OOP Kohiro Sannomiya: Documentation, 1st Assignment

Teréz A. Várkonyi **1. assignment/5.task** **21th March 2023**

CMDC1H

cmdc1h@inf.elte.hu

Group 4

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 type

Set of values

Set = {a ∈ ℤ* }

Operations

1. Insert

Inserting an element to the set given the element by the user.

Formally:

$$A : (elements : Set, element : \mathbb{Z}, c : \mathbb{N})$$

$$Pre = (elements = elements' \land element = element' \land \neg(element \in elements))$$

$$Post = (Pre \land elements = elements \cup \{element\})$$

This operation is executed only if the current set does not contain the new element given.

2. Remove

Removing an element from the set given the element by the user.

Formally:

$$A : (elements : Set, element : \mathbb{Z})$$

$$Pre = (elements = elements' \land element = element' \land (element \in elements))$$

$$Post = (Pre \land elements = elements \setminus \{element\})$$

This operation is executed only if the current set contains the new element given by the user. If the set is empty, it will return the exception “SetEmpty”.

3. IsEmpty

Checking whether the set is empty or not given the set.

Formally:

$$A : (elements : \text{Set}, l : L)$$

$$Pre = (elements = elements')$$

$$Post = (Pre \land l = (elements \neq \varnothing))$$

This operation returns true if the current set is empty, and false if otherwise.

4. Contains

Checking whether the set contains the element given by the user.

Formally:

$$A : (elements : \text{Set}, element : \mathbb{Z}, l : L)$$

$$Pre = (elements = elements' \land element = element')$$

$$Post = (Pre \land l = (element \in elements))$$

This operation returns true if the current set contains the element given by the user, and false if otherwise. If the set is empty, it will return the exception “SetEmpty”.

5. RandomElement

Returning a random element of the current set, without removing it from the set.

Formally:

$$A : (elements : \text{Set}, num : \mathbb{Z})$$

$$Pre = (elements = elements' \land num = num' \land \neg(elements = \varnothing))$$

$$Post = (Pre \land element \in elements)$$

This operation is executed only if the current set is not empty. If the set is empty, it will return the exception “SetEmpty”.

6. Maximum

Getting the maximum element of the current set.

Formally:

$$A : (elements : \text{Set}, maxElement : \mathbb{Z})$$

$$Pre = (elements = elements' \land maxElement = maxElement' \land \neg(elements = \varnothing))$$

$$Post = (Pre \land \forall i \in elements : i \geq maxElement)$$

This operation is executed only if the current set is not empty. If the set is empty, it will return the exception “SetEmpty”.

Representation

The set can be represented as a sequence of integers : elements: Set

The elements in the set can be represented as element: $\mathbb{Z}$

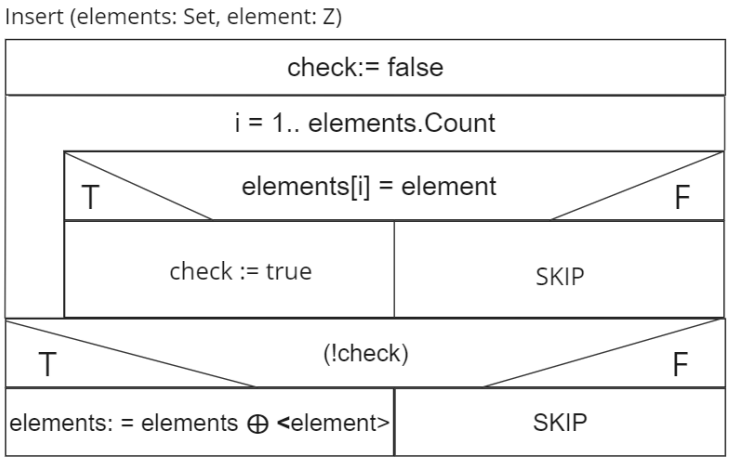
A set can store every element only once.

v = < 1, 3, 10, -4, -4, 6, 8, 12> ——> v = < 1, 3, 10, -4, 6, 8, 12>

Implementation

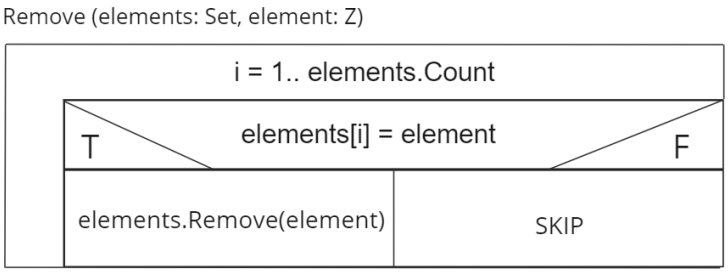
1. ***Insert***

Inserting an integer to the set, given the element from the user. If the set already contains the element given by the user, it will throw an exception.



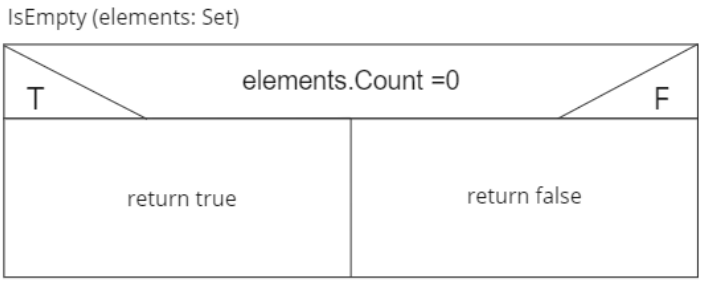
2. ***Remove***

Removing an integer of the set, given the element from the user. If the set is empty, it will throw an exception. If the set is not empty, and the set contains the element, it will successfully remove the integer. However, if the set does not contain the element, it will throw another exception.



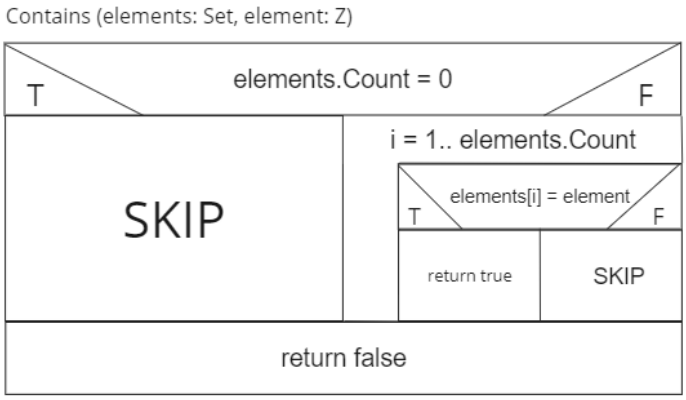
3. ***IsEmpty***

Checking if the current set is empty. If the set is empty, the function returns true, and false if otherwise.



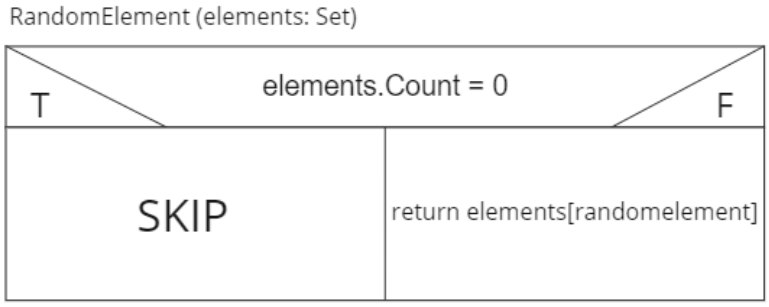
4. ***Contains***

Checking if the current set contains the element given by the user. If the set is empty, it will throw an exception. If the set is not empty, and it contains the element given by the user, it will return true. Otherwise, the function will return false.



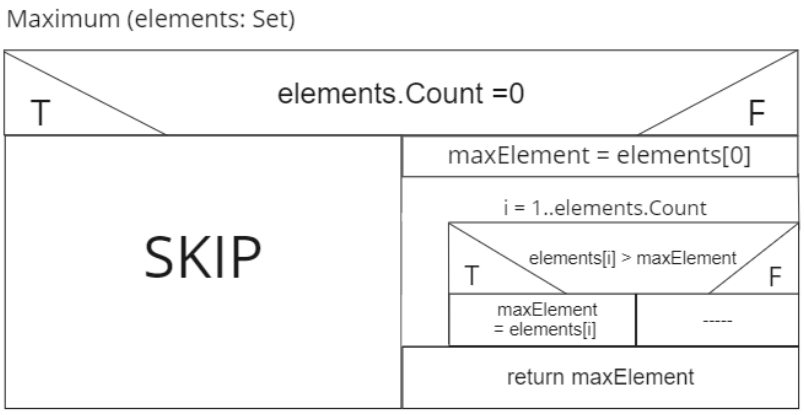
5. ***RandomElement***

Returning a random element of the current set. If the set is empty, it will throw an exception. Otherwise, the function uses the random number generator to return any single integer in the set.



6. ***Maximum***

Returning the maximum/largest number of the current set. If the set is empty, the function will throw an exception. Otherwise, the maxElement is set to the first integer in the array. Afterwards, the for loop is ran, and the integer with the biggest value(maxElement) is returned.



Testing

Testing the operations (black box testing)

1. Inserting an element

   a) Inserting elements into the set.

   b) Inserting 2 of the same elements into the set.

2. Removing an element

   a) Removing an element that exists in the current set.

   b) Removing an element when the set is empty.

   c) Removing an element that does not exist in the current set.

3. Checking whether the current set is empty or not

   a) Testing whether the function returns true when the set is empty.

   b) Inserting elements into the set and testing whether the function returns false or not.

4. Checking whether the set contains an element given by the user

   a) Inserting elements into the set and testing if the exact same elements given by the user is contained in the set and if the function returns true.

b) Testing if the function returns false when the element given by the user is not contained in the set.

c) Testing if the element given by the user is contained in an empty set.

5. Returning a random element from the current set without removing it

   a) Testing if any single and random element of the set is returned after inserting a few elements.

   b) Returning a random element from an empty set.

6. Returning the largest/maximum element from the set

   a) Inserting multiple elements into the set and testing if the function returns the largest element of the set.

   b) Returning the largest element from an empty set.

7. Printing the current set

a) Inserting multiple elements into the set, and checking if all of the elements in the current set are printed.

Testing based on the code (white box testing)

1. Generating exceptions in the class program and catching it in the menu.