

MAHARISHI UNIVERSITY of MANAGEMENT

Engaging the Managing Intelligence of Nature

Computer Science Department

**CS401 Modern Programming
Practices (MPP)
Professor Paul Corazza**

Lecture 6:

Building GUIs with JavaFX

Reflection of the Self

Wholeness of the Lesson

JavaFX is a UI library in Java that allows developers to create user interfaces that are rich in content and functionality. The ultimate provider of tools for the creation of beautiful and functional content in manifest existence is pure intelligence itself; all creativity arises from this field's self-interacting dynamics.

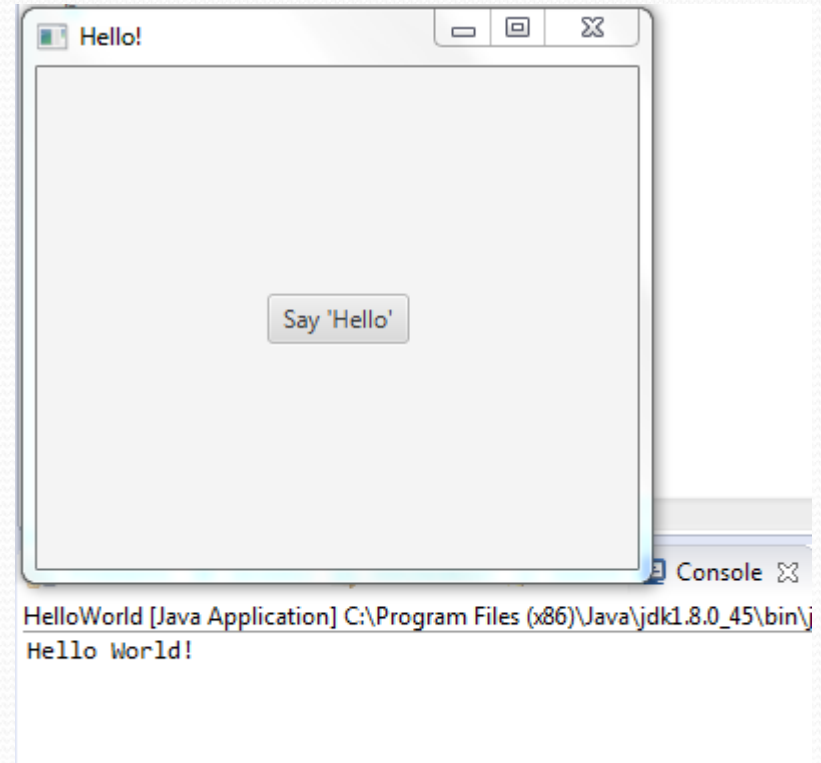
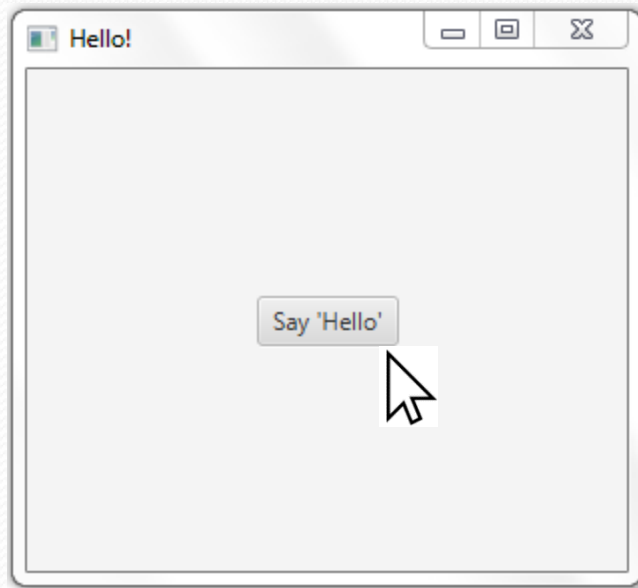
JavaFX Intro

- Began in 2007 as a small Sun Microsystems project to compete with Adobe Flash Player, to create advanced types of graphics, customized to run on modern graphics hardware. The underlying language was not Java.
- In 2011, Oracle provided a 100% Java version – JavaFX 2.0 – still aiming to compete with Flash.
- In Java 7, Java FX 2.2 was bundled with the Java libraries. At that time, Oracle announced that Swing would no longer be updated in future releases. The UI library to use was to be JavaFX.
- In 2018, Oracle announced that, starting with JDK 11, JavaFX will no longer be bundled with the JDK, but will be available through a separate download. The JDK 8 version of JavaFX will continue to be supported through the "open source" project through 2022. On the other hand, Oracle has announced that it will resume support of Swing (along with AWT) in JDK 8 and 11 and for the foreseeable future.
- *Why not bundle the new features with Swing?*
 - It would have required a complete re-write of Swing – easier to write enhancements to JavaFX.

Overview

- **Using JavaFX components** (learn more from api docs at <http://docs.oracle.com/javafx/2/api/>)
- Layout basics
- Handling GUI events
- Using CSS to style your app
- Declarative UI building using FXML
- Deployment

First Example - HelloWorld.java



First Example - HelloWorld.java

```
public class HelloWorld extends Application {  
    public static void main(String[] args) {  
        launch(args);  
    }  
  
    @Override  
    public void start(Stage primaryStage) {  
        primaryStage.setTitle("Hello World!");  
        Button btn = new Button();  
        btn.setText("Say 'Hello'");  
        btn.setOnAction(new EventHandler<ActionEvent>() {  
            @Override  
            public void handle(ActionEvent event) {  
                System.out.println("Hello World!");  
            }  
        });  
        StackPane root = new StackPane();  
        root.getChildren().add(btn);  
        primaryStage.setScene(new Scene(root, 300, 250));  
        primaryStage.show();  
    }  
}
```

About the Hello World Example

Application class

The entry point for a JavaFX application is always a user-defined subclass of the abstract class `javafx.application.Application` class. The `start()` method starts up the application – it is the only abstract method of `Application` (and so must be implemented).

Stage Class

A JavaFX application defines the user interface container by means of a *stage* and a *scene*. The JavaFX Stage class is the top-level JavaFX container. The JavaFX Scene class is the container for all content. The demo above creates the stage and scene and makes the scene visible in a given pixel size.

Difference Between Stage and Scene?

Analogy with a theater: many scenes on the same stage. The Stage has methods for changing the dimensions and other features (like the title) of the visible frame. The Scene has methods for managing content.



StackPane Class

In JavaFX, the content of the scene is represented as a hierarchical scene graph of *nodes*. In this example, the root node is a StackPane object, which is a resizable *layout* node. (In a StackPane nodes are added along the z axis. Makes it easy to overlay text on a shape or image or to overlap common shapes to create a complex shape)

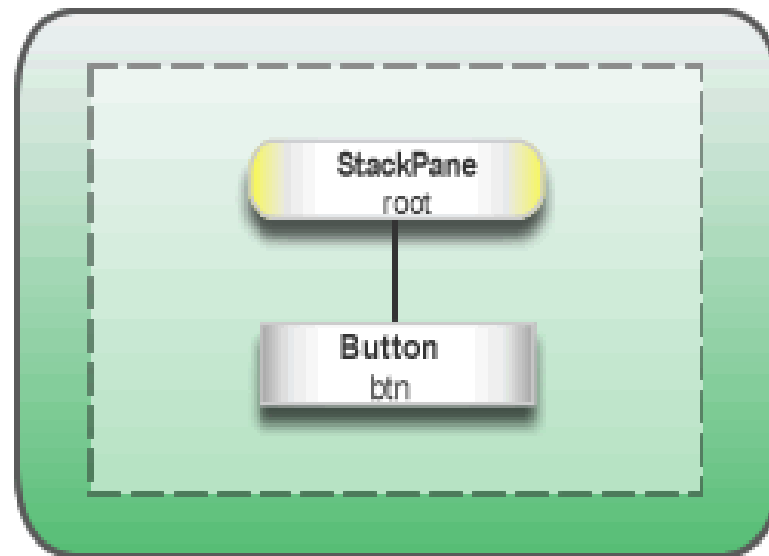
Components

The root node contains one child node, a button control with text, plus an event handler to print a message when the button is pressed.

The Scene Graph

Stage javafx.stage (window)

Scene javafx.scene



Main Point 1

For creating the look of a JavaFX application, two types of classes are primary: *components* and *containers*. A screen is created by setting the stage with the Stage and Scene container classes. And then the screen is populated with components, like buttons, textboxes, labels, and so on, starting at a root node and extending. Components and containers are analogous to the *manifest* and *unmanifest* fields of life; manifest existence, in the form of individual expressions, lives and moves within the unbounded container of pure existence.

Some General Points about JavaFX Apps

1. Main Method Is not Required

- The main() method is not required when the JAR file is created with the JavaFX Packagertool.
 - The JavaFX Packager tool is a command-line tool used to compile, package and deploy a Java FX application (can be found here: `<JAVA_HOME>\bin\javafxpackager.exe`)
 - Using the tool embeds the JavaFX Launcher in the output JAR file, so there is no need to call the Launcher from a main method.
- It is useful to include the main() method because
 - You can run JAR files that were created without the JavaFX Launcher (such as when using an IDE in which the JavaFX tools are not fully integrated, which is the case with Eclipse).
 - Swing applications that embed JavaFX code require the main() method.
- Read about the Packager tool here: <http://docs.oracle.com/javafx/2/deployment/packager.htm> and here: http://www.java2s.com/Tutorials/Java/JavaFX/0030_JavaFX_Package.htm

2. The Life-cycle of a JavaFX Application

The entry point for JavaFX applications is the Application class. The JavaFX runtime does the following, in the following order, whenever an application is launched:

- Constructs an instance of the specified Application class
- Calls the **init()** method (for initializing; typical use: read command line args – see lesson6.lecture.javafx.helloworld)
- Calls the **start(javafx.stage.Stage)** method
- Waits for the application to finish, which happens when either of the following occurs: (see the HelloSecondWindow demo)
 - the application calls **Platform.exit()** (this can be done explicitly in code)
 - the last window has been closed
- Calls the **stop()** method (typical use: clean up connections to resources)

Notes:

- The **start** method is abstract and must be overridden.
- The **init** and **stop** methods have concrete implementations that do nothing by default

3. Two Threads

- *Launcher thread.* Application **constructor** and **init** method are called on this thread
- *Application thread.* JavaFX creates an application thread for running the application **start** method, processing input events, and running animation timelines.
 - Creation of JavaFX **Scene** and **Stage** objects as well as modification of scene graph operations to *live objects* (those objects already attached to a scene) must be done on the JavaFX application thread.
 - This means that an application must not construct a Scene or a Stage in either the constructor or in the **init** method.

Overview

- Using JavaFX components (learn more from api docs at <http://docs.oracle.com/javafx/2/api/>)
- **Layout basics**
- Handling GUI events
- Using CSS to style your app
- Deployment

Second Example - Creating a Form in JavaFX

- In this example we build a login form – illustrates:
 - Basics of screen layout
 - How to add controls to a layout pane
 - How to create input events and handle them



Demo: `lesson6.lecture.javafx.login`

Sample Code

@Override

```
public void start(Stage primaryStage) {  
    primaryStage.setTitle("JavaFX Welcome");  
    GridPane grid = new GridPane();  
    grid.setAlignment(Pos.CENTER);  
    grid.setHgap(10);  
    grid.setVgap(10);  
    //top, right, bottom, left  
    grid.setPadding(new Insets(25, 25, 25, 25));  
  
    Text scenetitle = new Text("Welcome");  
    scenetitle.setFont(Font.font("Tahoma", FontWeight.NORMAL, 20));  
    grid.add(scenetitle, 0, 0, 2, 1);  
  
    Label userName = new Label("User Name:");  
    grid.add(userName, 0, 1);  
  
    TextField userTextField = new TextField();  
    grid.add(userTextField, 1, 1);  
  
    Label pw = new Label("Password:");  
    grid.add(pw, 0, 2);
```



Sample Code (Contd.)

```
PasswordField pwBox = new PasswordField();  
grid.add(pwBox, 1, 2);
```

```
Button btn = new Button("Sign in");  
HBox hbxBtn = new HBox(10);  
hbxBtn.setAlignment(Pos.BOTTOM_RIGHT);  
hbxBtn.getChildren().add(btn);  
grid.add(hbxBtn, 1, 4);
```

```
final Text statusMsg = new Text();  
grid.add(statusMsg, 1, 6);  
btn.setOnAction(new EventHandler<ActionEvent  
    @Override  
    public void handle(ActionEvent e) {  
        statusMsg.setFill(Color.FIREBRICK);  
        statusMsg.setText("Sign in button pressed");  
    }  
));  
Scene scene = new Scene(grid, 300, 275);  
primaryStage.setScene(scene);  
primaryStage.show();
```

```
}
```

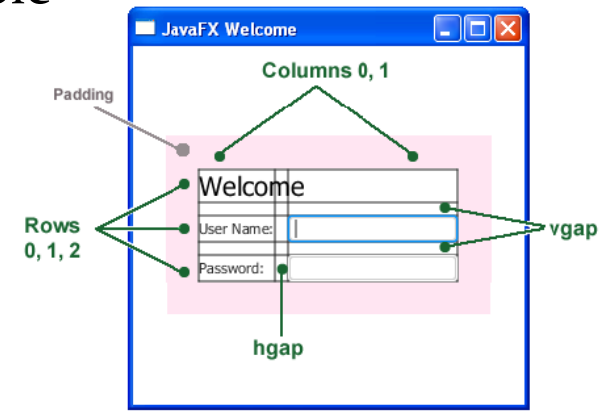


Create a GridPane Layout

- GridPane

- Is a layout mode that works like an HTML table
- Controls can be placed in any cell in the grid
- Controls can span cells as needed

```
GridPane grid = new GridPane();  
grid.setAlignment(Pos.CENTER);  
grid.setHgap(10);  
grid.setVgap(10);  
grid.setPadding(new Insets(25, 25, 25, 25));
```



- grid.setAlignment** changes the default position of the grid from the top left of the scene to the center.
- gap** controls the spacing between the rows and columns in the grid
- padding** property controls the space around the edges of the grid pane
- insets** occur in this order: *top, right, bottom, and left*

Note: padding and gaps are measured in *pixels*.

NOTES:

- When the scene is created, the grid pane is the root node – this is usual approach when using layout containers
- As the window is resized, the nodes within the grid pane are resized according to their layout constraints.
- The padding properties ensure there is a padding around the grid pane when you make the window smaller.
- Code sets the scene width and height to 300 by 275. If you do not set the scene dimensions, the scene defaults to the minimum size needed to display its contents.

Add Text, Labels, and Text Fields

Sample Code:

```
Text scenetitle = new Text("Welcome");  
scenetitle.setFont(Font.font("Tahoma", FontWeight.NORMAL, 20));  
grid.add(scenetitle, 0, 0, 2, 1); //colspan = 2, rowspan = 1
```

```
Label userName = new Label("User Name:");  
grid.add(userName, 0, 1);
```

```
TextField userTextField = new TextField();  
grid.add(userTextField, 1, 1);
```

```
Label pw = new Label("Password:");  
grid.add(pw, 0, 2);
```

```
PasswordField pwBox = new PasswordField();  
grid.add(pwBox, 1, 2);
```



NOTES

- TextFields are constructed to have width of 12 pixels by default. The preferred width can be modified using `setPrefColumnCount(numCols)`, or `setPrefWidth(pixels)`, but layout may override preferences.
- How positions in the grid are specified: (*column num*, *row num*):

(0,0)	(1,0)
(0,1)	(1,1)
(0,2)	(1,2)

- The **grid.add()** method can also set the column span to 2 and the row span to 1, as shown in the code
- Labels and Texts are both displayed as read-only. Labels can contain images and allow borders but Texts cannot.

Exercise 6.1

Modify the sample code by inserting another row that lets the user enter a User ID. For this exercise, the code is available in the `lesson6.exercise_1` package of the `InClassExercises` project. When you are finished, your UI should look like this:



The screenshot shows a JavaFX window titled "JavaFX Welcome". Inside the window, the word "Welcome" is displayed in a stylized font. Below it, there are three input fields: "User Name:", "User ID:", and "Password:". Each field has a corresponding text label to its left. The "User Name:" field is currently active, showing a cursor. At the bottom right of the window, there is a "Sign in" button.

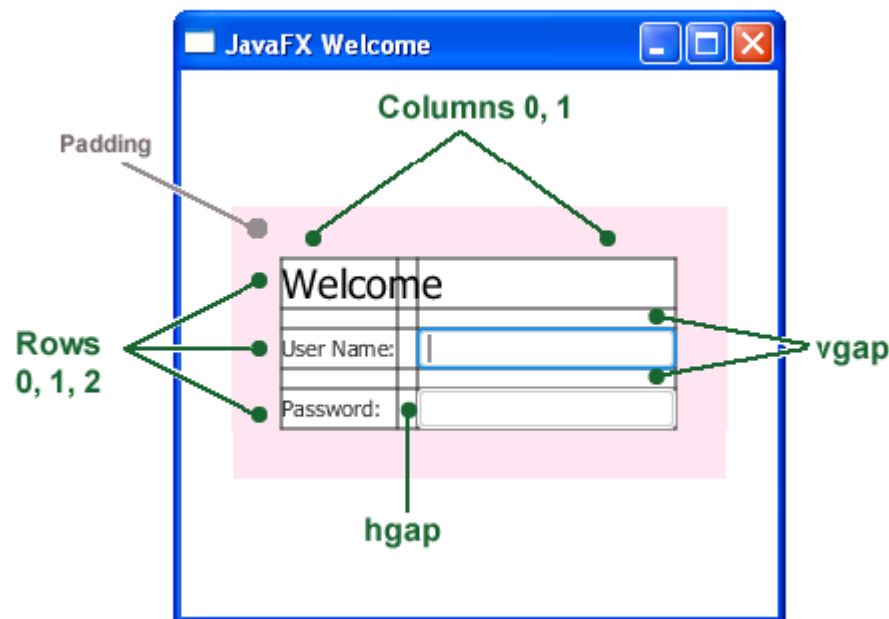
Debugging

For debugging, GridPane allows you to display the grid lines. Do this here by adding this line of code

`grid.setGridLinesVisible(true)`

right after adding the password field.

When code is run, you see this:



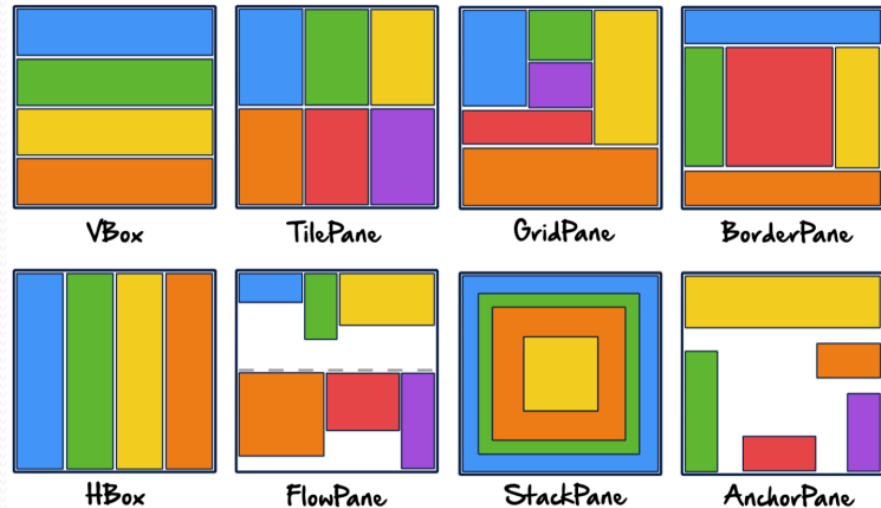
Positioning a Component in GridPane with HBox

Sample Code:

```
Button btn = new Button("Sign in");
HBox hbxBtn = new HBox(10);    //space is 10
hbxBtn.setAlignment(Pos.BOTTOM_RIGHT);
hbxBtn.getChildren().add(btn);
grid.add(hbxBtn, 1, 4);
```

- The HBox layout pane is created to allow you to place components like the button in a special place.
- HBox constructor accepts a spacing parameter (spacing between components). In this case, alignment is set to Pos.BOTTOM_RIGHT
- If other components are added to an HBox, they are laid out from left to right

Other Layouts



Pane Class	Description
HBox, VBox	Lines up children horizontally or vertically.
GridPane	Lays out children in a tabular grid, similar to the Swing GridBagLayout.
TilePane	Lays out children in a grid, giving them all the same size, similar to the Swing GridLayout.
BorderPane	Provides the areas North, East, South, West, and Center, similar to the Swing BorderLayout.
FlowPane	Flows children in rows, making new rows when there isn't sufficient space, similar to the Swing FlowLayout.
AnchorPane	Children can be positioned in absolute positions, or relative to pane's boundaries. This is the default in the SceneBuilder layout tool.
StackPane	Stacks children above each other. Can be useful for decorating components, such as stacking a button over a colored rectangle.

Main Point 2

In JavaFX, components are arranged in a container through the use of *layouts* that organize components in different ways. The most convenient layout is GridPane, which allows you to organize components in a table format, and suffices for most layout needs. For special layout requirements, JavaFX provides half a dozen other layout types. Likewise, all of manifest life is conducted by a vast network of natural laws.

Overview

- Using JavaFX components (learn more from api docs at <http://docs.oracle.com/javafx/2/api/>)
- Layout basics
- **Handling GUI events**
- Using CSS to style your app
- Deployment

Event Handling

Sample code:


```
final Text actiontarget = new Text();  
grid.add(actiontarget, 1, 6);  
btn.setOnAction(new EventHandler<ActionEvent>() {  
    @Override  
    public void handle(ActionEvent e) {  
        actiontarget.setFill(Color.FIREBRICK);  
        actiontarget.setText("Sign-in button pressed");  
    }  
});
```



- Adds a Text control for displaying the message.
- The `setOnAction()` method is used to register an event handler that sets the text value of `actiontarget` to “Sign-in button pressed” when the user presses the button.
- The color of the `actiontarget` object is set to firebrick red.

Exercise 6.2

Extend your UI from Exercise 6.1 so that the user can choose to sign out. Your modified UI should look like this:



The screenshot shows a JavaFX window titled "JavaFX Welcome". Inside the window, there is a "Welcome" heading. Below it are three input fields labeled "User Name:", "User ID:", and "Password:". At the bottom of the form are two buttons: "Sign in" and "Sign out". Below the buttons, the text "Sign out button pressed" is displayed in red, indicating that the sign out button has been clicked.

More Examples – Other Techniques

Demo `lesson6.lecture.javafx.secondwindow` illustrates:

- Working with multiple windows – by creating multiple Stages
- Setting background color of the root
- Creating and using a status bar
- Setting up a ComboBox and responding to user selections with a `ChangeListener`
- `ToggleButton` for toggling between states in response to button clicks

More Examples – Other Techniques (Contd.)

Demo lesson6.lecture.javaafx.tables illustrates the use of menus and tables in JavaFX.

1. **Menus.** The Start class creates a MenuBar, adds two Menus, and adds MenuItems to the first Menu.
2. **Tables.** The ShoppingCartWindow creates a TableView.
 - TableViews are created one column at a time.
 - In this example, all cells have been made read-only, but with more work, cells can be editable.
 - A TableView requires some Java class to provide the data that it will read and present. In this example, ShoppingCartItem provides the necessary data.
 - During TableView construction, the field names from ShoppingCartItem are specified and each will represent one of the TableView columns.
 - After the ShoppingCartWindow has been created, data for the table can be set using the setData method that has been provided. This method accepts a List of ShoppingCartItems; each ShoppingCartItem in the list will be displayed as a row in the table.

Main Point 3

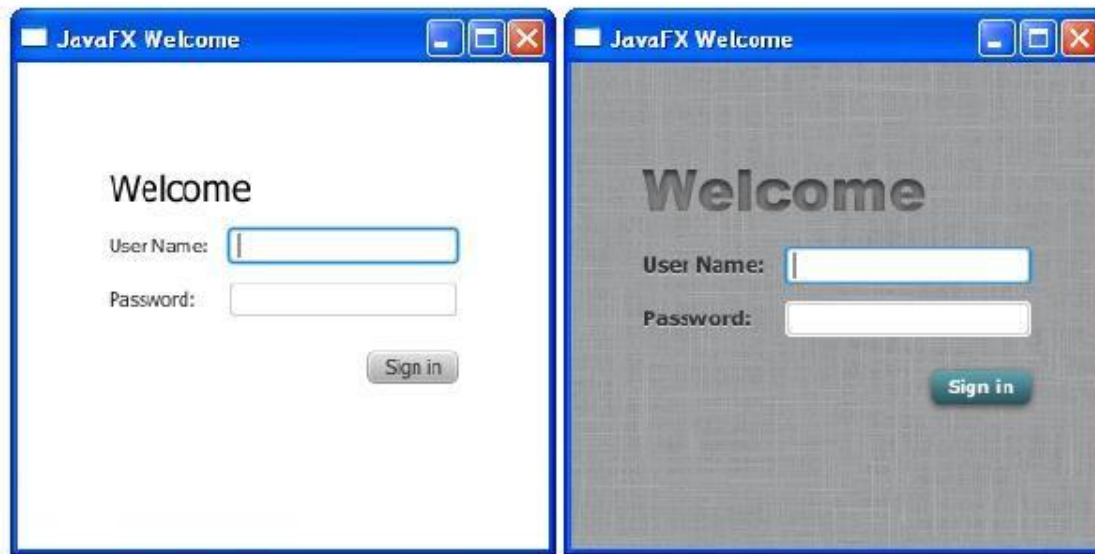
A GUI becomes responsive to user interaction (for example, button clicks and mouse clicks) through the event-handling model of JavaFX, in which event sources are associated with EventHandler classes, whose handle method is called (and is passed an Event object) whenever a relevant action occurs. To make use of this event-handling model, the developer defines a handler class, implements the handle method, and, when defining an event source (like a button), registers the handler class with this event source component. The “observer” pattern that is used in JavaFX mirrors the fact that in creation, the influence of every action is felt everywhere; existence is a field of infinite correlation; every behavior is “listened to” throughout creation

Overview

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Third Example - Fancy Forms with JavaFX CSS

For this example, we are going to add a Cascading Style Sheet (CSS) to the JavaFX application as shown below.



Add CSS Styling to the Login Class

Steps:

1. Create a new CSS file and save it in the same directory as Login.java
2. Specify location of the CSS file using the following code:

```
Scene scene = new Scene(grid, 300, 275);
primaryStage.setScene(scene);
scene.getStylesheets().add(
    getClass().getResource("Login.css").toExternalForm());
primaryStage.show();
```

Reference:

http://docs.oracle.com/javafx/2/css_tutorial/jfxpub-css_tutorial.htm

Detailed reference:

http://docs.oracle.com/cd/E17802_01/javafx/javafx/1.3/docs/api/javafx.scene/doc-files/cssref.html

Other ways to access a CSS file are discussed here:

<https://blog.idrsolutions.com/2014/04/use-external-css-files-javafx/>

Add a Background Image

```
.root {  
    -fx-background-image: url("background.jpg");  
}
```

The background image is applied to the `.root` style, which means it is applied to the root node of the `Scene` instance.

The style definition consists of

- the name of the property: `-fx-background-image`
- the value for the property: `url("background.jpg")`.

Style the Labels

When you specify *.label* in your stylesheet, the values that are set affect all Labels in the form.

```
.label {  
    -fx-font-size: 12px;  
    -fx-font-weight: bold;  
    -fx-text-fill: #333333;  
    -fx-effect: dropshadow(  
        gaussian, rgba(255,255,255,0.5) , 0,0,0,1 );  
}
```

This example

- sets the font size and weight
- sets text-fill to gray
- applies a drop shadow (the purpose of the drop shadow is to add contrast between the dark gray text and the light gray background).
- rgba is RGB + alpha. Alpha (values in range 0..1) specifies opacity
- dropshadow parameters can be looked up at

<http://docs.oracle.com/javafx/2/api/javafx/scene/doc-files/cssref.html>

Style Text

Apply css styling to the two Text objects: *scenetitle* (includes the text Welcome) and *actiontarget* (“signed in” message at bottom).

Steps:

- Remove the Java coding that formats the style of the texts:
`scenetitle.setFont(Font.font("Tahoma", FontWeight.NORMAL, 20));`
`statusMsg.setFill(Color.FIREBRICK);`
- Create an ID for each text node by using the `setID()` method of the Node class:
`scenetitle.setId("welcome-text");`
`statusMsg.setId("actiontarget");`
- In the Login.css file, define the style properties for the IDs. :

```
#welcome-text {  
    -fx-font-size: 32px;  
    -fx-font-family: "Arial Black";  
    -fx-fill: #818181;  
    -fx-effect: innershadow(three-pass-box, rgba(0,0,0,0.7), 6, 0.0, 0, 2);  
}  
#actiontarget {  
    -fx-fill: FIREBRICK;  
    -fx-font-weight: bold;  
    -fx-effect: dropshadow( gaussian, rgba(255,255,255,0.5), 0,0,0,1 );  
}
```


Style The Button

We style the button so that it changes style when the user hovers the mouse over it.

Steps:

1. Create the style for the initial state of the button by adding the code below. This code uses the `.button` style class selector, such that if you add a button to the form at a later date, then the new button will also use this style.

```
.button {  
    -fx-text-fill: white;  
    -fx-font-family: "Arial Narrow";  
    -fx-font-weight: bold;  
    -fx-background-color: linear-gradient(#61a2b1, #2A5058);  
    -fx-effect: dropshadow( three-pass-box , rgba(0,0,0,0.6) ,  
        5, 0.0 , 0 , 1 );  
}
```

2. Create a slightly different look for when the user hovers the mouse over the button. You do this with the hover *pseudo-class*. A pseudo-class includes the selector for the class and the name for the state separated by a colon (:), as shown below -

```
.button:hover {  
    -fx-background-color: linear-gradient(#2A5058, #61a2b1);  
}
```

Exercise 6.3

Modify the UI you created in Exercise 6.2 so that it uses the image "gentle.jpg" as background. This image file is in the lesson6.exercise_3 package of the InClassExercises project. When you are finished, your UI should look like this:



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Deploying JavaFX Application

- JavaFX applications can be run in several ways:
 - Launch as a desktop application from a JAR file or self-contained application launcher
 - Launch from the command line using the Java launcher
 - Launch by clicking a link in the browser to download an application
 - View in a web page when opened

Deploying Your First JavaFX Application(cont.)

For this course, we are going to do it in the first way.
Here are instructions for doing that:

From your Eclipse workspace:

- right click your JavaFX application
- create a special Run Configuration – example: HelloWorldToJar (Duplicate existing Run Configuration and rename it) , then Close
- right click on the application again and select export...select Java folder
- Runnable JAR file (Next)
- Select launch configuration you just created
- choose Export Destination

Now, run the JAR file you just created by double-clicking the file.

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

*The self-referral dynamics
arising from the reflexive association of container classes*

1. In JavaFX, components are placed and arranged in container classes for attractive display.
 2. In JavaFX, certain container classes (like HBox) are also considered to be components; this makes it possible to place and arrange container classes inside other container classes. These self-referral dynamics support a much broader range of possibilities in the design of GUIs.
-
3. **Transcendental Consciousness:** TC is the self-referral field of all possibilities.
 4. **Wholeness moving within Itself:** In Unity Consciousness, all activity is appreciated as the self-referral dynamics of one's own Self.

