

Session 2 SMV: ADTs

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1 ADTs (Abstract data types)

An ADT consists of:

1. Interface
2. Operation: Generator / Modifier / Observer
3. Axioms

The goal of this exercise is to construct ADTs, especially with their axioms.

1.1 Lists

To help you write your first ADT, we start by giving an example of an ADT for the **List**.

```
Adt List;
Interface: Nat, Bool, List
  Operations
  Generator:
    empty: -> List;
    cons _ _ : Nat, List -> List
  Modifier:
    concat _ _ : List, List -> List
    removeFirst _ _ : Nat, List -> List
  Observer:
    eq _ _ : List, List -> Bool
  Axioms:
    (1) concat(empty, l) = l
    (2) concat(cons(n, l1), l2) = concat(l1, cons(n, l2))
    (3) removeFirst(n, empty) = empty
    (4) removeFirst(n1, cons(n2, l)) = l, n1 == n2
    (5) removeFirst(n1, cons(n2, l)) = cons(n2, removeFirst(n1, l)), n1 != n2
    (6) eq(empty, empty) = true
    (7) eq(cons(n1, l1), cons(n2, l2)) = eq(l1, l2), n1 == n2
    (8) eq(cons(n1, l1), cons(n2, l2)) = false, n1 != n2
  Where l, l1, l2: List, n, n1, n2: Nat
```

1. Write two examples of a list only using generators.
2. Using the axioms of *concat*, rewrite the following term to get only generators:
 $concat(cons(s(zero), cons(zero, empty)), cons(zero, empty))$
3. Using the axioms of *removeFirst*, rewrite the following term to get only generators:
 $removeFirst(zero, cons(s(zero), cons(zero, empty)))$

1.2 Stack

1. Construct the ADT of *Stack*. It has to contain at least two modifiers and two observers in addition to generators ! You can suppose your stack contains only natural. You have to write axioms for your modifiers and observers.

1.3 Table

1. Construct the ADT of *Table*. It has to contain at least two modifiers and two observers in addition to generators ! You can suppose your *table* contains only natural. You have to write axioms for your modifiers and observers.

1.4 Binary Search Tree

1. Construct the ADT of *Binary Search Tree (BST)*. It has to contain at least two modifiers and two observers in addition to generators ! You can suppose your *BST* contains only natural. You have to write axioms for your modifiers and observers.