INSTITUTE OF TECHNOLOGY BLANCHARDSTOWN

BACHELOR OF SCIENCE IN COMPUTING
(Information Technology)

Object Orientation with Design Patterns
CM302

Semester I

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Time of examination here

Instructions to candidates:

1) Section A: Attempt any five parts.
2) Section B: Answer any 3 Questions.

3) All questions carry equal marks.

DO NOT TURN OVER THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Section A

Attempt any 5 parts of this question (5 marks each)

Question 1

a) Describe the difference between **Class Adapters** and **Object Adapters**.

[5 Marks]

b) Graphical representations of design patterns only capture the end product of the design process.
Why?
List and briefly describe **four** essential elements that can be used to describe a design pattern.

[5 Marks]

c) Briefly describe how the **Proxy Design Pattern** works and give three situations where it might be used.

[5 Marks]

d) Describe with the aid of a code sample how you can easily determine that you are dealing with two identical instances of a **Flyweight** class.

[5 Marks]

e) Briefly describe the difference between the **Factory Method Pattern** and the **Abstract Factory Pattern**.

[5 Marks]

f) A common pattern cited in early literature on programming frameworks is the **Model-View-Controller (MVC)** pattern.

Briefly describe the role of the various participants in the **MVC** pattern.

[5 Marks]

g) What is a "Design Pattern"?

What are the advantages of using Design Patterns?

[5 Marks]

(Total Marks 25)

Section B
Candidates should attempt any 3 of the following questions.

Question 2

a) What are **Creational Patterns?**

Name four.

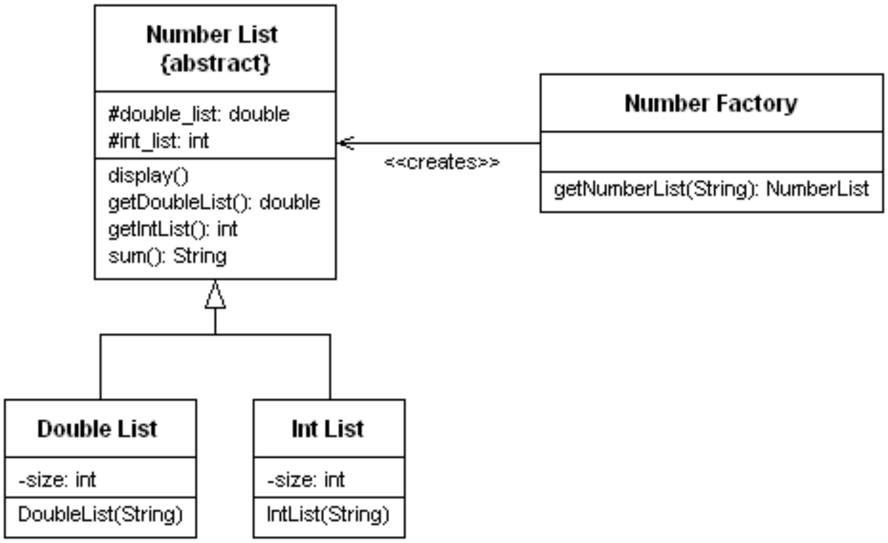
[6 Marks]

b) What is the **Singleton Pattern** and when would you use it?

Write a simple Singleton Class that uses exception handling to force the programmer to deal with the possibility of null pointers.

[8 Marks]

c) The following UML class diagram describes a **Simple Factory Pattern** that is used to create two different kinds of **NumberList** objects based on a value passed to the **getNumberList** method.



Question 2 (Contd.)

Using the following test code as a reference, implement each of the classes shown in the UML class diagram above.

```
String list1 = new String("1 2 3 4 5 6 7 8 9 10");
String list2 = new String("1.1 2.2 3.3 4.4 5.5 6.6
                                    7.7 8.8 9.9 10.1");

NumberFactory nfactory = new NumberFactory();
nfactory.getNumberList(list1).display();

NumberList numberlist2 =
                 nfactory.getNumberList(list2);

numberlist2.display();

System.out.println("Sum of list 2 : " +
                         numberlist2.sum());
```

[11 Marks]

(Total Marks 25)

Question 3

a) The **Chain of Responsibility Pattern** helps to keep separate the knowledge of what each object in a program can do. That is it reduces the coupling between objects so that they can act independently.

Describe four situations where this pattern might be used.

[4 Marks]

b) The program given in **code listing 1 (on next page)** creates a simple user interface that allows the user to select menu items, File|Open and File|Exit, and click on a button labelled Blue that turns the background of the window blue.

As long as there are only a few menu items and buttons this approach works fine, but when there are several menu items and buttons the *actionPerformed* code can get pretty unwieldy.

Using a simple **Command Pattern** re-write the appropriate sections of this program so that the conditional block in the *actionPerformed* code is removed.

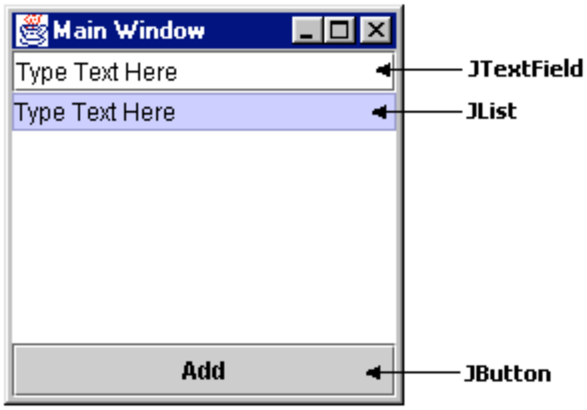
[10 Marks]

c) Write a program that allows the user to add items to a JList control by typing text into a JTextField and clicking on an add button. Your program should take advantage of the Model View Controller (MVC) architecture.

In developing your program you must incorporate the following classes

MainWindow extends JFrame

ListData extends AbstractListModel



d)

[11 Marks]

(Total Marks 25)

Code Listing 1

```
public class SimpleApp extends Frame implements ActionListener
{
  Menu mnuFile;
  MenuItem mnuOpen, mnuExit;
  Button btnBlue;
  Panel p;

  public SimpleApp()
  {
    super("Simple App");

    //Create a new menu bar for the frame
    MenuBar mbar = new MenuBar();
    setMenuBar(mbar);

    // Create the menu items and add them to the bar
    mnuFile = new Menu("File", true);
    mbar.add(mnuFile);
    mnuOpen = new MenuItem("Open...");
    mnuFile.add(mnuOpen);
    mnuExit = new MenuItem("Exit");
    mnuFile.add(mnuExit);

    // Add an actionlistener for each menu item
    // actions will be handled by this class
    mnuOpen.addActionListener(this);
    mnuExit.addActionListener(this);

    // Create a button for the frame
    btnBlue = new Button("Blue");

    // Create a panel and add the button
    p = new Panel();
    add(p);
    p.add(btnBlue);

    // Add an actionlistener for the button
    // actions will be handled by this class
    btnBlue.addActionListener(this);

    setBounds(100,100,200,100);
    setVisible(true);
  }


  // Handle actions from the menu items and button
  public void actionPerformed(ActionEvent e)
  {
    // Determine the source of the action and
    // carry out the appropriate action
    Object obj = e.getSource();
    if(obj == mnuOpen)
      fileOpen();
    if (obj == mnuExit)
      exitClicked();
    if (obj == btnBlue)
      redClicked();
  }

  // Called from actionPerformed when exit selected
  private void exitClicked()
  {
    System.exit(0);
  }
  // Called from actionPerformed when Open selected
  private void fileOpen()
  {
    FileDialog fDlg = new FileDialog(this, "Open a
                    file",FileDialog.LOAD);
    fDlg.show();
  }
  // Called from actionPerformed when button clicked
  private void redClicked()
  {
    p.setBackground(Color.blue);
  }

  static public void main(String argv[])
  {
    new SimpleApp();
  }
}
```

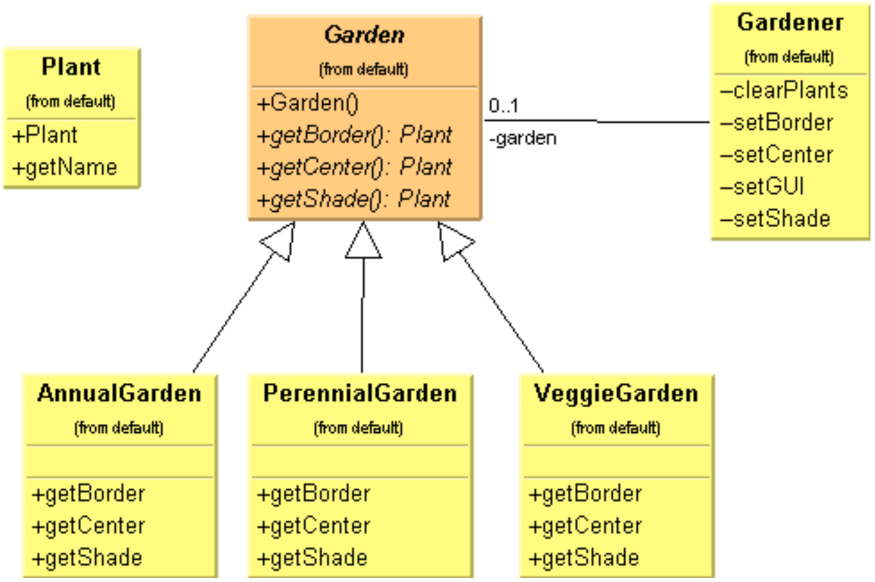
Question 4

a) Define the terms **Observer** and **Subject** with regard to the **Observer Pattern**.

Write an abstract class called **Observer** and an abstract class called **Subject** that could be used to implement the Observer Pattern.

[6 Marks]

b) The following UML class diagram describes a commonly used creational pattern. Name the pattern and describe how each of the classes in the diagram contributes to the patterns implementation.



[8 Marks]

Question 4 (Contd.)

c) The **Iterator Pattern** is one of the simplest and most frequently used of the design patterns.
Java supports the Iterator pattern by providing Enumerations for its Vector and Hashtable classes.

Given a Vector containing a list of names, write a class which implements the Enumeration interface so as to provide a filter that will only iterate through names that begin with some prefix.

So, for example, a test program for the Filter class might look as follows:

```
class MainApp
{
private Vector data;

public MainApp()
{
        data = new Vector();
        data.addElement("Alan");
        data.addElement("Conor");
        data.addElement("Joanne");
        data.addElement("David");
        data.addElement("John");
        data.addElement("Martin");
}

public void filterNames()
{
        Filter filter = new Filter(data.elements(), "Jo");
        while(filter.hasMoreElements())
        {
                String s = (String)filter.nextElement();
                System.out.println(s);
        }
}

public static void main(String[] args)
{
        MainApp app = new MainApp();
        app.filterNames();
}
}
```

[11 Marks]

(Total Marks 25)

Question 5

a) Compare the intent of the **Facade** and **Adapter** design patterns.

[6 Marks]

b) Use an intuitive example to explain the intent of the **Composite** design pattern.

[6 Marks]

c) Examine the classes in **code listing 2 (on next page)**, then answer the following questions:

i) Create a new Decorator class called CrazyDecorator.
The CrazyDecorator class must change a JComponent's background colour to red when the mouse enters the JComponent.
The JComponent's background colour must be reset to it's original colour when the mouse exits the JComponent.

[9 Marks]

ii) Create a simple test program call DecoratorTester which will decorate a JButton with the SlashDecorator **AND** the CrazyDecorator.

[4 Marks

(Total Marks 25)

Code Listing 2
Decorater.java

```
public class Decorator extends JComponent
{
   public Decorator(JComponent c)
   {
      setLayout(new BorderLayout());
      add("Center", c);
   }
}
```

SlashDecorator.java

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.text.*;
import javax.swing.*;
import javax.swing.event.*;
import javax.swing.border.*;

public class SlashDecorator extends Decorator {
   int x1, y1, w1, h1;

   public SlashDecorator(JComponent c) {
      super(c);
   }
   public void setBounds(int x, int y, int w, int h) {
      x1 = x; y1= y;
      w1 = w; h1 = h;
      super.setBounds(x, y, w, h);
   }
   public void paint(Graphics g) {
      super.paint(g);
      g.setColor(Color.red);
      g.drawLine(0, 0, w1, h1);
   }
}
```