

**MACHINE** *blocks5b*

**SEES** *Bool\_TYPE*

**SETS** *block* = { *block1* , *block2* , *block3* , *block4* , *block5* , *block6* , *block7* } ;  
*gripper* = { *tom* }

**VARIABLES** *on\_block* , *on\_table* , *clear* , *gripped* , *busy* , *free*

**INVARIANT**

$on\_block \in block \Leftrightarrow block \wedge$   
 $on\_table \in block \rightarrow BOOL \wedge$   
 $clear \in block \rightarrow BOOL \wedge$   
 $gripped \in block \Leftrightarrow gripper \wedge$   
 $busy \in gripper \rightarrow BOOL \wedge$   
 $free \in gripper \rightarrow BOOL \wedge$   
 $\forall vblock1 . ( vblock1 \in block \Rightarrow$   
     $vblock1 \in \text{dom} ( gripped ) \wedge$   
     $vblock1 \notin \text{dom} ( on\_block ) \wedge$   
     $on\_table ( vblock1 ) = FALSE \wedge$   
     $clear ( vblock1 ) = FALSE$   
     $\vee$   
     $vblock1 \in \text{dom} ( on\_block ) \wedge$   
     $clear ( vblock1 ) = TRUE \wedge$   
     $vblock1 \neq on\_block ( vblock1 ) \wedge$   
     $on\_table ( vblock1 ) = FALSE \wedge$   
     $vblock1 \notin \text{dom} ( gripped )$   
     $\vee$   
     $vblock1 \in \text{dom} ( on\_block ) \wedge$   
     $vblock1 \neq on\_block ( vblock1 ) \wedge$   
     $on\_table ( vblock1 ) = FALSE \wedge$   
     $clear ( vblock1 ) = FALSE \wedge$   
     $vblock1 \notin \text{dom} ( gripped )$   
     $\vee$   
     $on\_table ( vblock1 ) = TRUE \wedge$   
     $clear ( vblock1 ) = TRUE \wedge$   
     $vblock1 \notin \text{dom} ( on\_block ) \wedge$   
     $vblock1 \notin \text{dom} ( gripped )$   
     $\vee$   
     $on\_table ( vblock1 ) = TRUE \wedge$   
     $vblock1 \notin \text{dom} ( on\_block ) \wedge$   
     $clear ( vblock1 ) = FALSE \wedge$   
     $vblock1 \notin \text{dom} ( gripped ) ) \wedge$   
 $\forall vgrripper1 . ( vgrripper1 \in gripper \Rightarrow$   
     $busy ( vgrripper1 ) = TRUE \wedge$   
     $free ( vgrripper1 ) = FALSE$

$\vee$   
 $free ( vgrripper1 ) = TRUE \wedge$   
 $busy ( vgrripper1 ) = FALSE )$

## Cross-references

*BOOL*

*Bool\_TYPE*

SETS

1

## INITIALISATION

$on\_block := \{ block5 \mapsto block4 ,$   
 $block7 \mapsto block3 \} \parallel$   
 $on\_table := \{ block1 \mapsto TRUE ,$   
 $block2 \mapsto TRUE ,$   
 $block3 \mapsto TRUE ,$   
 $block4 \mapsto TRUE ,$   
 $block5 \mapsto FALSE ,$   
 $block6 \mapsto TRUE ,$   
 $block7 \mapsto FALSE \} \parallel$   
 $clear := \{ block1 \mapsto TRUE ,$   
 $block2 \mapsto TRUE ,$   
 $block3 \mapsto FALSE ,$   
 $block4 \mapsto FALSE ,$   
 $block5 \mapsto TRUE ,$   
 $block6 \mapsto TRUE ,$   
 $block7 \mapsto TRUE \} \parallel$   
 $gripped := \{ \} \parallel$   
 $busy := \{ tom \mapsto FALSE \} \parallel$   
 $free := \{ tom \mapsto TRUE \}$

## OPERATIONS

**grip\_from\_blocks** ( *vblock1* , *vgrripper2* )  $\hat{=}$

### PRE

$vblock1 \in block \wedge$   
 $vgrripper2 \in gripper \wedge$   
 $vblock1 \in dom ( on\_block ) \wedge$   
 $clear ( vblock1 ) = TRUE \wedge$   
 $vblock1 \neq on\_block ( vblock1 ) \wedge$   
 $on\_block ( vblock1 ) \in dom ( on\_block ) \wedge$   
 $on\_block ( vblock1 ) \neq on\_block ( on\_block ( vblock1 ) ) \wedge$   
 $free ( vgrripper2 ) = TRUE$

### THEN

$on\_block := \{ vblock1 \} \triangleleft on\_block \parallel$   
 $clear := clear \triangleleft \{ on\_block ( vblock1 ) \mapsto TRUE , vblock1 \mapsto FALSE \} \parallel$   
 $gripped := gripped \triangleleft \{ vblock1 \mapsto vgrripper2 \} \parallel$   
 $busy := busy \triangleleft \{ vgrripper2 \mapsto TRUE \} \parallel$

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    free := free  $\Leftarrow$  { vgrripper2  $\mapsto$  FALSE }
  END ;

grip_from_one_block ( vblock1 , vgrripper2 )  $\hat{=}$ 
  PRE
    vblock1  $\in$  block  $\wedge$ 
    vgrripper2  $\in$  gripper  $\wedge$ 
    vblock1  $\in$  dom ( on_block )  $\wedge$ 
    clear ( vblock1 ) = TRUE  $\wedge$ 
    vblock1  $\neq$  on_block ( vblock1 )  $\wedge$ 
    on_table ( on_block ( vblock1 ) ) = TRUE  $\wedge$ 
    free ( vgrripper2 ) = TRUE
  THEN
    on_block := { vblock1 }  $\Leftarrow$  on_block ||
    clear := clear  $\Leftarrow$  { on_block ( vblock1 )  $\mapsto$  TRUE , vblock1  $\mapsto$  FALSE } ||
    gripped := gripped  $\Leftarrow$  { vblock1  $\mapsto$  vgrripper2 } ||
    busy := busy  $\Leftarrow$  { vgrripper2  $\mapsto$  TRUE } ||
    free := free  $\Leftarrow$  { vgrripper2  $\mapsto$  FALSE }
  END ;

grip_from_table ( vblock1 , vgrripper2 )  $\hat{=}$ 
  PRE
    vblock1  $\in$  block  $\wedge$ 
    vgrripper2  $\in$  gripper  $\wedge$ 
    on_table ( vblock1 ) = TRUE  $\wedge$ 
    clear ( vblock1 ) = TRUE  $\wedge$ 
    free ( vgrripper2 ) = TRUE
  THEN
    on_table := on_table  $\Leftarrow$  { vblock1  $\mapsto$  FALSE } ||
    clear := clear  $\Leftarrow$  { vblock1  $\mapsto$  FALSE } ||
    gripped := gripped  $\Leftarrow$  { vblock1  $\mapsto$  vgrripper2 } ||
    busy := busy  $\Leftarrow$  { vgrripper2  $\mapsto$  TRUE } ||
    free := free  $\Leftarrow$  { vgrripper2  $\mapsto$  FALSE }
  END ;

put_on_blocks ( vblock1 , vblock2 )  $\hat{=}$ 
  PRE
    vblock1  $\in$  block  $\wedge$ 
    vblock2  $\in$  block  $\wedge$ 
    vblock1  $\in$  dom ( gripped )  $\wedge$ 
    vblock2  $\in$  dom ( on_block )  $\wedge$ 
    clear ( vblock2 ) = TRUE  $\wedge$ 
    vblock2  $\neq$  on_block ( vblock2 )  $\wedge$ 
    busy ( gripped ( vblock1 ) ) = TRUE
  THEN
    on_block := on_block  $\Leftarrow$  { vblock1  $\mapsto$  vblock2 } ||
    clear := clear  $\Leftarrow$  { vblock1  $\mapsto$  TRUE , vblock2  $\mapsto$  FALSE } ||

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    gripped := { vblock1 }  $\Leftarrow$  gripped ||
    busy := busy  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  FALSE } ||
    free := free  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  TRUE }
END ;

put_on_one_block ( vblock1 , vblock2 )  $\hat{=}$ 
PRE
    vblock1  $\in$  block  $\wedge$ 
    vblock2  $\in$  block  $\wedge$ 
    vblock1  $\in$  dom ( gripped )  $\wedge$ 
    on_table ( vblock2 ) = TRUE  $\wedge$ 
    clear ( vblock2 ) = TRUE  $\wedge$ 
    busy ( gripped ( vblock1 ) ) = TRUE
THEN
    on_block := on_block  $\Leftarrow$  { vblock1  $\mapsto$  vblock2 } ||
    clear := clear  $\Leftarrow$  { vblock1  $\mapsto$  TRUE , vblock2  $\mapsto$  FALSE } ||
    gripped := { vblock1 }  $\Leftarrow$  gripped ||
    busy := busy  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  FALSE } ||
    free := free  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  TRUE }
END ;

put_on_table ( vblock1 )  $\hat{=}$ 
PRE
    vblock1  $\in$  block  $\wedge$ 
    vblock1  $\in$  dom ( gripped )  $\wedge$ 
    busy ( gripped ( vblock1 ) ) = TRUE
THEN
    on_table := on_table  $\Leftarrow$  { vblock1  $\mapsto$  TRUE } ||
    clear := clear  $\Leftarrow$  { vblock1  $\mapsto$  TRUE } ||
    gripped := { vblock1 }  $\Leftarrow$  gripped ||
    busy := busy  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  FALSE } ||
    free := free  $\Leftarrow$  { gripped ( vblock1 )  $\mapsto$  TRUE }
END

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**END**

#### Cross-references for blocks5b

<i>BOOL</i>	<i>Bool_TYPE</i>	SETS	1
<i>Bool_TYPE</i>		MACHINE	1