Academic Year	**2022**
Semester	☒ Fall ☐ Winter ☐ Summer
Course Code - Name	CSCI 2010U – Data Structures
Instructor	Dr. Razi Iqbal
Assessment	Exercise 2

Question 1 (Basic)

This exercise tests your knowledge of basic Java operations.

You are required to create a class called `Number` that has an instance variable `number` of type `double`. Your class should also have two parameterized constructors as `Number(int number)` and `Number(double number)`. This class should also have an inner class called `Precision` which has a `double setPrecision()` method that takes in the instance member `number` of the outer class and sets its precision to 2 decimal places and returns it as a `double` value.

`Number` should not have a main method. Create a new class called `Driver` in a `Driver.java` file that contains the `main` method. Create an object of outer class in the main method to provide a double value with 6 decimal places and then call `double setPrecision()` method of the inner class to set the precision to 2 decimal places.

Below is the screenshot of the expected output of this program:

```
PROBLEMS   OUTPUT   TERMINAL   DEBUG CONSOLE

Microsoft Windows [Version 10.0.19042.1083]
(c) Microsoft Corporation. All rights reserved.

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Basic/Number.java

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Basic/Driver.java

C:\Razi\CSCI2010\Exercises>java Exercise_2/Basic/Driver
Original number: 3.1146789
Resultant number: 3.11
```

Try to run the program using commands in terminal to get more practice.

Question 2 (Intermediate)

This exercise tests your knowledge of Inheritance in Java operations.

Write a Java program that creates a class `CarbonFootprint` with only a `getCarbonFootprint()` member function. Have each of your classes below inherit from this class and implement the `getCarbonFootprint()` member function to calculate an appropriate carbon footprint for that class. The program should also contain three small classes `Bicycle`, `Car` and `Building` as below:

- `Bicycle`
  - Overrides the `getCarbonFootprint()`
  - Consider carbonfootprint to be 0.
- `Car`
  - `double gallons`
  - Parameterized constructor that takes `gallons` as a parameter
  - Overrides the `getCarbonFootprint()`
    - Multiply `gallons` with 20 to get carbon footprint
- `Building`
  - `int squareFeet, wood, concrete, steel, glass`
  - Parameterized constructor that takes `squareFeet, wood, concrete, steel, glass` as parameters
  - Overrides the `getCarbonFootprint()`
    - Multiply `squarefeet` with the sum of `wood, concrete, steel, glass` to get carbon footprint

`getCarbonFootprint()` method simply calculates the carbon footprint of each entity in their respective classes and returns `double`. Once classes have been created along with their relationship defined, create an object of each class in the main method defined in Driver.java class and call their respective `getCarbonFootprint()` methods. Below is the expected output:

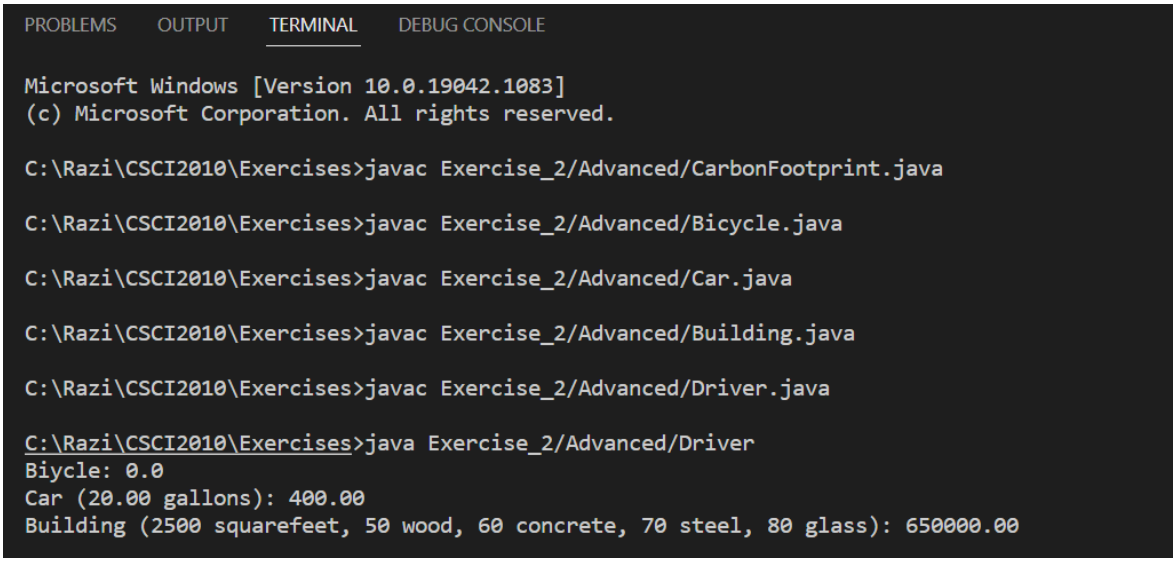
```
PROBLEMS   OUTPUT   TERMINAL   DEBUG CONSOLE

Microsoft Windows [Version 10.0.19042.1083]
(c) Microsoft Corporation. All rights reserved.

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Intermediate/CarbonFootprint.java

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Intermediate/Bicycle.java

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Intermediate/Car.java

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Intermediate/Building.java

C:\Razi\CSCI2010\Exercises>javac Exercise_2/Intermediate/Driver.java

C:\Razi\CSCI2010\Exercises>java Exercise_2/Intermediate/Driver
CarbonFootprint class: 0.0
Biycle: 0.0
Car (60.00 gallons): 1200.00
Building (2500 squarefeet, 50 wood, 60 concrete, 70 steel, 80 glass): 650000.00
```

Try to run the program using commands in terminal to get more practice.

Question 3 (Advanced)

This exercise tests your knowledge of Polymorphism in Java operations.

This is the continuation of the previous question (Question 2). Once classes have been created along with their relationship defined, create an array of `CarbonFootprint` class with a size of 3. In each element of the array store an object of `Bicycle` or `Car` or `Building` respectively. Run a quick for loop to show the output of `getCarbonFootprint()` method. Please note that you are demonstrating Polymorphism here so you are storing each child object in its parent. You might want to look into `getClass()` method of the Object class that can help you differentiate between different objects so that you can show a different output for each object as shown in the screenshot below:



Try to run the program using commands in terminal to get more practice.