JAVA PROGRAMMING

Chap 8 : GUI Design using Java FX

Java FX

- JavaFX is a Java library and a GUI toolkit designed to develop and facilitate Rich Internet applications, web applications, and desktop applications.
- Rich Internet Applications are those web applications that allow alike characteristics and expertise as that of desktop applications. These applications contribute more satisfying visual experience to the users when compared to the standard web applications.
- The most significant perk of using JavaFX is that the applications written using this library can run on multiple operating systems like Windows, Linux, iOS, Android, and several platforms like Desktops, Web, Mobile Phones, TVs, Tablets, etc.
- This characteristic of the JavaFX library makes it very versatile across operating systems and different platforms.
- After the arrival of JavaFX, Java developers and programmers were able to develop the GUI applications more effectively and more productively.
- JavaFX was introduced to supersede the Java Swing GUI framework.
- Nevertheless, the JavaFX provides more enhanced functionalities and features than the Java Swing.

Steps to configure Java FX on Netbeans & Eclipse :
https://www.tutorialspoint.com/javafx/javafx_environment.htm

Features of Java FX

Java Library – JavaFX is a Java library, which allows the user to gain the support of all the Java characteristics such as multithreading, generics, lambda expressions, and many more. The user can also use any of the Java editors or IDE's of their choice, such as Eclipse, NetBeans, to write, compile, run, debug, and package their JavaFX application.

Platform Independent – The rich internet applications made using JavaFX are platform-independent. The JavaFX library is open for all the scripting languages that can be administered on a JVM, which comprise – Java, Groovy, Scala, and JRuby.

FXML – JavaFX emphasizes an HTML-like declarative markup language known as FXML. FXML is based on extensible markup language (XML). The sole objective of this markup language is to specify a user interface (UI). In FXML, the programming can be done to accommodate the user with an improved GUI.

Scene Builder – JavaFX also implements a tool named Scene Builder, which is a visual editor for FXML. Scene Builder generates FXML mark-ups that can be transmitted to the IDE's like Eclipse and NetBeans, which further helps the user to combine the business logic to their applications. The users can also use the drag and drop design interface, which is used to design FXML applications.

Hardware-accelerated Graphics Pipeline – The graphics of the JavaFX applications are based on the hardware-accelerated graphics rendering pipeline, commonly known as Prism. The Prism engine offers smooth JavaFX graphics that can be rendered quickly when utilized with a supported graphics card or graphics processing unit (GPU). In the case where the system does not hold the graphic cards, then the prism engine defaults to the software rendering stack.

Swing Interoperability – In a JavaFX application, you can embed Swing content using the Swing Node class. Similarly, you can also update the existing Swing applications with JavaFX features.

Features of Java FX

WebView – JavaFX applications can also insert web pages. To embed web pages, Web View of JavaFX uses a new HTML rendering engine technology known as WebKitHTML. WebView is used to make it possible to insert web pages within a JavaFX application. JavaScript running in WebView can call Java APIs and vice-versa.

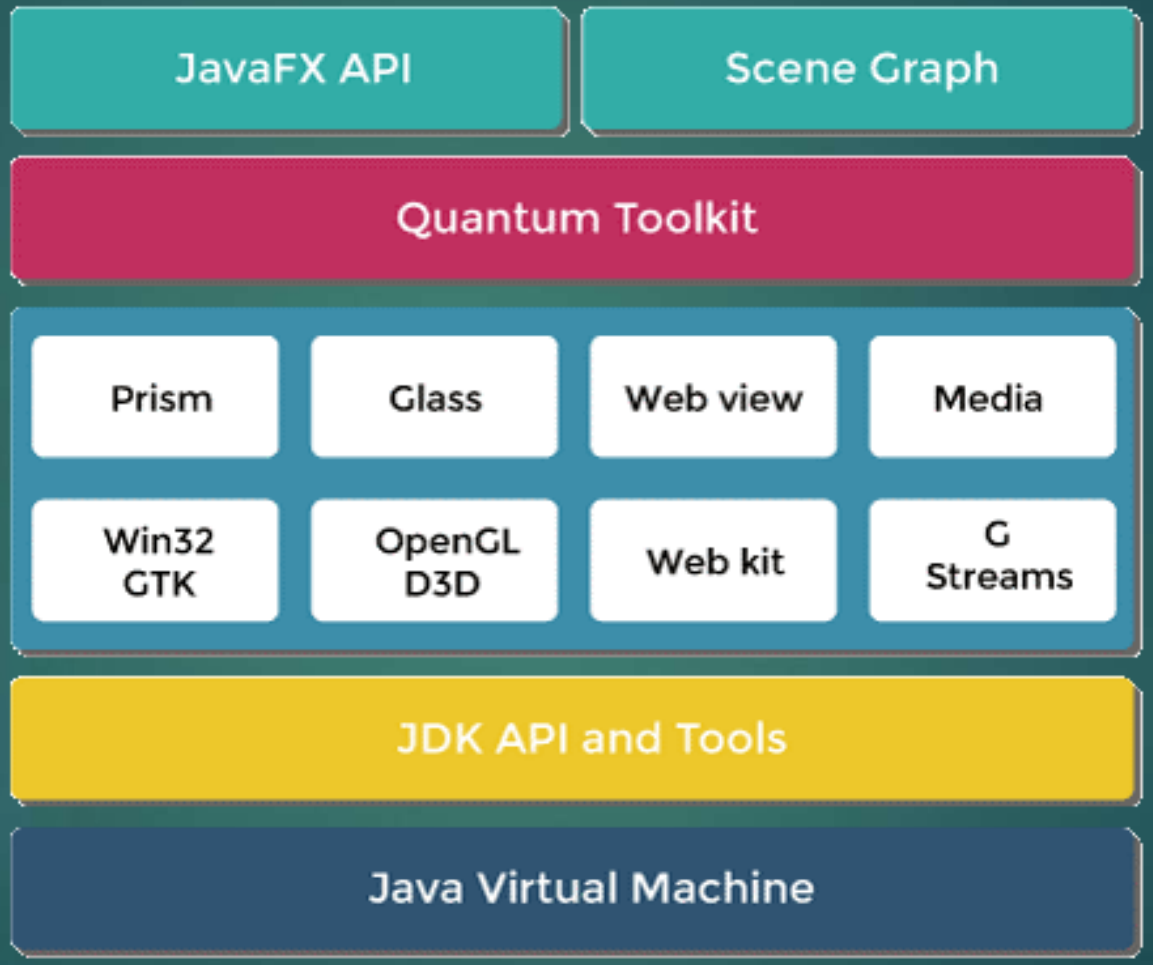
Built-in UI controls – JavaFX comprises all the major built-in UI controls that help in developing well-featured applications. These built-in UI components are not operating system-dependent. In simple words, these controls do not depend on any of the Operating systems like Windows, iOS, Android, etc. These built-in controls are single-handedly ample to perform a whole implementation of the applications.

CSS Styling – Just like websites use CSS for styling, JavaFX also provides the feature to integrate the application with CSS styling. The users can enhance the styling of their applications and can also improve the outlook of their implementation by having simple knowledge and understanding of CSS styling.

Rich set of APIs – JavaFX library also presents a valuable collection of APIs that helps in developing GUI applications, 2D and 3D graphics, and many more. This collection of APIs also includes all the characteristics of the Java platform. Hence, working with this API, a user can access the specialties of Java languages such as Generics, Annotations, Multithreading, and Lambda Expressions, and many other features as well. In JavaFX, the popular Java Collections library was also improved, and notions like lists and maps were introduced. Using these APIs, the users can witness the variations in the data models.

High-Performance media engine – Like the graphics pipeline, JavaFX also possesses a media pipeline that advances stable internet multimedia playback at low latency. This high-performance media engine or media pipeline is based on a multimedia framework known as Gstreamer.

Architecture of Java FX



Architecture of Java FX

- **JavaFX API** – The topmost layer of JavaFX architecture holds a JavaFX public API that implements all the required classes that are capable of producing a full-featured JavaFX application with rich graphics. The list of all the important packages of this API is as follows.
  - javafx.animation: It includes classes that are used to combine transition-based animations such as fill, fade, rotate, scale and translation, to the JavaFX nodes (collection of nodes makes a scene graph).
  - javafx.css − It comprises classes that are used to append CSS–like styling to the JavaFX GUI applications.
  - javafx.geometry − It contains classes that are used to represent 2D figures and execute methods on them.
  - javafx.scene − This package of JavaFX API implements classes and interfaces to establish the scene graph. In extension, it also renders sub-packages such as canvas, chart, control, effect, image, input, layout, media, paint, shape, text, transform, web, etc. These are the diverse elements that sustain this precious API of JavaFX.
  - javafx.application − This package includes a collection of classes that are responsible for the life cycle of the JavaFX application.
  - javafx.event − It includes classes and interfaces that are used to perform and manage JavaFX events.
  - javafx.stage − This package of JavaFX API accommodates the top-level container classes used for the JavaFX application.
- **Scene Graph** – A Scene Graph is the starting point of the development of any of the GUI Applications. In JavaFX, all the GUI Applications are made using a Scene Graph only. The Scene Graph includes the primitives of the rich internet applications that are known as nodes. In simple words, **a single component in a scene graph is known as a node**. In general, a scene graph is made up of a collection of nodes. All these nodes are organized in the form of a hierarchical tree that describes all of the visual components of the application's user interface (UI). A node instance can be appended to a scene graph only once.

Architecture of Java FX

- A node is a visual/graphical object and it may include −
  - Geometrical (Graphical) objects − (2D and 3D) such as circle, rectangle, polygon, etc.
  - UI controls − such as Button, Checkbox, Choice box, Text Area, etc.
  - Containers − (layout panes) such as Border Pane, Grid Pane, Flow Pane, etc.
  - Media elements − such as audio, video and image objects.
- The nodes are of three general types.
  - Root Node – A root node is a node that does not have any node as its parent.
  - Leaf Node – A leaf node is a node that does not contain any node as its children.
  - Branch Node – A branch node is a node that contains a node as its parent and also has a node as its children.
- **Quantum Toolkit –** Quantum Toolkit is used to connect prism and glass windowing tool kits collectively and prepares them for the above layers in the stack. In simple words, it ties Prism and GWT together and makes them available to JavaFX.
- **Prism –** The graphics of the JavaFX applications are based on the hardware-accelerated graphics rendering pipeline, commonly known as Prism. The Prism engine supports smooth JavaFX graphics that can be executed swiftly when utilized with a backed graphics card or graphics processing unit (GPU). In the situation where the system does not contain the graphic cards, then the prism engine defaults to the software rendering stack. To render graphics, a Prism uses −
  - DirectX 9 on Windows XP and Vista.
  - DirectX 11 on Windows 7.
  - OpenGL on Mac and Linux, Embedded Systems.

Architecture of Java FX

- **Glass Windowing Toolkit –** Glass Windowing Toolkit or simply Glass is a platform-dependent layer that assists in connecting the JavaFX platform to the primary operating system (OS). Glass Windowing Toolkit is very useful as it provides services such as controlling the windows, events, timers, and surfaces to the native operating system.
- **WebView –** JavaFX applications can also insert web pages. To embed web pages, Web View of JavaFX uses a new HTML rendering engine technology known as WebKitHTML. WebView is used to make it possible to insert web pages within a JavaFX application. JavaScript appearing in WebView can call Java APIs and vice-versa. This element promotes different web technologies like HTML5, CSS, JavaScript, DOM, and SVG. Using web view, we can execute the HTML content from the JavaFX application and can also implement some CSS styles to the user interface (UI) part of the application. Using WebView, you can −
  - Render HTML content from local or remote URL.
  - Support history and provide Back and Forward navigation.
  - Reload the content.
  - Apply effects to the web component.
  - Edit the HTML content.
  - Execute JavaScript commands.
  - Handle events.

Media Engine – Like the graphics pipeline, JavaFX also possesses a media pipeline that advances stable internet multimedia playback at low latency. This high-performance media engine or media pipeline is based on a multimedia framework known as Gstreamer. By applying the Media engine, the JavaFX application can support the playback of audio and video media files. The package javafx.scene.media covers all the classes and interfaces that can provide media functionalities to JavaFX applications. It is provided in the form of three components, which are − Media Object − This represents a media file, Media Player − To play media content, Media View − To display media.

LifeCycle of Java FX Application

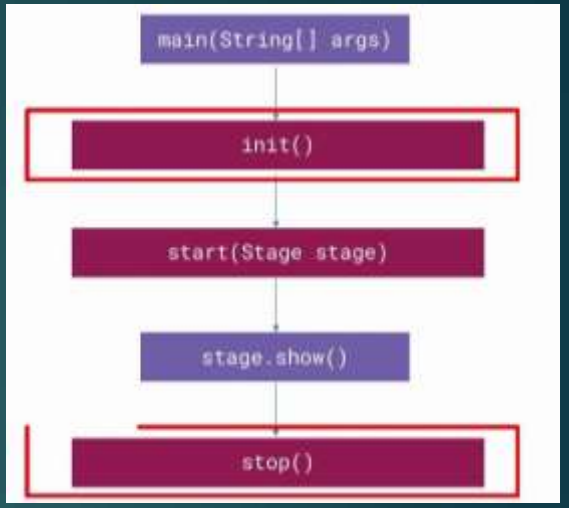
- We need to import javafx.application.Application class in every JavaFX application.
- This provides the following life cycle methods for JavaFX application.

  public void init()

  public abstract void start(Stage primaryStage)

  public void stop()

- **init()** – The init() method is an empty method that can be overridden. In this method, the user cannot create a stage or a scene.
- **start()** – The start() method is the entry point method of the JavaFX application where all the graphics code of JavaFX is to be written.
- **stop()** – The stop() method is an empty method that can also be overridden, just like the init() method. In this method, the user can write the code to halt the application.
- Other than these methods, the JavaFX application also implements a static method known as **launch()**. This launch() method is used to launch the JavaFX application. As stated earlier, the launch() method is static, the user should call it from a static method only. Generally, that static method, which calls the launch() method, is the main() method only.



LifeCycle of Java FX Application

- Whenever a user launches a JavaFX application, there are few actions that are carried out in a particular manner only.
- The following is the order given in which a JavaFX application is launched.
  - Firstly, an instance of the application class is created.
  - After that, the init() method is called.
  - After the init() method, the start() method is called.
  - After calling the start() method, the launcher waits for the JavaFX application to end and then calls the stop() method.
- in order to create a basic JavaFX application, we need to:

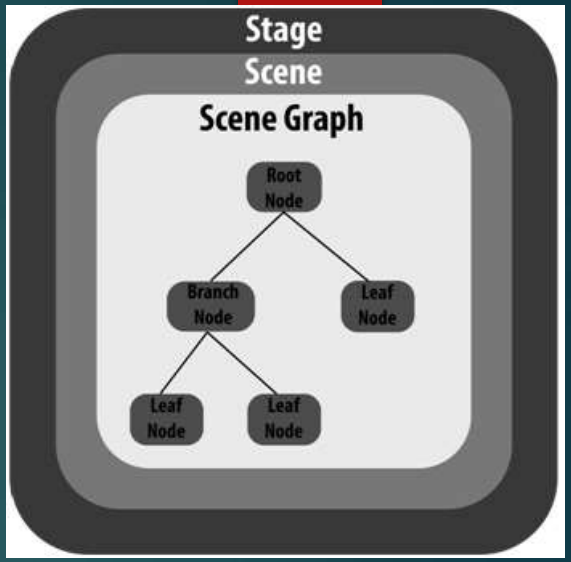
  Import javafx.application.Application into our code.

  Inherit Application into our class.

  Override start() method of Application class.

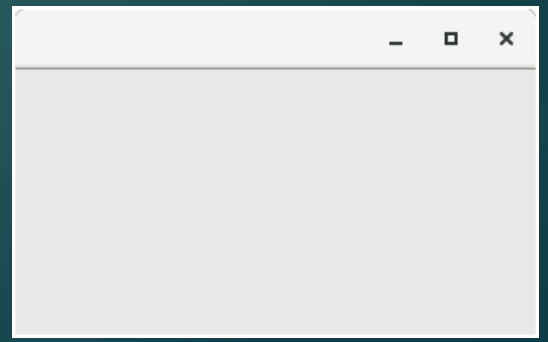
Application Structure of Java FX

- JavaFX application is divided hierarchically into three main components known as Stage, Scene and nodes.



Stage

- Stage in a JavaFX application is similar to the Frame in a Swing Application.
- It acts like a container for all the JavaFX objects.
- Primary Stage is created internally by the platform.
- Other stages can further be created by the application.
- The object of primary stage is passed to start method.
- We need to call show method on the primary stage object in order to show our primary stage.
- Initially, the primary Stage looks like following.
- However, we can add various objects to this primary stage.
- The objects can only be added in a hierarchical way i.e. first, scene graph will be added to this primaryStage and then that scene graph may contain the nodes.
- A node may be any object of the user's interface like text area, buttons, shapes, media, etc.
- It is represented by Stage class of the package javafx.stage.
- A stage has two parameters determining its position namely Width and Height. It is divided as Content Area and Decorations (Title Bar and Borders).
- You have to call the show() method to display the contents of a stage.



Application Structure of Java FX

Scene

- A scene represents the physical contents of a JavaFX application.
- It contains all the contents of a scene graph.
- The class Scene of the package javafx.scene represents the scene object. **Javafx.scene.Scene** class provides all the methods to deal with a scene object.
- At an instance, the scene object is added to only one stage.
- You can create a scene by instantiating the Scene Class.
- You can opt for the size of the scene by passing its dimensions (height and width) along with the root node to its constructor.
- Creating scene is necessary in order to visualize the contents on the stage.
- In order to implement Scene in our JavaFX application, we must import javafx.scene package in our code.

Application Structure of Java FX

Scene Graph

- A scene graph is a tree-like data structure (hierarchical) representing the contents of a scene.
- In contrast, a node is a visual/graphical object of a scene graph. A node is the element which is visualized on the stage. It can be any button, text box, layout, image, radio button, check box, etc.
- A node may include −
  - Geometrical (Graphical) objects (2D and 3D) such as − Circle, Rectangle, Polygon, etc.
  - UI Controls such as − Button, Checkbox, Choice Box, Text Area, etc.
  - Containers (Layout Panes) such as Border Pane, Grid Pane, Flow Pane, etc.
  - Media elements such as Audio, Video and Image Objects.It can be seen as the collection of various nodes.
- The nodes are implemented in a tree kind of structure.
- There is always one root in the scene graph. This will act as a parent node for all the other nodes present in the scene graph. However, this node may be any of the layouts available in the JavaFX system.
- The leaf nodes exist at the lowest level in the tree hierarchy.
- Each of the node present in the scene graphs represents classes of javafx.scene package therefore we need to import the package into our application in order to create a full featured javafx application.

Application Structure of Java FX

Scene Graph

- As discussed earlier a node is of three types −
- **Root Node** − The first Scene Graph is known as the Root node.
- **Branch Node/Parent Node** − The node with child nodes are known as branch/parent nodes. The abstract class named Parent of the package javafx.scene is the base class of all the parent nodes, and those parent nodes will be of the following types −
  - Group − A group node is a collective node that contains a list of children nodes. Whenever the group node is rendered, all its child nodes are rendered in order. Any transformation, effect state applied on the group will be applied to all the child nodes.
  - Region − It is the base class of all the JavaFX Node based UI Controls, such as Chart, Pane and Control.
  - WebView − This node manages the web engine and displays its contents.
- Leaf Node − The node without child nodes is known as the leaf node. For example, Rectangle, Ellipse, Box, ImageView, MediaView are examples of leaf nodes.

- It is mandatory to pass the root node to the scene graph.

First JavaFX Application

Create a simple JavaFX application which prints **hello world** on the console on clicking the button shown on the stage.

Step-1 : Extend javafx.application.Application and override start()

- As we have studied earlier that start() method is the starting point of constructing a JavaFX application therefore we need to first override start method of javafx.application.Application class.
- Object of the class javafx.stage.Stage is passed into the start() method therefore import this class and pass its object into start method.
- JavaFX.application.Application needs to be imported in order to override start method.

```
package application;                          // creating source package. Created while making project in netbeans
import javafx.application.Application;       // importing Application class
import javafx.stage.Stage;
public class Hello_World extends Application{     // inheriting Application class

    @Override
    public void start(Stage primaryStage) throws Exception {    // primaryStage is created. Object of primaryStage is passed to abstract method start() of Application class

// JavaFX objects can be added here
    }
}
```

First JavaFX Application

Step-2 : Create a Button

- A button can be created by instantiating the javafx.scene.control.Button class.
- For this, we have to import this class into our code.
- Pass the button label text in Button class constructor.
- The code will look like following.

```
package application;                              // creating source package. Created while making project in netbeans
import javafx.application.Application;
Import javafx.scene.control.Button;
import javafx.stage.Stage;
public class Hello_World extends Application{     // inheriting Application class

    @Override
    public void start(Stage primaryStage) throws Exception {    // Object of the Stage class is passed to abstract method start() of Application class

Button btn1=new Button(“Hello World");    // create a button and pass the caption on the button as parameter to the constructor
 }
}
```

First JavaFX Application

Step 3: Create a layout and add button to it

- JavaFX provides the number of layouts.
- We need to implement one of them in order to visualize the widgets properly.
- It exists at the top level of the scene graph and can be seen as a root node.
- All the other nodes (buttons, texts, etc.) need to be added to this layout.
- In this application, we have implemented StackPane layout.
- It can be implemented by instantiating javafx.scene.layout.StackPane class.
- The code will now look like following.

```
package application;                          // creating source package. Created while making project in netbeans
import javafx.application.Application;
importjavafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;
public class Hello_World extends Application{     // inheriting Application class
    @Override
    public void start(Stage primaryStage) throws Exception {    // Object of the Stage class is passed to abstract
method start() of Application class
Button btn1=new Button(“Hello World");    // create a button and pass the caption on the button as parameter to
the constructor
StackPane root=new StackPane();      // create layout object
 root.getChildren().add(btn1);
} }
```

First JavaFX Application

Step 4: Create a Scene

- The layout needs to be added to a scene.
- Scene remains at the higher level in the hierarchy of application structure.
- It can be created by instantiating javafx.scene.Scene class.
- We need to pass the layout object to the scene class constructor. we can also pass the width and height of the required stage for the scene in the Scene class constructor.
- Our application code will now look like following.

```
package application;                                    // creating source package. Created while making project in netbeans
import javafx.application.Application;
import javafx.scene.Scene;
importjavafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;
public class Hello_World extends Application{      // inheriting Application class
    @Override
    public void start(Stage primaryStage) throws Exception {    // Object of the Stage class is passed to abstract method start() of Application class
Button btn1=new Button(“Hello World");    // create a button and pass the caption on the button as parameter to the constructor
StackPane root=new StackPane();
 root.getChildren().add(btn1);
Scene scene=new Scene(root, 300, 250);  // pass layout object, width and height of the stage to Scene class constructor
} }
```

First JavaFX Application

Step 5: Prepare the Stage

- javafx.stage.Stage class provides some important methods which are required to be called to set some attributes for the stage.
- We can set the title of the stage.
- We also need to call show() method without which, the stage won't be shown.
- Lets look at the code which describes how can we prepare the stage for the application.

```
package application;                                    // creating source package. Created while making project in netbeans
import javafx.application.Application;
import javafx.scene.Scene;
importjavafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;
public class Hello_World extends Application{      // inheriting Application class
    @Override
    public void start(Stage primaryStage) throws Exception {     // Object of the Stage class is passed to abstract method start() of Application class
Button btn1=new Button(“Hello World");     // create a button and pass the caption on the button as parameter to the constructor
StackPane root=new StackPane();
 root.getChildren().add(btn1);
Scene scene=new Scene(root, 300, 250);  // pass layout object, width and height of the stage to Scene class constructor
 primaryStage.setScene(scene);
 primaryStage.setTitle("First JavaFX Application");
 primaryStage.show();    } }
```

First JavaFX Application

Step 6: Create an event for the button

- As our application prints hello world for an event on the button, we need to create an event for the button.
- For this purpose, call setOnAction() on the button and define a anonymous class Event Handler as a parameter to the method.
- Inside this anonymous class, define a method handle() which contains the code for how the event is handled.
- In our case, it is printing hello world on the console.

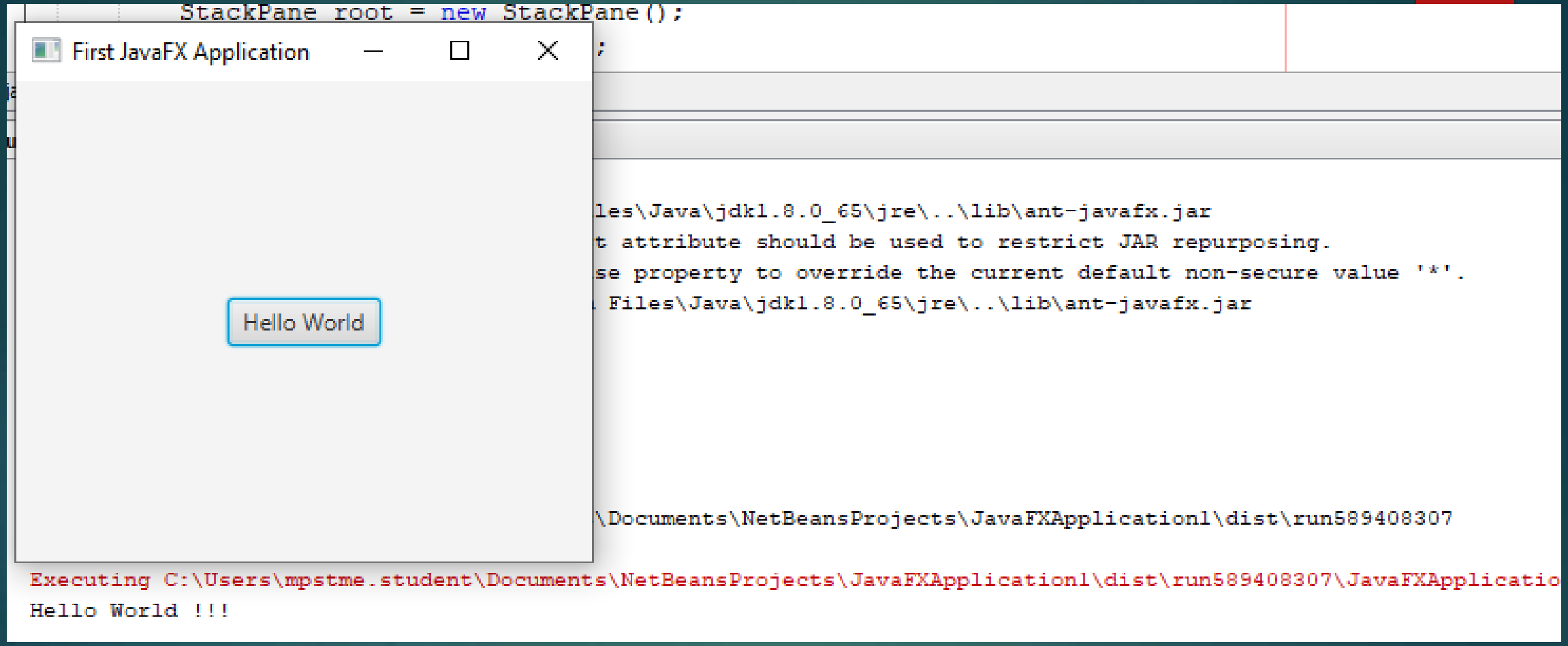
```
package application;
import javafx.application.Application;
import javafx.event.ActionEvent;
import javafx.event.EventHandler;
import javafx.scene.Scene;
importjavafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;
public class Hello_World extends Application{
@Override
    publicvoid start(Stage primaryStage) throws Exception {

        // TODO Auto-generated method stub
        Button btn1=new Button("Hello World");
        btn1.setOnAction(new EventHandler<ActionEvent>() {
         @Override
public void handle(ActionEvent arg0) {
                // TODO Auto-generated method stub
                System.out.println("Hello World !!!");
            }
        });
        StackPane root=new StackPane();
        root.getChildren().add(btn1);
        Scene scene=new Scene(root,600,400);
        primaryStage.setScene(scene);
        primaryStage.setTitle("First JavaFX Application");
        primaryStage.show();
    }

}
```

First JavaFX Application

Step 7: Create a main method

- Till now, we have configured all the necessary things which are required to develop a basic JavaFX application but this application is still incomplete.
- We have not created main method yet.
- Hence, at the last, we need to create a main method in which we will launch the application i.e. will call launch() method and pass the command line arguments (args) to it.
- The code will now look like following.

```
package application;
import javafx.application.Application;
import javafx.event.ActionEvent;
import javafx.event.EventHandler;
import javafx.scene.Scene;
importjavafx.scene.control.Button;
import javafx.stage.Stage;
import javafx.scene.layout.StackPane;
public class Hello_World extends Application{
@Override
    publicvoid start(Stage primaryStage) throws Exception {

        // TODO Auto-generated method stub
        Button btn1=new Button("Hello World");
        btn1.setOnAction(new EventHandler<ActionEvent>() {
         @Override
public void handle(ActionEvent arg0) {
                // TODO Auto-generated method stub
                System.out.println("Hello World !!!");
            }
        });
        StackPane root=new StackPane();
        root.getChildren().add(btn1);
        Scene scene=new Scene(root,600,400);
        primaryStage.setScene(scene);
        primaryStage.setTitle("First JavaFX Application");
        primaryStage.show();
    } }

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


StackPane root = new StackPane();
;
First JavaFX Application
Hello World
les\Java\jdk1.8.0_65\jre\..\lib\ant-javafx.jar
t attribute should be used to restrict JAR repurposing.
se property to override the current default non-secure value '*'.
Files\Java\jdk1.8.0_65\jre\..\lib\ant-javafx.jar
\Documents\NetBeansProjects\JavaFXApplication1\dist\run589408307
Executing C:\Users\mpstme.student\Documents\NetBeansProjects\JavaFXApplication1\dist\run589408307\JavaFXApplicatio
Hello World !!!

2D SHAPES

2D Shapes

- In some of the applications, we need to show two dimensional shapes to the user.
- However, JavaFX provides the flexibility to create our own 2D shapes on the screen .
- There are various classes which can be used to implement 2D shapes in our application.
- All these classes resides in **javafx.scene.shape package.**
- This package contains the classes which represents different types of 2D shapes.
- There are several methods in the classes which deals with the coordinates regarding 2D shape creation.
- **What are 2D shapes?**
- In general, a two dimensional shape can be defined as the geometrical figure that can be drawn on the coordinate system consist of X and Y planes.
- Using JavaFX, we can create 2D shapes such as Line, Rectangle, Circle, Ellipse, Polygon, Cubic Curve, quad curve, Arc, etc. The class **javafx.scene.shape.Shape is the base class for all the shape classes**.
- Using the JavaFX library and Shape Class, you can draw −
  - Predefined shapes such as Line, Rectangle, Circle, Ellipse, Polygon, Polyline, Cubic Curve, Quad Curve, Arc.
  - Path elements such as MoveTO Path Element, Line, Horizontal Line, Vertical Line, Cubic Curve, Quadratic Curve, Arc.
  - In addition to these, you can also draw a 2D shape by parsing SVG path.
- To create a shape, you need to −
  - Instantiate the respective class of the required shape.
  - Set the properties of the shape.
  - Add the shape object to the group.

2D Shapes

- Eg : Drawing a rectangle

```
Rectangle rect = new Rectangle();        //instantiate the rectangle class
// setting properties of rectangle like x and y coordinates, width and height using respective methods
    rect.setX(10);
    rect.setY(20);
    rect.setWidth(100);
    rect.setHeight(100);
Group root = new Group(rect);            // adding object of the shape to the group
```

2D Shapes

Shape	Description
Line	In general, Line is the geometrical figure which joins two (X,Y) points on 2D coordinate system. In JavaFX, **javafx.scene.shape.Line** class needs to be instantiated in order to create lines.
Rectangle	In general, Rectangle is the geometrical figure with two pairs of two equal sides and four right angles at their joint. In JavaFX, **javafx.scene.shape.Rectangle** class needs to be instantiated in order to create Rectangles.
Ellipse	In general, ellipse can be defined as a curve with two focal points. The sum of the distances to the focal points are constant from each point of the ellipse. In JavaFX. **javafx.scene.shape.Ellipse** class needs to be instantiated in order to create Ellipse.
Arc	Arc can be defined as the part of the circumference of the circle of ellipse. In JavaFX, **javafx.scene.shape.Arc** class needs to be instantiated in order to create Arcs.
Circle	A circle is the special type of Ellipse having both the focal points at the same location. In JavaFX, Circle can be created by instantiating **javafx.scene.shape.Circle** class.
Polygon	Polygon is a geometrical figure that can be created by joining the multiple Co-planner line segments. In JavaFX, **javafx.scene.shape**. Pollygon class needs to be instantiated in order to create polygon.
Cubic Curve	A Cubic curve is a curve of degree 3 in the XY plane. In Javafx, **javafx.scene.shape.CubicCurve** class needs to be instantiated in order to create Cubic Curves.
Quad Curve	A Quad Curve is a curve of degree 2 in the XY plane. In JavaFX, **javafx.scene.shape.QuadCurve** class needs to be instantiated in order to create QuadCurve.

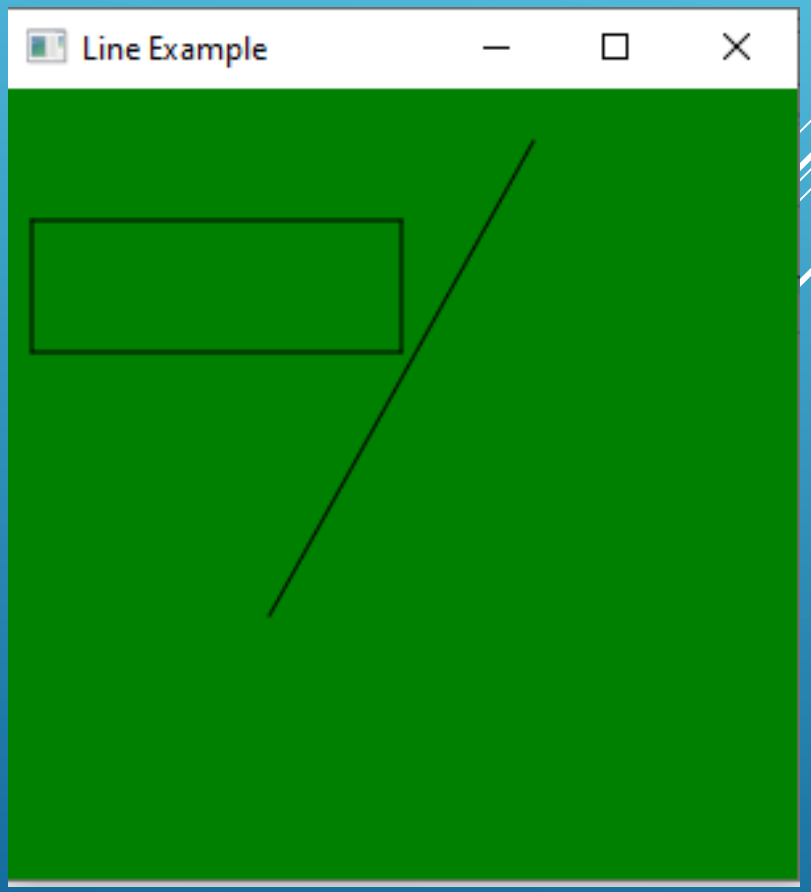
Line

- Line can be defined as the geometrical structure which joins two points (X1,Y1) and (X2,Y2) in a X-Y coordinate plane.
- JavaFX allows the developers to create the line on the GUI of a JavaFX application.
- JavaFX library provides the class Line which is the part of javafx.scene.shape package.
- **How to create a Line?**
  - Instantiate the class javafx.scene.shape.Line.
  - set the required properties of the class object.
  - Add class object to the group
- Properties : Line class contains various properties described below.

Property	Description	Setter Methods
endX	The X coordinate of the end point of the line	setEndX(Double)
endY	The y coordinate of the end point of the line	setEndY(Double)
startX	The x coordinate of the starting point of the line	setStartX(Double)
startY	The y coordinate of the starting point of the line	setStartY(Double)

Line

```
package javafxapplication1;

import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.Group;
import javafx.scene.shape.Line;
import javafx.stage.Stage;
import javafx.scene.paint.Color;
public class DrawLine extends Application{

    @Override
    public void start(Stage primaryStage) throws Exception {
        // TODO Auto-generated method stub
        Line line = new Line(); //instantiating Line class
        line.setStartX(200); //setting starting X point of Line
        line.setStartY(20); //setting starting Y point of Line
        line.setEndX(100); //setting ending X point of Line
        line.setEndY(200); //setting ending Y point of Line
        //adding multiple lines
        Line line1 = new Line(10,50,150,50);
        Line line2 = new Line(10,100,150,100);
        Line line3 = new Line(10,50,10,100);
        Line line4 = new Line(150,50,150,100);
        Group root = new Group(line, line1, line2, line3,
line4); //Creating a Group and adding line object to the
group
Scene scene = new Scene(root,300,300,Color.GREEN);   //
set background color
        primaryStage.setScene(scene);
        primaryStage.setTitle("Line Example");
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



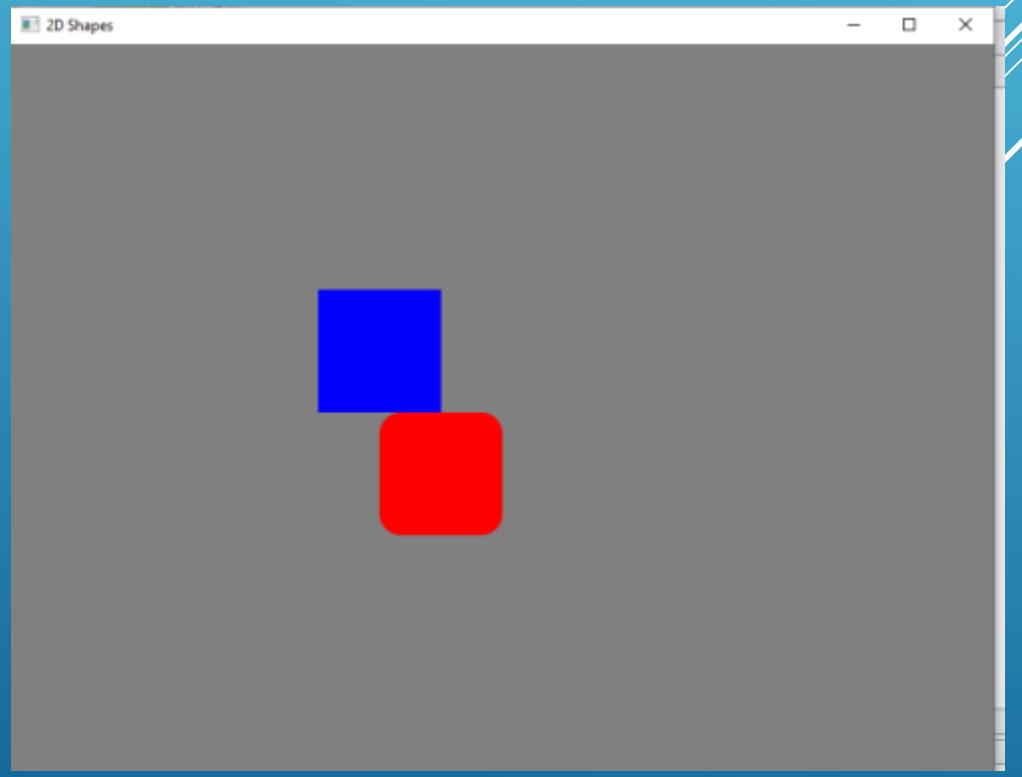
Rectangle

- In general, Rectangles can be defined as the geometrical figure consists of four sides, out of which, the opposite sides are always equal and the angle between the two adjacent sides is 90 degree.
- A Rectangle with four equal sides is called square.
- JavaFX library allows the developers to create a rectangle by instantiating javafx.scene.shape.Rectangle class
- Properties of Rectangle Class -

Property	Description	Setter Method
ArcHeight	Vertical diameter of the arc at the four corners of rectangle	setArcHeight(Double height)
ArcWidth	Horizontal diameter of the arc at the four corners of the rectangle	setArcWidth(Double Width)
Height	Defines the height of the rectangle	setHeight(Double height)
Width	Defines the width of the rectangle	setWidth(Double width)
X	X coordinate of the upper left corner	setX(Double X-value)
Y	Y coordinate of the upper left corner	setY(Double(Y-value)

Rectangle

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.Group;
import javafx.scene.shape.Rectangle;
import javafx.stage.Stage;
import javafx.scene.paint.Color;
public class Drawrect extends Application {

    @Override
    public void start(Stage primaryStage)throws Exception {
        Rectangle rect=new Rectangle();
        rect.setX(250);
    rect.setY(200);
    rect.setWidth(100);
    rect.setHeight(100);
     rect.setFill(Color.BLUE);
    // Rounded Rectangle
    Rectangle rect1=new Rectangle();
    rect1.setX(300);
    rect1.setY(300);
    rect1.setWidth(100);
    rect1.setHeight(100);
    rect1.setArcHeight(35.0);
    rect1.setArcWidth(35.0);
    rect1.setFill(Color.RED);
Group root = new Group(rect, rect1);
Scene scene = new Scene(root,800,800,Color.GRAY);

        primaryStage.setTitle("2D Shapes");
        primaryStage.setScene(scene);
        primaryStage.show();
    }

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



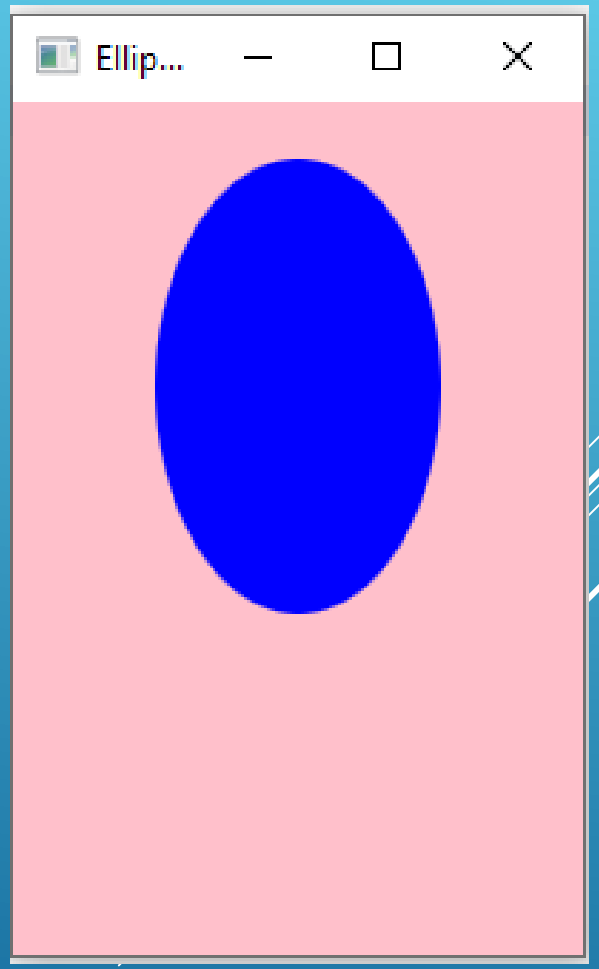
Ellipse

- In general, ellipse can be defined as the geometrical structure with the two focal points.
- The focal points in the ellipse are chosen so that the sum of the distance to the focal points is constant from every point of the ellipse.
- In JavaFX, the class javafx.scene.shape.Ellipse represents Ellipse.
- This class needs to be instantiated in order to create ellipse.
- This class contains various properties which needs to be set in order to render ellipse on a XY place.

Property	Description	Setter Methods
CenterX	Horizontal position of the centre of eclipse	setCenterX(Double X-value)
CenterY	Vertical position of the centre of eclipse	setCenterY(Double Y-value)
RadiusX	Width of Eclipse	setRadiusX(Double X-Radius Vaue)
RadiusY	Height of Eclipse	setRadiusY(Double Y-Radius Value)

Ellipse

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.Group;
import javafx.scene.shape.Ellipse;
import javafx.stage.Stage;
import javafx.scene.paint.Color;
public class DrawEllipse extends Application {

    @Override
    public void start(Stage primaryStage)throws Exception {
        Ellipse e = new Ellipse();
    e.setCenterX(100);
    e.setCenterY(100);
    e.setRadiusX(50);
    e.setRadiusY(80);
    e.setFill(Color.BLUE);
    Group root = new Group(e);
    Scene scene = new Scene(root,200,300,Color.PINK);
 primaryStage.setTitle("Ellipse Example");
        primaryStage.setScene(scene);
        primaryStage.show();
    }
public static void main(String[] args) {
        launch(args);
    }}
```



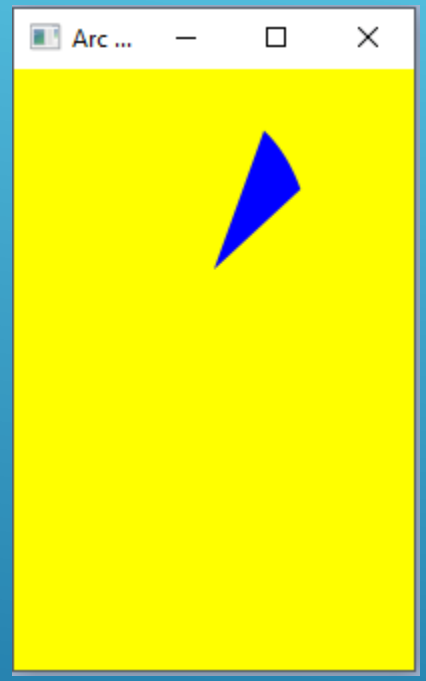
Arc

- In general, Arc is the part of the circumference of a circle or ellipse.
- It needs to be created in some of the JavaFX applications wherever required.
- JavaFX allows us to create the Arc on GUI by just instantiating javafx.scene.shape.Arc class.
- Just set the properties of the class to the appropriate values to show arc as required by the Application.

Property	Description	Method
CenterX	X coordinate of the centre point	serCenterX(Double value)
CenterY	Y coordinate of the centre point	setCenterY(Double value)
Length	Angular extent of the arc in degrees	setLength(Double value)
RadiusX	Full width of the ellipse of which, Arc is a part.	setRadiusX(Double value)
RadiusY	Full height of the ellipse of which, Arc is a part	setRadiusY(Double value)
StartAngle	Angle of the arc in degrees	setStartAngle(Double value)
type	Type of Arc : OPEN, CHORD, ROUND	setType(Double value)

Arc

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.paint.Color;
import javafx.scene.shape.Arc;
import javafx.scene.shape.ArcType;
import javafx.stage.Stage;
public class DrawArc extends Application{
      @Override
    public void start(Stage primaryStage) throws Exception {
Arc arc = new Arc();
    arc.setCenterX(100);
    arc.setCenterY(100);
    arc.setRadiusX(50);
    arc.setRadiusY(80);
    arc.setStartAngle(30);
    arc.setLength(30);
    arc.setType(ArcType.ROUND);
    arc.setFill(Color.BLUE);
    Group root = new Group(arc);
    Scene scene = new Scene(root,200,300,Color.YELLOW);
    primaryStage.setTitle("Arc Example");
    primaryStage.setScene(scene);
    primaryStage.show();
}
public static void main(String[] args) {
    launch(args);
} }
```



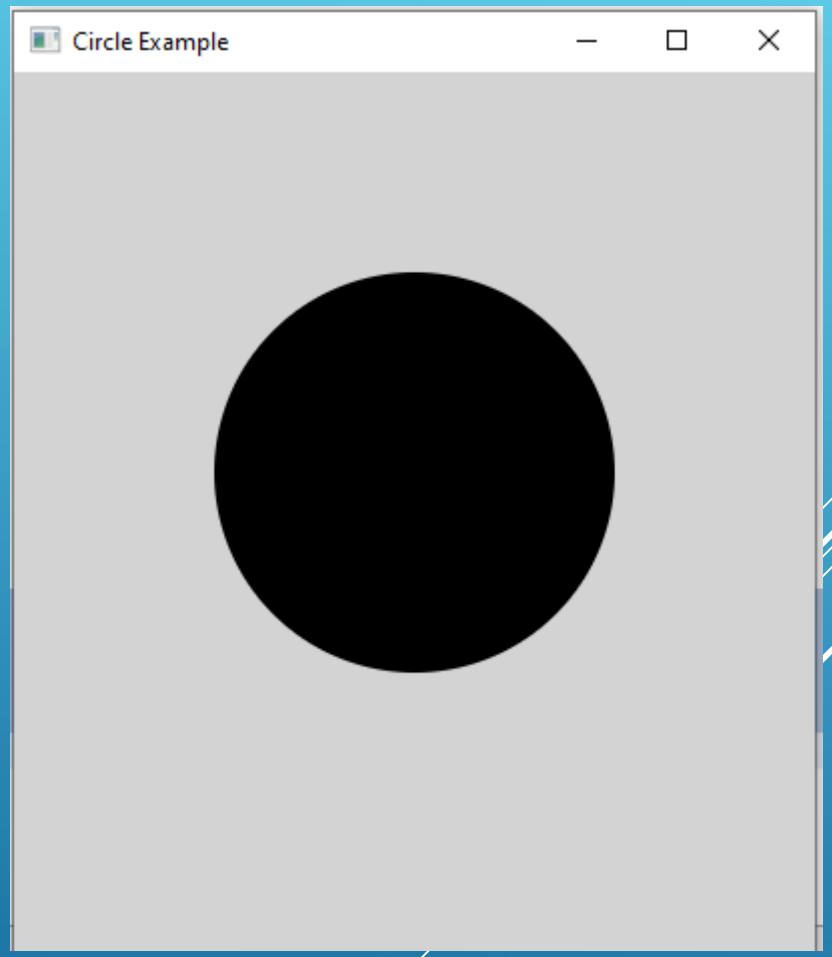
Circle

- A circle is a special type of ellipse with both of the focal points at the same position.
- Its horizontal radius is equal to its vertical radius.
- JavaFX allows us to create Circle on the GUI of any application by just instantiating javafx.scene.shape.Circle class.
- Just set the class properties by using the instance setter methods and add the class object to the Group.

Property	Description	Setter Methods
centerX	X coordinate of the centre of circle	setCenterX(Double value)
centerY	Y coordinate of the centre of circle	setCenterY(Double value)
radius	Radius of the circle	setRadius(Double value)

Circle

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.paint.Color;
import javafx.scene.shape.Arc;
import javafx.scene.shape.ArcType;
import javafx.stage.Stage;
public class DrawCircle extends Application{
      @Override
    public void start(Stage primaryStage) throws Exception {
Circle c = new Circle();
    c.setCenterX(200);
    c.setCenterY(200);
    c.setRadius(100);
    Group root = new Group(c);
    Scene scene = new Scene(root,400,500,Color.LIGHTGRAY);
    primaryStage.setTitle("Circle Example");
primaryStage.setScene(scene);
    primaryStage.show();
}
public static void main(String[] args) {
    launch(args);
} }
```



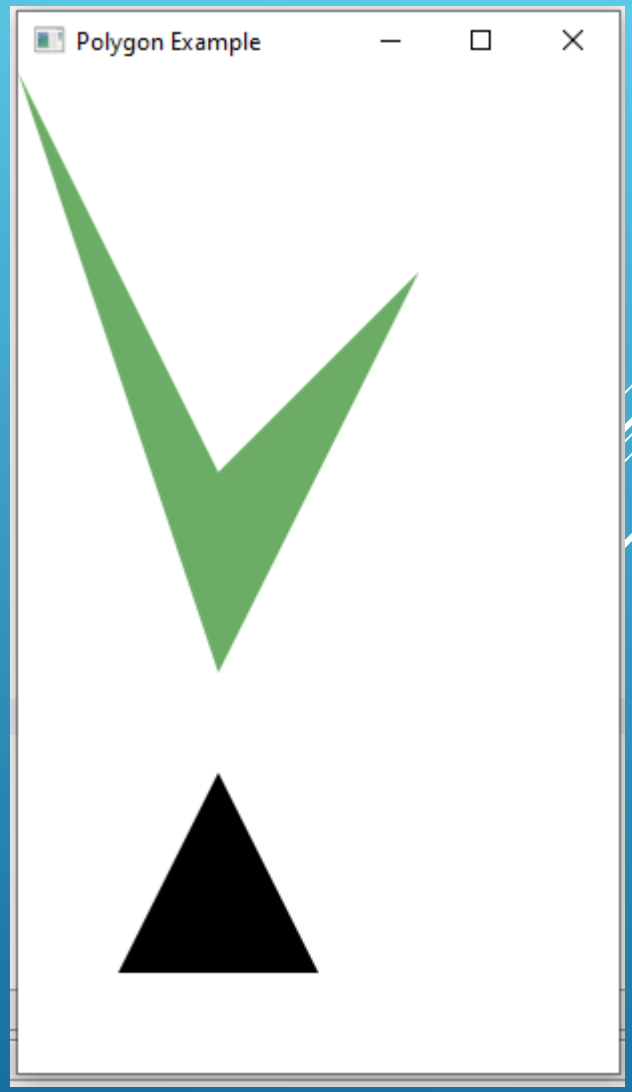
Polygons

- Polygon can be defined as a plain figure with at least three straight sides forming a loop.
- In the case of polygons, we mainly considers the length of its sides and the interior angles.
- Triangles, squares, Pentagons, Hexagons,etc are all polygons.
- In JavaFX, Polygon can be created by instantiating javafx.scene.shape.Polygon class.
- We need to pass a Double array into the class constructor representing X-Y coordinates of all the points of the polygon.
- The syntax is given below.

```
Polygon poly = new Polygon(DoubleArray);
```

Polygons

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.shape.Polygon;
import javafx.stage.Stage;
import javafx.scene.paint.Color;
public class DrawPolygon extends Application {
    @Override
  public void start(Stage primarystage) {
    Polygon poly = new Polygon(0.0,0.0,100.0, 200.0, 200.0, 100.0, 100.0,300.0);
    Polygon poly1 =new Polygon(100.0, 350.0, 50.0, 450.0, 150.0, 450.0);
   // setting color based on rgb values
    int red=20, green=125, blue=10;
    poly.setFill(Color.rgb(red, green, blue,0.63));
    Group root = new Group(poly, poly1);
    Scene scene = new Scene(root,500,500);
    primarystage.setTitle("Polygon Example");
    primarystage.setScene(scene);
    primarystage.show();
  }

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



Text

- In some of the cases, we need to provide the text based information on the interface of our application.
- JavaFX library provides a class named javafx.scene.text.Text for this purpose.
- This class provides various methods to alter various properties of the text.
- We just need to instantiate this class to implement text in our application.
- Use the setter method setText(string) to set the string as a text for the text class object.
- Follow the syntax given below to instantiate the Text class.

  Text <text_Object> = new Text();

  text.setText(<string-text>);
- By default, the text will be displayed to the center of the screen.

- **Font and position of the Text**
- JavaFX enables us to apply various fonts to the text nodes.
- We just need to set the property font of the Text class by using the setter method setFont().
- This method accepts the object of Font class.
- The class Font belongs to the package javafx.scene.text.
- It contains a static method named font().
- This returns an object of Font type which will be passed as an argument into the setFont() method of Text class.

Text

- The method Font.font() accepts the following parameters.
- **Family:** it represents the family of the font. It is of string type and should be an appropriate font family present in the system.
- **Weight:** this Font class property is for the weight of the font. There are 9 values which can be used as the font weight. The values are FontWeight. BLACK, BOLD, EXTRA_BOLD, EXTRA_LIGHT, LIGHT, MEDIUM, NORMAL, SEMI_BOLD, THIN.
- **Posture:** this Font class property represents the posture of the font. It can be either FontPosture.ITALIC or FontPosture.REGULAR.
- **Size:** this is a double type property. It is used to set the size of the font.
- The Syntax of the method setFont() is given below.

  <text_object>.setFont(Font.font(<String font_family>, <FontWeight>, <FontPosture>, <FontSize>)

- **Applying Stroke and Color to Text**
- Stroke means the padding at the boundary of the text.
- JavaFX allows us to apply stroke and colors to the text.
- javafx.scene.text.Text class provides a method named setStroke() which accepts the Paint class object as an argument. Just pass the color which will be painted on the stroke.
- We can also set the width of the stroke by passing a width value of double type into setStrokeWidth() method.
- To set the color of the Text, javafx.scene.text.Text class provides another method named setFill(). We just need to pass the color which is to be filled in the text.

Text

- **Text Decoration**
- We can apply the decorations to the text by setting the properties strikethrough and underline of javafx.scene.text.Text class.
- The syntax of both the methods is given below.

  <TextObject>.setStrikeThrough(Boolean value) //pass true to put a line across the text

  <TextObject>.setUnderLine(Boolean value) //pass true to underline the text

Text

Property	Description	Setter Methods
boundstype	This property is of object type. It determines the way in which the bounds of the text is being calculated.	setBoundsType(TextBoundsType value)
font	Font of the text.	setFont(Font value)
fontsmoothingType	Defines the requested smoothing type for the font.	setFontSmoothingType(FontSmoothingType value)
linespacing	Vertical space in pixels between the lines. It is double type property.	setLineSpacing(double spacing)
strikethrough	This is a boolean type property. We can put a line through the text by setting this property to true.	setStrikeThrough(boolean value)
textalignment	Horizontal Text alignment	setTextAlignment(TextAlignment value)
textorigin	Origin of text coordinate system in local coordinate system.	setTextOrigin(VPos value)
text	It is a string type property. It defines the text string which is to be displayed.	setText(String value)
underline	It is a boolean type property. We can underline the text by setting this property to true.	setUnderLine(boolean value)
wrappingwidth	Width limit for the text from where the text is to be wrapped. It is a double type property.	setWrappingWidth(double value)
x	X coordinate of the text	setX(double value)
y	Y coordinate of the text	setY(double value)

Text

```
package javafxapplication1;
import javafx.application.Application;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.text.Font;
import javafx.scene.text.FontPosture;
import javafx.scene.text.FontWeight;
import javafx.scene.text.Text;
import javafx.stage.Stage;
import javafx.scene.paint.Color;
import javafx.scene.text.TextAlignment;
//import javafx.scene.layout.StackPane;
public class JavaFXText extends Application{
@Override
public void start(Stage primaryStage) throws Exception {
    Text text = new Text("Hello !! Welcome to Java FX");
    text.setX(50);
    text.setY(100);

text.setFont(Font.font("Arial",FontWeight.EXTRA_BOLD,Font
Posture.ITALIC,50)); // font formatting
    text.setFill(Color.YELLOW); // setting colour of the text
    text.setStroke(Color.BLACK); // setting the border for the
text
    text.setStrokeWidth(3); // setting border width to 3
    text.setUnderline(true);  // underline the text
    Text text1 = new Text("The line spacing property of the
javafx.scene.text.The text class specifies the line spacing
between the lines of the text (node) vertically.You can set
the value to this property using the setLineSpacing()
method. This method accepts a boolean value as a
parameter and sets the specified space between the lines
(vertically).");

    text1.setX(50);
    text1.setY(300);
    text1.setStrikethrough(true);    // strike the text
    text1.setTextAlignment(TextAlignment.CENTER);
//Aligning text
    text1.setLineSpacing(10);  // Line Spacing
    text1.setWrappingWidth(300);  // text wrapping
    Group root = new Group(text, text1);
    Scene scene = new Scene(root,800,400);
    primaryStage.setScene(scene);
    primaryStage.setTitle("Text Example");
    primaryStage.show();
}
public static void main(String[] args) {
    launch(args);
} }
```

Text


Text Example
Hello !! Welcome to Java FX
The line spacing property of the javafx.scene.text.The text class specifies the line spacing between the lines of the text (node) vertically.You can set the value to this property using the setLineSpacing() method. This method accepts a boolean value as a parameter and sets the specified space between the lines (vertically).

Java FX Layouts

Java FX Layouts

- Layouts are the top level container classes that define the UI styles for scene graph objects.
- Layout can be seen as the parent node to all the other nodes.
- JavaFX provides various layout panes that support different styles of layouts.
- In JavaFX, Layout defines the way in which the components are to be seen on the stage.
- It basically organizes the scene-graph nodes.
- We have several built-in layout panes in JavaFX that are HBox, VBox, StackPane, FlowBox, AnchorPane, etc.
- Each Built-in layout is represented by a separate class which needs to be instantiated in order to implement that particular layout pane.
- All these classes belong to javafx.scene.layout package. javafx.scene.layout.Pane class is the base class for all the built-in layout classes in JavaFX..
- **Steps to create layout**
- In order to create the layouts, we need to follow the following steps.
  - Instantiate the respective layout class, for example, HBox root = new HBox();
  - Setting the properties for the layout, for example, root.setSpacing(20);
  - Adding nodes to the layout object, for example, root.getChildren().addAll(<NodeObjects>);

Java FX Layouts

Class	Description
BorderPane	Organizes nodes in top, left, right, centre and the bottom of the screen.
FlowPane	Organizes the nodes in the horizontal rows according to the available horizontal spaces. Wraps the nodes to the next line if the horizontal space is less than the total width of the nodes
GridPane	Organizes the nodes in the form of rows and columns.
HBox	Organizes the nodes in a single row.
Pane	It is the base class for all the layout classes.
StackPane	Organizes nodes in the form of a stack i.e. one onto another
VBox	Organizes nodes in a vertical column.

BorderPane

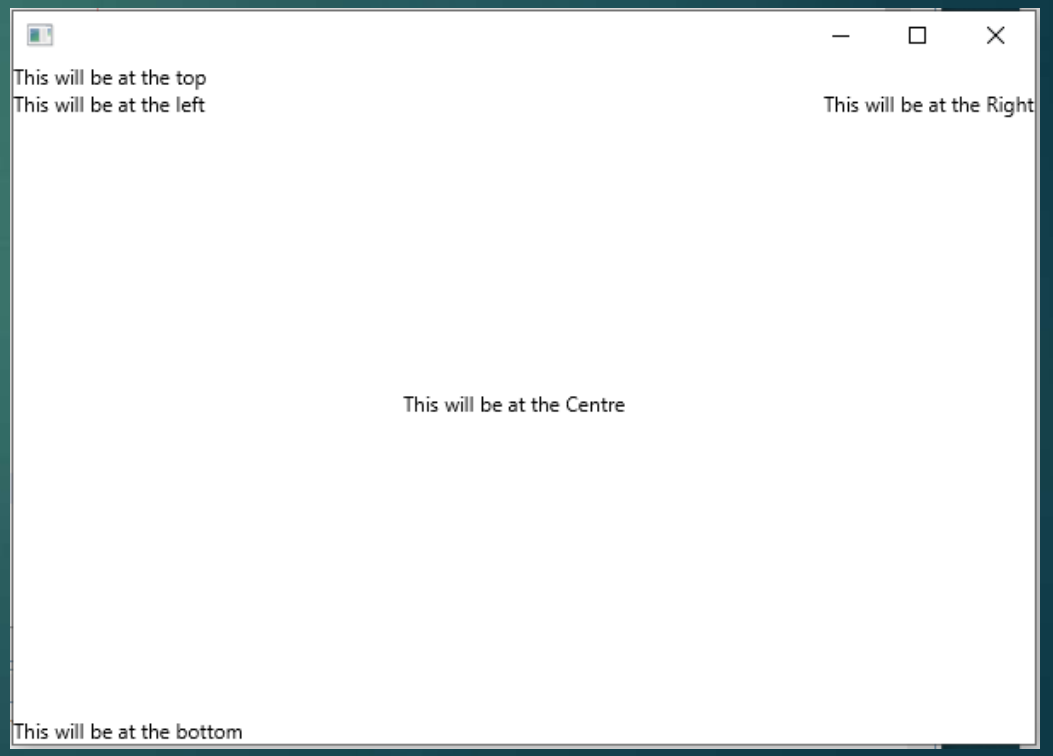
- BorderPane arranges the nodes at the left, right, centre, top and bottom of the screen.
- It is represented by javafx.scene.layout.BorderPane class.
- This class provides various methods like setRight(), setLeft(), setCenter(), setBottom() and setTop() which are used to set the position for the specified nodes.
- We need to instantiate BorderPane class to create the BorderPane layout.

Type	Property	Setter Methods	Description
Node	Bottom	setBottom()	Add the node to the bottom of the screen
Node	Centre	setCenter()	Add the node to the center of the screen
Node	Left	setLeft()	Add the node to the left of the screen
Node	Right	setRight()	Add the node to the right of the screen
Node	Top	setTop()	Add the node to the top of the screen

- There are the following constructors in the class.
  - BorderPane() : create the empty layout
  - BorderPane(Node Center) : create the layout with the center node
  - BorderPane(Node Center, Node top, Node right, Node bottom, Node left) : create the layout with all the nodes

BorderPane

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Label;
import javafx.scene.layout.*;
import javafx.stage.Stage;
import javafx.scene.text.Text;
public class BorderPaneDemo extends Application {
    @Override
    public void start(Stage primaryStage) throws Exception {
        BorderPane BPane = new BorderPane();
        BPane.setTop(new Text("This will be at the top"));
        BPane.setLeft(new Text("This will be at the left"));
        BPane.setRight(new Text("This will be at the Right"));
        BPane.setCenter(new Text("This will be at the Centre"));
        BPane.setBottom(new Text("This will be at the bottom"));
        Scene scene = new Scene(BPane,600,400);
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



HBox

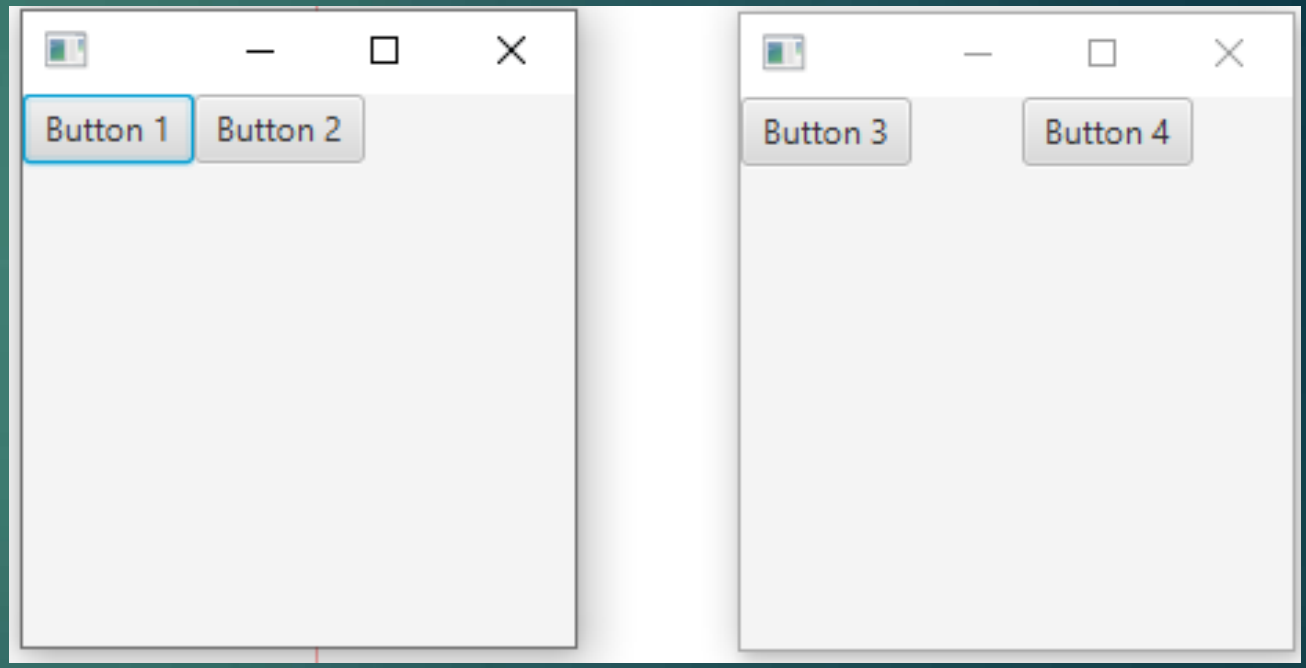
- HBox layout pane arranges the nodes in a single row.
- It is represented by javafx.scene.layout.HBox class.
- We just need to instantiate HBox class in order to create HBox layout.

Property	Description	Setter Methods
alignment	This represents the alignment of the nodes.	setAlignment(Double)
fillHeight	This is a boolean property. If you set this property to true the height of the nodes will become equal to the height of the HBox.	setFillHeight(Double)
spacing	This represents the space between the nodes in the HBox. It is of double type.	setSpacing(Double)

- The HBox class contains two constructors that are given below.
  - new HBox() : create HBox layout with 0 spacing
  - new Hbox(Double spacing) : create HBox layout with a spacing value

HBox

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.layout.HBox;
import javafx.stage.Stage;
public class HBoxDemo extends Application {
  @Override
public void start(Stage primaryStage) throws Exception {
Button btn1 = new Button("Button 1");
Button btn2 = new Button("Button 2");
Button btn3 = new Button("Button 3");
Button btn4 = new Button("Button 4");
HBox root = new HBox(btn1,btn2);
Scene scene = new Scene(root,200,200);
primaryStage.setScene(scene);
primaryStage.show();

HBox root1 = new HBox(btn3,btn4);
root1.setSpacing(40);
Scene scene1 = new Scene(root1,200,200);
Stage newStage=new Stage();
newStage.setScene(scene1);
newStage.show();
}
public static void main(String[] args) {
        launch(args);
} }
```



VBox

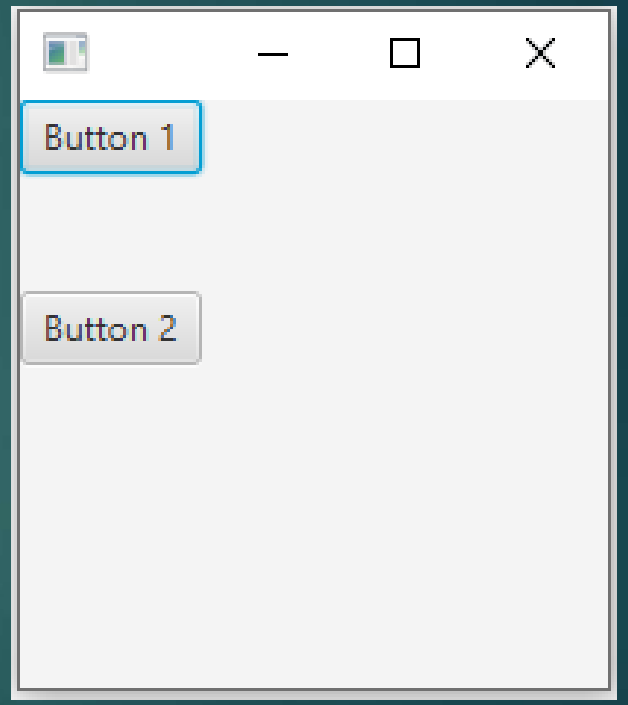
- Instead of arranging the nodes in horizontal row, Vbox Layout Pane arranges the nodes in a single vertical column.
- It is represented by javafx.scene.layout.VBox class which provides all the methods to deal with the styling and the distance among the nodes.
- This class needs to be instantiated in order to implement VBox layout in our application.

Property	Description	Setter Methods
Alignment	This property is for the alignment of the nodes.	setAlignment(Double)
FillWidth	This property is of the boolean type. The Width of resizeable nodes can be made equal to the Width of the VBox by setting this property to true.	setFillWidth(boolean)
Spacing	This property is to set some spacing among the nodes of VBox.	setSpacing(Double)

- The VBox class contains constructors that are given below.
  - VBox() : creates layout with 0 spacing
  - Vbox(Double spacing) : creates layout with a spacing value of double type
  - Vbox(Double spacing, Node? children) : creates a layout with the specified spacing among the specified child nodes
  - Vbox(Node? children) : creates a layout with the specified nodes having 0 spacing among them

VBox

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.layout.VBox;
import javafx.stage.Stage;
public class VBoxDemo extends Application {

    @Override
    public void start(Stage primaryStage) throws Exception {
        Button btn1 = new Button("Button 1");
        Button btn2 = new Button("Button 2");
        VBox root = new VBox(btn1,btn2);
        root.setSpacing(40);
        Scene scene = new Scene(root,200,200);
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



StackPane

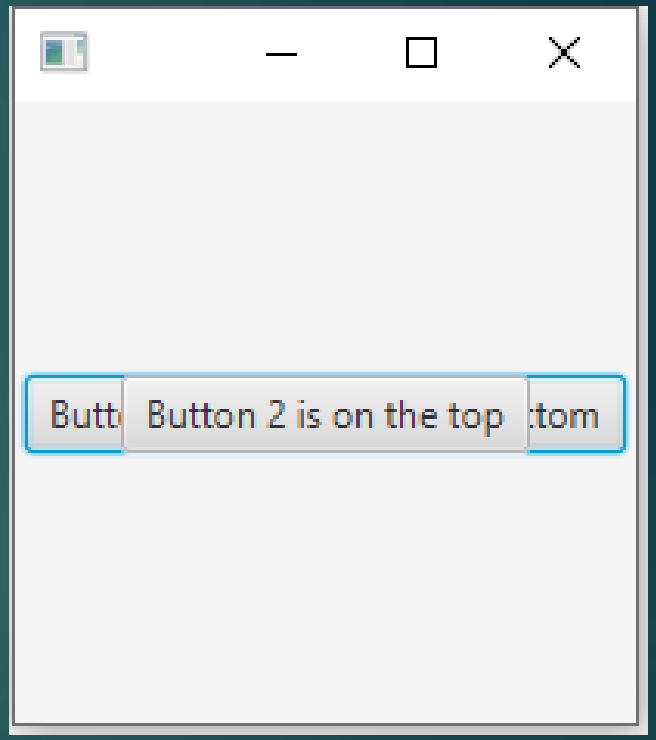
- The StackPane layout pane places all the nodes into a single stack where every new node gets placed on the top of the previous node.
- It is represented by javafx.scene.layout.StackPane class.
- We just need to instantiate this class to implement StackPane layout into our application.

Property	Description	Setter Method
alignment	It represents the default alignment of children within the StackPane's width and height	setAlignment(Node child, Pos value) setAlignment(Pos value)

- The class contains two constructors that are given below.
  - StackPane()
  - StackPane(Node? Children)

StackPane

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.layout.StackPane;
import javafx.stage.Stage;
public class StackPaneDemo extends Application {

    @Override
    public void start(Stage primaryStage) throws Exception {
        Button btn1 = new Button("Button 1 is stacked to the bottom");
        Button btn2 = new Button("Button 2 is on the top");
        StackPane root = new StackPane(btn1,btn2);
        Scene scene = new Scene(root,200,200);
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



GridPane

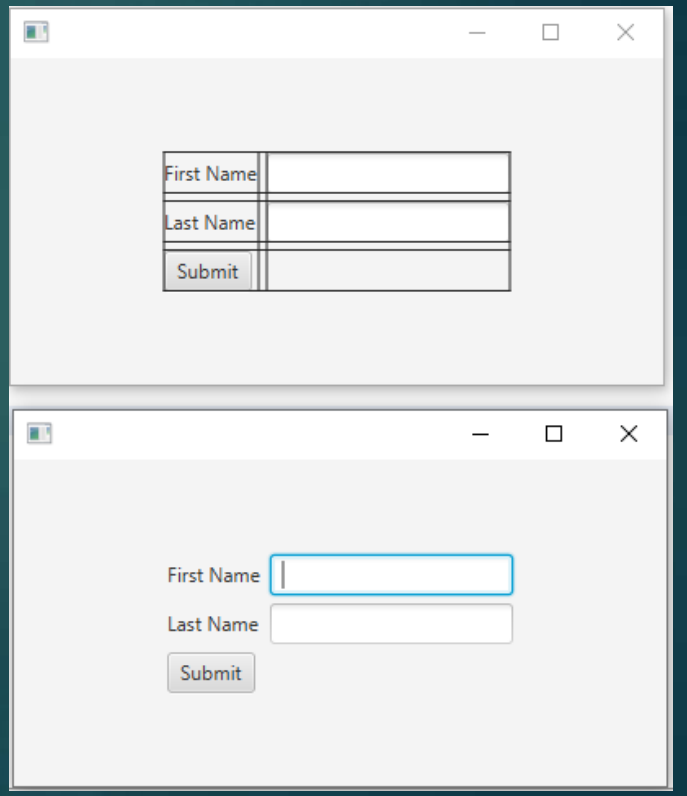
- GridPane Layout pane allows us to add the multiple nodes in multiple rows and columns.
- It is seen as a flexible grid of rows and columns where nodes can be placed in any cell of the grid.
- It is represented by javafx.scence.layout.GridPane class. We just need to instantiate this class to implement GridPane.

Property	Description	Setter Methods
alignment	Represents the alignment of the grid within the GridPane.	setAlignment(Pos value)
gridLinesVisible	This property is intended for debugging. Lines can be displayed to show the gridpane's rows and columns by setting this property to true.	setGridLinesVisible(Boolean value)
hgap	Horizontal gaps among the columns	setHgap(Double value)
vgap	Vertical gaps among the rows	setVgap(Double value)

- The class contains only one constructor that is given below.
  - Public GridPane(): creates a gridpane with 0 hgap/vgap.

GridPane

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.geometry.Pos;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.control.Label;
import javafx.scene.control.TextField;
import javafx.scene.layout.GridPane;
import javafx.stage.Stage;
public class GridPaneDemo extends Application {
      @Override
    public void start(Stage primaryStage) throws Exception {
        Label first_name=new Label("First Name");
        Label last_name=new Label("Last Name");
        TextField tf1=new TextField();
        TextField tf2=new TextField();
        Button Submit=new Button ("Submit");
        GridPane root=new GridPane();
        Scene scene = new Scene(root,400,200);
        root.add(first_name,0,0);
        root.add(tf1,1,0);
        root.addRow(1, last_name,tf2);
        root.addRow(2, Submit);
        root.setAlignment(Pos.CENTER);
        //root.setGridLinesVisible(false);
        root.setGridLinesVisible(true);
        root.setHgap(5);
        root.setVgap(5);
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



FlowPane

- FlowPane layout pane organizes the nodes in a flow that are wrapped at the flowpane's boundary.
- The horizontal flowpane arranges the nodes in a row and wrap them according to the flowpane's width.
- The vertical flowpane arranges the nodes in a column and wrap them according to the flowpane's height.
- FlowPane layout is represented by javafx.scene.layout.FlowPane class.

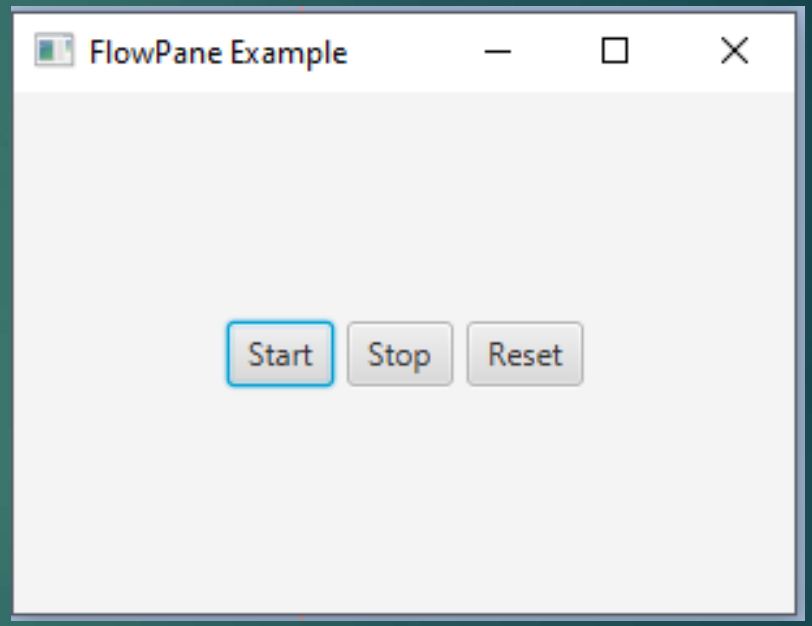
Property	Description	Setter Methods
alignment	The overall alignment of the flowpane's content.	setAlignment(Pos value)
columnHalignment	The horizontal alignment of nodes within the columns.	setColumnHalignment(HPos Value)
hgap	Horizontal gap between the columns.	setHgap(Double value)
orientation	Orientation of the flowpane	setOrientation(Orientation value)
prefWrapLength	The preferred height or width where content should wrap in the horizontal or vertical flowpane.	setPrefWrapLength(double value)
rowValignment	The vertical alignment of the nodes within the rows.	setRowValignment(VPos value)
vgap	The vertical gap among the rows	setVgap(Double value)

FlowPane

- There are 8 constructors in the class that are given below.
  - FlowPane()
  - FlowPane(Double Hgap, Double Vgap)
  - FlowPane(Double Hgap, Double Vgap, Node? children)
  - FlowPane(Node... Children)
  - FlowPane(Orientation orientation)
  - FlowPane(Orientation orientation, double Hgap, Double Vgap)
  - FlowPane(Orientation orientation, double Hgap, Double Vgap, Node? children)
  - FlowPane(Orientation orientation, Node... Children)

FlowPane

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.geometry.Pos;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.layout.FlowPane;
import javafx.stage.Stage;
public class FlowPaneDemo extends Application {

    @Override
    public void start(Stage primaryStage) {
        Button btn1=new Button("Start");
        Button btn2=new Button("Stop");
        Button btn3=new Button("Reset");
        FlowPane root = new FlowPane(btn1, btn2, btn3);
        root.setVgap(6);
        root.setHgap(5);
        root.setPrefWrapLength(250);
        root.setAlignment(Pos.CENTER);
        Scene scene = new Scene(root,300,200);
        primaryStage.setTitle("FlowPane Example");
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    }
}
```



UI Controls

Java FX UI Controls

- The graphical user interface of every desktop application mainly considers UI elements, layouts and behaviour.
- The UI elements are the one which are actually shown to the user for interaction or information exchange.
- Layout defines the organization of the UI elements on the screen.
- Behaviour is the reaction of the UI element when some event is occurred on it.
- However, the package javafx.scene.control provides all the necessary classes for the UI components like Button, Label, etc.
- Every class represents a specific UI control and defines some methods for their styling.

Java FX UI Controls

SN	Control	Description
1	Label	Label is a component that is used to define a simple text on the screen. Typically, a label is placed with the node, it describes.
2	Button	Button is a component that controls the function of the application. Button class is used to create a labelled button.
3	RadioButton	The Radio Button is used to provide various options to the user. The user can only choose one option among all. A radio button is either selected or deselected.
4	CheckBox	Check Box is used to get the kind of information from the user which contains various choices. User marked the checkbox either on (true) or off (false).
5	TextField	Text Field is basically used to get the input from the user in the form of text. javafx.scene.control.TextField represents TextField
6	PasswordField	PasswordField is used to get the user's password. Whatever is typed in the password field is not shown on the screen to anyone.
7	HyperLink	HyperLink are used to refer any of the webpage through your application. It is represented by the class **javafx.scene.control.HyperLink**
8	Slider	Slider is used to provide a pane of options to the user in a graphical form where the user needs to move a slider over the range of values to select one of them.
9	ProgressBar	Progress Bar is used to show the work progress to the user. It is represented by the class **javafx.scene.control.ProgressBar**.
10	ProgressIndicator	Instead of showing the analogue progress to the user, it shows the digital progress so that the user may know the amount of work done in percentage.
11	ScrollBar	JavaFX Scroll Bar is used to provide a scroll bar to the user so that the user can scroll down the application pages.
12	Menu	JavaFX provides a Menu class to implement menus. Menu is the main component of any application.
13	ToolTip	JavaFX ToolTip is used to provide hint to the user about any component. It is mainly used to provide hints about the text fields or password fields being used in the application.

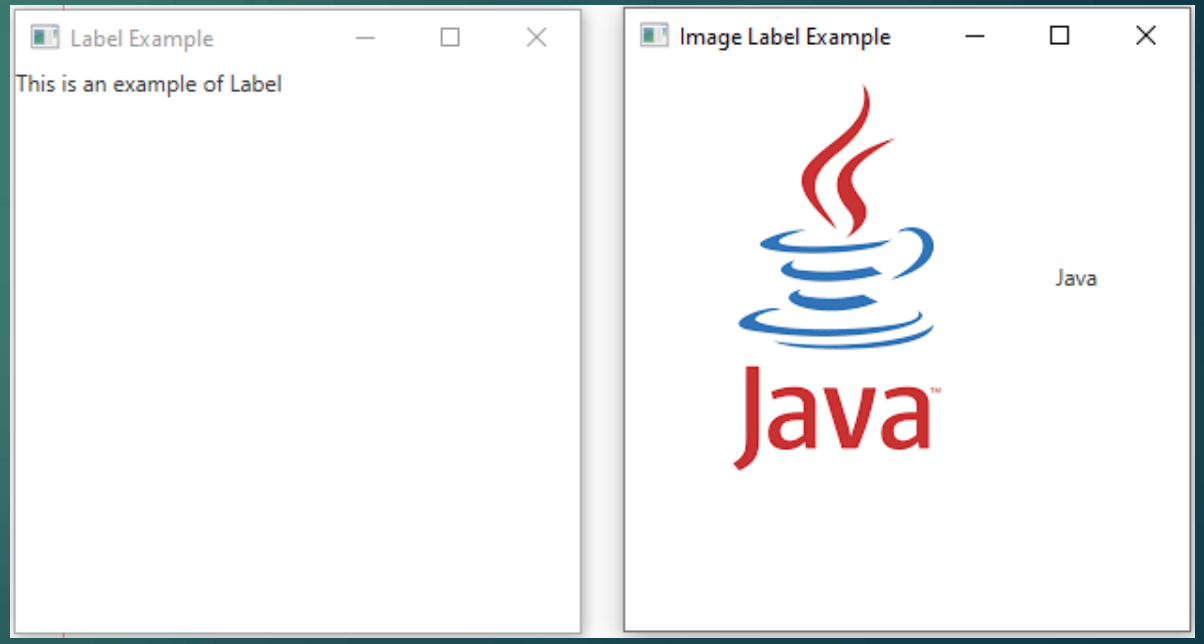
Label

- javafx.scene.control.Label class represents label control.
- As the name suggests, the label is the component that is used to place any text information on the screen.
- It is mainly used to describe the purpose of the other components to the user.
- You can not set a focus on the label using the Tab key.
- Package: javafx.scene.control
- Constructors:
  - Label(): creates an empty Label
  - Label(String text): creates Label with the supplied text
  - Label(String text, Node graphics): creates Label with the supplied text and graphics

Label

```
package javafxapplication1.UIControls;
import java.io.FileInputStream;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Label;
import javafx.scene.image.Image;
import javafx.scene.image.ImageView;
import javafx.stage.Stage;
import javafx.scene.Group;
public class LabelDemo extends Application {
    @Override
    public void start(Stage primaryStage) throws Exception {
        // TODO Auto-generated method stub
        Label my_label=new Label("This is an example of Label");
        FileInputStream input= new
FileInputStream("C:/Users/mpstme.student/Documents/NetBeansPr
ojects/JavaFXApplication1/src/javafxapplication1/UIControls/javai
mg.png");
        Image img = new Image(input);
        ImageView imageview=new ImageView(img);
        Label my_label1=new Label("Java",imageview);
        Group root = new Group(my_label);
        Group root1 = new Group(my_label1);
        Scene scene=new Scene(root,300,300);
        Scene scene1=new Scene(root1,300,300);
        primaryStage.setScene(scene);
        primaryStage.setTitle("Label Example");
        primaryStage.show();
```

```
// creating another stage to add another scene
        Stage newstage = new Stage();
        newstage.setScene(scene1);
        newstage.setTitle("Image Label Example");
        newstage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



Button

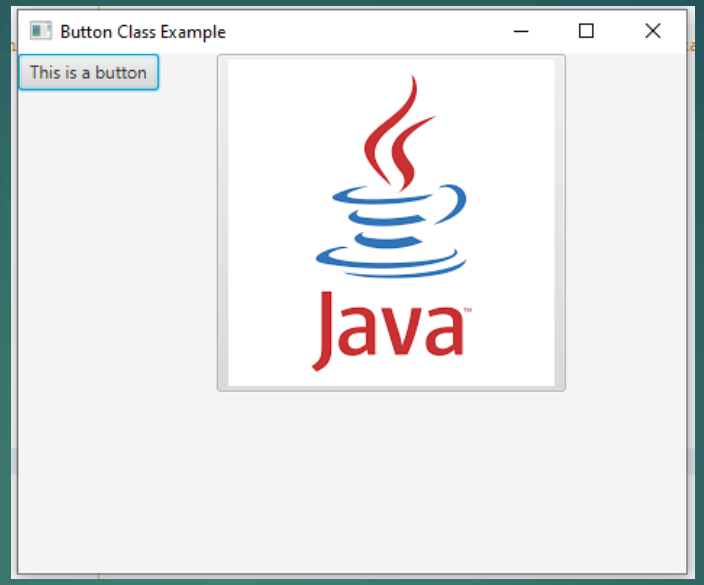
- JavaFX button control is represented by javafx.scene.control.Button class. A button is a component that can control the behaviour of the Application. An event is generated whenever the button gets clicked.
- Button can be created by instantiating Button class. Use the following line to create button object.

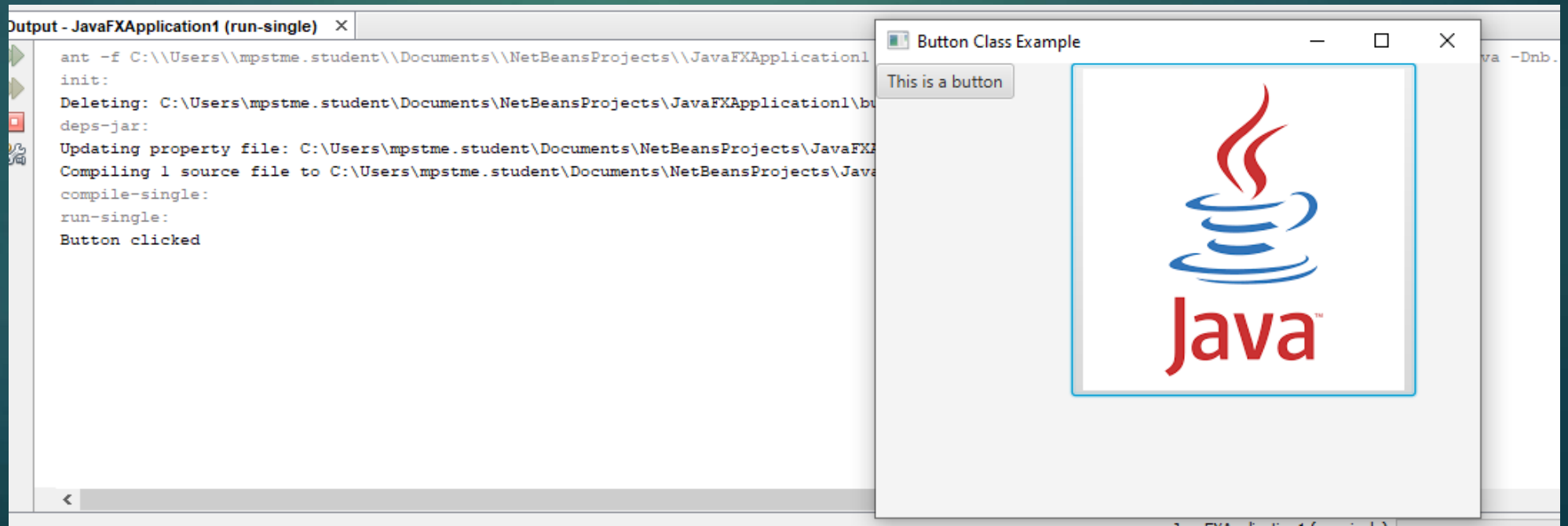
  Button btn = new Button("My Button");
- **Button Action**
- Button class provides setOnAction() method which is used to set the action for the button click event.
- An object of the anonymous class implementing the handle() method, is passed in this method as a parameter.
- We can also pass lambda expressions to handle the events.

Button

```
package javafxapplication1.UIControls;
import java.io.FileInputStream;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.image.Image;
import javafx.scene.image.ImageView;
import javafx.stage.Stage;
import javafx.scene.layout.HBox;
public class ButtonDemo extends Application {
    @Override
    public void start(Stage primaryStage) throws Exception
{
        Button btn=new Button("This is a button");
        // Image Button
        FileInputStream input=new
FileInputStream("C:/Users/mpstme.student/Documents/
NetBeansProjects/JavaFXApplication1/src/javafxapplicat
ion1/UIControls/javaimg.png");
        Image image = new Image(input);
        ImageView img=new ImageView(image);
        Button btn1=new Button();
        btn1.setGraphic(img);
//button event handling
        btn1.setOnAction(new EventHandler<ActionEvent>()
@Override
            public void handle(ActionEvent args) {
                // TODO Auto-generated method stub
                System.out.println("Button clicked");
            }
        } );
        HBox root = new HBox(btn,btn1);
        root.setSpacing(40);
Scene scene=new Scene(root,300,300);
primaryStage.setScene(scene);
        primaryStage.setTitle("Button Class Example");
        primaryStage.show();
        }
    public static void main(String[] args) {
        launch(args);
    }
}
```

Button


Button Class Example
This is a button
Java

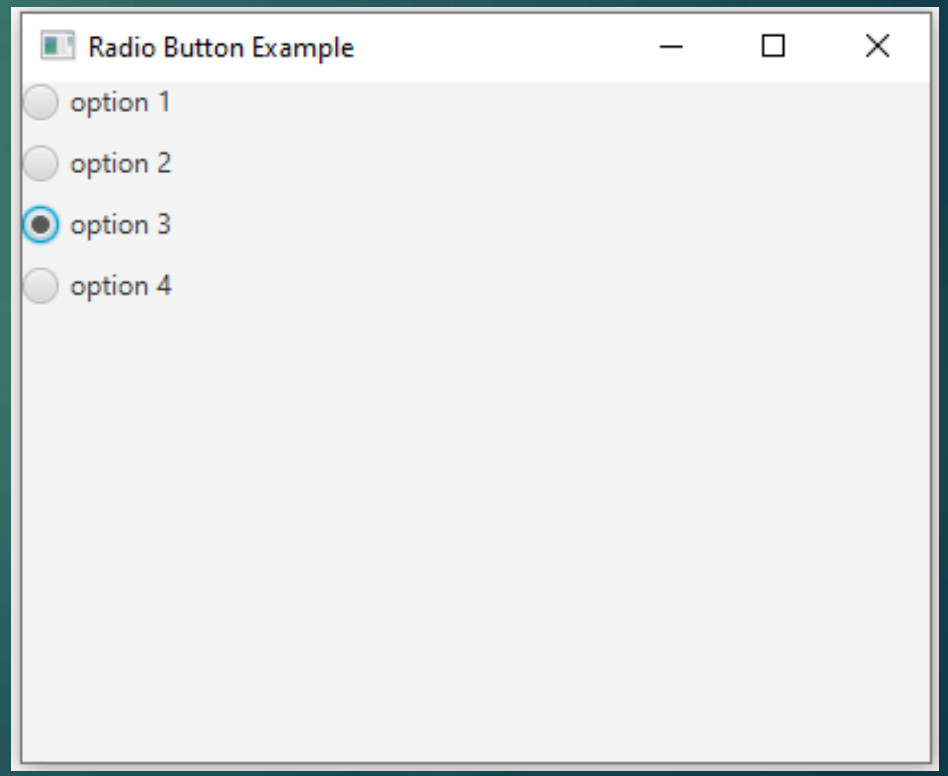

Output - JavaFXApplication1 (run-single)
ant -f C:\\Users\\mpstme.student\\Documents\\NetBeansProjects\\JavaFXApplication1
init:
Deleting: C:\Users\mpstme.student\Documents\NetBeansProjects\JavaFXApplication1\bu
deps-jar:
Updating property file: C:\Users\mpstme.student\Documents\NetBeansProjects\JavaFXA
Compiling 1 source file to C:\Users\mpstme.student\Documents\NetBeansProjects\Java
compile-single:
run-single:
Button clicked
Button Class Example
This is a button
Java

Radio Button

- The Radio Button is used to provide various options to the user.
- The user can only choose one option among all.
- A radio button is either selected or deselected.
- It can be used in a scenario of multiple choice questions in the quiz where only one option needs to be chosen by the student.

Radio Button

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.RadioButton;
import javafx.scene.control.ToggleGroup;
import javafx.scene.layout.VBox;
import javafx.stage.Stage;
public class RadioButtonDemo extends Application {
@Override
public void start(Stage primaryStage) throws Exception {
    // TODO Auto-generated method stub
    //ToggleGroup is used to define group of radiobuttons.
Only one radiobutton in each group can be selected at a
time.
   ToggleGroup group = new ToggleGroup();
    RadioButton button1 = new RadioButton("option 1");
    RadioButton button2 = new RadioButton("option 2");
    RadioButton button3 = new RadioButton("option 3");
    RadioButton button4 = new RadioButton("option 4");
    button1.setToggleGroup(group);
    button2.setToggleGroup(group);
    button3.setToggleGroup(group);
    button4.setToggleGroup(group);
VBox root=new VBox(button1,button2,button3,button4);
root.setSpacing(10);
Scene scene=new Scene(root,400,300);
    primaryStage.setScene(scene);
    primaryStage.setTitle("Radio Button Example");
    primaryStage.show();
}
public static void main(String[] args) {
launch(args);
} }
```



Checkbox

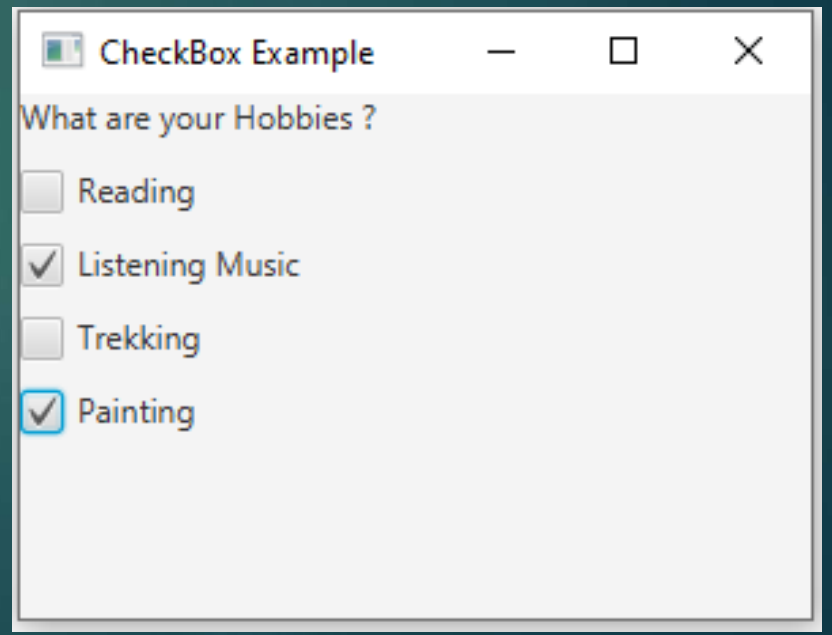
- The Check Box is used to provide more than one choices to the user.
- It can be used in a scenario where the user is prompted to select more than one option or the user wants to select multiple options.
- It is different from the radio button in the sense that, we can select more than one checkboxes in a scenerio.
- Instantiate javafx.scene.control.CheckBox class to implement CheckBox.

  CheckBox checkbox = new CheckBox();
- Use the following line to attach a label with the checkbox.

  CheckBox checkbox = new CheckBox("Label Name");
- We can change the CheckBox Label at any time by calling an instance method setText("text").
- We can make it selected by calling setSelected("true")

Checkbox

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.CheckBox;
import javafx.scene.control.Label;
import javafx.scene.layout.VBox;
import javafx.stage.Stage;
public class CheckboxDemo extends Application {
@Override
public void start(Stage primaryStage) throws Exception {
    // TODO Auto-generated method stub
    Label lbl = new Label("What are your Hobbies ?");
    CheckBox c1 = new CheckBox("Reading");
    CheckBox c2 = new CheckBox("Listening Music");
    CheckBox c3 = new CheckBox("Trekking");
    CheckBox c4 = new CheckBox("Painting");
    VBox root = new VBox(lbl,c1,c2,c3,c4);
    root.setSpacing(10);
    Scene scene=new Scene(root,800,200);
    primaryStage.setScene(scene);
    primaryStage.setTitle("CheckBox Example");
    primaryStage.show();
}
public static void main(String[] args) {
launch(args);     } }
```

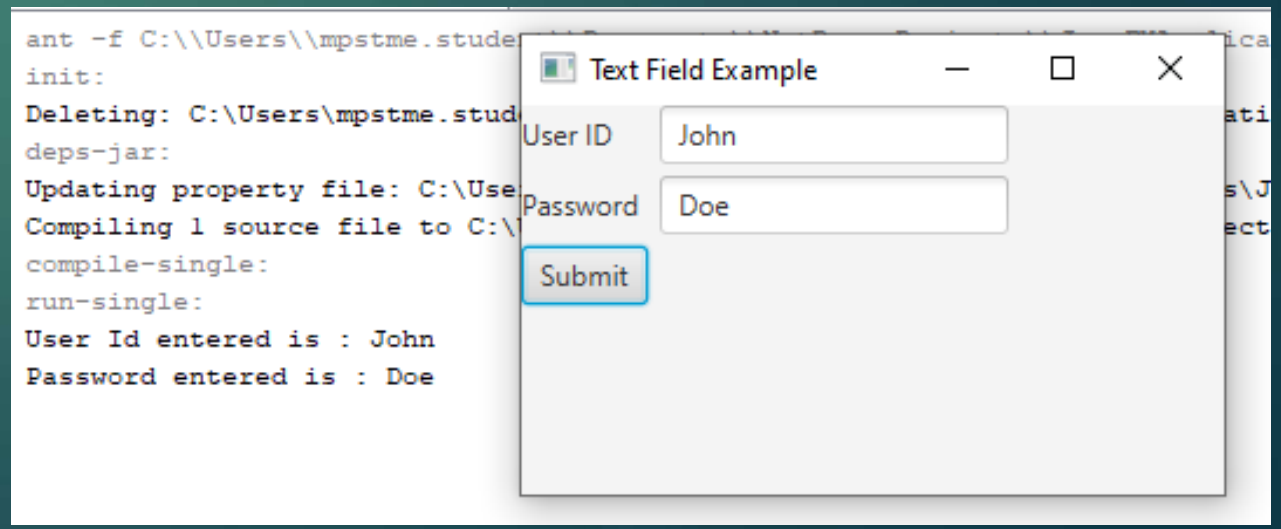


Text Field

- Text Field is basically used to get the input from the user in the form of text.
- javafx.scene.control.TextField represents TextField.
- It provides various methods to deal with textfields in JavaFX.
- TextField can be created by instantiating TextField class.
- TextField class provides an instance method getText() to retrieve the textfield data.
- It returns String object which can be used to save the user details in database.

Text Field

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.control.Label;
import javafx.scene.control.TextField;
import javafx.scene.layout.GridPane;
import javafx.stage.Stage;
import javafx.event.ActionEvent;
import javafx.event.EventHandler;
public class TextFieldDemo extends Application {
@Override
public void start(Stage primaryStage) throws Exception {
    // TODO Auto-generated method stub
    Label user_id=new Label("User ID");
    Label password = new Label("Password");
    TextField tf1=new TextField();
    TextField tf2=new TextField();
    Button b = new Button("Submit");
    GridPane root = new GridPane();
    root.addRow(0, user_id, tf1);
    root.addRow(1, password, tf2);
    root.addRow(2, b);
    root.setHgap(5);
    root.setVgap(5);
    b.setOnAction(new EventHandler<ActionEvent>() {
@Override
    public void handle(ActionEvent args) {
    // TODO Auto-generated method stub
    System.out.println("User Id entered is : " + tf1.getText());
    System.out.println("Password entered is : " + tf2.getText());
            }
        } );
     Scene scene=new Scene(root,300,300);
     primaryStage.setScene(scene);
     primaryStage.setTitle("Text Field Example");
     primaryStage.show();
}
public static void main(String[] args) {
launch(args);
} }
```



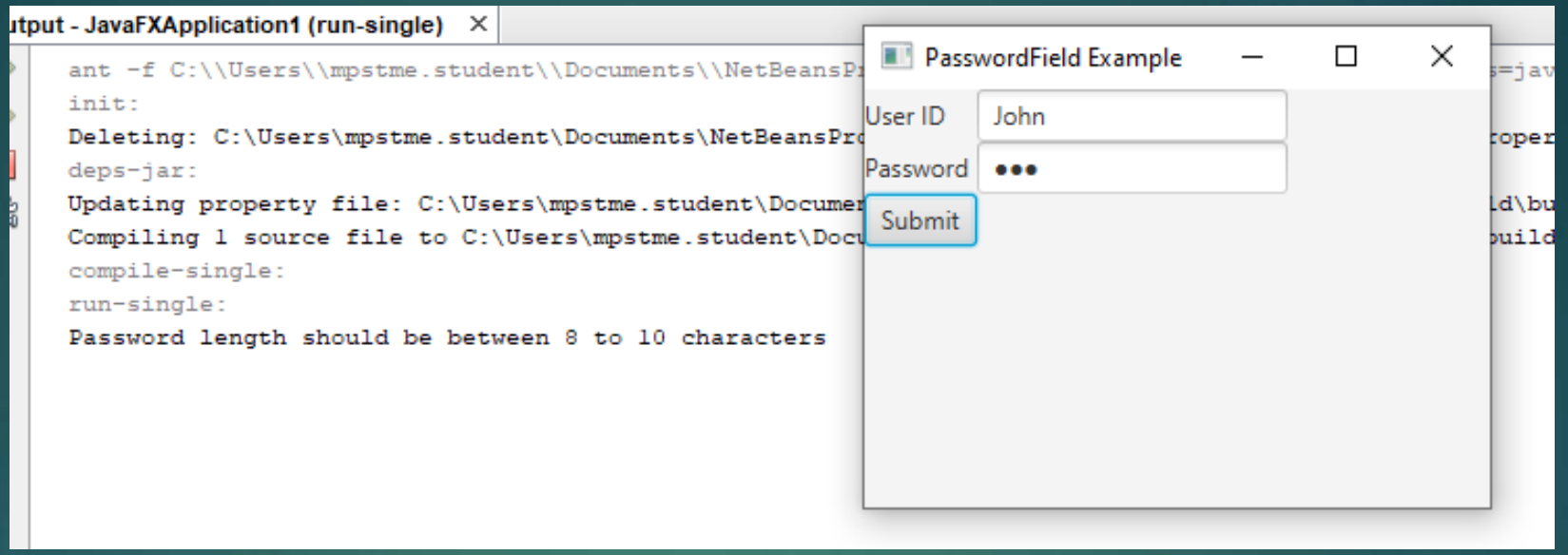
Password Field

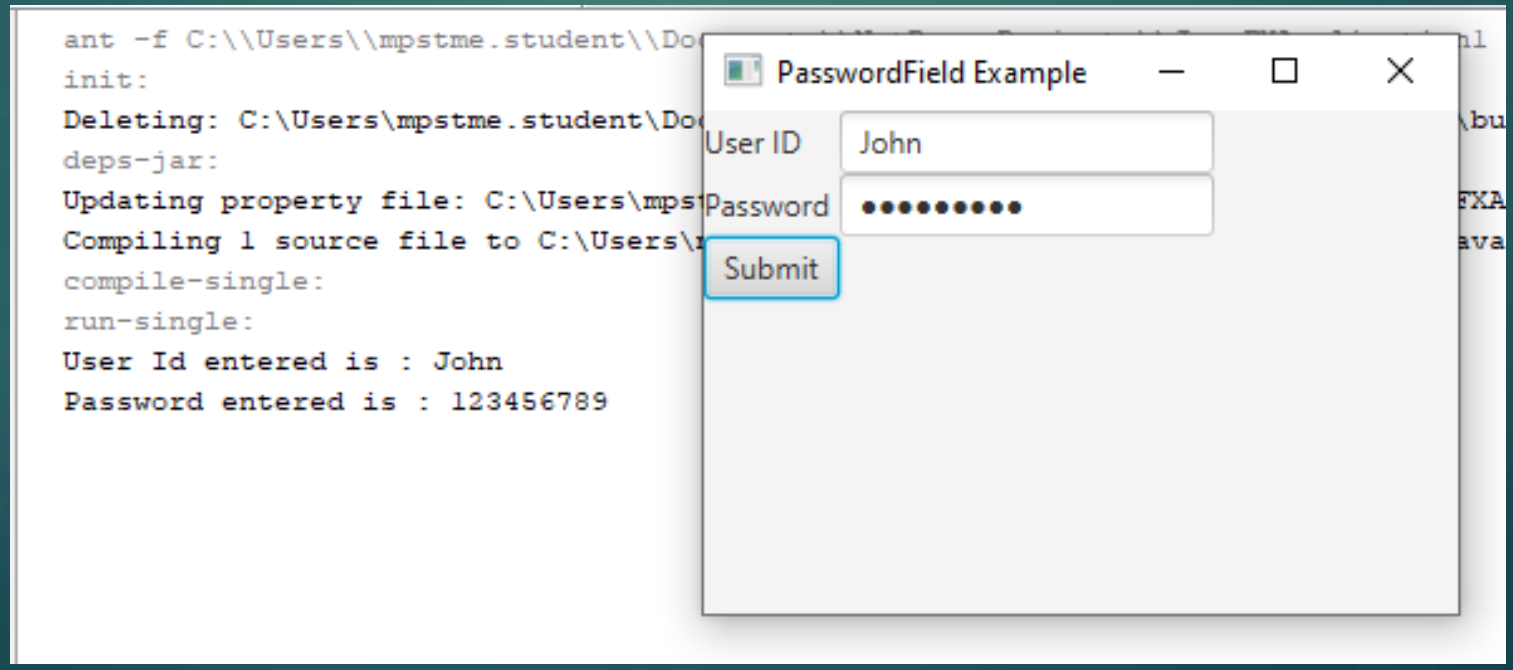
- Typing a password in a text field is not secure for the user.
- The Application must use a specific component to get the password from the user.
- Password Field can be created by instantiating javafx.scene.control.PasswordField class.
- PasswordField class contains a method named as setPromptText() for showing a prompt text to the user in password field.
- The data written in the password field is retrieved by getText() method.

Password Field

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.event.ActionEvent;
import javafx.event.EventHandler;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.control.Label;
import javafx.scene.control.PasswordField;
import javafx.scene.control.TextField;
import javafx.scene.layout.GridPane;
import javafx.stage.Stage;
public class PasswordFieldDemo extends Application {
public void start(Stage primaryStage) throws Exception {
    Label user_id=new Label("User ID");
    Label password = new Label("Password");
    TextField tf=new TextField();
    PasswordField pf=new PasswordField();
    tf.setPromptText("Enter U_Id");
    pf.setPromptText("Enter Password");
    Button b = new Button("Submit");
    GridPane root = new GridPane();
    root.addRow(0, user_id, tf);
    root.addRow(1, password, pf);
    root.addRow(5, b);
    b.setOnAction(new EventHandler<ActionEvent>() {
@Override
            public void handle(ActionEvent args) {
             String pwd=pf.getText();
             if(pwd.length()<8 || pwd.length()>10)
             {
              System.out.println("Password length should be between
8 to 10 characters");
             }
               else
             {
                System.out.println("User Id entered is : " + tf.getText());
                System.out.println("Password entered is : " + pwd);
             }
            }
        } );

    Scene scene=new Scene(root,300,200);
    primaryStage.setScene(scene);
    primaryStage.setTitle("PasswordField Example");
    primaryStage.show();
}
public static void main(String[] args) {
launch(args);
} }
```

Password Field





File Chooser

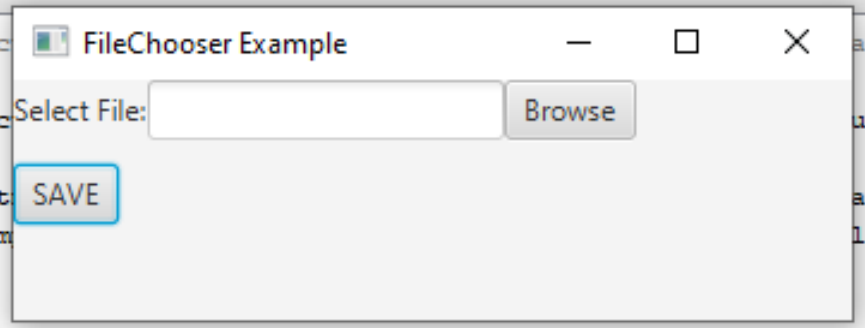
- JavaFX File chooser enables users to browse the files from the file system.
- javafx.stage.FileChooser class represents FileChooser.
- It can be created by instantiating FileChooser class.
- As we see in the modern day applications, there are two types of dialogues shown to the user, one is for opening the file and the other is for saving the files.
- In each case, the user needs to browse a location for the file and give the name to the file.
- The FileChooser class provides two types of methods,
  - showOpenDialog()
  - showSaveDialog()

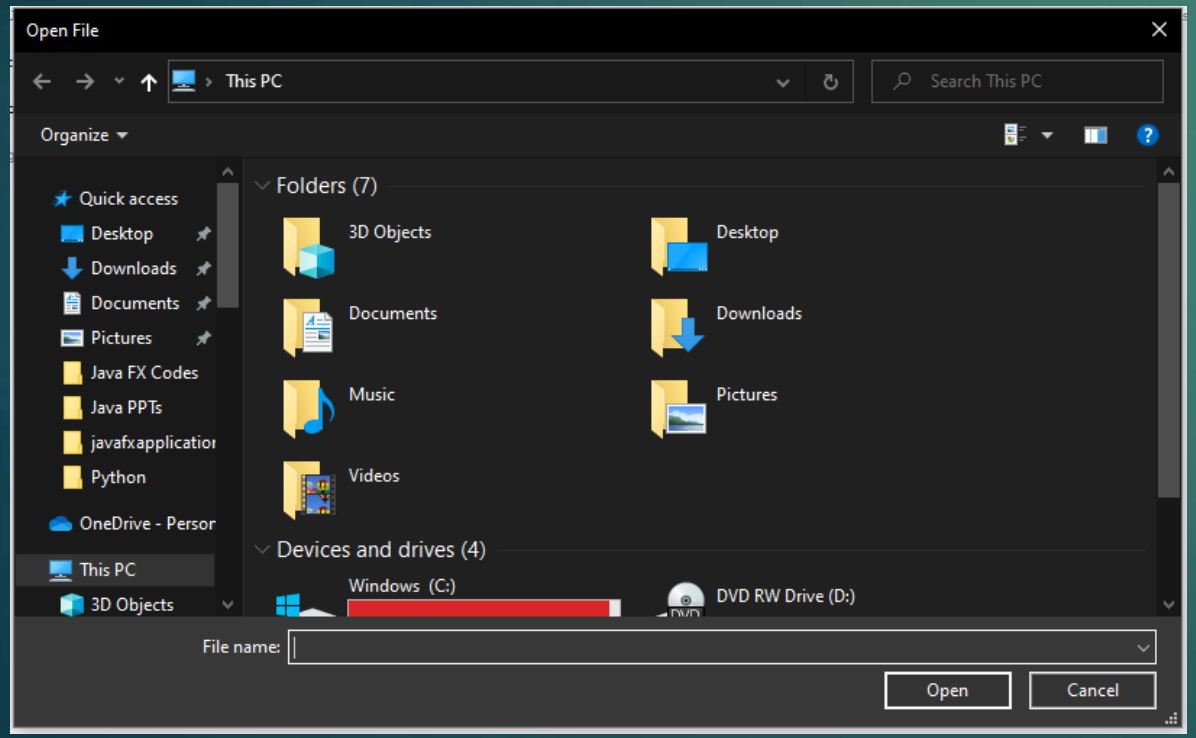
File Chooser

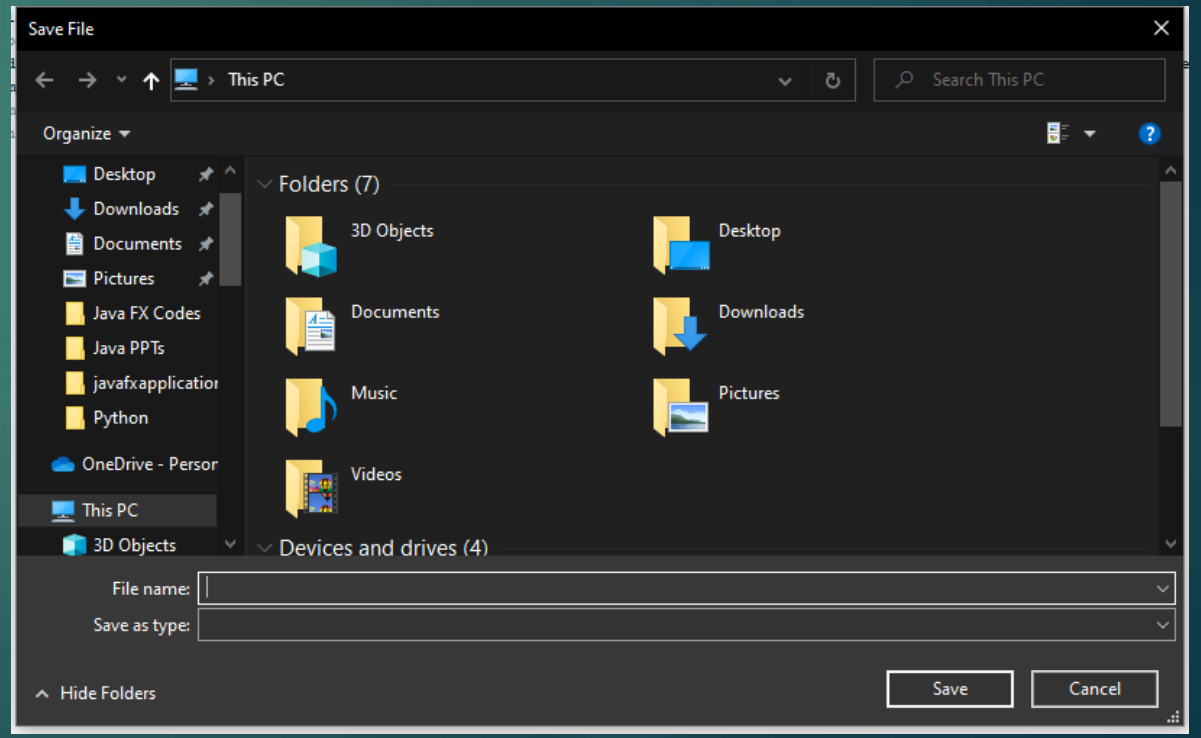
```
package javafxapplication1.UIControls;
import java.io.File;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.*;
import javafx.scene.layout.GridPane;
import javafx.stage.FileChooser;
import javafx.stage.Stage;
public class FileChooserDemo extends Application{

    @Override
    public void start(Stage primaryStage) throws Exception {
        // TODO Auto-generated method stub
       // showOpenDialog() Demo
        Label label = new Label("Select File:");
        TextField tf= new TextField();
        Button btn = new Button("Browse");
        btn.setOnAction(e->
        {
            FileChooser file = new FileChooser();
            file.setTitle("Open File");
            File file3=file.showOpenDialog(primaryStage);
            System.out.println("File Opened : "+file3);
        });
// showSaveDialog() Demo
 Button btn1 = new Button("SAVE");
    btn1.setOnAction(e->
    {
        FileChooser file1 = new FileChooser();
        file1.setTitle("Save File");
        File file2 = file1.showSaveDialog(primaryStage);
        System.out.println("File Saved : "+file2);
    });
        GridPane root = new GridPane();
        root.addRow(0,label,tf,btn);
        root.addRow(1,btn1);
        root.setVgap(10);
        Scene scene = new Scene(root,350,100);
        primaryStage.setScene(scene);
        primaryStage.setTitle("FileChooser Example");
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```

File Chooser

```
ant -f C:\\Users\\mpstme.student\\Doc
init:
Deleting: C:\Users\mpstme.student\Doc
deps-jar:
Updating property file: C:\Users\mpst
Compiling 1 source file to C:\Users\m
compile-single:
run-single:
File Opened : C:\Users\mpstme.student\Downloads\Exception Handling.pptx
File Saved : C:\Users\mpstme.student\Documents\Impact of online gaming.pptx
```





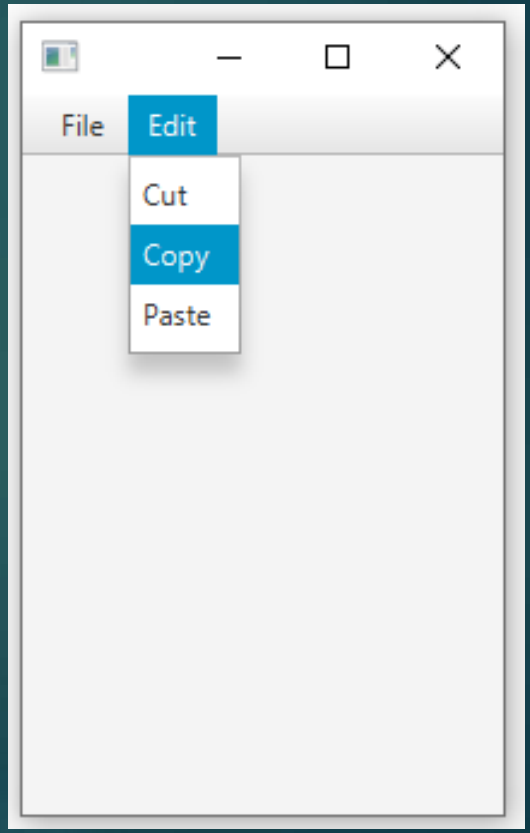


Menu

- JavaFX provides a Menu class to implement menus.
- Menu is the main component of any application.
- In JavaFX, javafx.scene.control.Menu class provides all the methods to deal with menus.
- This class needs to be instantiated to create a Menu.

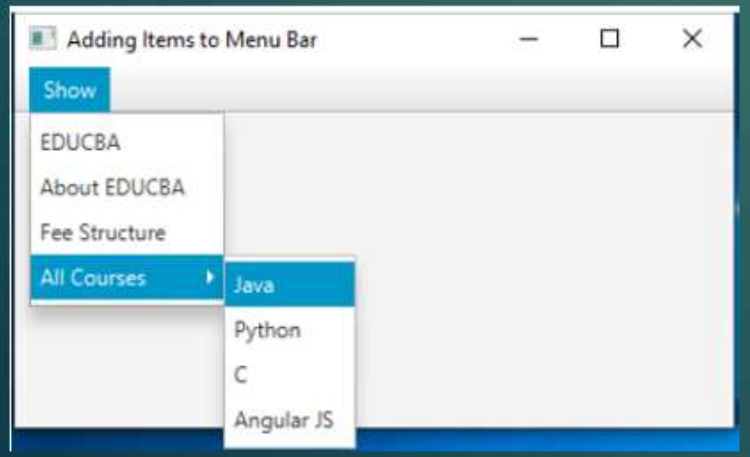
Menu

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.*;
import javafx.scene.layout.BorderPane;
import javafx.stage.Stage;
public class MenuDemo extends Application {
    @Override
    public void start(Stage primaryStage) throws Exception {
        BorderPane root = new BorderPane();
        Scene scene = new Scene(root,200,300);
        MenuBar menubar = new MenuBar();
        Menu FileMenu = new Menu("File");
        MenuItem filemenuitem1=new MenuItem("New");
        MenuItem filemenuitem2=new MenuItem("Save");
        MenuItem filemenuitem3=new MenuItem("Exit");
        Menu EditMenu=new Menu("Edit");
        MenuItem editmenuitem1=new MenuItem("Cut");
        MenuItem editmenuitem2=new MenuItem("Copy");
        MenuItem editmenuitem3=new MenuItem("Paste");
EditMenu.getItems().addAll(editmenuitem1,editmenuitem2,editmenuitem3);
FileMenu.getItems().addAll(filemenuitem1,filemenuitem2,filemenuitem3);
        menubar.getMenus().addAll(FileMenu,EditMenu);
        root.setTop(menubar);
primaryStage.setScene(scene);
        primaryStage.show();
    }
     public static void main(String[] args) {
    launch(args);
        } }
```



Programming Practice Questions

- Create a simple GUI-based calculator using JavaFX. The calculator should perform basic operations like addition, subtraction, multiplication, and division. The GUI should include buttons for digits (0-9) and operations, as well as a display area to show the input and result.
- Create a JavaFX application with a button and a label. Each time the button is clicked, the label should update to show the current count of clicks.
- Build a simple JavaFX application with a text field and a button. When the button is clicked, display "Hello, [input text] !" in a label, where [input text] is what the user entered. Also format the text using various javafx text formatting classes and methods.
- Create a basic quiz application that presents a single multiple-choice question. When the user selects an answer and clicks a button, display whether their answer was correct or incorrect.
- Create a number guessing game where the application randomly selects a number between 1 and 100. The user should input their guess, and upon clicking a button, the app will indicate whether the guess is too high, too low, or correct.
- Design the following UI's using Java FX -



JAVA PROGRAMMING

Chap 9 : Event Handling using Java FX

Introduction to Java FX Event Handling

- JavaFX provides us the flexibility to create various types of applications such as Desktop Applications, Web applications and graphical applications.
- In the modern day applications, the users play a vital role in the proper execution of the application. The user need to interact with the application in most of the cases.
- In JavaFX, An event is occurred whenever the user interacts with the application nodes.
- There are various sources by using which, the user can generate the event.
- For example, User can make the use of mouse or it can press any button on the keyboard or it can scroll any page of the application in order to generate an event.
- Hence, we can say that the events are basically the notifications that tell us that something has occurred at the user's end.
- A perfect Application is the one which takes the least amount of time in handling the events.
- **Types of Events**
- The events can be broadly classified into the following two categories −
- Foreground Events − These events require the direct interaction of a user. They are generated as consequences of a person interacting with the graphical components in a GUI. For example, clicking on a button, moving the mouse, entering a character through keyboard, selecting an item from list, scrolling the page, etc.
- Background Events − These events that don't require the interaction of end-user. The operating system interruptions, hardware or software failure, timer expiry, operation completion are the example of background events.

Java FX Events

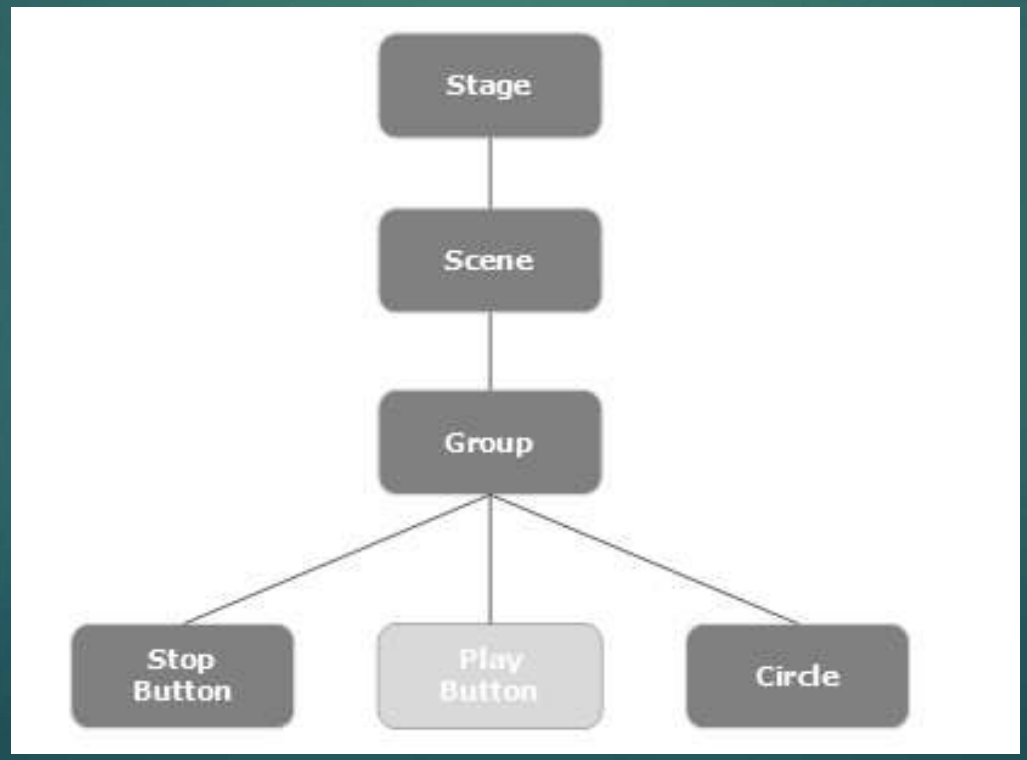
- Events are basically used to notify the application about the actions taken by the user.
- JavaFX provides the mechanism to capture the events, route the event to its target and letting the application handle the events.
- JavaFX provides support to handle a wide varieties of events.
- The class named Event of the package javafx.event is the base class for an event.
- An instance of any of its subclass is an event.
- JavaFX provides a wide variety of events. Some of them are are listed below.
- **Mouse Event** − This is an input event that occurs when a mouse is clicked. It is represented by the class named MouseEvent. It includes actions like mouse clicked, mouse pressed, mouse released, mouse moved, mouse entered target, mouse exited target, etc.
- **Key Event** − This is an input event that indicates the key stroke occurred on a node. It is represented by the class named KeyEvent. This event includes actions like key pressed, key released and key typed.
- **Drag Event** − This is an input event which occurs when the mouse is dragged. It is represented by the class named DragEvent. It includes actions like drag entered, drag dropped, drag entered target, drag exited target, drag over, etc.
- **Window Event** − This is an event related to window showing/hiding actions. It is represented by the class named WindowEvent. It includes actions like window hiding, window shown, window hidden, window showing, etc.

Java FX Event Handling

- Event Handling is the mechanism that controls the event and decides what should happen, if an event occurs.
- This mechanism has the code which is known as an event handler that is executed when an event occurs.
- JavaFX provides handlers and filters to handle events.
- In JavaFX every event has −
  - Target − The node on which an event occurred. A target can be a window, scene, and a node.
  - Source − The source from which the event is generated will be the source of the event. In the above scenario, mouse is the source of the event.
  - Type − Type of the occurred event; in case of mouse event – mouse pressed, mouse released are the type of events.

Phases of Event Handling in JavaFX

- Also known as **Event Delivery Process**
- Whenever an event is generated, JavaFX undergoes the following phases in order to handle the events.
- **Route Construction :** Whenever an event is generated, the default/initial route of the event is determined by construction of an Event Dispatch chain.
- It is the path from the stage to the source Node.
- An event dispatch chain is created in the following image for the event generated on one of the scene graph node.



Phases of Event Handling in JavaFX

- **Event Capturing Phase** : Once the Event Dispatch Chain is created, the event is dispatched from the source node of the event.
- All the nodes are traversed by the event from top to bottom.
- If the event filter is registered with any of these nodes, then it will be executed.
- If any of the nodes are not registered with the event filter then the event is transferred to the target node.
- The target node processes the event in that case.
- **Event Bubbling Phase** : In the event bubbling phase, the event is travelled from the target node to the stage node (bottom to top).
- If any of the nodes in the event dispatch chain has a handler registered for the generated event, it will be executed.
- If none of these nodes have handlers to handle the event, then the event reaches the root node and finally the process will be completed.
- **Event Handlers and Filters** : Event Handlers and filters contains application logic to process an event.
- A node can be registered to more than one Event Filters.
- The interface javafx.event.EventHandler must be implemented by all the event handlers and filters.
- In case of parent–child nodes, you can provide a common filter/handler to the parents, which is processed as default for all the child nodes.
- during the event processing phase, a filter is executed and during the event bubbling phase, a handler is executed.

Adding and Removing Event Filter

- To add an event filter to a node, you need to register this filter using the method addEventFilter() of the Node class.

```
//Creating the mouse event handler
EventHandler<MouseEvent> eventHandler = new EventHandler<MouseEvent>() {
   @Override
   public void handle(MouseEvent e) {
      System.out.println("Hello World");
      circle.setFill(Color.DARKSLATEBLUE);
   }
};
//Adding event Filter
Circle.addEventFilter(MouseEvent.MOUSE_CLICKED, eventHandler);
```

- In the same way, you can remove a filter using the method removeEventFilter() as shown below –

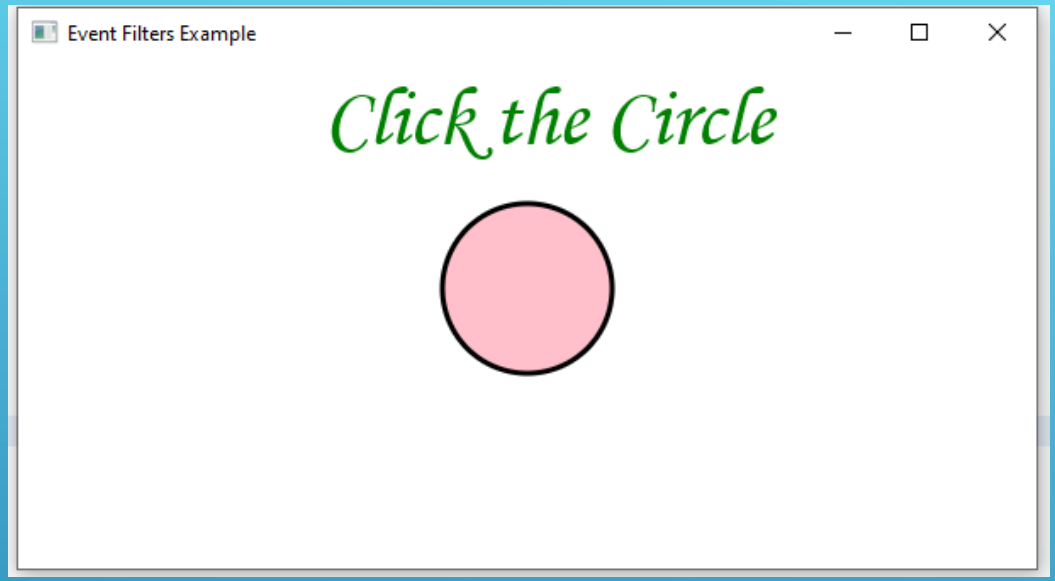
```
circle.removeEventFilter(MouseEvent.MOUSE_CLICKED, eventHandler);
```

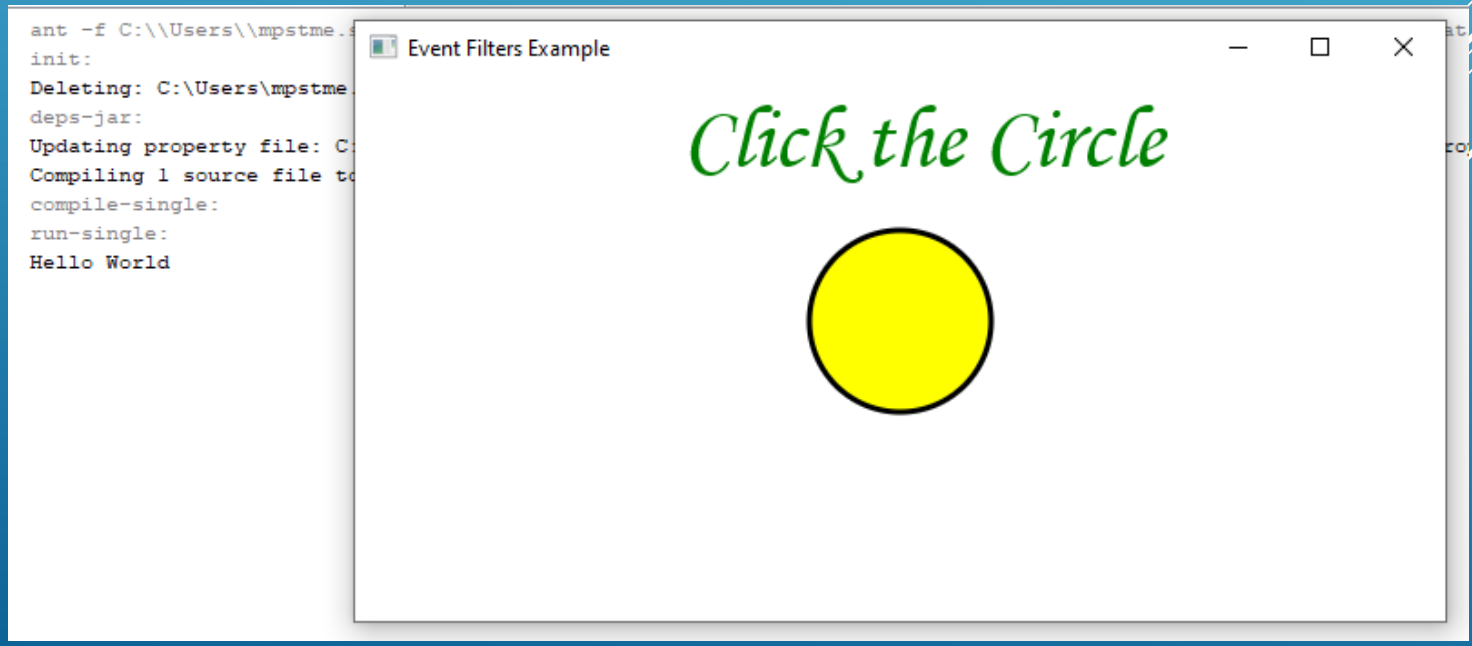
Adding and Removing Event Filter

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.event.EventHandler;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.input.MouseEvent;
import javafx.scene.paint.Color;
import javafx.scene.shape.Circle;
import javafx.scene.text.Font;
import javafx.scene.text.FontWeight;
import javafx.scene.text.Text;
import javafx.stage.Stage;

public class EventHandling extends Application {
   @Override
   public void start(Stage stage) {
      Circle circle = new Circle();
      circle.setCenterX(300.0f);
      circle.setCenterY(135.0f);
      circle.setRadius(50);
      circle.setFill(Color.PINK);
      circle.setStrokeWidth(3);
      circle.setStroke(Color.BLACK);
      Text text = new Text("Click the Circle");
      text.setFont(Font.font("Monotype Corsiva", FontWeight.BOLD, 50));
      text.setFill(Color.GREEN);
      text.setX(180);
      text.setY(50);

      //Creating the mouse event handler
      EventHandler<MouseEvent> eventHandler = new
EventHandler<MouseEvent>() {
         @Override
         public void handle(MouseEvent e) {
            System.out.println("Hello World");
            circle.setFill(Color.YELLOW);
         }  };

      //Registering the event filter
      circle.addEventFilter(MouseEvent.MOUSE_CLICKED, eventHandler);
```

Adding and Removing Event Filter

```
Group root = new Group(circle, text);
        Scene scene = new Scene(root, 600, 300);
        stage.setTitle("Event Filters Example");
        stage.setScene(scene);
        stage.show();
    }
    public static void main(String args[]){
        launch(args);
    }
}
```





Convenience Methods

- Some of the classes in JavaFX define event handler properties.
- By setting the values to these properties using their respective setter methods, you can register to an event handler. These methods are known as convenience methods.
- Most of these methods exist in the classes like Node, Scene, Window, etc., and they are available to all their sub classes.
- Some EventHandler properties along with their setter methods (convenience methods) are described in the following table.

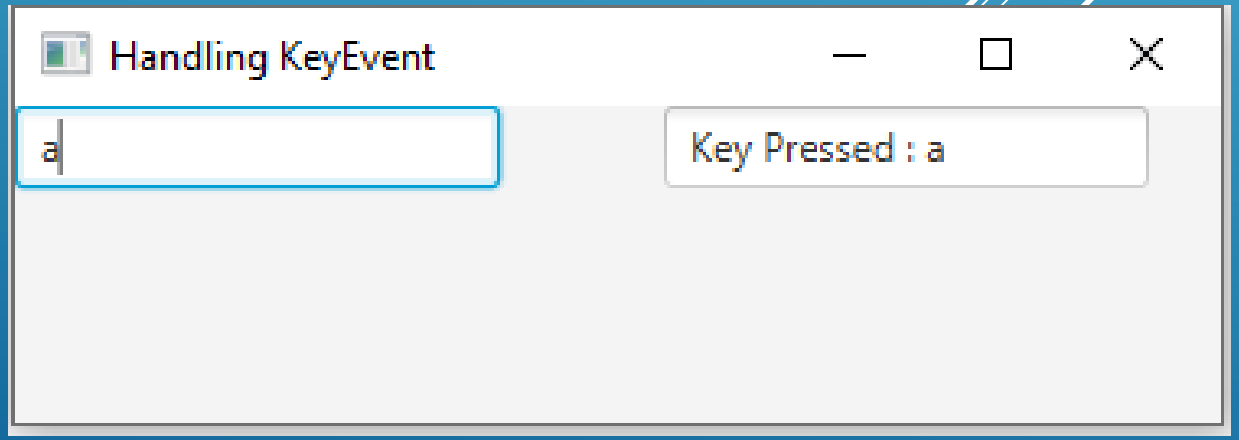
EventHandler Property	Description	Setter Methods
onDragDetected	This is of the type EventHandler of MouseEvent. This indicates a function which is to be called when the drag gesture is detected.	setOnDragDetected(EventHandler value)
onDragDone	This is of the type EventHandler of DragEvent.	setOnDragDone(EventHandler value)
onDragDropped	This is of the type EventHandler of DragEvent. This is assigned to a function which is to be called when the mouse is released during a drag and drop operation.	setOnDragDropped(EventHandler value)
onInputMethodTextChanged	This is of the type EventHandler of InputMethodEvent. This is assigned to a function which is to be called when the Node has focus and the input method text has changed.	setOnInputMethodTextChanged(EventHandler value)
onKeyPressed	This is of the type EventHandler of KeyEvent. This is assigned to a function which is to be called when the Node has focus and key is pressed.	setOnKeyPressed(EventHandler value)
onKeyReleased	This is of the type EventHandler of KeyEvent. This is assigned to a function which is to be called when the Node has focus and key is released.	setOnKeyReleased(EventHandler value)
onKeyTyped	This is of the type EventHandler of KeyEvent.This is assigned to a function which is to be called when the Node has focus and key is typed.	setOnKeyTyped(EventHandler value)

Convenience Methods

EventHandler Property	Description	Setter Methods
onMouseClicked	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse button is clicked on the node.	setOnMouseClicked(EventHandler value)
onMouseDragEntered	This is of the type EventHandler of MouseDragEvent. This is assigned to a function which is to be called when a full press drag release gesture enters the node.	setOnMouseDragEntered(EventHandler value)
onMouseDragExited	This is of the type EventHandler of MouseDragEvent.This is assigned to a function which is to be called when a full press drag release gesture exits the node.	setOnMouseDragExited(EventHandler value)
onMouseDragged	This is of the type EventHandler of MouseDragEvent. This is assigned to a function which is to be called when the mouse button is pressed and dragged on the node.	setOnMouseDragged(EventHandler value)
onMouseDragOver	This is of the type EventHandler of MouseDragEvent. This is assigned to a function which is to be called when a full press drag release gesture progresses within the node.	setOnMouseDragOver(EventHandler value)
onMouseDragReleased	This is of the type EventHandler of MouseDragEvent. This is assigned to a function which is to be called when a full press drag release gesture ends within the node.	setOnMouseDragReleased(EventHandler value)
onMouseEntered	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse enters the node.	setOnMouseEntered(EventHandler value)
onMouseExited	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse exits the node.	setOnMouseExited(EventHandler value)
onMouseMoved	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse moves within the node and no button has been pushed.	setOnMouseMoved(EventHandler value)
onMousePressed	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse button is pressed on the node.	setOnMousePressed(EventHandler value)
onMouseReleased	This is of the type EventHandler of MouseEvent. This is assigned to a function which is to be called when the mouse button is released on the node.	setOnMouseReleased(EventHandler value)

Convenience Methods Example (setOnKeyPressed)

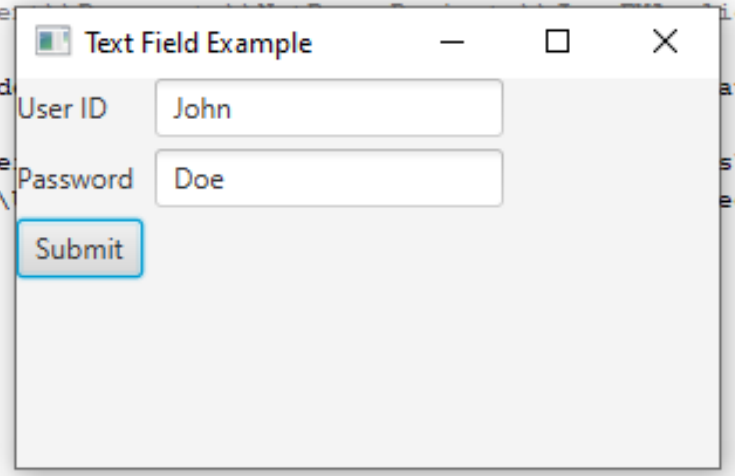
```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.event.EventHandler;
import javafx.scene.Group;
import javafx.scene.Scene;
import javafx.scene.control.TextField;
import javafx.scene.input.KeyEvent;
import javafx.stage.Stage;
import javafx.scene.layout.GridPane;
public class ConvenienceMethodsDemo extends Application{
    @Override
    public void start(Stage primaryStage) throws Exception {
        TextField tf1 = new TextField();
        TextField tf2 = new TextField();
        //Handling KeyEvent for textfield 1
        tf1.setOnKeyPressed(new EventHandler<KeyEvent>() {
            @Override
            public void handle(KeyEvent k) {
                // TODO Auto-generated method stub
                tf2.setText("Key Pressed :"+" "+k.getText());
            }    });
        //setting group and scene
        GridPane root = new GridPane();
        root.addRow(0, tf1, tf2);
        root.setHgap(50);
        Scene scene = new Scene(root,500,200);
        primaryStage.setScene(scene);
        primaryStage.setTitle("Handling KeyEvent");
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    } }
```



Convenience Methods Example (setOnAction)

```
package javafxapplication1.UIControls;
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.control.Label;
import javafx.scene.control.TextField;
import javafx.scene.layout.GridPane;
import javafx.stage.Stage;
import javafx.event.ActionEvent;
import javafx.event.EventHandler;
public class TextFieldDemo extends Application {
@Override
public void start(Stage primaryStage) throws Exception {
    // TODO Auto-generated method stub
    Label user_id=new Label("User ID");
    Label password = new Label("Password");
    TextField tf1=new TextField();
    TextField tf2=new TextField();
    Button b = new Button("Submit");
    GridPane root = new GridPane();
    root.addRow(0, user_id, tf1);
    root.addRow(1, password, tf2);
    root.addRow(2, b);
    root.setHgap(5);
    root.setVgap(5);
    b.setOnAction(new EventHandler<ActionEvent>() {
@Override
    public void handle(ActionEvent args) {
    // TODO Auto-generated method stub
    System.out.println("User Id entered is : " + tf1.getText());
    System.out.println("Password entered is : " + tf2.getText());
            }
        } );
     Scene scene=new Scene(root,300,300);
     primaryStage.setScene(scene);
     primaryStage.setTitle("Text Field Example");
     primaryStage.show();
}
public static void main(String[] args) {
launch(args);
} }
```

```
ant -f C:\\Users\\mpstme.stude
init:
Deleting: C:\Users\mpstme.stud
deps-jar:
Updating property file: C:\Use
Compiling 1 source file to C:\
compile-single:
run-single:
User Id entered is : John
Password entered is : Doe
```



Event Handlers

- JavaFX facilitates us to use the Event Handlers to handle the events generated by Keyboard Actions, Mouse Actions, and many more source nodes.
- Event Handlers are used to handle the events in the Event bubbling phase. There can be more than one Event handlers for a single node.
- We can also use single handler for more than one node and more than one event type. In this part of the tutorial, we will discuss, how the Event Handlers can be used for processing events.
- **Adding an Event Handler**
- Event Handler must be registered for a node in order to process the events in the event bubbling phase.
- Event handler is the implementation of the EventHandler interface.
- The handle() method of the interface contains the logic which is executed when the event is triggered.
- To register the EventHandler, addEventHandler() is used.
- In this method, two arguments are passed. One is event type and the other is EventHandler object.
- The syntax of addEventHandler() is given below.

```
node.addEventHandler(<EventType>,new EventHandler<Event-Type>()
{
public void handle(<EventType> e)
{
//handling code
}       });
```

Event Handlers

- **Removing EventHandler**
- when we no longer need an EventHandler to process the events for a node or event types, we can remove the EventHandler by using the method removeEventHandler() method.
- This method takes two arguments, event type and EventHandler Object.
- node.removeEventHandler(<EventType>,handler);

JAVA PROGRAMMING

Chap 10 : Java and Database Programming

Need for Database Programming with Java

- Database programming is an integral part of Java programming because it allows applications to store, retrieve, manipulate, and manage data efficiently. Here are some reasons why database programming is essential in Java:
  - **Data Storage:** Many applications require persistent data storage, where data can be saved and retrieved even after the application is closed or restarted. Databases provide a structured and efficient way to store data.
  - **Data Retrieval:** Java applications often need to retrieve data from databases to present it to users or perform operations on it. Databases allow developers to query and retrieve specific data easily.
  - **Data Manipulation**: Databases enable developers to add, update, and delete data, which is crucial for maintaining the integrity of data and performing operations like CRUD (Create, Read, Update, Delete).
  - **Scalability:** Databases are designed to handle large amounts of data efficiently. Java applications can scale effectively by using databases to store and manage data.
  - **Data Security:** Databases provide security features such as authentication, authorization, and encryption to protect sensitive data. This is crucial for applications that deal with user information or other confidential data.
  - **Data Consistency**: Databases enforce data consistency through constraints and transactions, ensuring that data remains accurate and reliable.
  - **Data Sharing:** Databases enable multiple users or applications to access and share data concurrently while maintaining data integrity.
  - **Reporting and Analysis:** Java applications often need to generate reports or perform complex data analysis. Databases can store and structure data in a way that makes these tasks more efficient.
  - **Persistence Layer:** In many Java applications, a database serves as the persistence layer, separating the application's logic from the data storage concerns. This separation allows for more maintainable and scalable code.

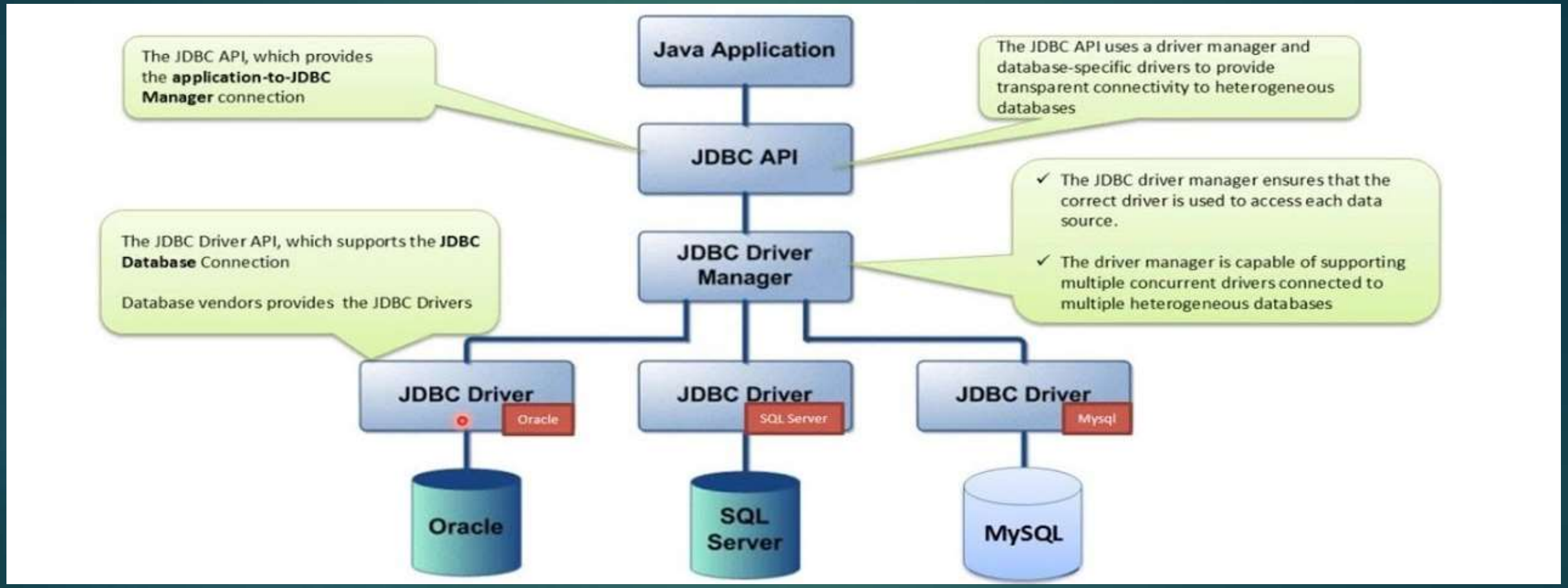
Need for Database Programming with Java

- **Integration:** Java applications can easily integrate with various database management systems (DBMS) such as MySQL, PostgreSQL, Oracle, MongoDB, and others. This flexibility allows developers to choose the database system that best suits their application's requirements.
- To interact with databases in Java, developers typically use Database Connectivity APIs like JDBC (Java Database Connectivity) or Object-Relational Mapping (ORM) frameworks like Hibernate. These tools provide the necessary abstractions and methods to connect to databases, execute queries, and handle database-related tasks seamlessly within Java applications.

JDBC

- JDBC stands for Java Database Connectivity is a Java API(Application Programming Interface) used to interact with databases.
- JDBC is a specification from Sun Microsystems and it is used by Java applications to communicate with relational databases.
- We can use JDBC to execute queries on various databases and perform operations like SELECT, INSERT, UPDATE and DELETE.
- JDBC API helps Java applications interact with different databases like MSSQL, ORACLE, MYSQL, etc.
- It consists of classes and interfaces of JDBC that allow the applications to access databases and send requests made by users to the specified database.
- **Purpose of JDBC**
- Java programming language is used to develop enterprise applications.
- These applications are developed with intention of solving real-life problems and need to interact with databases to store required data and perform operations on it.
- Hence, to interact with databases there is a need for efficient database connectivity, ODBC(Open Database Connectivity) driver is used for the same.
- ODBC is an API introduced by Microsoft and used to interact with databases.
- It can be used by only the windows platform and can be used for any language like C, C++, Java, etc. ODBC is procedural.
- JDBC is an API with classes and interfaces used to interact with databases. It is used only for Java languages and can be used for any platform. JDBC is highly recommended for Java applications as there are no performance or platform dependency problems.

JDBC Architecture



JDBC Architecture

- **Application :** Applications in JDBC architecture are java applications like applets or servlet that communicates with databases.
- **JDBC API :** The JDBC API is an Application Programming Interface used to create Databases. JDBC API uses classes and interfaces to connect with databases. Some of the important classes and interfaces defined in JDBC architecture in java are the DriverManager class, Connection Interface, etc. The primary packages in JDBC are java.sql and javax.sql, which contain classes and interfaces for core database operations.
- **DriverManager :** DriverManager class in the JDBC architecture is used to establish a connection between Java applications and databases. Using the getConnection method of this class a connection is established between the Java application and data sources. It loads the appropriate JDBC driver based on the provided database URL and establishes a connection to the database.
- **JDBC Drivers :** JDBC drivers are used to connecting with data sources. All databases like Oracle, MSSQL, MYSQL, etc. have their drivers, to connect with these databases we need to load their specific drivers. Class is a java class used to load drivers. Class.forName() method is used to load drivers in JDBC architecture. There are four types of JDBC drivers:
  a. Type-1: JDBC-ODBC Bridge Driver (now deprecated)
  b. Type-2: Native-API Driver
  c. Type-3: Network Protocol Driver
  d. Type-4: Thin Driver (also known as the Direct-to-Database Pure Java Driver)
- Each type of driver uses a different mechanism to connect to the database, and the choice of driver depends on the specific database and deployment requirements.

JDBC Architecture

- **Data Sources :** Data Sources in the JDBC architecture are the databases that we can connect using this API. These are the sources where data is stored and used by Java applications. JDBC API helps to connect various databases like Oracle, MYSQL, MSSQL, PostgreSQL, etc.

Types of Drivers

- JDBC (Java Database Connectivity) drivers are platform-specific or database-specific implementations that allow Java applications to connect to and interact with relational databases. There are four main types of JDBC drivers, known as JDBC driver types 1, 2, 3, and 4. Each type has its own characteristics and is suited for different scenarios:

- **Type-1 JDBC Driver (JDBC-ODBC Bridge Driver):**
- Type-1 drivers are also known as JDBC-ODBC Bridge drivers.
- They use the JDBC-ODBC bridge to connect to the database.
- The bridge relies on the ODBC (Open Database Connectivity) driver installed on the system to communicate with the database.
- Type-1 drivers are considered legacy and have been deprecated in favor of other driver types. They are not recommended for new development.

- **Type-2 JDBC Driver (Native-API Driver):**
- Type-2 drivers are known as Native-API drivers.
- They are platform-specific drivers that use a database-specific native API to communicate with the database.
- These drivers provide better performance than Type-1 drivers because they communicate directly with the database without the ODBC layer.
- However, they are still somewhat dependent on the platform and database, which can limit portability.

Types of Drivers

- **Type-3 JDBC Driver (Network Protocol Driver):**
- Type-3 drivers are also called Network Protocol drivers.
- They use a middleware or network protocol to connect to the database server.
- The client-side of the driver translates JDBC calls into a database-independent protocol, which is then transmitted over the network to a server-side component that interacts with the database.
- Type-3 drivers are generally platform-independent and can work with different databases as long as there is a compatible server-side component.

- **Type-4 JDBC Driver (Thin Driver or Direct-to-Database Pure Java Driver):**
- Type-4 drivers are known as Thin drivers.
- They are pure Java drivers that communicate directly with the database using a database-specific protocol.
- Type-4 drivers are highly portable because they don't rely on platform-specific libraries or middleware.
- They are typically the preferred choice for modern Java applications as they offer good performance and platform independence.
- Examples of Type-4 drivers include Oracle Thin Driver, PostgreSQL JDBC Driver, and MySQL Connector/J.

- The choice of JDBC driver type depends on various factors, including the specific database being used, the application's portability requirements, and performance considerations. In general, Type-4 drivers are recommended for new Java applications because they offer good performance and are platform-independent. However, in some legacy or specialized scenarios, other driver types may still be used.

JDBC Components

- **JDBC API :** The JDBC API is an Application Programming Interface used to create Databases. JDBC API uses classes and interfaces to connect with databases. Some of the important classes and interfaces defined in JDBC architecture in java are the DriverManager class, Connection Interface, etc. The primary packages in JDBC are java.sql and javax.sql, which contain classes and interfaces for core database operations.

- **DriverManager :** DriverManager class in the JDBC architecture is used to establish a connection between Java applications and databases. Using the getConnection method of this class a connection is established between the Java application and data sources. It loads the appropriate JDBC driver based on the provided database URL and establishes a connection to the database.

- **JDBC Test Suite :** JDBC Test Suite is used to test operations being performed on databases using JDBC drivers. JDBC Test Suite tests operations such as insertion, updating, and deletion.

- **JDBC-ODBC Bridge Drivers :** As the name suggests JDBC-ODBC Bridge Drivers are used to translate JDBC methods to ODBC function calls. JDBC-ODBC Bridge Drivers are used to connect database drivers to the database. Even after using JDBC for Java Enterprise Applications, we need an ODBC connection for connecting with databases.

  JDBC-ODBC Bridge Drivers are used to bridge the same gap between JDBC and ODBC drivers. The bridge translates the object-oriented JDBC method call to the procedural ODBC function call. It makes use of the sun.jdbc.odbc package. This package includes a native library to access ODBC characteristics.

JDBC Interfaces

- JDBC API uses various interfaces to establish connections between applications and data sources. Some of the popular interfaces in JDBC API are as follows:
- **Driver interface -** The JDBC Driver interface provided implementations of the abstract classes such as java.sql.Connection, Statement, PreparedStatement, Driver, etc. provided by the JDBC API.
- **Connection interface -** The connection interface is used to create a connection with the database. getConnection() method of DriverManager class of the Connection interface is used to get a Connection object.
- **Statement interface -** The Statement interface provides methods to execute SQL queries on the database. executeQuery(), executeUpdate() methods of the Statement interface are used to run SQL queries on the database.
- **ResultSet interface -** ResultSet interface is used to store and display the result obtained by executing a SQL query on the database. executeQuery() method of statement interface returns a resultset object.
- **RowSet interface -** RowSet interface is a component of Java Bean. It is a wrapper of ResultSet and is used to keep data in tabular form.
- **ResultSetMetaData interface -** Metadata means data about data. ResultSetMetaData interface is used to get information about the resultset interface. The object of the ResultSetMetaData interface provides metadata of resultset like number of columns, column name, total records, etc.
- **DatabaseMetaData interface -** DatabaseMetaData interface is used to get information about the database vendor being used. It provides metadata like database product name, database product version, total tables/views in the database, the driver used to connect to the database, etc.

JDBC Classes

- JDBC API uses various classes that implement the above interfaces. Methods of these classes in JDBC API are used to create connections and execute queries on databases. A list of most commonly used class in JDBC API are as follows:
- **DriverManager class -** DriverManager class is a member of the java.sql package. It is used to establish a connection between the database and its driver.
- **Blob class -** A java.sql.Blob is a binary large object that can store large amounts of binary data, such as images or other types of files. Fields defined as TEXT also hold large amounts of data.
- **Clob class -** The java.sql.Clob interface of the JDBC API represents the CLOB datatype. Since the Clob object in JDBC is implemented using an SQL locator, it holds a logical pointer to the SQL CLOB (not the data).
- **Types class -** Type class defined and store constants that are used to identify generic SQL types also known as JDBC types.

Steps for querying the database with JDBC

- Java applications need to be programmed for interacting with data sources. JDBC Drivers for specific databases are to be loaded in a java application for JDBC support which can be done dynamically at run time. These JDBC drivers communicate with the respective data source.
- Steps to connect a Java program using JDBC API.

1. Import JDBC Packages: Import the necessary JDBC packages at the beginning of your Java program. You'll typically need to import classes from the java.sql package.

2. Load Driver: Load JDBC Driver for specific databases using forName() method of class Class. Syntax: Class.forName("com.mysql.jdbc.Driver")

3. Create Connection: Create a connection with a database using DriverManager class. Database credentials are to be passed while establishing the connection. Syntax: DriverManager.getConnection()

4. Create SQL Query: To manipulate the database we need to create a query using commands like INSERT, UPDATE, DELETE, etc. These queries are created and stored in string format. Syntax: String sql_query = "INSERT INTO Student(name, roll_no) values('ABC','XYZ')"

5. Create SQL Statement: The query we have created is in form of a string. To perform the operations in the string on a database we need to fire that query on the database. To achieve this we need to convert a string object into SQL statements. This can be done using createStatement() and prepareStatement() interfaces.

Syntax: Statement St = con.createStatement();

Steps for querying the database with JDBC

6. Execute Statement: To execute SQL statements on the database we can use two methods depending on which type of query we are executing.

Execute Update: Execute update method is used to execute queries like insert, update, delete, etc. Return type of executeUpdate() method is int. Syntax: int check = st.executeUpdate(sql);

Execute Query: Execute query method is used to execute queries used to display data from the database, such as select. Return type of executeQuery() method is result set. Syntax: Resultset = st.executeUpdate(sql);

7. Closing Statement: After performing operations on the database, it is better to close every interface object to avoid further conflicts. Synatx: con.close();