

Flat Missile VDM-SL example

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types

1.0 $MissileInputs = MissileInput^*$;

2.0 $MissileInput = MissileType \times Angle$;

3.0 $MissileType = \text{MISSILEA} \mid \text{MISSILEB} \mid \text{MISSILEC} \mid \text{NONE}$;

4.0 $Angle = \mathbb{N}$

.1 $\text{inv } num \triangleq num \leq 360$;

5.0 $Output = MagId \xrightarrow{m} OutputStep^*$;

6.0 $MagId = \text{token}$;

7.0 $OutputStep = FlareType \times AbsTime$;

8.0 $Response = FlareType \times \mathbb{N}$;

9.0 $AbsTime = \mathbb{N}$;

10.0 $FlareType = \text{FLAREONEA} \mid \text{FLARETWOA} \mid \text{FLAREONEB} \mid$
.1 $\text{FLARETWOB} \mid \text{FLAREONEC} \mid \text{FLARETWO C} \mid$
.2 $\text{DONOTHINGA} \mid \text{DONOTHINGB} \mid \text{DONOTHINGC}$;

11.0 $Plan = (FlareType \times Delay)^*$;

12.0 $Delay = \mathbb{N}$

values

13.0 $responseDB : MissileType \xrightarrow{m} Plan = \{ \text{MISSILEA} \mapsto [\text{mk-}(\text{FLAREONEA}, 900), \text{mk-}(\text{FLAREONEA}, 500), \text{mk-}(\text{DONOTHINGA}, 100), \text{mk-}(\text{FLAREONEA}, 500)],$
.1
.2 $\text{MISSILEB} \mapsto [\text{mk-}(\text{FLARETWOB}, 500), \text{mk-}(\text{FLAREONEA}, 500), \text{mk-}(\text{FLAREONEC}, 400), \text{mk-}(\text{FLARETWOB}, 500)],$
.3 $\text{MISSILEC} \mapsto [\text{mk-}(\text{FLAREONEC}, 400), \text{mk-}(\text{DONOTHINGA}, 100), \text{mk-}(\text{FLAREONEC}, 500)],$
.4 $\text{mk-}(\text{FLARETWOB}, 400), \text{mk-}(\text{FLAREONEC}, 500)] \}$

14.0 $missilePriority : MissileType \xrightarrow{m} \mathbb{N} = \{ \text{MISSILEA} \mapsto 1,$
.1 $\text{MISSILEB} \mapsto 2,$
.2 $\text{MISSILEC} \mapsto 3,$
.3 $\text{NONE} \mapsto 0 \};$

15.0 $stepLength : \mathbb{N} = 100;$

16.0 $testval : MissileInputs = [\text{mk-}(\text{MISSILEA}, 88),$
.1 $\text{mk-}(\text{MISSILEB}, 70),$
.2 $\text{mk-}(\text{MISSILEA}, 222),$
.3 $\text{mk-}(\text{MISSILEC}, 44)];$

17.0 $testval2 : MissileInputs = [\text{mk-}(\text{MISSILEC}, 188),$
.1 $\text{mk-}(\text{MISSILEB}, 70),$
.2 $\text{mk-}(\text{MISSILEA}, 2),$
.3 $\text{mk-}(\text{MISSILEC}, 44)];$

18.0 $testval3 : MissileInputs = [\text{mk-}(\text{MISSILEA}, 288),$
.1 $\text{mk-}(\text{MISSILEB}, 170),$
.2 $\text{mk-}(\text{MISSILEA}, 222),$
.3 $\text{mk-}(\text{MISSILEC}, 44)]$

functions

19.0 *CounterMeasures* : *MissileInputs* \rightarrow *Output*

.1 *CounterMeasures* (*missileInputs*) \triangle
.2 *CM* (*missileInputs*, $\{\mapsto\}$, NONE, 0, $\{\}$);

20.0 *CM* : *MissileInputs* \times *Output* \times [*MissileType*] \times \mathbb{N} \times *MagId-set* \rightarrow
Output

.1 *CM* (*missileInputs*, *outputSoFar*, *lastMissile*, *curTime*, *activemagids*) \triangle
.2 if *missileInputs* = \square
.3 then *outputSoFar*
.4 else let mk- (*curMis*, *angle*) = hd *missileInputs*,
.5 *magid* = *Angle2MagId* (*angle*) in
.6 if *missilePriority* (*curMis*) > *missilePriority* (*lastMissile*) \vee
.7 *magid* \notin *activemagids*
.8 then let *newOutput* = *InterruptPlan* (*curTime*, *outputSoFar*,
.9 *responseDB* (*curMis*), *magid*) in
.10 *CM* (tl *missileInputs*, *newOutput*, *curMis*,
.11 *curTime* + *stepLength*, *activemagids* \cup $\{\text{magid}\}$)
.12 else *CM* (tl *missileInputs*, *outputSoFar*, *lastMissile*,
.13 *curTime* + *stepLength*, *activemagids*);

21.0 *InterruptPlan* : $\mathbb{N} \times$ *Output* \times *Plan* \times *MagId* \rightarrow *Output*

.1 *InterruptPlan* (*curTime*, *expOutput*, *plan*, *magid*) \triangle
.2 $\{\text{magid} \mapsto$
.3 (if *magid* \in dom *expOutput*
.4 then *LeavePrefixUnchanged* (*expOutput* (*magid*), *curTime*)

.5 else $\square\}) \curvearrowright$
.6 *MakeOutputFromPlan* (*curTime*, *plan*) $\}$ \sqcup
.7 ($\{\text{magid}\} \triangleleft \text{expOutput}$);

22.0 *LeavePrefixUnchanged* : *OutputStep*^{*} \times $\mathbb{N} \rightarrow$ *OutputStep*^{*}

.1 *LeavePrefixUnchanged* (*output-l*, *curTime*) \triangle
.2 [*output-l* (*i*) | *i* \in inds *output-l* .
.3 let mk- (\cdot , *t*) = *output-l* (*i*) in
.4 *t* \leq *curTime*];

23.0 $MakeOutputFromPlan : \mathbb{N} \times Response^* \rightarrow OutputStep^*$

```

.1  $MakeOutputFromPlan (curTime, response) \triangleq$ 
.2   let  $output = OutputAtTimeZero (response)$  in
.3   [let mk- ( $flare, t$ ) =  $output (i)$  in
.4     mk- ( $flare, t + curTime$ ) |
.5      $i \in \text{inds } output$ ];
```

24.0 $OutputAtTimeZero : Response^* \rightarrow OutputStep^*$

```

.1  $OutputAtTimeZero (response) \triangleq$ 
.2   let  $absTimes = RelativeToAbsoluteTimes (response)$  in
.3   let mk- ( $firstFlare, -$ ) =  $\text{hd } absTimes$  in
.4   [mk- ( $firstFlare, 0$ )]  $\curvearrowright$ 
.5   [let mk- ( $-, t$ ) =  $absTimes (i - 1)$ ,
.6     mk- ( $f, -$ ) =  $absTimes (i)$  in
.7     mk- ( $f, t$ ) |
.8      $i \in \{2, \dots, \text{len } absTimes\}$ ];
```

25.0 $RelativeToAbsoluteTimes : Response^* \rightarrow (FlareType \times \mathbb{N})^*$

```

.1  $RelativeToAbsoluteTimes (ts) \triangleq$ 
.2   if  $ts = []$ 
.3   then  $[]$ 
.4   else let mk- ( $f, t$ ) =  $\text{hd } ts$ ,
.5          $ns = RelativeToAbsoluteTimes (\text{tl } ts)$  in
.6     [mk- ( $f, t$ )]  $\curvearrowright$  [let mk- ( $nf, nt$ ) =  $ns (i)$  in
.7       mk- ( $nf, nt + t$ ) |
.8        $i \in \text{inds } ns$ ];
```

26.0 $Angle2MagId : Angle \rightarrow MagId$

```
.1  $Angle2MagId (angle) \triangle$ 
.2   if  $angle < 90$ 
.3   then mk-token ("Magazine 1")
.4   elseif  $angle < 180$ 
.5   then mk-token ("Magazine 2")
.6   elseif  $angle < 270$ 
.7   then mk-token ("Magazine 3")
.8   else mk-token ("Magazine 4")
```

Test Suite : vdm.tc

Module : DefaultMod

Name	#Calls	Coverage
CM	15	✓
Angle2MagId	12	✓
InterruptPlan	11	✓
CounterMeasures	3	✓
OutputAtTimeZero	11	✓
MakeOutputFromPlan	11	✓
LeavePrefixUnchanged	3	✓
RelativeToAbsoluteTimes	49	✓
Total Coverage		100%