LESSON XIII. GUI and Event Programming (2/2)

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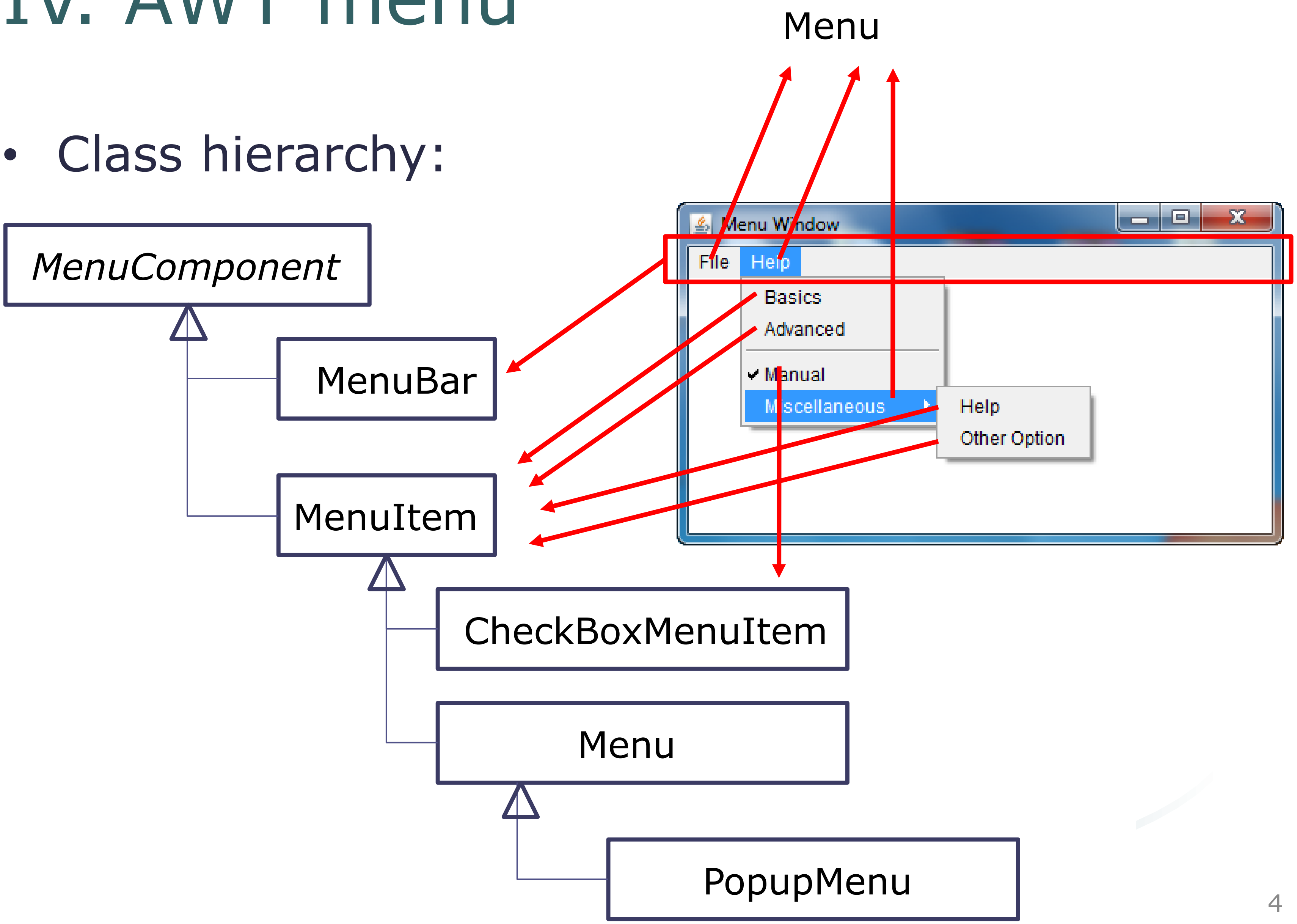
Objectives

- After this lesson, students (learners) can:
  - Create menus inside an AWT application
  - Process action when choosing a menu item
  - Create shortcuts for menu items
  - Create a popup menu when right-clicking on any AWT components
  - Understand Swing's advanced features compared to AWT's
  - Write Swing application

Content

IV. AWT menu

- Class hierarchy:



4.1. Steps to add menus to a Frame

- 1. Create a MenuBar

  ```
  MenuBar mb = new MenuBar();
  ```

- 2. Create a Menu

  ```
  Menu m = new Menu("File");
  ```

- 3. Add MenuItem to the menu

  ```
  m.add(new MenuItem("Open"));
  m.add(new CheckboxMenuItem("Type here"));
  ```

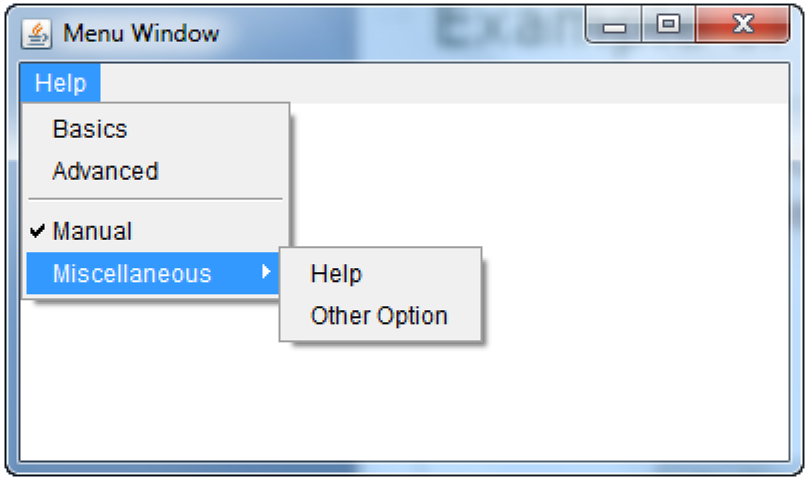
- 4. Add the menu to the Menubar

  ```
  mb.add(m);
  ```

- 5. add the MenuBar to the Frame by calling the `setMenuBar()` method

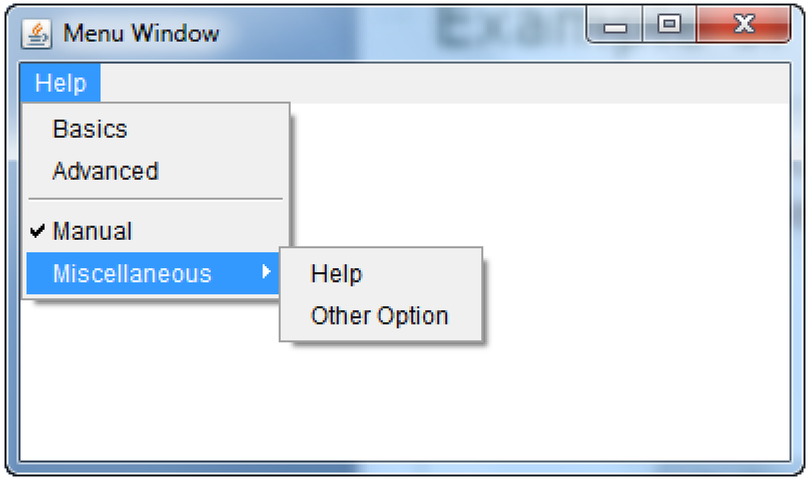
Example of a menu-description

- Application:
  - Create a MenuBar which has
    - A Menu: **Help** which has
      - 2 MenuItem: **Basics**, **Advanced**
      - A CheckboxMenuItem: **Manual**
      - A Menu: **Miscellaneous** which has
        - » 2 MenuItem: **Help**, **Other Option**
  - Event Handling: if we click on menu item Basics and Help, application prints something to the screen



Example of a menu – our Frame class

```
public class MainWindow extends Frame {
    public MainWindow() {
            super("Menu Window");
            setSize(400, 400);
            HelpMenu helpMenu = new HelpMenu();
            MenuBar mb = new MenuBar();
            mb.add(helpMenu);
            setMenuBar(mb);
            addWindowListener(new WindowAdapter() {
                  public void windowClosing(WindowEvent e) {
                        setVisible(false);
                        dispose();
                        System.exit(0);
                  }
            });
      }
      public static void main(String args[]) {
          MainWindow w = new MainWindow();
          w.setVisible(true);
      }
}
```



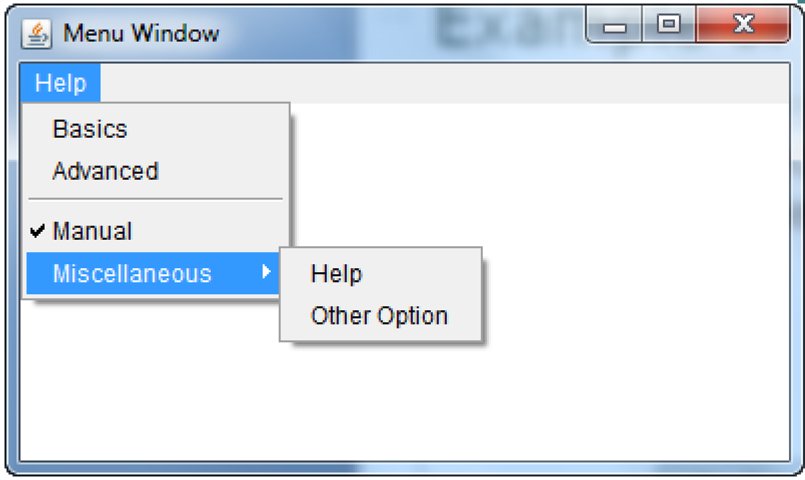
Example of a menu – our Menu class

```
public class HelpMenu extends Menu implements ActionListener {

    public HelpMenu() {
        super("Help");
        MenuItem mi;
        add(mi = new MenuItem("Basics"));
        mi.addActionListener(this);
        add(mi = new MenuItem("Advanced"));
        mi.addActionListener(this);
        addSeparator();
        add(mi = new CheckboxMenuItem("Manual"));
        mi.addActionListener(this);

        Menu subMenu = new Menu("Miscellaneous");
        subMenu.add(mi = new MenuItem("Help"));
        mi.addActionListener(this);
        subMenu.add(mi = new MenuItem("Other Option"));
        mi.addActionListener(this);
        add(subMenu);
    }

    public void actionPerformed(ActionEvent e) {
        String item = e.getActionCommand();
        if (item.equals("Basics"))
          System.out.println("Basics");
        else if (item.equals("Help"))
          System.out.println("Help");
    }
}
```



4.2. Menu Shortcuts

- How to quickly invoke a MenuItem?
  - Using Keyboard Shortcut
- When you create a MenuItem, using this constructor to associate it with a keyboard shortcut

```
MenuItem(String label, MenuShortcut s)
```

- MenuShortcut constructors:

```
/*Constructs a new MenuShortcut for the specified key*/
public MenuShortcut(int key)
/*Constructs a new MenuShortcut for the specified key*/
public MenuShortcut(int key, boolean useShiftModifier)
```

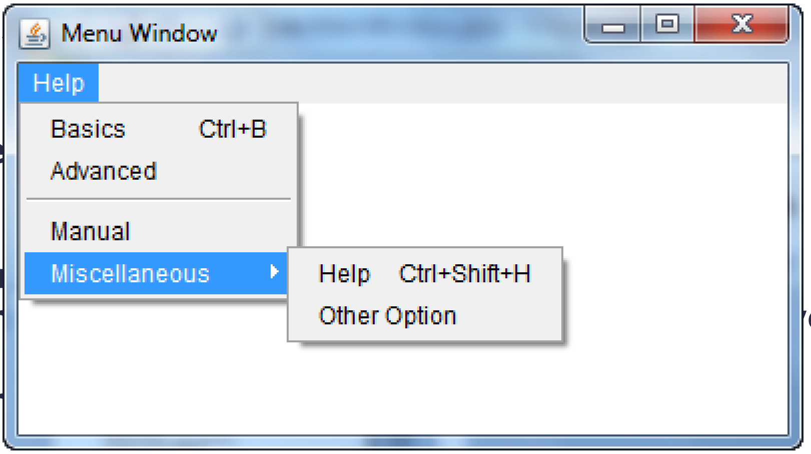
  - key: raw key code (each key has one)
  - useShiftModifier: whether this MenuShortcut is invoked with the SHIFT key down (Otherwise, CTRL only)

Example of Menu shortcuts

- Modify the previous example so that we can access **Basics** menu item with CTRL+B and **Help** menu item with CTRL+SHIFT+H

```
public HelpMenu() {
    super("Help");
    MenuItem mi;
    add(mi = new MenuItem("Basics", new MenuShortcut(KeyEvent.VK_B)));
    mi.addActionListener(this);
    add(mi = new MenuItem("
    mi.addActionListener(this);
    addSeparator();
    add(mi = new CheckboxMe
    mi.addActionListener(this);

    Menu subMenu = new Menu
    subMenu.add(mi = new Mer                                 ent.VK_H, true)));
    mi.addActionListener(this);
    subMenu.add(mi = new Mer
    mi.addActionListener(this);
    add(subMenu);
}
```



4.3. PopupMenu

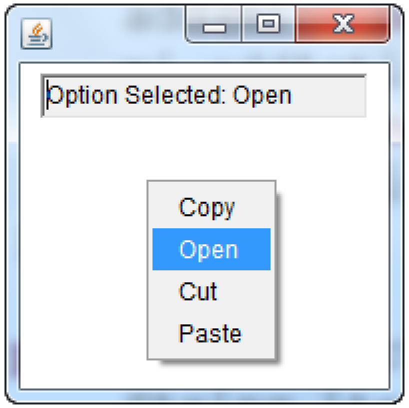
- PopupMenu:
  - extends Menu
  - can be add to any Component, using `add(aPopupMenu)`
  - Can be deinstalled from Component, using `remove(aPopupMenu)`
  - is activated when the user holds the right mouse button
- Constructors:
  - *public PopupMenu()*
    - creates an untitled PopupMenu.
  - *public PopupMenu(String label)*
    - creates a PopupMenu with a title of label
  - Once created, the menu can be populated with menu items like any other menu

4.3. PopupMenu

- Method to display the PopupMenu
  - *public void show(Component origin, int x, int y)*
  - x, y: location at which the pop-up menu should appear; origin specifies the Component whose coordinate system is used to locate x and y
- How to check whether the popup was triggered by right mouse click?
  - use isPopupTrigger() method of MouseEvent class.
  - Note: Popup menus are triggered differently on different systems
    - Therefore, isPopupTrigger should be checked in both mousePressed and mouseReleased

4.3. Popup menu Example - Description

- Application:
  - Has a Popup menu and a textfield
  - When Popup menu is triggered, the selection will be displayed on the textfield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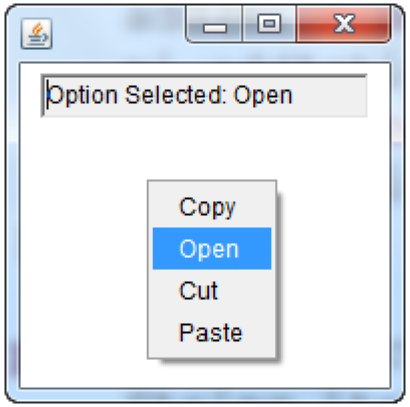
4.3. Popup menu Example

```
public class PopupMenuDemo extends Frame {
   TextField msg; PopupAppMenu m;
   public PopupMenuDemo() {
      setLayout(new FlowLayout());
      msg = new TextField(20);
      msg.setEditable(false); add(msg);
      m = new PopupAppMenu(this); add(m);
      addMouseListener(new MouseAdapter() {
          public void mousePressed(MouseEvent e) {
              if (e.isPopupTrigger()) m.show(e.getComponent(), e.getX(), e.getY());
          }
          public void mouseReleased(MouseEvent e) {
             if (e.isPopupTrigger()) m.show(e.getComponent(), e.getX(), e.getY());
          }
      });
      addWindowListener(new WindowAdapter() {
           public void windowClosing(WindowEvent e) {
              setVisible(false); dispose(); System.exit(0);
          }
       });
       setSize(200, 200); setVisible(true);
   }
    public static void main(String[] args) {
       PopupMenuDemo app = new PopupMenuDemo();
    }
}
```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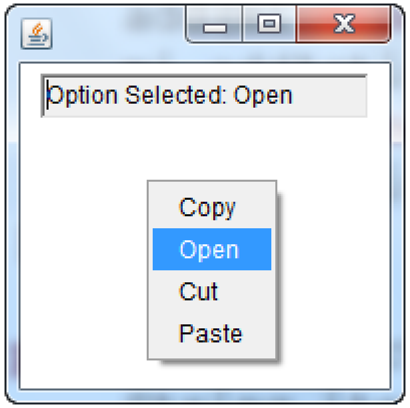
4.3. Popup menu Example

```
class PopupAppMenu extends PopupMenu implements ActionListener {
    PopupMenuDemo ref;
    public PopupAppMenu(PopupMenuDemo ref) {
        super("File");
        this.ref = ref;
        MenuItem mi;
        add(mi = new MenuItem("Copy"));
        mi.addActionListener(this);
        add(mi = new MenuItem("Open"));
        mi.addActionListener(this);
        add(mi = new MenuItem("Cut"));
        mi.addActionListener(this);
        add(mi = new MenuItem("Paste"));
        mi.addActionListener(this);
    }
    public void actionPerformed(ActionEvent e) {
        String item = e.getActionCommand();
        ref.msg.setText("Option Selected: " + item);
    }
}
```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Content

IV. AWT Menu

V. Programming GUI with Swing

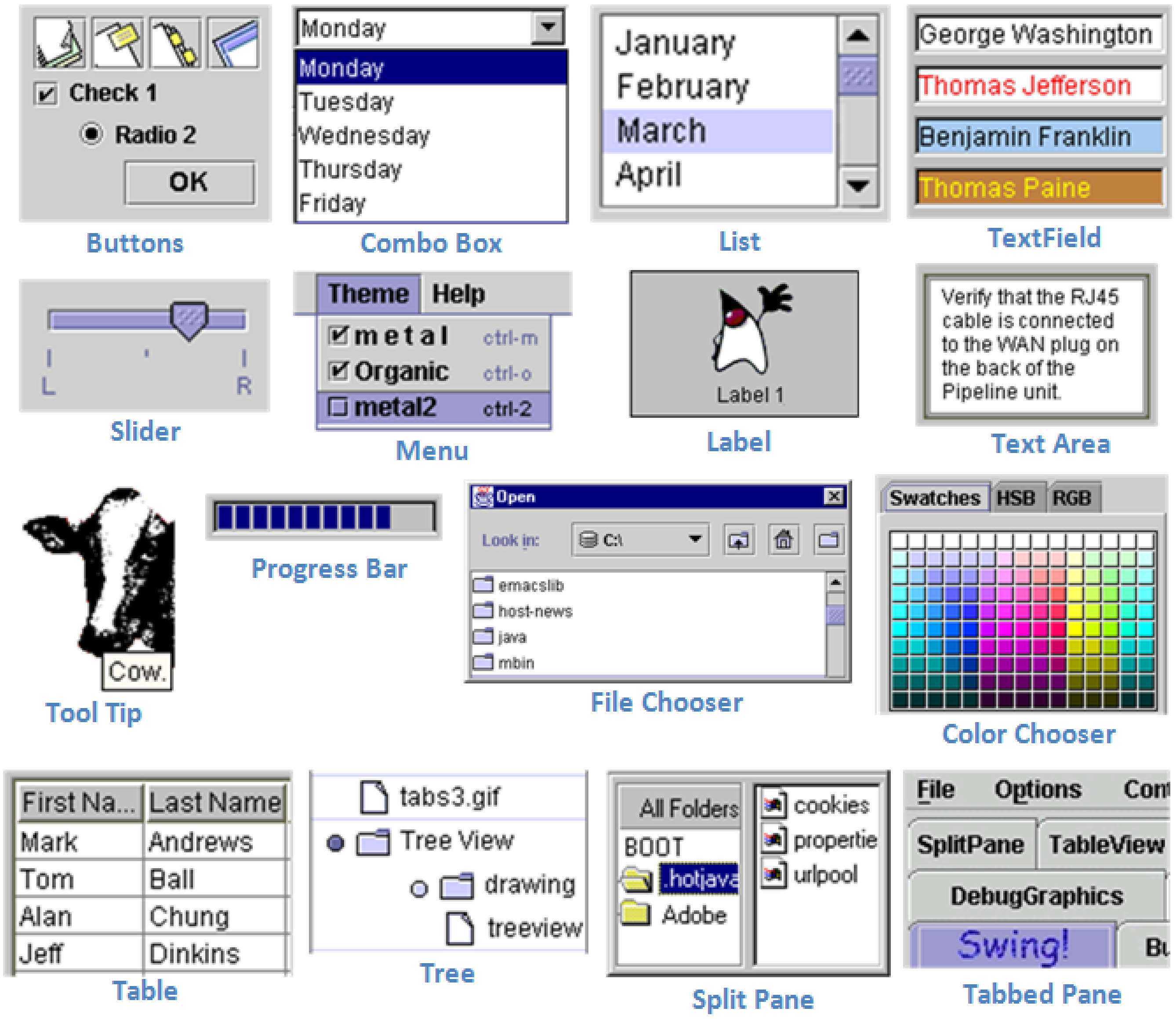
V. Swing

5.1. Introduction
5.2. Swing features
5.3. Swing API
5.4. Sample Swing Application

5.1. Introduction

- Java Foundation Classes (JFC):
  - Swing API
  - Accessibility API
  - Java 2D API
  - Pluggable look and feel supports.
  - Drag-and-drop support between Java and native applications
- Swing appeared after JDK 1.1
- Swing is a rich set of easy-to-use, easy-to-understand GUI components

5.2. Swing features



Verify that the RJ45 cable is connected to the WAN plug on the back of the Pipeline unit.

First Na...	Last Name
Mark	Andrews
Tom	Ball
Alan	Chung
Jeff	Dinkins

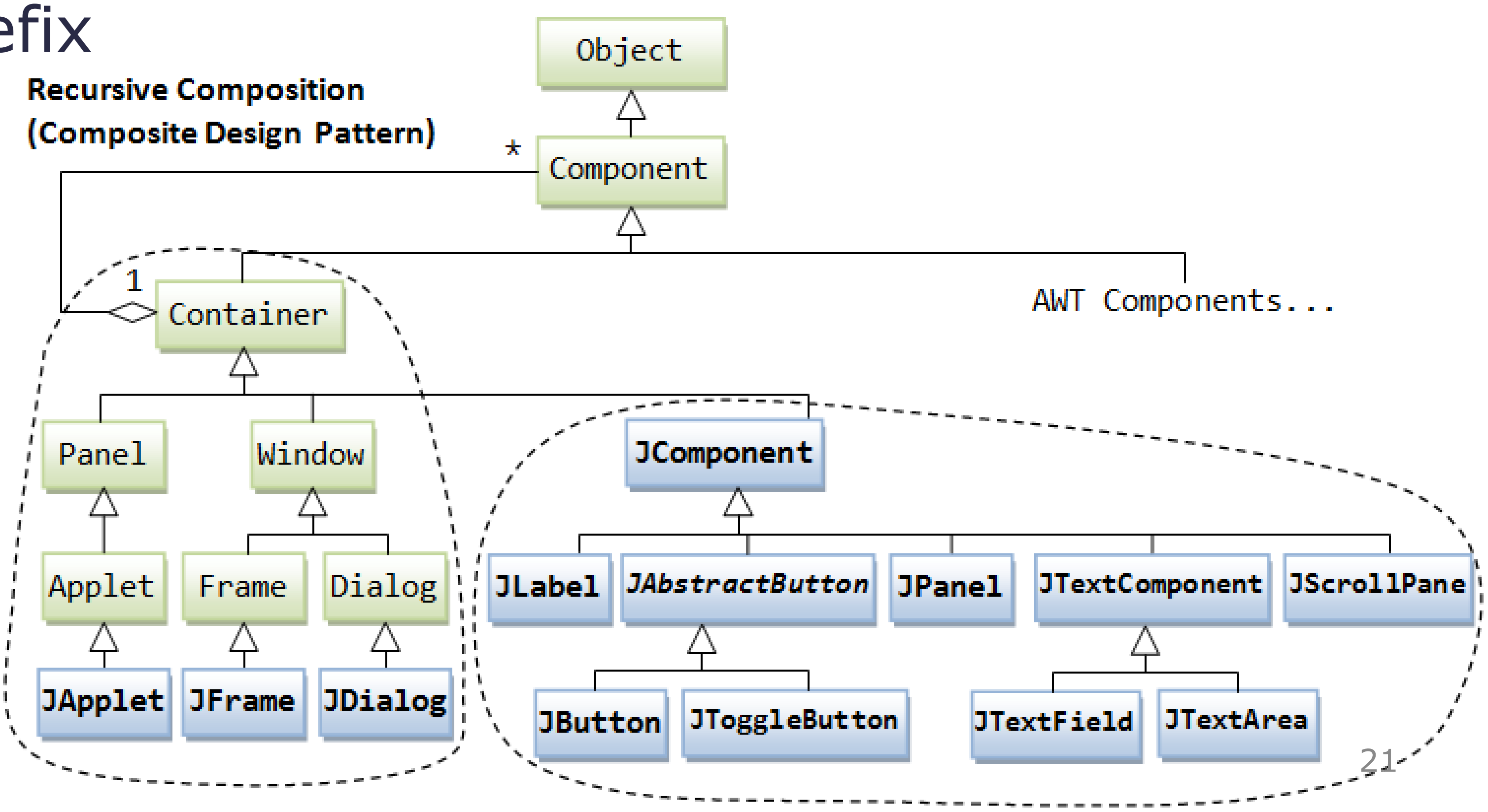
- Huge:
  - 18 packages

5.2. Swing features

- Written in pure java
- Swing components are lightweight
- Swing components support pluggable look-and-feel
- Swing supports *mouse-less operation*
- Swing components support "tool-tips".
- Swing components are *JavaBeans*
- Swing application uses AWT event-handling classes
- Swing application uses AWT's layout manager
- Swing implements *double-buffering* and automatic repaint batching
- Swing supports floating toolbars (in JToolBar), splitter control, "undo"

5.3. Swing API

- Switching AWT programming (container/component, event-handling, layout manager) to Swing is straight-forward
- "J" Prefix



a. Swing's Top-Level and Secondary Containers

- Three top-level containers in Swing:
  - JFrame: used for the application's main window (with an icon, a title, minimize/maximize/close buttons, an optional menu-bar, and a content-pane).
  - JDialog: used for secondary pop-up window (with a title, a close button, and a content-pane).
  - JApplet: used for the applet's display-area (content-pane) inside a browser’s window.
- Secondary containers (JPanel)
  - Used to group and layout components

b. The Content-Pane of Swing's Top-Level Container

- JComponents shall not be added onto the top-level container (e.g., JFrame, JApplet) directly.
  - JComponents must be added onto the so-called *content-pane* of the top-level container
  - Content-pane: a java.awt.Container, can be used to group and layout components
- Two ways to add JComponent to top-level container:
  - get the content-pane via getContentPane() from a top-level container, and add components onto it
  - set the content-pane to a JPanel (the main panel created in your application which holds all your GUI components) via JFrame's setContentPane()
- **Note**: If a component is added directly into a JFrame, it is added into the content-pane of JFrame instead. Inside a Jframe

```
add(new JLabel("add to JFrame directly"));
```

is executed as

```
getContentPane().add(new JLabel("add to JFrame directly"));
```

Using getContentPane()

```
public class TestGetContentPane extends JFrame {
   public TestGetContentPane() {
      Container cp = this.getContentPane();
      cp.setLayout(new FlowLayout());
      cp.add(new JLabel("Hello, world!"));
      cp.add(new JButton("Button"));
      ......
   }
   .......
```

Using setContentPane()

```
public class TestSetContentPane extends JFrame {
  public TestSetContentPane() {
    JPanel mainPanel = new JPanel(new FlowLayout());
    mainPanel.add(new JLabel("Hello, world!"));
    mainPanel.add(new JButton("Button"));

    this.setContentPane(mainPanel);
    ……
  }
  …….
}
```

c. How to write swing application

- Similar to write awt application
  - Remember prefix "J"
    - Use the Swing components with prefix "J" in package javax.swing
  - Add JComponents to content-pane of the top-level container
  - Event-handling:
    - uses the AWT event-handling classes
    - Swing introduces a few new event-handling classes (in package javax.swing.event) but they are not frequently used.

d. Swing program template

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
public class Template extends JFrame {
   // private variables
   public Template() {
      Container cp = this.getContentPane();
      // cp.setLayout(new ....Layout());
      // adds components

      setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
         // Exit the program when the close-window button clicked
      setTitle("Some title");  // "this" JFrame sets title
      setSize(300, 150);   // "this" JFrame sets initial size (or pack())
      setVisible(true);    // show it
   }
   public static void main(String[] args) {
      // Run GUI codes in Event-Dispatching thread for thread-safety
      SwingUtilities.invokeLater(new Runnable() {
         @Override
         public void run() {
            new Template();  // Let the constructor do the job
         }
      });
   }
}
```

e. Special notes working with Swing

- JFrame's setDefaultCloseOperation(int operation)
  - to process the "close-window" button without writing a WindowEvent listener, use setDefaultCloseOperation()
  - Operation can be:
    - DO_NOTHING_ON_CLOSE; don't do anything
    - HIDE_ON_CLOSE: Automatically hide the frame
    - DISPOSE_ON_CLOSE: Automatically hide and dispose the frame
    - EXIT_ON_CLOSE: Exit the application using the System.exit() method
  - we choose the option JFrame.EXIT_ON_CLOSE, which terminates the application via a System.exit():
    - setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

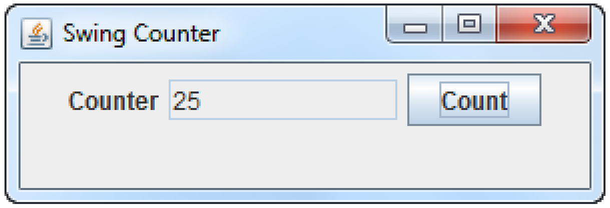
e. Special notes working with Swing

- Running the GUI Construction Codes on the Event-Dispatching Thread
  - We can invoke the constructor directly in the main() method → it is executed in the so-called "Main-Program" thread, causing multi-threading issues (e.g., unresponsive user-interface & deadlock)
  - Recommendation:
    - execute the GUI setup codes in the so-called "Event-Dispatching" thread, for thread-safe operations. To do so, invoke static method SwingUtilities.invokeLater()

```
public static void main(String[] args) {
      // Run GUI codes in Event-Dispatching thread for thread-safety
      SwingUtilities.invokeLater(new Runnable() {
         @Override
         public void run() {
            new Template();  // Let the constructor do the job
         }
      });
   }
```

5.4. Sample Swing application

- The application includes 3 JComponents:
  - A JLabel
  - A JTextField
  - A Jbutton
- Whenever users click the count button, a number representing times of clicks is updated in the JTextField

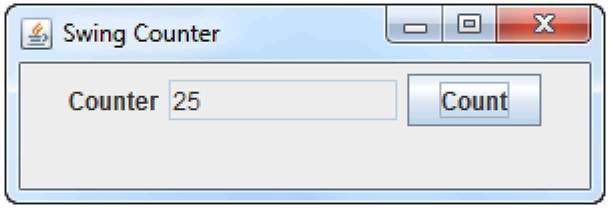


5.4. Sample Swing application

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class SwingCounter extends JFrame{
  private JTextField tfCount;
  private int count = 0;


  /** The entry main() method */
  public static void main(String[] args){
    SwingUtilities.invokeLater(new Runnable(){
      @Override
      public void run() {
        new SwingCounter();
      }
    });
  } // End of main
```



```
  public SwingCounter () {
    Container cp = getContentPane();
    cp.setLayout(new FlowLayout());

    cp.add(new JLabel("Counter"));
    tfCount = new JTextField("0", 10);
    tfCount.setEditable(false);
    cp.add(tfCount);

    JButton btnCount = new JButton("Count");
    cp.add(btnCount);

    btnCount.addActionListener(new ActionListener() {
      @Override
      public void actionPerformed(ActionEvent e) {
        count++;
        tfCount.setText(count + "");
      }
    });

    setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
    setTitle("Swing Counter");
    setSize(300, 100);
    setVisible(true);
  } //end of constructor
}//end of class
```

Quick quiz (1/2)

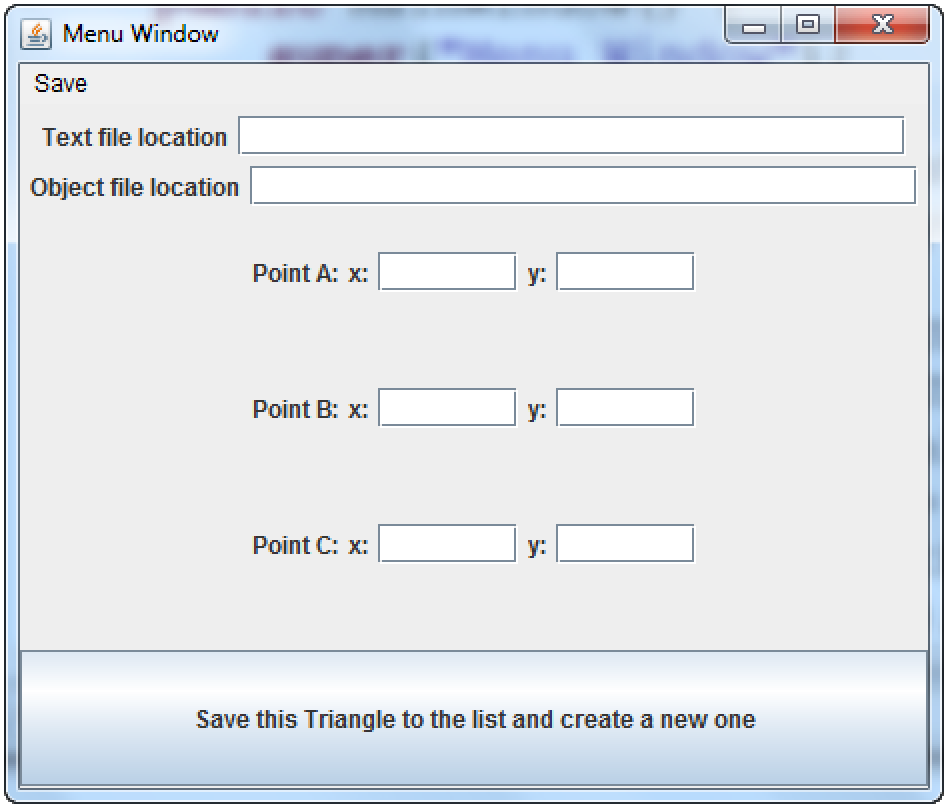
- 1. Out of all these following classes, which one is root class?
  a. MenuItem
  b. MenuComponent
  c. MenuBar
  d. CheckBoxMenuItem
  e. Menu
  f. PopupMenu
- 2. Which command should be used to add MenuBar mb to a Frame fr?
  a. fr.add(mb);
  b. fr.addMenuBar(mb);
  c. fr.setMenuBar(mb);

Quick quiz (2/2)

- 3. Which class we can get key raw code from?
  a. Key
  b. KeyEvent
  c. Container
  d. Component
- 4. Why isPopupTrigger should be checked in both mousePressed and mouseReleased
- 5. What are the top-level containers in Swing?
- 6. Can we add components directly into a JFrame?

Quiz

- Transform your AWT application in previous lesson in to an Swing application
  - The interface now looks better?



Review

- AWT Menu
  - 4 steps to add menus to a frame
  - MenuShortcut to associate a MenuItem with a keyboard shortcut
  - PopupMenu can be added to any Component
- Programming GUI with Swing
  - 3 top-level containers: JFrame, JDialog, Japplet
  - JComponents must be added onto the content-pane of the top-level container.
  - Execute the GUI setup codes in the "Event-Dispatching" thread for thread-safe operations.