# Comp151 Lab02

Write **three** independent applications as per descriptions below:

**Project1**

Define a class ArraySetWithResizableArrayBag that represents a set and implements the SetInterface (described in Segment 1.21 of chapter 1). Use the class ResizableArrayBag in your implementation as defined in the UML diagram below: the instance variable setOfEntries is defined as ResizableArrayBag object. Test your class with the test cases provided in main. Load to IDEA only the classes needed for this project from the provided Lab02.zip file. Make sure that the DEFAULT\_CAPACITY in ResizableArrayBag is set to 3.

Most of the methods can be implemented by simply calling appropriate methods from the ResizableArrayBag, for example the clear method would be implemented as:

**public void** clear()  
{  
 **this**.setOfEntries.clear();  
}

NOTE:

1. Ensure that your add method **does not** allow duplicates and checks for null entries.
2. The **third constructor**: **public** ArraySetWithResizableArrayBag(T[] contents) must call **your** add method to populate **this**.setOfEntries with elements from the passed contents array (check for null elements!).

See the UML diagram and the sample run below.

A screenshot of a cell phone

Description automatically generated

### Sample Run:

--> Creating aSet with the secondary constructor - capacity of 8

--> Adding elements from inputData to aSet

The set contains 4 string(s): A B C D

--> Clearing aSet

The set is empty

--> aSet isEmpty returns

true

--> The number of elements in aSet is

0

--> Creating set1 with default constructor

--> set1 initially empty

The set is empty

--> Adding elements to set1

--> set1 after adding elements

The set contains 3 string(s): A B C

--> Adding elements to set1

--> set1 after adding more elements

The set contains 10 string(s): A B C V T U W X Y Z

--> set1 contains "A":

true

--> set1 contains "E":

false

--> Removing "B" from set1

--> After removing "B" from set1:

The set contains 9 string(s): A Z C V T U W X Y

--> Removing random element from set1

--> After removing "Y" from set1:

The set contains 8 string(s): A Z C V T U W X

--> Trying to remove "Q" from set1

--> After trying to remove non-existent element "Q" from set1:

The set contains 8 string(s): A Z C V T U W X

--> Adding 4 elements to set1

--> After adding 4 elements to set1:

The set contains 12 string(s): A Z C V T U W X K L M N

--> Adding 1 element to set1

--> After adding 1 more element to set1:

The set contains 13 string(s): A Z C V T U W X K L M N O

--> Creating set2 with the secondary constructor that takes an array as input

The set contains 4 string(s): A B C D

--> Adding more elements to set2

--> set2 after adding:

The set contains 8 string(s): A B C D E F G H

Trying to add null entry

--> set2 after adding:

The set contains 8 string(s): A B C D E F G H

Process finished with exit code 0

**Project2**

Load to the IDEA the remaining classes from the provided Lab02.zip file. Repeat the previous project inside the ArraySetWithArray class. As shown in the UML diagram below ArraySetWithArray class does not utilize ResizableArrayBag object as its instance variable, it has setOfEntries defined as an array which should be dynamically resized if more room needed (double the size). displaySet method should check if the set is empty and display appropriate message; if the set is not empty should display the number of elements and the capacity, followed by all the elements in the set (see sample run). Test your class with the test cases provided in main. See the sample run below.

**A screenshot of a cell phone

Description automatically generated**

### Sample Run:

--> Creating aSet with the secondary constructor - capacity of 8

--> Adding elements from inputData to aSet

The set contains 4 string(s); capacity is 8

A B C D

--> Clearing aSet

The set is empty; capacity is 8

--> aSet isEmpty returns

true

--> The number of elements in aSet is

0

--> Creating set1 with default constructor

--> set1 initially empty, capacity should be 3:

The set is empty; capacity is 3

--> Adding elements to set1

--> set1 after adding elements, capacity should be 3:

The set contains 3 string(s); capacity is 3

A B C

--> Adding elements to set1

--> Resizing this.setOfEntries from 3 to 6--> Resizing this.setOfEntries from 6 to 12

--> set1 after adding more elements which should have triggered resizing, and the capacity should be 12:

The set contains 10 string(s); capacity is 12

A B C V T U W X Y Z

--> set1 contains "A":

true

--> set1 contains "E":

false

--> Removing "B" from set1

--> After removing "B" from set1:

The set contains 9 string(s); capacity is 12

A Z C V T U W X Y

--> Removing random element from set1

--> After removing "Y" from set1:

The set contains 8 string(s); capacity is 12

A Z C V T U W X

--> Trying to remove "Q" from set1

--> After trying to remove non-existent element "Q" from set1:

The set contains 8 string(s); capacity is 12

A Z C V T U W X

--> Adding 4 elements to set1

--> After adding 4 elements to set1:

The set contains 12 string(s); capacity is 12

A Z C V T U W X K L M N

--> Adding 1 element to set1

--> Resizing this.setOfEntries from 12 to 24--> After adding 1 more element to set1:

The set contains 13 string(s); capacity is 24

A Z C V T U W X K L M N O

--> Creating set2 with the secondary constructor that takes an array as input

The set contains 4 string(s); capacity is 8

A B C D

--> Adding more elements to set2

--> set2 after adding:

The set contains 8 string(s); capacity is 8

A B C D E F G H

Trying to add null entry

--> set2 after adding:

The set contains 8 string(s); capacity is 8

A B C D E F G H

Process finished with exit code 0

**Project3**

Consider a bag as a way to organize data. A grocery bag, for example, contains items in no particular order. Some of them might be duplicate items. The ADT bag, like a grocery bag, is perhaps the simplest of data organizations. It holds objects but does not arrange or organize them further.

The attached BagIterface.java contains java interface that defines all the operations that can be performed on ADT bag. Please note that the interface has been expanded from its definition in Chapter 1; javadoc comments describe operation’s purpose, parameters and return values.

In addition to these basic operations, the following are included:

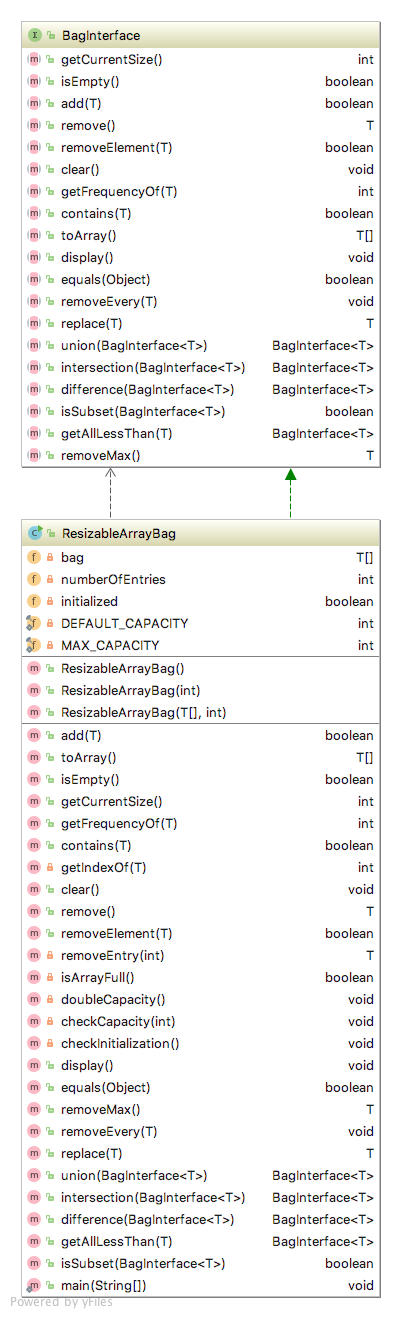
* **union** - combines the contents of two bags into a third bag (see Exercise 5 in Chapter 1)
* **intersection** - creates a third bag of only those items that occur in both two bags (see Exercise 6 in Chapter 1)
* **difference** - creates a third bag of the items that would be left in the given bag after removing those that also occur in another bag (see Exercise 7 in Chapter 1)
* **getAllLessThan** - creates a bag of all the items that are smaller than the given item
* **removeMax** – removes and returns the largest element from the bag
* **isSubset** - returns true if all the elements of the given bag are also included in the other bag
* **equals** - returns true if the contents of two bags are the same. Note that two equal bags contain the same number of entries, each entry occurs in each bag in the same position in the “collection of objects”

### Your Task:

1. The class ResizableArrayBag implements the interface BagInterface where the bag is represented as an array that can expand dynamically as necessary. Make sure that the DEFAULT\_CAPACITY in ResizableArrayBag is set to 25.
2. Analyze provided interface including javadoc comments that describe the purpose of each method, its parameters and return values. UML diagram is also provided for your reference.
3. Analyze the implementation of the methods provided in the ResizableArrayBag class. Note that the main is included in this class as well.
4. Implement the remaining methods that are “stubs” at this moment:
   1. public boolean equals(BagInterface <T> other);
   2. public void removeEvery(T anEntry);
   3. public T replace(T replacement);
   4. public BagInterface <T> union(BagInterface <T> other);
   5. public BagInterface <T> intersection(BagInterface <T> other);
   6. public BagInterface <T> difference(BagInterface <T> other);
   7. public boolean isSubset(BagInterface <T> other);
   8. public BagInterface <T> getAllLessThan(T anEntry);
   9. public T removeMax();
5. Make sure that the output is correct (see Sample Run below).

NOTE: Efficiency of your algorithms will also be graded. Even though your method produces correct results it is possible that some points may be deducted if the code is not efficient.

### UML Diagram:



### Sample Run:

RUNNING TEST CASES

Created bag1:

There are 5 element(s): C A A A X

Created bag2:

The bag is empty

After removing the last element X from bag1, it contains:

There are 4 element(s): C A A A

\*\*\*Testing equals method\*\*\*

Are bag1 and bag2 equal? --> NO

Are bag2 and bag1 equal? --> NO

bag2:

There are 5 element(s): A A A C X

Are bag1 and bag2 equal? --> NO

Removed X from bag2:

There are 4 element(s): A A A C

Are bag1 and bag2 equal now? --> NO

Created bagCopyOfBag1:

There are 4 element(s): C A A A

Are bag1 and bagCopyOfBag1 equal? --> YES

\*\*\*Testing union, intersection, difference, removeMax, getAllLessThan and isSubset methods\*\*\*

bag1:

There are 5 element(s): C A A X A

bag2:

There are 7 element(s): A B B A C C D

\*\*\*Testing union method\*\*\*

The union of bag1 and bag2 is:

There are 12 element(s): C A A X A A B B A C C D

\*\*\*Testing removeMax method\*\*\*

Removed the largest element "X" from the union bag; the current content is:

There are 11 element(s): C A A D A A B B A C C

The bag is empty and removeMax returned null - CORRECT

\*\*\*Testing intersection method\*\*\*

The intersection of bag1 and bag2 is:

There are 3 element(s): C A A

\*\*\*Testing difference method\*\*\*

The difference of bag1 and bag2 is:

There are 2 element(s): A X

The difference of bag2 and bag1 is:

There are 4 element(s): C B B D

\*\*\*Testing getAllLessThan method\*\*\*

The following entries in bag1 are smaller than "Z":

There are 5 element(s): C A A X A

The following entries in bag2 are smaller than "C":

There are 4 element(s): A B B A

\*\*\*Testing isSubset method\*\*\*

Is bag1 a subset of bag1 ? --> YES

Is bag1 a subset of bag2 ? --> NO

Is an empty bag a subset of bag2 ? --> YES

Is bag2 a subset of an empty bag ? --> NO

Created bag3:

There are 3 element(s): A B C

Created bag4:

There are 3 element(s): B C A

Is bag3 a subset of bag4 ? --> YES

Is bag3 a subset of bag4 after adding "Z" to it ? --> YES

Is bag4 a subset of bag3 ? --> NO

Adding "Z" to bag 3 twice

bag3:

There are 5 element(s): A B C Z Z

bag4:

There are 4 element(s): B C A Z

Is bag3 a subset of bag4 ? --> NO

\*\*\*Testing replace method\*\*\*

bag1:

There are 7 element(s): A A B X A C A

Replaced "A" with "X"

Now bag1 contains:

There are 7 element(s): A A B X A C X

\*\*\*Testing removeEvery method\*\*\*

bag1:

There are 7 element(s): A A B X A C X

Removing all "Z"

After removing all "Z" bag1 contains:

There are 7 element(s): A A B X A C X

Removing all "A"

After removing all "A" bag1 contains:

There are 4 element(s): X C B X

Removing all "X"

After removing all "X" bag1 contains:

There are 2 element(s): B C

Process finished with exit code 0