BIRZEIT UNIVERSITY

JavaFX Basics

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Motivations

- **JavaFX** is a new framework for developing Java graphical user interface (**GUI)** programs.
- The **JavaFX API** is an **excellent** example of how the **OO** principle is applied.
- This chapter serves two purposes:
  - 1st: it presents the basics of **JavaFX** programming.
  - 2nd: it uses **JavaFX** to demonstrate **OOP**.
- Specifically, this chapter introduces the framework of **JavaFX** and discusses **JavaFX GUI** components and their relationships.

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JavaFX vs Swing and AWT

- When Java was introduced, the **GUI** classes were bundled in a library known as the ***Abstract Windows Toolkit (AWT)***.
  - **AWT** is fine for developing simple graphical user interfaces, but not for developing comprehensive **GUI**.
  - In addition, **AWT** is prone to platform-specific bugs.
- The **AWT** components were replaced by a more robust, versatile, and flexible library known as ***Swing***.
  - **Swing** components depend less on the target platform and use less of the native **GUI** resource.
- With the release of **Java 8**, **Swing** is replaced by a completely new **GUI** platform known as ***JavaFX***.

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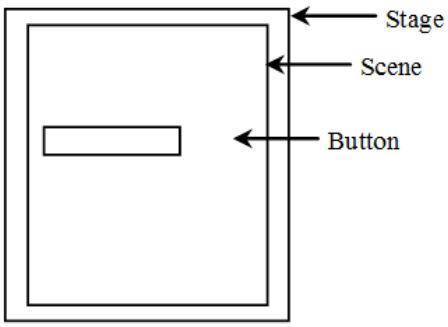
Basic Structure of JavaFX

- Extend **Application** class
- Override the **start (Stage)** method
- **Stage**, **Scene**, and **Nodes (Shapes, UI Controls)**



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Basic Structure of a JavaFX Program

```
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.stage.Stage;

public class MyJavaFX extends Application{
    // Override the start method in the Application class
    public void start(Stage primaryStage) {
        // Create a scene and place a button in the scene
        Button btOK = new Button("OK");
        Scene scene = new Scene(btOK, 200, 250);
        primaryStage.setTitle("MyJavaFX"); // Set the stage title
        primaryStage.setScene(scene); //Place the scene in the stage
        primaryStage.show(); // Display the stage
    }

    public static void main(String[] args) {
        Application.launch(args);
    }
}
```

1: Extend Application

2: Override start

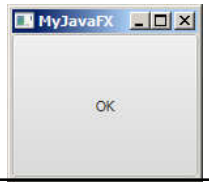
3: Create a button

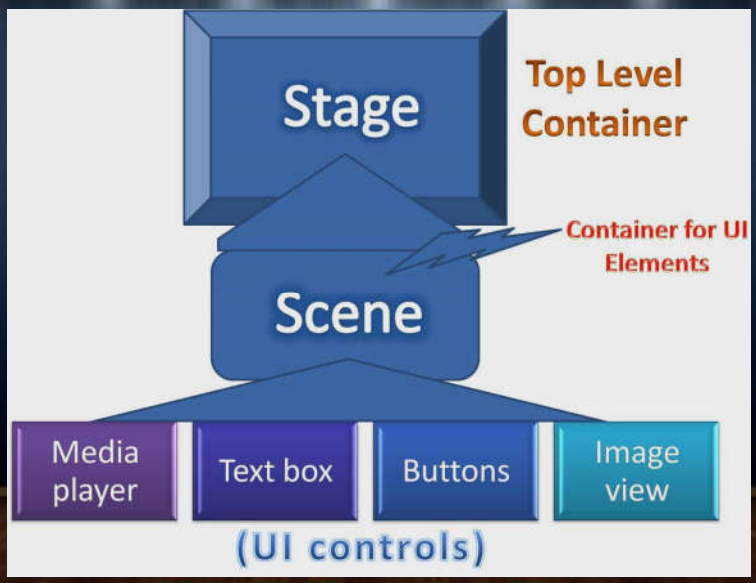
4: Create a scene

5: Set a scene

6: Display stage

7: Launch application

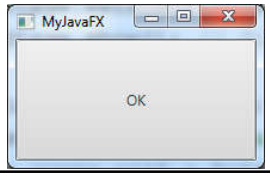


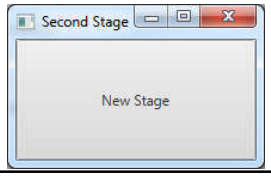


Multiple Stage Demo

```
public void start(Stage primaryStage) {
    // Create a scene and place a button in the scene
    Scene scene = new Scene(new Button("OK"), 100, 100);
    primaryStage.setTitle("MyJavaFX"); // Set the stage title
    primaryStage.setScene(scene); // Place the scene in the stage
    primaryStage.show(); // Display the stage

    Stage stage = new Stage(); // Create a new stage
    stage.setTitle("Second Stage"); // Set the stage title
    // Set a scene with a button in the stage
    stage.setScene(new Scene(new Button("New Stage"), 100, 100));
    stage.show(); // Display the stage
}
```

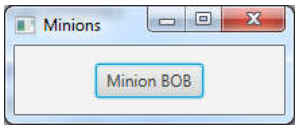




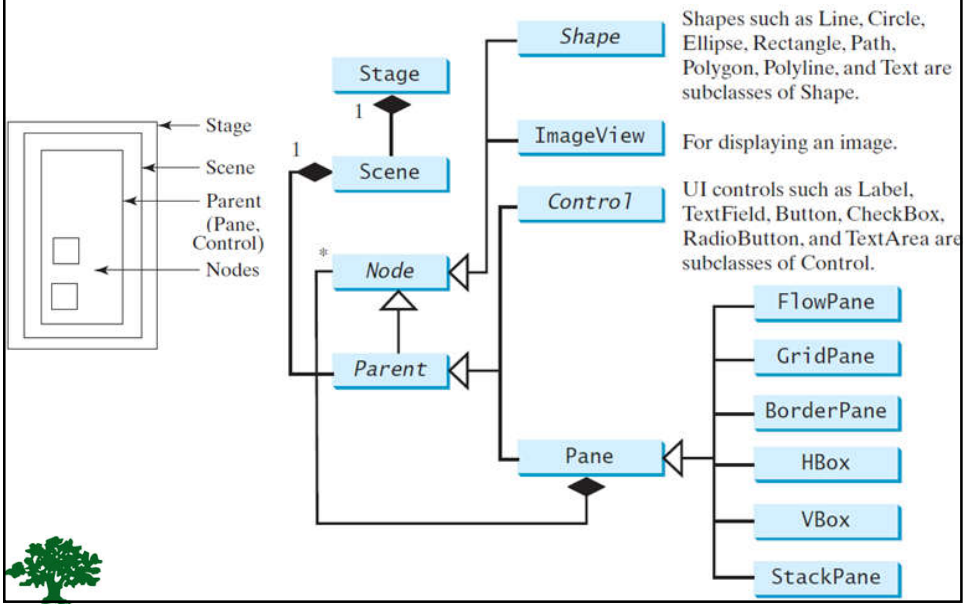
Placing Button in the Center

```
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;

public class ButtonInPane extends Application {
    public void start(Stage primaryStage) {
        StackPane pane = new StackPane();
        pane.getChildren().add(new Button("Minion BOB"));
        Scene scene = new Scene(pane, 200, 50);
        primaryStage.setTitle("Minions");
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        Application.launch(args);
    }
}
```



Panes, UI Controls, and Shapes

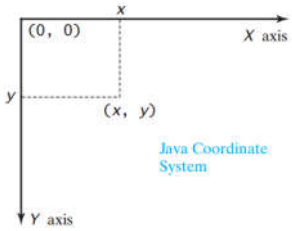


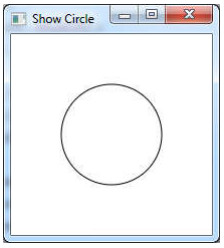
Display a Circle Shape

```
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.layout.Pane;
import javafx.scene.paint.Color;
import javafx.scene.shape.Circle;
import javafx.stage.Stage;
public class ShowCircle extends Application {
    public void start(Stage primaryStage) {
        // Create a circle and set its properties
        Circle circle = new Circle();
        circle.setCenterX(100);
        circle.setCenterY(100);
        circle.setRadius(50);
        circle.setStroke(Color.BLACK);
        circle.setFill(Color.WHITE);

        // Create a pane to hold the circle
        Pane pane = new Pane();
        pane.getChildren().add(circle);

        Scene scene = new Scene(pane, 200, 200);
        primaryStage.setTitle("Show Circle");
        primaryStage.setScene(scene);
        primaryStage.show();
    }
}
```





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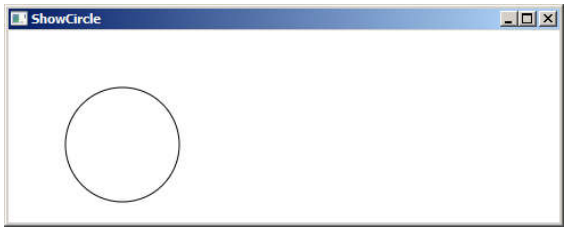
Binding Properties

- **JavaFX** introduces a new concept called ***binding property*** that enables a ***target object*** to be bound to a ***source object***.
  - If the value in the source object changes, the target property is also changed automatically.
- The target object is simply called a ***binding object*** or a ***binding property***.



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Binding Properties

```
public void start(Stage primaryStage) {
  Pane pane = new Pane();
  Circle circle = new Circle();
  circle.centerXProperty().bind(pane.widthProperty().divide(2));
  circle.centerYProperty().bind(pane.heightProperty().divide(2));
  circle.setRadius(50);
  circle.setStroke(Color.BLACK);
  circle.setFill(Color.WHITE);
  pane.getChildren().add(circle);

  Scene scene = new Scene(pane, 200, 200);
  primaryStage.setTitle("ShowCircleCentered");
  primaryStage.setScene(scene);
  primaryStage.show();
}
```

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Binding Property:

getter, setter, and property getter

```java
public class SomeClassName {

  private PropertyType x;

  /** Value getter method */
  public propertyValueType getX() { ... }

  /** Value setter method */
  public void setX(propertyValueType value) { ... }

  /** Property getter method */
  public PropertyType xProperty() { ... }
}
```

(a) x is a binding property

```java
public class Circle {

  private DoubleProperty centerX;

  /** Value getter method */
  public double getCenterX() { ... }

  /** Value setter method */
  public void setCenterX(double value) { ... }

  /** Property getter method */
  public DoubleProperty centerXProperty() { ... }
}
```

(b) centerX is binding property

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Binding Property

❖ **JavaFX** defines binding properties for primitive types and strings:

Type	Binding Property Type
double	DoubleProperty
float	FloatProperty
long	LongProperty
int	IntegerProperty
boolean	BooleanProperty
String	StringProperty

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```java
import javafx.beans.property.DoubleProperty;
import javafx.beans.property.SimpleDoubleProperty;

public class BindingDemo {
  public static void main(String[] args) {
    DoubleProperty d1 = new SimpleDoubleProperty(1);
    DoubleProperty d2 = new SimpleDoubleProperty(2);
    d1.bind(d2);
    System.out.println("d1 is " + d1.getValue()
      + " and d2 is " + d2.getValue());
    d2.setValue(70.2);
    System.out.println("d1 is " + d1.getValue()
      + " and d2 is " + d2.getValue());
  }
}
```

```
d1 is 2.0 and d2 is 2.0
d1 is 70.2 and d2 is 70.2
```

Common Properties and Methods for Nodes

- The abstract **Node** class defines many properties and methods that are common to all nodes.
  - **style**: set a **JavaFX CSS** style

```java
circle.setStyle("-fx-stroke: black; -fx-fill: red;");
```

  - **rotate**: Rotate a node

```java
button.setRotate(80);
```

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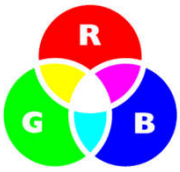
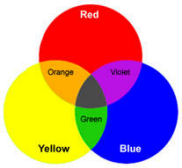
The Color Class





javafx.scene.paint.Color	
-red: double	The red value of this Color (between 0.0 and 1.0).
-green: double	The green value of this Color (between 0.0 and 1.0).
-blue: double	The blue value of this Color (between 0.0 and 1.0).
-opacity: double	The opacity of this Color (between 0.0 and 1.0).
+Color(r: double, g: double, b: double, opacity: double)	Creates a Color with the specified red, green, blue, and opacity values.
+brighter(): Color	Creates a Color that is a brighter version of this Color.
+darker(): Color	Creates a Color that is a darker version of this Color.
+color(r: double, g: double, b: double): Color	Creates an opaque Color with the specified red, green, and blue values.
+color(r: double, g: double, b: double, opacity: double): Color	Creates a Color with the specified red, green, blue, and opacity values.
+rgb(r: int, g: int, b: int): Color	Creates a Color with the specified red, green, and blue values in the range from 0 to 255.
+rgb(r: int, g: int, b: int, opacity: double): Color	Creates a Color with the specified red, green, and blue values in the range from 0 to 255 and a given opacity.

```
Color color = new Color(0.25, 0.14, 0.333, 0.51);
```

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The Font Class

javafx.scene.text.Font	
-size: double	The size of this font.
-name: String	The name of this font.
-family: String	The family of this font.
+Font(size: double)	Creates a Font with the specified size.
+Font(name: String, size: double)	Creates a Font with the specified full font name and size.
+font(name: String, size: double)	Creates a Font with the specified name and size.
+font(name: String, w: FontWeight, size: double)	Creates a Font with the specified name, weight, and size.
+font(name: String, w: FontWeight, p: FontPosture, size: double)	Creates a Font with the specified name, weight, posture, and size.
+getFamilies(): List<String>	Returns a list of font family names.
+getFontNames(): List<String>	Returns a list of full font names including family and weight.

```
Font font1 = new Font("SansSerif", 16);
Font font2 = Font.font("Times New Roman", FontWeight.BOLD,
  FontPosture.ITALIC, 12);
```

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The Image, ImageView Class

javafx.scene.image.Image	
-error: ReadOnlyBooleanProperty	Indicates whether the image is loaded correctly?
-height: ReadOnlyBooleanProperty	The height of the image.
-width: ReadOnlyBooleanProperty	The width of the image.
-progress: ReadOnlyBooleanProperty	The approximate percentage of image's loading that is completed.
+Image(filenameOrURL: String)	Creates an Image with contents loaded from a file or a URL

javafx.scene.image.ImageView	
-fitHeight: DoubleProperty	The height of the bounding box within which the image is resized to fit.
-fitWidth: DoubleProperty	The width of the bounding box within which the image is resized to fit.
-x: DoubleProperty	The x-coordinate of the ImageView origin.
-y: DoubleProperty	The y-coordinate of the ImageView origin.
-image: ObjectProperty<Image>	The image to be displayed in the image view.
+ImageView()	Creates an ImageView.
+ImageView(image: Image)	Creates an ImageView with the specified image.
+ImageView(filenameOrURL:String)	Creates an ImageView with image loaded from the specified file or URL

Layout Panes

Definitions of pane

noun

a single sheet of glass in a window or door.

- **JavaFX** provides many types of panes for organizing nodes in a container.

Class	*Description*
Pane	Base class for layout panes. It contains the `getChildren()` method for returning a list of nodes in the pane.
StackPane	Places the nodes on top of each other in the center of the pane.
FlowPane	Places the nodes row-by-row horizontally or column-by-column vertically
GridPane	Places the nodes in the cells in a two-dimensional grid.
BorderPane	Places the nodes in the top, right, bottom, left, and center regions.
HBox	Places the nodes in a single row.
VBox	Places the nodes in a single column.

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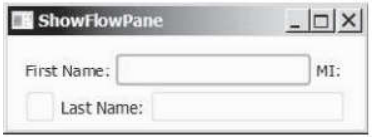
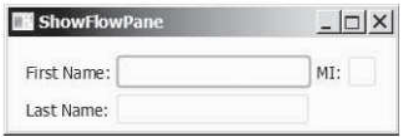
StackPane Example

```
public void start(Stage primaryStage) {
    StackPane pane = new StackPane();
    pane.getChildren().add(new Button("BOB"));
    pane.getChildren().add(new Button("Kevin"));
    pane.getChildren().add(new Button("Stuart"));
    Scene scene = new Scene(pane, 200, 50);
    primaryStage.setTitle("Minions");
    primaryStage.setScene(scene);
    primaryStage.show();
}
```

FlowPane

javafx.scene.layout.FlowPane	
-alignment: ObjectProperty<Pos>	The overall alignment of the content in this pane (default: Pos.LEFT).
-orientation: ObjectProperty<Orientation>	The orientation in this pane (default: Orientation.HORIZONTAL).
-hgap: DoubleProperty	The horizontal gap between the nodes (default: 0).
-vgap: DoubleProperty	The vertical gap between the nodes (default: 0).
+FlowPane()	Creates a default FlowPane.
+FlowPane(hgap: double, vgap: double)	Creates a FlowPane with a specified horizontal and vertical gap.
+FlowPane(orientation: ObjectProperty<Orientation>)	Creates a FlowPane with a specified orientation.
+FlowPane(orientation: ObjectProperty<Orientation>, hgap: double, vgap: double	Creates a FlowPane with a specified orientation, horizontal gap and vertical gap.





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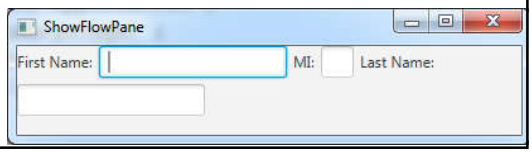
FlowPane Example

```
public void start(Stage primaryStage) {
    FlowPane pane = new FlowPane();
    pane.setHgap(5);
    pane.setVgap(5);
    pane.getChildren().addAll(new Label("First Name:"),
            new TextField(), new Label("MI:"));
    TextField tfMi = new TextField();
    tfMi.setPrefColumnCount(1);
    pane.getChildren().addAll(tfMi, new Label("Last Name:"),
            new TextField());
    Scene scene = new Scene(pane, 400, 70);
    primaryStage.setTitle("ShowFlowPane");
    primaryStage.setScene(scene);
    primaryStage.show();
}
```

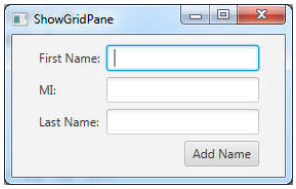


GridPane

javafx.scene.layout.GridPane	
-alignment: ObjectProperty<Pos>	The overall alignment of the content in this pane (default: Pos.LEFT).
-gridLinesVisible: BooleanProperty	Is the grid line visible? (default: false)
-hgap: DoubleProperty	The horizontal gap between the nodes (default: 0).
-vgap: DoubleProperty	The vertical gap between the nodes (default: 0).
+GridPane()	Creates a GridPane.
+add(child: Node, columnIndex: int, rowIndex: int): void	Adds a node to the specified column and row.
+addColumn(columnIndex: int, children: Node...): void	Adds multiple nodes to the specified column.
+addRow(rowIndex: int, children: Node...): void	Adds multiple nodes to the specified row.
+getColumnIndex(child: Node): int	Returns the column index for the specified node.
+setColumnIndex(child: Node, columnIndex: int): void	Sets a node to a new column. This method repositions the node.
+getRowIndex(child:Node): int	Returns the row index for the specified node.
+setRowIndex(child: Node, rowIndex: int): void	Sets a node to a new row. This method repositions the node.
+setHalighnment(child: Node, value: HPos): void	Sets the horizontal alignment for the child in the cell.
+setValighnment(child: Node, value: VPos): void	Sets the vertical alignment for the child in the cell.

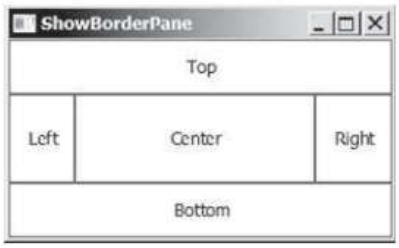
GridPane Example

```
public void start(Stage primaryStage) {
    GridPane pane = new GridPane();
    pane.setAlignment(Pos.CENTER);
    pane.setHgap(5.5);
    pane.setVgap(5.5);

    pane.add(new Label("First Name:"), 0, 0);
    pane.add(new TextField(), 1, 0);
    pane.add(new Label("MI:"), 0, 1);
    pane.add(new TextField(), 1, 1);
    pane.add(new Label("Last Name:"), 0, 2);
    pane.add(new TextField(), 1, 2);
    Button btAdd = new Button("Add Name");
    pane.add(btAdd, 1, 3);
    GridPane.setHalignment(btAdd, HPos.RIGHT);

    Scene scene = new Scene(pane);
    primaryStage.setTitle("ShowGridPane");
    primaryStage.setScene(scene);
    primaryStage.show();
}
```



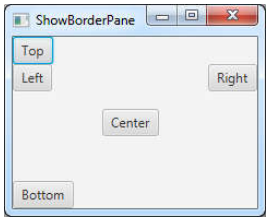
BorderPane

javafx.scene.layout.BorderPane	
-top: ObjectProperty<Node>	The node placed in the top region (default: null).
-right: ObjectProperty<Node>	The node placed in the right region (default: null).
-bottom: ObjectProperty<Node>	The node placed in the bottom region (default: null).
-left: ObjectProperty<Node>	The node placed in the left region (default: null).
-center: ObjectProperty<Node>	The node placed in the center region (default: null).
+BorderPane()	Creates a BorderPane.
+setAlignment(child: Node, pos: Pos)	Sets the alignment of the node in the BorderPane.



BorderPane Example

```
public void start(Stage primaryStage) {
    BorderPane pane = new BorderPane();
    pane.setTop(new Button("Top"));
    pane.setRight(new Button("Right"));
    pane.setBottom(new Button("Bottom"));
    pane.setLeft(new Button("Left"));
    pane.setCenter(new Button("Center"));

    Scene scene = new Scene(pane);
    primaryStage.setTitle("ShowBorderPane");
    primaryStage.setScene(scene);
    primaryStage.show();
}
```



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HBox , VBox

javafx.scene.layout.HBox

```
-alignment: ObjectProperty<Pos>
-fillHeight: BooleanProperty
-spacing: DoubleProperty
+HBox()
+HBox(spacing: double)
+setMargin(node: Node, value:
   Insets): void
```

The overall alignment of the children in the box (default: `Pos.TOP_LEFT`).
Is resizable children fill the full height of the box (default: `true`).
The horizontal gap between two nodes (default: 0).

Creates a default HBox.
Creates an HBox with the specified horizontal gap between nodes.
Sets the margin for the node in the pane.

javafx.scene.layout.VBox

```
-alignment: ObjectProperty<Pos>
-fillWidth: BooleanProperty
-spacing: DoubleProperty
+VBox()
+VBox(spacing: double)
+setMargin(node: Node, value:
   Insets): void
```

The overall alignment of the children in the box (default: `Pos.TOP_LEFT`).
Is resizable children fill the full width of the box (default: `true`).
The vertical gap between two nodes (default: 0).

Creates a default VBox.
Creates a VBox with the specified horizontal gap between nodes.
Sets the margin for the node in the pane.

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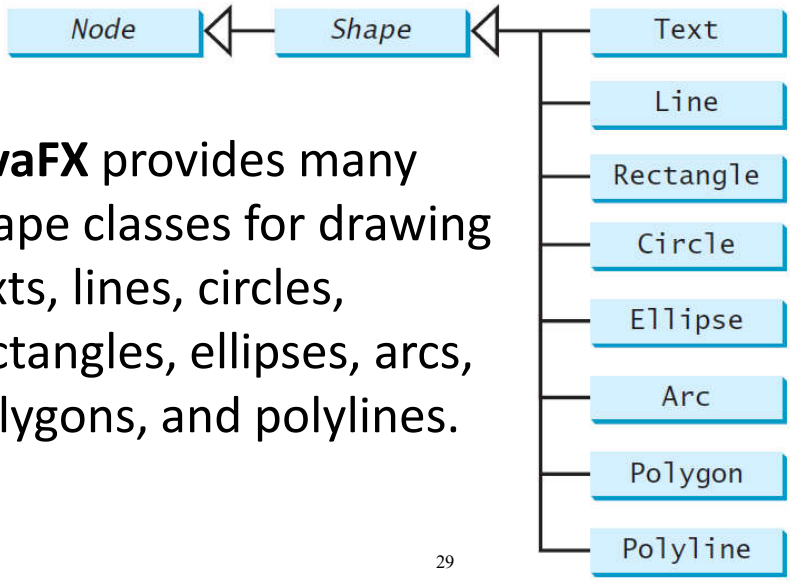
Shapes



- **JavaFX** provides many shape classes for drawing texts, lines, circles, rectangles, ellipses, arcs, polygons, and polylines.

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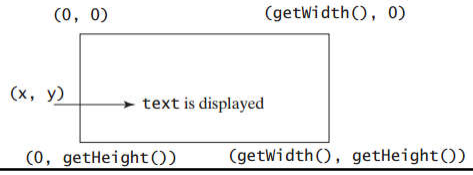
Text

javafx.scene.text.Text	
-text: StringProperty	Defines the text to be displayed.
-x: DoubleProperty	Defines the x-coordinate of text (default 0).
-y: DoubleProperty	Defines the y-coordinate of text (default 0).
-underline: BooleanProperty	Defines if each line has an underline below it (default `false`).
-strikethrough: BooleanProperty	Defines if each line has a line through it (default `false`).
-font: ObjectProperty<Font>	Defines the font for the text.
+Text()	Creates an empty Text.
+Text(text: String)	Creates a Text with the specified text.
+Text(x: double, y: double, text: String)	Creates a Text with the specified x-, y-coordinates and text.



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Line

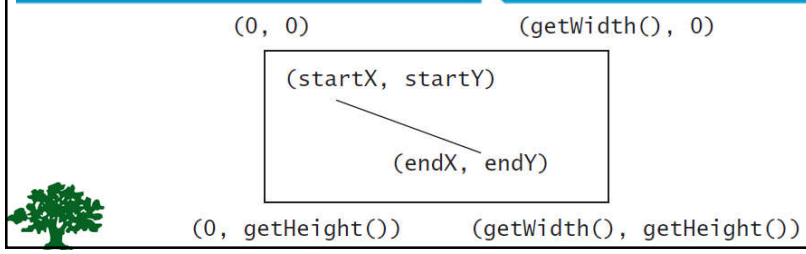
javafx.scene.shape.Line

```
-startX: DoubleProperty
-startY: DoubleProperty
-endX: DoubleProperty
-endY: DoubleProperty
```

```
+Line()
+Line(startX: double, startY:
   double, endX: double, endY:
   double)
```

The x-coordinate of the start point.
The y-coordinate of the start point.
The x-coordinate of the end point.
The y-coordinate of the end point.

Creates an empty `Line`.
Creates a `Line` with the specified starting and ending points.



31

Rectangle

javafx.scene.shape.Rectangle

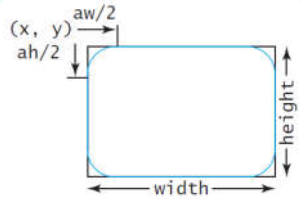
```
-x: DoubleProperty
-y:DoubleProperty
-width: DoubleProperty
-height: DoubleProperty
-arcWidth: DoubleProperty

-arcHeight: DoubleProperty
```

```
+Rectangle()
+Rectanlge(x: double, y:
   double, width: double,
   height: double)
```

The x-coordinate of the upper-left corner of the rectangle (default 0).
The y-coordinate of the upper-left corner of the rectangle (default 0).
The width of the rectangle (default: 0).
The height of the rectangle (default: 0).
The `arcWidth` of the rectangle (default: 0). `arcWidth` is the horizontal diameter of the arcs at the corner (see Figure 14.31a).
The `arcHeight` of the rectangle (default: 0). `arcHeight` is the vertical diameter of the arcs at the corner (see Figure 14.31a).

Creates an empty `Rectangle`.
Creates a `Rectangle` with the specified upper-left corner point, width, and height.



(a) Rectangle(x, y, w, h)

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Circle, Ellipse

javafx.scene.shape.Circle

```
-centerX: DoubleProperty
-centerY: DoubleProperty
-radius: DoubleProperty
```

```
+Circle()
+Circle(x: double, y: double)
+Circle(x: double, y: double,
   radius: double)
```

The x-coordinate of the center of the circle (default 0).
The y-coordinate of the center of the circle (default 0).
The radius of the circle (default: 0).

Creates an empty `Circle`.
Creates a `Circle` with the specified center.
Creates a `Circle` with the specified center and radius.

javafx.scene.shape.Ellipse

```
-centerX: DoubleProperty
-centerY: DoubleProperty
-radiusX: DoubleProperty
-radiusY: DoubleProperty
```

```
+Ellipse()
+Ellipse(x: double, y: double)
+Ellipse(x: double, y: double,
   radiusX: double, radiusY:
   double)
```

The x-coordinate of the center of the ellipse (default 0).
The y-coordinate of the center of the ellipse (default 0).
The horizontal radius of the ellipse (default: 0).
The vertical radius of the ellipse (default: 0).

Creates an empty `Ellipse`.
Creates an `Ellipse` with the specified center.
Creates an `Ellipse` with the specified center and radiuses.

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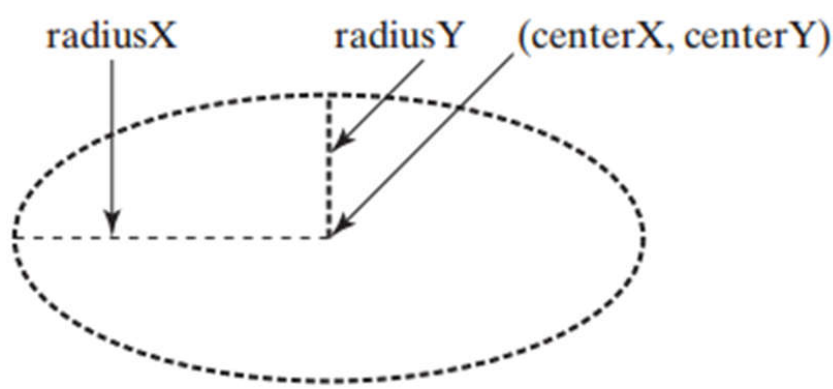
Ellipse




```
Ellipse(centerX,centerY,radiusX,radiusY)
```

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Arc

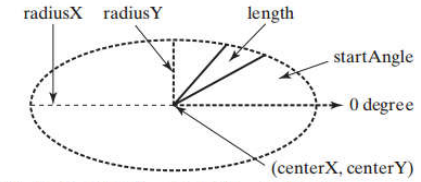
javafx.scene.shape.Arc

```
-centerX: DoubleProperty
-centerY: DoubleProperty
-radiusX: DoubleProperty
-radiusY: DoubleProperty
-startAngle: DoubleProperty
-length: DoubleProperty
-type: ObjectProperty<ArcType>
```

```
+Arc()
+Arc(x: double, y: double,
   radiusX: double, radiusY:
   double, startAngle: double,
   length: double)
```

The x-coordinate of the center of the ellipse (default 0).
The y-coordinate of the center of the ellipse (default 0).
The horizontal radius of the ellipse (default: 0).
The vertical radius of the ellipse (default: 0).
The start angle of the arc in degrees.
The angular extent of the arc in degrees.
The closure type of the arc (`ArcType.OPEN`, `ArcType.CHORD`, `ArcType.ROUND`).

Creates an empty `Arc`.
Creates an `Arc` with the specified arguments.



(a) `Arc(centerX, centerY, radiusX, radiusY, startAngle, length)`

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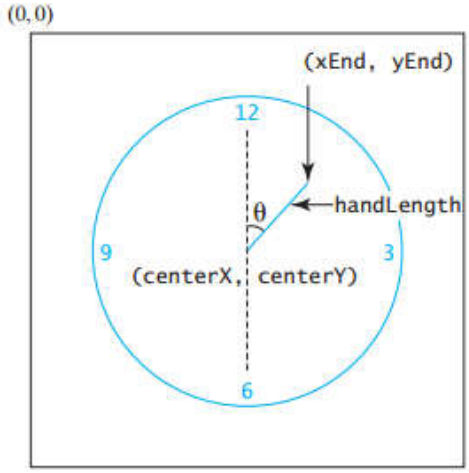
Case Study: The ClockPane Class

- This case study develops a class that displays a clock on a pane.



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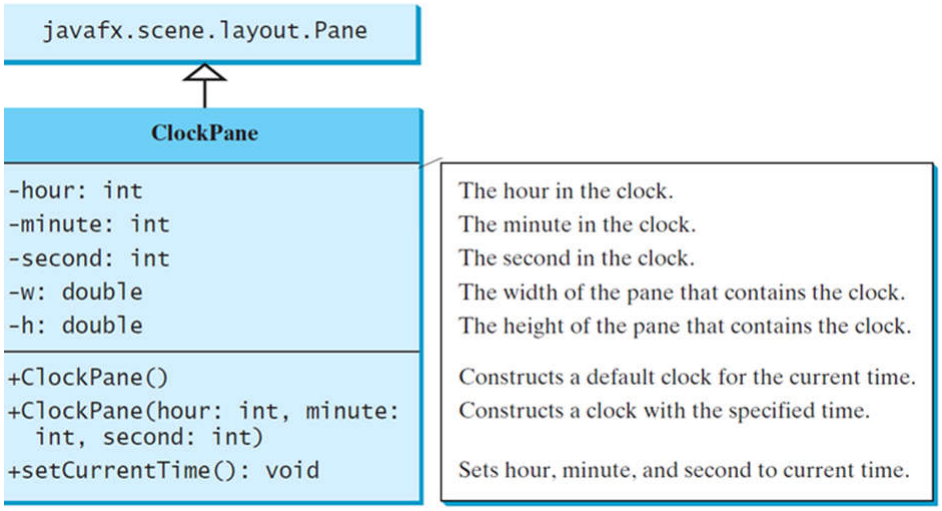
Case Study: The ClockPane Class



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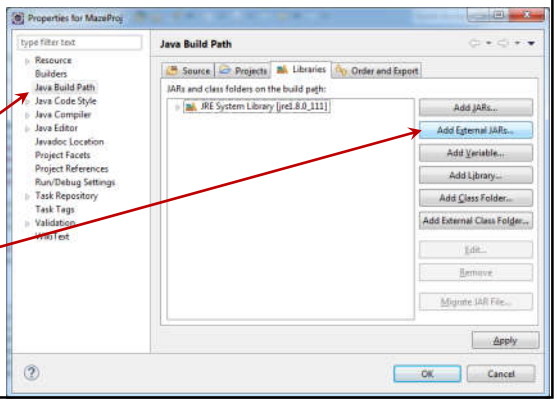
Running JavaFX in Eclipse

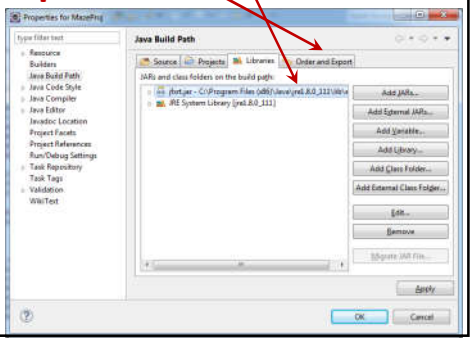
There is a problem with the default installation of Eclipse and getting **JavaFX** to run. Here's the fix:

- When you create a **JavaFX** project, right-click on the project (under the Package Explorer in Eclipse), and select "**Properties**"
- In the window that appears, click on "**Java Build Path**" on the left side, then "**Add External JARs**" on the right from **Libraries** tab



Running JavaFX in Eclipse

- Navigate to:
  C:\Program Files (x86)\Java\jre1.8.0_**111**\lib\ext
- Double-click on **`jfxrt.jar`**, which should now appear at the top of your build path
- Click on the "**Order and Export**" tab



Running JavaFX in Eclipse

- Click on **`jfxrt.jar`** to highlight it
- Then click the button labeled "**Top**" to move it to the top of the list
- Click "**OK**"