Introductory Java Programming

Queen Mary University of London
School of Electronic Engineering and Computer Science

Course Code: EBU4201

Lab Sheet 4: Arrays and ArrayLists

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1. For this question, you will need to use and modify the file **`Cat.java`** that you wrote in *Lab Sheet 3 – Q1*. You will also need to write a new test class named **`CatTest2`**, to be stored in file **`CatTest2.java`**.

   i) Add a **`toString()`** method in the **`Cat`** class, such that this method provides a **`String`** representation of the **`Cat`** object. This method should return all the **`Cat`** attributes in a **`String`**.

   ii) Write a new test program called **`CatTest2`**, such that it creates an array of **6 `Cat`** objects. Using a **`for`** loop, the test program should loop through the array of **`Cat`** objects and print out the details of each **`Cat`** object[1].

2. Download the file **`RandomArray.java`** from the course area in QMplus; this class does NOT currently compile. You need to fill in the FOUR incomplete methods in that file so it produces similar output to the indicated below, when you run the program on the command line:

```
> java RandomArray 5
9 7 2 1 4
Sum: 23
Mean: 4.6
```

```
> java RandomArray 8
0 9 5 3 5 6 0 8
Sum: 36
Mean: 4.5
```

   i) Complete the code for the constructor **`public RandomArray(int size)`**, such that:
   - it initialises the instance variable called **`array`** to an array of **`int`** values of length **`size`**;
   - each value stored in the array is a randomly generated number[2] between **`0`** and **`9`**.

   ii) Complete the code for the method **`public void printArray()`**, such that it simply prints out the value of each array element.

   iii) Complete the code for the method **`public int calcSum()`**, such that it calculates the sum of all the values in the array and returns their sum.

   iv) Complete the code for the method **`public double calcMean()`**, such that it calculates the mean of all the values in the array and returns their mean (or average)[3].

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[1] **Hint**: If you provide an implementation for the **`toString()`** method in the **`Cat`** class, then you can print out the whole object directly using **`System.out.print()`**.

[2] **Hint**: You can use **`Math.random()*10`** to generate a random number in the range **`0–9`**, but you will need to convert it into an **`int`**. See the API for the **`Math`** class at https://docs.oracle.com/en/java/javase/21/docs/api/java.base/java/lang/Math.html; find the **`random()`** method and then read about it.

[3] **Hint**: Consider the concept of *reusing code*; e.g. you should call the method **`calcSum()`** to get the sum value.

3. For this question, you will need to use and modify the file **`CatTest2.java`** that you wrote using *arrays* in *Q1*. Now you will write a new version of that test class using an **`ArrayList`** and you will store it in a file called **`CatTest3.java`**[4]. This means that you will also need the **`Cat`** class that you have written before.[5] Write code to do the following:

   i) Create **5** **`Cat`** objects; create also an **`ArrayList`** and add the **5** **`Cat`** objects to the list.

   ii) Print out the details of the **`Cat`** object at *index 4*.

   iii) Print out the size (or length) of the **`ArrayList`**.

   iv) Remove the **`Cat`** object at *index 3*.

   v) Using a **`for`** loop, iterate through the **`ArrayList`** and print out the details of the remaining **4** **`Cat`** objects.

4. Download the files **`Student.java`** and **`StudentList.java`** from the course area in QMplus and save both files in the same folder.

   The file **`Student.java`** is a complete file (i.e., it compiles and runs) so you should NOT modify it. This class defines the **`Student`** objects, with FOUR attributes representing: first and last names, email and year of registration. It has an *accessor* (or *getter*) for both **`firstName`** and **`lastName`**. It also has a **`toString()`** method to provide a **`String`** representation of **`Student`** objects.

   You need to modify the **`StudentList.java`** file. The class contained in this file does NOT currently compile. You need to fill in the THREE incomplete methods so that it produces the output as indicated below, when you run the program[6]:

```
>java StudentList
John Smith has been added to the student list
Mary Davis has been added to the student list
your_firstname your_lastname has been added to the student list
--Begin--
Name: John Smith  Email: js@qmul.ac.uk  Year: 2021
Name: Mary Davis  Email: md@qmul.ac.uk  Year: 2022
Name: your_firstname your_lastname  Email: your_email  Year: your_year
--End--
Mary Davis has been removed from the student list
--Begin--
Name: John Smith  Email: js@qmul.ac.uk  Year: 2021
Name: your_firstname your_lastname  Email: your_email  Year: your_year
--End--
```

   i) Complete the code for the method **`public void printList()`**, such that it prints out each **`Student`** in the list.

   ii) Complete the code for the method **`public void addToList(Student stu)`**, such that:
   - the method takes a **`Student`** object from the input parameter and adds the given **`Student`** to the list;
   - the method then prints out a message in the format: "***`FirstName LastName`*** **`has been added to the list`**".

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[4] **Note**: You will also need to rename the class from **`CatTest2`** to **`CatTest3`**.

[5] **Hint**: To help you answer *Q1.ii) – Q1.v)* of this lab sheet, please check the Java API to decide which methods of the **`ArrayList`** to use; see the information at https://docs.oracle.com/en/java/javase/21/docs/api/java.base/java/util/ArrayList.html.

[6] **Note**: The text in ***blue italics*** should be replaced with your own details.

iii) Complete the code for the method **`public void removeFromList(Student stu)`**, such that:

- the method takes a **`Student`** object from the input parameter and removes the given **`Student`** from the list;
- the method then prints out a message in the format: "***`FirstName LastName`*** **`has been removed from the list`**".

iv) Complete the code for the **`main()`** method, such that it also creates object **`stu3`** with your own details.

Ensure that all your programs contain both internal comments and *Javadoc* comments.