Meki Gelashvili **1. assignment/5. task** 16h March 2024
G8BX8W
g8bx8w@inf.elte.hu
Group 1

Task

Implement the set type which contains integers. Represent the set as a sequence of its elements. Implement as methods: inserting an element, removing an element, returning whether the set is empty, returning whether the set contains an element, returning a random element without removing it from the set, returning the largest element of the set (suggestion: store the largest entry and update it when the set changes), printing the set. A set can store every element only once.

Set

Set of values

$Set=\{a \in \mathbb{Z}^n \mid \forall i \in [1..n]: a[i] \in \mathbb{Z}\}$

Operations

1.insert

Insert an element in to the set.

Formally :

A :=(x**:**$\mathbb{Z}$, set : Set)

Pre := (set = set' ∧ x = x' ∧ ∀ i ∈ [1..|set.n|] : set.n[i] ≠ x)

Post := (set = set' ∪ {x'})

2.isEmpty

Checking if the set is Empty

Formally :

A := (set : Set, x**:L)**

Pre := (set = set')

Post := (Pre ∧ x = (|set.n|=0))

3. largest

Getting the maximum element of the set

Formally :

A := (max**:**$\mathbb{Z}$**,** set : Set **)**

Pre := (set= set' $\wedge$ |set.n| $>$ 0)

Post := (Pre $\wedge$ max = $\underset{i \in set.n}{MAX}$ (i))

4. remove

Removing an element from the set

Formally:

A := (set : Set, x**:**$\mathbb{Z}$ **)**

Pre := (set = set' $\wedge$ x=x' $\wedge$ |set.n| $>$ 0 $\wedge$ $\exists$i $\in$ [1..|set.n|] : set.n[i]=x)

Post := (set = set' \{x'})

5. random

Getting a random element from the set

Formally:

A := (set :Set, x**:**$\mathbb{Z}$**)**

Pre := (set = set' $\wedge$ |set.n| $>$ 0)

Post := (Pre $\wedge$ x = set.n[random])

6. Contains

Formally:

A := (set :Set, x**:**$\mathbb{Z}$**,** a**:L)**

Pre := (set = set' $\wedge$ x=x')

Post := (Pre $\wedge$ x = $\underset{i \in |set.n|}{MAX}$ set.n[i])

$$Post := (Pre \wedge a = set.n[i]{=}x)_{i:=1}$$

Representation

The list of integers should be stored.

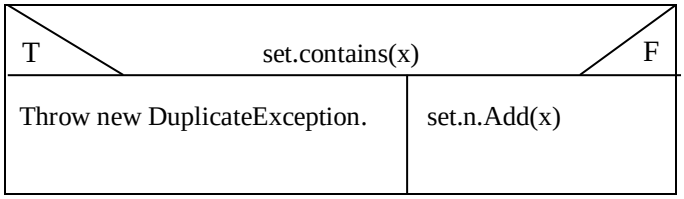
n : ℤ*

Implementation[1]

1. Getting an entry

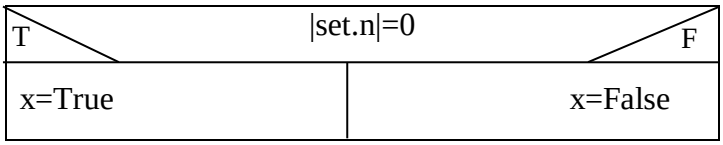
1.insert

Inserting an element (x) to the set. DuplicateException will occur if given element (x) is already in the set.



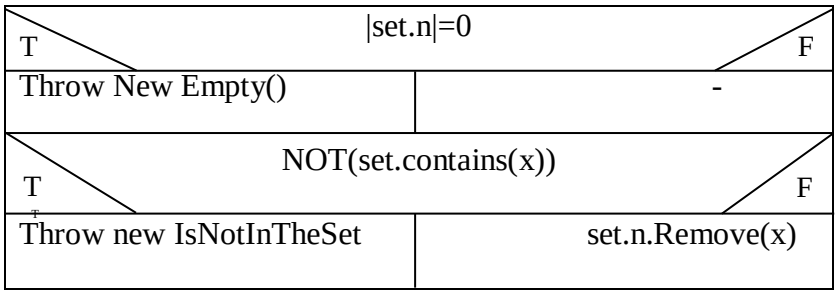
2.isEmpty

Checking if the set is empty.



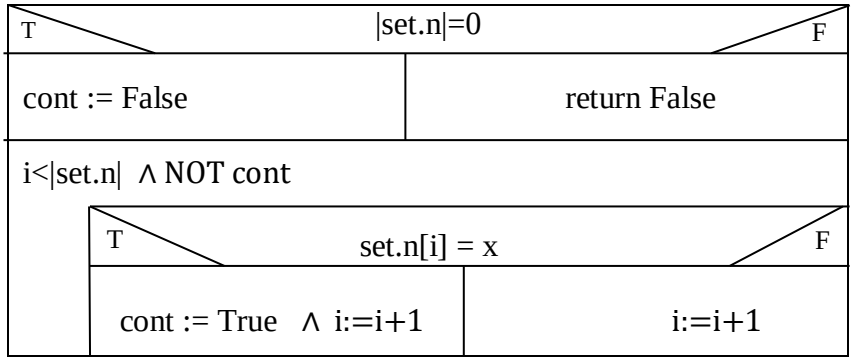
3.remove

Removing given element (x) from the set. Exception Empty will occur if the set is empty and IsNotInTheSet exception will occur if the element (x) is not in the set.



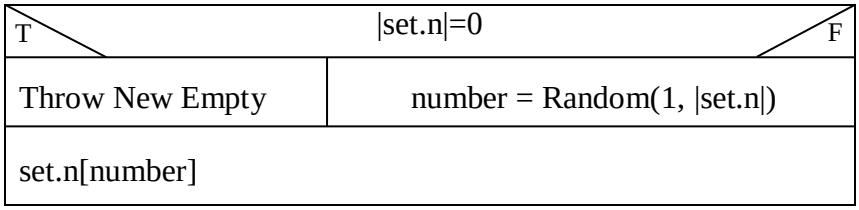
4.contains

Checking if given set contains given element x. If the set is empty, Empty exception will be thrown



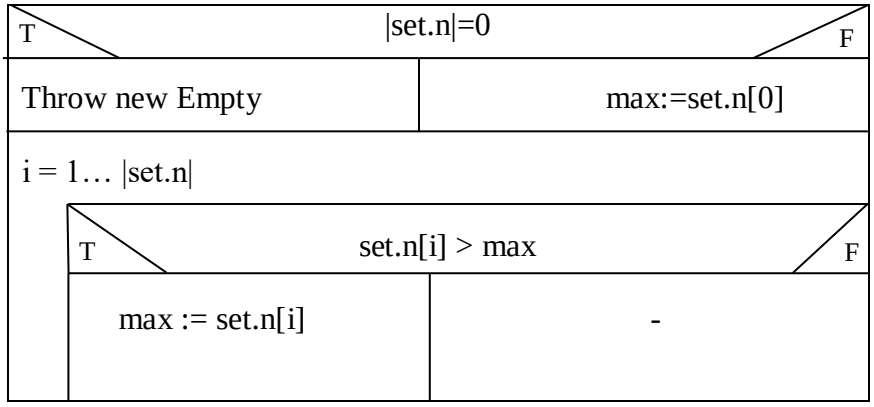
5.random

Getting the random element from the set. Exception Empty occurs if the set is empty.



6.largest

Checks if the set is empty, if so throws Empty exception and gives the max element of the set.



Testing

Testing the operations (black box testing)

1) Testing isEmpty

   a) with an empty set,

   b) a set that contains 1 element,

   c) set that contains 1000 elements, and checking if the set is empty when we remove the elements.

2) Testing insert

   inserting elements 1,2,5 checking if function inserts and updates largest element properly. Inserting more elements 6,7,8,9 and checking if function throws exception when trying to insert a duplicate element. Inserting more elements, total 1000 elements and checking same way.

3) Testing largest

   a) If largest element is in the start

   b) If the largest element is in the middle

   c) If the largest element is the last

4) Testing remove
   a) Removing from empty set
   b) Removing the first element
   c) Removing the middle element
   d) Removing last element
   e) Checking if max updates properly, when it is in the start, middle and last
   f) Getting and setting an entry in the diagonal

5) Testing contains
   a) Checking on the empty set
   b) Checking when set does not contain the element
   c) When element is at the start
   d) When element is at the middle
   e) When element is at the end
   f) Checking same way on the extreme values

6) Testing Random
   a) Checking random on the empty set
   b) When set contains one element
   c) When set contains two elements
   d) When set contains three elements
   e) When set contains 1000 elements