

## Sequences , Bags , and Tuple Projection

### Example 1 : Sequence Literals

(a)

Empty sequence

$\langle \rangle$

(b)

Single element

$\langle a \rangle$

(c)

Multiple elements

$\langle 1, 2, 3, 4, 5 \rangle$

(d)

Sequence of identifiers

$\langle x, y, z \rangle$

### Example 2 : Sequence Operators

(a)

$head(\langle 1, 2, 3 \rangle)$

(b)

$tail(\langle 1, 2, 3 \rangle)$

(c)

$last(\langle 1, 2, 3 \rangle)$

(d)

$front(\langle 1, 2, 3 \rangle)$

(e)

$rev(\langle 1, 2, 3 \rangle)$

### Example 3 : Sequence Concatenation

(a)

$\langle 1, 2 \rangle \frown \langle 3, 4 \rangle$

(b)

$$s \frown t \frown u$$

(c)

$$\langle a \rangle \frown \langle b, c \rangle \frown \langle d \rangle$$

### Example 4 : Tuple Projection

(a)

$$x.1$$

(b)

$$x.2$$

(c)

$$(a, b, c).1$$

(d)

$$(a, b, c).2$$

### Example 5 : Bag Literals

(a)

$$\llbracket x \rrbracket$$

(b)

$$\llbracket 1, 2, 3 \rrbracket$$

(c)

$$\llbracket a, b, c \rrbracket$$

(d)

Bags with duplicates

$$\llbracket 1, 2, 2, 3, 3, 3 \rrbracket$$

### Example 6 : Sequences elem Expressions

(a)

$$x \in \langle 1, 2, 3 \rangle$$

(b)

$$head(s) = a$$

(c)

$$\text{tail}(\langle 1, 2, 3 \rangle) = \langle 2, 3 \rangle$$

## Example 7 : Complex Expressions

(a)

$$\forall i : \mathbb{N} \bullet i \in \langle 1, 2, 3 \rangle \Rightarrow i > 0$$

(b)

$$\exists s : \text{seq } \mathbb{N} \bullet \text{head}(s) = 1$$

(c)

$$\{ x : \mathbb{N} \mid x > 0 \bullet \langle x, x^2 \rangle \}$$

## Example 8 : Real Examples

(a)

From Solution 37

$$\langle a \rangle$$

(b)

Tuple projection from Solution 38

$$\text{trains}(x).2$$

(c)

Bags from Solution 39

$$\llbracket d \rrbracket$$