

## Assignment 2

### 1 Abstract Data type: Point

- Write the implementation of the data type Point.
- Write a client program that computes the closest points regarding a certain distance.

### 2 Recursive lists

#### 1. Concatenation of lists

We define  $\text{concat}: \text{list} \times \text{list} \rightarrow \text{list}$  as the concatenation of two lists. Complete the following axioms:

- $\text{length}(\text{concat}(l, m))$
- $i^{\text{th}}(\text{concat}(l, m), j)$
- $\text{concat}(\text{empty\_list}, l)$
- $\text{concat}(\text{cons}(e, l), m)$

#### 2. Search of an element (present) in a list

We define  $\text{search}: \text{list} \times \text{element} \rightarrow \text{position}$ . Complete the following axioms:

- $\text{content}(\text{search}(l, e))$
- $\text{search}(\text{cons}(e, l), e)$
- $e \neq f, \text{search}(\text{cons}(e, l), f)$

#### 3. Implementation

Give a linked list implementation of a recursive list.

### **3 Pushdown stack**

- Give a linked list implementation of a pushdown stack.
- Write a program that reads any postfix expression involving multiplication and addition of integers, then evaluates the expression and prints the computed result.

### **4 Mathematical properties of binary trees**

Prove by induction that the external path length of any binary tree with  $N$  internal nodes is  $2N$  greater than the internal path length.