1. What are the three types of analysis classes? Draw the UML notation for each of these. Why would you choose these three types rather than just one type? [5 pts]

2. Mention the benefit(s) and disadvantage(s) of using a Composite Pattern. [3pts]

3. Given the following code:
   ```java
   class Memory {...} // Assume a copy constructor is provided for this class.
   class Memory1 extends Memory {...} // Assume a copy constructor is provided.
   class Computer
   {
       private Memory theMemory;
       public Computer(Computer another)
       {
           if (another.theMemory instanceof Memory1)
               theMemory = new Memory1(another.theMemory);
           else
               theMemory = new Memory(another.theMemory);
       }
   }
   ```
   Draw a UML class diagram showing the relationship between these classes [2pts].
4. What principle is being violated in the above code. Explain. [3 pts]

5. How would you solve the problem above[3 pts]? What pattern are you using [2 pts]?
   What principle is being applied in your solution [2 pts]?

6. A class called SystemClock implements the following methods: getTime() returns the number of milliseconds since midnight January 1, 2001. I would like to make this class a singleton. In a language of your choice write the complete class with implementation (for getTime simply return 0 as this is not the focus of the problem on hand). Also show how some one could use an object of the class [5 pts].

Please answer only in the space provided under each question.

If the back side of this page is blank, leave it blank and do not write any thing on back.
7. A class Door belongs to a package/module called AccessItems. Another class Buzzer belongs to a package called Monitors. Door would depend on Buzzer and Buzzer would depend on Door. When door is opened, it activates a Buzzer which monitors the door. If door is not shut within a few seconds, the Buzzer will sound an alarm.

(a) Derive (show how you get these values) the value of I (the Instability value), the value of A (the Abstraction value) and the value of D’ (normalized distance from main sequence = |A + I − 1|) for each package. Plot these values for the two packages on the graph of A vs. I (I on x-axis). What is the average D’ value of the code above [3 pts].

(b) Now, draw a UML diagram showing your redesign. Feel free to add other packages, classes and interfaces/abstract classes, if necessary [4 pts].
(c) Derive the value of I, A and D’ for each package in your design. What is the average D’ value of your code [4 pts]?

(d) Apart from reduced D’ value, is there any benefit to your design? What pattern would come in handy (need to be added more) to get your code working properly [4 pts]?