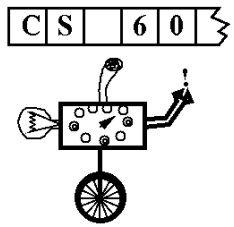


Introduction to Java Graphics

October 5, 2001

Java Graphics

- Two main Graphics libraries:
  - java.awt (Abstract Window Toolkit)
    - older
    - major versions:
      - 1.0: Old original, accepted by most web browsers
      - 1.1: Accepted by Internet Explorer, but not yet entirely by Netscape
  - java.swing
    - newer
    - more portable (less sensitive to window system)
    - might not be supported on your browser, without plugins

We will use 1.0 awt

- relatively simple to use
- works on most browsers
- will generate a “deprecation” warning when compiling with Java 1.2:
  Usually this can be ignored.
- 1.1 graphics avoids the warnings, but will *not* run on all browsers

Step 1

- To do graphics we need somewhere to put the output
  - To create a new window, could create a specialized instance of class `java.awt.Frame`.
    - i.e., we must define a subclass of `Frame` with methods that display what we want to see.
  - To run inside a web browser, our code will be a specialized instance of class `java.applet.Applet`.
    - i.e., we must define a subclass of `Applet` with methods that display what we want to see.

Step 2

- We then need the "canvas" to draw on
  - This is represented in Java by an object of class `java.awt.Graphics`.
    - We create our drawing by invoking methods of the `Graphics` object.
  - `Frame` and `Applet` have a `getGraphics()` method that can be used to get the corresponding `Graphics` object.
    - Graphics objects can be connected to more than just displayed items: offscreen image buffers, printers, etc.

Desired Result

examples\java\Frame\MyApplet1.html

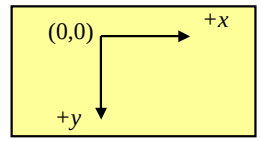
MyApplet1

```
import java.applet.*;
import java.awt.*;

public class MyApplet1 extends Applet {

// init is called from outside to initialize the Applet
//    Roughly equivalent to main (which applets
//    don't have)

public void init()
  {
  setup("My Frame", 50, 50); // Do all the work in
                             // another method
  }
```

```
// setup frame with title and position

void setup(String title, int x, int y)
  {
  setBackground(Color.white);  // set the bg color

  reshape(x, y, 500, 400);     // set location and size

  setVisible(true);            // show the frame
  }
```

```
// paint(Graphics) will be called by the system to
//   paint the applet when necessary, e.g. when
//   setVisible(true) is called.  This call is done
//   implicitly; we do not see it in the source.
//   It is also called when the window is opened or
//   moved. The Graphics of the applet is given as an
//   argument.

public void paint(Graphics g)
  {
  drawStuff(g);  // Do all the work in another method
  }
}
```

```
void drawStuff(Graphics g)
{
  g.setColor(Color.black);        // set drawing color
  g.drawRect(50, 50, 400, 300);   // draw a rectangle
  g.fillOval(100, 100, 300, 200); // fill an oval

  g.setFont(new Font("Times", Font.BOLD, 20));
  g.setColor(Color.yellow);
  g.drawString("Harvey Mudd College", 120, 210);
}
```



Typical awt Drawing Methods

- **void drawLine(int x1, int y1, int x2, int y2)**
- **void drawRect(int x, int y, int width, int height)**
- **void drawOval(int x, int y, int width, int height)**
- **void drawPolygon(int[] xPoints, int[] yPoints, int nPoints)**
- **void drawArc(int x, int y, int width, int height, int startAngle, int arcAngle)**
- **void drawString(String str, int x, int y)**
- **void drawImage(Image img, int x, int y, Color bgcolor, ImageObserver observer)**

- **(Blue bullets also have fill instead of draw.)**

http://java.sun.com/j2se/1.3/docs/api/java/awt/Graphics.html

`paint()` method

some **event** occurs, such as setting Frame visible, or `repaint()` called

The **`update()`** method can be over-ridden.

`update()` is called on Graphics of Frame or Applet, resulting in:

(1) Drawing area cleared with background color

(2) `paint()` is called

whatever is drawn by `paint` is displayed

Flicker Prevention 1

- Clearing the background in **`update()`** can create lots of **flicker** in the application.
- It is customary to **override** `update()` in the customized frame:

```
public void update(Graphics g)
  {
  paint(g);
  }
```

- Object-oriented languages specialize in this kind of overriding.

Flicker Prevention 2

- Instead of painting the background, then drawing on it, it is better to paint the complete image and then display it only when done.
- This image is known as an o**ff-screen buffer**.
- The buffer is drawn on prior to `update()`.

Applet without Flicker

```
public class MyApplet2 extends Applet {
public void init()
  {
  buffer = createImage(getWidth(), getHeight());
  graphics = buffer.getGraphics();
  drawStuff(graphics); // initialize the buffer!
  }
...
public void update(Graphics g)
  {
  paint(g);
  }
```

No Flicker 2: off-screen buffer

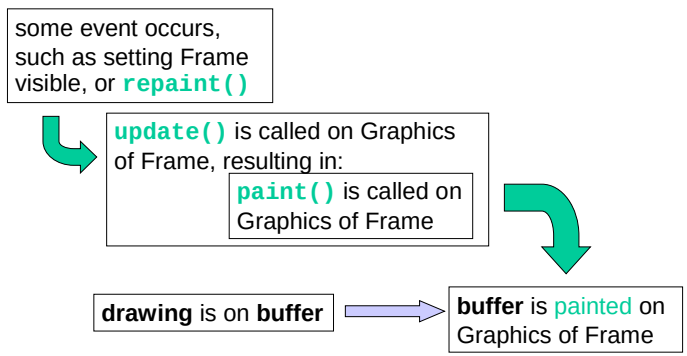
No Flicker 1: over-ride update()

```
public void paint(Graphics g)
  {
  g.drawImage(buffer, 0, 0, null);
  }
}
// ...other code as before
```

Alternate Organization

```
Image buffer;

public void paint(Graphics g)
  {
  // Create buffer on demand
  if( buffer == null )
    buffer = createImage(getWidth(), getHeight());

  // overwrite existing buffer contents
  drawStuff(buffer.getGraphics());

  // write the buffer to the screen
  g.drawImage(buffer, 0, 0, null);
  }
```

Flicker Prevention Summary



`repaint()`

- When the programmer wants to force repainting he/she calls
  `repaint()`
- This causes the system to schedule a call to **`update()`**.
- **`repaint()`** has no arguments.
- The programmer normally does not call **`paint()`** directly, outside of **`update()`**.

Applets

- "Applet" means "small application"
- Compiled with `javac`, but cannot run with `java`
  - No **`main()`**; instead: **`init()`**, **`run()`**.
- Run in one of two ways:
  - In a web browser
  - Using a program `appletviewer`

Viewing Applets on the Web or using appletviewer

contents of MyApplet1.html:

```
<html>
<title>MyApplet1</title>
<head>
<!-- MyApplet1 applet-->
</head>
<body>

<applet code=MyApplet1.class
        width=500 height=400></applet>

</body>
</html>
```

run by:

```
appletviewer MyApplet1.html
```

`.html`, not `.class`

Web Applet Restrictions

- Can't load files on server or client
- Can only load content of URL's, and then only from the same server that contains the applet code

Examples

- appletGraphics examples on our web pages
  - and others
- Look for "Examples" on the main course page