Introduction to Java Applets

Outline

3.1 Introduction

- Applet
  - Program that runs in
    - **`appletviewer`** (test utility for applets)
    - Web browser (IE, Communicator)
  - Executes when HTML (Hypertext Markup Language) document containing applet is opened
  - *Applications* run in command windows
- Notes
  - Mimic several features of Chapter 2 to reinforce them
  - Focus on fundamental programming concepts first
    - Some specific details will not be explained
    - Explanations will come later

3.2 Thinking About Objects

- Java is an object-oriented language
  - However, Java has constructs from structured programming
  - In first seven chapters, focus on "conventional" parts of Java
  - Introduce object-oriented concepts as we encounter them
- Object orientation
  - Natural way to think about world and writing computer programs
    - Object-oriented programming models the real world
  - Attributes - properties of objects
    - Size, shape, color, weight, etc.
  - Behaviors - actions that objects can perform
    - A ball rolls, bounces, inflates and deflates

3.2 Thinking About Objects

- Object orientation (continued)
  - Inheritance
    - New classes of objects absorb characteristics of existing classes
  - Information hiding
    - Objects usually do not know how other objects are implemented
    - We can drive cars without knowing how every part works internally
- Abstraction
  - View the big picture
    - See a photograph rather than a group of colored dots
    - Think in terms of houses, not bricks

3.2 Thinking About Objects

- Class - unit of Java programming
  - Java focuses on nouns rather than verbs
    - C focuses on verbs and is action oriented
  - "blueprint" of the objects
    - Objects are created from the class
    - Built-in types (like **`int`**s) are variables
    - User-defined types are objects
  - Contain methods
    - Implement behaviors
  - Contain data
    - Implement attributes
  - Classes are reusable
    - Create standardized, interchangeable parts

3.3 Sample Applets from the Java 2 Software Development Kit

- Sample Applets
  - Provided in Java 2 Software Development Kit (J2SDK)
  - Source code included (**`.java`** files)
    - Can study and mimic source code to learn new features
    - Remember, all programmers begin by mimicking existing programs
  - Located in **`demo`** directory of J2SDK install
  - Can download demos and J2SDK from
    `http://java.sun.com/products/jdk/1.2/`

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3.3.1 The TicTacToe Applet

- Running applets
  - In command prompt, change to subdirectory of applet

    `cd c:\jdk1.2.1\demo\applets`

    `cd appletDirectoryName`
  - There will be an HTML file used to execute applet
  - Type **`appletviewer example1.html`**
    - **`appletviewer`** loads the html file specified as its command-line argument
    - From the HTML file, determines which applet to load (more section 3.4)
  - Applet will run, **Reload** and **Quit** commands under **Applet** menu

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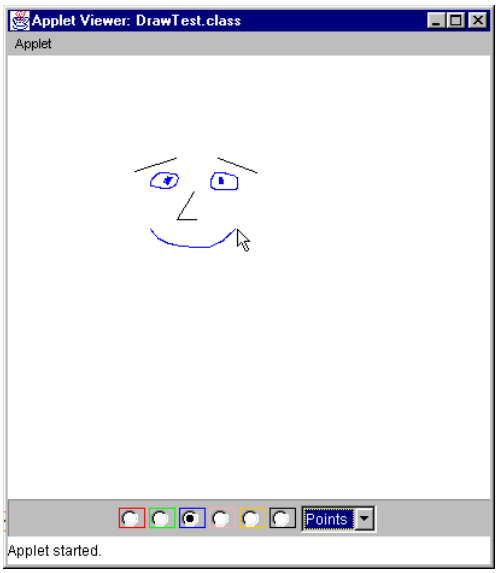
3.3.2 The DrawTest Applet



3.4 A Simple Java Applet: Drawing a String

- Now, create applets of our own
  - Take a while before we can write applets like in the demos
  - Will cover many of same techniques
- Upcoming program
  - Create an applet to display
    "Welcome to Java Programming!"
  - Show applet and HTML file, then discuss them line by line

Outline

Java applet

```
1  // Fig. 3.6: WelcomeApplet.java
2  // A first applet in Java
3  import javax.swing.JApplet;  // import class JApplet
4  import java.awt.Graphics;    // import class Graphics
5
6  public class WelcomeApplet extends JApplet {
7     public void paint( Graphics g )
8     {
9        g.drawString( "Welcome to Java Programming!", 25, 25 );
10    }
11 }
```

HTML file

```
1  <html>
2  <applet code="WelcomeApplet.class" width=300 height=30>
3  </applet>
4  </html>
```

Program Output

3.4 A Simple Java Applet: Drawing a String

```
1 // Fig. 3.6: WelcomeApplet.java
2 // A first applet in Java
```

– Lines that begin with **//** are comments
  • Gives name of source code and brief description of applet

```
3 import javax.swing.JApplet;  // import class JApplet
4 import java.awt.Graphics;    // import class Graphics
```

– As stated in Chapter 2, Java has predefined classes grouped into packages
  • **import** statements tell compiler where to locate classes used
  • When you create applets, **import** the **JApplet** class (package **javax.swing**)
  • **import** the **Graphics** class (package **java.awt**) to draw graphics
    – Can draw lines, rectangles ovals, strings of characters
  • **import** specifies directory structure

3.4 A Simple Java Applet: Drawing a String

– Applets have at least once class definition (like applications)
  • Rarely create classes from scratch
    – Use pieces of existing class definitions
  • Java uses inheritance to create new classes from old ones

```
6 public class WelcomeApplet extends JApplet {
```

– Begins **class** definition for class **WelcomeApplet**
  • Keyword **class** then class name
– **extends** followed by class name
  • Indicates the class to inherit from (**JApplet**)
    – **JApplet** : superclass (base class)
    – **WelcomeApplet** : subclass (derived class)
  • **WelcomeApplet** now has methods and data of **JApplet**

3.4 A Simple Java Applet: Drawing a String

```
6 public class WelcomeApplet extends JApplet {
```

- Someone else has defined "what it means to be an applet"
  - Class **JApplet** is defined for us
  - Applets require over 200 methods!
  - **extends JApplet** allows us to inherit methods
    - Do not have to define them all
  - Do not need to know every detail of class **JApplet**
- Class **WelcomeApplet** is a blueprint
  - Creates (instantiates) an object for use by program
  - **appletviewer** or browser creates an object of class **WelcomeApplet**
    - Keyword **public** required
    - File can only have one **public** class
    - **public** class name must be file name

3.4 A Simple Java Applet: Drawing a String

```
7    public void paint( Graphics g )
```

- Our class inherits method **paint** from **JApplet**
  - By default, **paint** has an empty body
  - We override (redefine) **paint** in our class
- Methods **paint**, **init**, and **start**
  - Guaranteed to be called automatically for us
  - Our applet gets a "free" version of these by inheriting from **JApplet**
    - Free versions have an empty body (do nothing)
    - Every applet does not need all three - override only the ones you need

3.4 A Simple Java Applet: Drawing a String

```
7    public void paint( Graphics g )
```

- Method **paint**
  - Draws graphics on screen
  - **void** means **paint** returns nothing when it finishes its task
  - Parenthesis define parameter list - where methods receive data to perform tasks
    - Normally, data passed by programmer, as in **JOptionPane.showMessageDialog**
  - **paint** gets parameters automatically
    - **Graphics** object used by **paint**
  - Mimic **paint**'s first line

3.4 A Simple Java Applet: Drawing a String

```
8    {
9       g.drawString( "Welcome to Java Programming!", 25, 25 );
10   }
```

- Body of **paint**
  - Method **drawString** (of class **Graphics**)
  - Called using **Graphics** object **g** and dot operator (**.**)
  - Method name followed by parenthesis containing argument list
    - First argument: **String** to draw
    - Second: x coordinate of location to draw at (in pixels)
    - Third: y coordinate of location to draw at (in pixels)
- Java coordinate system
  - Measured in pixels (picture elements)
  - Upper left is (**0**,**0**)

3.4 A Simple Java Applet: Drawing a String

- Line 11: Right brace to end class **`WelcomeApplet`**

- Running the applet
  - Compile
    - **`javac WelcomeApplet.java`**
    - If no errors, bytecodes stored in **`WelcomeApplet.class`**
  - We must create an HTML file
    - Loads the applet into **`appletviewer`** or a browser
    - Ends in **`.htm`** or **`.html`**
  - To execute an applet
    - Create an HTML file indicating which applet the browser (or **`appletviewer`**) should load and execute

3.4 A Simple Java Applet: Drawing a String

```
1 <html>
2 <applet code="WelcomeApplet.class" width=300 height=30>
3 </applet>
4 </html>
```

- Simple HTML file (**`WelcomeApplet.html`**)
  - Usually in same directory as **`.class`** file
  - Remember, **`.class`** file created after compilation
- HTML codes (tags)
  - Usually come in pairs
  - Begin with **`<`** and end with **`>`**
- Lines 1 and 4 - begin and end the HTML tags
- Line 2 - begins **`<applet>`** tag
  - Specifies code to use for applet
  - Specifies **`width`** and **`height`** of display area in pixels
- Line 3 - ends **`<applet>`** tag

3.4 A Simple Java Applet: Drawing a String

```
1 <html>
2 <applet code="WelcomeApplet.class" width=300 height=30>
3 </applet>
4 </html>
```

- **`appletviewer`** only understands **`<applet>`** tags
  - Ignores everything else
  - Minimal browser
- Executing the applet
  - **`appletviewer WelcomeApplet.html`**
  - Perform in directory containing **`.class`** file

Outline

```
1  // Fig. 3.6: WelcomeApplet.java
2  // A first applet in Java
3  import javax.swing.JApplet;  // import class JApplet
4  import java.awt.Graphics;    // import class Graphics
5
6  public class WelcomeApplet extends JApplet {
7     public void paint( Graphics g )
8     {
9        g.drawString( "Welcome to Java Programming!", 25, 25 );
10    }
11 }
```

`import` allows us to use predefined classes (allowing us to use applets and graphics, in this case).

`extends` allows us to inherit the capabilities of class **`JApplet`**.

Method **`paint`** is guaranteed to be called in all applets. Its first line must be defined as above.

2. Class WelcomeApplet

3 paint

```
1 <html>
2 <applet code="WelcomeApplet.class" width=300 height=30>
3 </applet>
4 </html>
```

HTML file

Program Output

3.5 Two More Simple Applets: Drawing Strings and Lines

- More applets
  - First example
    - Display two lines of text
    - Use **drawString** to simulate a new line
    - We will actually use two **drawString** statements
  - Second example
    - Method **drawLine(x1, y1, x2, y2)**
      - Draws a line from (**x1**, **y1**) to (**x2**, **y2**)
      - Remember that (**0**, **0**) is upper left
    - Use **drawLine** to draw a line beneath and above a string

Outline

1. import

2. Class WelcomeApplet2 (extends JApplet)

3. paint

```
1  // Fig. 3.8: WelcomeApplet2.java
2  // Displaying multiple strings
3  import javax.swing.JApplet;  // import class JApplet
4  import java.awt.Graphics;    // import class Graphics
5
6  public class WelcomeApplet2 extends JApplet {
7     public void paint( Graphics g )
8     {
9        g.drawString( "Welcome to", 25, 25 );
10       g.drawString( "Java Programming!", 25, 40 );
11    }
12 }
```

The two **drawString** statements simulate a newline. In fact, the concept of lines of text does not exist when drawing strings.

```
1  <html>
2  <applet code="WelcomeApplet2.class" width=300 height=45>
3  </applet>
4  </html>
```

HTML file

Program Output

Outline

1. `import`

2. Class `WelcomeLines` `(extends JApplet)`

3. `paint`

3.1 `drawLine`

3.2 `drawLine`

3.3 `drawString`

HTML file

Program Output

```
1  // Displaying text and lines
2  import javax.swing.JApplet;  // import class JApplet
3  import java.awt.Graphics;    // import class Graphics
4
5  public class WelcomeLines extends JApplet {
6     public void paint( Graphics g )
7     {
8        g.drawLine( 15, 10, 210, 10 );
9        g.drawLine( 15, 30, 210, 30 );
10       g.drawString( "Welcome to Java Programming!", 25, 25 );
11    }
12 }
```

Draw horizontal lines with **`drawLine`** (endpoints have same y coordinate).

```
1  <html>
2  <applet code="WelcomeLines.class" width=300 height=40>
3  </applet>
4  </html>
```