# An Event-B Specification of
# Vectors

This project tests code generation for vectors.

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**CONSTANTS**

lo
hi
index
loo
hii

**AXIOMS**

axm1:    $lo = 1$
axm2:    $hi = 10$
axm3:    $index = lo..hi$
axm4:    $loo \in \mathbb{Z}$
axm5:    $hii \in \mathbb{Z}$
axm6:    $hii > loo$

**THEOREM**

thm1:    $card(index) = max(index)$
thm2:    $lo = min(index)$
thm3:    $hi = max(index)$
thm4:    $5 = card(5..9)$
thm5:    $9 = max(5..9)$
thm6:    $hii = max(loo..hii)$

**END**

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## VARIABLES

*bytes*

*bytes_size*

## INVARIANTS

inv1:   $bytes \in 1..bytes\_size \to 0..255$

inv2:   $bytes\_size = \mathrm{card}(\mathrm{dom}(bytes))$

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## EVENT INITIALISATION

THEN

init1:   $bytes := 1..10 \times \{1\}$

init2:   $bytes\_size := 10$

END

## EVENT cut

ANY

*new_size*

WHERE

grd1:   $bytes\_size > 1$

grd2:   $new\_size = bytes\_size - 1$

grd3:   $new\_size \in \mathbb{N}_1$

THEN

act1:   $bytes\_size := new\_size$

act2:   $bytes := \{x \cdot x \in 1..new\_size \mid x \mapsto bytes(x + 1)\}$

END

## EVENT split

ANY

*new_size*

*left_size*

*out_msg*

WHERE

grd1:   $new\_size \in \mathbb{N}_1$

grd2:   $left\_size \in \mathbb{N}_1$

grd3:   $bytes\_size > left\_size$

grd4:   $new\_size = bytes\_size - left\_size$

grd5:   $out\_msg = 1..new\_size \triangleleft bytes$

THEN

act1:   $bytes\_size := new\_size$

act2:   $bytes := \{x \cdot x \in 1..new\_size \mid x \mapsto bytes(x + left\_size)\}$

END

REFINES Test

VARIABLES        3.1

EVENT split        3.2
EXTENDS split
WHERE
  grd1_1:    $2 \in \mathrm{dom}(bytes)$
  grd1_2:    $left\_size = bytes(1)$

END

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## VARIABLES <span style="float:right">4.1</span>

| | |
|---|---|
| *heights* | A fixed size vector of heights. |
| *bytes_size* | Size of the bytes vector |
| *bytes* | A vector of bytes |

## INVARIANTS

inv_he:    $heights \in (1..100) \to \mathbb{N}$

inv_bs:    $bytes\_size \in \mathbb{N}$

inv_by:    $bytes \in (1..bytes\_size) \to 0..255$

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## EVENT INITIALISATION
THEN

init_he:    $heights := 1..100 \times \{0\}$

init_ws:    $bytes\_size := 0$

init_we:    $bytes := \varnothing$

END

## EVENT setHeight <span style="float:right">4.2</span>
ANY

   $at$

   $h$

WHERE

grd_p:    $at \in \text{dom}(heights)$

grd_h:    $h \in \mathbb{N}$

THEN

act_1:    $heights(at) := h$

END

## EVENT setHeights <span style="float:right">4.3</span>
ANY

   $hs$

WHERE

grd_hs:    $hs \in (1..100) \to \mathbb{N}$

THEN

act_1:    $heights := hs$

END

## EVENT findHeight <span style="float:right">4.4</span>
ANY

   $h$

   $out\_i$

WHERE

grd1:    $h \in \mathbb{N}$

grd3:    $out\_i \in \text{dom}(heights)$

grd4:    $\exists x \cdot x \in \text{dom}(heights) \land heights(x) = h \land out\_i = x$

END

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EVENT addByte                                                    4.5
ANY
  b
WHERE
  grd_b:    b ∈ 0..255
THEN
  act_1:    bytes := bytes ∪ {bytes_size + 1 ↦ b}
  act_2:    bytes_size := bytes_size + 1
END
```

$$\text{grd\_b:} \quad b \in 0..255$$

$$\text{act\_1:} \quad bytes := bytes \cup \{bytes\_size + 1 \mapsto b\}$$

$$\text{act\_2:} \quad bytes\_size := bytes\_size + 1$$

```
EVENT cut                                                        4.6
ANY
  new_size
WHERE
  grd1:    bytes_size > 1
  grd2:    new_size ∈ ℕ₁
  grd3:    new_size = bytes_size − 1
THEN
  act1:    bytes_size := new_size
  act2:    bytes := {x · x ∈ 1..new_size | x ↦ bytes(x + 1)}
END
```

$$\text{grd1:} \quad bytes\_size > 1$$

$$\text{grd2:} \quad new\_size \in \mathbb{N}_1$$

$$\text{grd3:} \quad new\_size = bytes\_size - 1$$

$$\text{act1:} \quad bytes\_size := new\_size$$

$$\text{act2:} \quad bytes := \{x \cdot x \in 1..new\_size \mid x \mapsto bytes(x + 1)\}$$