

Swing: Components for Graphical User Interfaces

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Lecture 23

GUI

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The screenshot shows the Attensity Discover search interface. It features a search bar at the top with the text "Reuters (Category Set: No Category Set Opened) - Attensity Discover". Below the search bar are several filter panels:

- Actor:** Includes filters for COMPANY (11613, 23%), COMPANY'S (16, < 1%), UNITED_STATES (1202, 4%), AMERICANS (147, < 1%), and DEPARTMENT (1048, 3%).
- Action:** Includes filters for BE (631, 1%), HAVE (398, 1%), REPORT (232, < 1%), EXPECT (218, < 1%), PLAN (198, < 1%), CONTRIBUTE (121, < 1%), ACREE (110, < 1%), SELL (109, < 1%), MAKE (104, < 1%), ADD (99, < 1%), EARN (78, < 1%), ANNOUNCE (76, < 1%), and PAY (72, < 1%).
- Object:** Includes filters for PHRASE (5697, 15%), SHARE (195, < 1%), DURS (178, < 1%), COMPANY (80, < 1%), OUTSTANDING (74, < 1%), PERCENT (62, < 1%), SALE (60, < 1%), OFFER (59, < 1%), DIVIDEND (56, < 1%), AGREE (54, < 1%), LOSS (48, < 1%), and PRICE (44, < 1%).

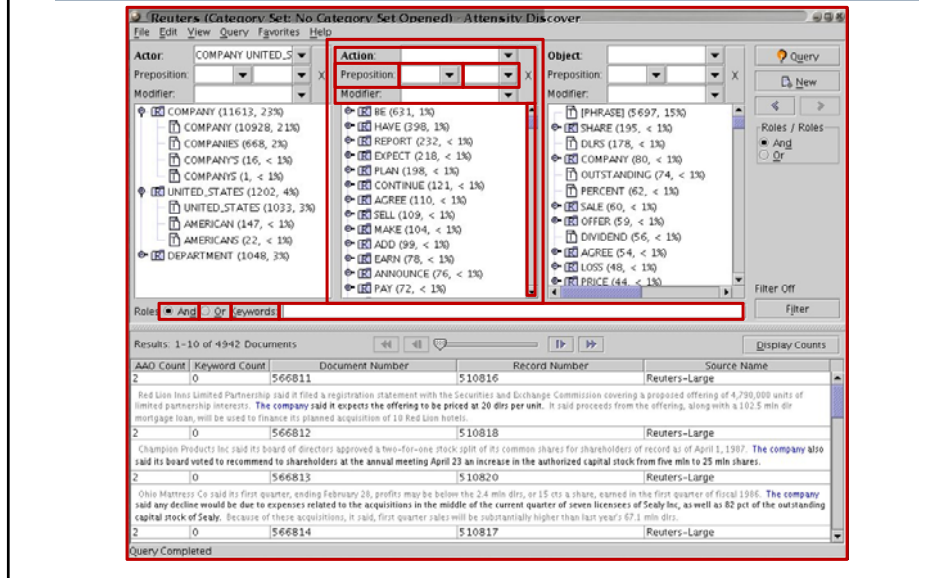
Below the filters is a "Roles / Roles" section with "And" and "Or" options. The main results area shows a table of search results:

AAO Count	Keyword Count	Document Number	Record Number	Source Name
2	0	566811	510816	Reuters-Large
Red Lion Inns Limited Partnership said it filed a registration statement with the Securities and Exchange Commission covering a proposed offering of 4,790,000 units of limited partnership interests. The company said it expects the offering to be priced at 20 dms per unit. It said proceeds from the offering, along with a 102.5 mln dlr mortgage loan, will be used to finance its planned acquisition of 10 Red Lion hotels.				
2	0	566812	510818	Reuters-Large
Champion Products Inc said its board of directors approved a two-for-one stock split of its common shares for shareholders of record as of April 1, 1987. The company also said its board voted to recommend to shareholders at the annual meeting April 23 an increase in the authorized capital stock from five mln to 25 mln shares.				
2	0	566813	510820	Reuters-Large
Ohio Mattress Co said its first quarter, ending February 28, profits may be below the 2.4 mln dms, or 15 cts a share, earned in the first quarter of fiscal 1986. The company said any decline would be due to expenses related to the acquisitions in the middle of the current quarter of seven licenses of Sealy Inc, as well as 82 pct of the outstanding capital stock of Sealy. Because of these acquisitions, it said, first quarter sales will be substantially higher than last year's 67.1 mln dms.				
2	0	566814	510817	Reuters-Large

At the bottom of the window, it says "Query Completed".

GUI: A Hierarchy of Nested Widgets

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Visual (Containment) Hierarchy

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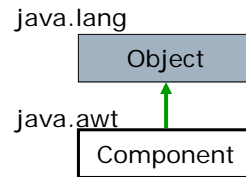
- Top-level widgets: outermost window (a container)
 - Frame, applet, dialog
- Intermediate widgets: allow nesting (a container)
 - General purpose
 - Panel, scroll pane, tabbed pane, tool bar
 - Special purpose
 - Layered pane
- Atomic widgets: nothing nested inside
 - Basic controls
 - Button, list, slider, text field
 - Uneditable information displays
 - Label, progress bar, tool tip
 - Interactive displays of highly formatted information
 - Color chooser, file chooser, tree
- For a visual ("look & feel") of widgets see:
 - <http://download.oracle.com/javase/tutorial/ui/features/components.html>
- Vocabulary: Widgets usually referred to as "GUI components" or simply "components"

History

- Java 1.0: AWT (Abstract Window Toolkit)
 - Platform-dependent implementations of widgets
- Java 1.2: Swing
 - Most widgets written entirely in Java
 - More portable
- Main Swing package: javax.swing
 - Defines various GUI widgets
 - Extensions of classes in AWT
 - Many class names start with "J"
 - Includes 16 nested subpackages
 - javax.swing.event, javax.swing.table, javax.swing.text...
- Basic GUI widgets include
 - JFrame, JDialog
 - JPanel, JScrollPane, JTabbedPane, JToolBar
 - JButton, JRadioButton, JCheckBox, JTextField, JSlider
 - JLabel, JToolTip
 - JColorChooser, JFileChooser

Class Hierarchy: Component

- A *component* is an object having a graphical representation that can be displayed on the screen and that can interact with the user.
- Operations common to nonmenu-related GUI widgets
 - More than 60 (public) methods!
- Drawing the widget
 - `paint()`: draw the whole widget
 - `repaint()`: schedule the widget to be redrawn, will result in framework calling...
 - `update()`: modifies part of widget, or just calls `paint()` for full refresh
- Appearance of widget
 - `setVisible()`: determine whether widget will be visible on screen
 - `setLocation()`
- Dealing with user events

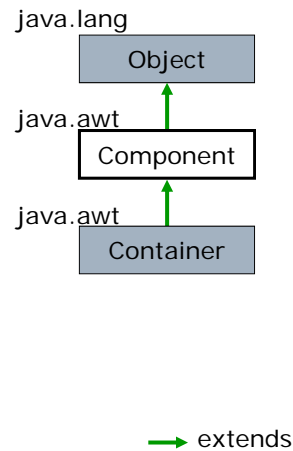


→ extends

Class Hierarchy: Container

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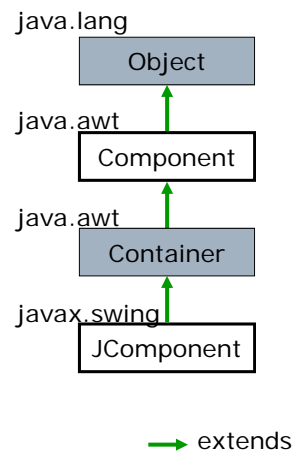
- A widget that can include other widgets
 - Visual nesting
- Contained widgets are called “children”
 - But not children as in behavioral subtypes
- Methods for managing contained widgets
 - add: adds widgets to container
 - setLayout: specifies the layout manager that helps container position and size contained widgets



Basic Hierarchy: JComponent

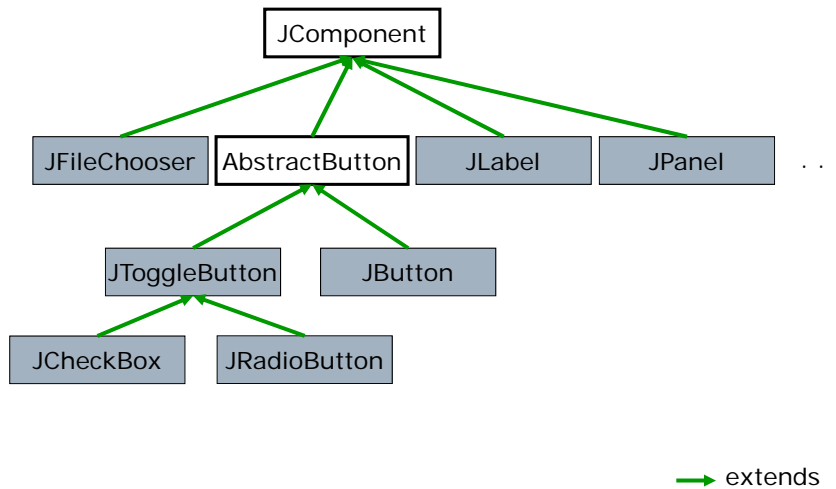
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- Base class for all Swing widgets, except top-level containers (ie applet, frame, dialog)



Part of JComponent Hierarchy

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JLabel

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- A JLabel object provides text instructions or information on a GUI
 - Displays a single line of *read-only* text, an image, or both
- See
 - Example code
 - Output
- One thing to be emphasized:
 - If you do not *explicitly add* a widget to a container, the widget will not be displayed when the container appears on the screen

An Interactive GUI Component

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- To make an interactive GUI program, you need:
 - Widgets (ie GUI components)
 - Buttons, windows, menus, etc.
 - Events
 - Mouse clicked, window closed, button clicked, etc.
 - Event listeners (implement an interface) and event handlers (methods)
 - Listen for events to be triggered, and then perform actions to handle them

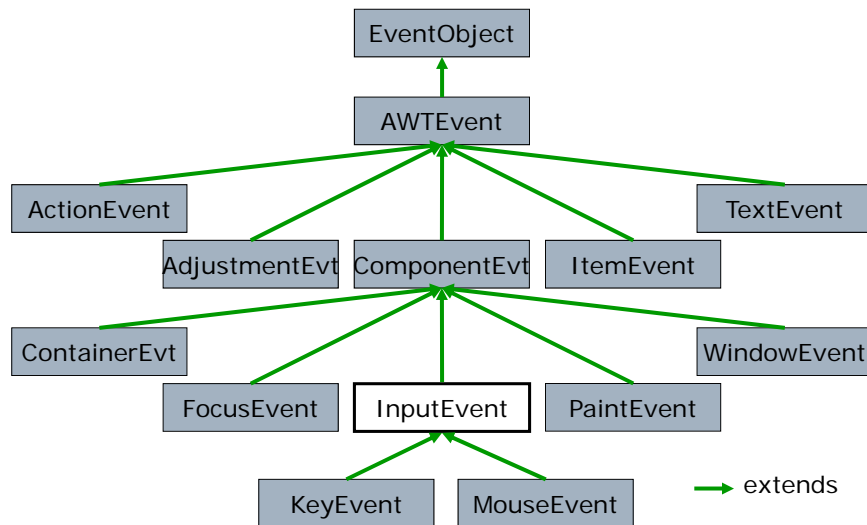
Handling Events

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- GUI is *event driven*
- Event handling occurs as a loop:
 - GUI program is idle
 - User performs an action, for example:
 - Moving the mouse, clicking a button, closing a window, typing in a text box, selecting an item from a menu, ...
 - Such an action generates an event
 - The event is sent to the program, which responds
 - Code executes, GUI updates
 - GUI program returns to being idle
- Many event types defined in `java.awt.event` and `javax.swing.event`

Part of AWTEvent Hierarchy

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Handling Events Mechanism

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- Three parts of the event-handling mechanism
 - *Event source*: the widget with which the user interacts
 - *Event object*: encapsulated information about the occurred event
 - *Event listener*: an object that is notified by the event source when an event occurs, and responds to the event



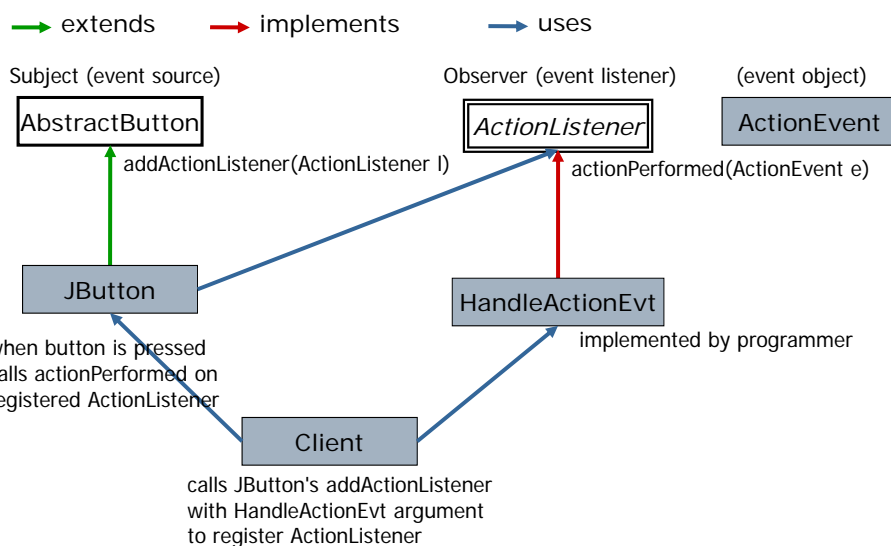
Programmer Tasks

- Implement an event listener
 - A class X that implements one (or more) of the event listener interfaces

```
interface ActionListener {
    void actionPerformed (ActionEvent e);
}
interface FocusListener {
    void focusGained (FocusEvent e);
    void focusLost (FocusEvent e);
}
```
- Register an instance of X with widget
 - java.awt's Component, Container, etc. have methods for adding listeners

```
void addFocusListener (FocusListener f)
```

Observer Pattern



JTextField and JPasswordField

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- Single-line areas for text
 - Can be editable (user enters text from keyboard) or not
 - Password field does not show individual characters
- When the user types data into them and presses the Enter key:
 - An event occurs (ActionEvent)
 - All registered listeners (ActionListeners) receive the event
 - Argument to method actionPerformed includes text from field
- See:
 - Example code
 - Output

Buttons

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- A button is a clickable widget
- There are several types of buttons, all are subclasses of AbstractButton
 - Command button:
 - Class JButton, generates(ActionEvent)
 - Toggle button:
 - Has on/off or true/false values
 - Check boxes:
 - A group of buttons in which more than one can be selected, generates(ItemEvent)
 - Radio buttons:
 - A group of buttons in which only one can be selected, generates(ItemEvent)
- See:
 - Example code
 - Output

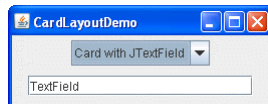
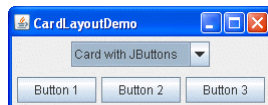
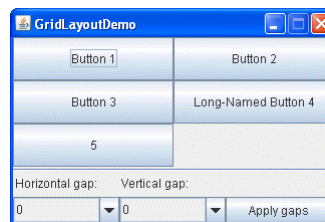
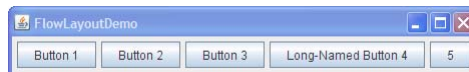
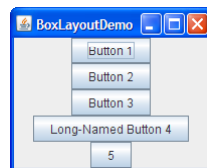
More Widgets...

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- JComboBox:
 - A drop-down list from which the user can make a selection
 - Generates an ItemEvent
- JList:
 - A list supporting both single and multiple selection
 - Generates a ListSelectionEvent

Layout Management

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Layout Management

- Layout: how components are arranged in the container



- This positioning is determined by a layout manager
 - Buttons in the above example are managed by the flow layout manager, which is the default layout manager for a panel
 - The default manager lines the components horizontally until there is no more room and then start a new row of components
 - After resizing the container, the layout manager reflows the components automatically
 - The default is to center the components in each row, but this can be overridden with left or right alignment
- Other managers: for a visual (“look & feel”) index see <http://download.oracle.com/javase/tutorial/uiswing/layout/visual.html>

```
panel.setLayout(new FlowLayout(FlowLayout.LEFT));
```

Layout Management with Panels

- Problem with BorderLayout:

- The button is stretched to fill the entire southern region of the frame
- If you add another button to the southern region, it just displaces the first button

- Solution: use additional panels

- Act as containers for interface elements and can themselves be arranged inside a larger panel
- Use flow layout by default

- To fix the BorderLayout problem

1. Create a new panel
2. Add each element to the panel
3. Add the panel to the larger container



```
JPanel p = new JPanel();  
p.add(button1);  
p.add(button2);  
p.add(button3);  
frame.add(panel,  
BorderLayout.PAGE_END);
```

Supplemental Reading

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- A visual index to the Swing Components
 - <http://download.oracle.com/javase/tutorial/uiswing/components/>
- Creating a GUI with JFC/Swing
 - <http://download.oracle.com/javase/tutorial/uiswing/index.html>
- Building a User Interface
 - <http://java.sun.com/new2java/divelog>
 - <http://www.oracle.com/technetwork/articles/javase/index-142890.html>

Summary

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- Containment hierarchy
 - Containers (frame, applet, dialog)
 - Components (panel, scroll pane, tabbed pane,...)
 - Controls (button, text field, label,...)
- Event-driven programming
 - Register handlers with components
 - Events are passed from components to handlers
- Layout
- Look and feel?