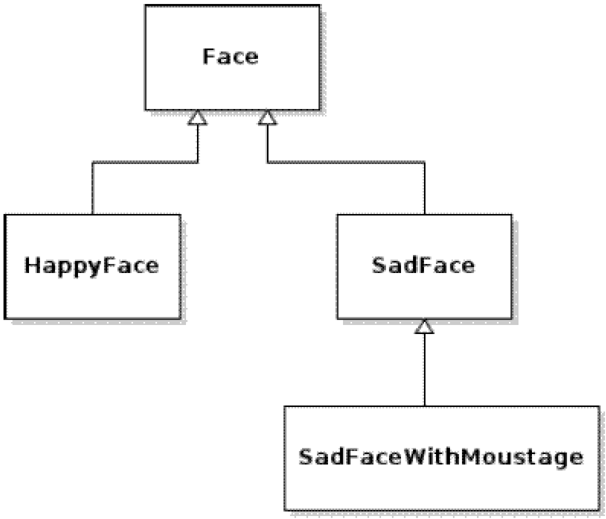
Tutorial 4:

Inheritance: by J.Madar & h.Darbandi

Inheritance, at the most basic level, is a way to extend a class and provide additional functionality. The UML of the classes we are going to developed in this tutorial:



Part A
Download code_tutorial4.zip file; Compile and run it.
Study the Class Face since it has been modified from its first version.
Notes:

1. here we used java.awt.Point2D object. (refer to java.awt.geom.Point2D).
2. Do not change private instance field to public.

Part B
B1) Create class HappyFace that extends Face :

```
public class HappyFace extends Face
{

}
```

Note that the HappyFace has no instance fields.

B2) Create constructor of HappyFace and call the super class constructor:

```
public HappyFace(int x, int y, int radius)
{
     super(x,y,radius);
}
```

B3) Override the draw method:

```
public void draw(Graphics2D graphics)
```

```
      {
      super.draw(graphics);
      // draw happy mouth below:
      }
```

Note that we are simply calling the draw method of the super class.

B4) Draw happy mouth using Arc2D.Double :
get the radius of the super class by calling super class accessor method:

```
      int r = getRadius();
```

note that radius is private in super class, and since we are going to use it many times we store it in a local variable for efficiency purpose.
set the color and width of the month:

```
      graphics.setColor(Color.RED);
      graphics.setStroke(new BasicStroke(r/40));
```

Study Arc2D and create an arc to resemple a smily mouth

```
      double start = 0;
      double extent = -180;
      Arc2D.Double arc = new Arc2D.Double(getX()-r/2, getY()+r/2,
                                        r, r/4,start , extent, Arc2D.OPEN);
```

and finally draw it:

```
      graphics.draw(arc);
```

putting all together it will be:

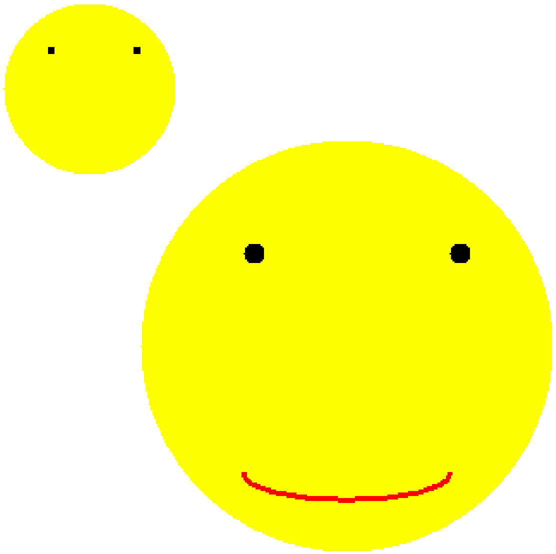
```
      public void draw(Graphics2D graphics)
      {
            int r = getRadius();
            double start = 0;
            ouble extent = -180;

            super.draw(graphics);

            // draw happy mouth below:
            graphics.setColor(Color.RED);
            graphics.setStroke(new BasicStroke(r/40));

            Arc2D.Double arc = new Arc2D.Double(getX()-r/2, getY()+r/2, r,
           r/4,start , extent, Arc2D.OPEN);
            graphics.draw(arc);
      }
```

Now create a HappyFace at coordinates 250, 250 with radius 120 in the paintComponent(Graphics g) method of DisplayComponent class and draw it.

Note that you need to import following classes into your HappyFace first

```
import java.awt.geom.Arc2D;
import java.awt.Graphics2D;
import java.awt.Color;
import java.awt.BasicStroke;
```

The output of your program should be something as shown below:



Part C

Extend class Face and create class SadFace that resembles a sad face.

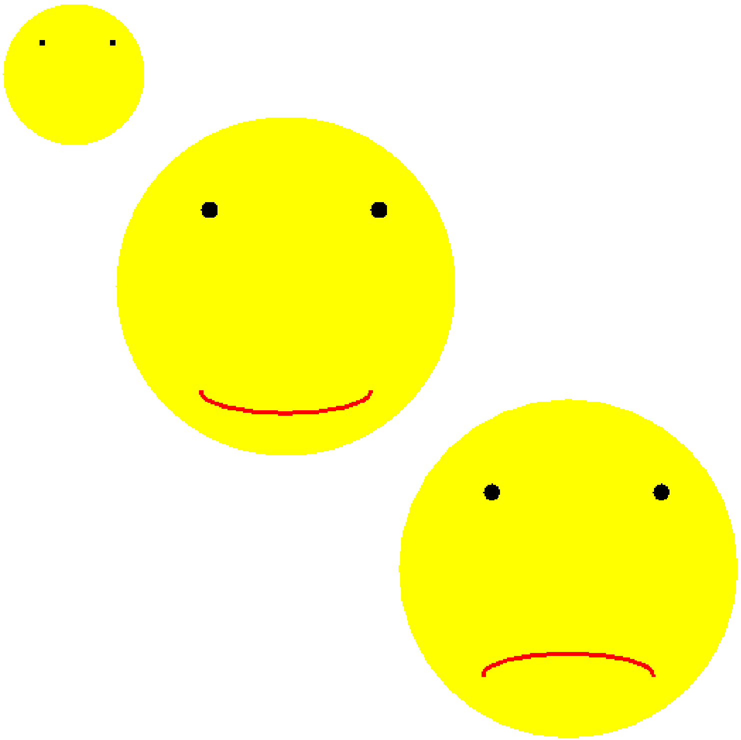
```
public class SadFace extends Face
{
}
```

To create a sad face follow the exact process you have done in creating HappyFace and set

```
double extent = 180;
```

Now create a SadFace at coordinates 450, 450 and radius 120 in the paintComponent(Graphics g) method of DisplayComponent class and draw it.

The output of your program should be something as shown below:



Part D

Extend SadFace and create a new class, SadFaceWithMustache that draws a sad face with a mustache on the screen.

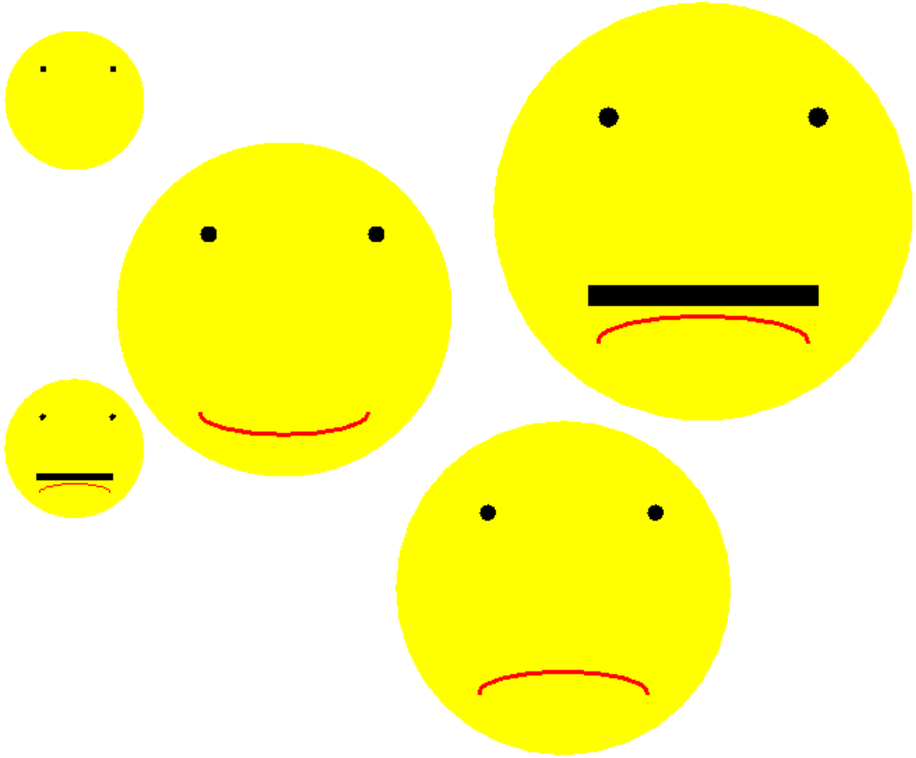
```
public class SadFaceWithMustache extends SadFace
{
}
```

Add constructor, and override the draw method.
Use a horizontal line to resemble a mustache.
Create and draw two SadFaceWIthMustache on the screen with following specifications:

1. one at coordinates 100, 350, and radius 50
2. one at coordinates 550, 180, and radius 150

Important note: in reality we do not extend a SadFace to create a SadFaceWithMustache. Mustache is an object that we simply create and add it to our object. However, for the purpose of this tutorial we are extending the SadFace to learn inheritance.

The output of your program should be something as shown below:



Part E
Zip and upload all source files into your studentId.zip file and upload to tuL4.

Total mark: 6