JavaTecture III

User Interfaces that Vary with Your Data

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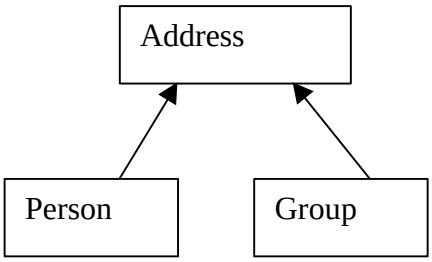
In the last two columns we've begun talking about *Design Patterns,* which are proven object-oriented program design techniques. Last time we discussed the Factory Pattern, a class that returns one of several different subclasses depending on the data it has presented to it. For example, it might return a derived class whose computation method is optimized for a particular subset of your data.

But suppose we don't want just a computing algorithm, but a whole different user interface depending on the data we need to display. A typical example might be your E-mail address book. You probably have both people and groups of people in your address book, and you would expect the display for the address book to change so that the People screen has places for first and last name, company, E-mail address and phone number.

On the other hand if you were displaying a group address page, you'd like to see the name of the Group, its purpose, and a list of members and their E-mail addresses. You click on a person and get one display and on a group and get the other display. Lt's assume that all Email addresses are kept in an object called an Address and that people and groups are derived from this base class as shown in Figure 1:



Depending on which type of Address object we click on, we'd like a somewhat different display of that object's properties. This is a little more than just a Factory pattern because we aren't returning objects which are simple descendents of a base display object, but totally different user interfaces made up of differen combinations of display objects. The Design Pattern that describes this kind of display is called a *Builder Pattern*. It assembles a number of objects, such as display widgets, in various ways depending on the data. And furthermore, Java is one of the few languages where you can cleanly separate the data from the display methods into simple objects. So Java is the ideal language to implement Builder patterns.

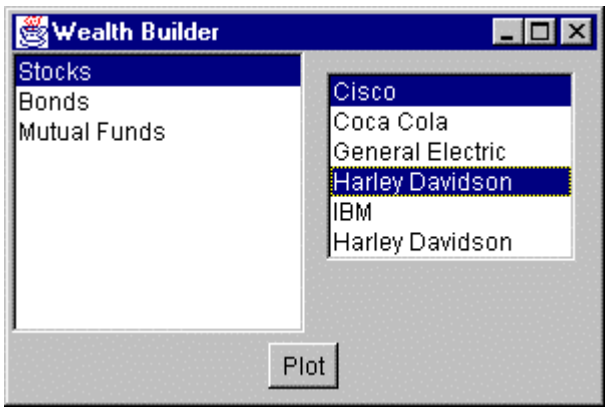
Building Your Wealth

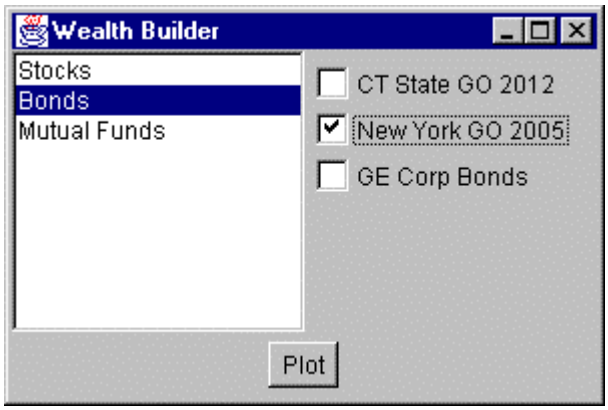
Let's consider a somewhat simpler case where it would be useful to have a class build our UI for us. Suppose we are going to write a program to keep track of the performance of our investments. We might have stocks, bonds and mutual funds, and we'd like to display

a list of our holdings in each category so we can select one or more of the investments and plot their comparative performance.

Now we can't predict in advance how many of each kind of investment we might own at any given time, but we'd like to have a display that is easy to use for either a large number of funds (such as stocks) or a small number of funds, (such as mutual funds). In each case, we want some sort of a multiple-choice display so we can select one or more funds to plot. If there is a large number of funds, we'll use a multi-choice list box and if there are 3 or fewer funds, we'll use a set of check boxes. We want our Builder class to generate an interface which depends on the number of items to be displayed, and yet have the same methods for returning the results.

The display we are going to build is shown in Figures 2 and 3 for a large number of stocks and a small number of bonds, respectively:





Now, let's consider how we can build the interface to carry out this variable display. We'll start with a **multiChoice** abstract class which defines the methods we need to implement:

```
abstract class multiChoice
{
   //This is the abstract base class
   //that the listbox and checkbox choice panels
   //are derived from
```

```
   Vector choices;    //array of labels
//-----------------------------------------
   public multiChoice(Vector choiceList)
   {
     choices = choiceList;    //save list
   }
   //to be implemented in derived classes
 abstract public Panel getUI();          //return a Panel of components
 abstract public String[] getSelected(); //get list of selected items
 abstract public void clearAll();       //clear all the selections
}
```

The **getUI** method returns a Panel container with a multiple choice display. The two displays we're using here -- a checkbox panel or a list box panel -- are derived from this abstract class:

```
class listboxChoice extends multiChoice
```

or

```
class checkBoxChoice extends multiChoice
```

Then we create a simple Factory class which decides which of these two classes to return:

```
class choiceFactory
{
   multiChoice ui;
   //This class returns a Panel containing
   //a set of choices displayed by one of
   //several UI methods.
   public multiChoice getChoiceUI(Vector choices)
   {
      if(choices.size() <=3)
        //return a panel of checkboxes
        ui = new checkBoxChoice(choices);
      else
        //return a multi-select list box panel
        ui = new listboxChoice(choices);
      return ui;
   }
}
```

In the language of the "Gang of Four [1]," this factory class is called the Director, and the actual classes derived from **multiChoice** are each Builders.

Calling the Builders

Since we're going to need one or more builders, we might have called our main class Architect or Contractor, but since we're dealing with lists of investments, we'll just call it WealthBuilder. In this main class, we create the user interface, consisting of a BorderLayout with the center divided into a 1 x 2 GridLayout. The left part contains our list of investment types and the right an empty panel which we'll fill depending on which kind of investments the user selects.

```
public wealthBuilder()
    {
       super("Wealth Builder");     //frame title bar
```

```
        setGUI();                    //set up display
        buildStockLists();           //create stock lists
        choiceFactory cfact;        //the factory
    }
    //---------------------------------
    private void setGUI()
    {
        setLayout(new BorderLayout());
        Panel p = new Panel();
        add("Center", p);
        //center contains left and right panels
        p.setLayout(new GridLayout(1,2));
        stockList= new List(10);              //left is list of stocks
        stockList.addItemListener(this);
        p.add(stockList);
        stockList.add("Stocks");
        stockList.add("Bonds");
        stockList.add("Mutual Funds");
        stockList.addItemListener(this);

        Panel p1 = new Panel();
        p1.setBackground(Color.lightGray);
        add("South", p1);
        Plot = new Button("Plot");
        Plot.setEnabled(false);        //disabled until stock picked
        Plot.addActionListener(this);
        p1.add(Plot);
        //right is empty at first
        choicePanel = new Panel();
        choicePanel.setBackground(Color.lightGray);
        p.add(choicePanel);

        w = new Winder();  //allows WindowClosing to be intercepted
        addWindowListener(w);
        setBounds(100, 100, 300, 200);
        setVisible(true);
    }
```

In this simple example program we keep our three lists of investments in three Vectors called Stocks, Bonds and Mutuals. We load them with arbitrary values as part of program initialization.

```
        Mutuals = new Vector();
        Mutuals.addElement("Fidelity Magellan");
        Mutuals.addElement("T Rowe Price");
        Mutuals.addElement("Vanguard PrimeCap");
        Mutuals.addElement("Lindner Fund");
```

and so forth. In a real system, we'd probably read them in from a file or database. Then, when the user clicks on one of the three investment type names in the left list box, we pass the equivalent vector to our Factory which returns one of the builders:

```
private void stockList_Click()
    {
        Vector v = null;
        int index = stockList.getSelectedIndex();
        choicePanel.removeAll();  //remove previous ui panel
```

```
      //this just switches among 3 different Vectors
      //and passes the one you select to the Builder pattern
      switch(index)
      {
      case 0:
         v = Stocks;  break;
      case 1:
         v = Bonds;   break;
      case 2:
         v = Mutuals;
      }
      mchoice = cfact.getChoiceUI(v);      //get one of the UIs
      choicePanel.add(mchoice.getUI());    //insert in right panel
      choicePanel.validate();              //re-layout and display
      Plot.setEnabled(true);               //allow plots
    }
```

We do save the multiChoice panel the factory creates in the **mchoice** variable so we can pass it to the Plot dialog.

The List box Builder

The simpler of the two builders is the List box builder. It returns a panel containing a list box showing the list of investments.

```
class listboxChoice extends multiChoice
{
   List list;           //investment list goes here
//-----------------------------------------
   public listboxChoice(Vector choices)
   {
      super(choices);
   }
//-----------------------------------------
   public Panel getUI()
   {
      //create a panel containing a list box
      Panel p = new Panel();
      list = new List(choices.size());    //list box
      list.setMultipleMode(true);         //multiple
      p.add(list);
//add investments into list box
      for (int i=0; i< choices.size(); i++)
         list.addItem((String)choices.elementAt(i));
     return p;          //return the panel
  }
```

The other important method is the **getSelected** method which returns a String array of the investments the user selects:

```
public String[] getSelected()
   {
      int count =0;
      //count the selected listbox lines
      for (int i=0; i < list.getItemCount(); i++ )
         {
```

```
         if (list.isIndexSelected(i))
            count++;
         }
      //create a string array big enough for those selected
      String[] slist = new String[count];
      //copy list elements into string array
      int j = 0;
      for (int i=0; i < list.getItemCount(); i++ )
         {
         if (list.isIndexSelected(i))
            slist[j++] = list.getItem(i);
         }
      return(slist);
   }
```

The Checkbox Builder

The Checkbox builder is even simpler. Here we need to find out how many elements are to be displayed and create a horizontal grid of that many divisions. Then we insert a check box in each grid line:

```
public checkBoxChoice(Vector choices)
   {
      super(choices);
      count = 0;
      p = new Panel();
   }
//-----------------------------------------
   public Panel getUI()
   {
      String s;

      //create a grid layout 1 column by n rows
      p.setLayout(new GridLayout(choices.size(), 1));
      //and add labeled check boxes to it
      for (int i=0; i< choices.size(); i++)
         {
         s =(String)choices.elementAt(i);
         p.add(new Checkbox(s));
         count++;
         }
      return p;
   }
```

The **getSelected** method is exactly analogous to the one we showed above, and is included in the example code you can download from this magazine's web site.

Summary

Now that we have our investments under control, we could start fantasizing about viewing a number of real-time displays of our holdings as they change with market movements every few moments. The trouble is, there are so many possible ways of viewing these data that we might want to have a number of plots all displayed at once, each with a different view of the data. And, of course, we'd like all of them to change in real time. The design patterns that implements this wish as well as a number of other related wishes is the Observer Pattern and we'll spend a future column discussing it.

References

1. Gamma, Eric; Helm, Richard; Johnson, Ralph and Vlissides, John, *Design Patterns. Elements of Reusable Software*., Addison-Wesley, Reading, MA, 1995

2. Cooper, J. W., *Principles of Object-Oriented Programming in Java 1.1 Coriolis (Ventana), 1997.*

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