

## Exercises from Chapter 4 sample solutions

Given an array  $f[0..100)$  of int. Express the following in Quantified form (the notation we learned about in yesterday's lecture ).

- R is the sum of the values in f
  - $R = \langle + j : 0 \leq j < 100 : f.j \rangle$
- P is the product of the values in f
  - $P = \langle * j : 0 \leq j < 100 : f.j \rangle$
- L is the largest value in f
  - $L = \langle \uparrow j : 0 \leq j < 100 : f.j \rangle$
- S is the smallest value in f
  - $S = \langle \downarrow j : 0 \leq j < 100 : f.j \rangle$
- K is the sum of the last 20 elements in f
  - $K = \langle + j : 80 \leq j < 100 : f.j \rangle$
- V is the product of the middle 20 elements in f
  - $V = \langle * j : 40 \leq j < 60 : f.j \rangle$
- All of the elements in f are greater than 10
  - $\langle \forall j : 0 \leq j < 100 : 10 < f.j \rangle$
- All of the elements in f are even numbers
  - $\langle \forall j : 0 \leq j < 100 : f.j \bmod 2 = 0 \rangle$
- None of the elements in f is larger than 123
  - $\langle \forall j : 0 \leq j < 100 : f.j \leq 123 \rangle$

Given the same array, what do the following expressions mean?

$$\langle \forall j, k : 0 \leq j \leq k < 100 : f.j \leq f.k \rangle$$

The array is sorted in ascending order

$$r = \langle + i : 0 \leq i < 50 : f.i \rangle$$

r is the sum of the elements in the first half of f

$$r = \langle + i : 12 \leq i < 53 : i \rangle$$

r is the sum of the elements from index 12 to index 52 in f

$$r = \langle + i : 40 \leq i < 50 : i*i \rangle$$

r is the sum of the squares of the integers from 40 to 49. Note that we are not referring to the array here.

$$r = \langle * i : 10 \leq i < 40 : f.i \rangle$$

r is the product of the values from index 10 to index 39 of f

$$s = \langle \downarrow i : 50 \leq i < 100 : f.i \rangle$$

s is the smallest value in the 2nd half of f

$$\langle \exists i : 0 \leq i < 50 : f.i < 0 \rangle$$

at least one of the elements in the first half of f is negative