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

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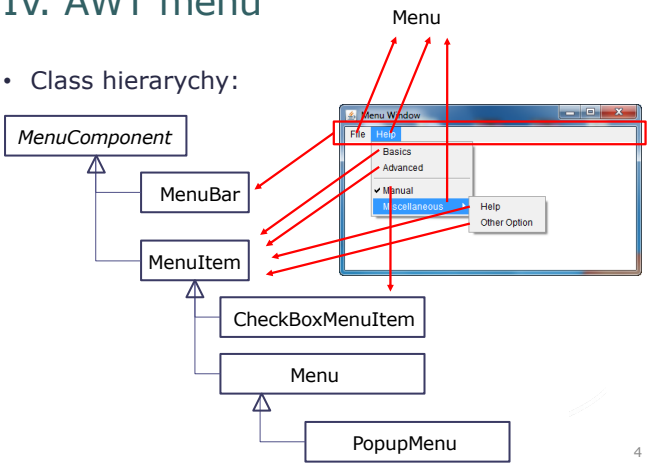
IV. AWT menu

- Class hierarychy:



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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

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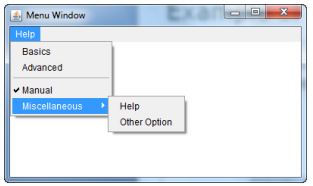
Example of a menu-description

- 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



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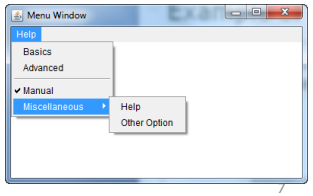
Example of a menu – our Frame class

```
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);
    }
}
```



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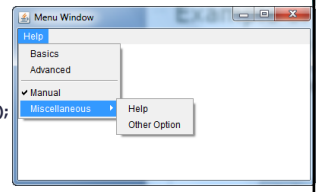
Example of a menu – our Menu class

```
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");
    }
}
```



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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)
```

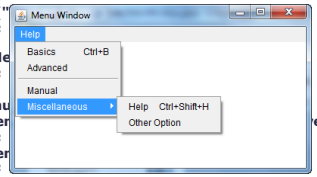
  - key: raw key code (each key has one)
  - useShiftModifier: whether this MenuShortcut is invoked with the SHIFT key down (Otherwise, CTRL only)

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

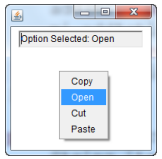
- PopupMenu:
  - extends Menu
  - can be add to any Component, using `add(aPopupMenu)`
  - Can be deinstalled from Component, using `remove(aPopupMenu)`
  - is activated when the user holds the right mouse button
- Constructors:
  - *public PopupMenu()*
    - creates an untitled PopupMenu.
  - *public 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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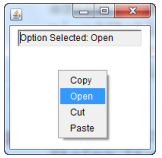
4.3. Popup menu Example

```
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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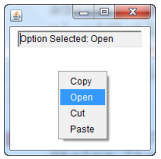
4.3. Popup menu Example

```
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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IV. AWT Menu

V. Programming GUI with Swing

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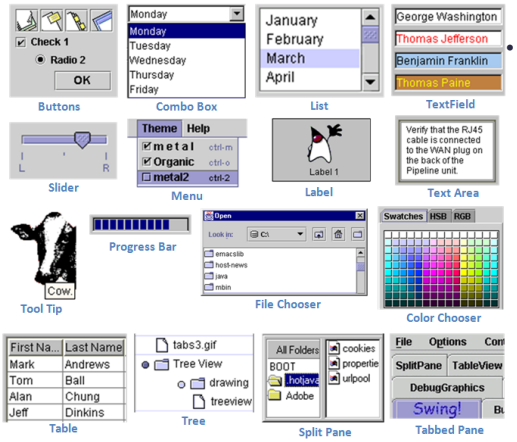
V. Swing

5.1. Introduction

- Swing is part of the so-called "Java Foundation Classes (JFC)"
- JFC consists of:
  - 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



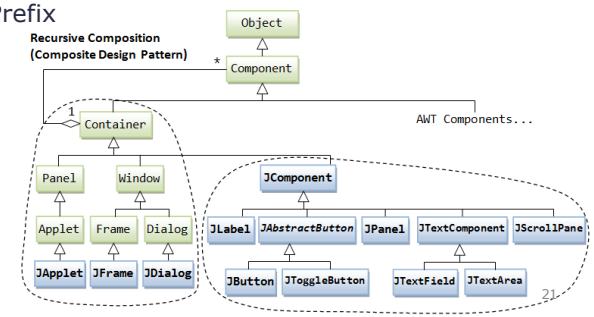
- Huge:
  - 18 packages

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



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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

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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"));
```

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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"));
      ......
   }
   .......
```

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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);
    ......
  }
  .......
}
```

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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.

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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
         }
      });
   }
}
```

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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);

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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
         }
      });
   }
```

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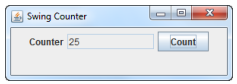
5.4. Sample Swing application

- 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



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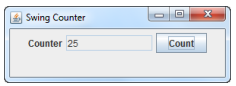
5.4. Sample Swing application

```
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
```

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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);

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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?

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Review

- 5 important classes to work with AWT menu: MenuComponent, MenuBar, MenuItem, CheckBoxMenuItem, Menu, PopupMenu
- There are four steps to add Menus to a frame: (1) create a MenuBar, (2) create a Menu, (3) Add MenuItem to the Menu and (4) add the MenuBar to the Frame
- Use MenuShortcut to associate a MenuItem with a keyboard shortcut
- PopupMenu can be added to any Component

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Review

- Swing is part of JFC. It is huge with 18 packages
- Switching AWT programming (container/component, event-handling, layout manager) to Swing is straight-forward
- Three top-level containers in Swing are JFrame, JDialog, Japplet
- JComponents must be added onto the so-called *content-pane* of the top-level container.
- It is recommended to execute the GUI setup codes in the so-called "Event-Dispatching" thread, instead of "Main-Program" thread, for thread-safe operations.

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