Name: Mamatova Bermet **Assignment 1/Task 6**
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Task Description:

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 number of even numbers in the set (suggestion: store the number of even numbers and update it when the set changes), printing the set. A set can store every element only once.

Creating a set type that contains integers.

Set of values

Set = {a $\in \mathbb{Z}$ }

Operations

1. *Inserting an element*
   The method inserts the element inputted by a user to the Set. If the element already contains in the Set, it will not be added.
   Specification: A: (s: Set, n: $\mathbb{Z}$)
   Pre = (s=s', n=n')
   Post = ($s = s' \cup \{n\}$)

2. *Removing an element*

   Removing the element "n" from the set only if it already exists in the set. If the element "n" is not in the set, this operation cannot remove that certain "n" element as it's nonexistent.

   Specification: A: (s: Set, n: $\mathbb{Z}$)
   Pre = (s=s', n=n')
   Post = (n $\in$ s) $\wedge$ s=s' \({n}))

3. *Returning whether the set is empty.*

Checking whether the set is empty and returns true if there is no element in the set. But if there is at least one element in the set, it returns false.

Specification A: (s: Set, l: L)
Pre = (s=s')
Post = (Pre ∧ l= (s ≠ Ø))

4. Returning whether the set contains an element.

Checking whether the set has a certain element and returns true if the element is in the set. But if the element is not in the set, it returns false.

Specification A: (s: Set, n: ℤ, l: L)
Pre = (s=s', n=n')
Post = (Pre ∧ l= (n ∈ s))

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

Returns a random element from the set without removing it from the set or changing the elements of the set.

Specification : A: (s: Set, rand: ℤ)
Pre = (s=s' ∧ s ≠ Ø)
Post = (Pre ∧ (n ∈ s))

6. Returning the number of even numbers that are in the set.

Returning the count of even numbers is possible only if the set is not empty. If the set contains elements, it returns the count of even numbers(evenCnt).

Specification: A: (s: Set,evenCnt: N)
Pre = (s=s' ∧ s ≠ Ø)
Post = (Pre ∧ evenCnt))

7. Printing the elements of the set

Printing out all the elements in the set sequentially while the set is not empty.
Formally: A: (s: Set, n: ℤ*)
Pre = (s=s' ∧ s ≠ Ø)
Post = (Pre ∧ n | n ∈ s)

Representation

The elements which appear only once have to be stored in the set.

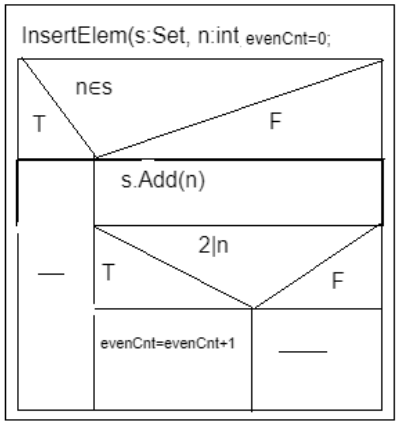
s = < $a1$, $a2$, $a3$, ... an> and

input = <6, 2, 5, 4, 5, -5, 6, 1, 7, -4, 2> ↛ s = < -5, 1, 2, 4, 5, 6, 7>

Implementation

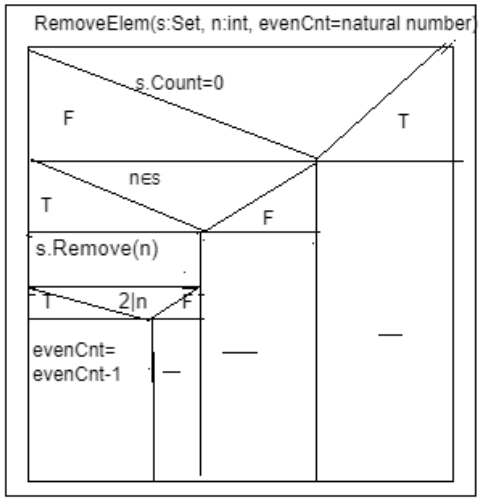
1. Inserting an element

Inserting a new element into the set and checking if the element has already been inserted. The method skips the element if it already exists in the set.

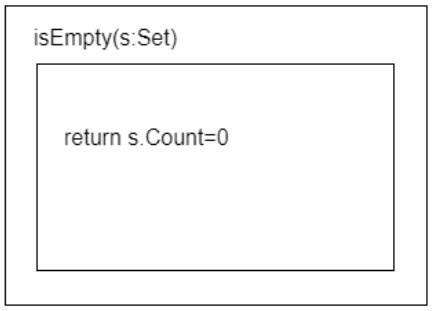


2. Removing an element

Removing the element "m" from the set but only if it's already in the set. If the element is not in the set, the method cannot perform.

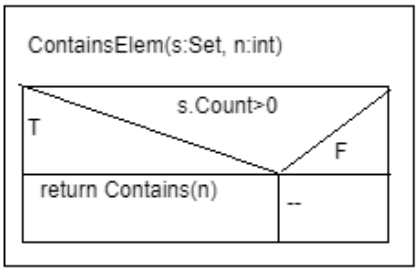


3. Returning whether the set is empty
   The method checks if there is an element in the set. If no, it returns true, if there are one or more elements, the method returns false.

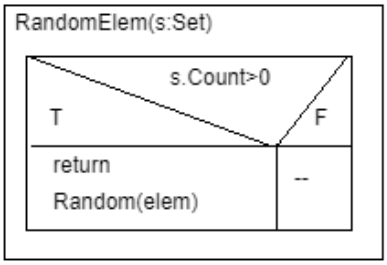


4. Returning whether the set contains an element.

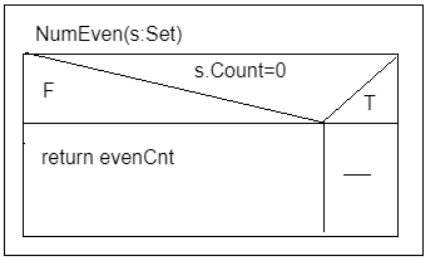
Checks whether the set has a certain element and returns true if the element is in the set. If the element is not in the set, it returns false. The function Contains checks if the set contains the element.



5. Returning a random element without removing it from the set.
   Checking whether the set has a certain element and returns true if the element is in the set. But if the element is not in the set, it returns false.



6. Returning the count of even numbers in the set
   Checking whether the set is not empty. If it is empty, nothing will be printed out. If the set contains one or more elements, it returns evenCnt.



Testing

Testing the operations (Black Box Testing)

1) Inserting an element:
a) Inserting an element twice should throw an exception “TheSetContains”

2) Removing an element:
a) Removing an element from the set which already exists in the set.
b) While removing an element from the set that either does not exist in the set or has been removed before, it gives an exception “ElementDoesNotExist”.
c) Removing an element from the empty set, it should throw the “TheSetDoesNotContain” exception.

3) Returning whether the set is empty:
a) Returning True if there is no element in the set.
b) Returning True after removal of all elements from the set.
c) Returning False when there is at least one element in the set.

4) Returning whether the set contains an element:
a) Returning True if the inserted parameter is in the set.
b) Returning False if the inserted parameter is not in the set.

5) Returning a random element without removing it from the set
a) Returning a random element from the inserted elements and checking if the random element is in the set.

6) Returning the largest element of the set
a) Counts the even numbers in the set and returns the value.
b) Throwing an exception “TheSetIsEmpty” if a user tries to get the count of even numbers from the empty set.

Testing based on the code (White Box Testing)
1. Generating and catching exceptions.