

OOP 1st Assignment - Documentation

KUMAR SARUN

1. assignment/5th task

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IWCYYD

iwcydd@inf.elte.hu

Group 3

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.

Set type

Set of values

$$\text{Set} = \{ a \in \mathbb{Z}^* \mid \forall i, j \in [1..|\text{set}|]: i \neq j \Rightarrow a[i] \neq a[j] \}$$

Type realization: Set is a collection of its element type(Z) of values and it does not contain duplicate values.

Operations

1. Setting an entry

Putting an entry in the set.

Formally: $A: \text{Set} \times \mathbb{Z}$
 $s \quad e$

$$\text{Pre} = (s = s' \wedge e = e' \wedge \forall i \in [1..|s|]: s[i] \neq e)$$

$$\text{Post} = (e = e' \wedge s = s' \cup e)$$

(“ \cup ” is symbol of insert)

This operation needs an integer entry that's not present in the set initially, otherwise it gives an error.

2. Taking out an entry.

Removing an entry from the set.

Formally: $A: \text{Set} \times \mathbb{Z}$
 $s \quad e$

$$Pre = (s=s' \wedge e=e' \vee i \in [1..|s|] : \exists s[i] = e)$$

$$Post = (e=e' \wedge s = s'/e)$$

("/" is symbol of takeout)

It is only possible when the operation gets the entry that already exists in the set, otherwise it gives an error.

3. Checking if set is empty.

Formally: $A: \text{Set} \times \text{Logical(Boolean)}$
 $s \quad l$

$$Pre = (s=s')$$

$$Post = (Pre \wedge l = |s|=0)$$

4. Check if a specific element is in the set

Formally: $A: \text{Set} \times \mathbb{Z} \times \text{Logical(Boolean)}$
 $s \quad e \quad l$

$$Pre = (s=s' \wedge e=e')$$

$$Post = (Pre \wedge l = \exists s[i] = e : i \in [1..|s|])$$

5. Random Element

It returns a random element from the set.

Formally: $A: \text{Set} \times \mathbb{Z}$
 $s \quad e$

$$Pre = (s=s' \wedge |s| > 0)$$

$$Post = (Pre \wedge e = s[i] : i \in [1..|s|])$$

For this operation the set should be greater than zero, otherwise it gives an error.

6. Largest Element

It return the largest element present in the current set.

Formally: $A: Set \times Z$
 $s \quad e$

$$Pre = (s = s' \wedge |s| > 0)$$

$$Post = (Pre \wedge e = s[i]: i \in [1..|s|])$$

Representation

Only the unique values has to be stored.

$$\{a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}\} \leftrightarrow v = \langle a_1 a_2 a_3 a_4 a_5 a_6 a_7 a_8 a_9 a_{10} \rangle$$

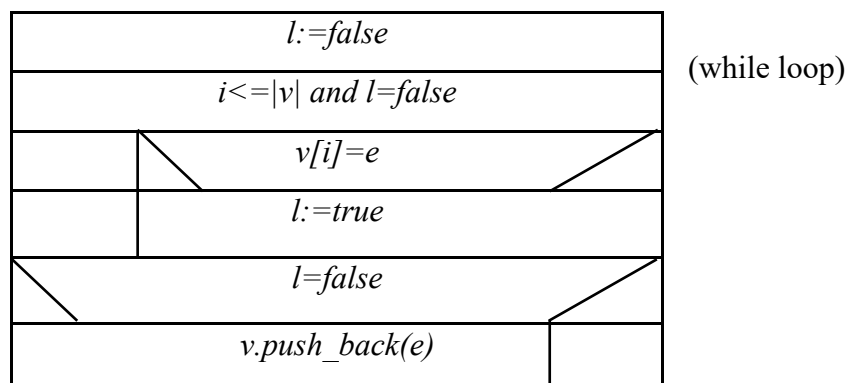
Only a one-dimension array (v) is needed, with the help of which we can store any unique any values.

The total number of elements in the vector will be v^* .

Implementation

1. Setting an entry

Setting the entry 'e' in the set, where the set is represented by 'v' and can be implemented as:-



2. Taking out an entry

Taking out an entry 'e' from the set, where the set is represented by 'v' and can be implemented as:-

$l:=false$		
$i \leq v \text{ and } l=false$		
	$v[i]=e$	
	$v[i]:=v[v]$	
	$l:=true$	
$v.pop_back()$		

(while loop)

3. Checking if set is empty

Checking if the set is empty , where the set is represented by ‘v’ and can be implemented as:-

$l:= v =0$

4. Check if a specific element is in the set

Checking if a specific element is in the set, where the set is represented by ‘v’ and can be implemented as:-

$l:=false$		
$i \leq v \text{ and } l=false$		
	$v[i]=e$	
	$l:=true$	

5. Random Element

Gives a random element is in the set, where the set is represented by ‘v’ and can be implemented as:-

$i := rand(null) * v $
$v[i]$

Here rand is a predefined function in C++ which return random numbers.

6. Largest Element

Gives the largest element in the set, where the set is represented by 'v', largest element is represented with 'e' and can be implemented as:-

$e := v[1]$
$i = 1.. v $
$v[i] > e$
$e := v[i]$

Testing

Testing the operations (black box testing)

- 1) Creating a set using default constructor which contains no element initially. Then checking if the set is empty or not.
- 2) Setting and taking out an entry
 - a) Setting and taking out an entry in the set
 - b) Setting an entry in the set which already exists
 - c) Taking out an entry from the set which does not exist in the set
- 3) Getting elements of set in other vector
 - a) Getting elements from the set and checking the correct indexing before and after using methods
- 4) Checking random element
 - a) Generating random element and then checking of it exists in the set.

- 5) Checking size after setting and taking out entry from the set several times with different conditions.
- 6) Checking if largest element from the result matches correctly in the set

Testing based on the code (white box testing)

- 1) Generating and catching exceptions.