CSE 331

Composite Layouts; Decorators

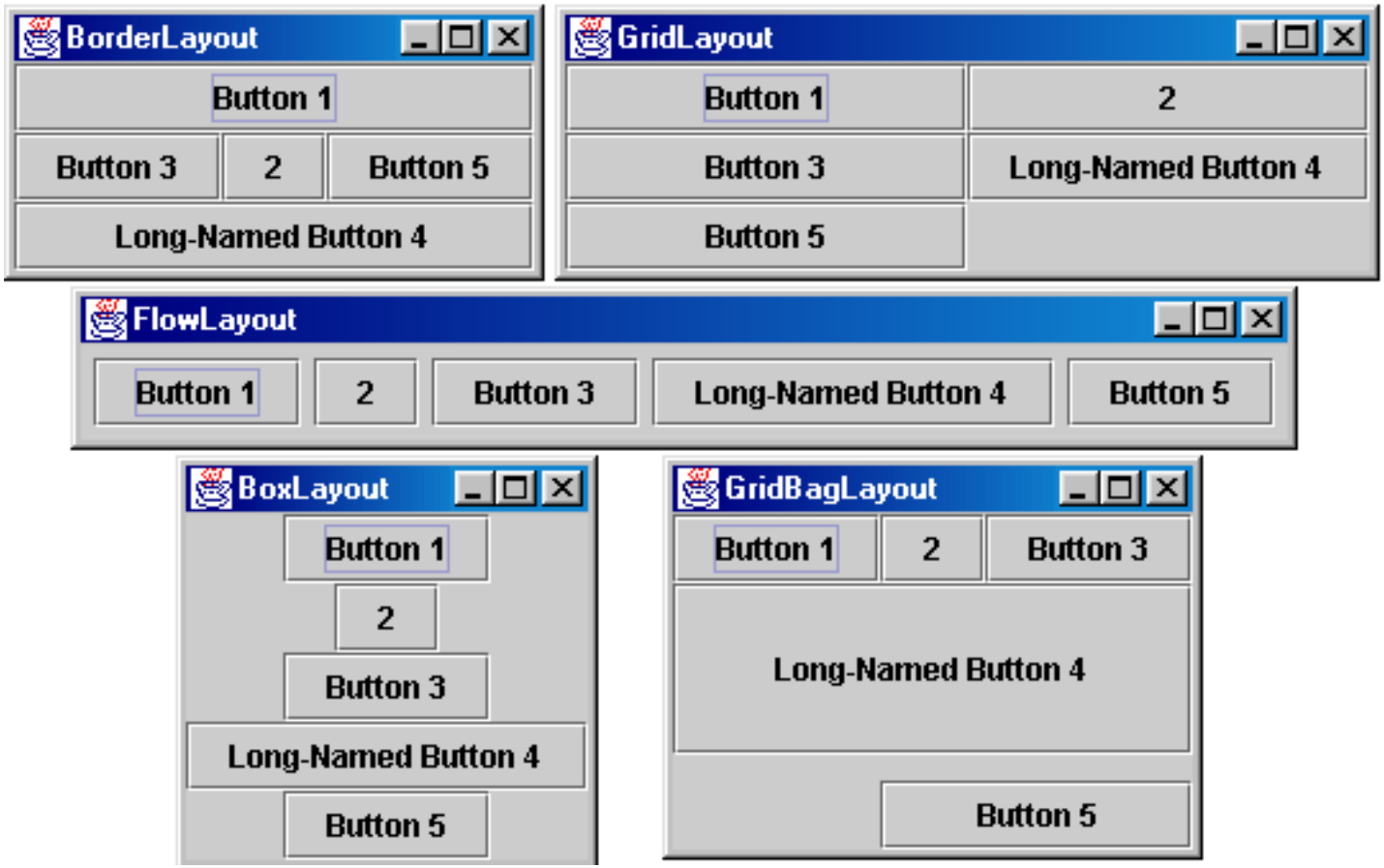
slides created by Marty Stepp
based on materials by M. Ernst, S. Reges, D. Notkin, R. Mercer, Wikipedia
http://www.cs.washington.edu/331/

Pattern: Composite

objects that can contain their own type

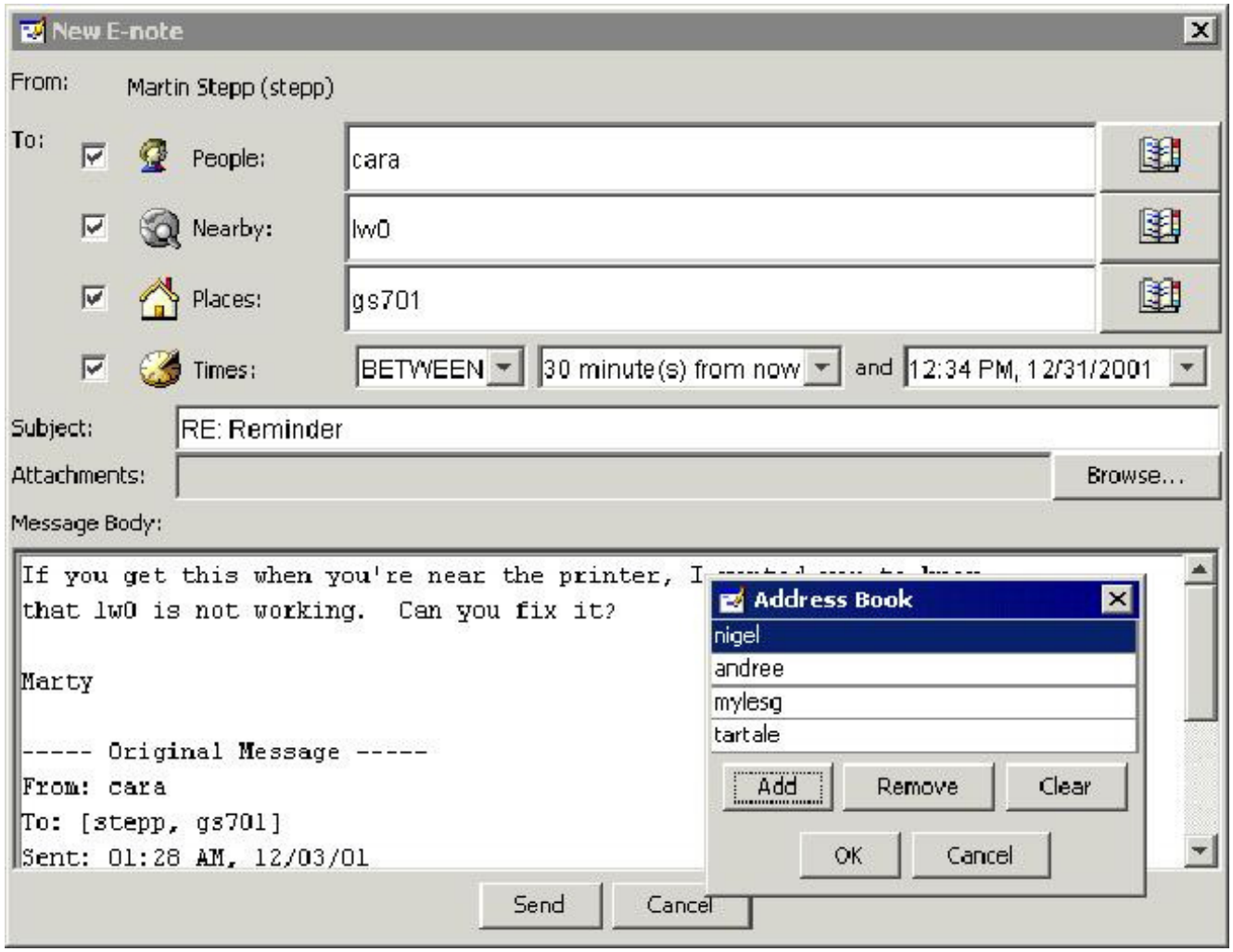
Containers and layout

- Place components in a *container*; add the container to a frame.
  - **container**: An object that stores components and governs their positions, sizes, and resizing behavior.



Complex layout ... how?

- How would you create a complex layout like this, using only the layout managers shown?



Composite pattern

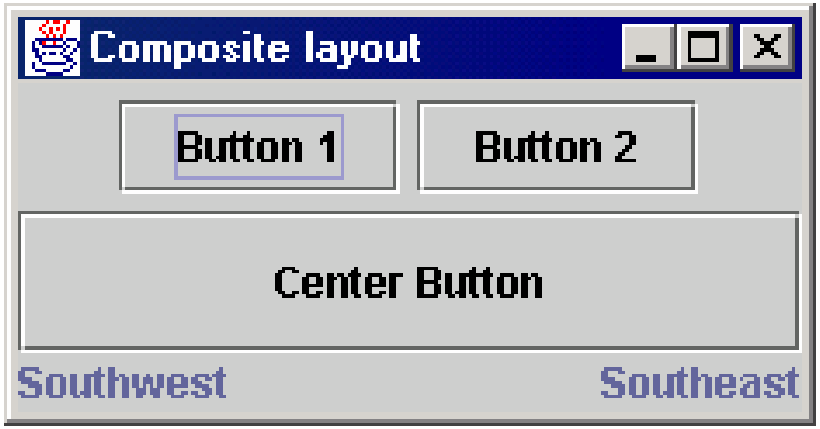
- **composite:** An object that can be either an individual item or a collection of many items.
  - Can be composed of individual items or other composites.
  - Recursive definition: Objects that can hold themselves.
  - Often leads to a tree structure of leaves and nodes:
    - **<node>** ::= **<leafnode>** | **<compositenode>**
    - **<compositenode>** ::= **<node>***
- Examples in Java:
  - collections (e.g. a list of lists)
  - GUI layout (containers of containers of components)

Composite layout

- **composite layout**: One made up of containers within containers.

- Each container has a different layout, and by combining the layouts, more complex / powerful layout can be achieved.
  - Example: A flow layout in the south region of a border layout.
  - Example: A border layout in square (1, 2) of a grid layout.

- In the GUI at right:
  - How many containers are there?
  - What layout is used in each?



JPanel

the default container class in Swing

- `public JPanel()`
  `public JPanel(LayoutManager mgr)`
  Constructs a panel with the given layout (default = flow layout).

- `public void add(Component comp)`
  `public void add(Component comp, Object info)`
  Adds a component to the container, possibly giving extra information about where to place it.

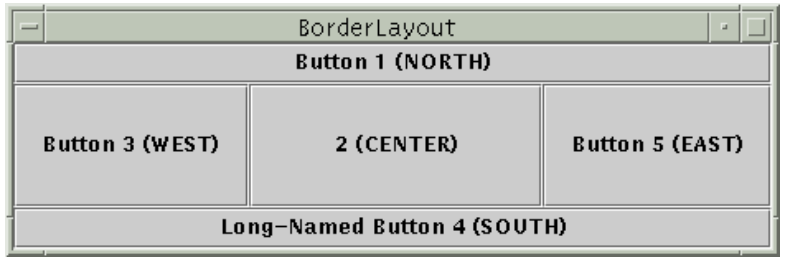
- `public void remove(Component comp)`

- `public void setLayout(LayoutManager mgr)`
  Uses the given layout manager to position components.

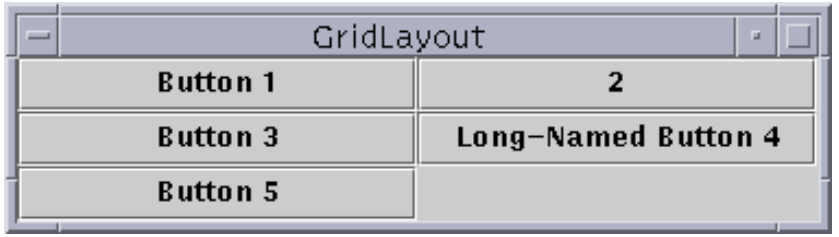
Flow, Border, Grid layouts

```
Container panel1 = new JPanel(new FlowLayout());
panel1.add(new JButton("Button 1"));
panel1.add(new JButton("Button 2"));
```


```
Container panel2 = new JPanel(new BorderLayout());
panel2.add(new JButton("Button 1 (NORTH)"),
           BorderLayout.NORTH);
```



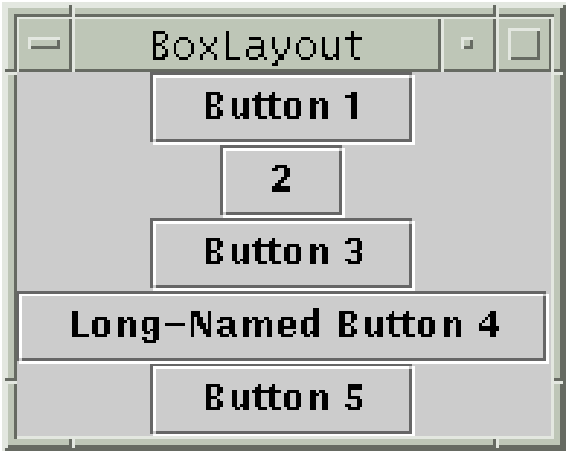

```
Container panel3 = new JPanel(new GridLayout(3, 2));
panel3.add(new JButton("Button 1"));
panel3.add(new JButton("Button 2"));
```



Box layout

```
Container box1 = Box.createHorizontalBox();
Container box2 = Box.createVerticalBox();
```

- aligns components in container in a single row or column
- components use preferred sizes and align based on their preferred alignment
  - vertical box is used to get a "vertical flow layout"



Other layouts

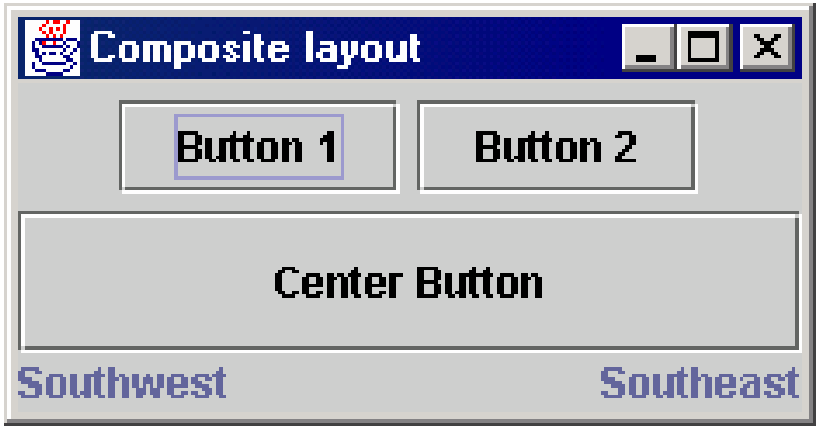
- `CardLayout`
  Layers of "cards" stacked
  on top of each other;
  one visible at a time.

- `GridBagLayout`
  Powerful, but very complicated;
  Our recommendation:
  never use it.

- `null` layout
  allows you to define absolute positions using `setX/Y` and `setWidth/Height` (not recommended; platform dependent)

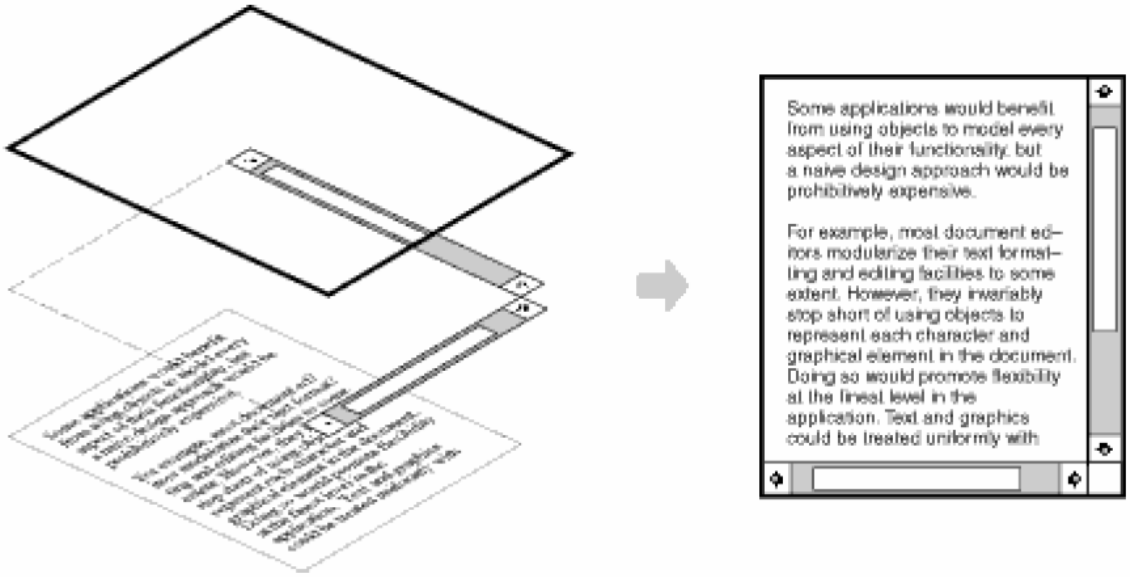
Composite layout code

```
Container north = new JPanel(new FlowLayout());
north.add(new JButton("Button 1"));
north.add(new JButton("Button 2"));

Container south = new JPanel(new BorderLayout());
south.add(new JLabel("Southwest"), BorderLayout.WEST);
south.add(new JLabel("Southeast"), BorderLayout.EAST);

// overall panel contains the smaller panels (composite)
Container overall = new JPanel(new BorderLayout());
overall.add(north, BorderLayout.NORTH);
overall.add(new JButton("Center"), BorderLayout.CENTER);
overall.add(south, BorderLayout.SOUTH);

frame.add(overall);
```



Pattern: Decorator

objects that "wrap" other objects to add features



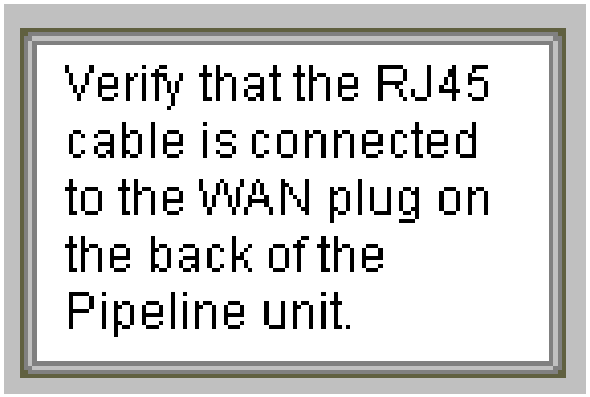
JTextField, JTextArea

an input control for typing text values
(field = single line; area = multi-line)

- `public JTextField(int columns)`
  `public JTextArea(int lines, int columns)`
  Creates a new field, the given number of letters wide.

- `public String getText()`
  Returns the text currently in the field.

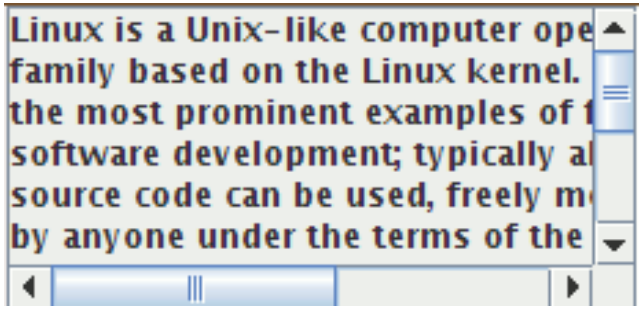
- `public void setText(String text)`
  Sets field's text to be the given string.



  - *What if the text area is too big to fit in the window?*

JScrollPane

a container that adds scrollbars around any other component



- `public JScrollPane(Component comp)`
  Wraps the given component with scrollbars.
  - After constructing the scroll pane, you must add the scroll pane, not the original component, to the onscreen container:

```
myContainer.add(new JScrollPane(textarea),
                BorderLayout.CENTER);
```

Decorator pattern

- **decorator**: An object that modifies behavior of, or adds features to, another object.
  - Must maintain the common interface of the object it wraps up.
  - Used so that we can add features to an existing simple object without needing to disrupt the interface that client code expects when using the simple object.
  - The object being "decorated" usually does not explicitly know about the decorator.

- Examples in Java:
  - Multilayered input streams adding useful I/O methods
  - Adding scroll bars to GUI controls

Decorator example: I/O

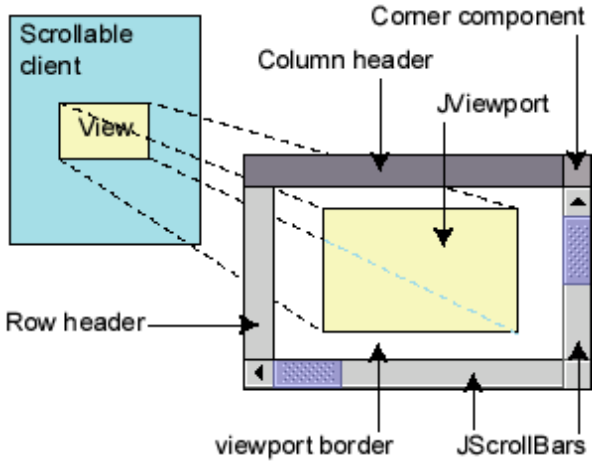
- normal `InputStream` class has only `public int read()` method to read one letter at a time
- decorators such as `BufferedReader` or `Scanner` add additional functionality to read the stream more easily

```
// InputStreamReader/BufferedReader decorate InputStream
InputStream in = new FileInputStream("hardcode.txt");
InputStreamReader isr = new InputStreamReader(in);
BufferedReader br = new BufferedReader(isr);

// because of decorator streams, I can read an
// entire line from the file in one call
// (InputStream only provides public int read() )
String wholeLine = br.readLine();
```

Decorator example: GUI

- `JScrollPane` is a container with scroll bars to which you can add any component to make it scrollable

```
// JScrollPane decorates GUI components
JTextArea area = new JTextArea(20, 30);
JScrollPane sp = new JScrollPane(area);
contentPane.add(sp);
```

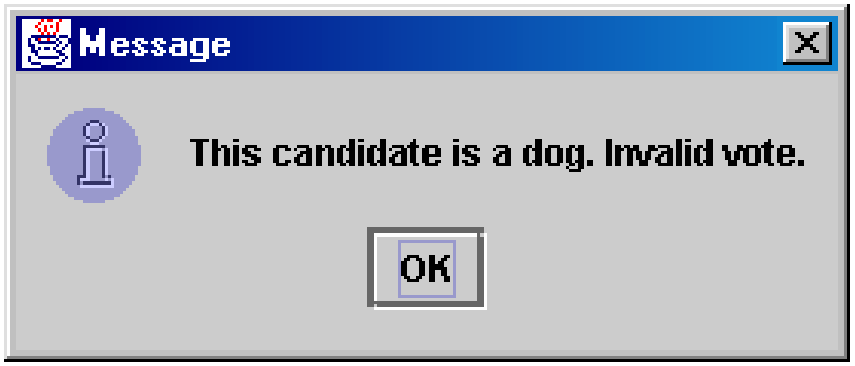


  - Components also have a `setBorder` method to add a "decorative" border. Is this another example of the Decorator pattern? Why or why not?

JOptionPane

- `JOptionPane.showMessageDialog(`**parent, message**`);`

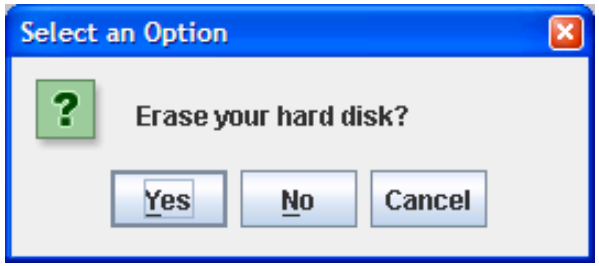
```
import javax.swing.*;

JOptionPane.showMessageDialog(null,
    "This candidate is a dog. Invalid vote.");
```



- Advantages:
  - Simple; looks better than console.
- Disadvantages:
  - Created with static methods; not object-oriented.
  - Not powerful (just simple dialog boxes).

More JOptionPane

- `JOptionPane.showConfirmDialog(`**parent, message**`)`
  - Displays a message and list of choices Yes, No, Cancel.
  - Returns an `int` such as `JOptionPane.YES_OPTION` or `NO_OPTION` to indicate what button was pressed.



- `JOptionPane.showInputDialog(`**parent, message**`)`
  - Displays a message and text field for input.
  - Returns the value typed as a String (or `null` if user presses Cancel).