Swing

- JFC (Java Foundation Classes)
- Componentele Swing
- Asemănări şi deosebiri cu AWT
- Folosirea ferestrelor
- Ferestre interne
- Arhitectura modelului Swing
- Folosirea modelelor
- Tratarea evenimentelor
- Folosirea componentelor
- Containere
- Desenarea
- Look and Feel

JFC (Java Foundation Classes)

- Componente Swing
- Look-and-Feel
- Accessibility API
- Java 2D API
- Drag-and-Drop
- Internaţionalizare

Swing API

```
javax.accessibility    javax.swing.plaf
javax.swing.text.html  javax.swing
javax.swing.plaf.basic javax.swing.text.parser
javax.swing.border     javax.swing.plaf.metal
javax.swing.text.rtf   javax.swing.colorchooser
javax.swing.plaf.multi javax.swing.tree
javax.swing.event      javax.swing.table
javax.swing.undo       javax.swing.filechooser
javax.swing.text
```

Cel mai important: **javax.swing**

Componentele Swing

- **Componente atomice**
  `JLabel, JButton, JCheckBox, JRadioButton, JToggleButton, JScrollBar, JSlider, JProgressBar, JSeparator`
- **Componente complexe**
  `JTable, JTree, JComboBox, JSpinner, JList, JFileChooser, JColorChooser, JOptionPane`
- **Componente pentru editare de text**
  `JTextField, JFormattedTextField, JPasswordField, JTextArea, JEditorPane, JTextPane`
- **Meniuri**
  `JMenuBar, JMenu, JPopupMenu, JMenuItem, JCheckboxMenuItem, JRadioButtonMenuItem`
- **Containere intermediare**
  `JPanel, JScrollPane, JSplitPane, JTabbedPane, JDesktopPane, JToolBar`
- **Containere de nivel înalt**
  `JFrame, JDialog, JWindow, JInternalFrame, JApplet`

Asemănări şi deosebiri cu AWT

Tehnologia Swing **extinde** AWT.

```
import javax.swing.*;
import java.awt.*; //Font, Color, ...
import java.awt.event.*;
```

Convenţia ”J”

`java.awt.Button` - `javax.swing.JButton`
`java.awt.Label` - `javax.swing.JLabel`, etc.

Noi gestionari de poziţionare: `BoxLayout` şi `SpringLayout`

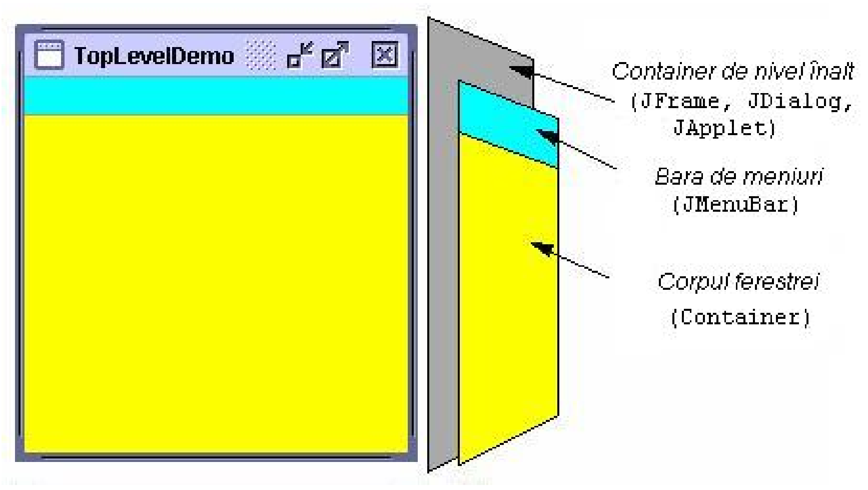
Folosirea HTML

```
JButton simplu = new JButton("Text simplu");
JButton html = new JButton(
  "<html><u>Text</u> <i>formatat</i></html>");
```

Listing 1: Aplicaţia rescrisă folosind Swing

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

public class ExempluSwing extends JFrame implements
    ActionListener {
  public ExempluSwing(String titlu) {
    super(titlu);
    // Metoda setLayout nu se aplica direct ferestrei
    getContentPane().setLayout(new FlowLayout());

    // Componentele au denumiri ce incep cu litera J
    // Textul poate fi si in format HTML
    getContentPane().add(new JLabel(
      "<html><u>Hello</u> <i>Swing</i></html>"));
    JButton b = new JButton("Close");
    b.addActionListener(this);

    // Metoda add nu se aplica direct ferestrei
    getContentPane().add(b);
    pack();
    show();
  }
  public void actionPerformed(ActionEvent e) {
    // Tratarea evenimentelor se face ca in AWT
    System.exit(0);
  }
  public static void main(String args[]) {
    new ExempluSwing("Hello");
  }
}
```

Folosirea ferestrelor



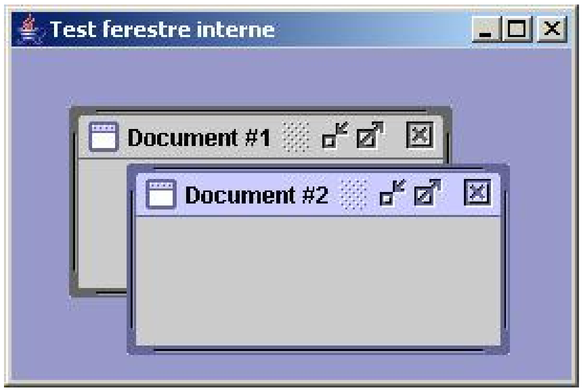
```
Frame f = new Frame();
f.setLayout(new FlowLayout());
f.add(new Button("OK"));

JFrame jf = new JFrame();
jf.getContentPane().setLayout(new FlowLayout());
jf.getContentPane().add(new JButton("OK"));

jf.setDefaultCloseOperation(
  WindowConstants.HIDE_ON_CLOSE);
  WindowConstants.DO_NOTHING_ON_CLOSE
  JFrame.EXIT_ON_CLOSE
```

Ferestre interne

Aplicaţiile pot fi împărţite în:

- **SDI** (Single Document Interface)
- **MDI** (Multiple Document Interface)

Clase:
JInternalFrame
DesktopPane - container



Listing 2: Folosirea ferestrelor interne

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

class FereastraPrincipala extends JFrame {
    public FereastraPrincipala(String titlu) {
      super(titlu);
      setSize(300, 200);
      setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

      FereastraInterna fin1 = new FereastraInterna();
      fin1.setVisible(true);
      FereastraInterna fin2 = new FereastraInterna();
      fin2.setVisible(true);

      JDesktopPane desktop = new JDesktopPane();
      desktop.add(fin1);
      desktop.add(fin2);
      setContentPane(desktop);

      fin2.moveToFront();
  }
}

class FereastraInterna extends JInternalFrame {
  static int n = 0; //nr. de ferestre interne
  static final int x = 30, y = 30;

  public FereastraInterna() {
    super("Document #" + (++n),
          true, //resizable
          true, //closable
          true, //maximizable
          true);//iconifiable
    setLocation(x*n, y*n);
    setSize(new Dimension(200, 100));
  }
}
public class TestInternalFrame {
  public static void main(String args[]) {
    new FereastraPrincipala("Test ferestre interne").show();
  }
}
```

Clasa JComponent

`JComponent` este superclasa tuturor componentelor Swing, mai puţin `JFrame`, `JDialog`, `JApplet`.
`JComponent` extinde clasa `Container`.

Facilităţi:

- **ToolTips** - `setToolTip`
- **Chenare** - `setBorder`
- **Suport pentru plasare şi dimensionare** - `setPreferredSize`, . . .
- **Controlul opacităţii** - `setOpaque`
- **Asocierea de acţiuni tastelor**
- **Double-Buffering**

Listing 3: Facilităţi oferite de clasa `JComponent`

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

class Fereastra extends JFrame {
  public Fereastra(String titlu) {
    super(titlu);
    getContentPane().setLayout(new FlowLayout());
    setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

    // Folosirea chenarelor
    Border lowered, raised;
    TitledBorder title;

    lowered = BorderFactory.createLoweredBevelBorder();
    raised = BorderFactory.createRaisedBevelBorder();
    title = BorderFactory.createTitledBorder("Borders");

    final JPanel panel = new JPanel();
    panel.setPreferredSize(new Dimension(400,200));
    panel.setBackground(Color.blue);
    panel.setBorder(title);
    getContentPane().add(panel);

    JLabel label1 = new JLabel("Lowered");
    label1.setBorder(lowered);
    panel.add(label1);

    JLabel label2 = new JLabel("Raised");
    label2.setBorder(raised);
    panel.add(label2);

    // Controlul opacitatii
    JButton btn1 = new JButton("Opaque");
    btn1.setOpaque(true); // implicit
    panel.add(btn1);

    JButton btn2 = new JButton("Transparent");
    btn2.setOpaque(false);
    panel.add(btn2);

    // ToolTips
    label1.setToolTipText("Eticheta coborata");
    label2.setToolTipText("Eticheta ridicata");
    btn1.setToolTipText("Buton opac");
    // Textul poate fi HTML
    btn2.setToolTipText("<html><b>Apasati <font color=red>F2
       </font> " +
        "cand butonul are <u>focusul</u>");

    // Asocierea unor actiuni (KeyBindings)
    /* Apasarea tastei F2 cand focusul este pe butonul al
       doilea
       va determina schimbarea culorii panelului */
    btn2.getInputMap().put(KeyStroke.getKeyStroke("F2"),
                                "schimbaCuloare");
    btn2.getActionMap().put("schimbaCuloare", new
       AbstractAction() {
      private Color color = Color.red;
      public void actionPerformed(ActionEvent e) {
        panel.setBackground(color);
        color = (color == Color.red ? Color.blue : Color.red)
           ;
      }
    });

    pack();
  }
}

public class TestJComponent {
  public static void main(String args[]) {
    new Fereastra("Facilitati JComponent").show();
  }
}
```

Arhitectura modelului Swing

MVC (model-view-controller).

- *Modelul* - datele aplicaţiei.
- *Prezentarea* - reprezentare vizuală
- *Controlul* - transformarea acţiunilor în evenimente

Arhitectură cu model separabil

Model + (Prezentare, Control)

Folosirea modelelor

Model	**Componentă**
`ButtonModel`	`JButton, JToggleButton, JCheckBox, JRadioButton, JMenu, JMenuItem, JCheckBoxMenuItem, JRadioButtomMenuItem`
`JComboBox`	`ComboBoxModel`
`BoundedRangeModel`	`JProgressBar, JScrollBarm, JSlider`
`JTabbedPane`	`SingleSelectionModel`
`ListModel`	`JList`
`ListSelectionModel`	`JList`
`JTable`	`TableModel`
`JTable`	`TableColumnModel`
`JTree`	`TreeModel`
`JTree`	`TreeSelectionModel`
`Document`	`JEditorPane, JTextPane, JTextArea, JTextField, JPasswordField`

Crearea unui model = implementarea interfeţei

`JList` - `ListModel`

`DefaultListModel`, `AbstractListModel`

Listing 4: Folosirea mai multor modele pentru o componenta

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

class Fereastra extends JFrame implements ActionListener {
  String data1[] = {"rosu", "galben", "albastru"};
  String data2[] = {"red", "yellow", "blue"};
  int tipModel = 1;
  JList lst;
  ListModel model1, model2;

  public Fereastra(String titlu) {
    super(titlu);
    setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

    // Lista initiala nu are nici un model
    lst = new JList();
    getContentPane().add(lst, BorderLayout.CENTER);

    // La apasara butonului schimbam modelul
    JButton btn = new JButton("Schimba modelul");
    getContentPane().add(btn, BorderLayout.SOUTH);
    btn.addActionListener(this);

    // Cream obiectele corespunzatoare celor doua modele
    model1 = new Model1();
    model2 = new Model2();
    lst.setModel(model1);

    pack();
  }

  public void actionPerformed(ActionEvent e) {
    if (tipModel == 1) {
      lst.setModel(model2);
      tipModel = 2;
    }
    else {
      lst.setModel(model1);
      tipModel = 1;
    }
  }
  // Clasele corespunzatoare celor doua modele
  class Model1 extends AbstractListModel {
    public int getSize() {
        return data1.length;
    }
    public Object getElementAt(int index) {
      return data1[index];
    }
  }

  class Model2 extends AbstractListModel {
    public int getSize() {
        return data2.length;
    }
    public Object getElementAt(int index) {
      return data2[index];
    }
  }

}


public class TestModel {
  public static void main(String args[]) {
    new Fereastra("Test Model").show();
  }
}
```

Tratarea evenimentelor

1. Informativ (lightweight)

`ChangeListener` - `ChangeEvent`

Modele: `BoundedRangeModel`, `ButtonModel` şi `SingleSelectionModel`

```
JSlider slider = new JSlider();
BoundedRangeModel model = slider.getModel();
model.addChangeListener(new ChangeListener() {
   public void stateChanged(ChangeEvent e) {
      // Sursa este de tip BoundedRangeModel
      BoundedRangeModel m =
        (BoundedRangeModel)e.getSource();
      // Trebuie sa interogam sursa asupra schimbarii
      System.out.println(
        "Schimbare model: " + m.getValue());
   }
});
```

2. Consistent(statefull)

Model	**Tip Eveniment**
ListModel	ListDataEvent
ListSelectionModel	ListSelectionEvent
ComboBoxModel	ListDataEvent
TreeModel	TreeModelEvent
TreeSelectionModel	TreeSelectionEvent
TableModel	TableModelEvent
TableColumnModel	TableColumnModelEvent
Document	DocumentEvent
Document	UndoableEditEvent

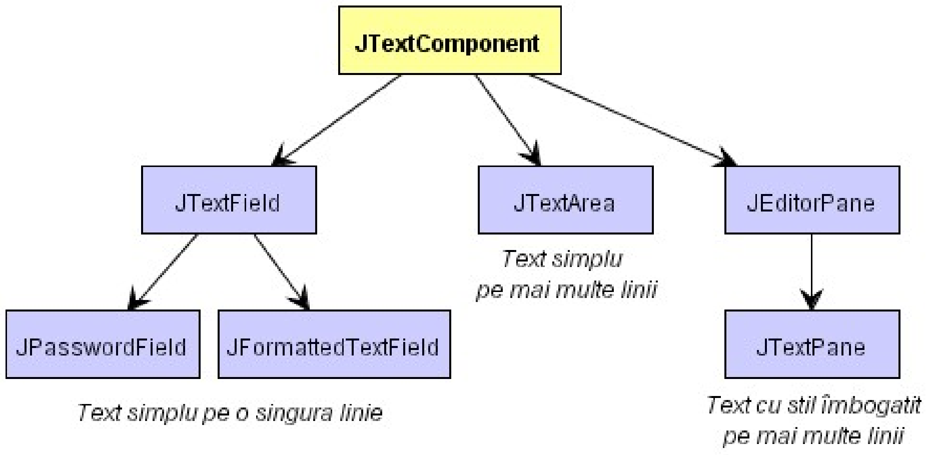
```
String culori[] = {"rosu", "galben", "albastru");
JList list = new JList(culori);
ListSelectionModel sModel = list.getSelectionModel();
sModel.addListSelectionListener(
  new ListSelectionListener() {
    public void valueChanged(ListSelectionEvent e) {
      // Schimbarea este continuta in eveniment
      if (!e.getValueIsAdjusting()) {
        System.out.println("Selectie curenta: " +
          e.getFirstIndex());
      }
   }
});
```

Folosirea componentelor

Componente atomice

- Etichete: `JLabel`
- Butoane simple sau cu două stări: `JButton`, `JCheckBox`, `JRadioButton`, `JToggleButton`;
- Componente pentru progres şi derulare: `JSlider`, `JProgressBar`, `JScrollBar`
- Separatori: `JSeparator`

Componente editare de text


JTextComponent
JTextField
JTextArea
JEditorPane
Text simplu pe mai multe linii
JPasswordField
JFormattedTextField
JTextPane
Text simplu pe o singura linie
Text cu stil îmbogatit pe mai multe linii

Facilităţi: *undo* şi *redo*, tratarea evenimentelor generate de cursor (caret), etc.

Arhitectura `JTextComponent`:

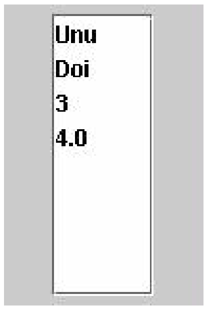
- **Model** - `Document`
- **Reprezentare**
- **'Controller'** - *editor kit*

Tratarea evenimentelor

- **ActionEvent**
  `ActionListener`
  - `actionPerformed`
- **CaretEvent**
  `CaretListener`
  - `caretUpdate`
- **DocumentEvent**
  `DocumentListener`
  - `insertUpdate`
  - `removeUpdate`
  - `changedUpdate`
- **PropertyChangeEvent**
  `PropertyChangeListener`
  - `propertyChange`

Componente pentru selectare

Clasa JList



Iniţializarea

```
Object elemente[] = {"Unu", new Integer(2)};
JList lista = new JList(elemente);

DefaultListModel model = new DefaultListModel();
model.addElement("Unu");
model.addElement(new Integer(2));
JList lista = new JList(model);

ModelLista model = new ModelLista();
JList lista = new JList(model);
```

Tratarea evenimentelor

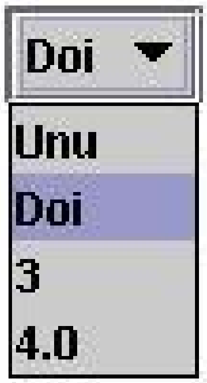
```
class Test implements ListSelectionListener {
  ...
  public Test() {
    ...
   // Stabilim modul de selectie
   list.setSelectionMode(
      ListSelectionModel.SINGLE_SELECTION);
           // sau SINGLE_INTERVAL_SELECTION
           //     MULTIPLE_INTERVAL_SELECTION

   // Adaugam un ascultator
   ListSelectionModel model = list.getSelectionModel();
   model.addListSelectionListener(this);
    ...
  }

  public void valueChanged(ListSelectionEvent e) {
    if (e.getValueIsAdjusting()) return;
    int index = list.getSelectedIndex();
    ...
  }
}
```

Obiecte de tip Renderer

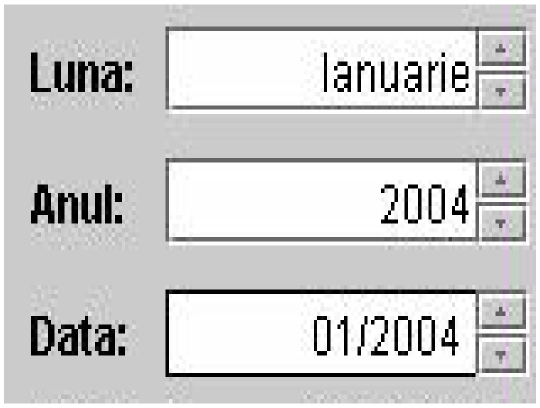
Un *renderer* este responsabil cu afişarea articolelor unei componente.

```
class MyCellRenderer extends JLabel
    implements ListCellRenderer {

  public MyCellRenderer() {
   setOpaque(true);
  }
  public Component getListCellRendererComponent(
      JList list, Object value, int index,
      boolean isSelected, boolean cellHasFocus)  {
    setText(value.toString());
    setBackground(isSelected ?
      Color.red : Color.white);
    setForeground(isSelected ?
      Color.white : Color.black);
    return this;
  }
}
...
list.setCellRenderer(new MyCellRenderer());
```

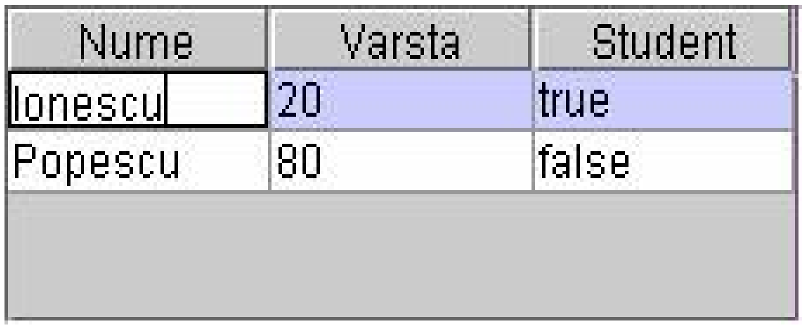
Clasa JComboBox



Clasa JSpinner



Tabele



Nume	Varsta	Student
Ionescu	20	true
Popescu	80	false

Iniţializarea

```
String[] coloane = {"Nume", "Varsta", "Student"};
Object[][] elemente = {
    {"Ionescu", new Integer(20), Boolean.TRUE},
    {"Popescu", new Integer(80), Boolean.FALSE}};
JTable tabel = new JTable(elemente, coloane);
```

Folosirea unui model

```
ModelTabel model = new ModelTabel();
JTable tabel = new JTable(model);
...
class ModelTabel extends AbstractTableModel {
  String[] coloane = {"Nume", "Varsta", "Student"};
  Object[][] elemente = {
    {"Ionescu", new Integer(20), Boolean.TRUE},
    {"Popescu", new Integer(80), Boolean.FALSE}};

  public int getColumnCount() {return coloane.length;}
  public int getRowCount() {return elemente.length;}
  public Object getValueAt(int row, int col) {
    return elemente[row][col];
  }
  public String getColumnName(int col) {
    return coloane[col];
  }
  public boolean isCellEditable(int row, int col) {
    // Doar numele este editabil
    return (col == 0);
  }
}
```

Tratarea evenimentelor

1. Generate de editarea celulelor

```
public class Listener implements TableModelListener {
  public void tableChanged(TableModelEvent e) {
    // Aflam celula care a fost modificata
    int row = e.getFirstRow();
    int col = e.getColumn();
    TableModel model = (TableModel)e.getSource();
    Object data = model.getValueAt(row, col);
    ...
  }
}
  ...
  tabel.getModel().addTableModelListener(new Listener());
```

2. Generate de selectarea liniilor

```
class Listener implements ListSelectionListener {
  public void valueChanged(ListSelectionEvent e) {
    if (e.getValueIsAdjusting()) return;
    ListSelectionModel model =
      (ListSelectionModel)e.getSource();
    if (model.isSelectionEmpty()) {
      // Nu este nici o linie selectata
      ...
    } else {
      int index = model.getMinSelectionIndex();
      // Linia cu numarul index este prima selectata
      ...
    }
  }
}
   ...
   tabel.setSelectionMode(
     ListSelectionModel.SINGLE_SELECTION);
   ListSelectionModel model = tabel.getSelectionModel();
   model.addListSelectionListener(new Listener());
```

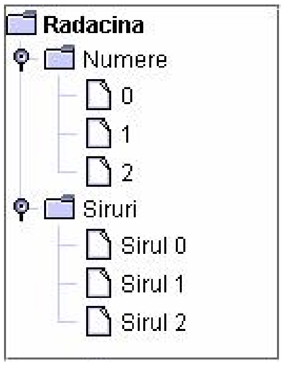
Folosirea unui renderer

```
public class MyRenderer extends JLabel
    implements TableCellRenderer {
  public Component getTableCellRendererComponent(...) {
    ...
    return this;
  }
}
```

Folosirea unui editor

```
public class MyEditor
    extends AbstractCellEditor
    implements TableCellEditor {
  public Object getCellEditorValue() {
    // Returneaza valoarea editata
    ...
  }
  public Component
    getTableCellEditorComponent(...) {
    // Returneaza componenta de tip editor
    ...
  }
}
```

Arbori



```
String text = "<html><b>Radacina</b></html>";
DefaultMutableTreeNode root =
  new DefaultMutableTreeNode(text);
DefaultMutableTreeNode numere =
    new DefaultMutableTreeNode("Numere");
DefaultMutableTreeNode siruri =
    new DefaultMutableTreeNode("Siruri");
for(int i=0; i<3; i++) {
  numere.add(
    new DefaultMutableTreeNode(new Integer(i)));
  siruri.add(
    new DefaultMutableTreeNode("Sirul " + i));
}
root.add(numere);
root.add(siruri);
JTree tree = new JTree(root);
```

Tratarea evenimentelor

```
class Listener implements TreeSelectionListener {
  public void valueChanged(TreeSelectionEvent e) {
    // Obtinem nodul selectat
    DefaultMutableTreeNode node =
      (DefaultMutableTreeNode)
       tree.getLastSelectedPathComponent();

    if (node == null) return;
    // Obtinem informatia din nod
    Object nodeInfo = node.getUserObject();
    ...
    }
}
   ...
   // Stabilim modul de selectie
   tree.getSelectionModel().setSelectionMode(
     TreeSelectionModel.SINGLE_TREE_SELECTION);
   // Adaugam un ascultator
   tree.addTreeSelectionListener(new Listener());
```

Personalizarea nodurilor

TreeCellRenderer

- `setRootVisible`
- `setShowsRootHandles`
- `putClientProperty`

```
tree.putClientProperty("JTree.lineStyle", "Angled");
// sau "Horizontal", "None"
```

- Specificarea unei iconiţe

```
ImageIcon leaf = createImageIcon("img/leaf.gif");
ImageIcon open = createImageIcon("img/open.gif");
ImageIcon closed = createImageIcon("img/closed.gif"

DefaultTreeCellRenderer renderer =
  new DefaultTreeCellRenderer();
renderer.setLeafIcon(leaf);
renderer.setOpenIcon(open);
renderer.setClosedIcon(closed);

tree.setCellRenderer(renderer);
```

Containere

1. **Containere de nivel înalt** - `JFrame`, `JDialog`, `JApplet`
2. **Containere intermediare**
   - `JPanel`
   - `JScrollPane`
   - `JTabbedPane`
   - `JSplitPane`
   - `JLayeredPane`
   - `JDesktopPane`
   - `JRootPane`

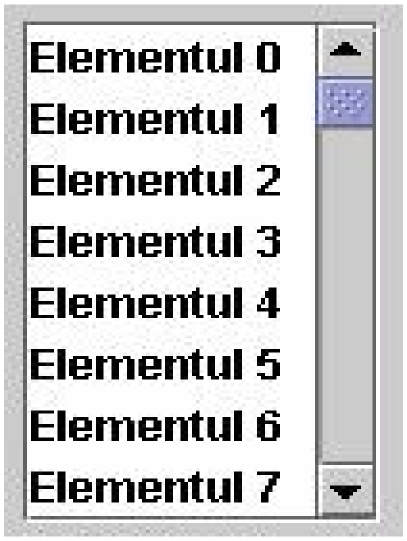
JPanel

Permite **gruparea** componentelor.

```
JPanel p = new JPanel(new BorderLayout());
/* Preferabil, deoarece nu mai este construit si
   un obiect de tip FlowLayout (implicit)
*/
p.add(new JLabel("Hello"));
p.add(new JButton("OK"));
...
```

JScrollPane

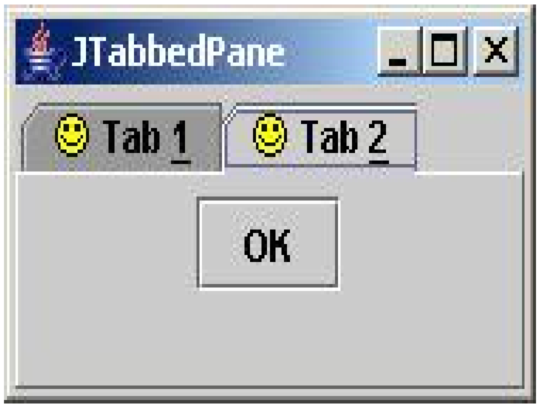
Oferă suport pentru **derulare**



```
String elemente[] = new String[100];
for(int i=0; i<100; i++)
 elemente[i] = "Elementul " + i;

JList lista = new JList(elemente);
JScrollPane sp = new JScrollPane(lista);
frame.getContentPane().add(sp);
```

JTabbedPane

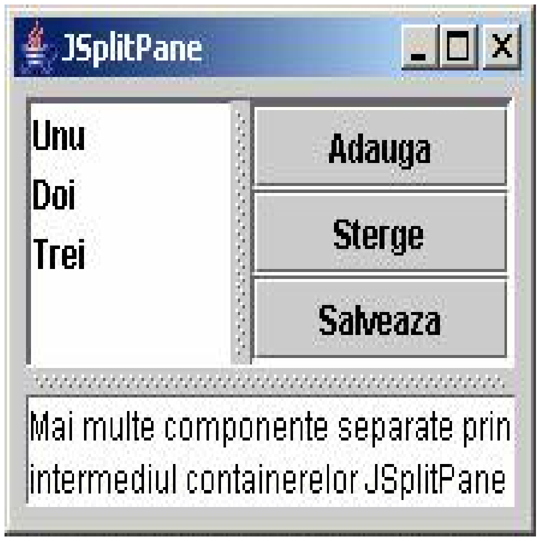
Permite **suprapunerea** mai multor containere.



```
JTabbedPane tabbedPane = new JTabbedPane();
ImageIcon icon = new ImageIcon("smiley.gif");

JComponent panel1 = new JPanel();
panel1.setOpaque(true);
panel1.add(new JLabel("Hello"));
tabbedPane.addTab("Tab 1", icon, panel1,
        "Aici avem o eticheta");
tabbedPane.setMnemonicAt(0, KeyEvent.VK_1);

JComponent panel2 = new JPanel();
...
```

JSplitPane

Oferă suport pentru **separarea** componentelor.



Mai multe componente separate prin intermediul containerelor JSplitPane

```
JList list;
JPanel panel;
JTextArea text;
...
JSplitPane sp1 = new JSplitPane(
    JSplitPane.HORIZONTAL_SPLIT, list, panel);
JSplitPane sp2 = new JSplitPane(
    JSplitPane.VERTICAL_SPLIT, sp1, text);

frame.getContentPane().add(sp2);
```

Dialoguri - Clasa JDialog

- **JOptionPane**

```
JOptionPane.showMessageDialog(frame,
    "Eroare de sistem !",  "Eroare",
    JOptionPane.ERROR_MESSAGE);

JOptionPane.showConfirmDialog(frame,
    "Doriti inchiderea aplicatiei ? ", "Intrebare",
    JOptionPane.YES_NO_OPTION,
    JOptionPane.QUESTION_MESSAGE);
```

- **JFileChooser**
- **JColorChooser**
- **ProgressMonitor**

Desenarea

Metoda **paint** e responsabilă cu:

- **paintComponent**
- **paintBorder**
- **paintChildern**
- ”double-buffering”

Afişarea imaginilor

```
ImageIcon img = new ImageIcon("smiley.gif");
JLabel label = new JLabel(img);
```

Transparenţa

Permite crearea de componente care nu au formă rectangulară.

Dimensiunile componentelor

```
Insets insets = getInsets();
int currentWidth = getWidth() -
  insets.left - insets.right;
int currentHeight = getHeight() -
  insets.top - insets.bottom;
```

Contexte grafice

```
public void paintComponent(Graphics g) {
  Graphics2D g2d = (Graphics2D)g;
  // Desenam apoi cu g2d

  // g este refolosit !!
  // 1. Revenirea la starea initiala
  g2d.translate(x, y);   // modificam contexul
  ...
  g2d.translate(-x, -y); // revenim la starea initiala

  // 2. Folosirea unei copii
  Graphics2D g2d = (Graphics2D)g.create();
  g2d.translate(x, y);
  ...
  g2d.dispose();
```

Look and Feel

- `javax.swing.plaf.metal.MetalLookAndFeel`
- `com.sun.java.swing.plaf.windows.WindowsLookAndFeel`
- `com.sun.java.swing.plaf.mac.MacLookAndFeel`
- `com.sun.java.swing.plaf.motif.MotifLookAndFeel`
- `com.sun.java.swing.plaf.gtk.GTKLookAndFeel`

```
UIManager.setLookAndFeel(
   "com.sun.java.swing.plaf.motif.MotifLookAndFeel");
SwingUtilities.updateComponentTreeUI(f);
f.pack();

java -Dswing.defaultlaf=
      com.sun.java.swing.plaf.gtk.GTKLookAndFeel App

// In lib/swing.properties
# Swing properties
swing.defaultlaf=
  com.sun.java.swing.plaf.windows.WindowsLookAndFeel
```