# 1.00/1.001

# Introduction to Computers and Engineering Problem Solving

# Spring 2012 - Quiz 2

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| **Name:** | Solutions |
| **MIT Email:** | |
| **TA:** | |
| **Section:** | |

You have 80 minutes to complete this exam. For coding questions, you do not need to include comments, and you should assume that all necessary packages have already been imported. You may only add code inside the boxes. The code written outside the boxes may not be altered in any way. Good luck!

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|---|---|
| **Question 1** | **/ 10** |
| **Question 2** | **/ 10** |
| **Question 3** | **/ 50** |
| **Question 4** | **/ 30** |
| **Total** | **/ 100** |

**Question 1 – True/False (10 points)**

**Circle** all answers that are correct.

1. A concrete class that extends an abstract class must implement all abstract methods.

   **TRUE** **FALSE**

2. A class can extend multiple classes.

   **TRUE** **FALSE**

3. A subclass can access _________ fields of its superclass in the same package.

   **Public** **Protected** **Private** **Package**

4. An abstract class may have

   **Public fields** **Protected fields** **Private fields**

   **Abstract methods** **Concrete methods**

5. A final method may only be declared in an abstract class.

   **TRUE** **FALSE**

## Question 2 - Recursion (10 points)

The greatest common divisor (GCD) is the largest positive integer that divides two numbers without a remainder. You will write a recursive method to find the GCD of two positive integers using Euclid's algorithm.

Euclid's algorithm is:

1. Let p be the larger of two positive integers p and q,
2. Divide p by q. Let integer r be the remainder. If r is zero, then q is the GCD.
3. Else, the GCD of p and q is the GCD of q and r.

```
public static int gcd(int p, int q){



}
```

**Question 3 - Inheritance (50 points)**

In this question, you will model some celestial bodies, including planets and stars.

3.a The `Planet` constructor accepts a `radius`, which should set the corresponding data member. In addition to the constructor, the `Planet` class should have an `abstract` method `calcAtmosphereThickness()` that returns the thickness of the `Planet`'s atmosphere (`double`). Write these two methods in the box below.

```
public abstract class Planet {

     protected double radius;

}/*End of Planet Class*/
```

3.b There are two kinds of planet: `RockyWorld` and `GasGiant`. For modeling purposes, we assume that the atmospheric thickness on a `RockyWorld` is 1% of its planetary `radius` (while on a `GasGiant` it is 80% of its planetary `radius`). Complete the `RockyWorld` class below while inheriting as much as possible from its parent class and implementing any necessary methods.

```
public class RockyWorld extends Planet{

}/*End of RockyWorld Class*/
```

3.c We note that some celestial bodies are gaseous, such as `GasGiant` planets and all stars. You are given the following `Gaseous` interface, which contains a method that determines the `density` of the gaseous material.

```
public interface Gaseous {
     double getDensity();
}
```

Complete the `GasGiant` class below, inheriting as much as possible and implementing any necessary methods. The constructor should take two inputs: the `Planet`'s `radius` and `density`. Recall that the atmospheric thickness is 80% of the radius.

```
public class GasGiant extends Planet implements Gaseous{

     private double density;

}/*End of GasGiant Class*/
```

3.d Complete the `Star` class below, inheriting as much as possible and implementing any additional methods as necessary. The class should have two data members: the `Star`'s `density` and an array of `Planet`s that revolve around the `Star`. The constructor should set these data members from arguments. You should also write a getter method for the array of `Planet`s.

```
public class Star implements Gaseous{
```

```
}/*End of Star Class*/
```

3.e Add code in the `TestUniverse` class to model the following:

- Create three `Planet`s, two `Rocky` and one `Gaseous`:
    - one called `earth` with `radius` = 6400,
    - one called `mars` with `radius` = 3400, and
    - one called `jupiter` with `radius` = 67000 and `density` = 1.3
- Place all of the `Planet`s into an array.
- Create a new `Star` called `sun` that has `density` 1.4 and contains the array of `Planet`s.
- Loop through `sun`'s `Planet`s and print the following to the console:
    - each `Planet’s` atmosphere thickness, and
    - each `Planet’s` `density` if it is `Gaseous`.

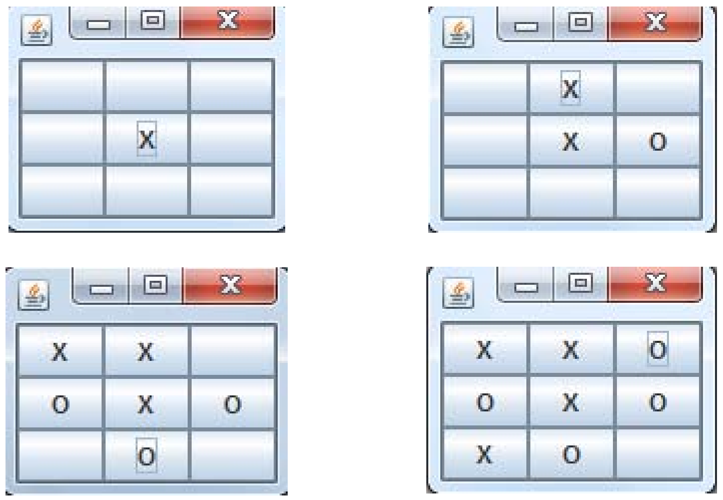
```
public class TestUniverse {

     public static void main(String[] args) {

     }
}/*End of TestUniverse Class*/
```

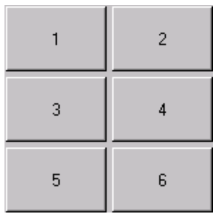
**Question 4 - Swing (30 points)**

In this question you will complete a Java program to play Tic-Tac-Toe. Your design will use the model-view-controller pattern. Snapshots of the program running are as follows:



The board is composed of 9 `JButton`s in a 3 by 3 `GridLayout`. The `GridLayout` lays out a container's components in a rectangular grid. The code snapshot on the left will result in the construction of the layout illustrated on the right.

```
setLayout(new
GridLayout(3,2));
add(new Button("1"));
add(new Button("2"));
add(new Button("3"));
add(new Button("4"));
add(new Button("5"));
add(new Button("6"));
```



Two players alternate taking turns. The first player uses marker “X” and the second player uses marker “O”.

4.a Complete the `Controller` constructor below. The constructor:

- Initializes `cells`, the array of `JButtons`
- Initializes `handle`, the object that will listen for events. The `ClickHandler` constructor takes one argument, the `Controller` object.
- Adds the 9 `JButton`s to the `JFrame`, in a `GridLayout`. All buttons share the same `ActionListener` named `handle`, which you will write in part b.

```
public class Controller extends JFrame{
     private JButton[] cells;    // References to 9 JButtons

     // When count is even, it is the first player’s turn
     // When count is odd, it is the second player’s turn
     private int count;

     // ClickHandler implements ActionListener
     private ClickHandler handle;

     public Controller(){
```

```
     }/* End of Constructor */

     public void addCount(){ count++; }

     public int getCount(){ return count; }

     public static void main(String[] args) { // Code not shown}
} /* End of Controller Class */
```

4.b Implement the method to handle button clicks within `ClickHandler`:

- If a button is already marked when clicked on, the method returns immediately without doing anything.
- Otherwise, a marker is put on the button.
- The first player uses String “X” as a marker and the second player uses String “O” as a marker.
- Use `getCount()` to tell you which player is making a move; remember to use `addCount()` after a valid move.
- There are methods `void setText(String s)` and `String getText()` in class `JButton`
- Last, call `checkWin()` to see if a player has won the game

```
public class ClickHandler implements ActionListener {
     private Controller control;
     public ClickHandler(Controller c){this.control = c;}

     private void checkWin(){
     // Code not shown. It checks if any player has won the game
     // A player has won the game if it has 3 markers in a row,
     // either horizontal, vertical, or diagonal. The method
     // pops up a dialog box if a player wins, e.g., "X wins!"
     }

     public void actionPerformed(ActionEvent e) {
```

```
   }
}/* End of ClickHandler class */
```