(short int)**

→ *[simplify]*

[1.3] **true**

End of proofs for file C:\Escher\Customers\prang\prang.c