

MODULE 9p - Applets - Trials C

The applet to be developed in this series of trials will exploit the mouse. The first version is a simple modification of AppletB but should be saved in AppletC.java

```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Button;
import java.awt.event.ActionListener;
import java.awt.event.ActionEvent;
import java.awt.event.MouseListener;           // new statement
import java.awt.event.MouseEvent;             // new statement

public class AppletC extends Applet           // new class name
{ private String s = "Greetings";

    private Button jack = new Button("Jack");
    private Button jill = new Button("Jill");

    public void init()
    { this.addMouseListener(new AppML());      // new statement
      this.add(this.jack);
      this.jack.addActionListener(new JackL());
      this.add(this.jill);
      this.jill.addActionListener(new JillL());
    }

    public void paint(Graphics g)
    { g.drawRect(15, 15, 270, 70);
      g.drawString(this.s, 100, 60);
    }

    class AppML implements MouseListener       // new class
    { public void mousePressed(MouseEvent e)
      { AppletC.this.s = "Mouse pressed in applet";
        AppletC.this.repaint();
      }

      public void mouseReleased(MouseEvent e)
      { AppletC.this.s = "Mouse released in applet";
        AppletC.this.repaint();
      }

      public void mouseClicked(MouseEvent e)
      { AppletC.this.s = "Mouse clicked in applet";
        AppletC.this.repaint();
      }

      public void mouseEntered(MouseEvent e)
      { AppletC.this.s = "Mouse entered applet";
        AppletC.this.repaint();
      }
    }
}
```

```

        public void mouseExited(MouseEvent e)
        { AppletC.this.s = "Mouse exited applet";
          AppletC.this.repaint();
        }
    }

    class JackL implements ActionListener
    { public void actionPerformed(ActionEvent e)
      { AppletC.this.s = "Jack pressed";           // new class name
        AppletC.this.repaint();                   // new class name
      }
    }

    class JillL implements ActionListener
    { public void actionPerformed(ActionEvent e)
      { AppletC.this.s = "Jill pressed";           // new class name
        AppletC.this.repaint();                   // new class name
      }
    }
}

```

This program makes use of another method inherited from class Component:

`addMouseListener()` - used for adding an object of type `MouseListener` to the putative listener array.

Like `ActionListener`, `MouseListener` is an interface (not a class) but it specifies that any class which implements the interface must incorporate FIVE methods; these deal with different usages of the mouse.

In this version of `AppletC`, class `AppML` is set up as the `MouseListener` class and `this.addMouseListener(new AppML())` is used to add an instantiation of class `AppML` to the applet's listener array.

NOTES ON THE PROGRAM

To keep the program reasonably short, the `println()` statements have been removed as have the overriding methods `start()` `stop()` and `destroy()`

Java's understanding of a mouse is a little restricted. A mouse is deemed to have only one button (the left-hand button) and this button can be pressed, released or clicked (this last is a press followed by a release without moving the mouse between the two actions). Additionally a mouse can be detected entering or leaving a component (in this case the applet).

Together, these amount to five usages and for each usage there has to be a separate method in any class that implements the `MouseListener` interface.

In the present program each of the five methods simply sets String `s` to an appropriate message explaining which usage has been detected.

Notice that the `MouseListener` has been added to the applet's listener array

and not to either button's listener array.

Any usage of the mouse provokes a `MouseEvent` and an instance of this Java class is handed to the relevant method in the `MouseListener`. Both class `MouseListener` and class `MouseEvent` need to be imported from the package `java.awt.event`

One may note a separate kind of listener, a `MouseMotionListener`, which is used for detecting mouse movement and mouse drag; this will be exploited later.

EXPERIMENTS WITH THE NEW APLET

Compile the program using the `javac` command:

```
$ javac AppletC.java
```

The associated HTML needs to refer to `AppletC.class` so modify the old `AppletB.html` to `AppletC.html` as in:

```
<HTML>
  <BODY>
    <APPLET code="AppletC.class" width=300 height=100>
      Java is not available.
    </APPLET>
  </BODY>
</HTML>
```

Give the following `appletviewer` command:

```
$ appletviewer AppletC.html &
```

When the applet appears, try out the five usages of the mouse:

1. Press the left-hand button in the central area and HOLD IT DOWN.
Mouse pressed in applet should appear.
2. Move the mouse before releasing the left-hand button and...
Mouse released in applet should appear.
3. Repeat (1) and (2) but without moving the mouse at step (2).
Mouse clicked in applet should appear.
4. Move the mouse outside the applet to provoke Mouse exited...
5. Move the mouse back inside the applet to provoke Mouse entered...

The Jack and Jill buttons should work normally.

THE `MouseAdapter` CLASS

Suppose you just want to detect the mouse entering the applet, then you still have to supply all five methods in class AppML even though four of them will have method headings but empty bodies.

As a somewhat strange facility, Java supplies a special class MouseAdapter which implements the MouseListener interface by providing all five methods with empty bodies:

```
class MouseAdapter implements MouseListener
{ public void mousePressed(MouseEvent e) {}
  public void mouseReleased(MouseEvent e) {}
  public void mouseClicked(MouseEvent e) {}
  public void mouseEntered(MouseEvent e) {}
  public void mouseExited(MouseEvent e) {}
}
```

At first sight, class MouseAdapter appears utterly useless! The reason for its existence is solely to save typing headings for methods which have no bodies. Given the availability of class MouseAdapter, you can write a MouseListener, such as AppML, by declaring that AppML extends MouseAdapter and supplying, as overrides, only the methods you want to use.

Such use of class MouseAdapter is exploited in the next version of the program...

A FIRST VARIATION

Modify the source code in AppletC.java so that it appears thus:

```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Button;
import java.awt.event.ActionListener;
import java.awt.event.ActionEvent;
import java.awt.event.MouseAdapter;           // modified statement
import java.awt.event.MouseEvent;

public class AppletC extends Applet
{ private String s = "Greetings";

  private Button jack = new Button("Jack");
  private Button jill = new Button("Jill");

  public void init()
  { this.addMouseListener(new AppML());
    this.add(this.jack);
    this.jack.addActionListener(new JackL());
    this.add(this.jill);
    this.jill.addActionListener(new JillL());
  }
```

```

public void paint(Graphics g)
{ g.drawRect(15, 15, 270, 70);
  g.drawString(this.s, 100, 60);
}

class AppML extends MouseAdapter           // modified class heading
{ public void mouseEntered(MouseEvent e)    // just one method in body
  { AppletC.this.s = "Mouse entered applet";
    AppletC.this.repaint();
  }
}

class JackL implements ActionListener
{ public void actionPerformed(ActionEvent e)
  { AppletC.this.s = "Jack pressed";
    AppletC.this.repaint();
  }
}

class JillL implements ActionListener
{ public void actionPerformed(ActionEvent e)
  { AppletC.this.s = "Jill pressed";
    AppletC.this.repaint();
  }
}
}

```

Compile the program using the javac command:

```
$ javac AppletC.java
```

Run the appletviewer program on this new applet:

```
$ appletviewer AppletC.html &
```

EXPERIMENTS WITH THE NEW APPLET

Unsurprisingly, the new applet has much less functionality than the previous version. When the mouse is moved into the applet the message `Mouse entered applet` appears but this won't now change until one of the Jack or Jill buttons is pressed.

A SECOND VARIATION

Modify the source code in AppletC.java so that it appears thus:

```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Button;
import java.awt.event.ActionListener;
import java.awt.event.ActionEvent;
import java.awt.event.MouseAdapter;
import java.awt.event.MouseEvent;

public class AppletC extends Applet
{ private String s = "Greetings";

    private Button jack = new Button("Jack");
    private Button jill = new Button("Jill");

    public void init()
    { this.addMouseListener(new AppML());

        this.add(this.jack);
        this.jack.addActionListener(new JackL());
        this.jack.addMouseListener(new JackML());

        this.add(this.jill);
        this.jill.addActionListener(new JillL());
    }

    public void paint(Graphics g)
    { g.drawRect(15, 15, 270, 70);
      g.drawString(this.s, 100, 60);
    }

    class AppML extends MouseAdapter
    { public void mouseEntered(MouseEvent e)
      { AppletC.this.s = "Mouse entered applet";
        AppletC.this.repaint();
      }
    }

    class JackL implements ActionListener
    { public void actionPerformed(ActionEvent e)
      { AppletC.this.s = "Jack pressed";
        AppletC.this.repaint();
      }
    }

    class JackML extends MouseAdapter
    { public void mouseEntered(MouseEvent e)
      { AppletC.this.s = "Mouse entered Jack";
        AppletC.this.repaint();
      }
    }
```

```

    }

    class JillL implements ActionListener
    { public void actionPerformed(ActionEvent e)
      { AppletC.this.s = "Jill pressed";
        AppletC.this.repaint();
      }
    }
}

```

The principal modification is that a second MouseListener has been added by the statement:

```

    this.jack.addMouseListener(new JackML());

```

The prefix `this.jack` rather than plain `this` indicates that this MouseListener is added to the Button `jack` rather than to the applet. One can add several listeners to a typical component and, of course, `jack` already has an ActionListener. The new MouseListener is an instantiation of the new class `JackML`.

Compile using `javac` and run the `appletviewer` program again.

Move the mouse from outside the applet to inside and then move it into Button `jack`. The message changes from `Mouse entered Jack` to `Mouse entered Applet`.

A similar MouseListener can be added to Button `jill` and any MouseListener can be used to detect the other forms of mouse usage either by overriding the appropriate methods of `MouseAdapter` or, perhaps, by supplying all five methods explicitly as in the first version of `AppletC`.

A THIRD VARIATION

Modify the source code in `AppletC.java` so that it appears thus:

```

import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Button;
import java.awt.event.ActionListener;
import java.awt.event.ActionEvent;
import java.awt.event.MouseMotionListener;           // new statement
import java.awt.event.MouseMotionAdapter;           // new statement
import java.awt.event.MouseEvent;

public class AppletC extends Applet
{ private String s = "Greetings";

    private Button jack = new Button("Jack");

```

```

public void init()
{ this.addMouseMotionListener(new AppMML());          // modified statement

  this.add(this.jack);
  this.jack.addActionListener(new JackL());
  this.jack.addMouseMotionListener(new JackMML()); // modified statement
}

public void paint(Graphics g)
{ g.drawRect(15, 15, 270, 70);
  g.drawString(this.s, 100, 60);
}

class AppMML implements MouseMotionListener           // modified class
{ public void mouseMoved(MouseEvent e)
  { AppletC.this.s = "Mouse moved in applet";
    AppletC.this.repaint();
  }

  public void mouseDragged(MouseEvent e)
  { AppletC.this.s = "Mouse dragged in applet";
    AppletC.this.repaint();
  }
}

class JackL implements ActionListener
{ public void actionPerformed(ActionEvent e)
  { AppletC.this.s = "Jack pressed";
    AppletC.this.repaint();
  }
}

class JackMML extends MouseMotionAdapter             // modified class
{ public void mouseMoved(MouseEvent e)
  { AppletC.this.s = "Mouse moved in Jack";
    AppletC.this.repaint();
  }
}
}

```

The principal modifications are that a `MouseMotionListener` has been added to the applet by the statement:

```

    this.addMouseMotionListener(new AppMML());

```

and another has been added to Button jack by the statement:

```

    this.jack.addMouseMotionListener(new JackMML());

```

Like `MouseListener`, `MouseMotionListener` is an interface but it specifies only two methods, `mouseMoved()` and `mouseDragged()`, each of which takes a `MouseEvent` argument. The first `MouseMotionListener`, `AppMML`, implements the interface by providing both methods.

Equivalent to class `MouseAdapter` there is class `MouseMotionAdapter` which provides both the required methods. The second `MouseMotionListener`, `JackMML`, extends this class and overrides the `mouseMoved()` method but leaves the `mouseDragged()` method with an empty body as inherited from `MouseMotionAdapter`.

Compile using `javac` and run the `appletviewer` program again.

When the mouse is moved or dragged inside the applet a flickering message appears in the central region. Both moving and dragging are continuous processes and the flicker rate indicates the frequency at which the events are being generated.

When the mouse is moved inside Button jack a flickering message appears in the central region announcing Mouse moved in Jack

A FOURTH VARIATION

Modify the source code in `AppletC.java` so that it appears thus:

```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Polygon; // new statement
import java.awt.event.MouseAdapter;
import java.awt.event.MouseMotionAdapter;
import java.awt.event.MouseEvent;

public class AppletC extends Applet
{ private Polygon poly = null; // new statement

    public void init()
    { this.addMouseListener(new AppML()); // new statement
      this.addMouseMotionListener(new AppMML());
    }

    public void paint(Graphics g) // new paint() method
    { if (this.poly != null)
      { g.drawPolygon(this.poly);
      }
    }

    class AppML extends MouseAdapter // new class
    { public void mousePressed(MouseEvent e)
      { AppletC.this.poly = new Polygon();
        AppletC.this.poly.addPoint(e.getX(), e.getY());
        AppletC.this.repaint();
      }
    }

    class AppMML extends MouseMotionAdapter // new class
    { public void mouseDragged(MouseEvent e)
      { AppletC.this.poly.addPoint(e.getX(), e.getY());
```

```

        AppletC.this.repaint();
    }
}

```

In this final version of AppletC both buttons have been dispensed with and the applet has been equipped with two listeners, a `MouseListener` `AppML` and a `MouseMotionListener` `AppMML`. The `MouseListener` `AppML` extends class `MouseAdapter` and overrides only the `mousePressed()` method. The `MouseMotionListener` `AppMML` extends class `MouseMotionAdapter` and overrides only the `mouseDragged()` method.

The program introduces a new class `Polygon` (which is imported from the `java.awt` package). A variable `poly` of type `Polygon` (potentially) stores a collection of point-pairs and these can be drawn on the central region as a connected set of points by the method `g.drawPolygon()`.

Initially `poly` is null and the central region is blank. As soon as the mouse button is pressed the `mousePressed()` method in `AppML` is invoked. A new `Polygon` is assigned to `poly` and the first point is added by the `addPoint()` method. This takes two arguments representing the coordinates of the point to be added. These points can be extracted from the event argument, `e`, by `e.getX()` and `e.getY()`.

If the button is held down and the mouse dragged around the central region the `mouseDragged()` method in `AppMML` is invoked; this happens at frequent intervals during dragging. At each activation a new point is added to `poly` and the call of `repaint()` ensures that the latest version of the polygon appears in the central region.

When the button is released, the latest polygon can be admired without any distracting flicker.

When the button is pressed again, the `mousePressed()` method in `AppML` is invoked again and assigns a new `Polygon` to `poly`. The old version becomes garbage and its image is cleared away at the call of `repaint()` in the `mousePressed()` method.

Compile using `javac` and run the `appletviewer` program again.

Observe the effect of pressing the mouse button and dragging the mouse around. Notice what happens if the mouse is dragged outside the applet and then back inside again. Check what happens when the button is released and then pressed again.