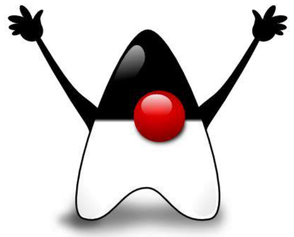

Advanced Programming

CMP 102

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Biruni Univarsity
Department of Computer Engineering
2023
Spring

Course Plan

- Introduction - Functions (Recursive functions)
- Arrays, ArrayList, Vector
- Collections (List, Queue, Stack, Set, Map, Tree)
- Streams, Files
- Generics and Exceptions
- Midterm Exam

Course Plan

- Visual Programming Fundamentals
- Designing a Form
- Controls and Forms
- Properties of Components and Events
- Final Exam

Last Lecture

- Midterm Exam.

Introduction

- In this lecture, you will learn generics and visual programming fundamentals.

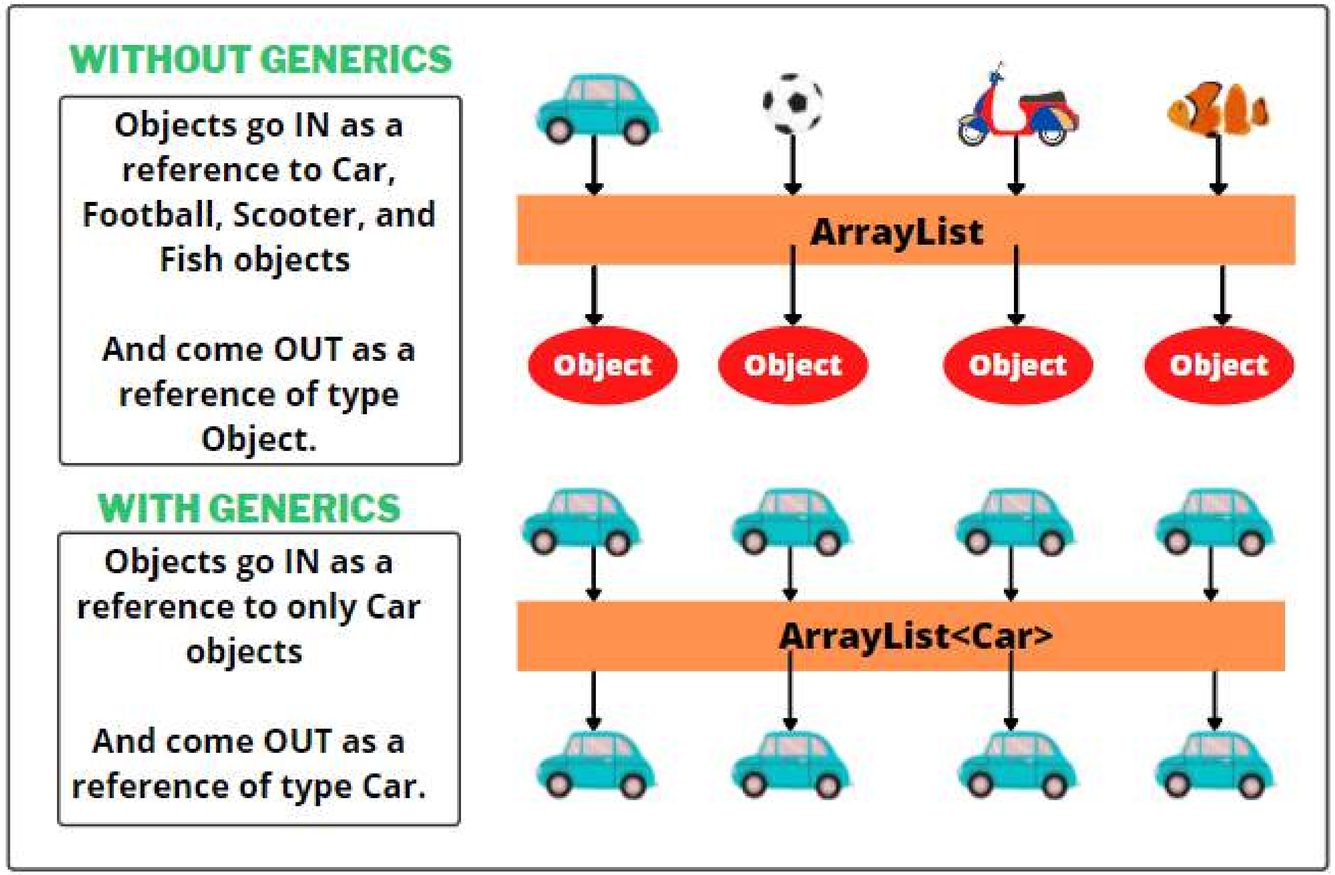
GENERICS

Generics

- From generic class, you can create an ArrayList object for holding strings, and an ArrayList object for holding numbers.

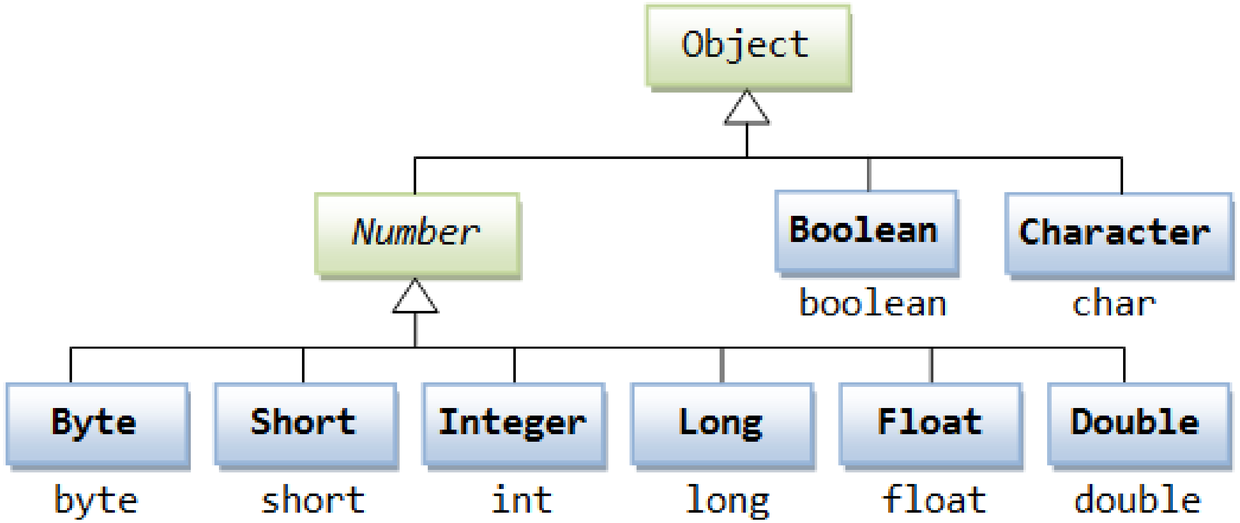
Generics

- The key benefit of generics is to enable errors to be detected at compile time rather than at runtime.
- A generic class or method permits you to specify allowable types of objects that the class or method can work with.
- If you attempt to use an incompatible object, the compiler will detect that error.



Generics

- Abbrevations:
  - E - Element (used extensively by the Java Collections Framework)
  - K - Key
  - N - Number
  - T - Type
  - V - Value
  - S,U,V etc. - 2nd, 3rd, 4th types



Generics

- Generic types have been added to the Java language to reduce code duplication. We can specify the data types of the classes, methods or interfaces we write with generic types at run time.
- For example, you have written a method and it takes a parameter. If you want this parameter to be of any data type, you can use generic types.
- This could be done with the object class before generic types, but it makes much more sense to do it with generic types because it requires extra operations such as type checking and type conversion.

Generics

- Generic types have many advantages such as code simplicity, allowing us to develop code quickly and type safety.
- Generic types, when used with classes, can be used as follows:.
- The general definition can be class ClassName<T,K,L,...>. We can specify as many different types as we want, such as T, K, L, all of them represent the type we specify when creating the object.
- Let's recall the use of ArrayList for example.

Generics

```
ArrayList<String> items = new ArrayList<String>();
```

- In between the above <> we make use of generics.

Arrays and Overloaded Methods

```
public class OverloadedMethods {
   public static void main(String[] args) {
      // create arrays of Integer, Double and Character
      Integer[] integerArray = {1, 2, 3, 4, 5, 6};
      Double[] doubleArray = {1.1, 2.2, 3.3, 4.4, 5.5, 6.6, 7.7};
      Character[] characterArray = {'H', 'E', 'L', 'L', 'O'};

      System.out.printf("Array integerArray contains: ");
      printArray(integerArray); // pass an Integer array
      System.out.printf("Array doubleArray contains: ");
      printArray(doubleArray); // pass a Double array
      System.out.printf("Array characterArray contains: ");
      printArray(characterArray); // pass a Character array
   }

   // method printArray to print Integer array
   public static void printArray(Integer[] inputArray) {
      // display array elements
      for (Integer element : inputArray) {
         System.out.printf("%s ", element);
      }

      System.out.println();
   }

   // method printArray to print Double array
   public static void printArray(Double[] inputArray) {
      // display array elements
      for (Double element : inputArray) {
         System.out.printf("%s ", element);
      }

      System.out.println();
   }

   // method printArray to print Character array
   public static void printArray(Character[] inputArray) {
      // display array elements
      for (Character element : inputArray) {
         System.out.printf("%s ", element);
      }

      System.out.println();
   }
}
```

```
Array integerArray contains: 1 2 3 4 5 6
Array doubleArray contains: 1.1 2.2 3.3 4.4 5.5 6.6 7.7
Array characterArray contains: H E L L O
```

Collections

```java
import java.util.ArrayList;

public class ArrayListCollection {
   public static void main(String[] args) {
      // create a new ArrayList of Strings with an initial capacity of 10
      ArrayList<String> items = new ArrayList<String>();

      items.add("red"); // append an item to the list
      items.add(0, "yellow"); // insert "yellow" at index 0

      // header
      System.out.print(
         "Display list contents with counter-controlled loop:");

      // display the colors in the list
      for (int i = 0; i < items.size(); i++) {
         System.out.printf(" %s", items.get(i));
      }

      // display colors using enhanced for in the display method
      display(items,
         "%nDisplay list contents with enhanced for statement:");

      items.add("green"); // add "green" to the end of the list
      items.add("yellow"); // add "yellow" to the end of the list
      display(items, "List with two new elements:");

      items.remove("yellow"); // remove the first "yellow"
      display(items, "Remove first instance of yellow:");

      items.remove(1); // remove item at index 1
      display(items, "Remove second list element (green):");

      // check if a value is in the List
      System.out.printf("\"red\" is %sin the list%n",
         items.contains("red") ? "": "not ");

      // display number of elements in the List
      System.out.printf("Size: %s%n", items.size());
   }

   // display the ArrayList's elements on the console
   public static void display(ArrayList<String> items, String header) {
      System.out.printf(header); // display header

      // display each element in items
      for (String item : items) {
         System.out.printf(" %s", item);
      }

      System.out.println();
   }
}
```

```
Display list contents with counter-controlled loop: yellow red
Display list contents with enhanced for statement: yellow red
List with two new elements: yellow red green yellow
Remove first instance of yellow: red green yellow
Remove second list element (green): red yellow
"red" is in the list
Size: 2
```

Generics Methods

```
public class GenericMethodTest {
   public static void main(String[] args) {
      // create arrays of Integer, Double and Character
      Integer[] integerArray = {1, 2, 3, 4, 5};
      Double[] doubleArray = {1.1, 2.2, 3.3, 4.4, 5.5, 6.6, 7.7};
      Character[] characterArray = {'H', 'E', 'L', 'L', 'O'};

      System.out.printf("Array integerArray contains: ");
      printArray(integerArray); // pass an Integer array
      System.out.printf("Array doubleArray contains: ");
      printArray(doubleArray); // pass a Double array
      System.out.printf("Array characterArray contains: ");
      printArray(characterArray); // pass a Character array
   }

   // generic method printArray
   public static <T> void printArray(T[] inputArray) {
      // display array elements
      for (T element : inputArray) {
         System.out.printf("%s ", element);
      }

      System.out.println();
   }
}
```

```
Array integerArray contains: 1 2 3 4 5
Array doubleArray contains: 1.1 2.2 3.3 4.4 5.5 6.6 7.7
Array characterArray contains: H E L L O
```

Here, **<T>** represents a *formal generic type*, which can be replaced later with an *actual concrete type*. Replacing a generic type is called a *generic instantiation*. By convention, a single capital letter such as **E** or **T** is used to denote a formal generic type.

Generics

- There are too many examples in open sources on the subject. You can review it.

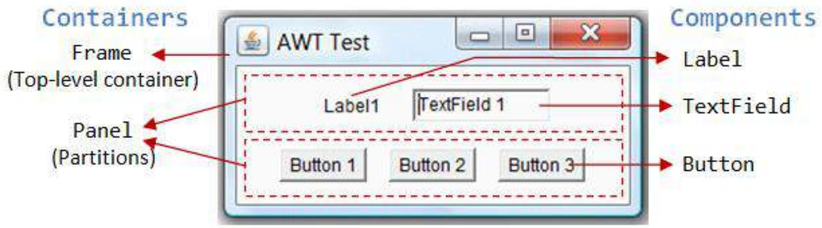
VISUAL PROGRAMMING

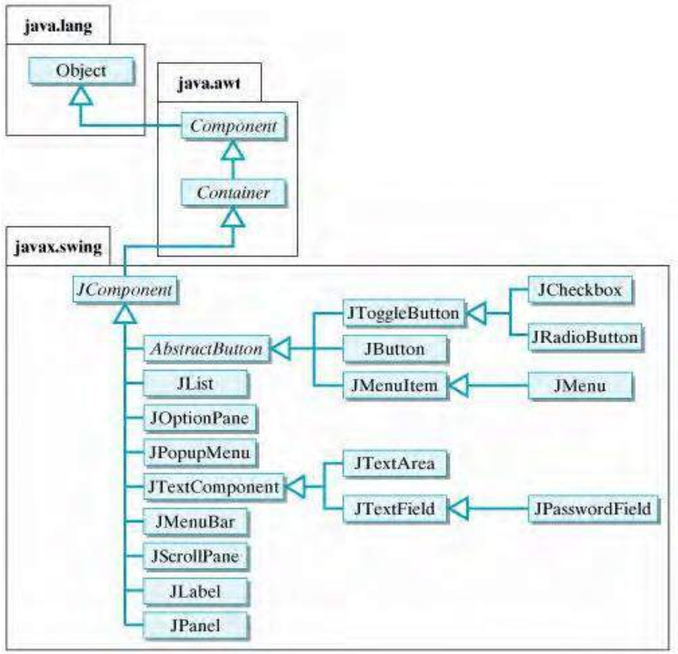
Visual Programming

- In this part, we will learn the basics of JavaFX for visual programming in Java.

Visual Programming in Java

- Development of visuality in Java:
  - ✓ Abstract Windows Toolkit (AWT),
  - ✓ Swing,
  - ✓ JavaFX, after Java 8.





Visual Programming in Java

Visual Programming in Java

Visual Programming in Java

Visual Programming in Java

Visual Programming in Java

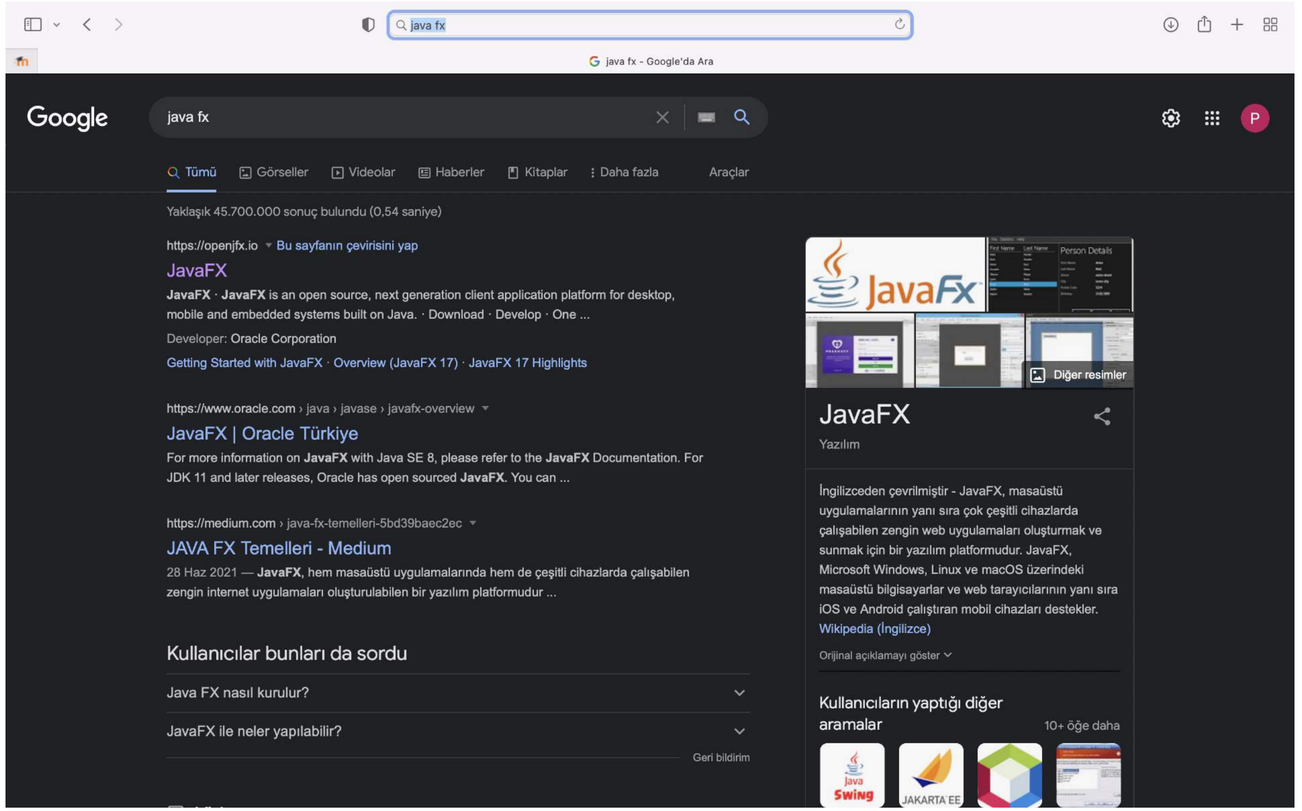
Visual Programming in Java

JavaFX Program Structure

- In this lecture, you will learn the basics of JavaFX for visual programming in Java.
- Coding made easy with IntelliJ IDEA.
- Eclipse is a little more challenging.

Installing JavaFX

- Let's visit the JavaFX website.



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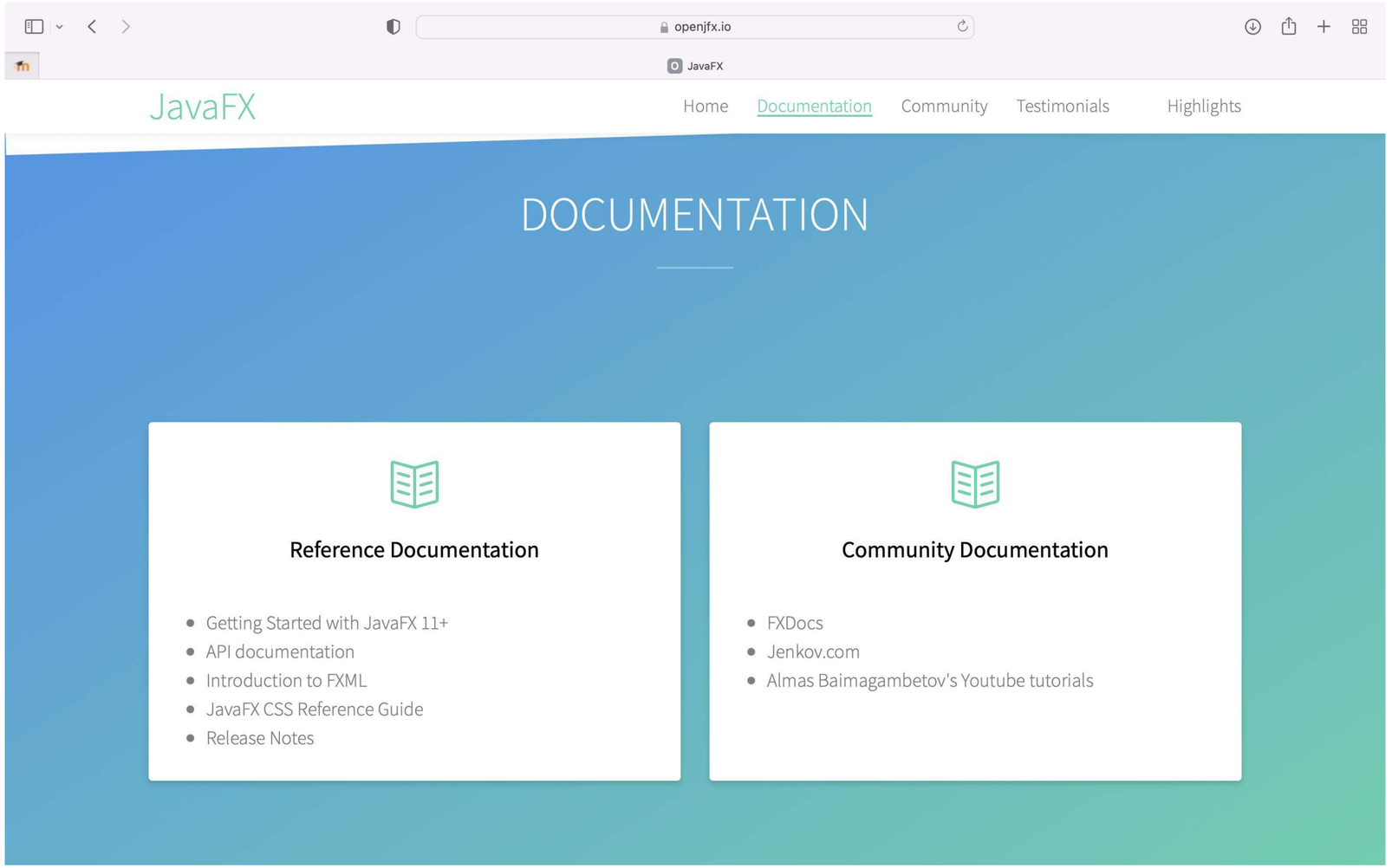
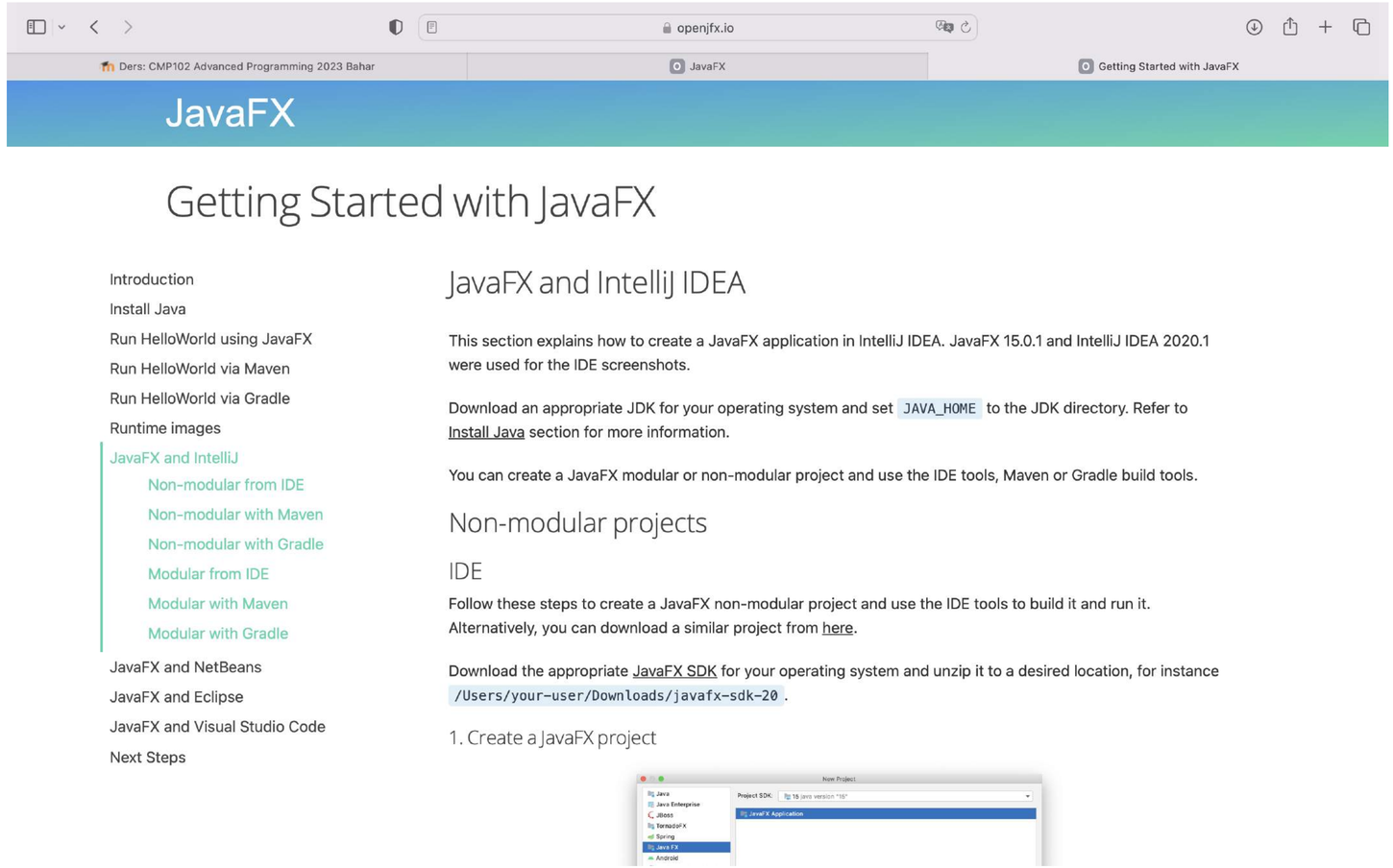


IntelliJ and Java FX

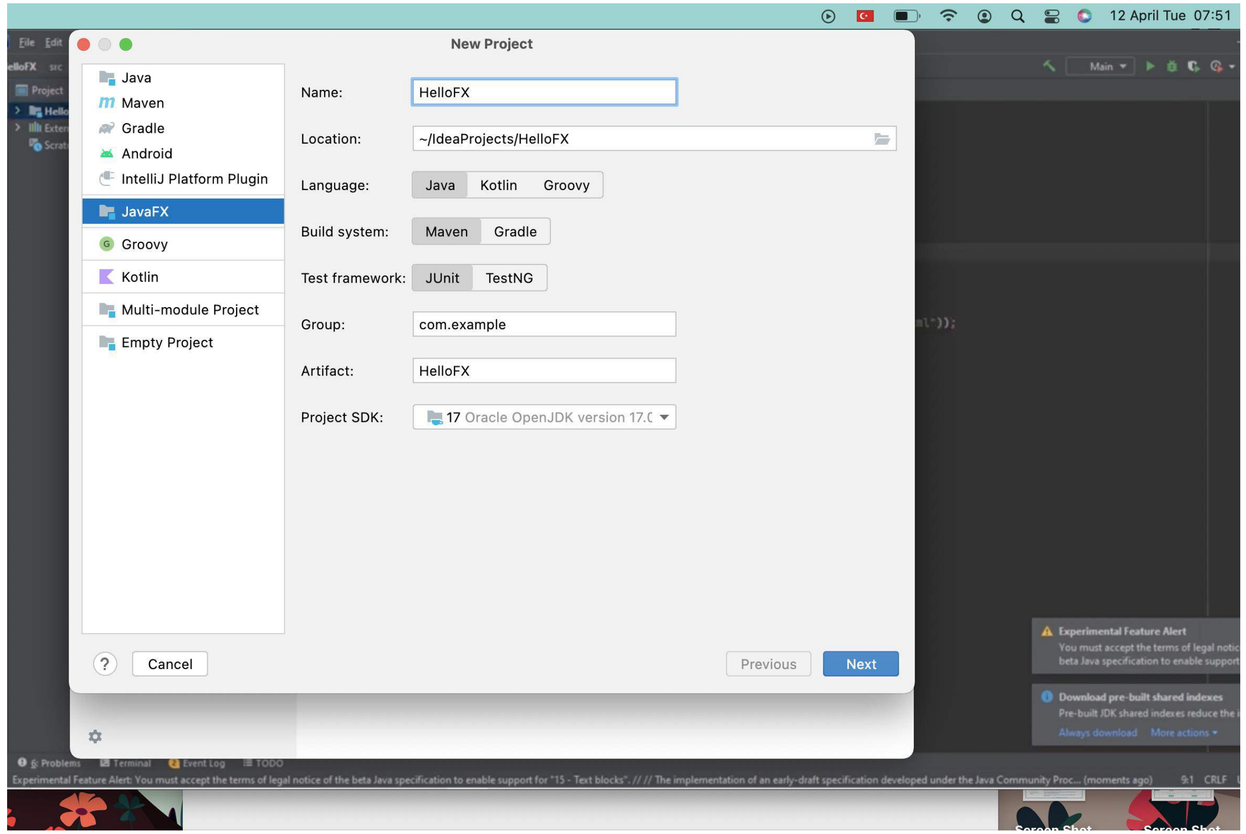
Installing JavaFX

- Let's visit the JavaFX website.



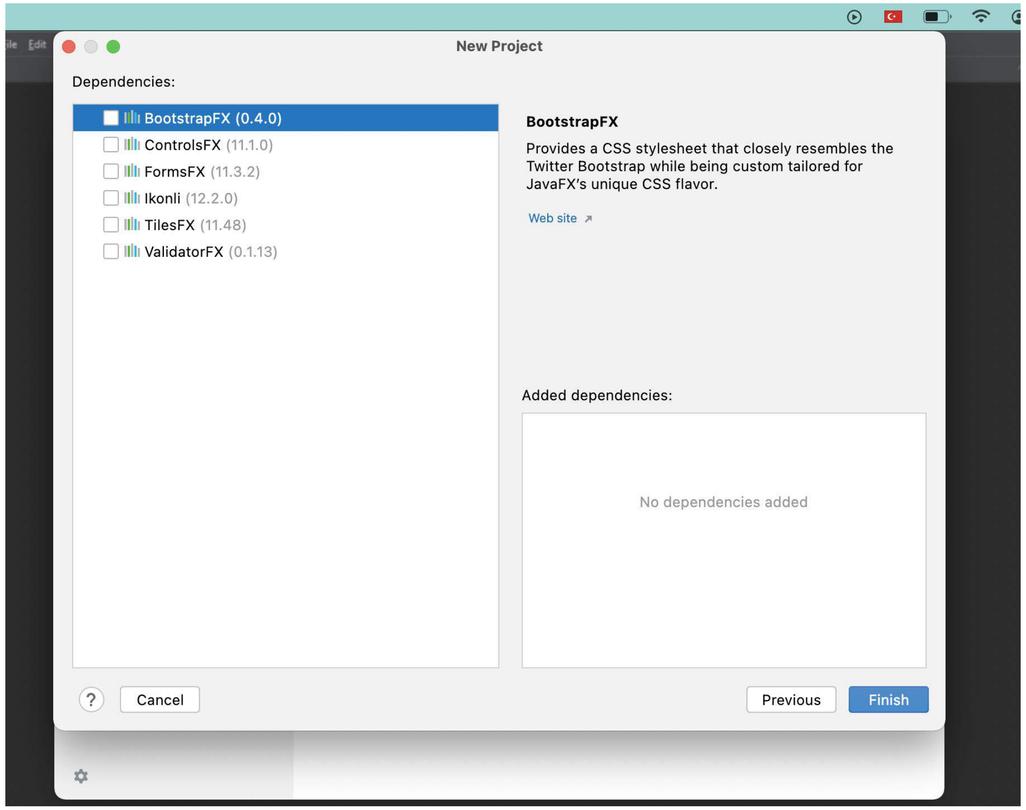
Installing JavaFX

- With IntelliJ IDEA create a new Project.



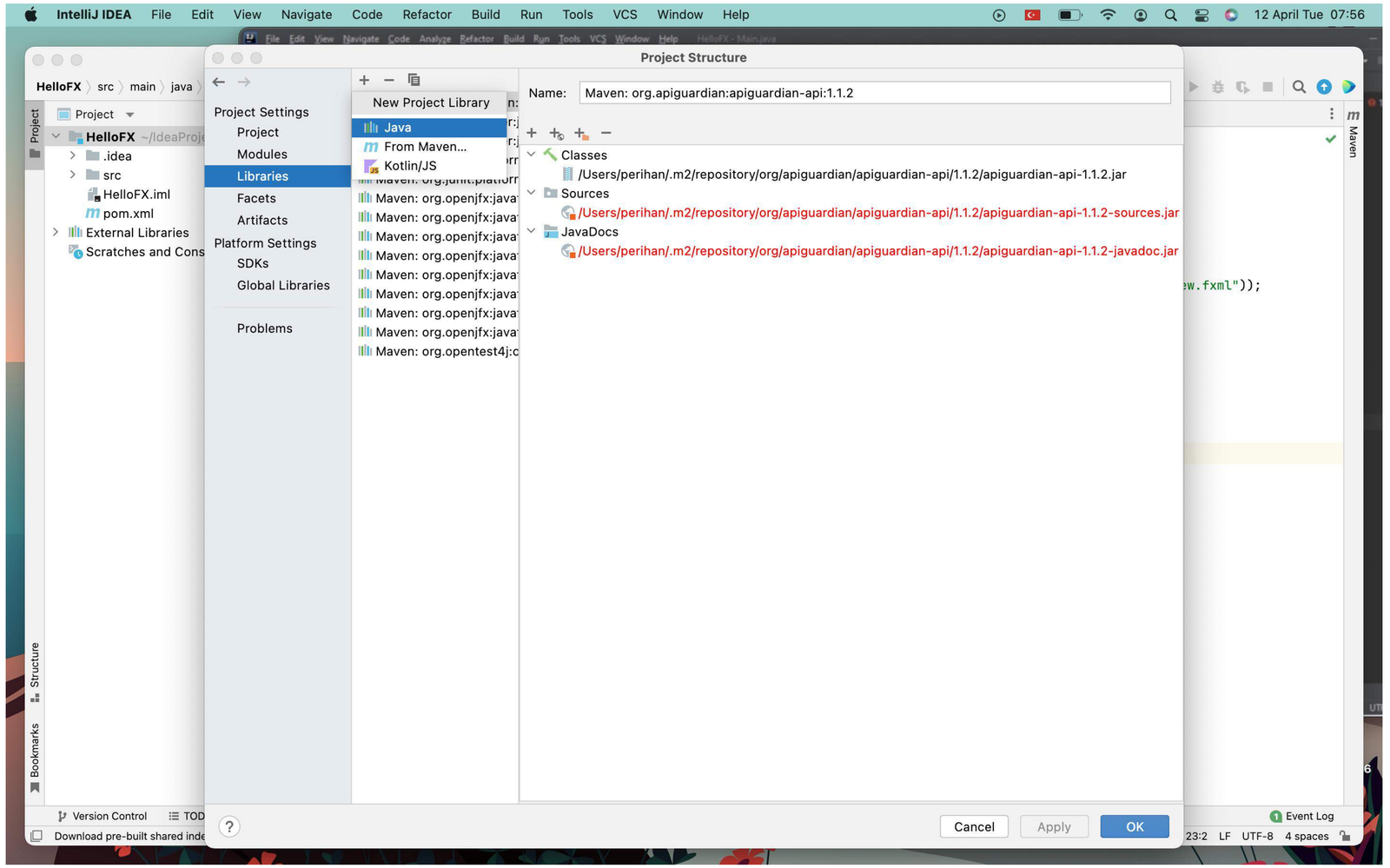
Installing JavaFX

- IntelliJ IDEA



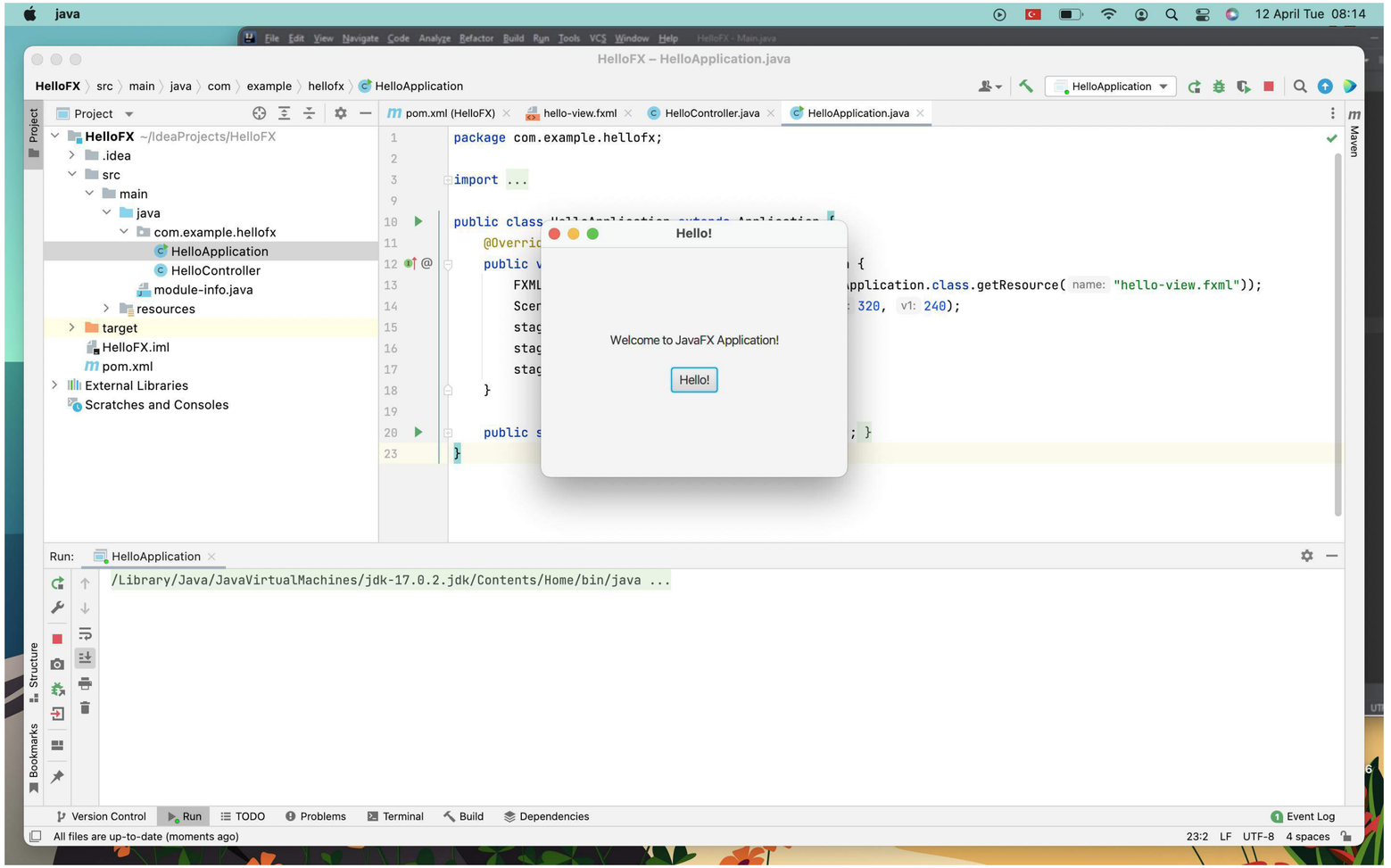
Installing JavaFX

- Let's add libraries to IntelliJ IDEA.



Installing JavaFX

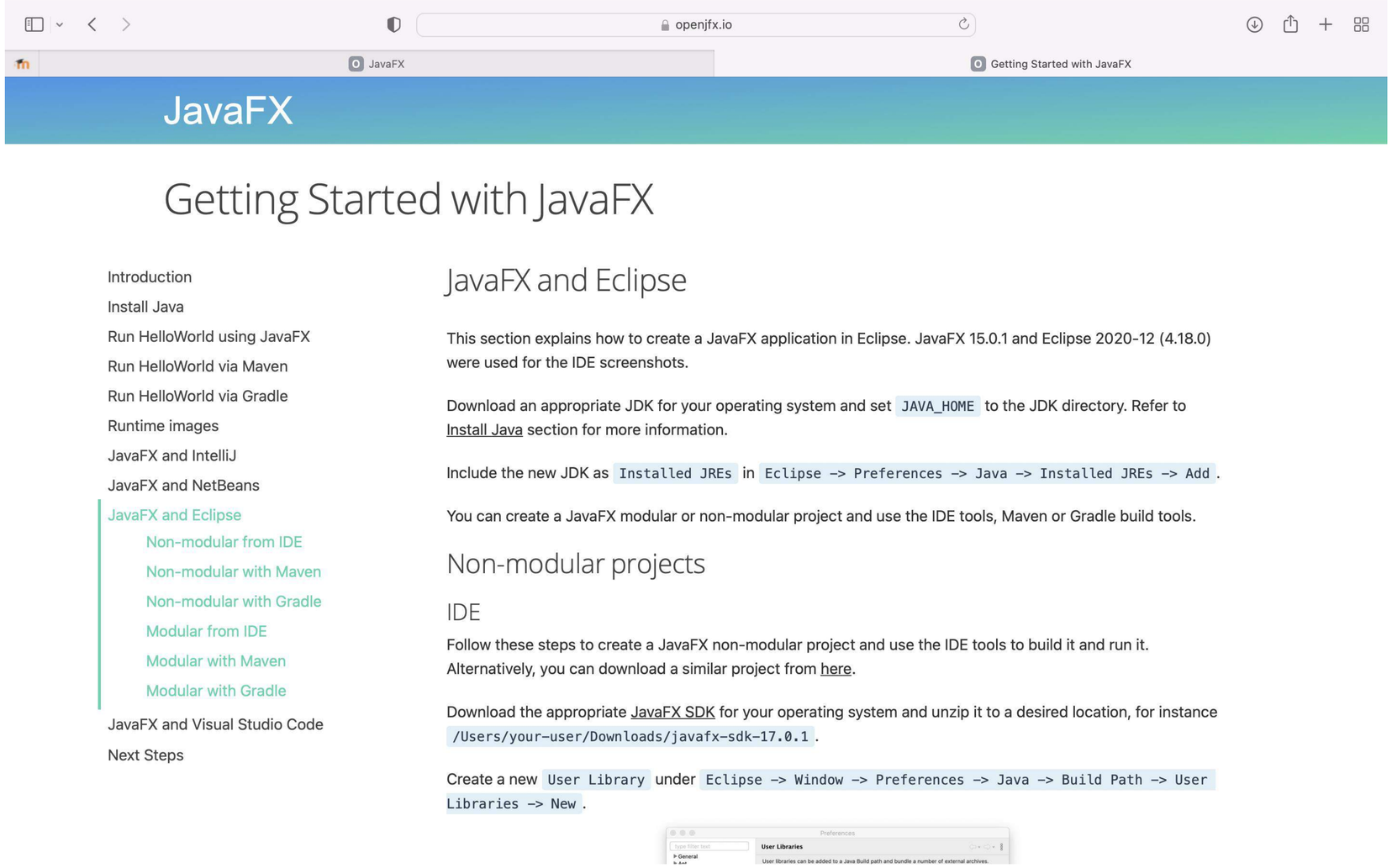
- Example.



IntelliJ and Eclipse

Installing JavaFX

- Let's visit the JavaFX website.



Installing JavaFX

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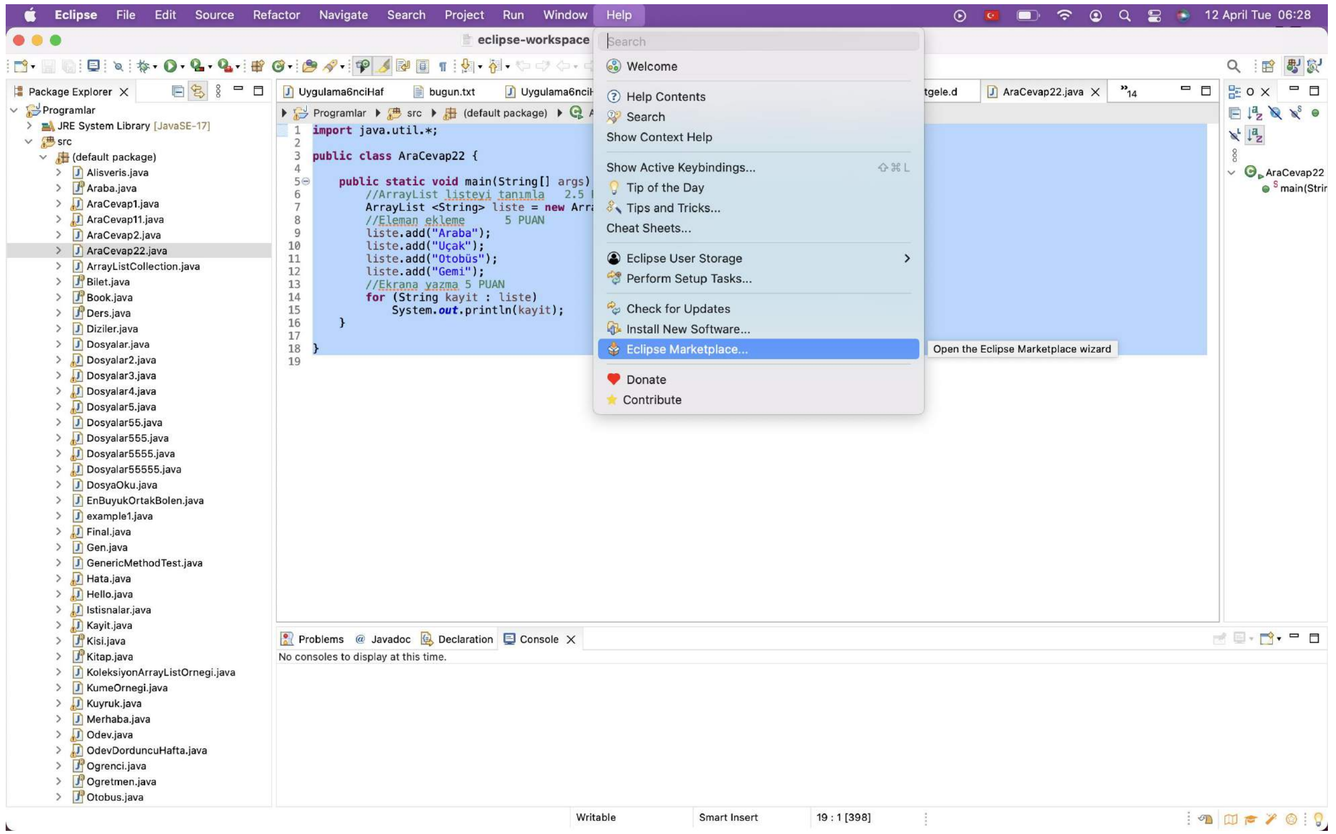
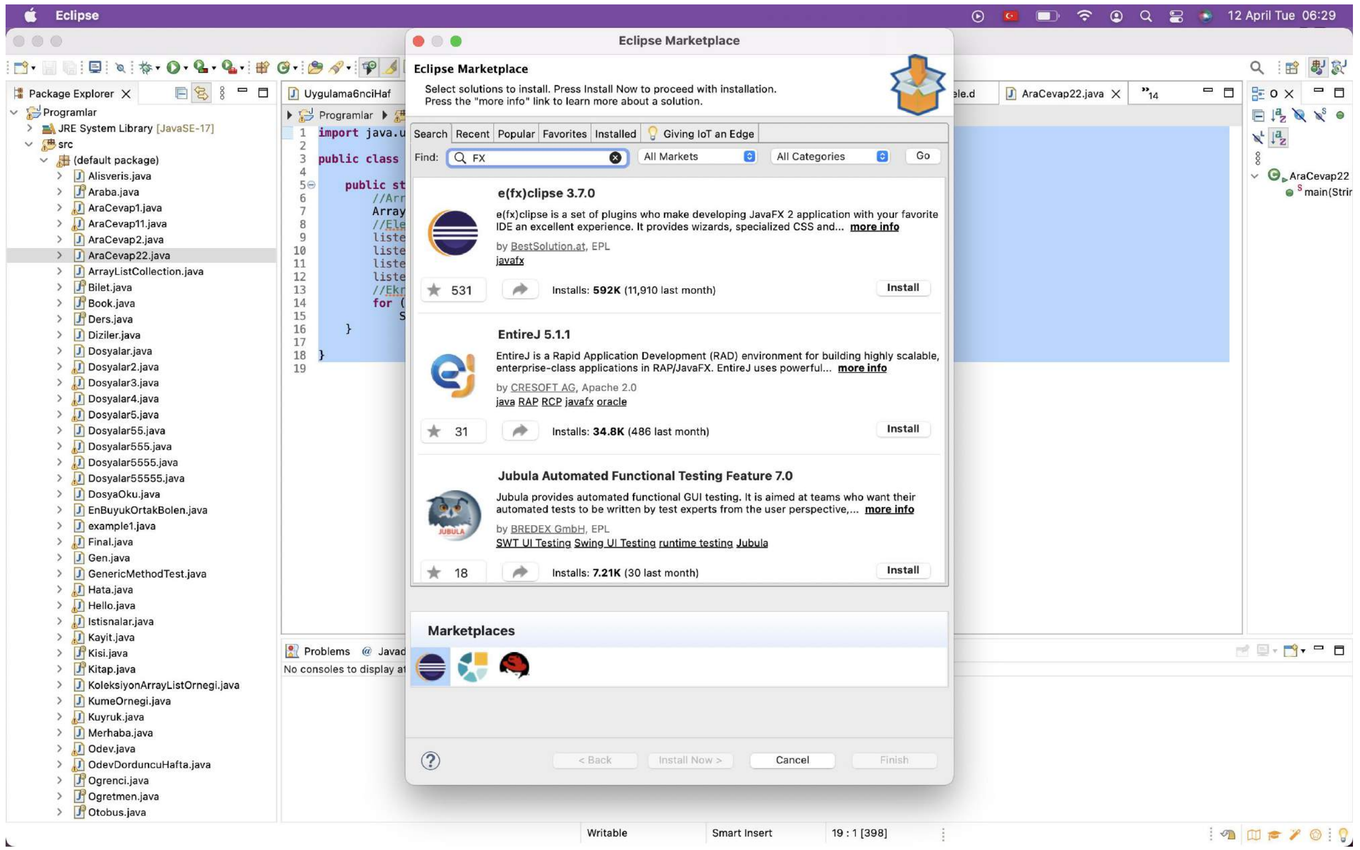


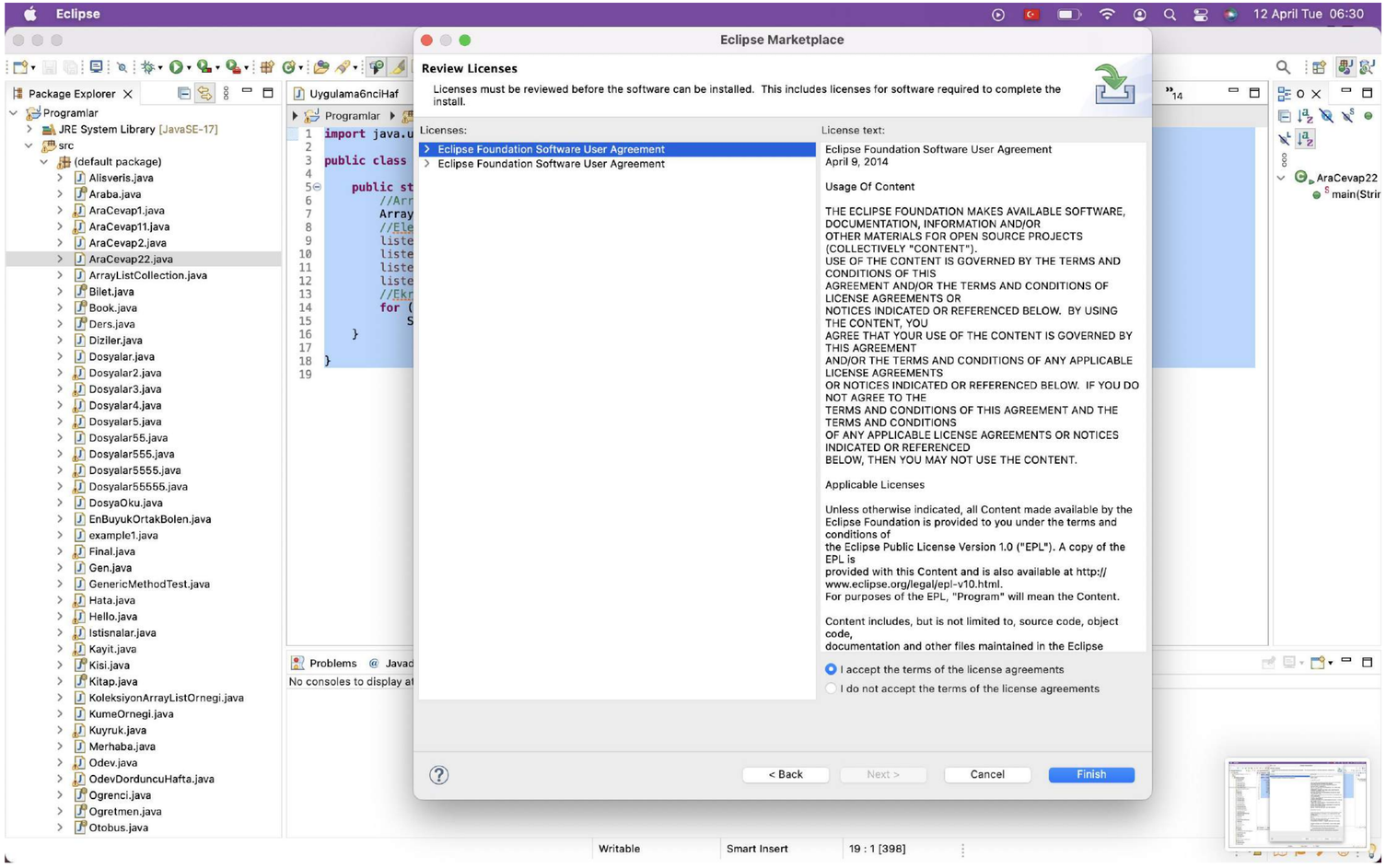
Installing JavaFX

- Let's install the JavaFX plugin.



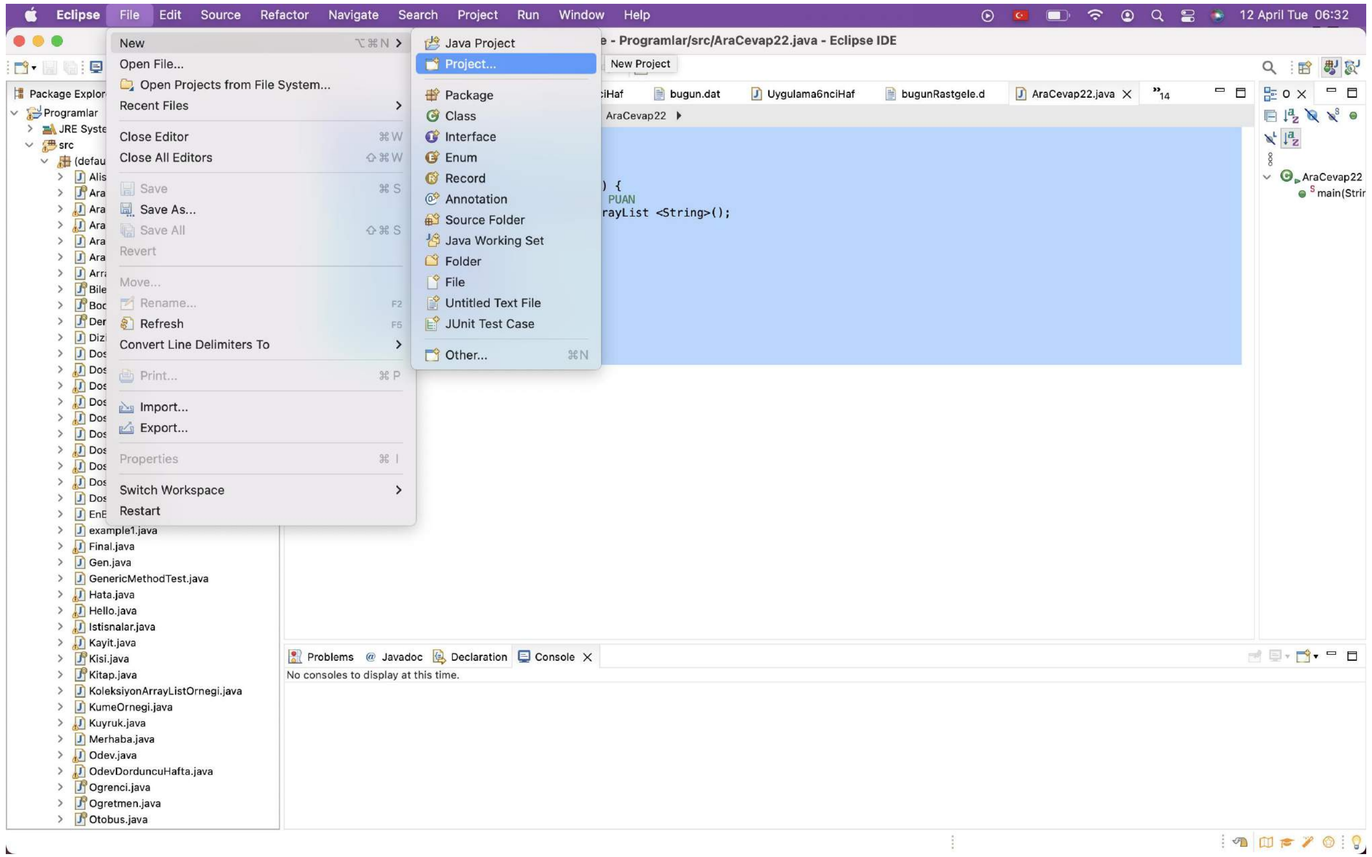
Installing JavaFX

- Let's install the JavaFX plugin.



Installing JavaFX

- Let's create a JavaFX project.



Installing JavaFX

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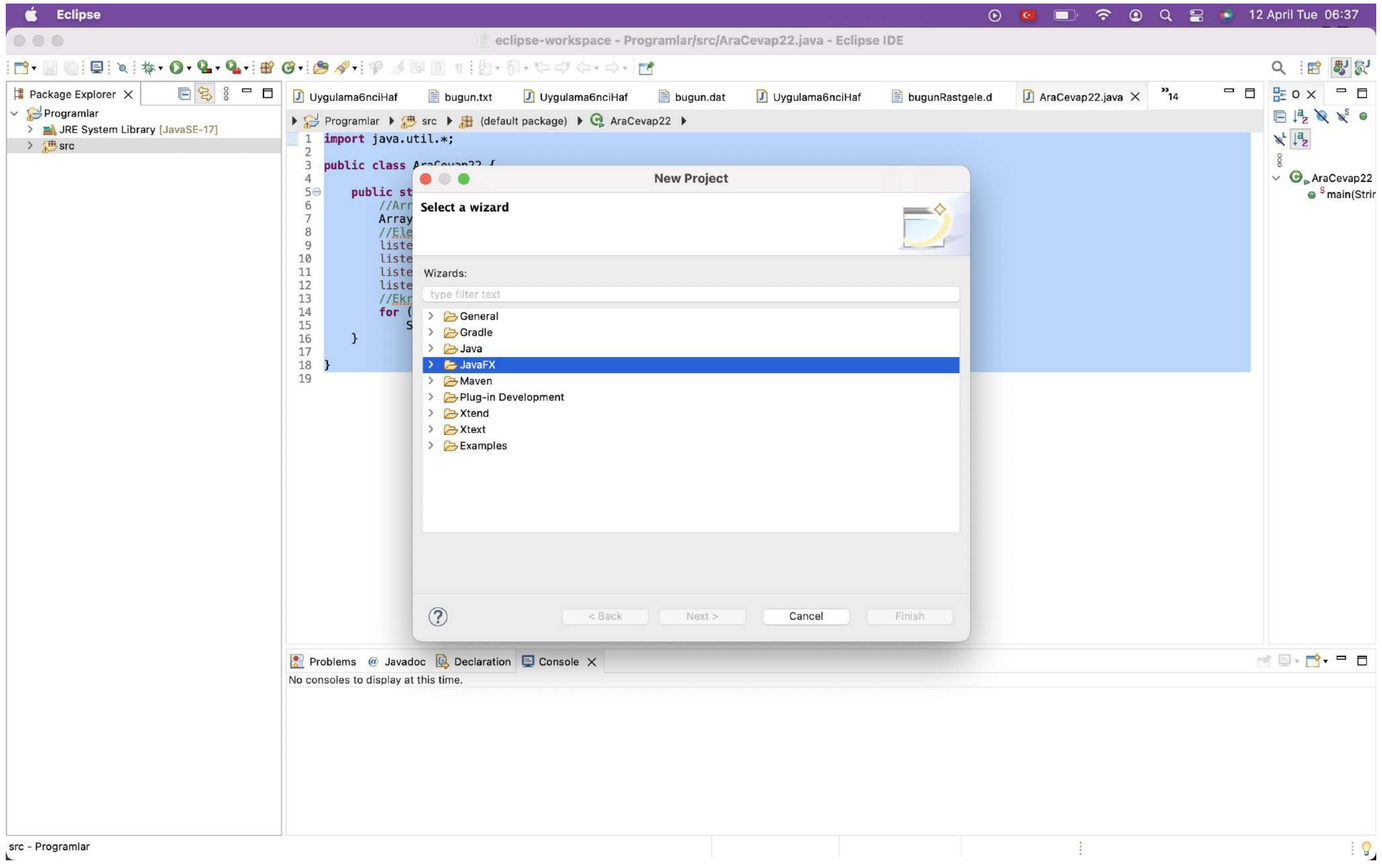
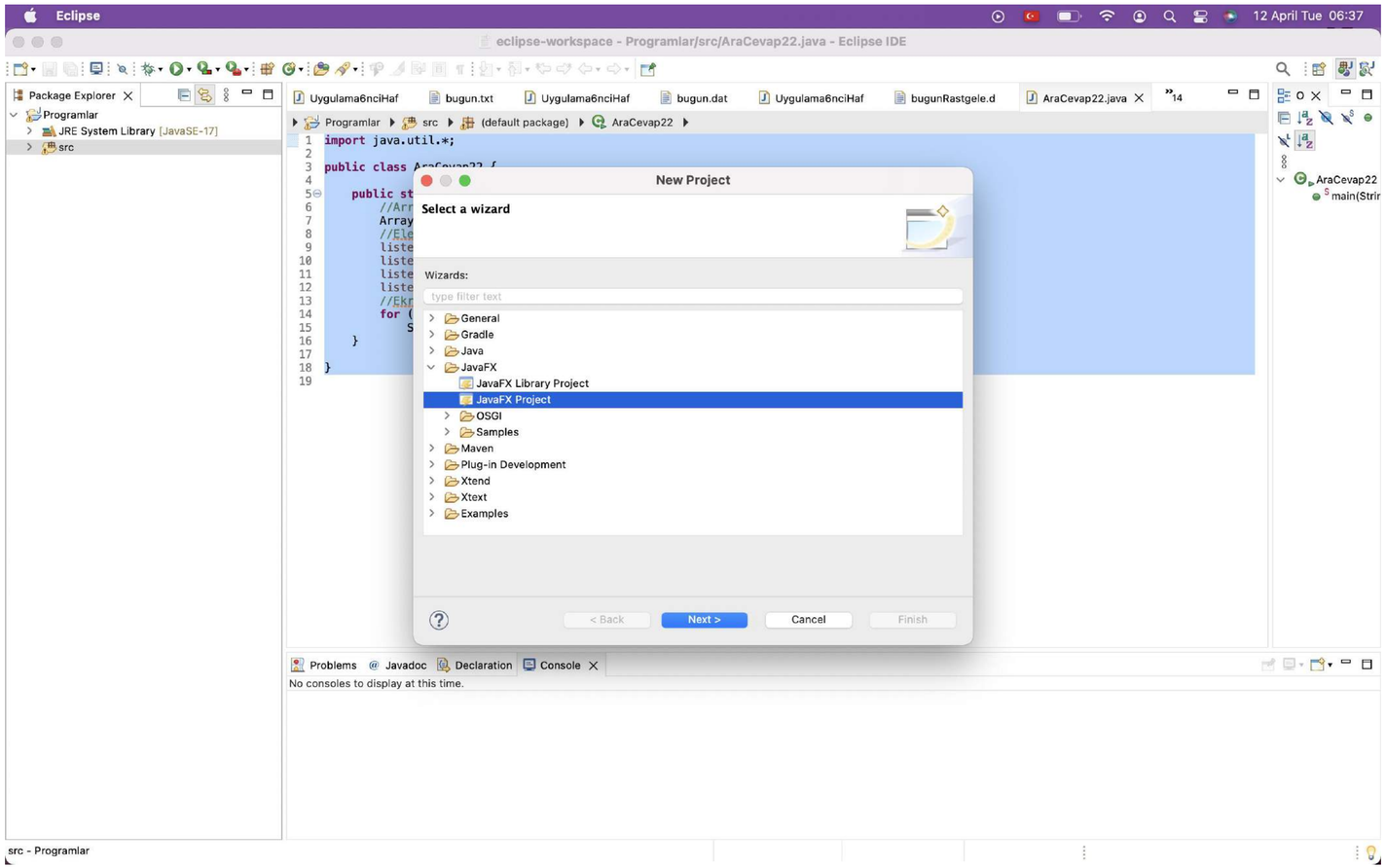


Installing JavaFX

- Let's create a JavaFX project.



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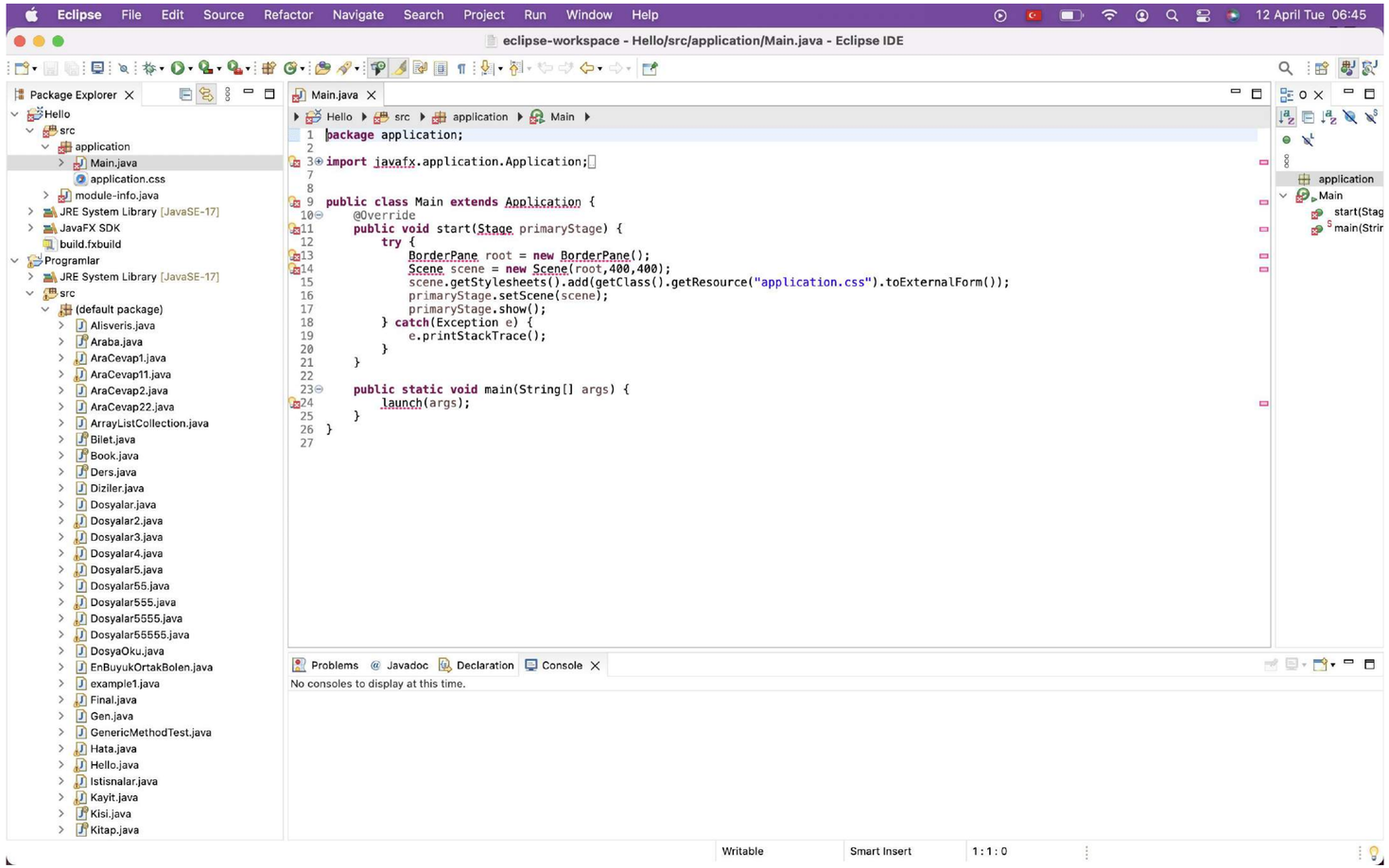
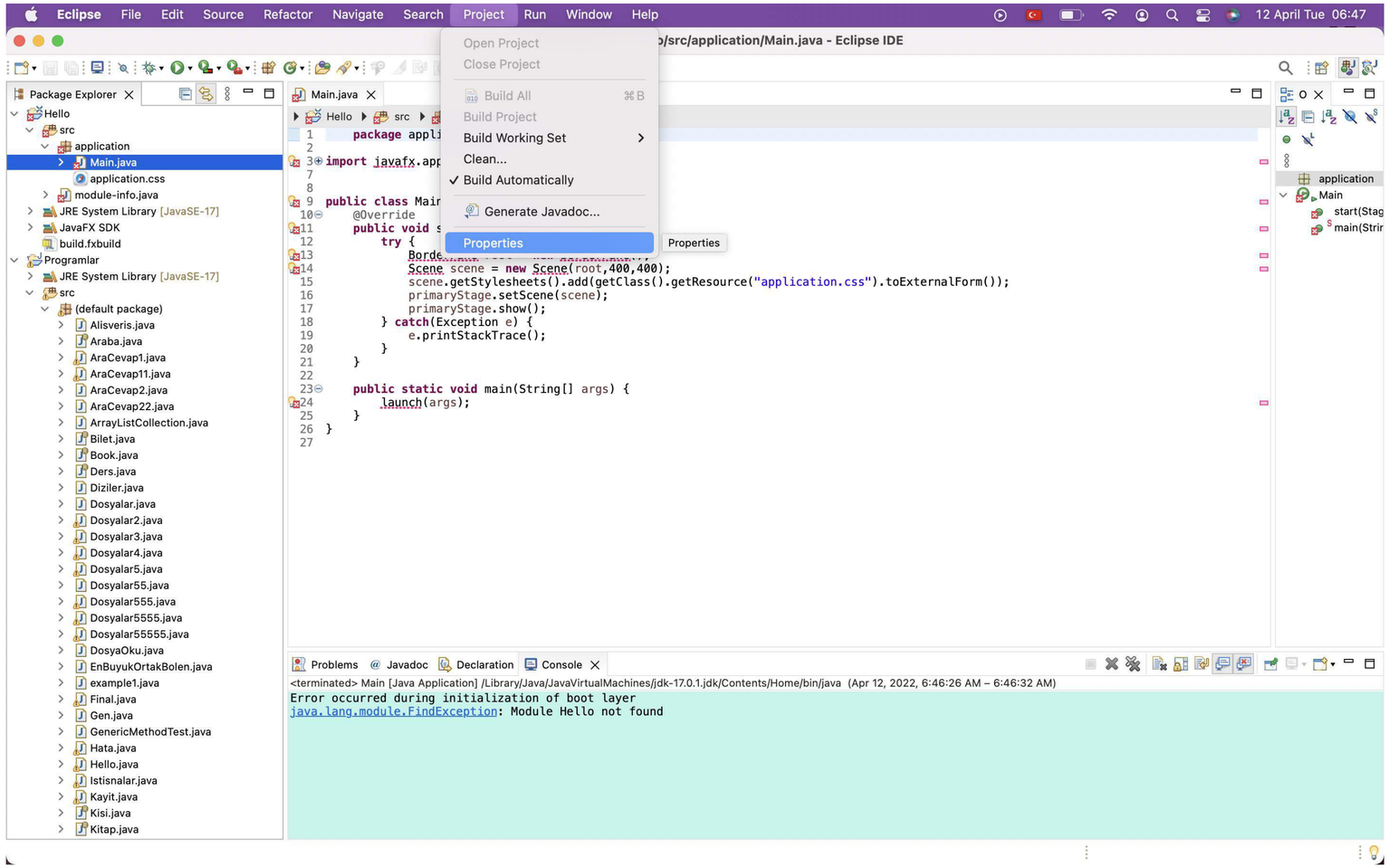


Installing JavaFX

- Let's add libraries to the JavaFX project.



Installing JavaFX

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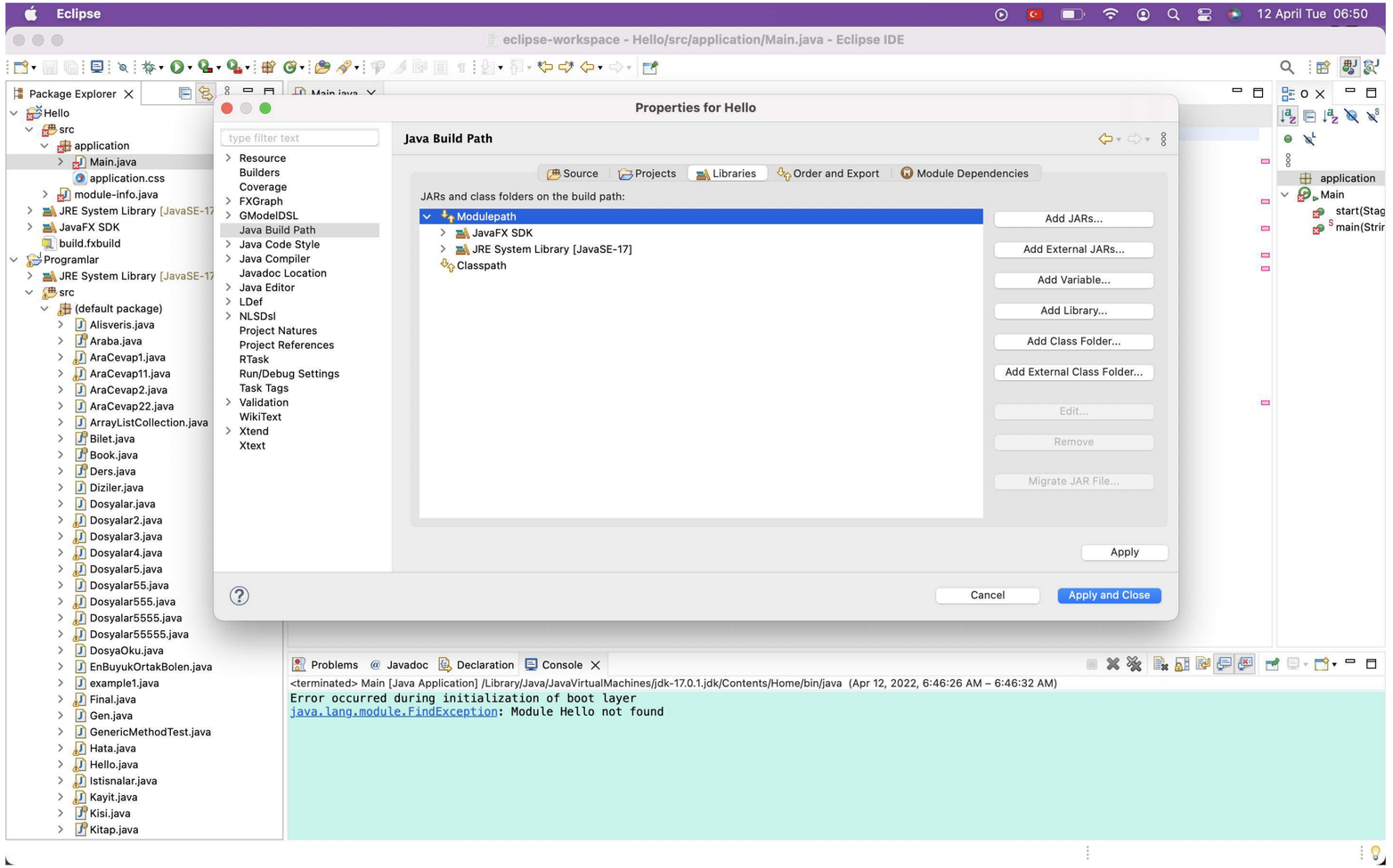

Installing JavaFX

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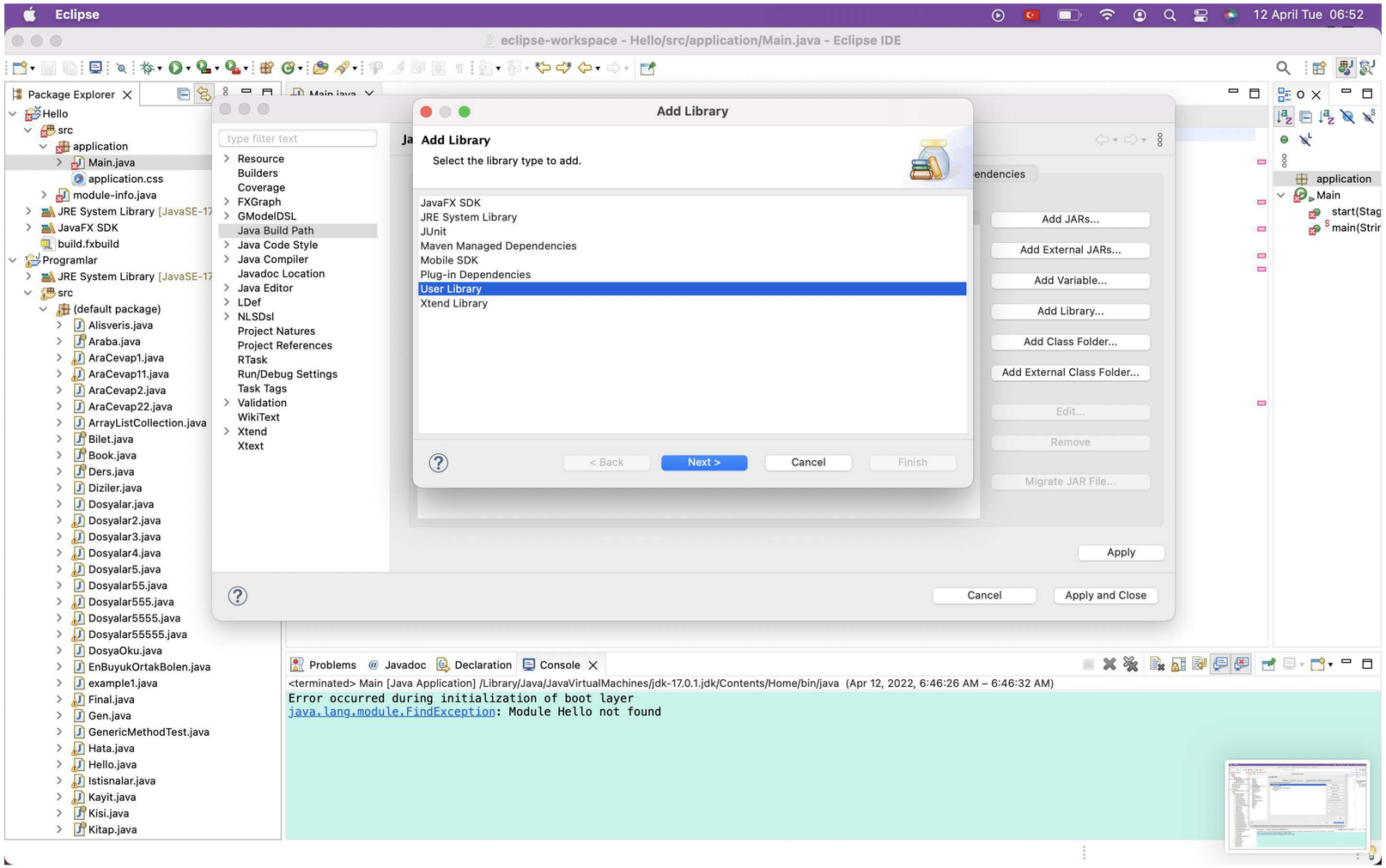

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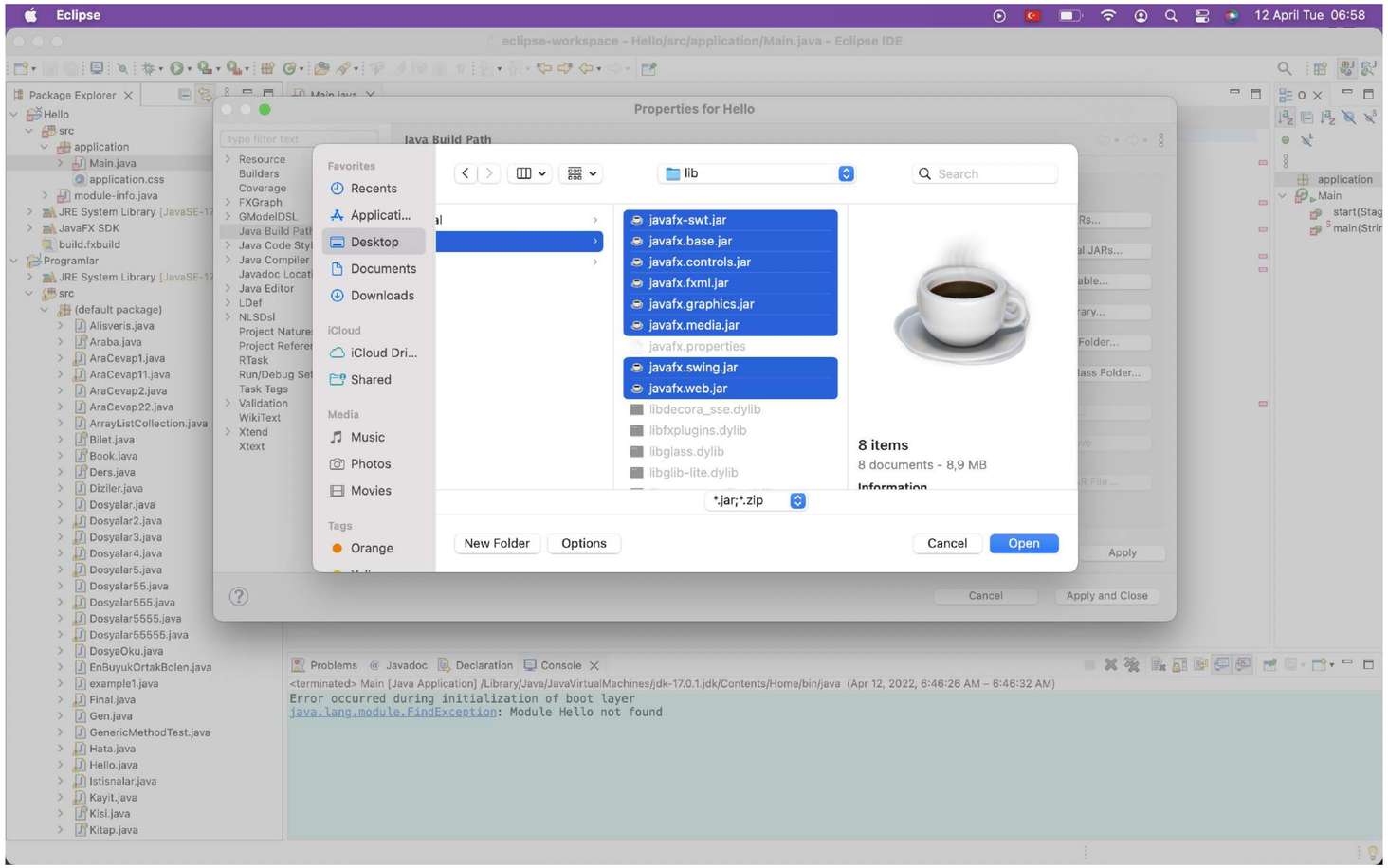

Installing JavaFX

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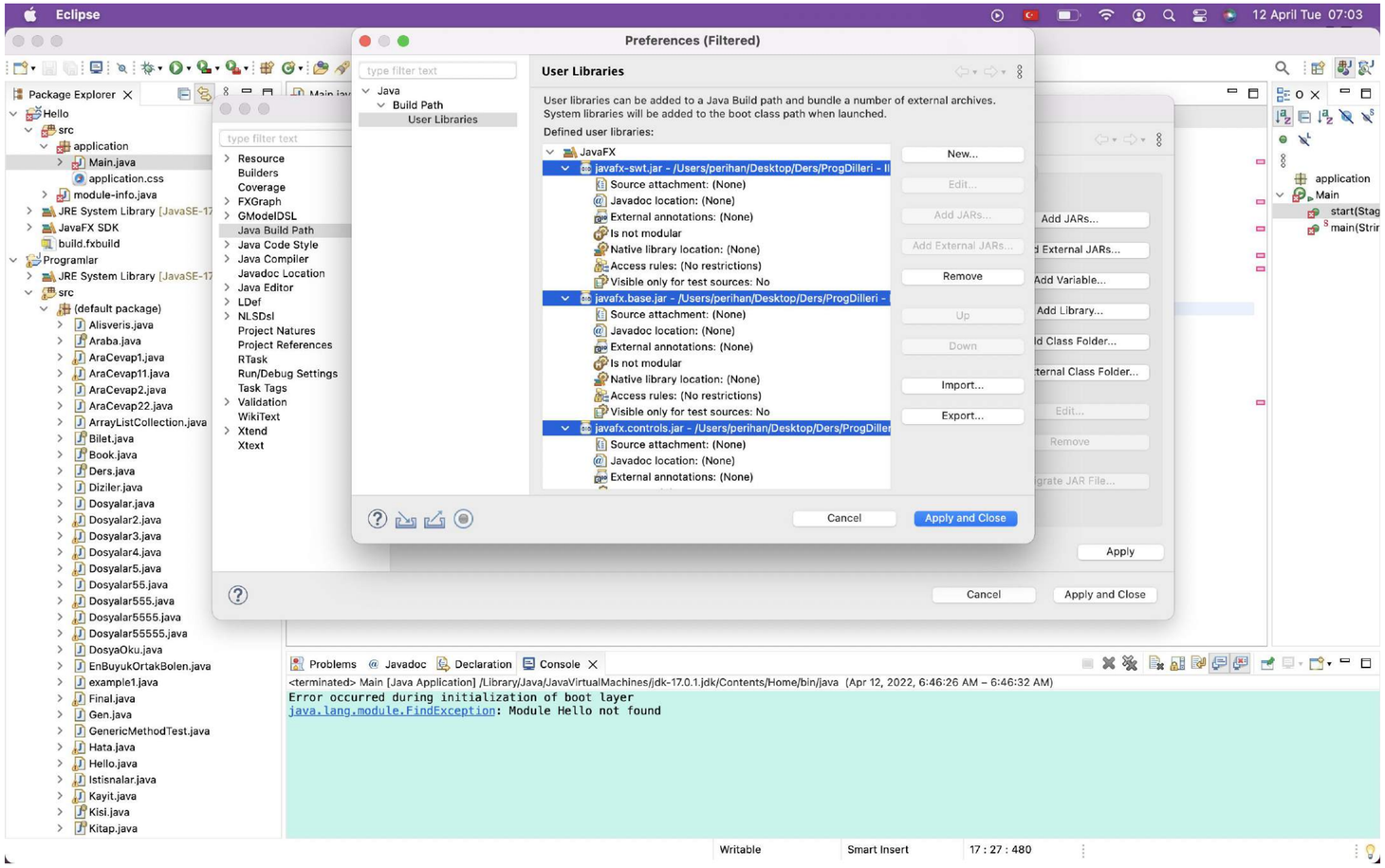

Installing JavaFX

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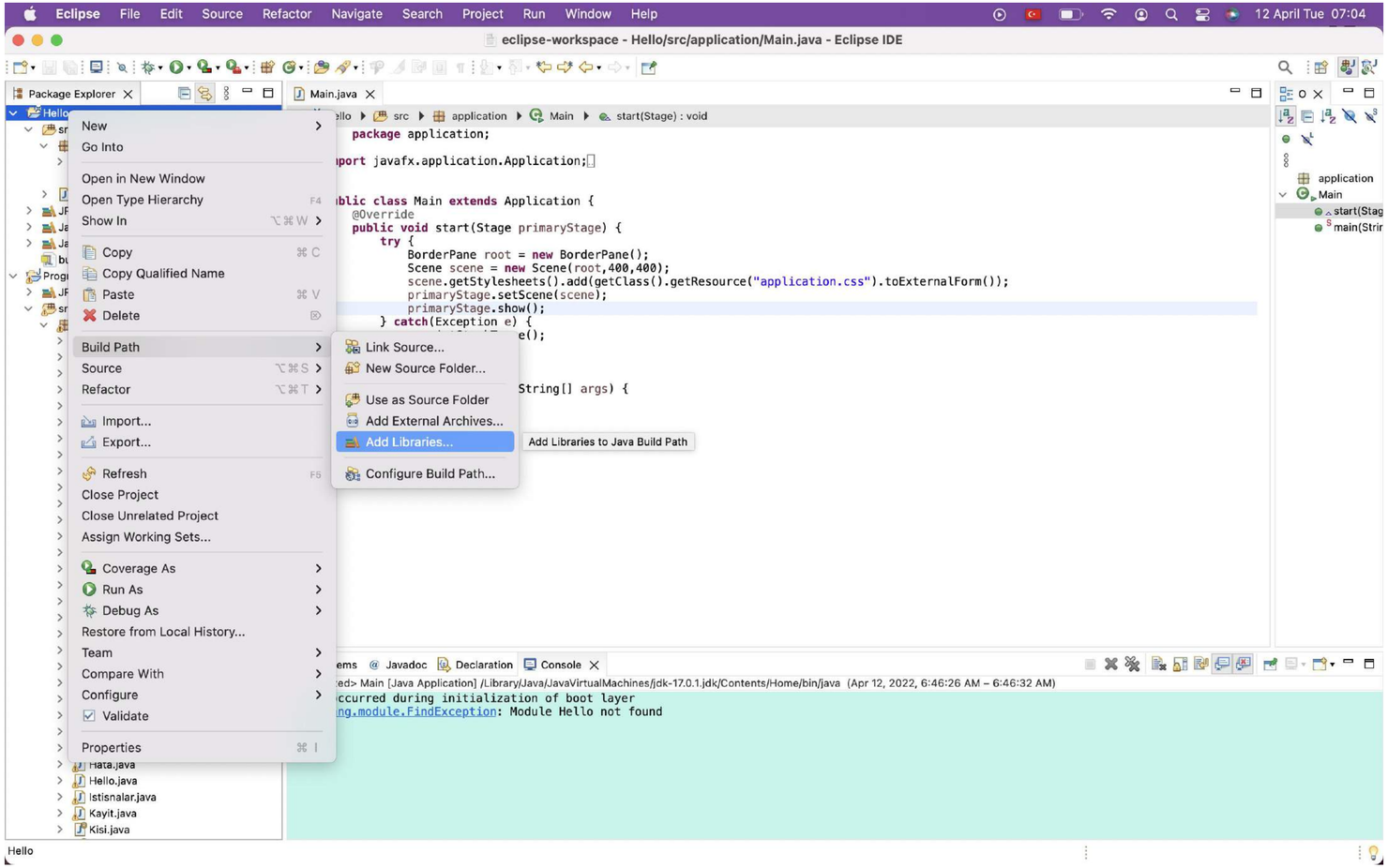
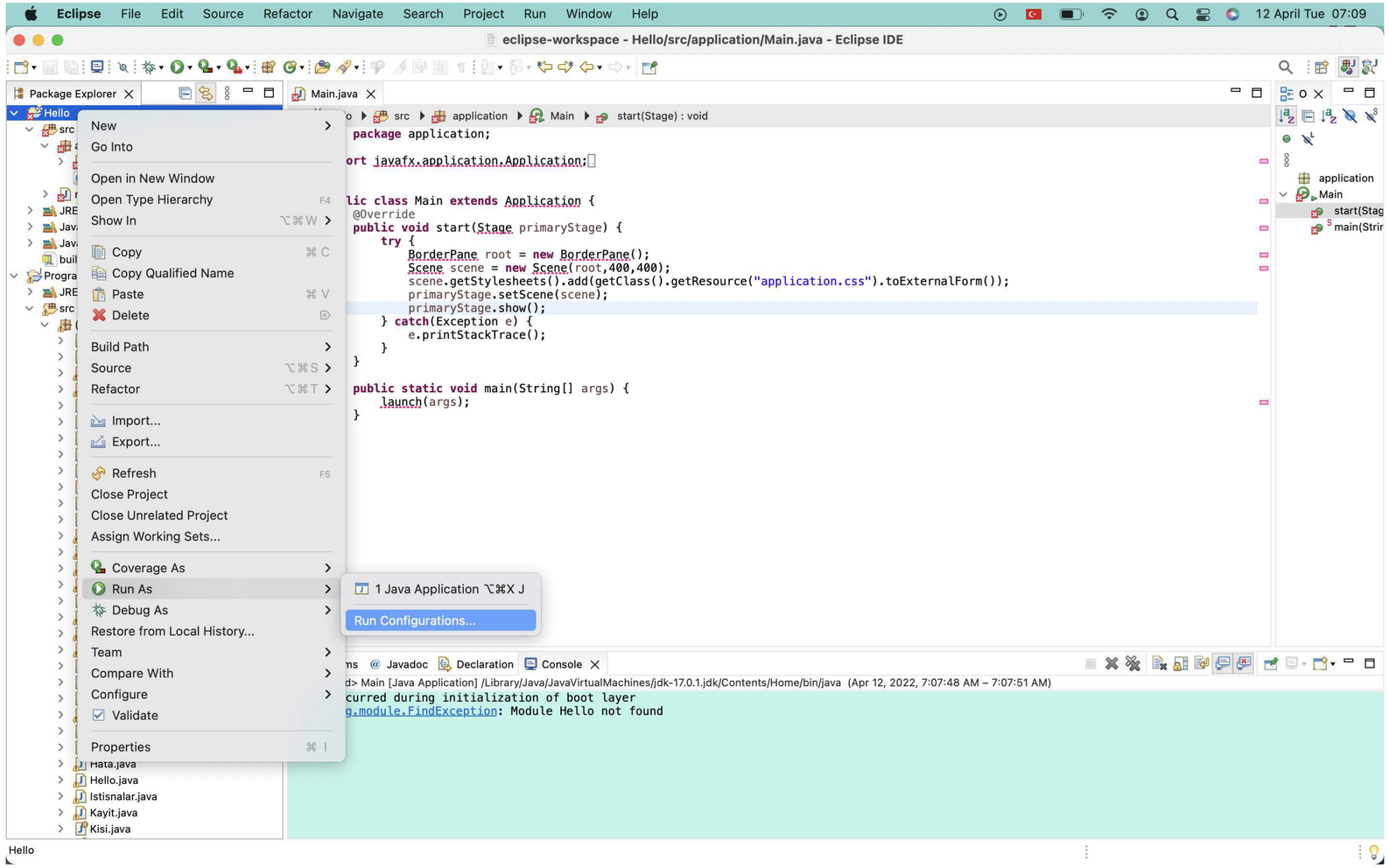


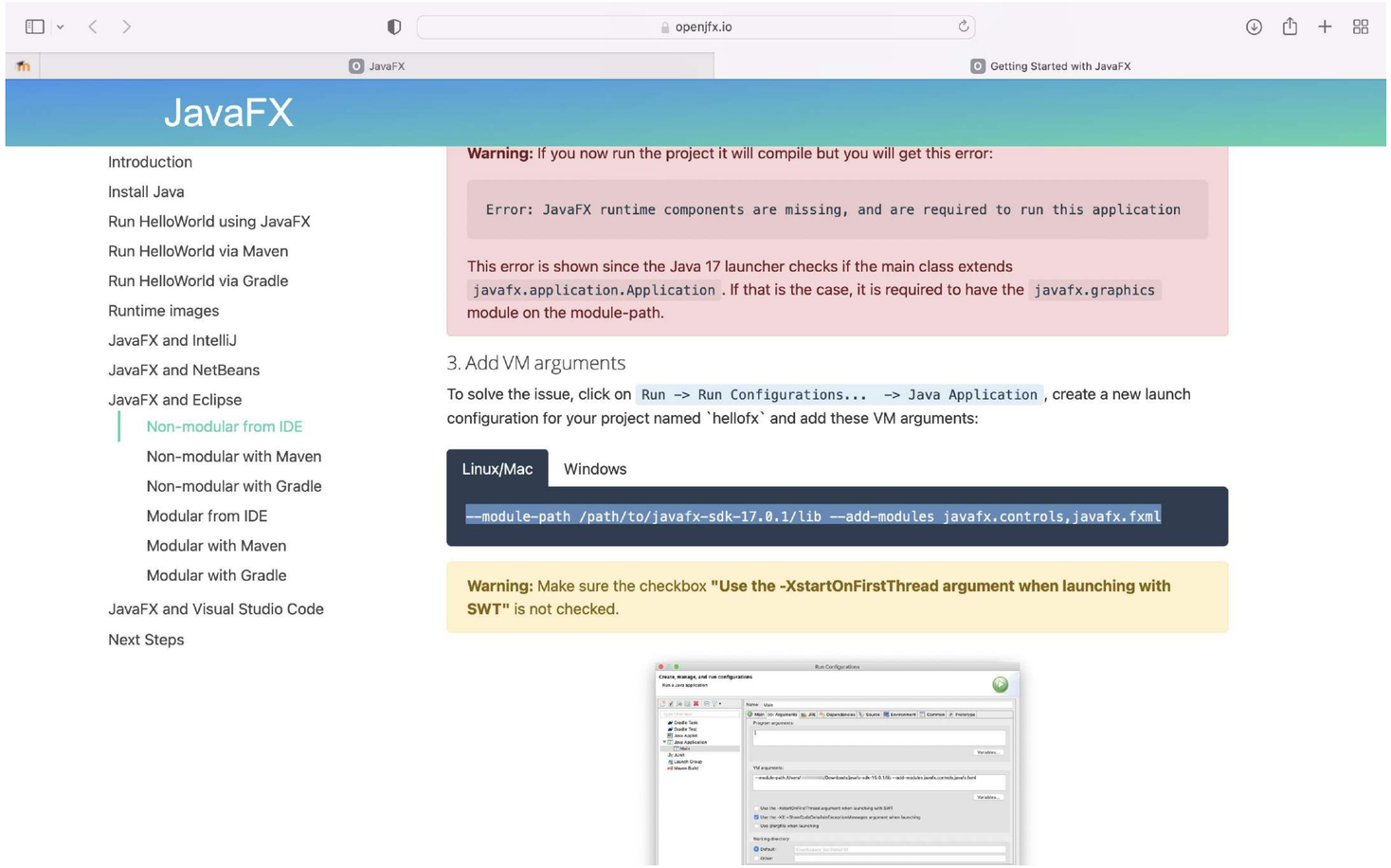
Installing JavaFX

- Let's add the VM to the JavaFX project.



Installing JavaFX

- Let's add the VM to the JavaFX project.



Example Program

Example - 1

- Let's write code that adds various shapes to the window.

Example Program

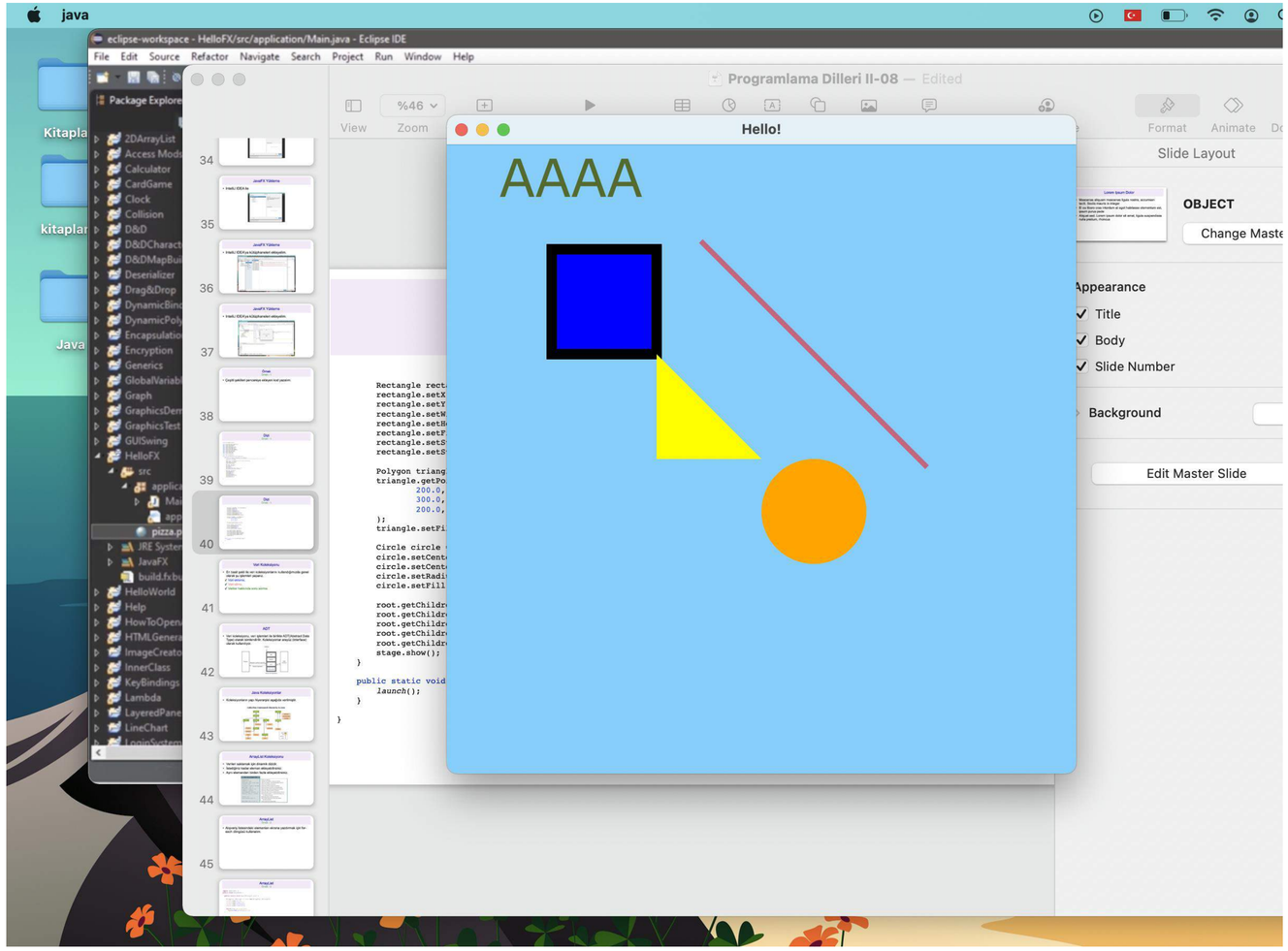
Example - 1

```
package com.example.hellofx;

import javafx.application.Application;
import javafx.fxml.FXMLLoader;
import javafx.scene.Scene;
import javafx.scene.paint.Color;
import javafx.scene.shape.Circle;
import javafx.scene.shape.Line;
import javafx.scene.shape.Polygon;
import javafx.scene.shape.Rectangle;
import javafx.scene.text.Font;
import javafx.scene.text.Text;
import javafx.stage.Stage;
import javafx.scene.Group;

import java.io.IOException;

public class HelloApplication extends Application {
    @Override
    public void start(Stage primaryStage) throws Exception {
        //FXMLLoader fxmlLoader = new FXMLLoader(HelloApplication.class.getResource("hello-view.fxml"));
        Group root = new Group();

        Scene scene = new Scene(root, 600,600, Color.LIGHTSKYBLUE);
        Stage stage = new Stage();
        stage.setTitle("Hello!");
        stage.setScene(scene);

        Text text = new Text();
        text.setText("AAAA");
        text.setX(50);
        text.setY(50);
        text.setFont(Font.font("Verdana", 50));
        text.setFill(Color.DARKOLIVEGREEN);

        Line line = new Line();
        line.setStartX(200);
        line.setStartY(200);
        line.setEndX(500);
        line.setEndY(200);
        line.setStrokeWidth(5);
        line.setStroke(Color.RED);
        line.setOpacity(0.5);
        line.setRotate(45);

}
```

Example Program

Example - 1

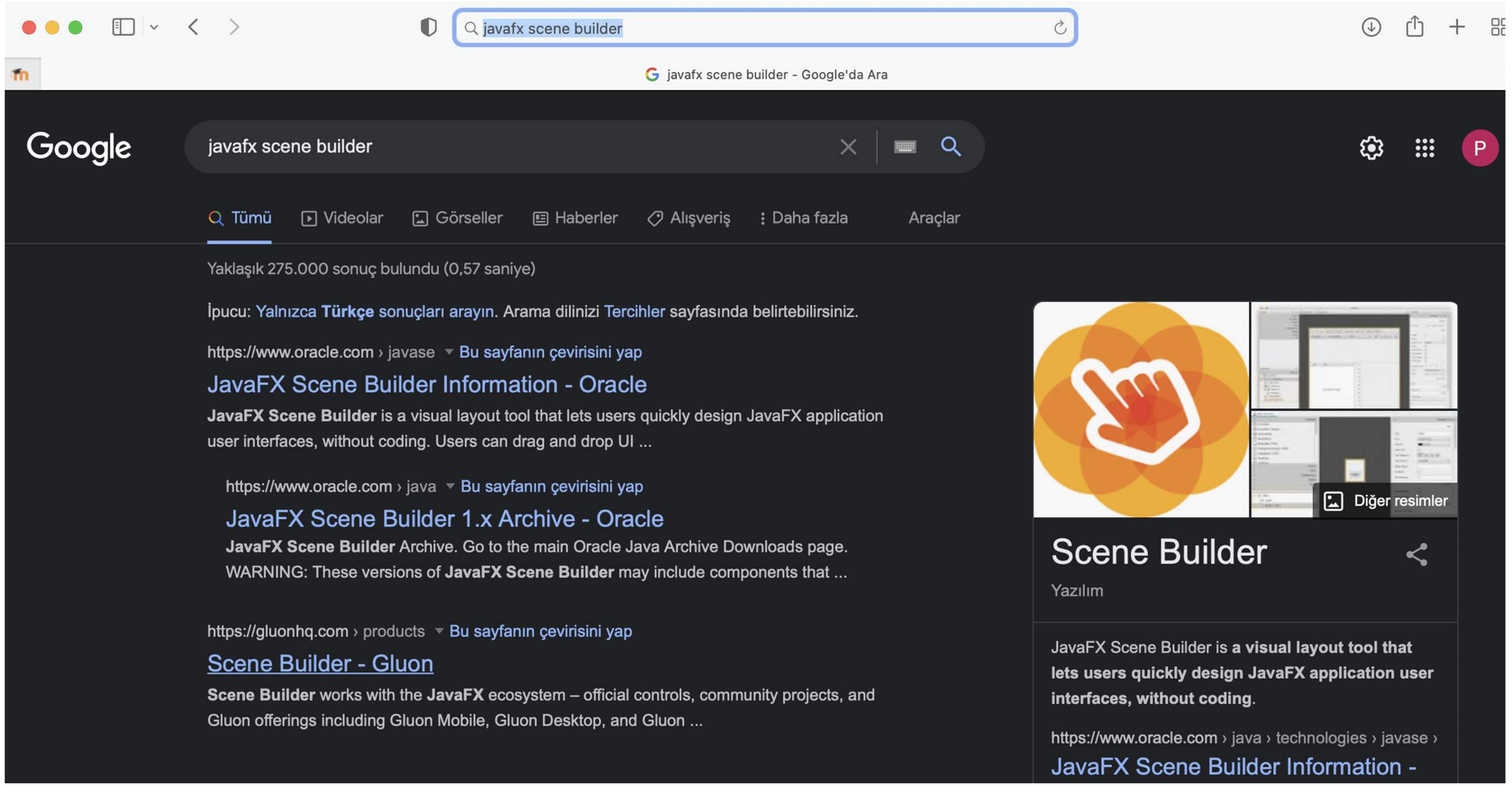
```
        Rectangle rectangle = new Rectangle();
        rectangle.setX(100);
        rectangle.setY(100);
        rectangle.setWidth(100);
        rectangle.setHeight(100);
        rectangle.setFill(Color.BLUE);
        rectangle.setStrokeWidth(10);
        rectangle.setStroke(Color.BLACK);

        Polygon triangle = new Polygon();
        triangle.getPoints().setAll(
                200.0, 200.0,
                300.0, 300.0,
                200.0, 300.0
        );
        triangle.setFill(Color.YELLOW);

        Circle circle = new Circle();
        circle.setCenterX(350);
        circle.setCenterY(350);
        circle.setRadius(50);
        circle.setFill(Color.ORANGE);

        root.getChildren().add(text);
        root.getChildren().add(line);
        root.getChildren().add(rectangle);
        root.getChildren().add(triangle);
        root.getChildren().add(circle);
        stage.show();
    }

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

}
```



JavaFX and Scene Builder

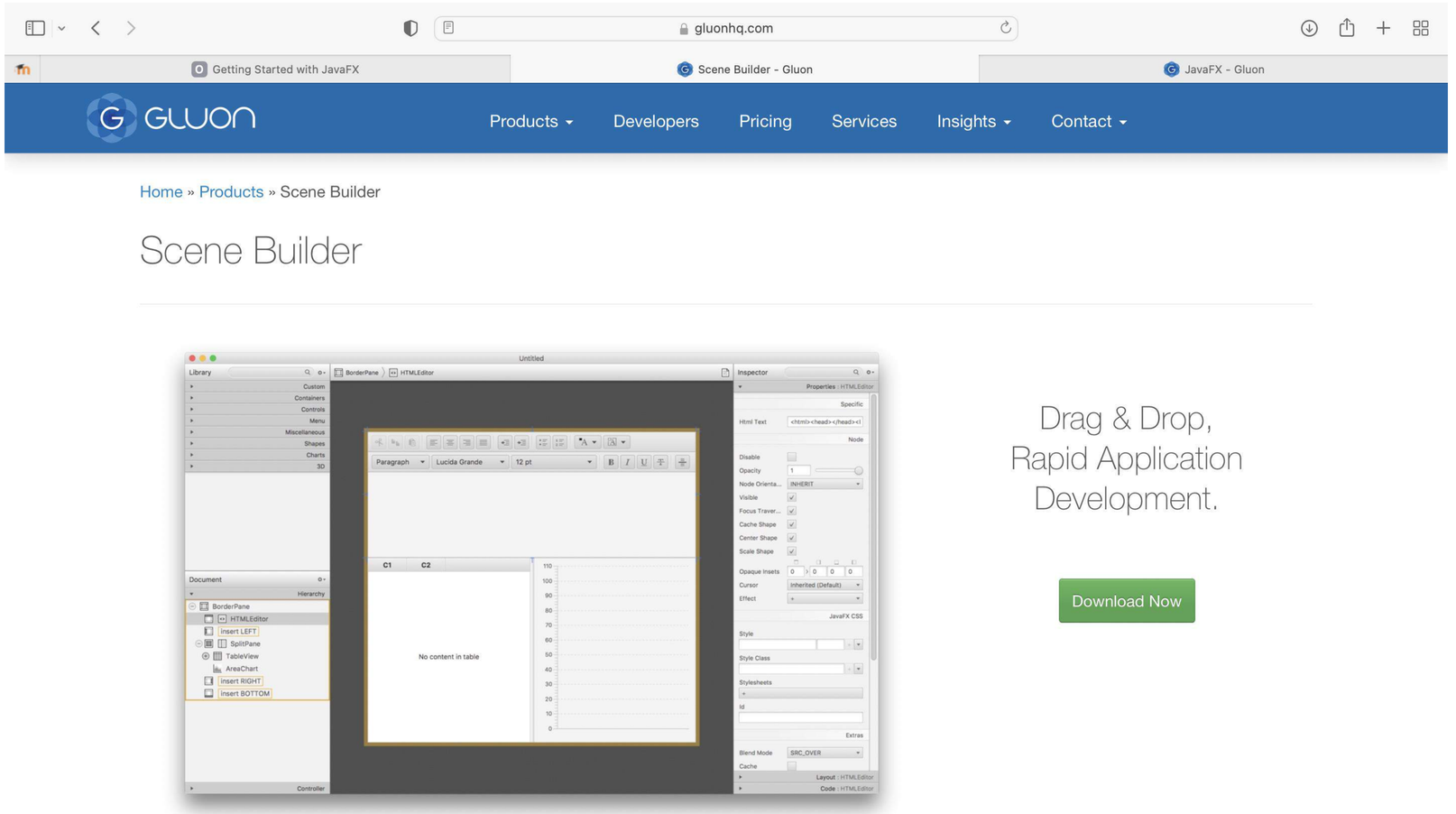
Installing JavaFX Scene Builder

- Type JavaFX Scene Builder and search Google.



Installing JavaFX Scene Builder

- Install JavaFX Scene Builder.



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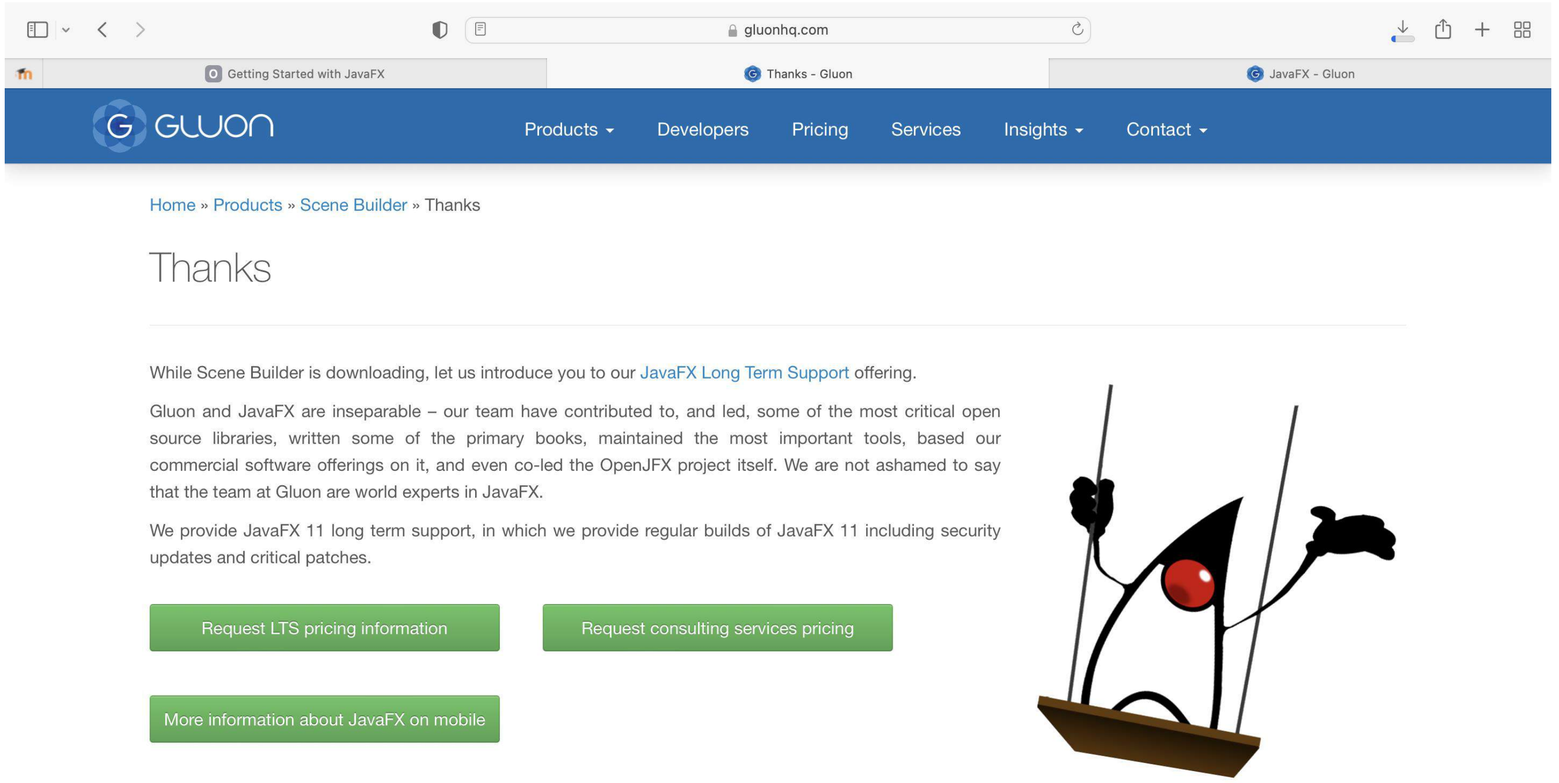

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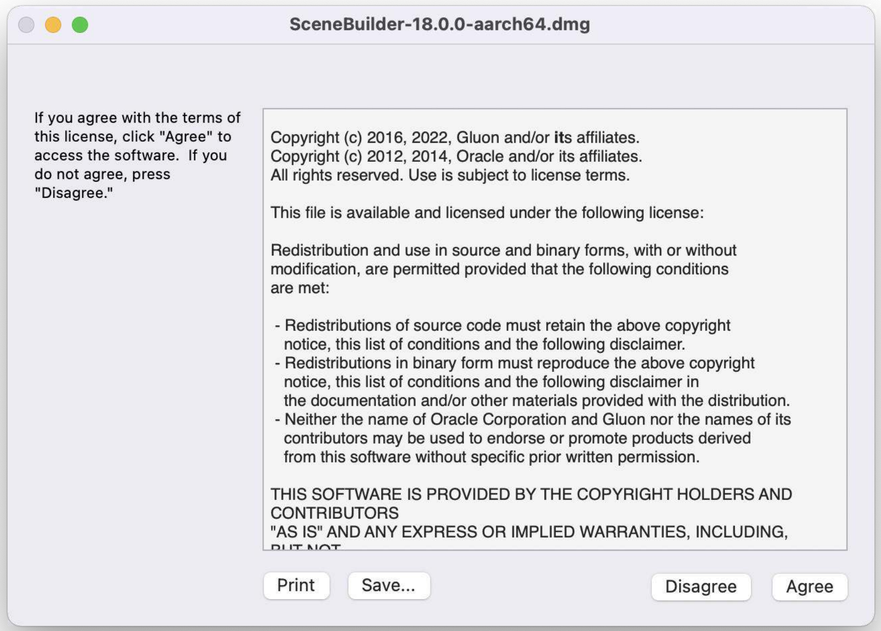

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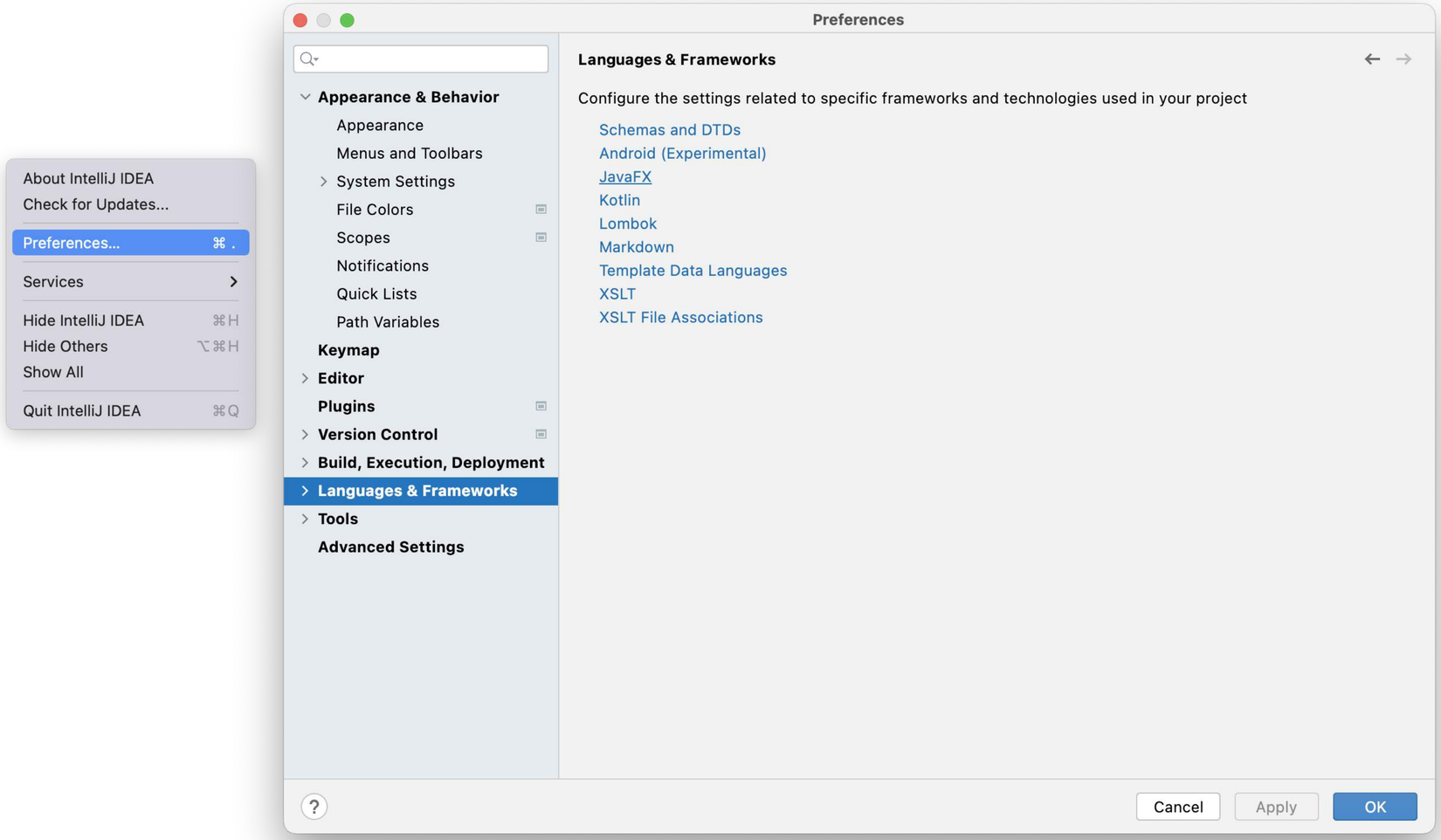

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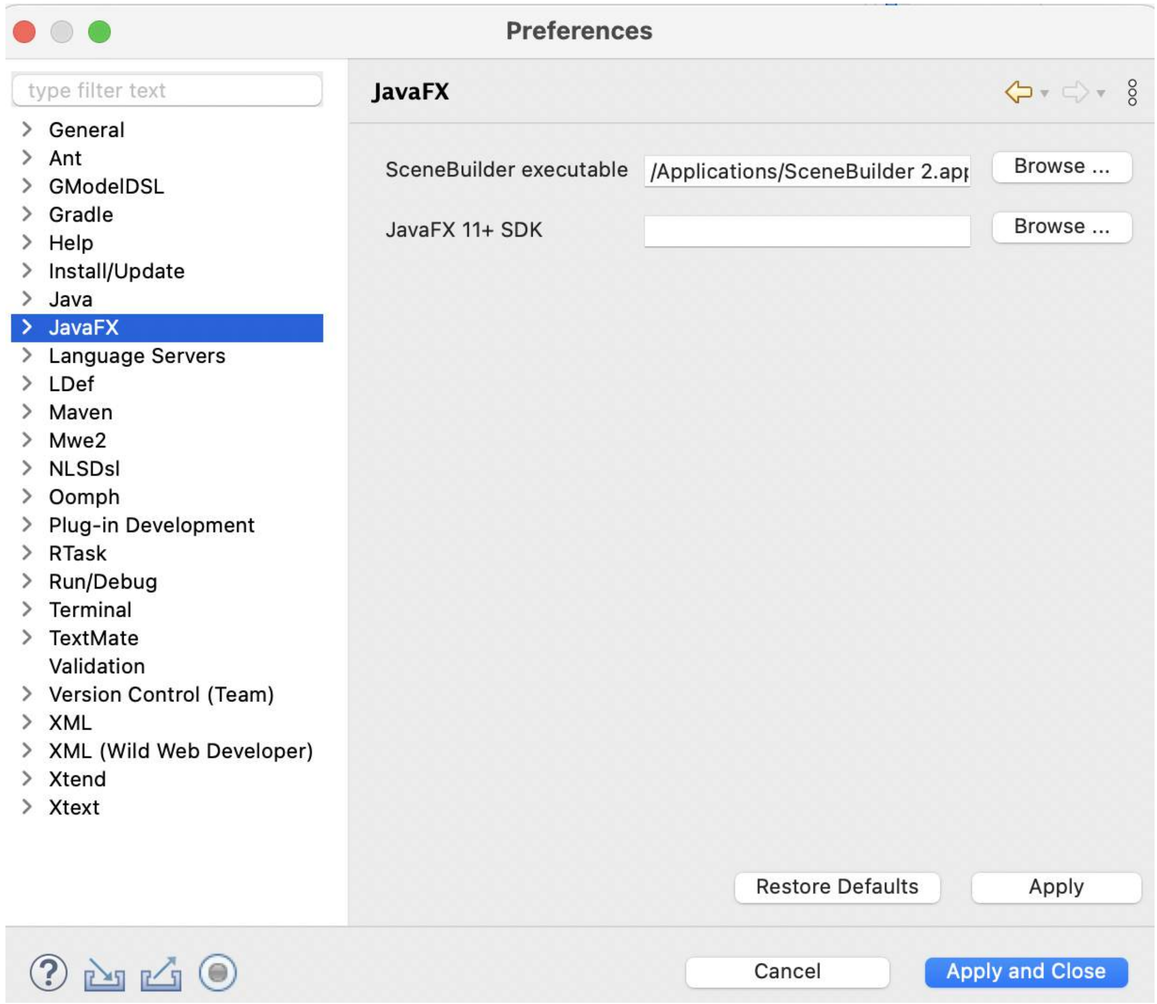

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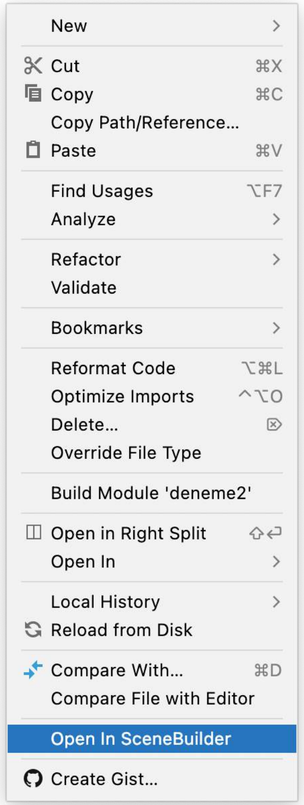

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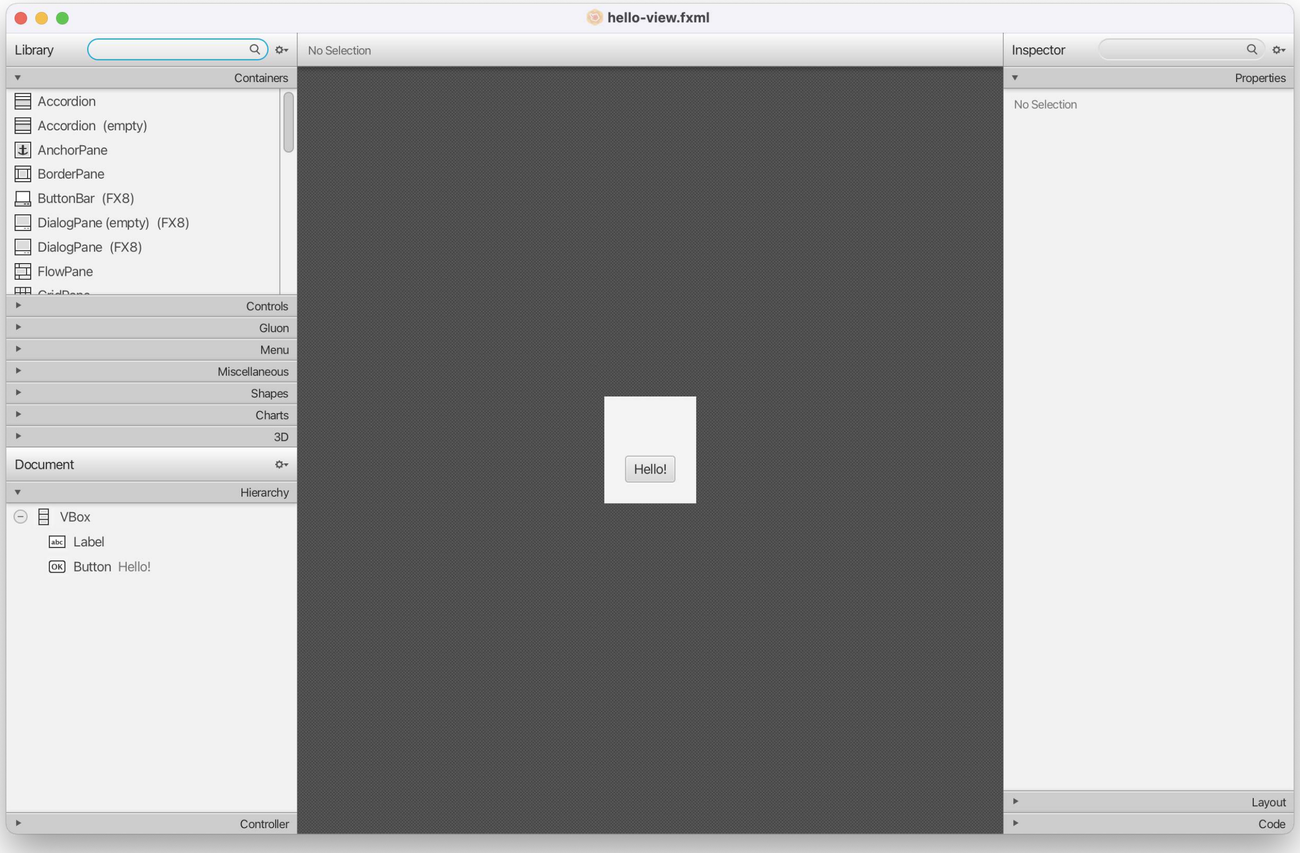

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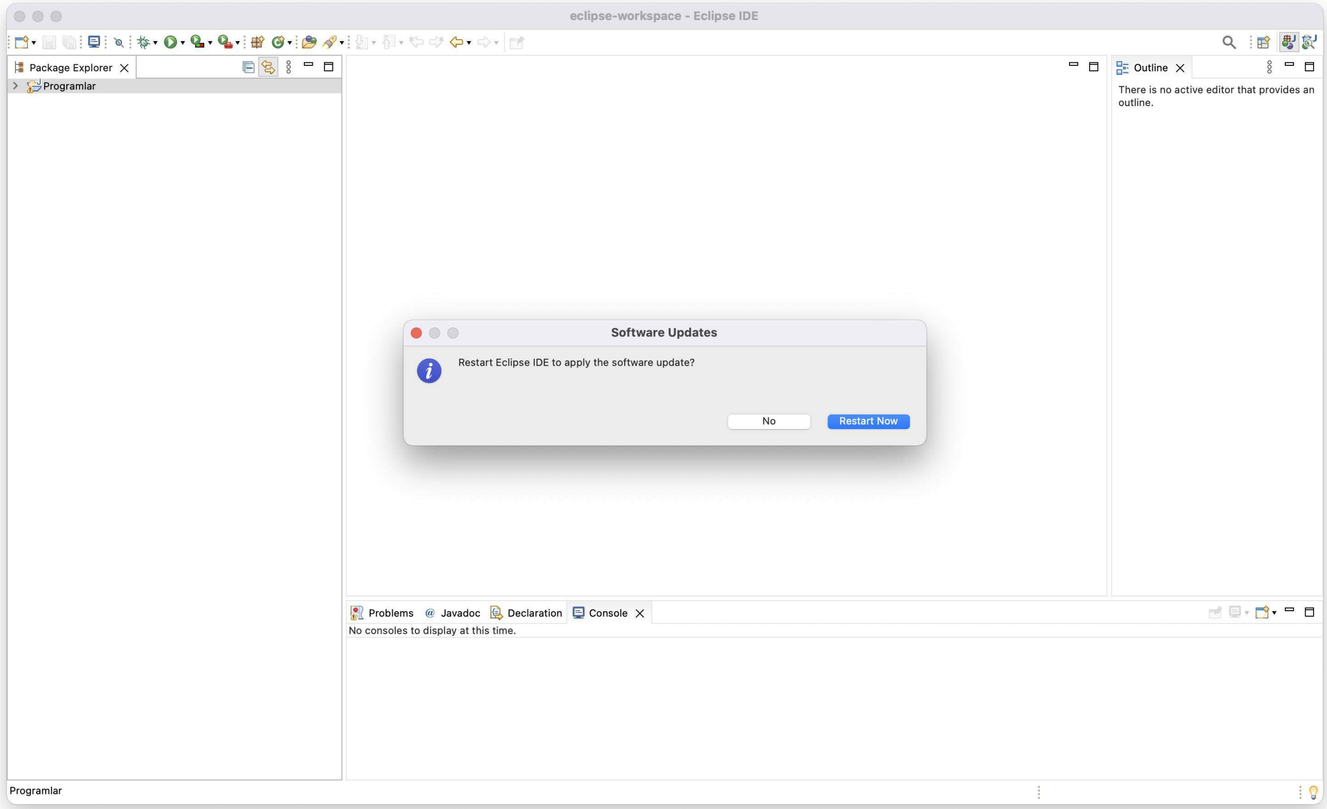


Example Program

Example - 2

- Let's implement the shape application we created with Scene Builder.

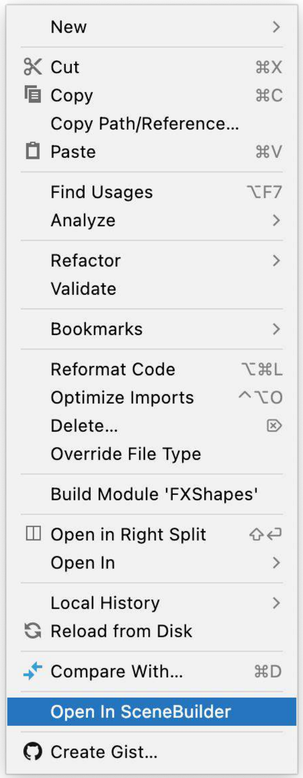
Shapes

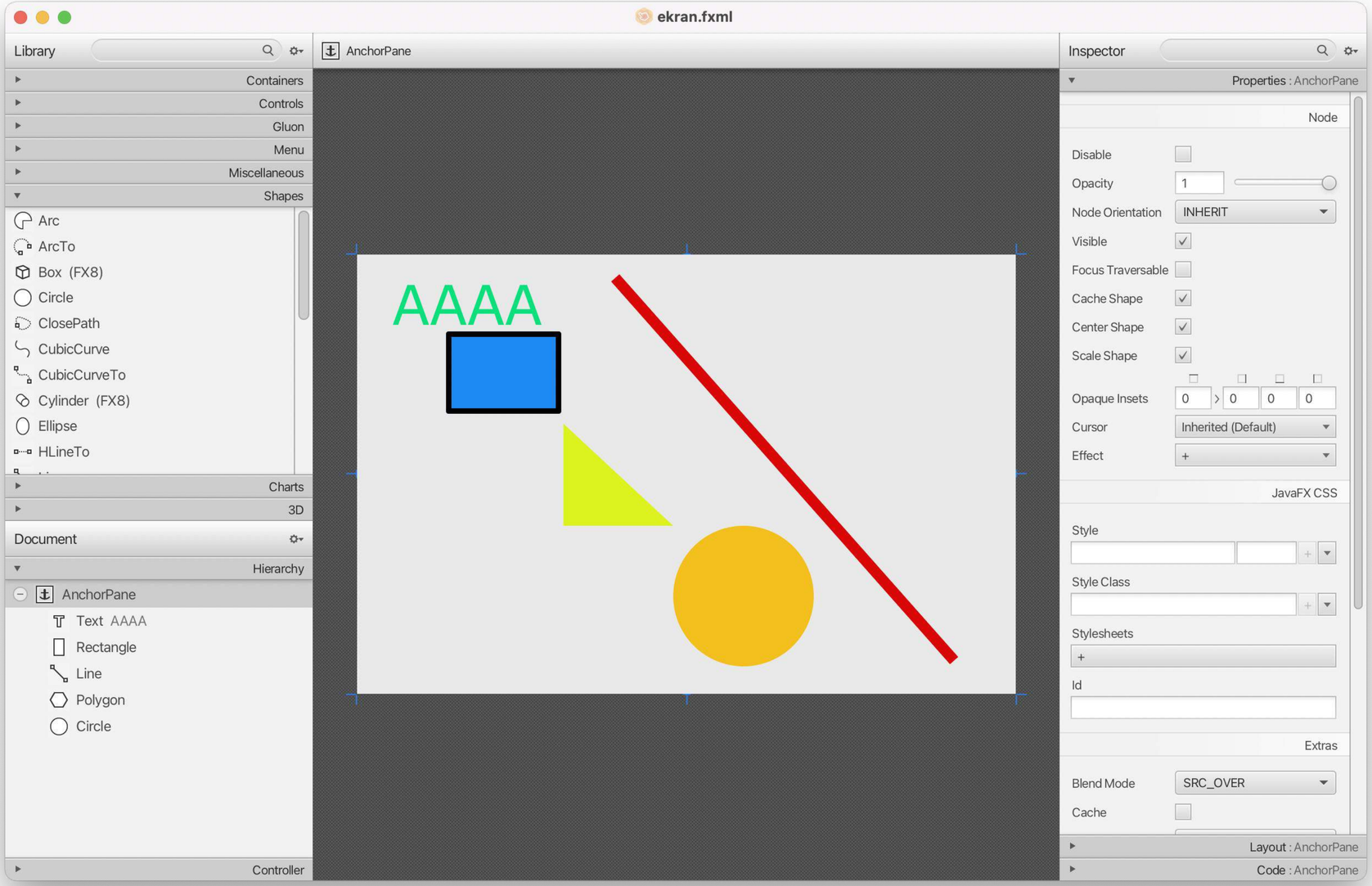
Example - 2

```
public class HelloApplication extends Application {
    @Override
    public void start(Stage stage) throws IOException {

        FXMLLoader fxmlLoader = new FXMLLoader(HelloApplication.class.getResource("ekran.fxml"));

        Scene scene = new Scene(fxmlLoader.load(), Color.LIGHTSKYBLUE);
        stage.setTitle("Hello!");
        stage.setScene(scene);
        stage.show();
    }

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

Shapes

Example - 2





Shapes
Example - 2

- Let's develop an application that moves a shape up, down, right, left.

- We will connect with the OnAction events of the buttons.

- We will call the .fxml file we created with the following code.

```
Parent root = FXMLLoader.load(getClass().getResource("Main.fxml"));
```

Shapes

Example - 2

```
package com.example.deneme4;

import javafx.application.Application;
import javafx.fxml.FXMLLoader;
import javafx.scene.Parent;
import javafx.scene.Scene;
import javafx.stage.Stage;

import java.io.IOException;

public class HelloApplication extends Application {
    @Override
    public void start(Stage stage) throws Exception {
        try {
            Parent root = FXMLLoader.load(getClass().getResource("Main.fxml"));
            Scene scene = new Scene(root);
            stage.setTitle("MERHABA ARKADAŞLAR!");
            stage.setScene(scene);
            stage.show();
        }  catch (Exception e){
            e.printStackTrace();}
        }


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

Shapes

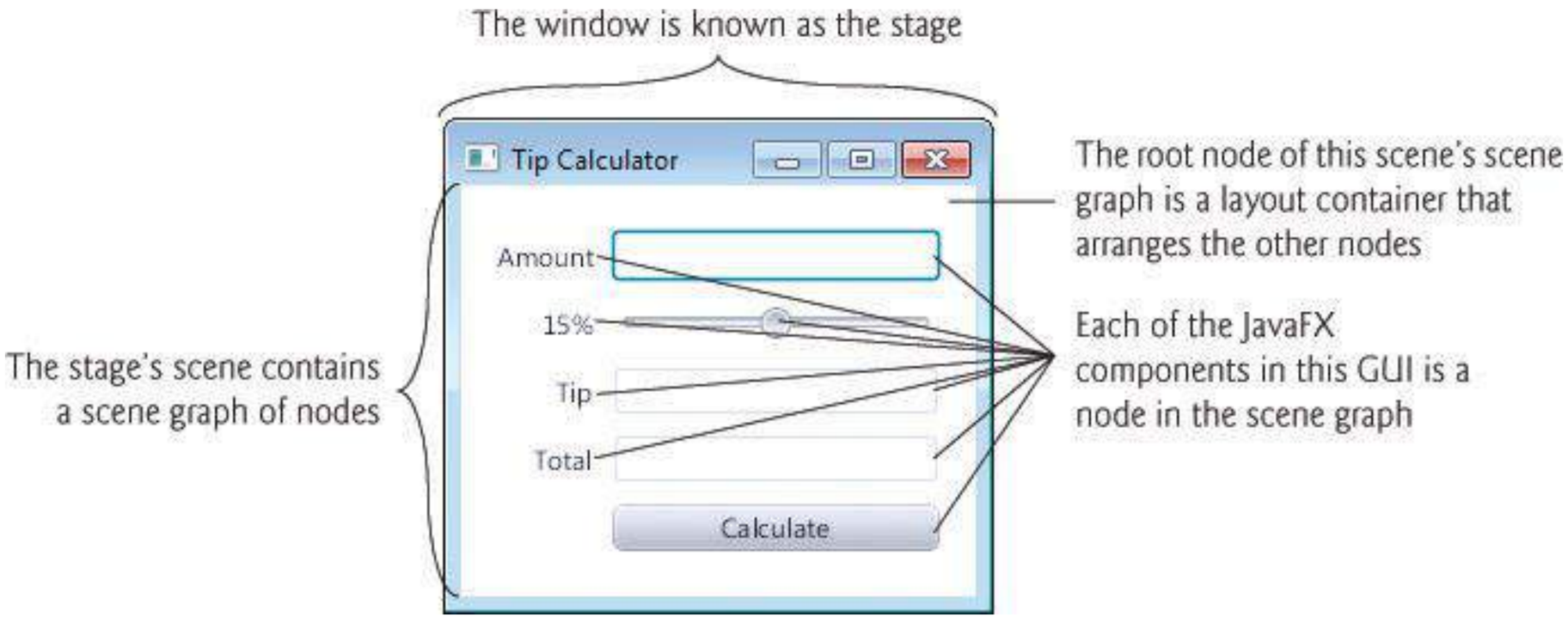
Example - 2

```
package com.example.deneme4;

import javafx.event.ActionEvent;
import javafx.fxml.FXML;
import javafx.scene.shape.Circle;

public class Controller {
    @FXML
    private Circle daire;
    private double x;
    private double y;

    public void yukariya(ActionEvent e){
        daire.setCenterY(y=y-10);
        //System.out.println("Yukarıya");
    }
    public void asagiya(ActionEvent e){
        daire.setCenterY(y=y+10);
        //System.out.println("Aşağıya");
    }
    public void sola(ActionEvent e){
        daire.setCenterX(x=x-10);
        //System.out.println("Sola");
    }
    public void saga(ActionEvent e){
        daire.setCenterX((x=x+10));
        //System.out.println("Sağa");
    }
```

JavaFX Program Structure

A JavaFX Program

- It consists of Stage, Scene and nodes.



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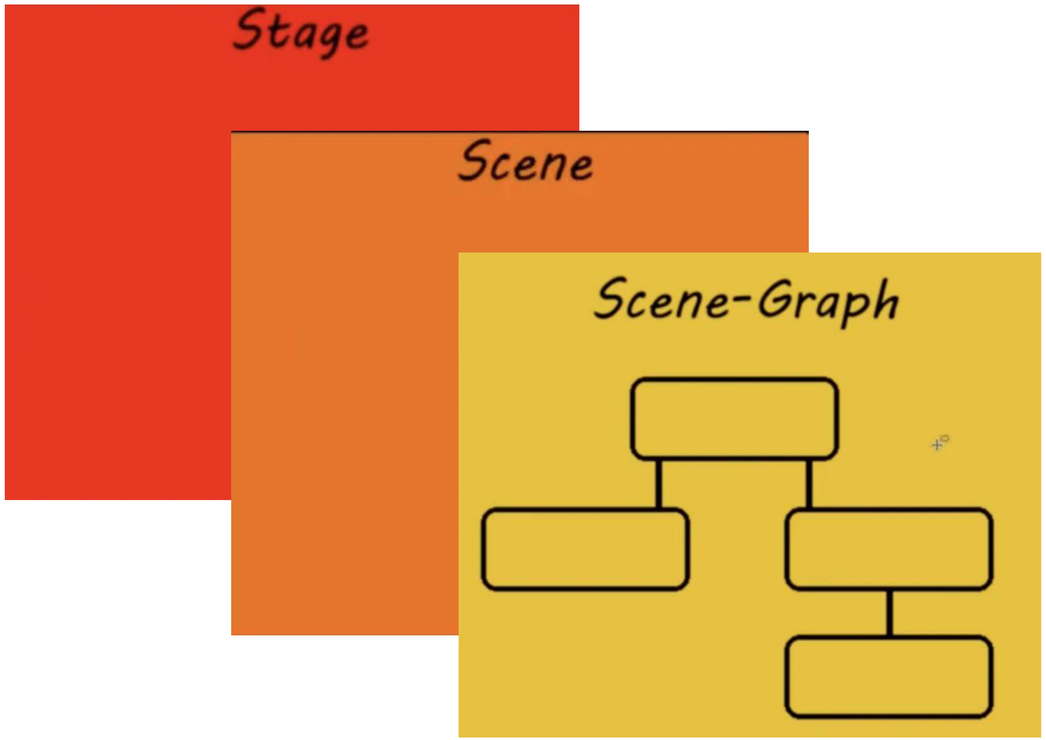

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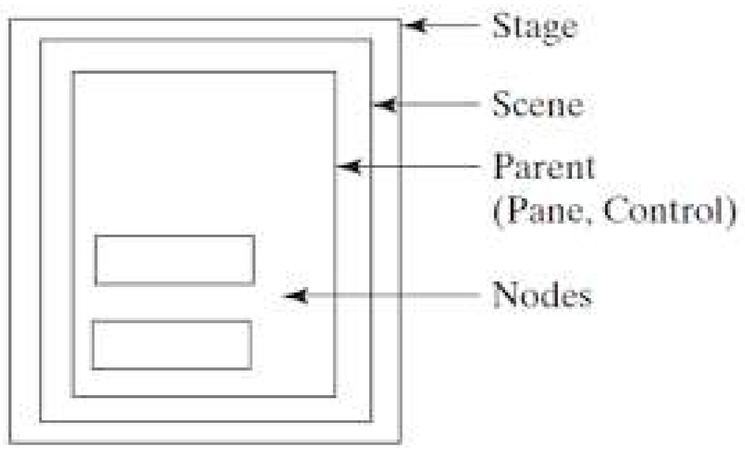

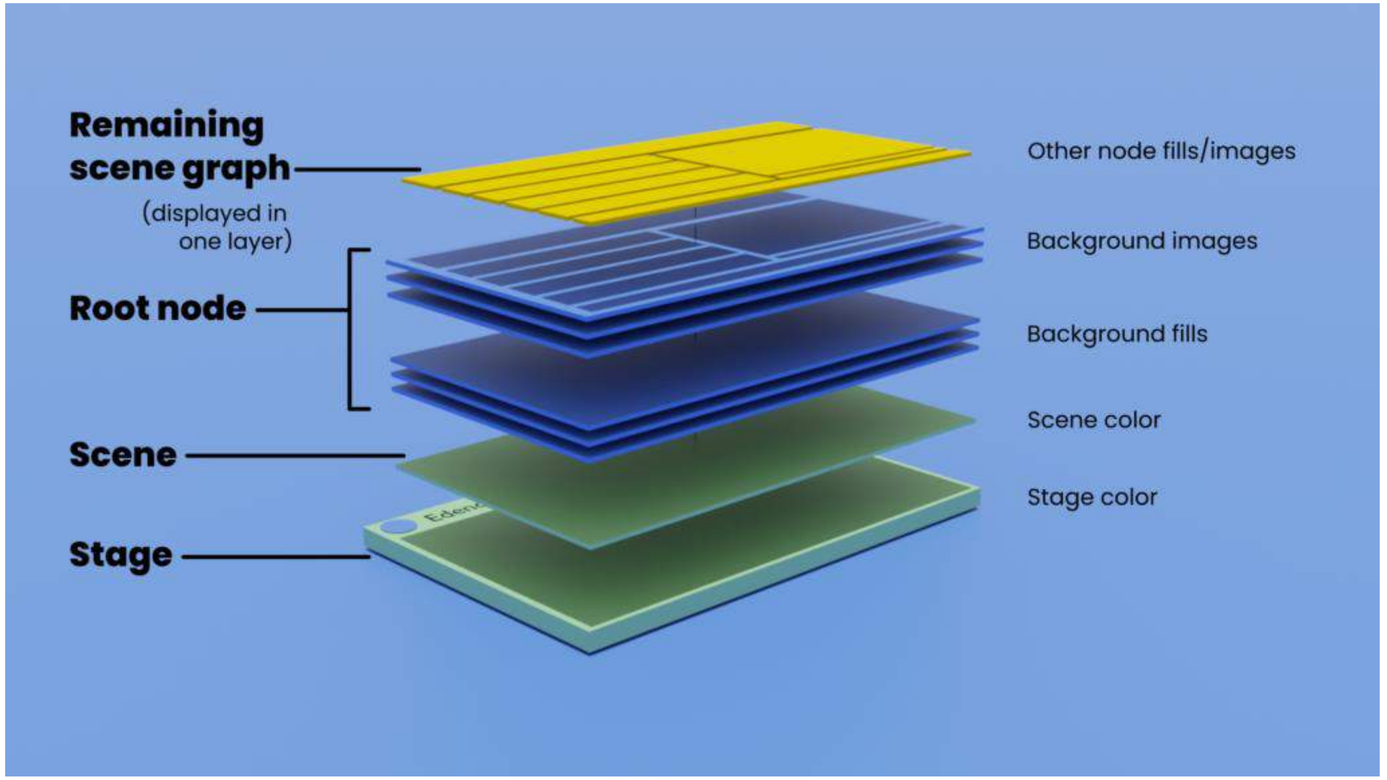

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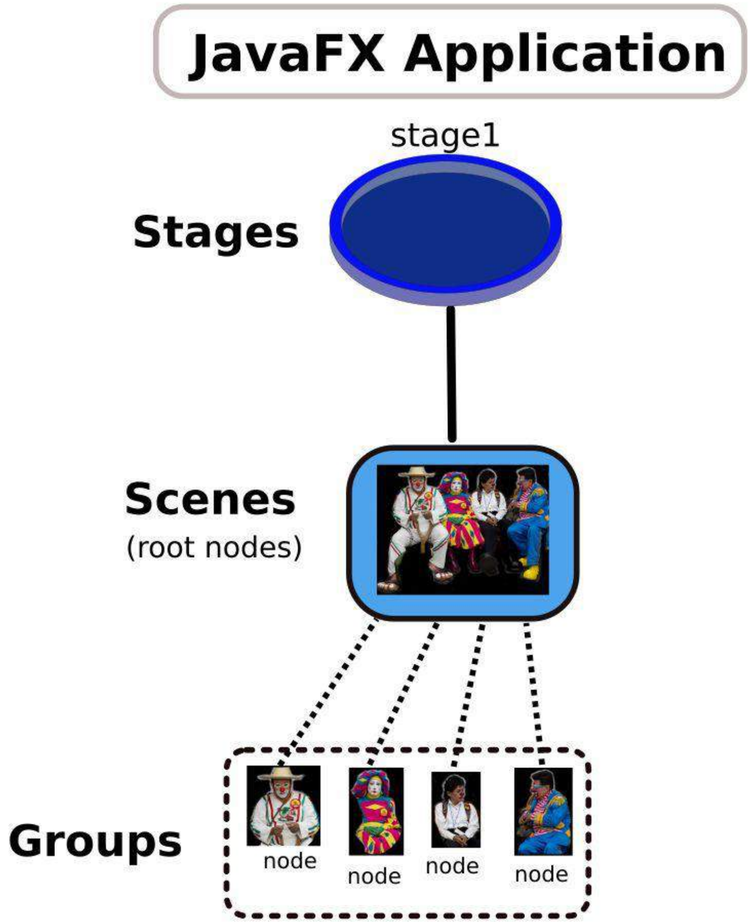

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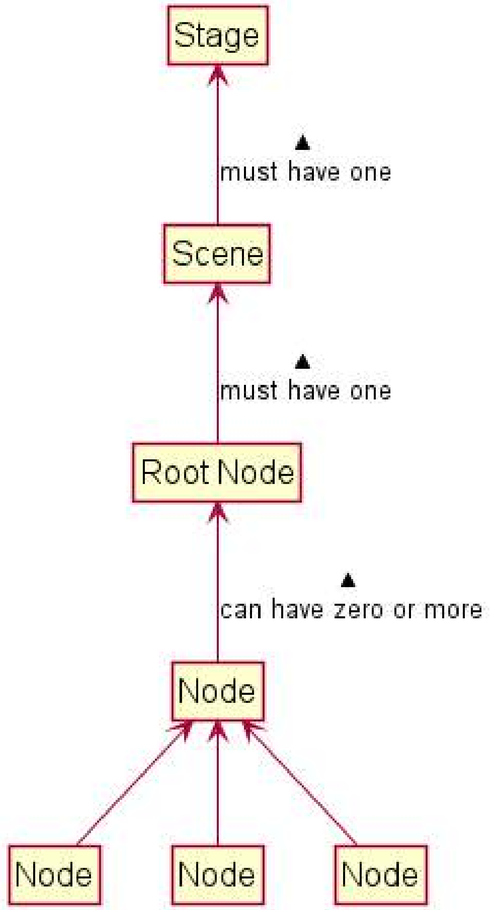

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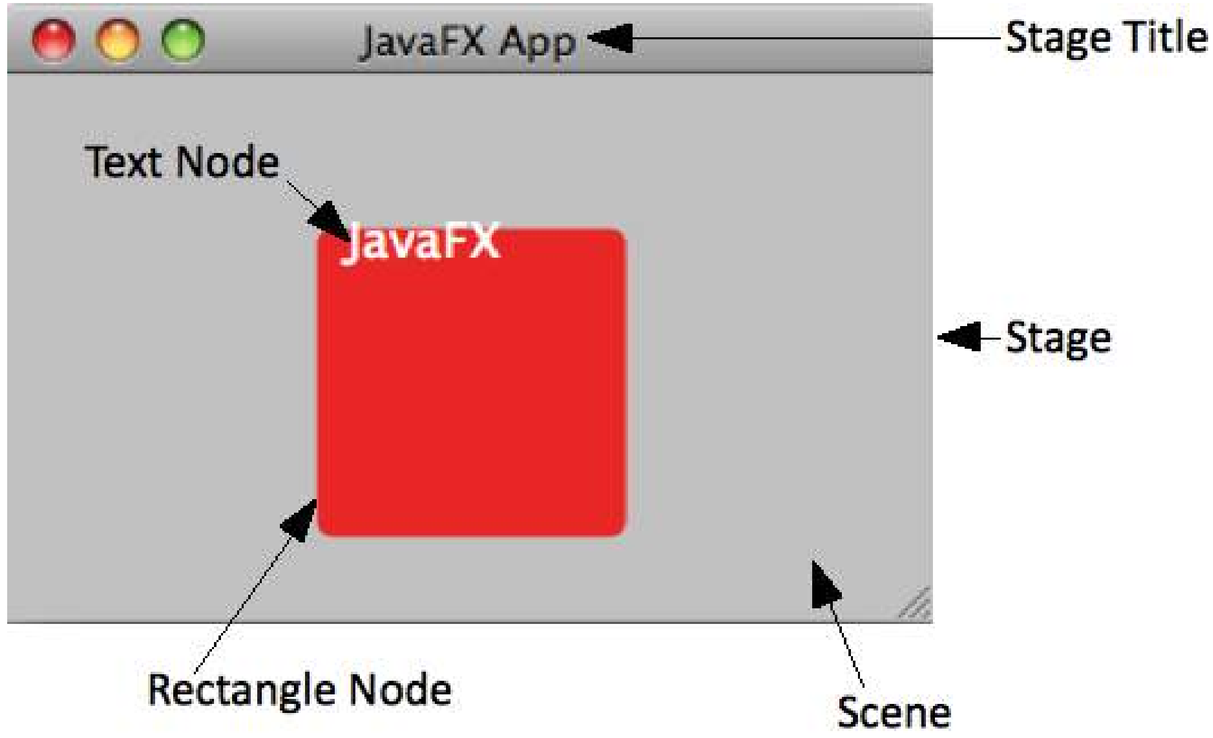

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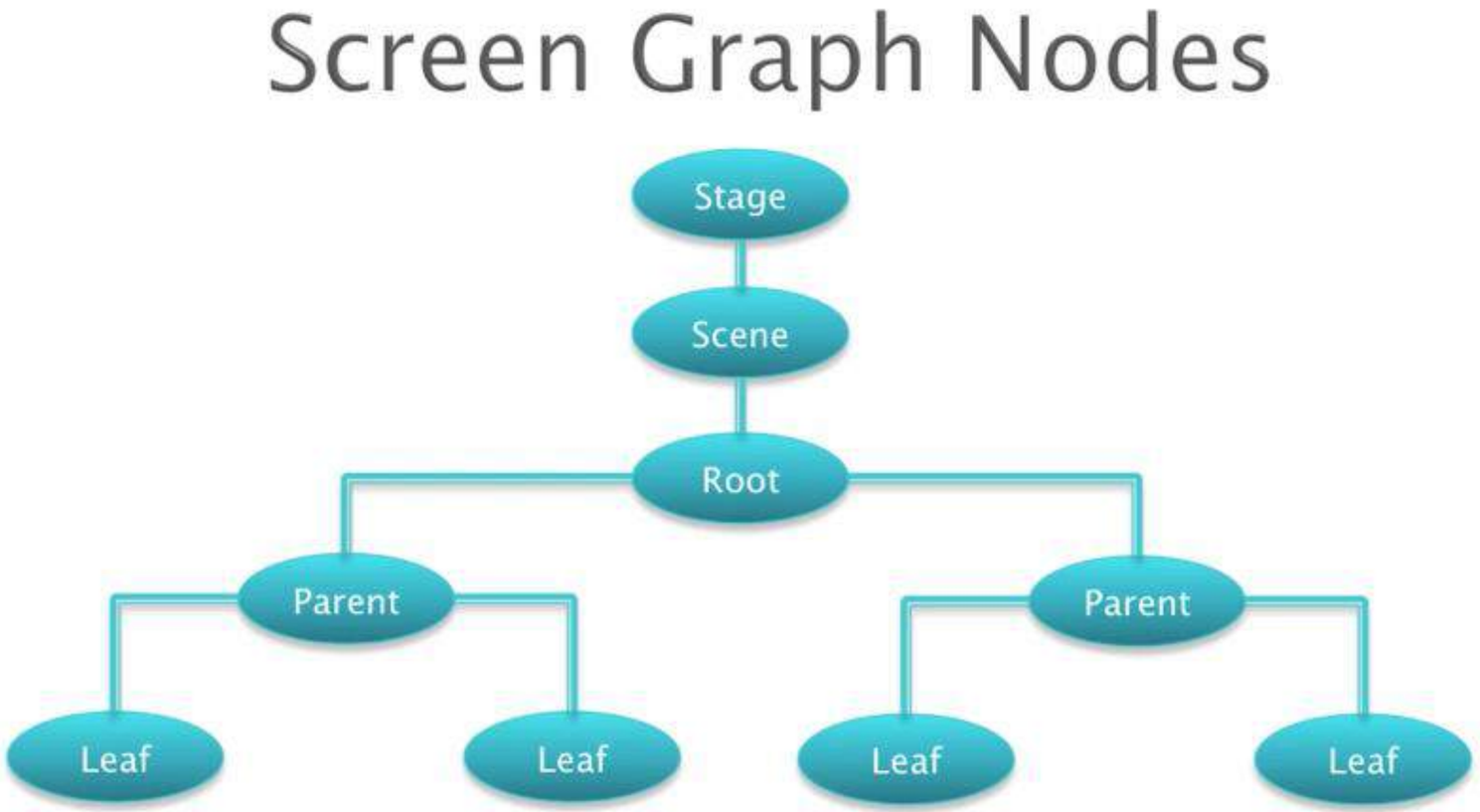

Homework - 1

- Work on your own sample shapes program.

Next Lecture

- We will continue to the topic.

Visual Programming

- There are too many examples in open sources on the subject. You can review it.

Programming Session

- Java FX

Summary

- As a result, this week we learned Java FX basic programming.