LAYOUT

CMPT 381

Overview

What is layout?

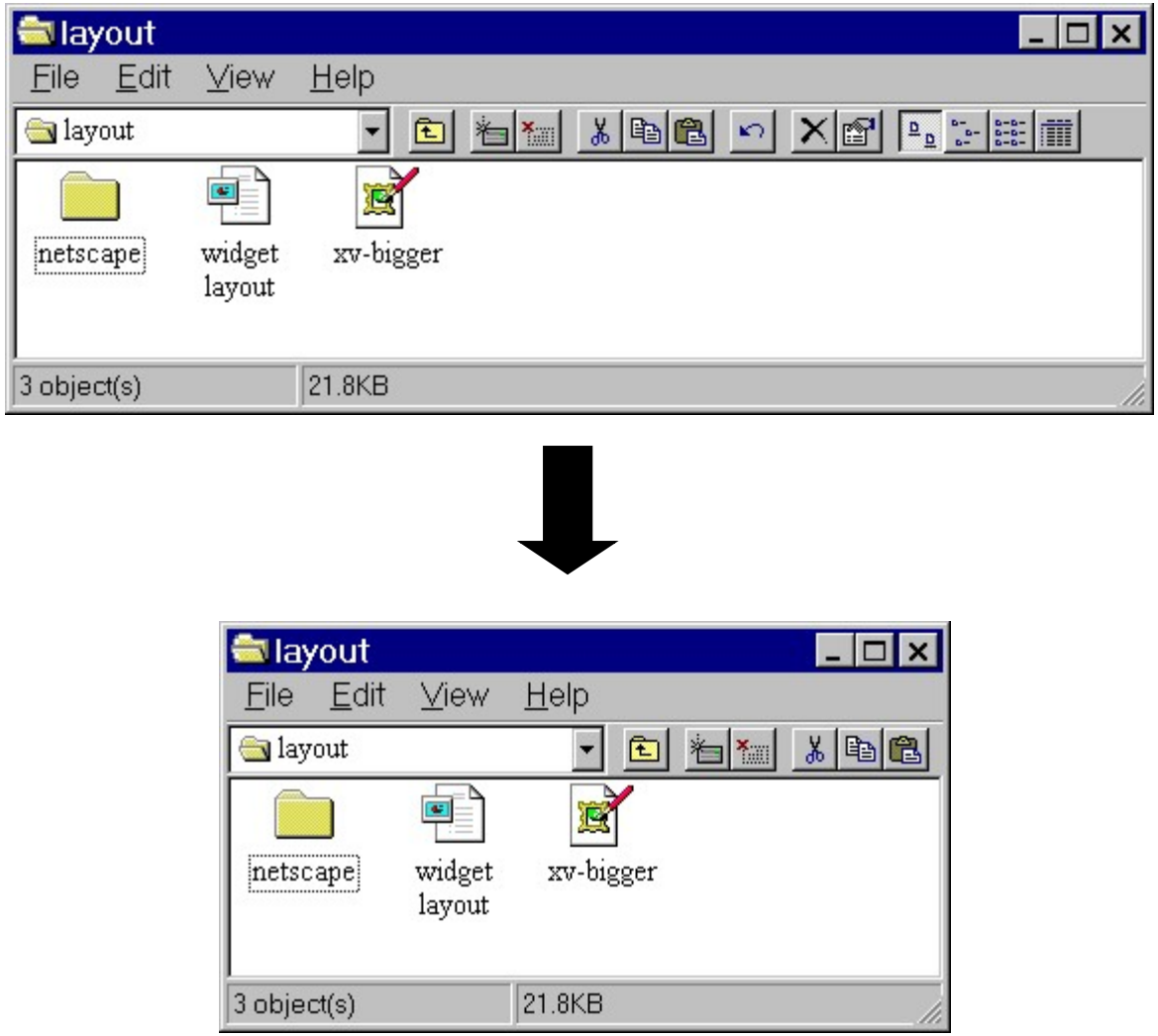
Examples

Layout models

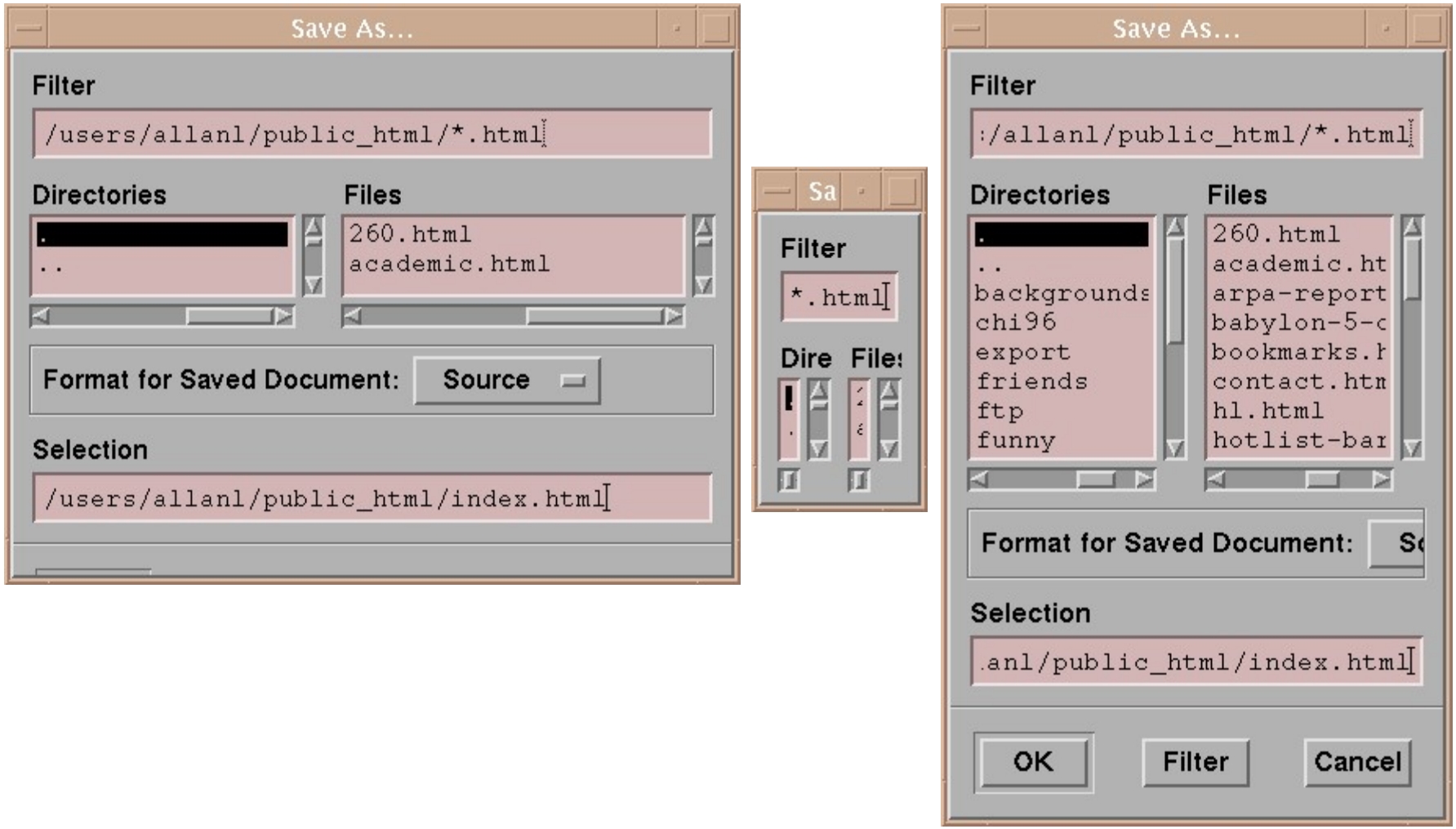
What is Layout?

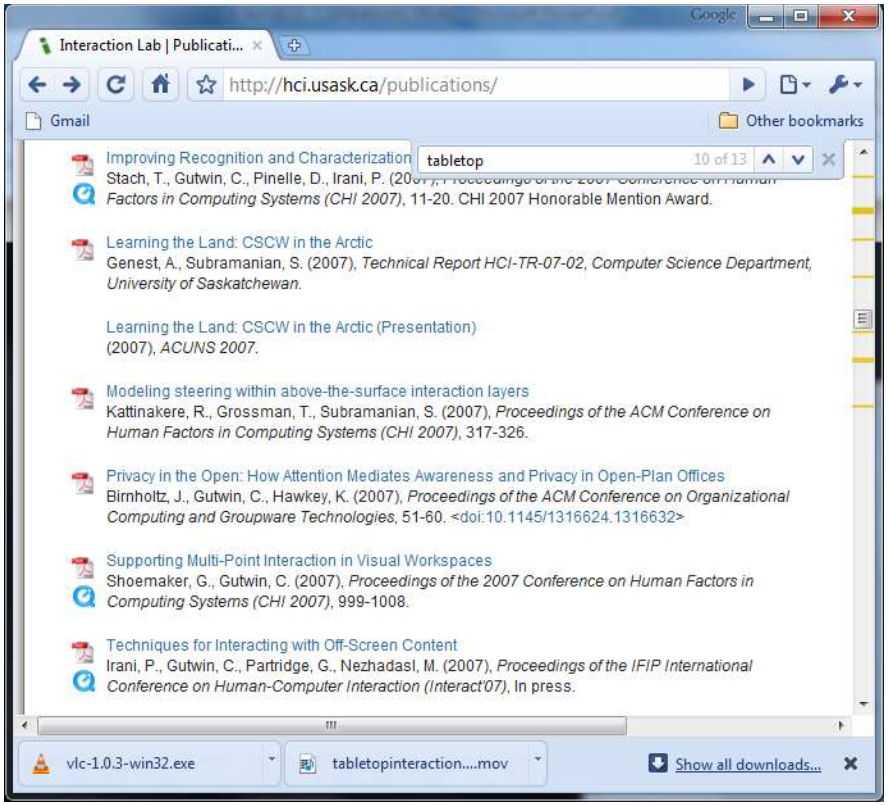
- Position of widgets in the containing window
- What to do when the window changes size?
  - Must be programmed
- **Layout Managers** greatly reduce the need to worry about positioning, sizing and alignment of widgets

Resizing problems



Resizing problems




Interaction Lab | Publicati...
http://hci.usask.ca/publications/
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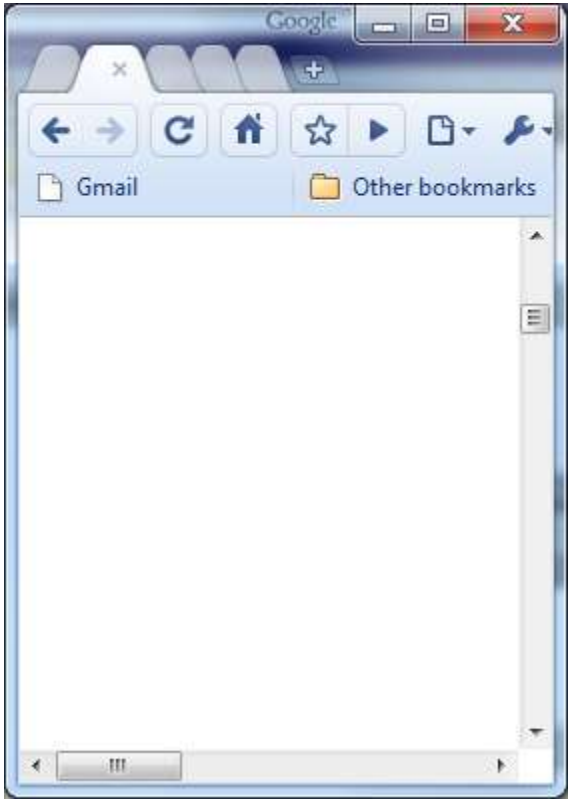
Other bookmarks
Improving Recognition and Characterization
tabletop
10 of 13
Stach, T., Gutwin, C., Pinelle, D., Irani, P. (20
Factors in Computing Systems (CHI 2007), 11-20. CHI 2007 Honorable Mention Award.
Learning the Land: CSCW in the Arctic
Genest, A., Subramanian, S. (2007), Technical Report HCI-TR-07-02, Computer Science Department, University of Saskatchewan.
Learning the Land: CSCW in the Arctic (Presentation)
(2007), ACUNS 2007.
Modeling steering within above-the-surface interaction layers
Kattinakere, R., Grossman, T., Subramanian, S. (2007), Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2007), 317-326.
Privacy in the Open: How Attention Mediates Awareness and Privacy in Open-Plan Offices
Birnholtz, J., Gutwin, C., Hawkey, K. (2007), Proceedings of the ACM Conference on Organizational Computing and Groupware Technologies, 51-60. <doi:10.1145/1316624.1316632>
Supporting Multi-Point Interaction in Visual Workspaces
Shoemaker, G., Gutwin, C. (2007), Proceedings of the 2007 Conference on Human Factors in Computing Systems (CHI 2007), 999-1008.
Techniques for Interacting with Off-Screen Content
Irani, P., Gutwin, C., Partridge, G., Nezhadasl, M. (2007), Proceedings of the IFIP International Conference on Human-Computer Interaction (Interact'07), In press.
vlc-1.0.3-win32.exe
tabletopinteraction....mov
Show all downloads...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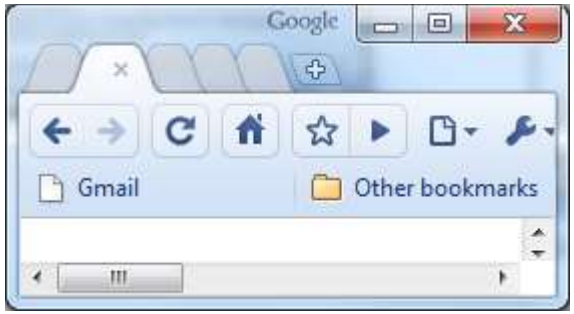
Other bookmarks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Other bookmarks

Window Tree

- hierarchical layout

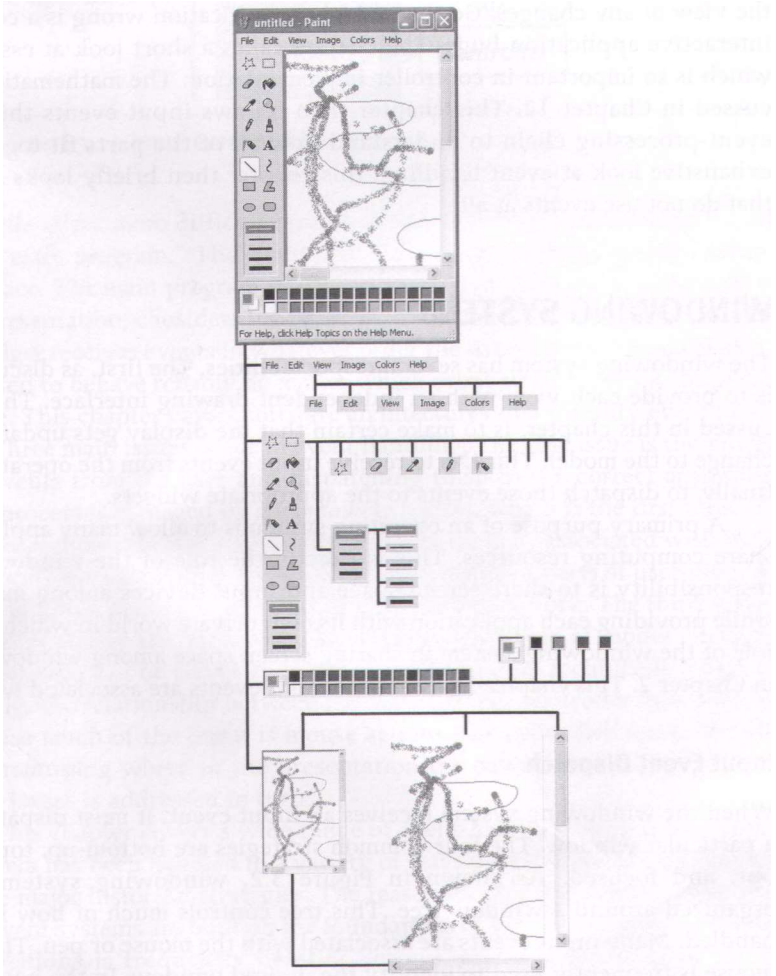
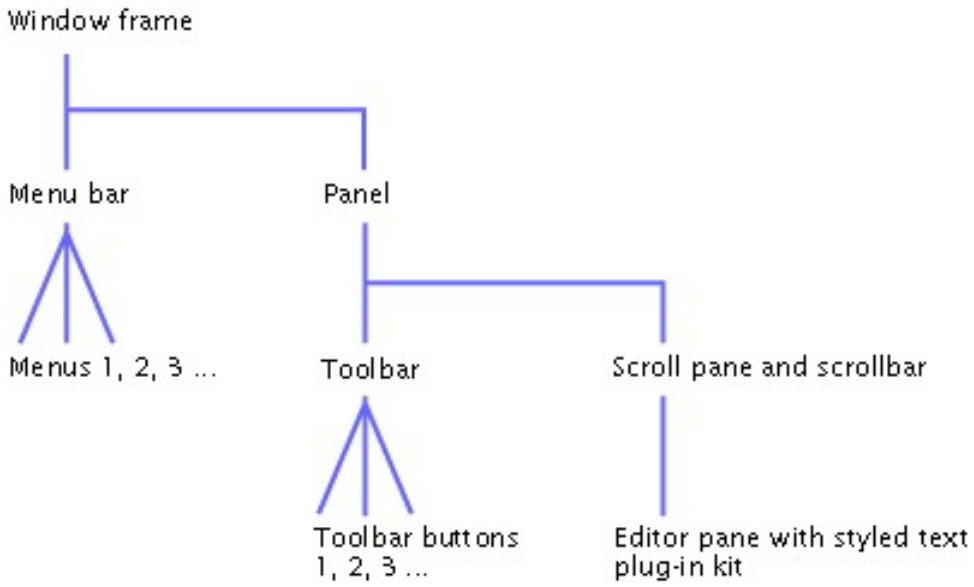


Figure 3.2 – Window tree

Hierarchical Layout

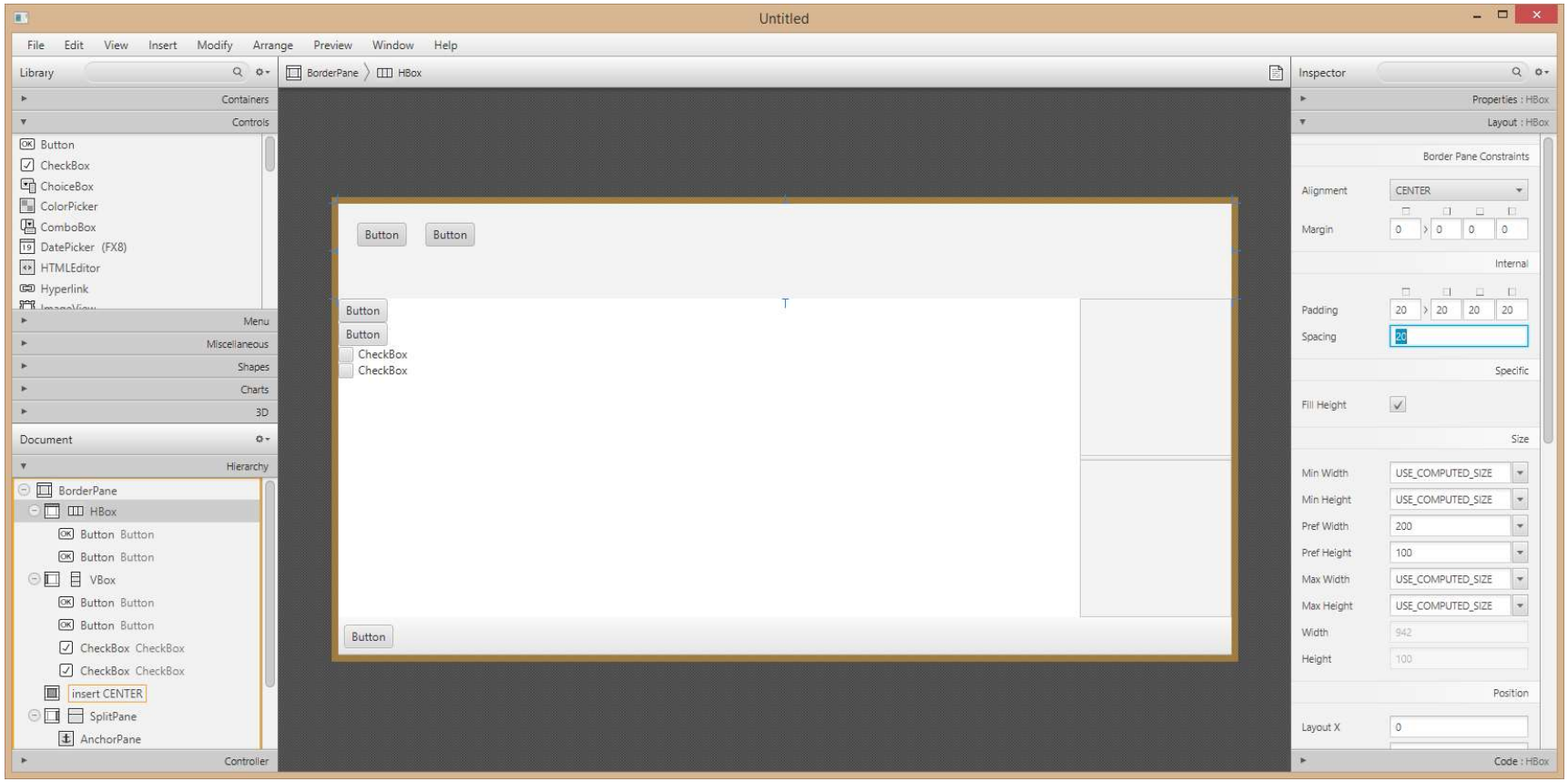
- Widgets positioned relative to their parent



Layout Approaches

- Fixed Layout
- Stacked Layout
- Edge-Anchored Layout
- Variable Intrinsic Size Layout
- Automated Approaches

GUI Builders

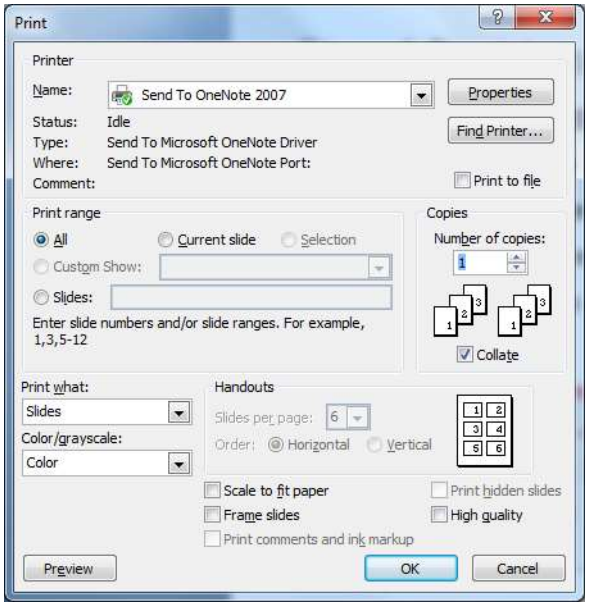


Why not use a GUI builder?

- These are getting better, BUT:
  - They can cause problems
    - e.g., they may use simplistic models
    - Resizing still an issue!
  - The generated code is often not maintainable
  - Fixing problems requires understanding the underlying principles anyway
  - leepoint.net/JavaBasics/gui/gui-commentary/guicom-20-byhand.html
  - gluonhq.com/labs/scene-builder/

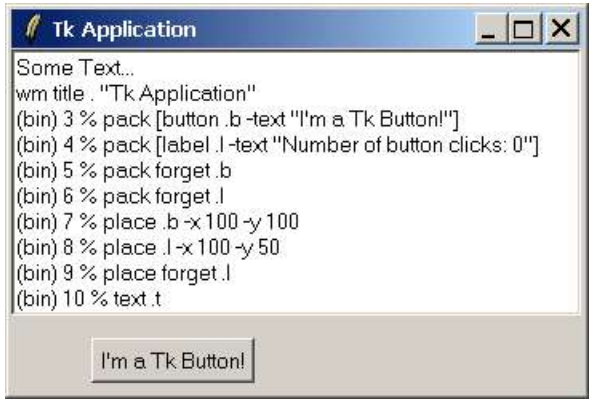
Fixed Position Layout

- Store a rectangle for each component
- Simple to implement
- Widgets stay where you put them
- Makes sense for a dialog that is not resizable



Tk Placer

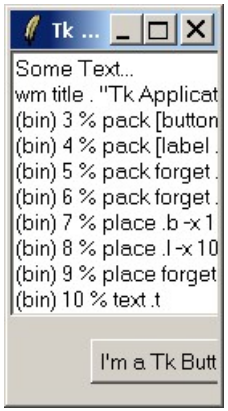
- button .b -text "I'm a Tk Button!"
- text .t -height 10 -width 50
- place .b -x 50 -y 180
- place .t -x 0 -y 0

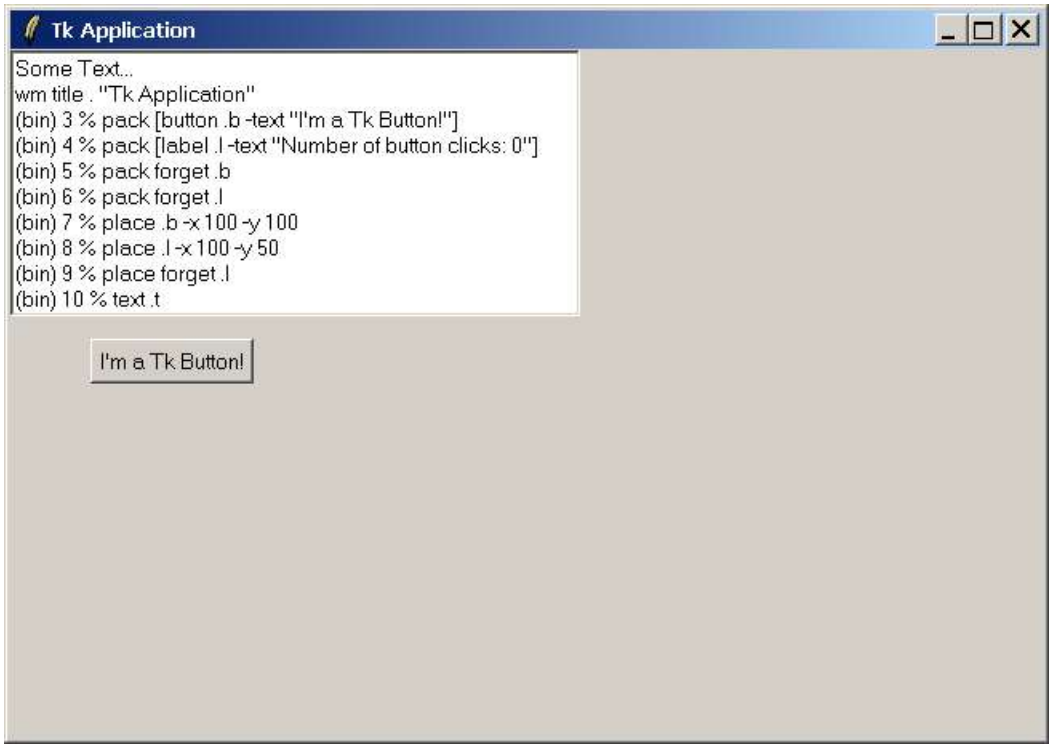


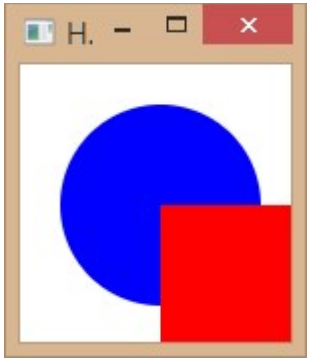
JavaFX Pane

```
public class LayoutTest extends Application {
    @Override
    public void start(Stage primaryStage) {
        Pane root = new Pane();
        Circle circle = new Circle(50, Color.BLUE);
        circle.relocate(20, 20);
        Rectangle rectangle = new Rectangle(100, 100, Color.RED);
        rectangle.relocate(70, 70);
        root.getChildren().addAll(circle, rectangle);

        Scene scene = new Scene(root, 300, 250);

        primaryStage.setScene(scene);
        primaryStage.show();
    }
```

Problems with fixed positioning

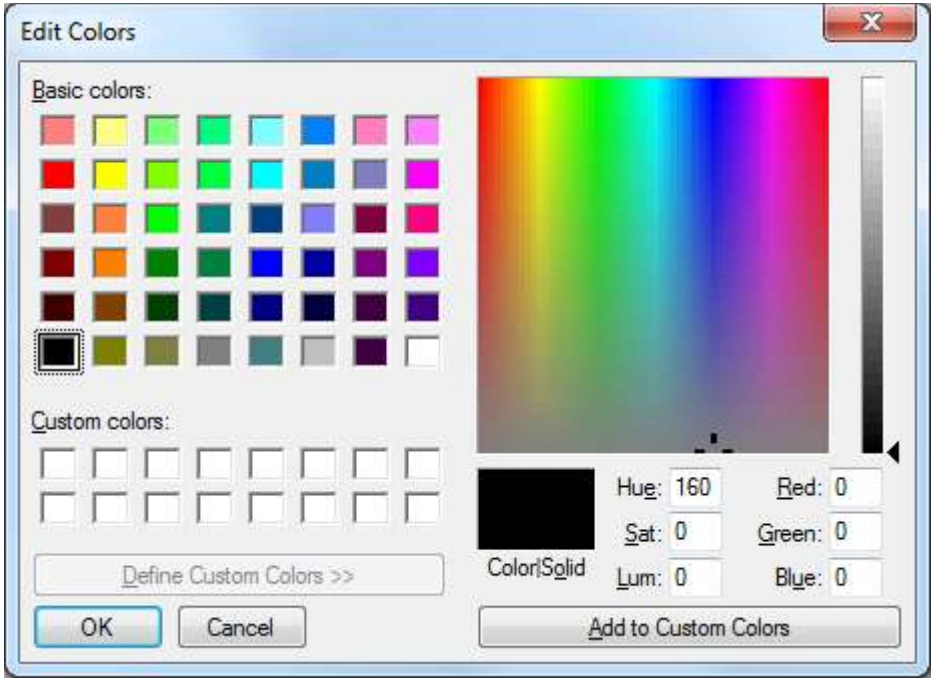






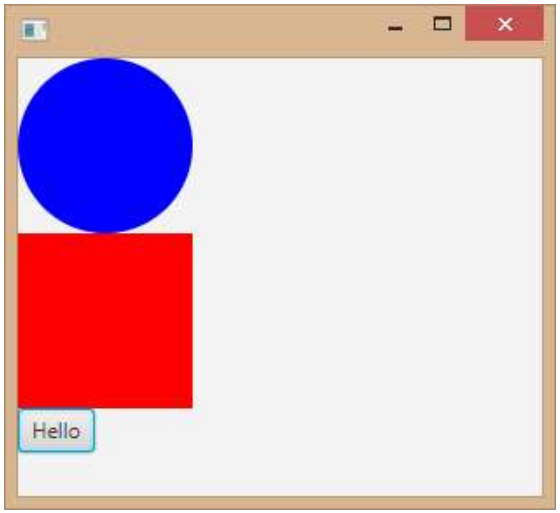
Linear Layouts

- Place sub-containers in horizontal or vertical lists
- No need to worry about specific locations
- Widgets arranged inside containers horizontally or vertically



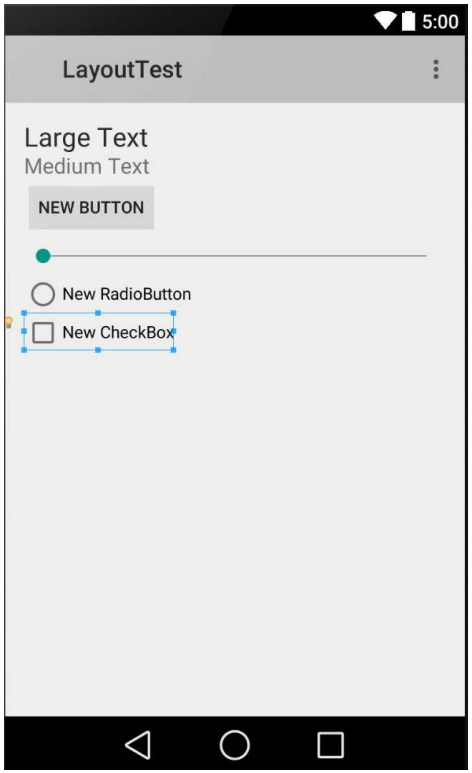
JavaFX VBox (HBox is similar)

```
public class LayoutTest extends Application {
@Override
public void start(Stage primaryStage) {
    VBox root = new VBox();
    Circle circle = new Circle(50, Color.BLUE);
    Rectangle rectangle = new Rectangle(100, 100, Color.RED);
    Button button = new Button("Hello");
    root.getChildren().addAll(circle, rectangle, button);

    Scene scene = new Scene(root, 300, 250);

    primaryStage.setScene(scene);
    primaryStage.show();
}
```



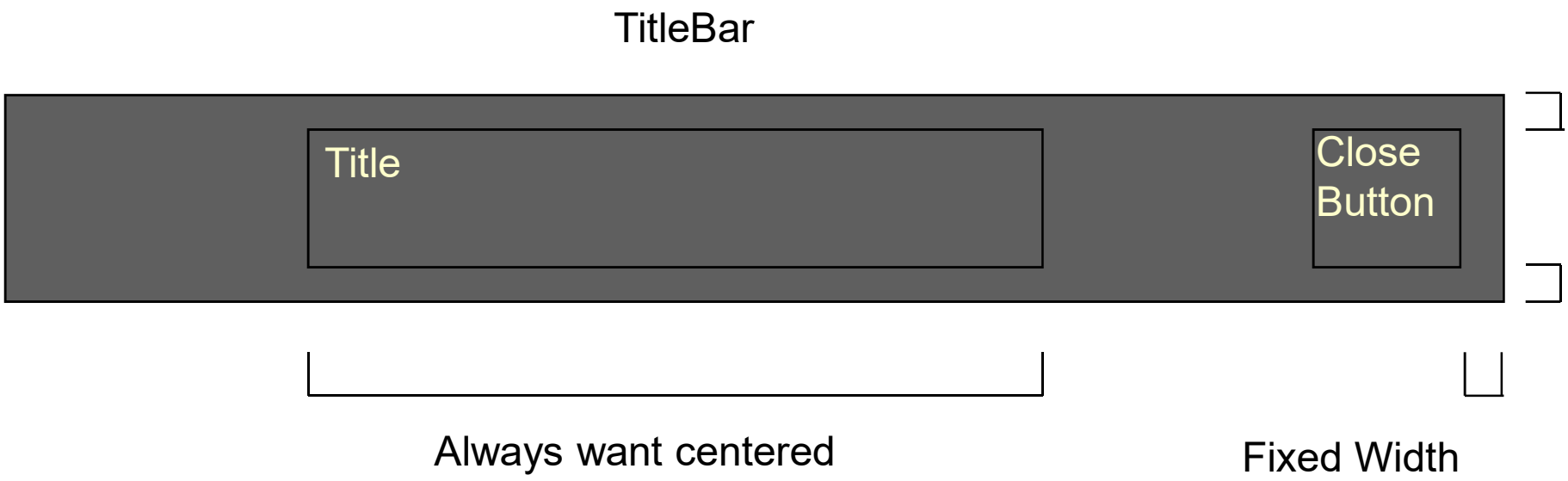
Android LinearLayout

```
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical">
    <TextView
        android:text="Large Text"
        android:id="@+id/textView2" />
    <TextView
        android:text="Medium Text"
        android:id="@+id/textView" />
    <Button
        android:text="New Button"
        android:id="@+id/button" />
[...]
</LinearLayout>
```



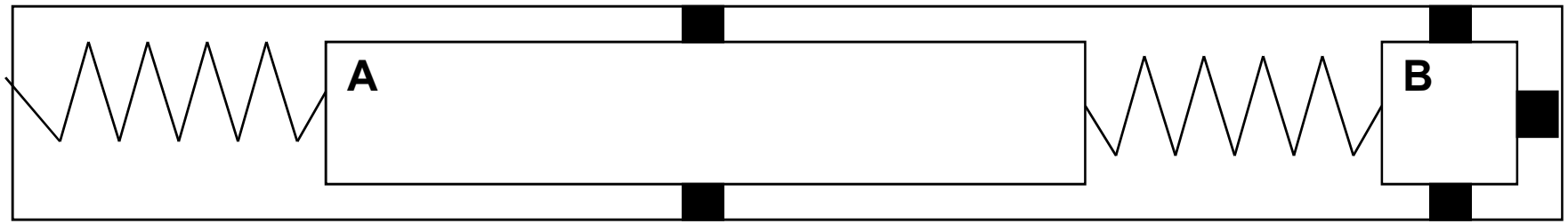
Edge-Anchored Layout

- We want something as easy to use as fixed position but that will also handle resizing
- Programmer doesn't worry about specific positions



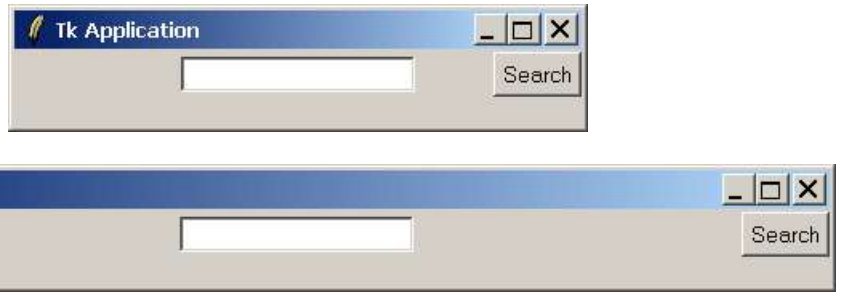
Struts and Springs

- Place struts and springs in the layout
- Struts represent fixed lengths
- Springs push as much as they can
- Could use constraints:
  - CloseButton.RIGHT = TitleBar.RIGHT – 5
  - Title.CENTER = TitleBar.CENTER



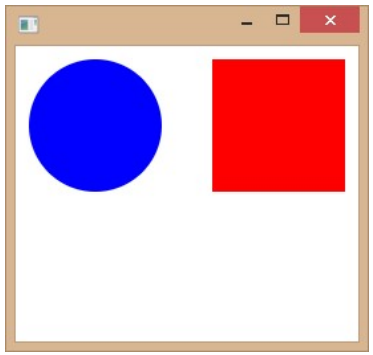
Struts and Springs

- Relative constraints in Tk placer:
  - entry .e
  - button .b –text “Search”
  - place .e -anchor c -relx 0.5 -rely 0 -y 15
  - place .b1 -anchor e -relx 1.0



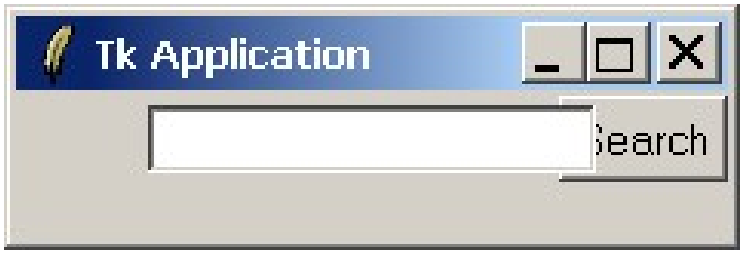
JavaFX AnchorPane

```
public void start(Stage primaryStage) {
        AnchorPane root = new AnchorPane();
        Circle circle = new Circle(50, Color.BLUE);
        AnchorPane.setTopAnchor(circle, 10.0);
        AnchorPane.setLeftAnchor(circle, 10.0);
        AnchorPane.setRightAnchor(circle, 65.0);
        Rectangle rectangle = new Rectangle(100, 100, Color.RED);
        AnchorPane.setTopAnchor(rectangle, 10.0);
        AnchorPane.setRightAnchor(rectangle, 10.0);
        root.getChildren().addAll(circle, rectangle);

        Scene scene = new Scene(root, 300, 250);
        primaryStage.setScene(scene);
        primaryStage.show();
    }
```



Problems with constraints

- Complicated
  - Programmer must keep track of geometry
  - With large numbers of widgets this is difficult
  - Often impossible to specify constraints adequately



Variable Intrinsic Size

- Size of widget determined by sizes of items within
  - e.g. Menus, most Java widgets

- Intrinsic size does not handle resizing
- Variable Intrinsic Size
  - Each widget reports its size needs (recursively if necessary)
  - Each widget also reports how much it can be reasonably squeezed or expanded

Automated Layout

- A layout manager positions and sizes widgets
  - Programmer provides constraints
- Many different algorithms to determine where widgets should go when added to a container
  - JavaFX:
    - BorderPane, FlowPane, GridPane, StackPane, TilePane
  - Android:
    - RelativeLayout, GridLayout

Two-Stage Layout Process

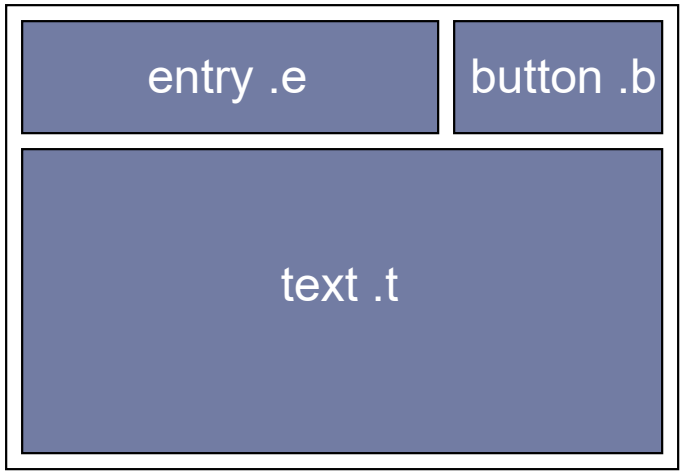
- Stage 1: allocation of space to each child
  - Determine each child's intrinsic size (recursively)
  - Allocate space according to the layout algorithm
    - Use the container-level constraints, if any
  - This gives each child an area of the screen (the *parcel*)
- Stage 2: layout within the parcel
  - Determine where the child goes inside its allocation
  - Alignment: top, bottom, left, right, middle
  - Padding: space at edges
  - Fill: horizontal, vertical, both

A Simple Layout Algorithm: Packing

- Tk pack layout:
  - Places widgets by packing them around window edges
  - Keeps track of remaining space (the *cavity*)
  - Algorithm:
    - For each widget to be packed:
      - Allocate a rectangular *parcel* on the indicated side of the cavity (keeping the cavity rectangular)
      - Determine the size of the widget
      - Position the widget in its parcel
      - Subtract the parcel from the cavity

Packing example

- We want to end up with this:



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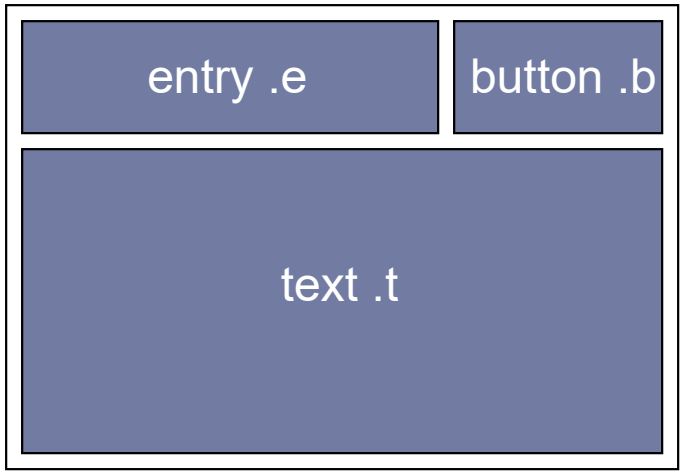

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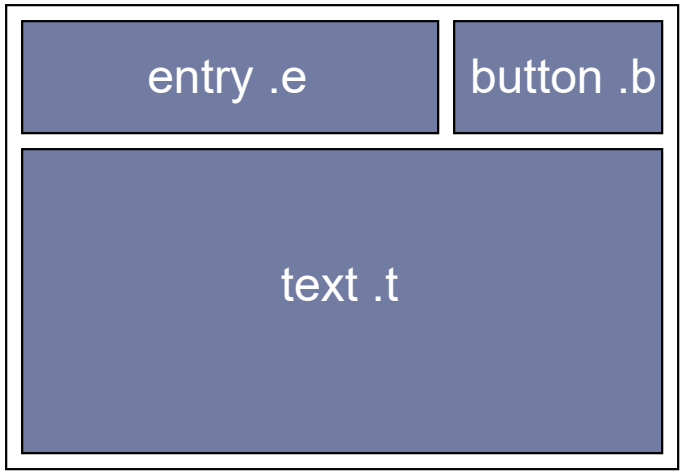
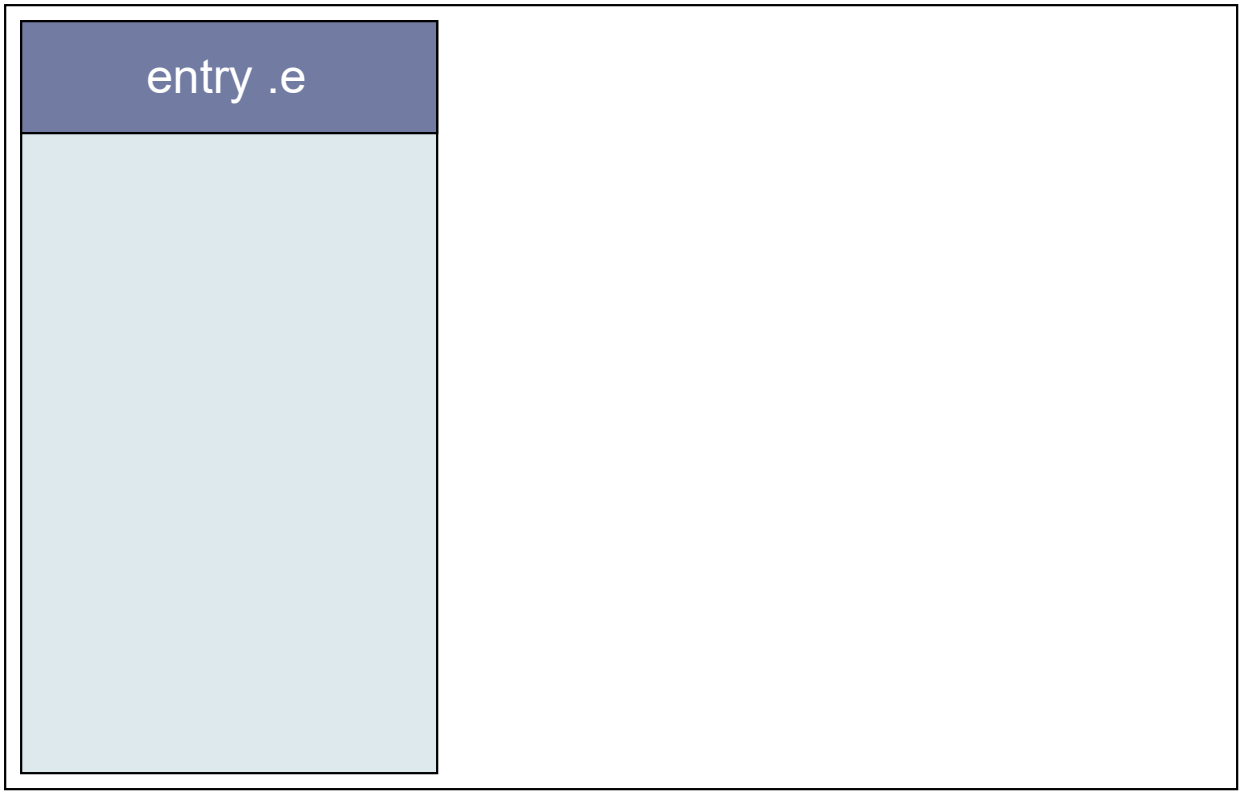


- Try:
  - pack .e -side left
  - pack .b -side right
  - pack .t -side bottom

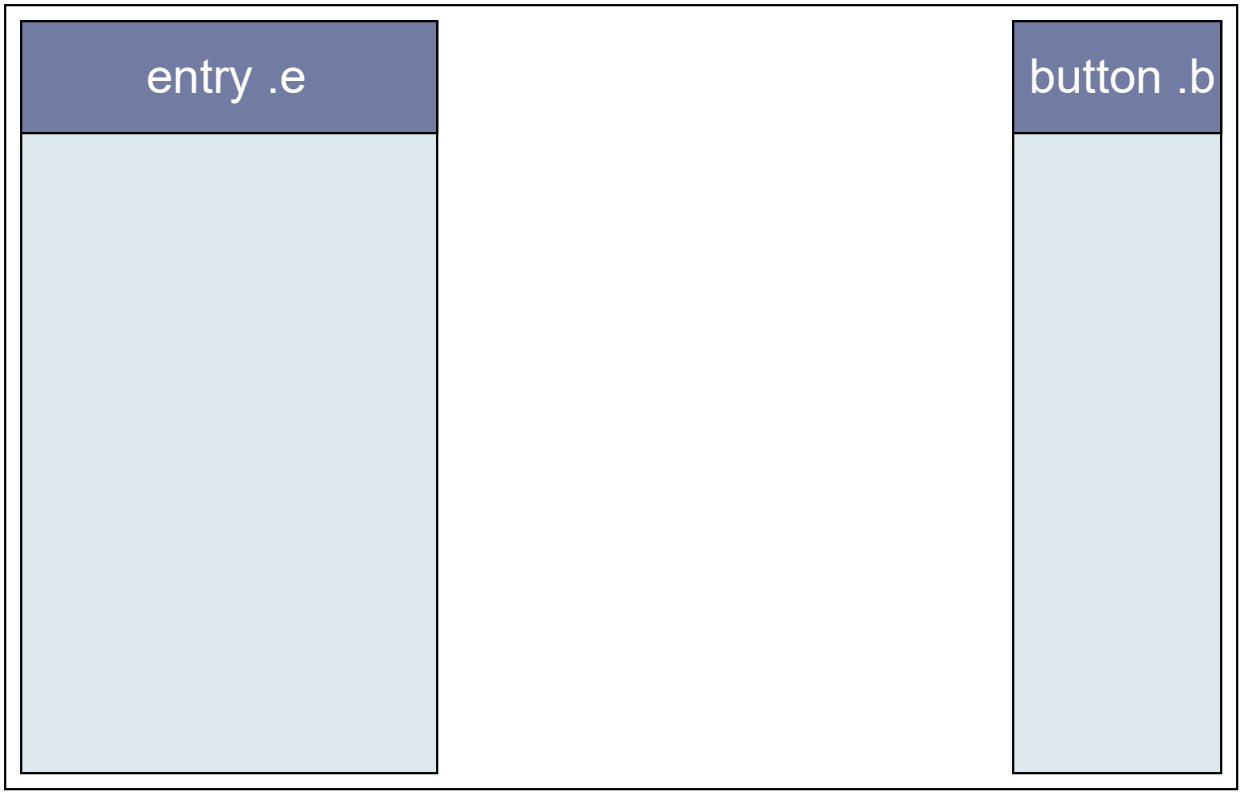
Packing example

- pack .e -side left -anchor n



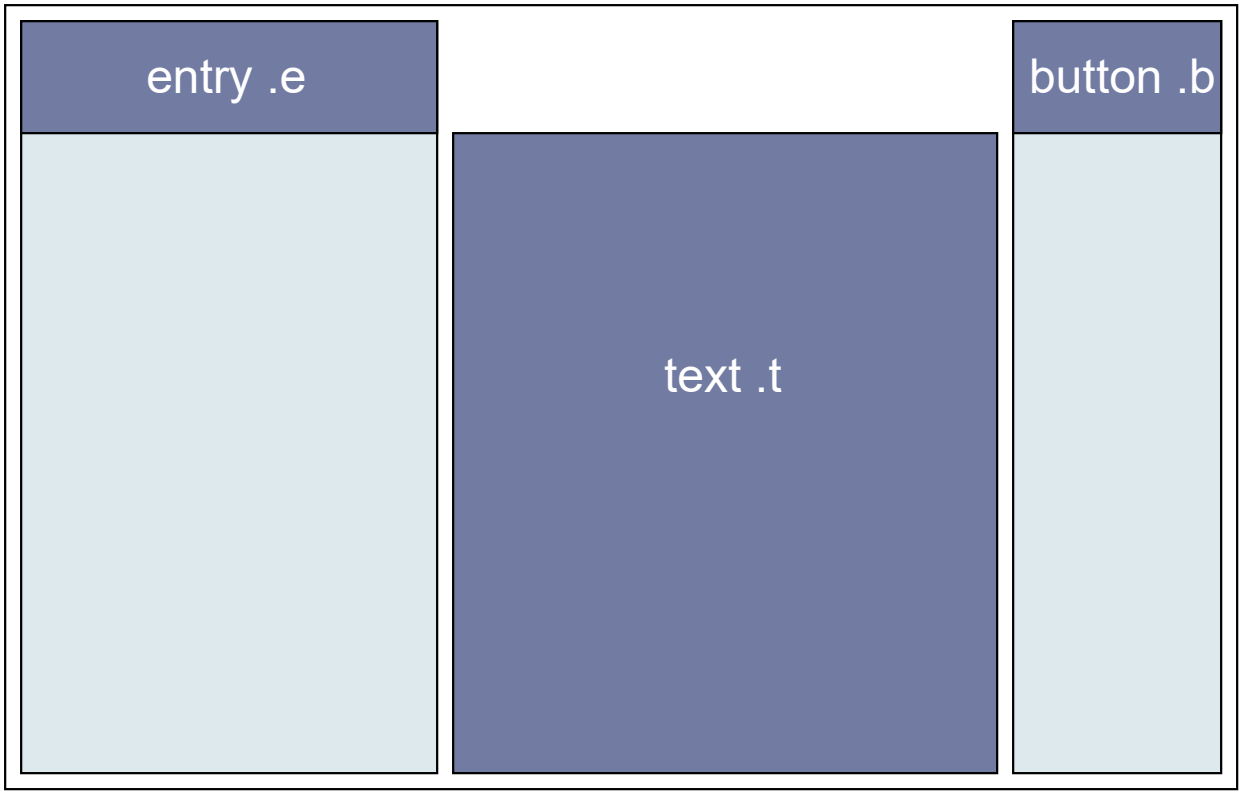
Packing example

- pack .b -side right -anchor n



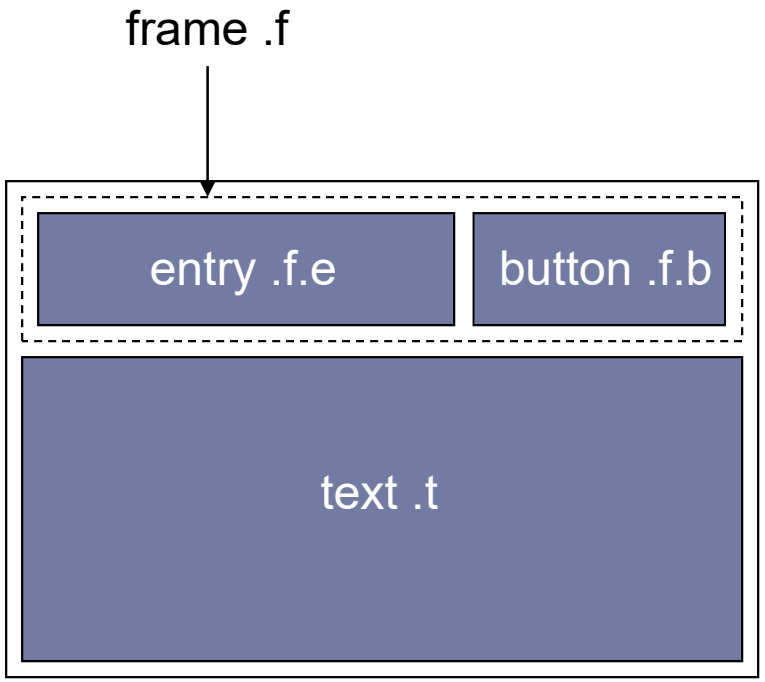
Packing example

- pack .t -side bottom

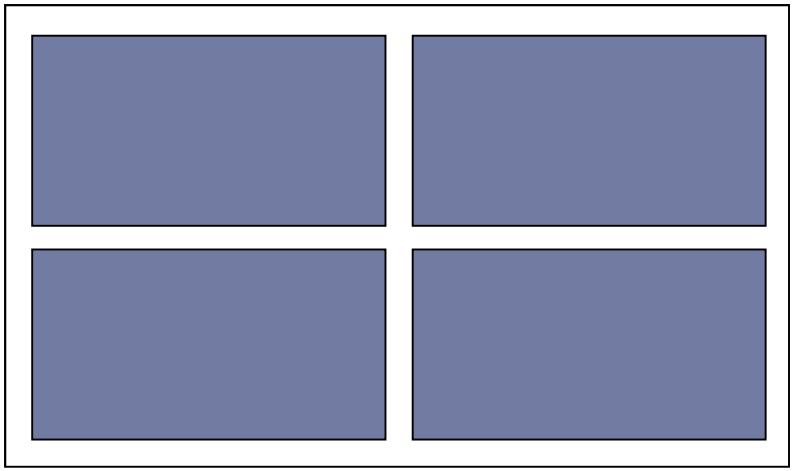


Packing example

- How to make this work?
  - Do we need an internal frame?

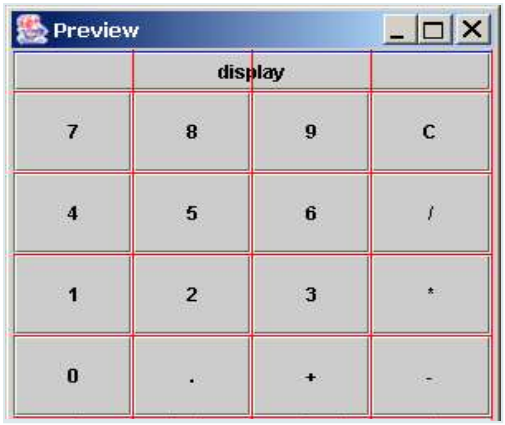


Pack layout challenge



Grid-based layout

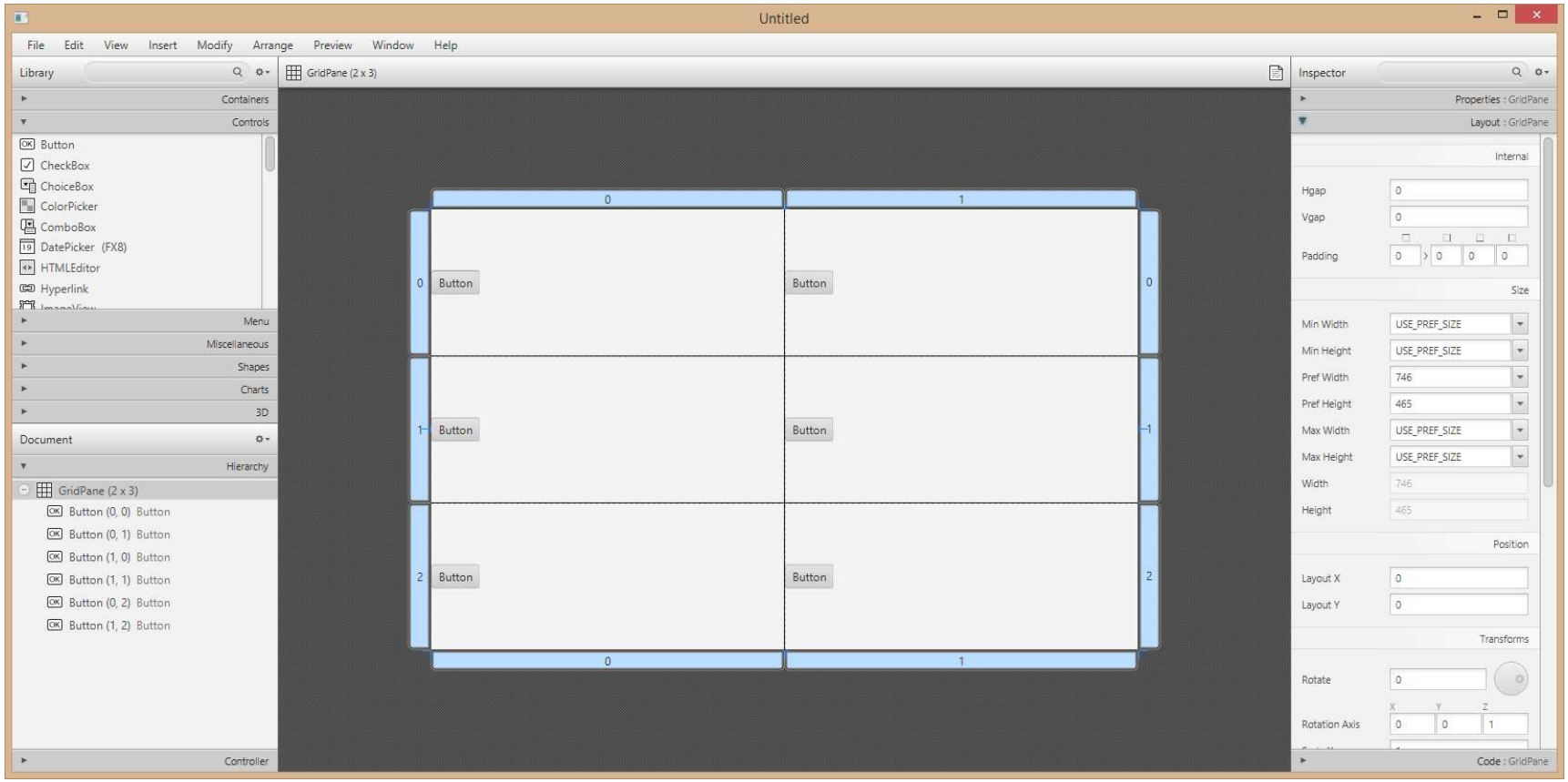
- Puts components on a virtual grid
  - Rows and columns
  - Components fit into one or more cells
- Easy for programmers to understand
  - Works well with grid-based screen design
- Layout controlled by constraints



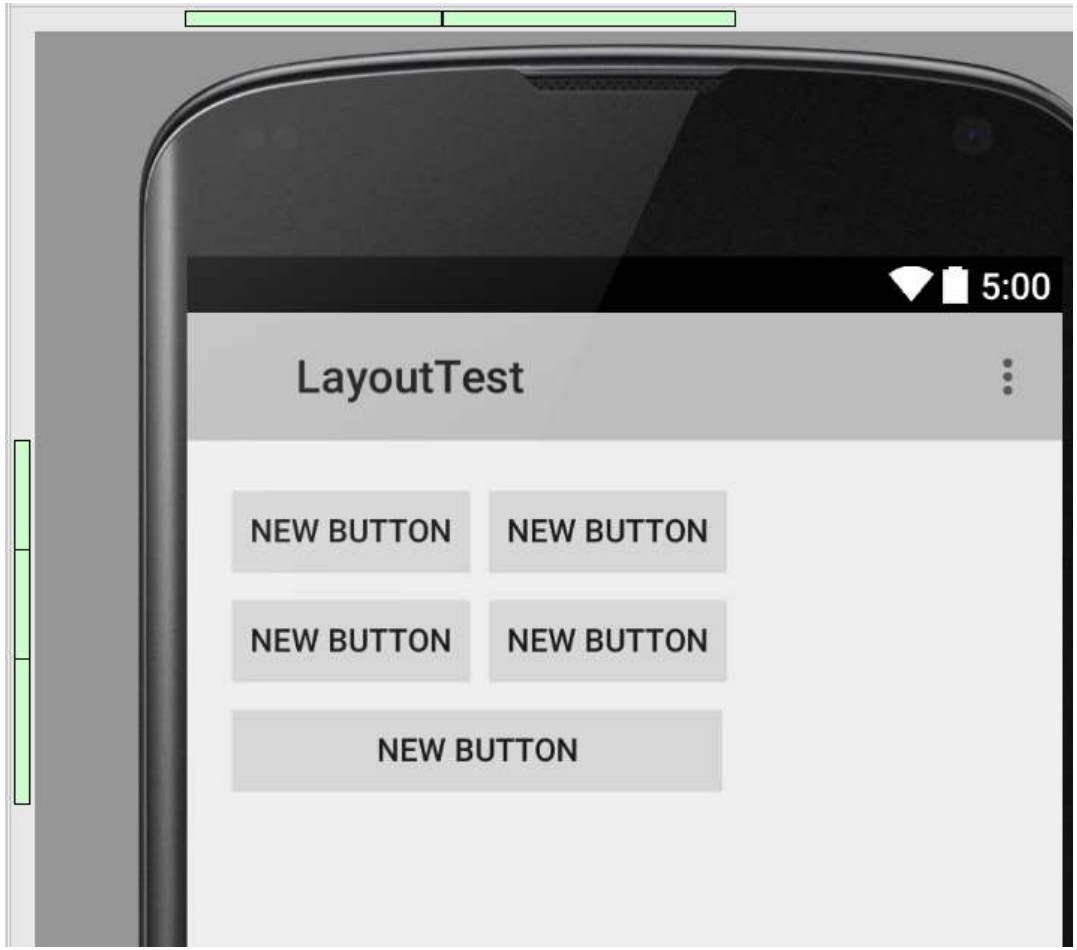
Grid constraints

- Where in the grid to start
  - JavaFX: setRowIndex(), setColumnIndex()
  - Android: android:layout_column, android:layout_row
- How many cells to take up
  - JavaFX: setRowSpan(), setColumnSpan()
  - Android: android:layout_columnSpan, layout_rowSpan
- What to do when the cell resizes
  - JavaFX: setHgrow(), setVgrow()
  - Android: android:layout_rowWeight, columnWeight

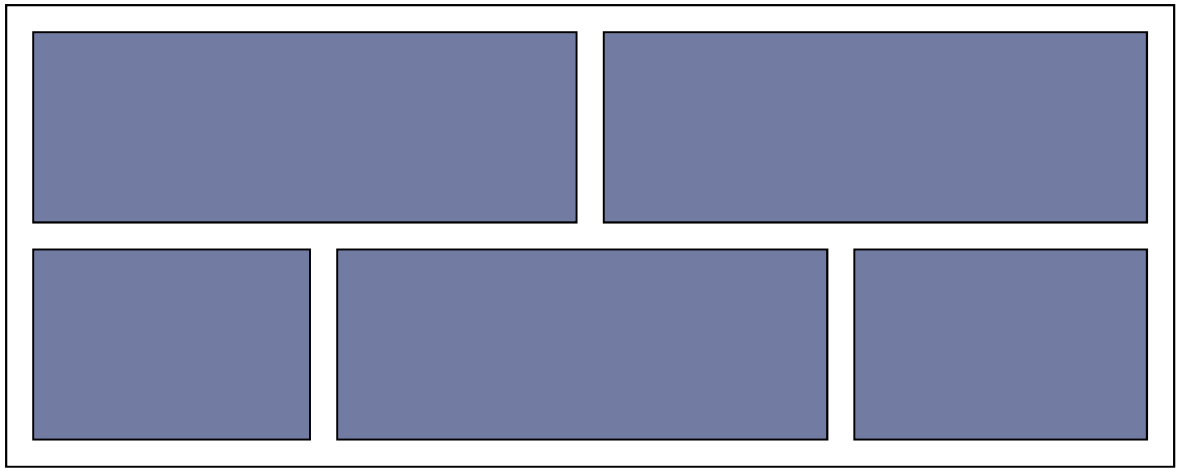
JavaFX GridPane (in Scene Builder)



Android GridLayout



Grid layout challenge



In Practice

- May combine layout managers
- e.g., in JavaFX:
  - Use GridPane or BorderPane to place main components
  - Use linear layouts (e.g., HBox) for sets of tools

Choosing a Layout Manager

- JavaFX
  - http://docs.oracle.com/javase/8/javafx/layout-tutorial/index.html
- Android
  - http://developer.android.com/guide/topics/ui/declaring-layout.html