

Exercises

Introduction to Schemas

Exercise 1.

Define a robust schema *UpKey* to define the operation of pressing the up key.

Exercise 2.

Define a schema *LinesRemaining* which delivers the number of lines below the cursor as an output parameter. Use the schemas we have already built.

Exercise 3.

Write a schema *DownKey* to define pressing the down key so that the cursor does not move at all if the cursor is at the bottom of the screen. Use all the schemas we have already seen.

Exercise 4.

Devise a schema *RightKey* to define pressing the right key where the cursor does not move at all if it already on the last column of the screen.

Solutions

Introduction to Schemas

Solution 1.

$ \begin{array}{l} \textit{UpKeyNormal} \\ \Delta \textit{Cursor} \\ \textit{key}? : \textit{KEY} \end{array} $
$ \begin{array}{l} \textit{key}? = \textit{up} \\ \textit{line} \geq 1 \\ \\ \textit{line}' = \textit{line} - 1 \\ \textit{column}' = \textit{column}' \end{array} $

$ \begin{array}{l} \textit{UpKeyAtTop} \\ \Delta \textit{Cursor} \\ \textit{key}? : \textit{KEY} \end{array} $
$ \begin{array}{l} \textit{key}? = \textit{up} \\ \textit{line} = 1 \\ \\ \textit{line}' = \textit{num_Lines} \\ \textit{column}' = \textit{column}' \end{array} $

The full behaviour of the Down key is defined as

$$\textit{UpKey} == \textit{UpKeyNormal} \vee \textit{UpKeyAtTop}$$

Solution 2.

$ \begin{array}{l} \textit{LinesRemaining} \\ \exists \textit{Cursor} \\ \textit{answer}! : \mathbb{N} \end{array} $
$\textit{answer}' = \textit{num_Lines} - \textit{line}$

Solution 3.

$DownKeyAtBottomUpdated$
$\Delta Cursor$ $key? : KEY$
$key? = down$ $line = num_Lines$ $line' = line$ $column' = column'$

or

$DownKeyAtBottomUpdated$
$\exists Cursor$ $key? : KEY$
$key? = down$ $line = num_Lines$

The full behaviour of the Down key is defined as

$$DownKey == DownKeyNormal \vee DownKeyAtBottom$$

Solution 4.

$RightKeyNormal$
$\Delta Cursor$ $key? : KEY$
$key? = right$ $column \leq num_Columns$ $line' = line$ $column' = column + 1$

$RightKeyAtEdge$
$\exists Cursor$ $key? : KEY$
$key? = right$ $column = num_Columns$

The full behaviour of the Down key is defined as

$$RightKey == RightKeyNormal \vee RightKeyAtEdge$$