CMSC 433 – Programming Language Technologies and Paradigms Spring 2007

Flyweight Pattern

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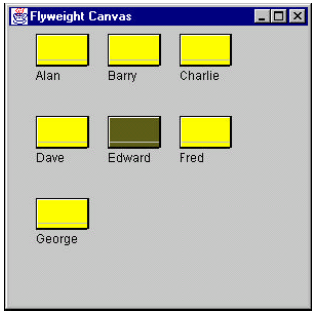
Example

- We want to draw a small folder icon with a name under it for each person in a an organization.
- We want two types of icons, one for "is Selected" and one for "not Selected."
- We can have an icon object for each person, with its own coordinates, name and selected state.
  - Each icon can then draw() itself.
- Lets code it.



Efficiency Issues

- If this is a large organization, there could be a large number of such icons, but they are actually all the same graphical image.
- Even if we have two icons, one for "is Selected" and one for "not Selected" the number of different icons is small.
- In such a system, having an icon object for each person, with its own coordinates, name and selected state is a waste of resources.

A "better" Approach

- Instead, we'll create a FolderFactory that returns either the selected or the unselected folder drawing class, but does not create additional instances once one of each has been created.
- Since this is such a simple case, we just create them both at the outset and then return one or the other.

```
class FolderFactory
{
   Folder unSelected, Selected;
   public FolderFactory()
      {
      Color brown = new Color(0x5f5f1c);
      Selected =  new Folder(brown);
      unSelected = new Folder(Color.yellow);
      }
//--------------------------------
   public Folder getFolder(boolean isSelected)
   {
      if (isSelected)
         return Selected;
      else
         return unSelected;
   }
}
```

More Complex Cases

- For cases where more instances could exist, the factory could keep a table of the ones it had already created and only create new ones if they weren't already in the table.

Flyweight Pattern

- The unique thing about using Flyweights in this example is that we pass the coordinates and the name to be drawn into the folder when we draw it.
- These coordinates are the *extrinsic* data that allow us to share the folder objects, and in this case create only two instances.
  - an instance's *intrinsic* data makes the instance unique, and the *extrinsic* data is passed in as arguments.

The Folder class

- We'll develop a folder class that simply creates a folder instance with one background color or the other and has a public Draw method that draws the folder at the point you specify.


```
class Folder extends JPanel
{
   private Color color;
   final int W = 50, H = 30;
   public Folder(Color c)
   {
      color = c;
   }
//-------------------------------
public void Draw(Graphics g, int tx, int ty, String name)
   {
    g.setColor(Color.black);            //outline
    g.drawRect(tx, ty, W, H);
    g.drawString(name, tx, ty + H+15);  //title

    g.setColor(color);                  //fill rectangle
    g.fillRect(tx+1, ty+1, W-1, H-1);

    g.setColor(Color.lightGray);        //bend line
    g.drawLine(tx+1, ty+H-5, tx+W-1, ty+H-5);

    g.setColor(Color.black);            //shadow lines
    g.drawLine(tx, ty+H+1, tx+W-1, ty+H+1);
    g.drawLine(tx+W+1, ty, tx+W+1, ty+H);

    g.setColor(Color.white);            //highlight lines
    g.drawLine(tx+1, ty+1, tx+W-1, ty+1);
    g.drawLine(tx+1, ty+1, tx+1, ty+H-1);
   }
}
```

The paint() routine

- To use a Flyweight class like this, your main program must calculate the position of each folder as part of its paint routine and then pass the coordinates to the folder instance.
- This is actually rather common, since you need a different layout depending on the window's dimensions, and you would not want to have to keep telling each instance where its new location is going to be.
- Hence, we compute the position dynamically during the paint routine.


```
public void paint(Graphics g)
 {
    Folder f;
    String name;

    int j = 0;      //count number in row
    int row = Top;  //start in upper left
    int x = Left;

    //go through all the names and folders
    for (int i = 0; i< names.size(); i++)
    {
    name = (String)names.elementAt(i);
    if(name.equals(selectedName))
       f = fact.getFolder(true);
    else
       f = fact.getFolder(false);
    //have that folder draw itself at this spot
    f.Draw(g, x, row, name);

    x = x + HSpace;          //change to next posn
    j++;
    if (j >= HCount)         //reset for next row
       {
       j = 0;
       row += VSpace;
       x = Left;
       }
    }
 }
```


Selecting a Folder

- Since we have two folder instances, that we termed selected and unselected, we'd like to be able to select folders by moving the mouse over them.
- In the paint routine, we simply remember the name of the folder which was selected and ask the factory to return a "selected' folder for it.
- We'll now check for mouse motion at the window level and if the mouse is found to be within a Rectangle, we make that corresponding name the selected name.
- This allows us to just check each name when we redraw and create a selected folder instance where it is needed.

Checking Mouse Coordinates

```
public void mouseMoved(MouseEvent e)
 {
 int j = 0;      //count number in row
 int row = Top;  //start in upper left
 int x = Left;

 //go through all the names and folders
 for (int i = 0; i< names.size(); i++)
 {
 //see if this folder contains the mouse
 Rectangle r = new Rectangle(x,row,W,H);
 if (r.contains(e.getX(), e.getY()))
  {
  selectedName=(String)names.elementAt(i);
  repaint();
  }
 x = x + HSpace;          //change to next posn
 j++;
 if (j >= HCount)         //reset for next row
    {
    j = 0;
    row += VSpace;
    x = Left;
    }
 }
```

What is it?

- There are cases in programming where it seems that you need to generate a very large number of small class instances to represent data.
- Sometimes you can greatly reduce the number of different classes that you need to instantiate if you can recognize that the instances are fundamentally the same except for a few parameters.
- If you can move those variables outside the class instance and pass them in as part of a method call, the number of separate instances can be greatly reduced.
- The Flyweight design pattern provides an approach for handling such classes.
- It refers to the instance's *intrinsic* data that makes the instance unique, and the *extrinsic* data which is passed in as arguments.
- The Flyweight is appropriate for small, fine-grained classes like individual characters or icons on the screen.