University of Dhaka
Dept. of Computer Science and Engineering

CSE-2112: Object Oriented Programming Lab (Spring, 2022)
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Lab 3: Exam 1
Date : February 03, 2022

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Solve all of the following three problems and submit the (1) source files **in unzipped form**, i.e., you need to submit three (03) .java files, not a zipped file, and (2) screenshots of outputs of each program.
Submission time ends at 3.30 PM. Late submissions will be accepted up to 5.00 PM but with a gradual penalty.

A. Write a Java program whose output must be exactly the following:

```
The world is beautiful.
The humans living in this world must also have beautiful hearts.
The humans living in this world must also have beautiful hearts.
The humans living in this world must also have beautiful hearts.
```

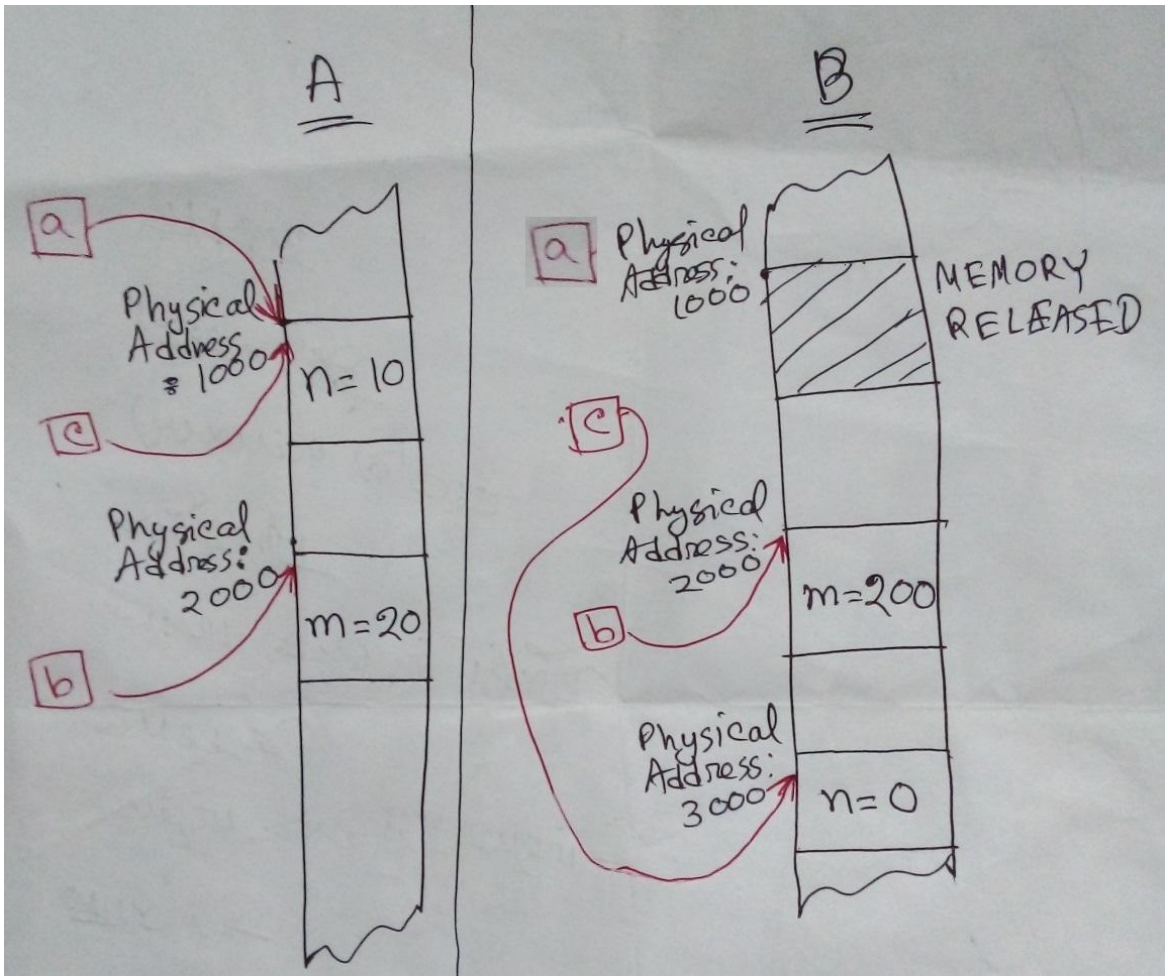
The following restrictions apply to your program:

- **a.** Only one class can be declared.
- **b.** Besides the main method, the class must have at most one user-defined method (including constructor, if required).
- **c.** At most three statements in the main method.
- **d.** No call to any type of built-in “display” method (e.g. System.out.println) in the main method.

B. Create a class named *student* that holds the name and roll number of a student -- both data fields should be declared private. Include appropriate constructor method(s) that sets up both the data. Note that while a student must have a name when he/she is getting admitted, but he/she may not have a roll number immediately when getting admitted -- so you must consider this scenario when devising your constructor method(s). Also include appropriate public methods to change the data and display the data.

- **a.** Create an object inside the main function but change the data inside another method. Check inside the main method (using display method) whether the change is reflected on your object.
- **b.** Create an object inside a method but change the data inside the main function. Check inside the main method (using display method) whether the change is reflected on your object.

C. Write a Java program to implement the following memory images. There are two scenes: A and B. From the image, needless to say that we are talking about physical memory regions of two objects of two separate classes. Imaginary physical addresses of the beginning of the memory regions occupied by the objects are indicated along with the reference variable names (*a*, *b* and *c*). A red arrow from a variable to a memory region indicates a referencing incident. Released memory region is marked by a striped region. The class(es') local variables are: *n* and *m*.



In the main method, you should first write code to implement scene A, followed by your code to implement scene B.

The following restrictions should be maintained by your program:

- **a.** All data fields must be private.
- **b.** At most six statements in the main method.

You may use display methods for your own debugging purpose, but do not forget to remove them or comment them out before submitting your code.

Also, recall that in Java we do not play with physical addresses in our code, rather we always deal with reference variables.