**Lab 3: Sets and Bits Manipulation**

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**Part 1: Basic Bit Operations:**

1. **Problem statement:**

Implement 4 bit operations. Index of position starts from 0 at the least significant bit of the number:

1. Get the bit of a number at certain position (bit at position 1 of number 10 (1010) is 1.
2. Set the bit of a number at certain position -make it 1-, and return the number after changes.
3. Clear the bit of a number at certain position -make it 0-, and return the number after changes.
4. Update the bit of a number at certain position -make 1 or 0 based on the passed Boolean value-, and return the number after changes.
5. **Used data structures:**
6. Int: for the number and position of the bit.
7. Boolean: for the passed “value” in the updateBit() function, that determines whether to set the bit or clear the bit.
8. **Sample runs and different test cases**
9. getBit

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1. getBit

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1. clearBit

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1. A screenshot of a computer program

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1. updateBit

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1. **Assumptions and details:**

There’s a never-ending user-input loop, unless user exits by entering ‘0’.

**Part 2: Sets Operations using Bits Manipulation:**

1. **Problem statement:**

Set data structure that takes in the constructor a **list of strings as a Universe (U)**. The elements in a Set are subset of U. **bits are used to represent the set**. The Set data structure has the following main operations:

1) Add string to a set

2) Union with another set

3) Intersection with another set

4) Complement of a set

5) Difference from another set

6) Cardinality of a set

7) Get elements of a set

8) Get elements of the Universe

9) Is an element in the Universe

1. **Used data structures:**
2. ArrayList:
3. Store the elements of the Universe, as strings.
4. Return a set (in case of printing a set) stored in an ArrayList, as strings.
5. HashMap:
6. Store each set name with its bitwise value, ex: {A:0100} , {B:1011} (binary for visualization only, they are stored ‘int’)
7. Used as a helper to remove repeated elements in a list (Universe)
8. Int:

Indices, store the sets values, etc..

1. String:

Set names, set/universe elements, etc..

1. BitsManipulator (Part 1 Class):
2. For setting bits, in the function addToSet: adds an element to a certain set by setting the bit that corresponds to the index of the element in the Universe to 1.
3. **Sample runs and different test cases:**

First: program sequence before choosing 1 of the 6 operations:

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Last Result: (Output of last operation)

Now: each operation:

1. Union

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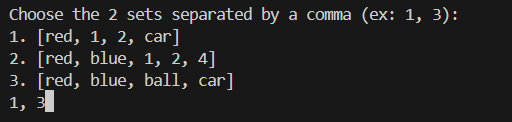
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1. Intersection



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1. Complement

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1. Difference

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1. Cardinality

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1. Print

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1. **Assumptions and details:**

There’s a never-ending user-input loop, unless user exits by entering ‘0’.

The program loop is as follow:

(Each stage only proceeds if correct input is entered)

1. Program asks for user input for the universe
2. Then, asks for the number of subsets (Must be at least 1)
3. Asks for elements of each set
4. Here is the operations loop, it never ends unless user enters 0.

Run Part1.java for Part 1 Problem

Run Part2.java for Part 2 Problem