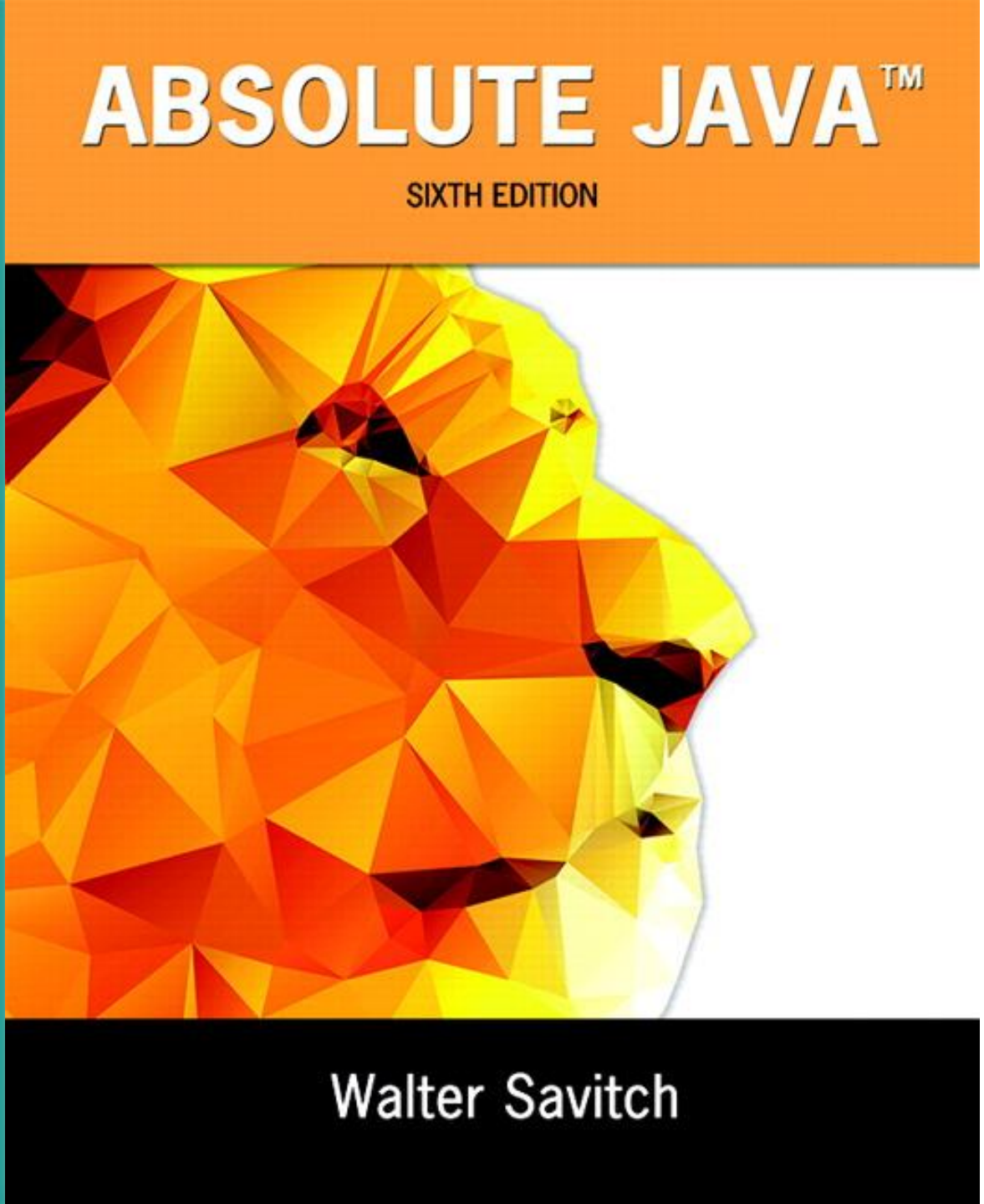

Chapter 20

Applets

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PEARSON

Introduction

- Java programs are divided into two main categories, *applets* and *applications*
- An application is an ordinary Java program
- An applet is a kind of Java program that can be run across the Internet

A Brief Introduction to HTML

- *HTML* stands for *Hypertext Markup Language*
  - *Hypertext* is text viewed on a browser that contains clickable entries called *links* or *hyperlinks*
  - When a link or hyperlink is clicked, the document specified by the link is displayed
- HTML is a language used to write *HTML documents* or *pages* that will be viewed on a Web browser

A Brief Introduction to HTML

- HTML is made up of a collection of simple commands that can be inserted into a text file
  - This converts the text file into a document meant to be viewed with a Web browser
- Some commands allow pictures and hyperlinks to be inserted
- Others are editing commands that specify the main heading, subheading, paragraph beginning, and so forth

A Brief Introduction to HTML

- Much of HTML is simply a language for formatting text
  - However, HTML is not a word processor
  - It is more like a very simple programming language
  - It is similar to the annotations used by copy editors to mark a manuscript before it is typeset for production
- HTML is not part of the Java language
  - There can be interaction between HTML and Java
  - HTML can be used to display a Java applet program

HTML Formatting Commands

- There are two basic kinds of HTML commands :
  - Those that mark the beginning and end of a section of text
  - Those that mark a single location in the text
- Commands that mark the beginning and end of a section of text have the form:

```
<Command>
Some text
</Command>
```

HTML Formatting Commands

- The following makes the phrase "World's Greatest Home Page" a level 1 heading
  - Level 1 is the largest standard heading

```
<h1>
World's Greatest Home Page
</h1>
```

- Smaller headings, Level 2 and level 3, are generated by the commands **`h2`** and **`h3`**, and so forth

HTML Formatting Commands

- Commands that mark a single location in the text are not closed with the command of form `</Command>`
  - For example, the horizontal line command:

    `<hr>`
- Commands in HTML are relative commands, instead of being absolute commands that determine exact size or locations
  - The browser determines the exact sizes and locations

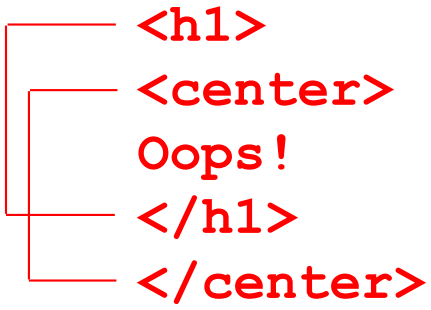
HTML Formatting Commands

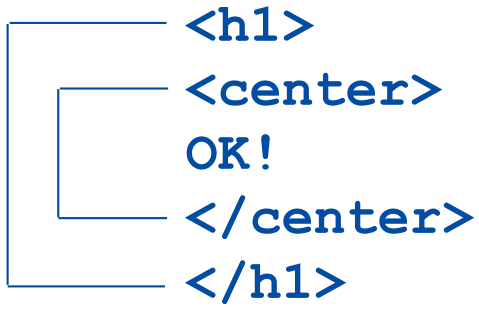
- The browser normally determines the location of line breaks in the displayed text
  - However, a line break can be forced by inserting a break command:

    `<br>`
- Some layout specifications can be made as well
  - Anything between the commands `<center>` and `</center>` will be centered on the page

HTML Formatting Commands

- Matching pairs of commands may be nested inside one another, but they may not cross each other:





- Unlike Java, HTML commands are not case sensitive
- An HTML file is a text file whose name should end with `.html`

Outline of an HTML Document

- The entire HTML document should be enclosed in the pair **<html>** and **</html>** at the beginning and end of the document
- The head of the document is enclosed in **<head>** and **</head>**
  - The head is not displayed when the page is viewed
  - It records information that is used by a browser
- The head can contain a title, enclosed in **<title>** and **</title>**
  - The title is used as a name for the document

Outline of an HTML Document

- The part of the document that is displayed on the screen is divided into two parts
- The body is the real content of the document
  - It is enclosed in **<body>** and **</body>**
- The other part should contain the e-mail address for contacting the document's maintainer, and the date that the document was last modified
  - It is enclosed in **<address>** and **</address>**

Outline of a Simple HTML Document (Part 1 of 3)

Outline of a Simple HTML Document

```
<html>  <-- Beginning of HTML document

<head>  <-- Beginning of document head
<title>  <-- Beginning of document title
Document Title
</title>  <-- End of document title
</head>  <-- End of document head

<body>  <-- Beginning of main text to appear on screen
<h1>
First of Largest Size Headings
</h1>
```

(continued)

Outline of a Simple HTML Document (Part 2 of 3)

Outline of a Simple HTML Document

```
Some text
<h2>
First Subheading
</h2>
Some text
<h2>
Second Subheading
</h2>
Some text.
<h1>
Second of Largest Size Headings
</h1>
More of the same
    .
    .
```

Most browsers do not require all the entries pointed to with blue arrows, but it is good to include them all.

(continued)

Outline of a Simple HTML Document (Part 3 of 3)

Outline of a Simple HTML Document

```
.
</body>          End of main text to appear on screen

<address>        Beginning of address section
<hr>             Horizontal line; nice, but not required
The e-mail address of the person maintaining the page.
Also, the date of the last time the page was changed.
(You can put in whatever you want here, but the
 e-mail address and date are what people expect.)
</address>       End of address section

</html>          End of HTML document
```

Although this is not part of the main body of text, it does appear on the screen.

An HTML Document (Part 1 of 3)

An HTML Document

```
<html>
<head>
<title>
Liars Club Home Page
</title>
</head>

<body>
<h1>
<center>
Liars Club
</center>
</h1>
```

This text does not appear on the screen but is used as the default name for any bookmark ("favorite") to this page.

Blank lines are ignored when the document is displayed, but they can make your HTML code easier to read.

(continued)

An HTML Document (Part 2 of 3)

An HTML Document

```
<h2>
Club Goals
</h2>
<p>
The goal of the club is to take over the world.
We already have members in key government positions.
</p>
<p>
Another goal is to improve the image of liars.
To this end, we have infiltrated many advertising agencies.
</p>

<h2>
Meeting Times
</h2>
```

Text may have different line breaks when displayed on your browser.

A new paragraph will always produce a line break and some space.

(continued)

An HTML Document (Part 3 of 3)

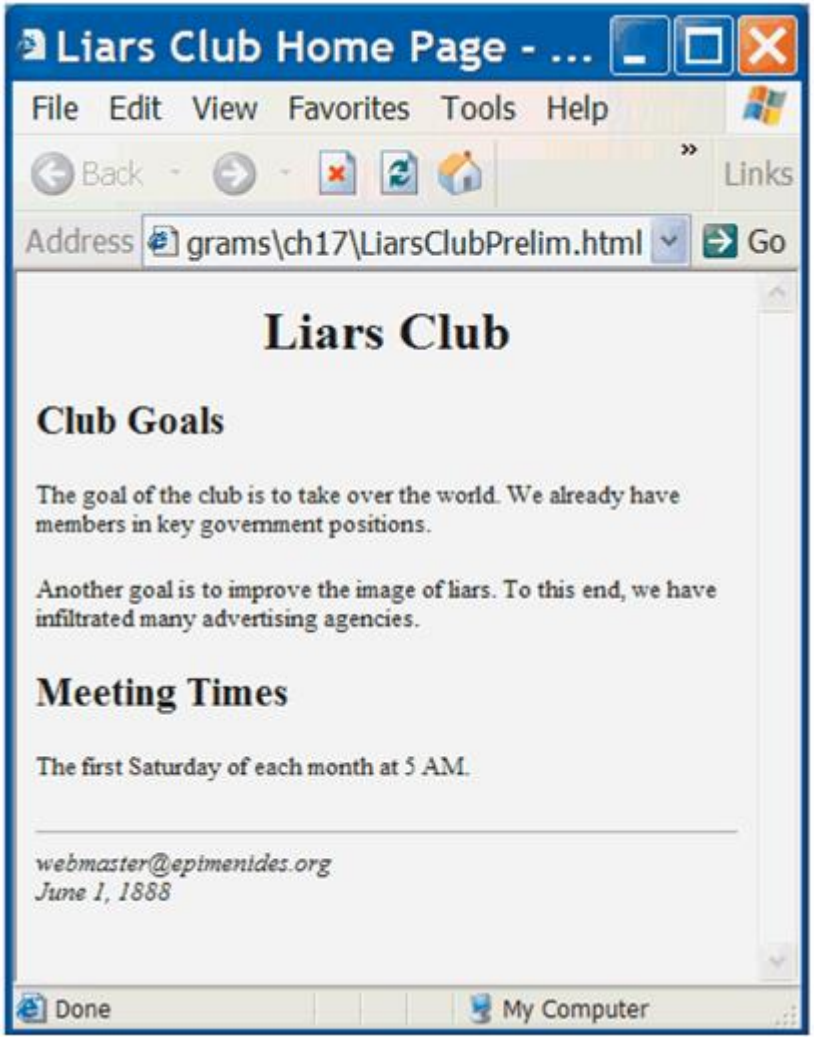
An HTML Document

```
The first Saturday of each month at 5 AM.
<p> <!--To add some space.-->
</p>

</body>

<address>
<hr>
webmaster@epimenides.org
<br>
June 1, 1888
</address>
</html>
```

A comment

This is the file `LiarsClubPrelim.html`.

Browser View of HTML Document



URL

- A *URL* is the name of an HTML document on the Web
  - URL is an acronym for *Uniform Resource Locator*
- URLs often begin with **`http`**
  - This is the name of the protocol used to transfer and interpret the HTML document
  - Most browsers will fill in **`http://`** if it is omitted

Hyperlinks

- Text can be marked as a hyperlink so that if a user clicks that text, the browser goes to another Web page specified by the link

```
<a href="PathToDocument">
TextToClick
</a>
```

  - The ***PathToDocument*** can be a full or relative path name to an HTML file, or a URL to any place on the Web
  - The ***TextToClick*** will be displayed and underlined by the browser

Inserting a Picture

- A picture can also be inserted in an HTML document

```
<img src="PathToPicture">
```

  - The ***PathToPicture*** can be a full or relative path name to a file with a digitally encoded picture
  - Most commonly used picture-encoding formats are accepted, such as **.gif**, **.tiff**, and **.jpg**

An HTML Document with a Hyperlink and a Picture (Part 1 of 3)

An HTML Document with a Hyperlink and a Picture

```
<html>
<head>
<title>
Liars Club Home Page
</title>
</head>

<body>
<h1>
<center>
Liars Club
</center>
</h1>
<h2>
Club Goals
</h2>
```

This is the file `LiarsClub.html`.

(continued)

An HTML Document with a Hyperlink and a Picture (Part 2 of 3)

An HTML Document with a Hyperlink and a Picture

```
<p>
The goal of the club is to take over the world.
We already have members in key government positions.
</p>
<p>
Another goal is to improve the image of liars.
To this end, we have infiltrated many advertising agencies.
</p>
<img src="smiley.gif">
<h2>
Meeting Times
</h2>
The first Saturday of each month at 5 AM.
<h2>
```

This is explained in the subsection entitled "Inserting a Picture."

(continued)

An HTML Document with a Hyperlink and a Picture (Part 3 of 3)

An HTML Document with a Hyperlink and a Picture

```
Other Liar Organizations
</h2>
<a href="http://liars.org/">
Click here for another kind of liar.
</a>
<p> <!--To add some space.-->
</p>
</body>

<address>
<hr>
webmaster@epimenides.org
<br>
June 1, 1888
</address>
</html>
```

A hyperlink to another HTML document, in this case another Web page.

Browser View of an HTML Document with a Hyperlink and a Picture

Pitfall: Not Using Your Browser's Refresh Command

- Browsers normally keep copies of the most recently viewed HTML pages
  - This helps the browser retrieve a page quickly when someone returns to that page
- This feature can be a problem when designing and debugging an HTML page
  - If a change is made to a page, and that page is viewed again, it may still look the same
  - This is because the copy is being viewed, not the new page
- Browsers have a command to reload a page, and thus get the most recent version of it
  - It is usually called "Refresh" or "Reload", and is a button or menu item

Tip: Other Languages for Authoring Web Pages

- HTML is a low-level language for a Web browser much the same as assembly language is a low-level language for a computer
- Most Web page designers today use a high-level Web page design language that translates into HTML
  - For example Dreamweaver (Macromedia, Inc.), FrontPage (Microsoft Corporation), and GoLive (Adobe Systems Inc.)

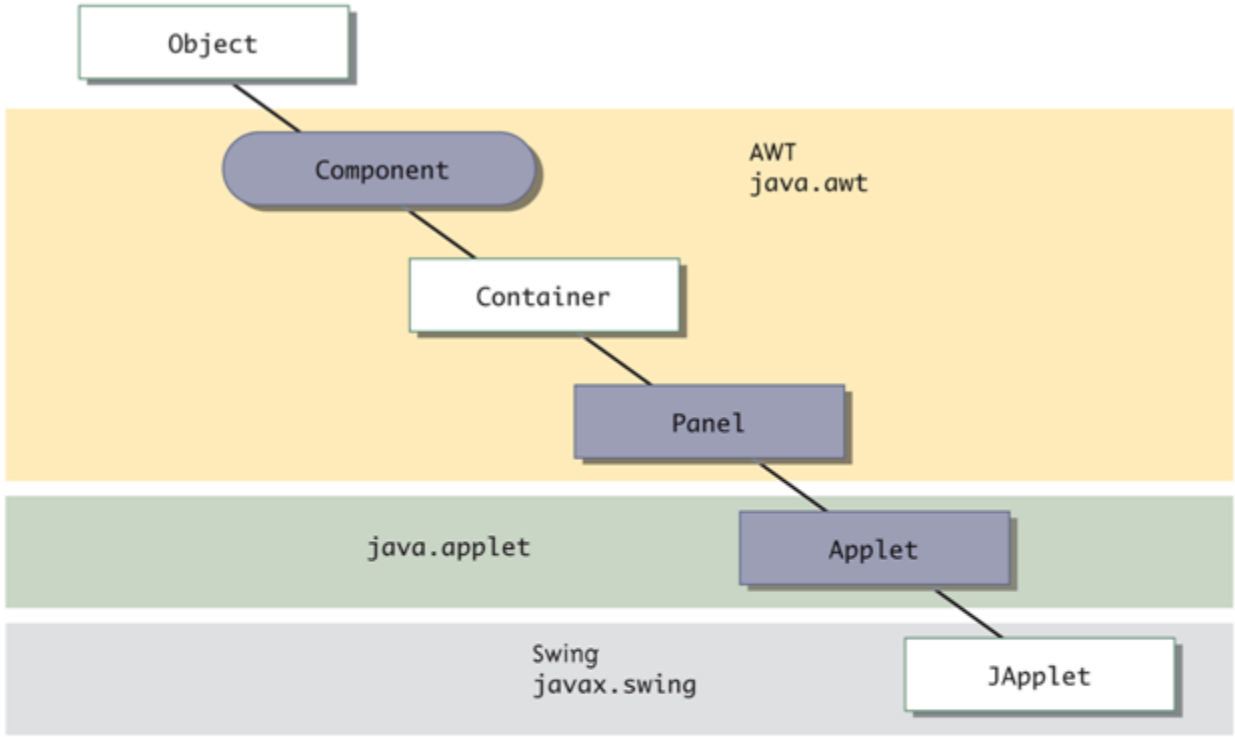
Programming Applets

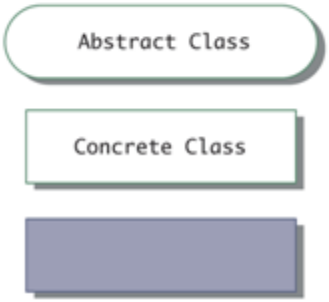
- The word *applet* is meant to suggest a small *application*
- Applets were intended to be small programs run over the Internet
  - However, there are no size constraints on applets
  - Applets can be viewed over the Internet, or without any connection to the internet
- An applet is similar to a Swing GUI
  - In fact, almost all of the Swing techniques can be used in applets

Defining an Applet

- An applet class is normally defined as a derived class of the class **`JApplet`**
  - The class **`JApplet`** is in the package **`javax.swing`**
- There is also an older class, **`Applet`**, which has been superseded by the **`JApplet`** class

Applets in the Class Hierarchy





A line between two boxes means the lower class is derived from (`extends`) the higher one.

This blue color indicates a class that is not used in this text but is included here for reference. If you have not heard of any of these classes, you can safely ignore them.

Designing an Applet

- An applet class can be designed as a derived class of **`JApplet`** in much the same way that regular Swing GUIs are defined as derived classes of **`JFrame`**
- However, an applet normally defines no constructors
  - The method **`init`** performs the initializations that would be performed in a constructor for a regular Swing GUI

Designing an Applet

- Components can be added to an applet in the same way that a component is added to a **`JFrame`**
  - The method **`add`** is used to add components to an applet in the same way that components are added to a **`JFrame`**

An Applet (Part 1 of 2)

An Applet

```
1  import javax.swing.JApplet;
2  import javax.swing.JLabel;
3  import java.awt.BorderLayout;
4  import java.awt.Color;
5
6  public class FirstApplet extends JApplet
7  {
8      public void init()
9      {
10         getContentPane().setBackground(Color.ORANGE);
11         setLayout(new BorderLayout());
12         JLabel aLabel =
13             new JLabel("An applet a day keeps the doctor away.");
14         add(aLabel, BorderLayout.CENTER);
15     }
```

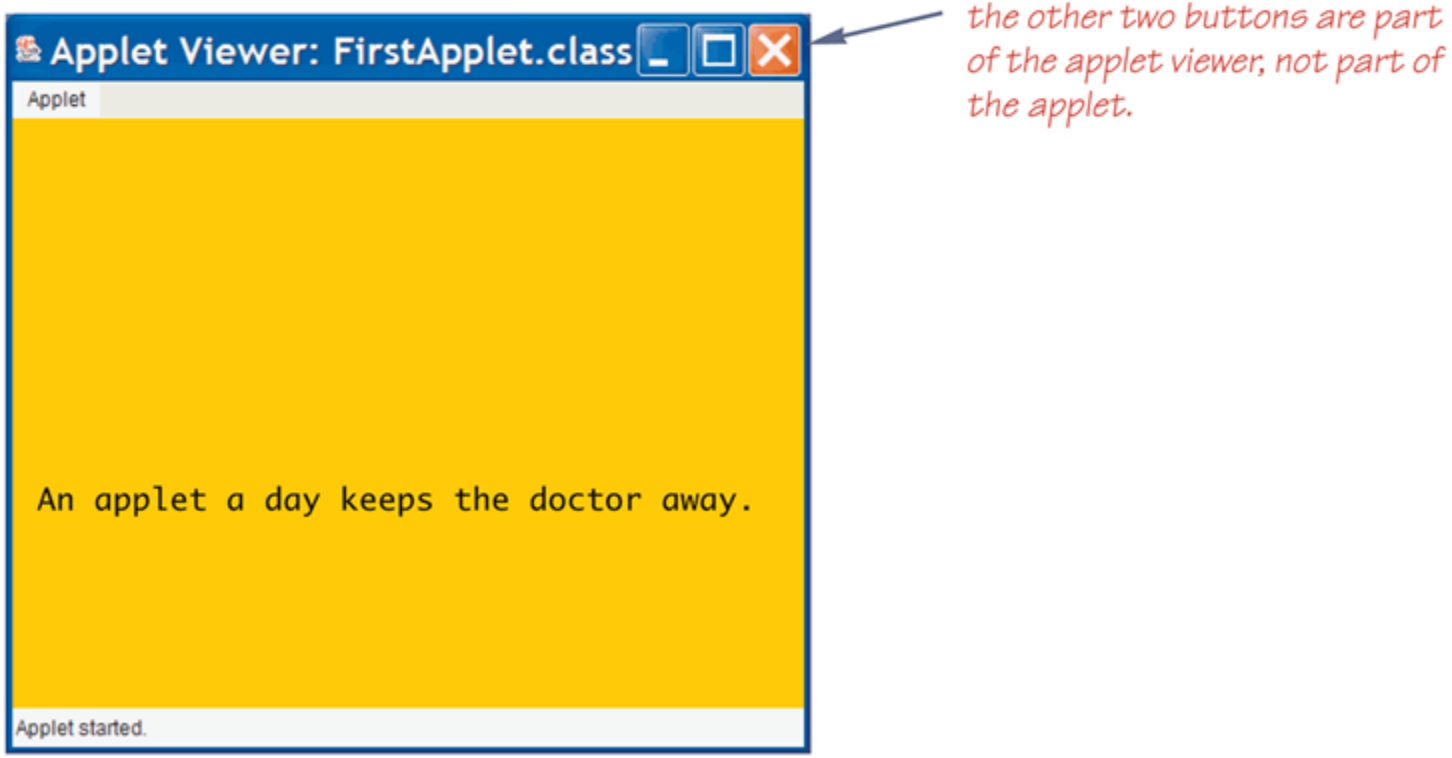
The `init()` method is used instead of a constructor.

(continued)

An Applet (Part 2 of 2)

An Applet

RESULTING GUI (Using an Applet Viewer)



How Applets Differ from Swing GUIs

- Some of the items included in a Swing GUI are not included in an applet
- Applets do not contain a **`main`** or **`setVisible`** method
  - Applets are displayed automatically by a Web page or an applet viewer
- Applets do not have titles
  - Therefore, they do not use the **`setTitle`** method
  - They are normally embedded in an HTML document, and the HTML document can add any desired title

How Applets Differ from Swing GUIs

- Applets do not use the **`setSize`** method
  - The HTML document takes care of sizing the applet
- Applets do not have a close-window button
  - Therefore, they do not have a **`setDefaultCloseOperation`** method
  - When the HTML document containing the applet is closed, then the applet is automatically closed

Running an Applet

- An applet class is compiled in the same way as any other Java class
  - However, an applet is run differently from other Java programs
- The normal way to run an applet is to embed it in an HTML document
  - The applet is then run and viewed through a Web browser

Running an Applet

- An applet can also be viewed using an *applet viewer*
  - An applet viewer is a program designed to run an applet as a stand-alone program
- The Java **`appletviewer`** can be used to run an applet:

```
appletviewer FirstApplet.html
```

- It may be necessary, however, to create the HTML document, and place the applet in it

Menus in a `JApplet`

- Menus are constructed and added to a **`JApplet`** as they are for a **`JFrame`**
  - **`JApplet`** has a method named **`setJMenuBar`** that behaves the same as the **`setJMenuBar`** method of a **`JFrame`**
  - **`JApplet`** can also have menu bars added to a **`JApplet`** or to a panel that is part of the **`JApplet`** using the **`add`** method

Tip: Converting a Swing Application to an Applet

- The fastest and easiest way to explain how to define an applet, is to explain how to modify a Swing GUI to transform it into an applet
  1. Derive the class from the class **`JApplet`** instead of from the class **`Jframe`**
  2. Remove the **`main`** method
  3. Replace the constructor with a no-parameter method named **`init`**
     - The body of the **`init`** method can be the same as the body of the deleted constructor, but with some items removed

Tip: Converting a Swing Application to an Applet

4. Delete any invocation of **`super`**
5. Delete any method invocations that program the close-window button of a windowing GUI
6. Delete any invocation of **`setTitle`**
7. Delete any invocation of **`setSize`**

- The following applet was generated in this way

An Applet Calculator (Part 1 of 9)

An Applet Calculator

```
1  import javax.swing.JApplet;
2  import javax.swing.JTextField;
3  import javax.swing.JPanel;
4  import javax.swing.JLabel;
5  import javax.swing.JButton;
6  import java.awt.BorderLayout;
7  import java.awt.FlowLayout;
8  import java.awt.Color;
9  import java.awt.event.ActionListener;
10 import java.awt.event.ActionEvent;
```

(continued)

An Applet Calculator (Part 2 of 9)

An Applet Calculator

```
11  /**
12   A simplified calculator as an applet.
13   The only operations are addition and subtraction.
14  */
15  public class AppletCalculator extends JApplet
16                                implements ActionListener
17  {
18      public static final int WIDTH = 400;
19      public static final int HEIGHT = 200;
20      public static final int NUMBER_OF_DIGITS = 30;
```

(continued)

An Applet Calculator (Part 3 of 9)

An Applet Calculator

```
21      private JTextField ioField;
22      private double result = 0.0;


23      public void init()
24      {
25          setLayout(new BorderLayout());
```

We deleted the `main` *method.*

We deleted invocations of `setSize`, `setTitle`, *and* `setDefaultCloseOperation`.

(continued)

An Applet Calculator (Part 4 of 9)

An Applet Calculator

```
26          JPanel textPanel = new JPanel();
27          textPanel.setLayout(new BorderLayout());
28          ioField =
29               new JTextField("Enter numbers here.", NUMBER_OF_DIGITS);
30          ioField.setBackground(Color.WHITE);
31          textPanel.add(ioField);
32          add(textPanel, BorderLayout.NORTH);

33          JPanel buttonPanel = new JPanel();
34          buttonPanel.setBackground(Color.BLUE);
35          buttonPanel.setLayout(new FlowLayout());
```

(continued)

An Applet Calculator (Part 5 of 9)

An Applet Calculator

```
36          JButton addButton = new JButton("+");
37          addButton.addActionListener(this);
38          buttonPanel.add(addButton);
39          JButton subtractButton = new JButton("-");
40          subtractButton.addActionListener(this);
41          buttonPanel.add(subtractButton);
42          JButton resetButton = new JButton("Reset");
43          resetButton.addActionListener(this);
44          buttonPanel.add(resetButton);

45          add(buttonPanel, BorderLayout.CENTER);
46      }
```

(continued)

The method **actionPerformed** is identical to the one in Display 17.19

An Applet Calculator (Part 6 of 9)

An Applet Calculator

```
47      public void actionPerformed(ActionEvent e)
48      {
49          try
50          {
51              assumingCorrectNumberFormats(e);
52          }
53          catch (NumberFormatException e2)
54          {
55              ioField.setText("Error: Reenter Number.");
56          }
57      }

58      //Throws NumberFormatException.
59      public void assumingCorrectNumberFormats(ActionEvent e)
60      {
61          String actionCommand = e.getActionCommand();
```

The methods assumingCorrectNumberFormats and stringToDouble are identical to the ones in Display 17.19

(continued)

An Applet Calculator (Part 7 of 9)

An Applet Calculator

```
62          if (actionCommand.equals("+"))
63          {
64              result = result + stringToDouble(ioField.getText());
65              ioField.setText(Double.toString(result));
66          }
67          else if (actionCommand.equals("-"))
68          {
69              result = result - stringToDouble(ioField.getText());
70              ioField.setText(Double.toString(result));
71          }
72          else if (actionCommand.equals("Reset"))
73          {
74              result = 0.0;
75              ioField.setText("0.0");
76          }
```

(continued)

An Applet Calculator (Part 8 of 9)

An Applet Calculator

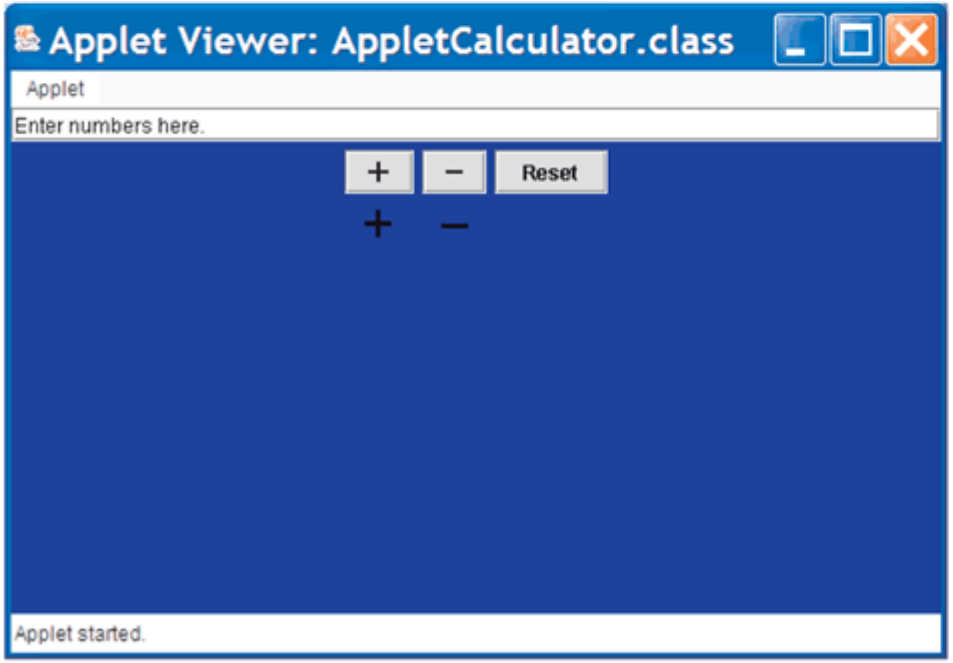
```
77              else
78                  ioField.setText("Unexpected error.");
79          }


80          //Throws NumberFormatException.
81          private static double stringToDouble(String stringObject)
82          {
83              return Double.parseDouble(stringObject.trim());
84          }

85      }
```

(continued)

An Applet Calculator (Part 9 of 9)

An Applet Calculator

RESULTING GUI (When started)



Pitfall: Browser Security

- If your applet does not run in the web browser, it may be due to security restrictions on the computer
  - In the control panel, select Java and change the security restrictions to allow Java applets to run in the browser

Icons

- An icon is a picture
  - It is typically, but not always, a small picture
- An icon can be stored in a file of many different standard formats
  - Such as .**gif**, .**tiff**, or .**jpg**
- The class **ImageIcon** is used to convert a picture file to a Swing icon
  - Then it can be added as a component to any **Container** class, such as **JApplet**
  - The class **ImageIcon** is in the **javax.swing** package

```
ImageIcon NameOfImageIcon = new
                    ImageIcon("PictureFileName");
```

Adding Icons to an Applet

- The easiest way to display an icon in an applet is to place it in a **`JLabel`**
- The following three lines create a label, create an icon, and then add the icon to the label:

```
JLabel aLabel=new JLabel("Welcome to my applet.");
ImageIcon dukeIcon = new
                     ImageIcon("duke_waving.gif");
aLabel.setIcon(dukeIcon);
```

- The character pictured in this icon is named *Duke*
  - He is Sun Microsystem's mascot for the Java language

An Applet with an Icon (Part 1 of 3)

An Applet with an Icon

```
1   import javax.swing.JApplet;
2   import javax.swing.JLabel;
3   import javax.swing.ImageIcon;
4   import java.awt.BorderLayout;
5   import java.awt.Color;

6   public class IconApplet extends JApplet
7   {
8       public void init()
9       {
10          getContentPane().setBackground(Color.YELLOW);
11          setLayout(new BorderLayout());
```

(continued)

An Applet with an Icon (Part 2 of 3)

An Applet with an Icon

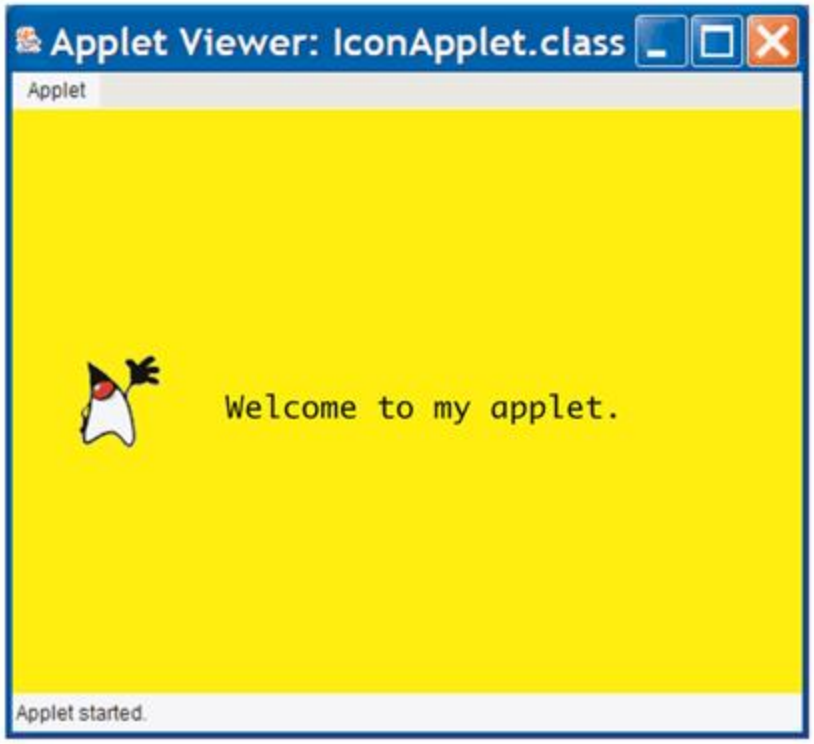
```
12          JLabel shift = new JLabel("              ");
13          JLabel aLabel = new JLabel("Welcome to my applet.");
14          ImageIcon dukeIcon = new ImageIcon("duke_waving.gif");
15          aLabel.setIcon(dukeIcon);
16          add(shift, BorderLayout.WEST);
17          add(aLabel, BorderLayout.CENTER);
18      }
19  }
```

(continued)

An Applet with an Icon (Part 3 of 3)

An Applet with an Icon

RESULTING GUI [1]



Inserting an Applet in an HTML Document

- An applet can be placed in an HTML document with an *applet tag:*

```
<applet code="PathToApplet"
            width=Number1 height=Number2>
</applet>
```

- If given a `.class` file name only, then the HTML file and the applet file must be in the same directory
  - The *`PathToApplet`* can be a full or relative path name

Inserting an Applet in an HTML Document

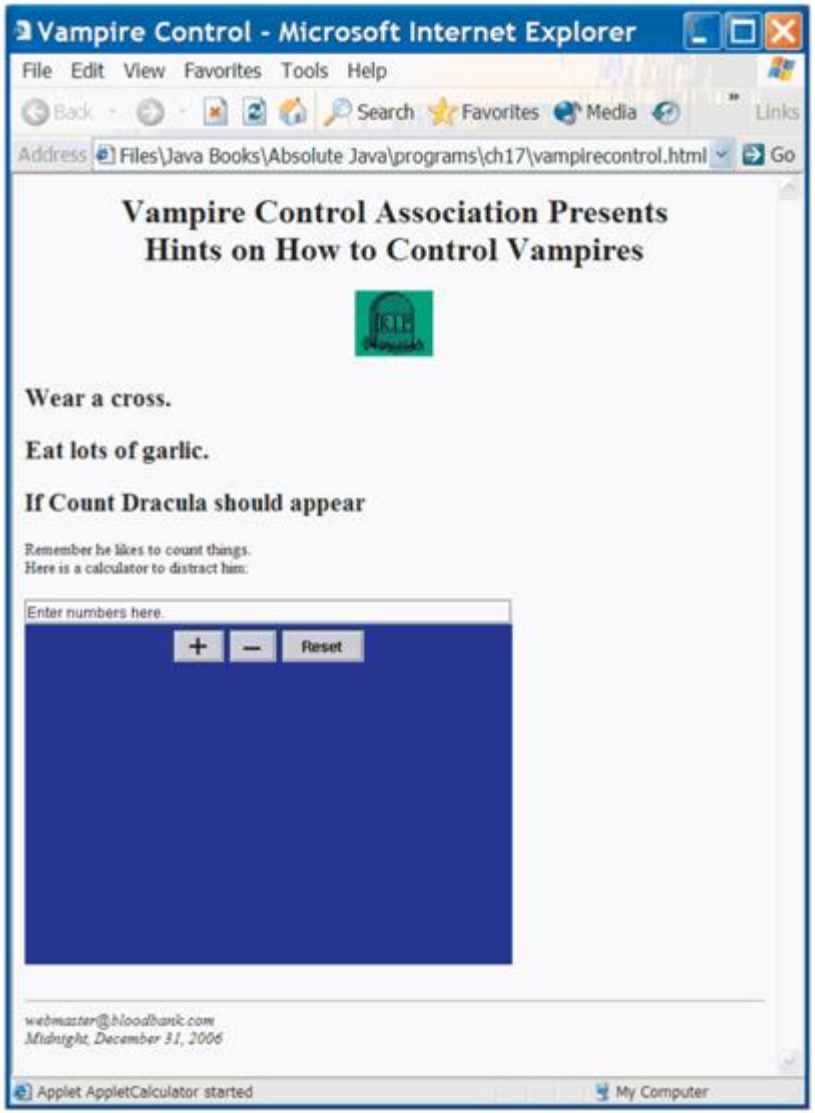
- Note that the name of the `.class` file, not the `.java` file, is given
- Note also that the width and height of the applet is given in this command, and not within the applet class definition
  - The width and height are in pixels
- The following code, when placed in an HTML document, will display the calculator applet in a browser as shown

```
<applet code="AppletCalculator.class"
                                width=400 height=300>
</applet>
```

An Applet in an HTML Document

```
<html>
<head>
<title>
Vampire Control
</title>
</head>
. . .

   <applet code="AppletCalculator.class"
     width=400 height=300>
   </applet>

 . . .
</html>
```

Browser View



Pitfall: Using an Old Web Browser

- An old browser may not be able to run applets from an HTML document
  - Even if a java application runs correctly on the same system
- Web browsers do not use the same Java Virtual Machine used to run regular Java applications
  - An old browser will have an old Java Virtual Machine, or perhaps, no Java Virtual Machine
- However, an applet viewer will work, as long as a recent version of Java is installed

Applets and Security

- An applet can be a program, written by someone else, that runs on your computer
- Whenever someone else's program runs on your computer, there are security questions you should ask:
  - Will it read information from your files?
  - Will it corrupt your operating system?

Applets are designed so that they cannot do any of these things (at least easily)