GIA DINH
UNIVERSITY

Chapter 4

Graphical User Interface Programming

Objectives

- *Explain GUI toolkits*
- *Explain various Containers and Components*
  - *Label, Text*
  - *TextFields*
  - *Button*
  - *Checkboxes and RadioButtons*
  - *HBox, VBox*
  - *BorderPane, GridPane, FlowPane*
- *Identify events generated by components*
- *Create a standalone GUI application*

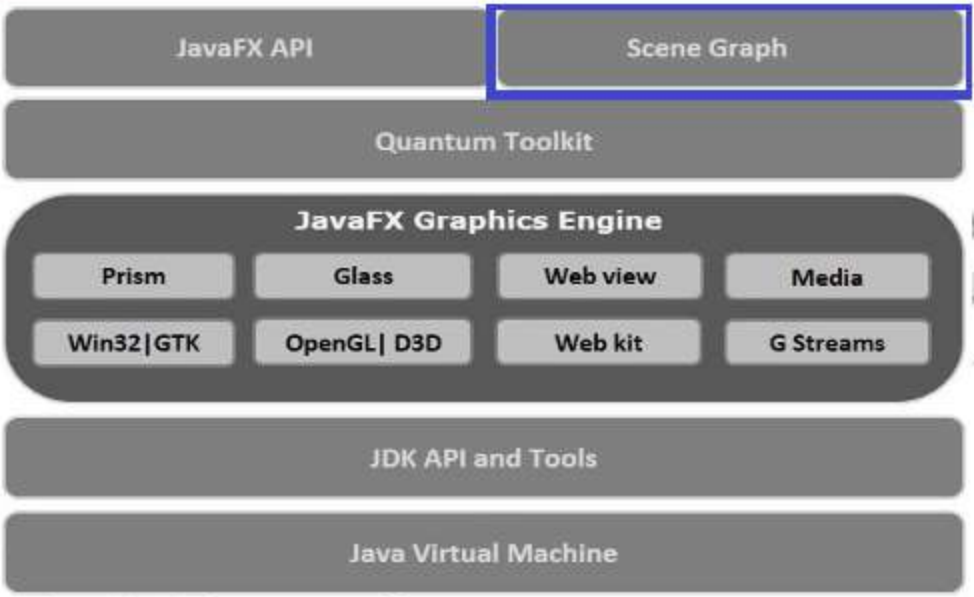
Overview

- RIA:
  - Rich Internet Applications
  - Three main technologies: Adobe Flash, Microsoft Silverlight, JavaFX
- GUI in Java:
  - AWT: Advanced Windowing Tool
  - Swing
  - JavaFX
  - Other:
    - SWT *(Eclipse's Standard Widget Toolkit)*,
    - GWT *(Google Web Toolkit)*,
    - 3D Graphics API: Java OpenGL, Java3D

Overview

- JavaFX:
  - a Java library used to build RIAs
  - across multiple platforms
  - run on various devices: desktop computers, mobile phones, TVs…

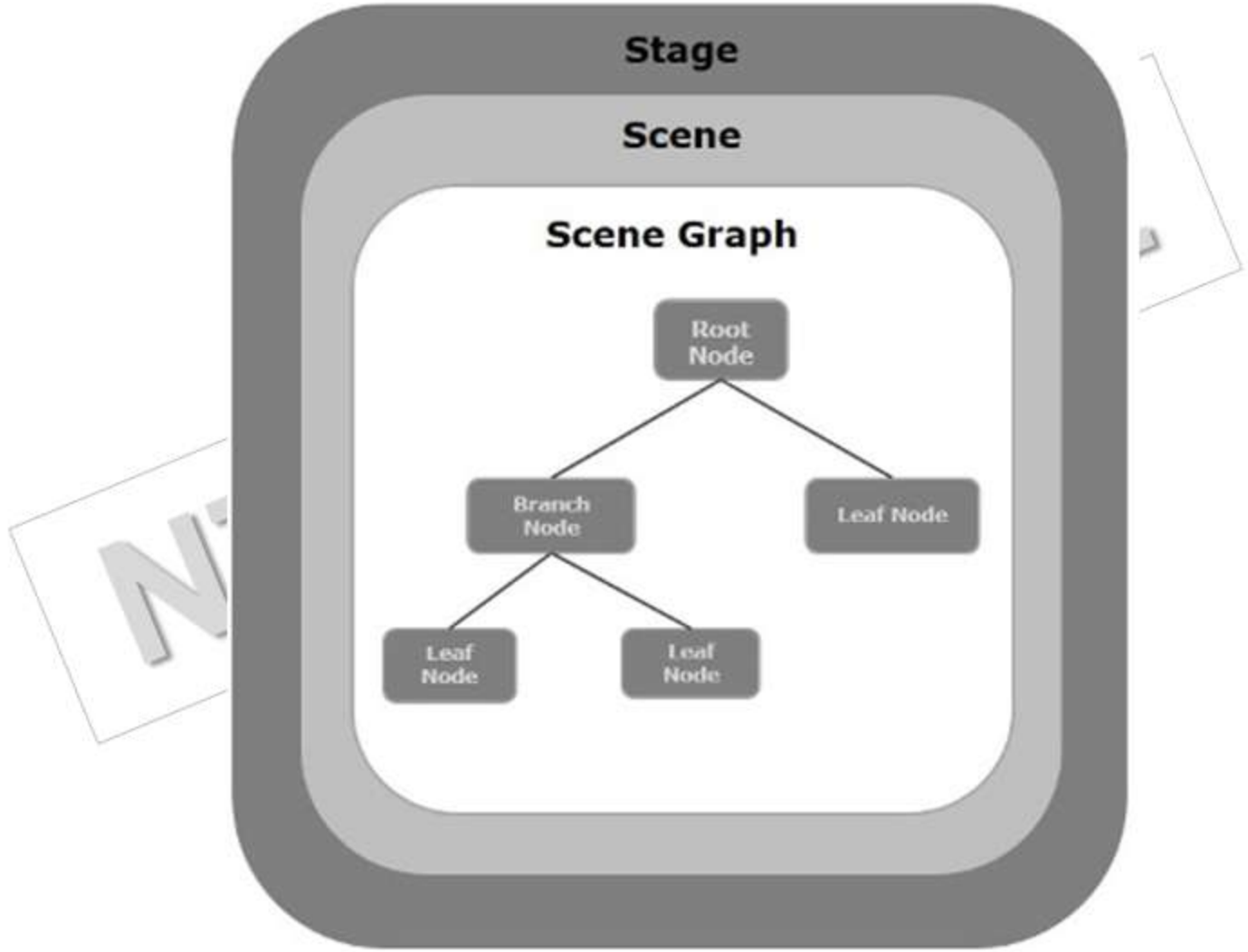
JavaFX



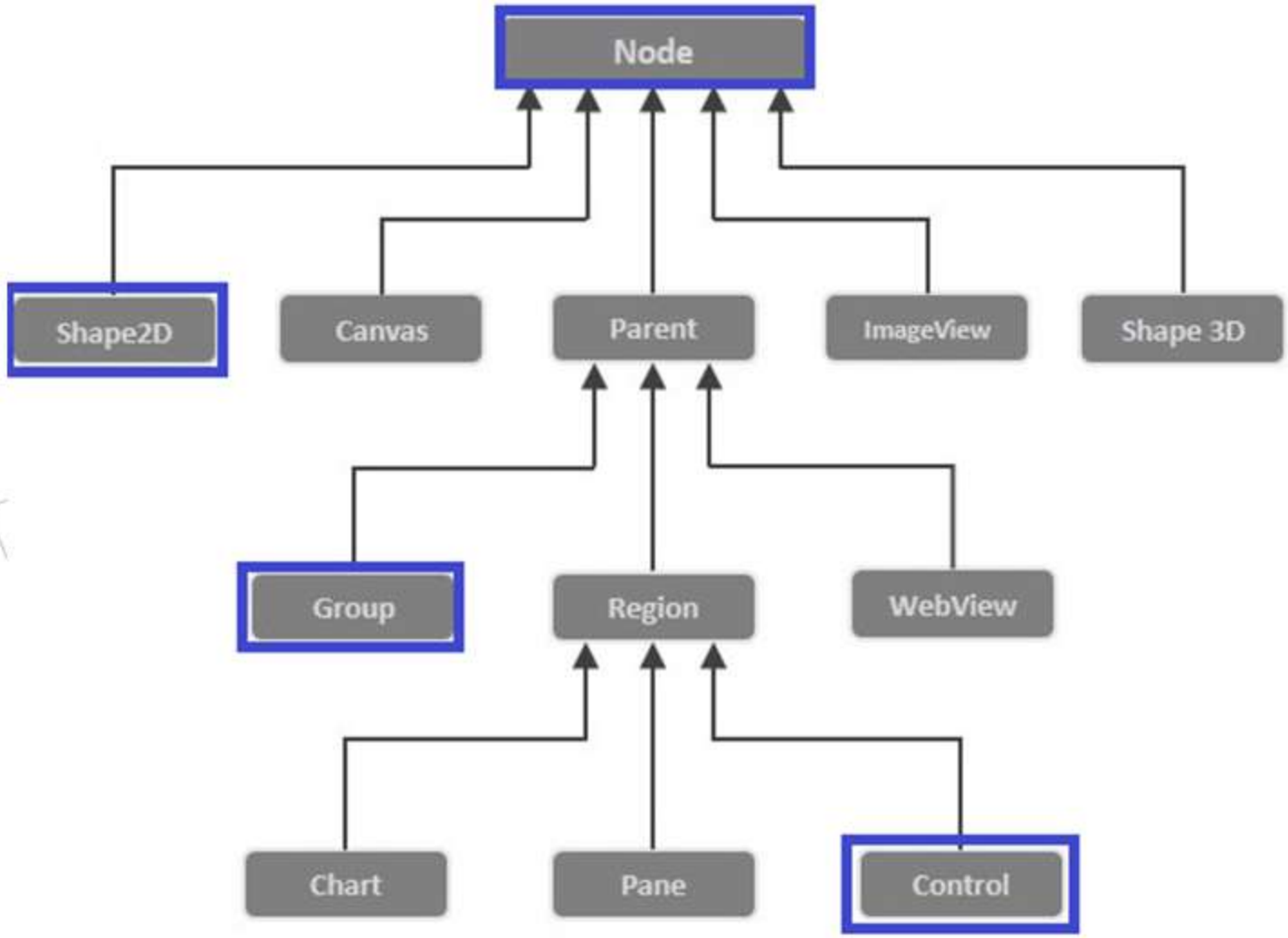
The architecture of JavaFX

- Scene Graph:
  - **Geometrical**: 2D and 3D such as circle, rectangle, polygon…
  - **UI controls**: Button, Checkbox, Choice box, Text Area …
  - **Containers** *(layout panes)*: Border Pane, Grid Pane, Flow Pane
  - Media elements: audio, video and image

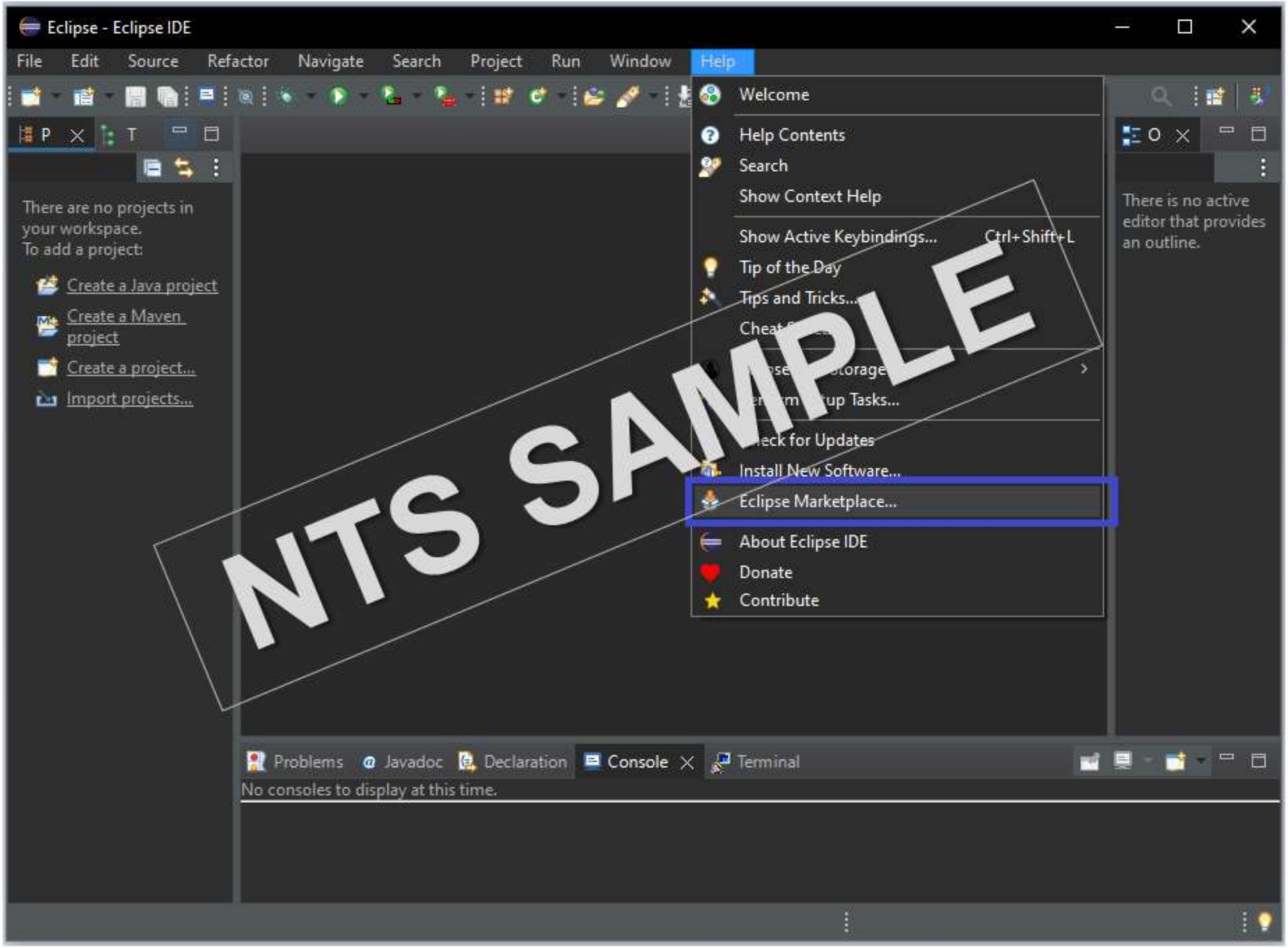
JavaFX Application Structure



The node class hierarchy of JavaFX



Installation


Eclipse - Eclipse IDE
File
Edit
Source
Refactor
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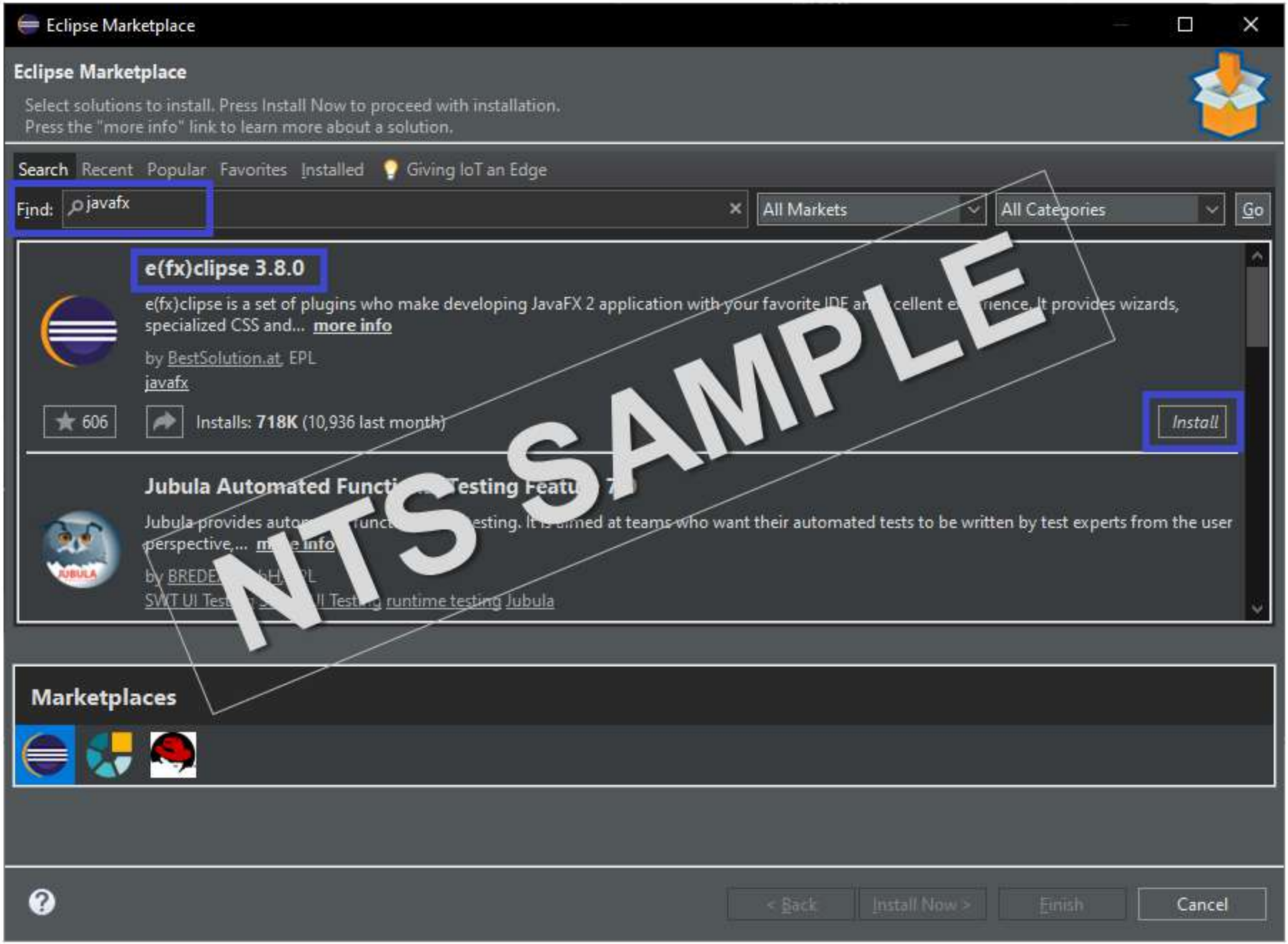
Search
Project
Run
Window
Help
Welcome
Help Contents
Search
Show Context Help
Show Active Keybindings... Ctrl+Shift+L
Tip of the Day
Tips and Tricks...
Install New Software...
Eclipse Marketplace...
About Eclipse IDE
Donate
Contribute
There are no projects in your workspace.
To add a project:
Create a Java project
Create a Maven project
Create a project...
Import projects...
There is no active editor that provides an outline.
Problems
Javadoc
Declaration
Console
Terminal
No consoles to display at this time.
NTS SAMPLE


Eclipse Marketplace
Eclipse Marketplace
Select solutions to install. Press Install Now to proceed with installation.
Press the "more info" link to learn more about a solution.
Search Recent Popular Favorites Installed Giving IoT an Edge
Find: javafx
All Markets
All Categories
Go
e(fx)clipse 3.8.0
e(fx)clipse is a set of plugins who make developing JavaFX 2 application with your favorite IDE an cellent e rience. It provides wizards, specialized CSS and... more info
by BestSolution.at EPL
javafx
606
Installs: 718K (10,936 last month)
Install
Jubula Automated Functi Testing Featu
Jubula provides auto unct esting. It is aimed at teams who want their automated tests to be written by test experts from the user perspective,... m e info
by BREDE bH PL
SWT UI Test ll Testing runtime testing Jubula
NTS SAMPLE
Marketplaces
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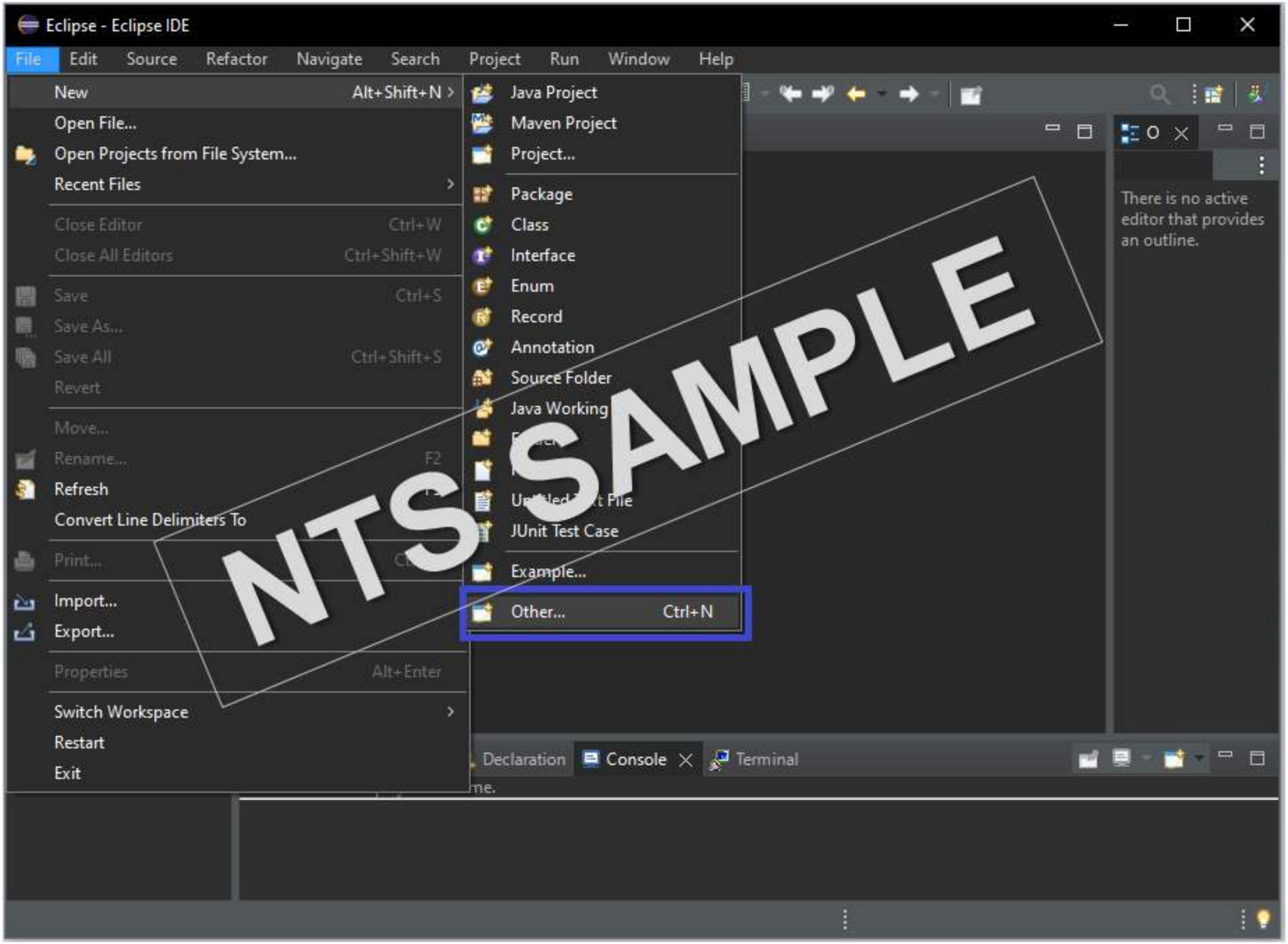
Eclipse - Eclipse IDE
File
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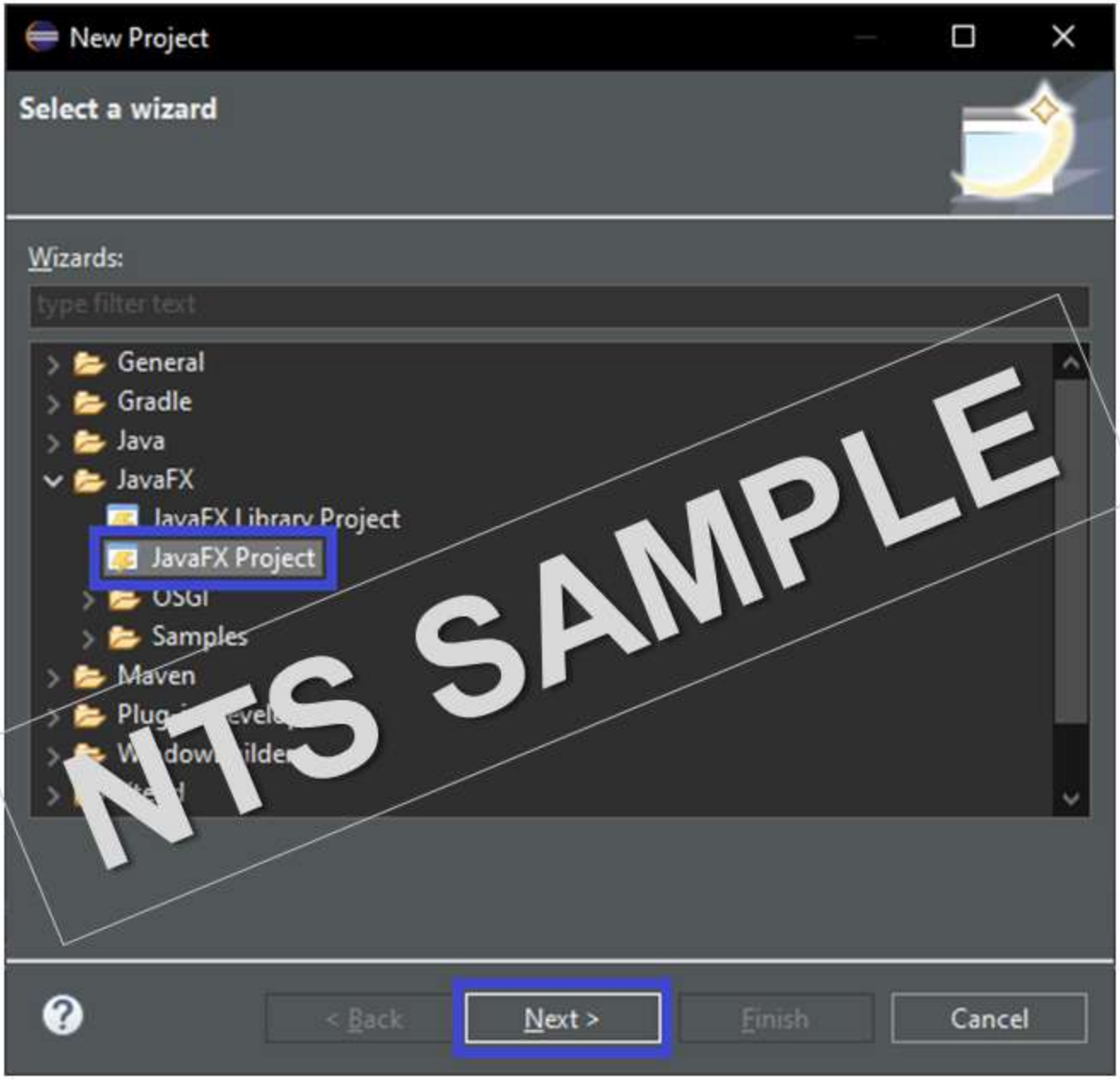
Source
Refactor
Navigate
Search
Project
Run
Window
Help
New Alt+Shift+N
Open File...
Open Projects from File System...
Recent Files
Close Editor Ctrl+W
Close All Editors Ctrl+Shift+W
Save Ctrl+S
Save As...
Save All Ctrl+Shift+S
Revert
Move...
Rename... F2
Refresh
Convert Line Delimiters To
Print...
Import...
Export...
Properties Alt+Enter
Switch Workspace
Restart
Exit
Java Project
Maven Project
Project...
Package
Class
Interface
Enum
Record
Annotation
Source Folder
JUnit Test Case
Example...
Other... Ctrl+N
There is no active editor that provides an outline.
Declaration
Console
Terminal
NTS SAMPLE


New Project
Select a wizard
Wizards:
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General
Gradle
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JavaFX Project
Samples
Maven
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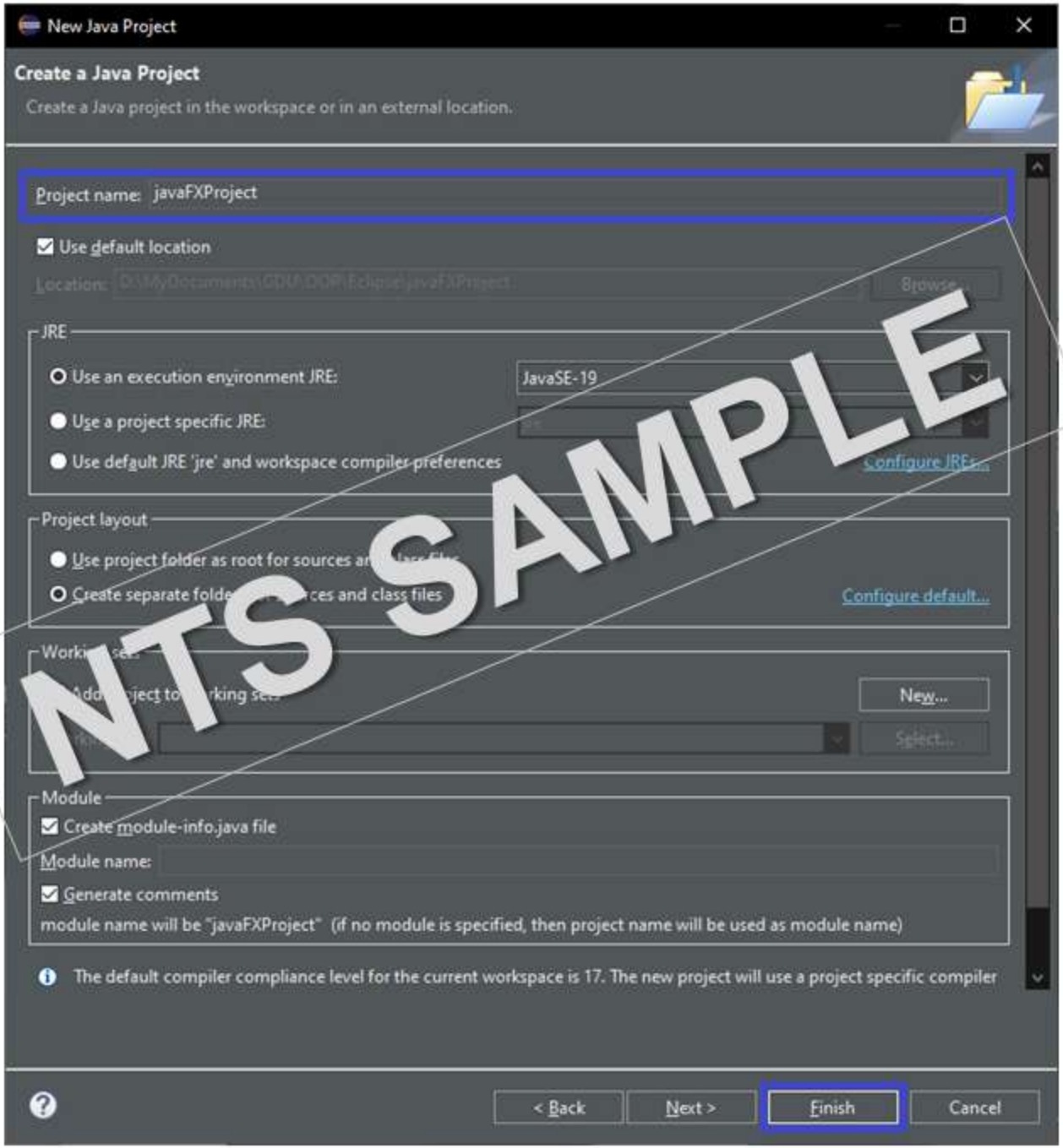
NTS SAMPLE


New Java Project
Create a Java Project
Create a Java project in the workspace or in an external location.
Project name: javaFXProject
Use default location
Location: D:\MyDocuments\GDU\JDK\Eclipse\javaFXProject
Browse...
JRE
Use an execution environment JRE:
JavaSE-19
Use a project specific JRE:
Use default JRE 'jre' and workspace compiler preferences
Configure JREs...
Project layout
Use project folder as root for sources and class files
Create separate folders for sources and class files
Configure default...
Working sets
Add project to working sets
New...
Select...
Module
Create module-info.java file
Module name:
Generate comments
module name will be "javaFXProject" (if no module is specified, then project name will be used as module name)
The default compiler compliance level for the current workspace is 17. The new project will use a project specific compiler
< Back
Next >
Finish
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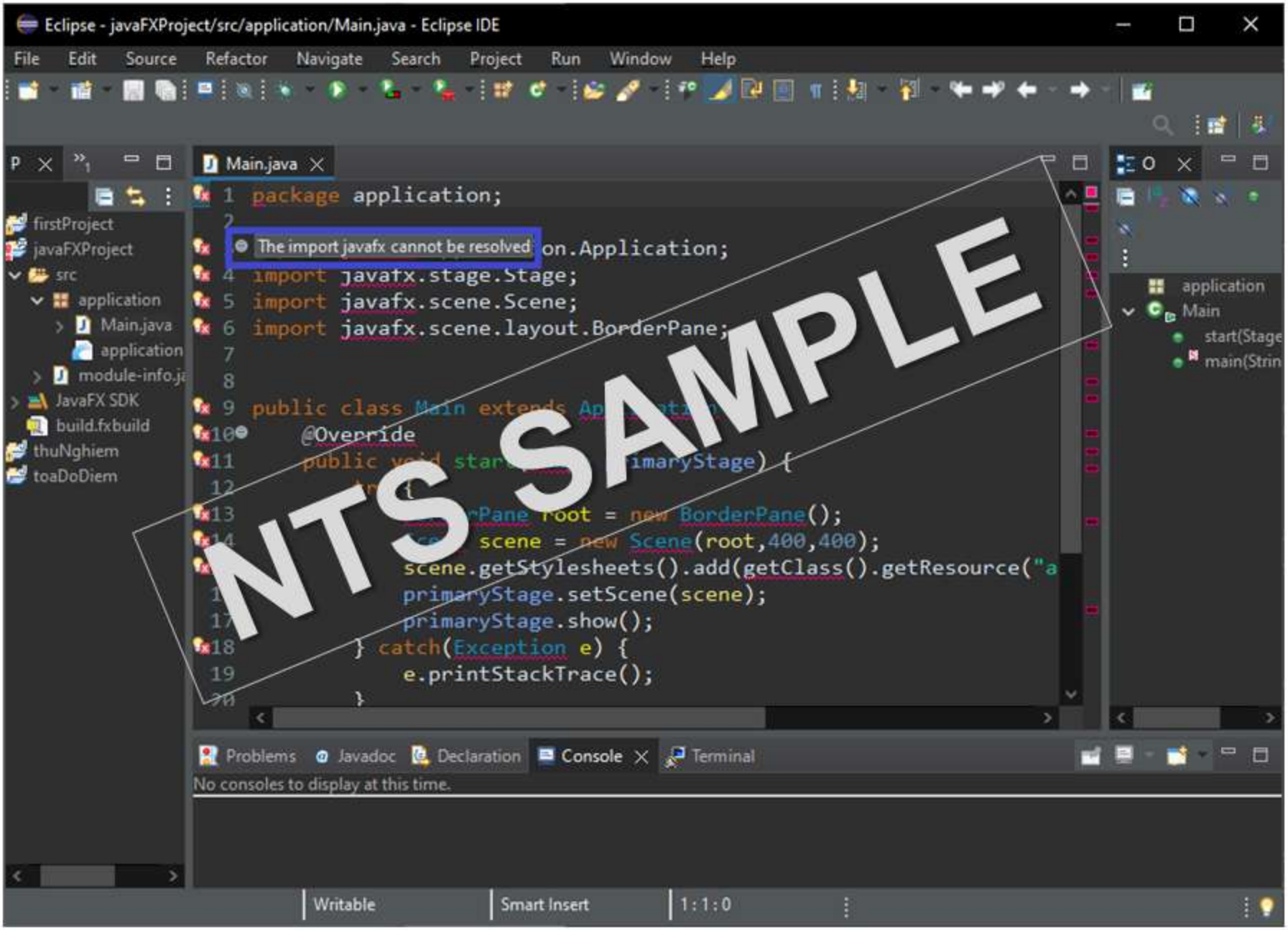
Eclipse - javaFXProject/src/application/Main.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Main.java
package application;
The import javafx cannot be resolved
import javafx.stage.Stage;
import javafx.scene.Scene;
import javafx.scene.layout.BorderPane;
public class Main extends Application {
@Override
public void start(Stage primaryStage) {
BorderPane root = new BorderPane();
Scene scene = new Scene(root,400,400);
scene.getStylesheets().add(getClass().getResource("a
primaryStage.setScene(scene);
primaryStage.show();
} catch(Exception e) {
e.printStackTrace();
firstProject
javaFXProject
src
application
Main.java
application
module-info.j
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Main
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Problems Javadoc Declaration Console Terminal
No consoles to display at this time.
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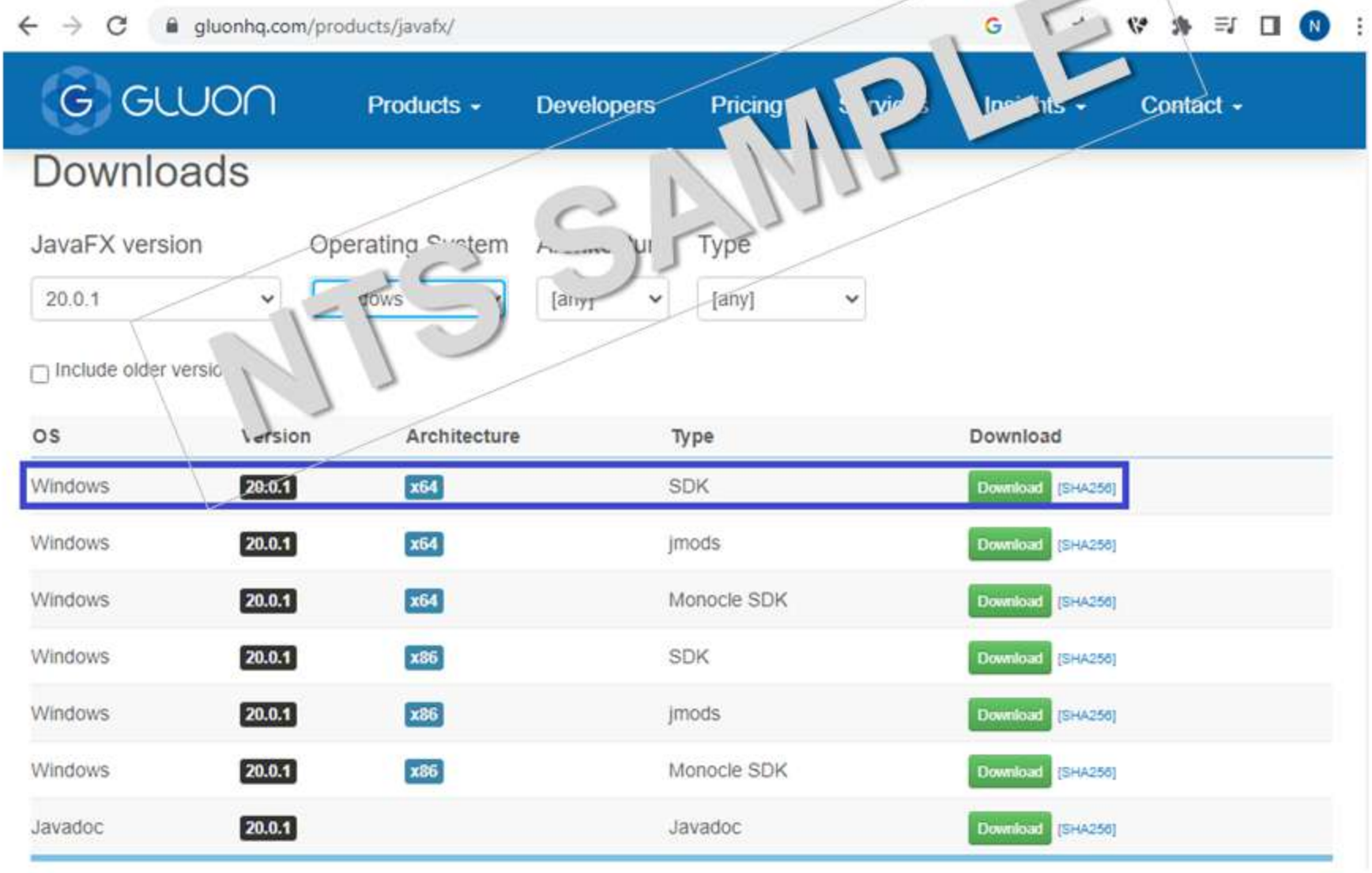
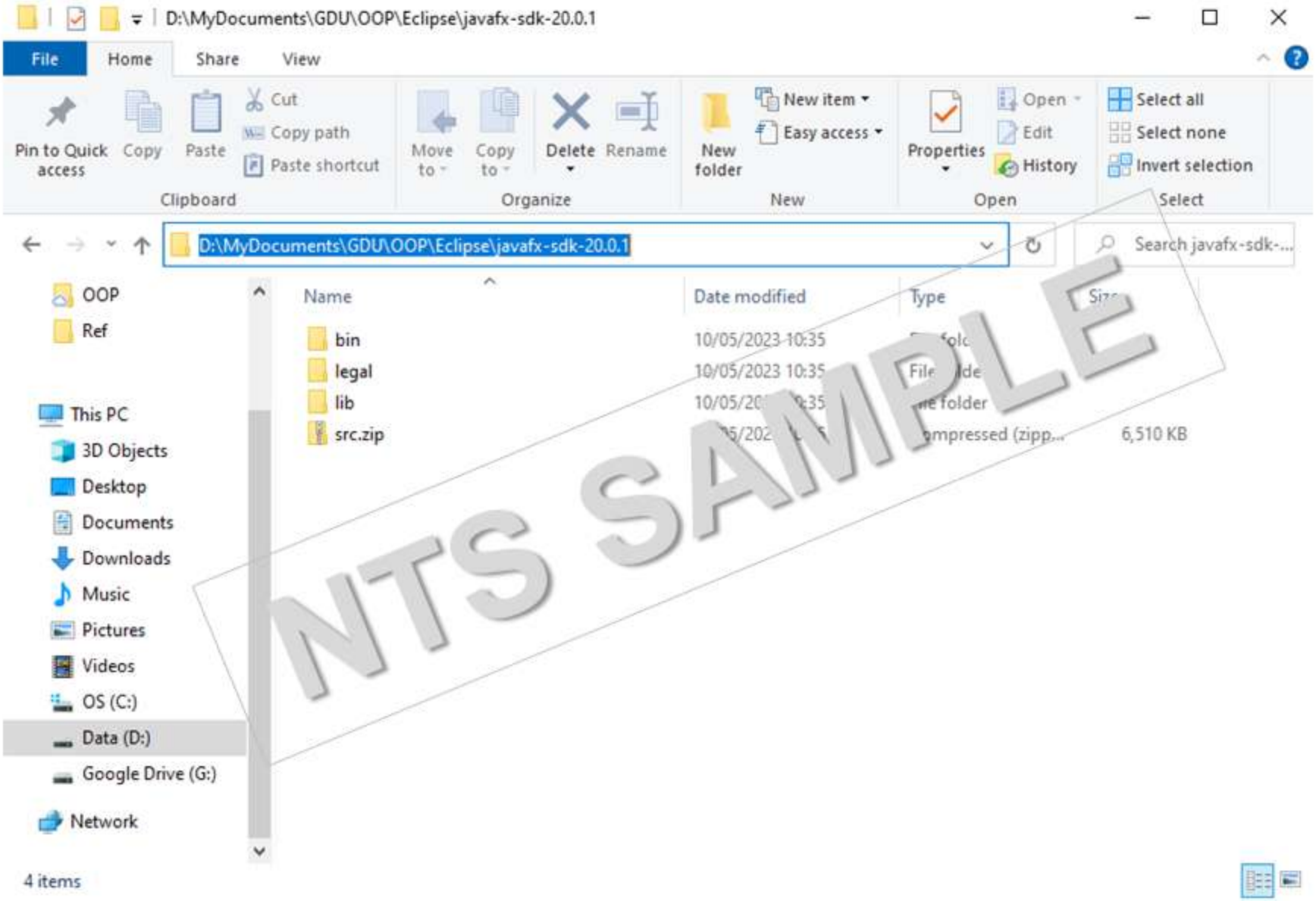
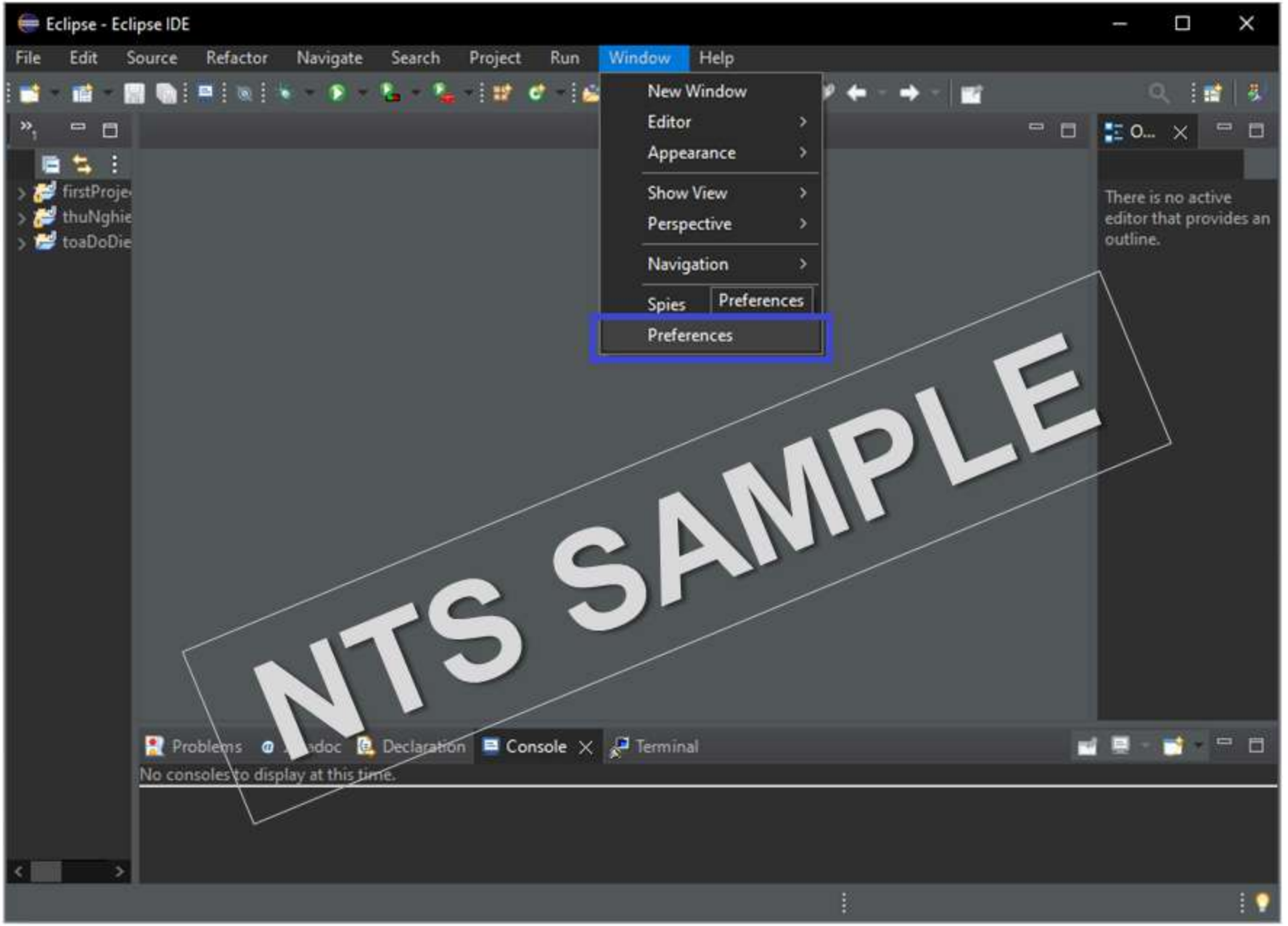
Download JavaFX: **https://gluonhq.com/products/javafx/**




D:\MyDocuments\GDU\OOP\Eclipse\javafx-sdk-20.0.1
File
Home
Share
View
Pin to Quick access
Copy
Paste
Cut
Copy path
Paste shortcut
Clipboard
Move to
Copy to
Delete
Rename
Organize
New folder
New item
Easy access
New
Properties
Open
Edit
History
Open
Select all
Select none
Invert selection
Select
D:\MyDocuments\GDU\OOP\Eclipse\javafx-sdk-20.0.1
Search javafx-sdk-...
OOP
Ref
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
OS (C:)
Data (D:)
Google Drive (G:)
Network
Name
Date modified
Type
Size
bin
10/05/2023 10:35
legal
10/05/2023 10:35
lib
src.zip
6,510 KB
4 items
NTS SAMPLE


Eclipse - Eclipse IDE
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Project
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Window
Help
New Window
Editor
Appearance
Show View
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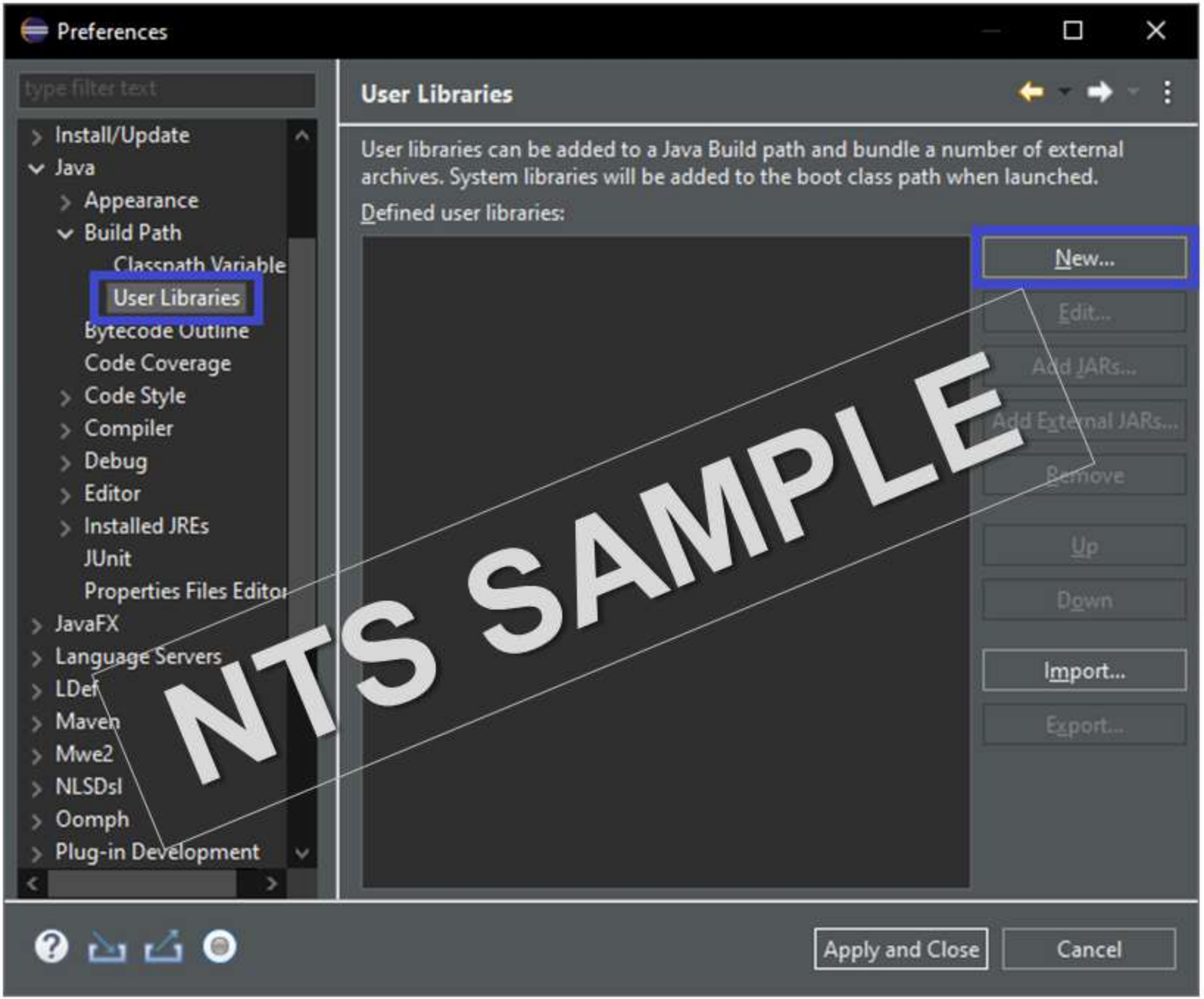
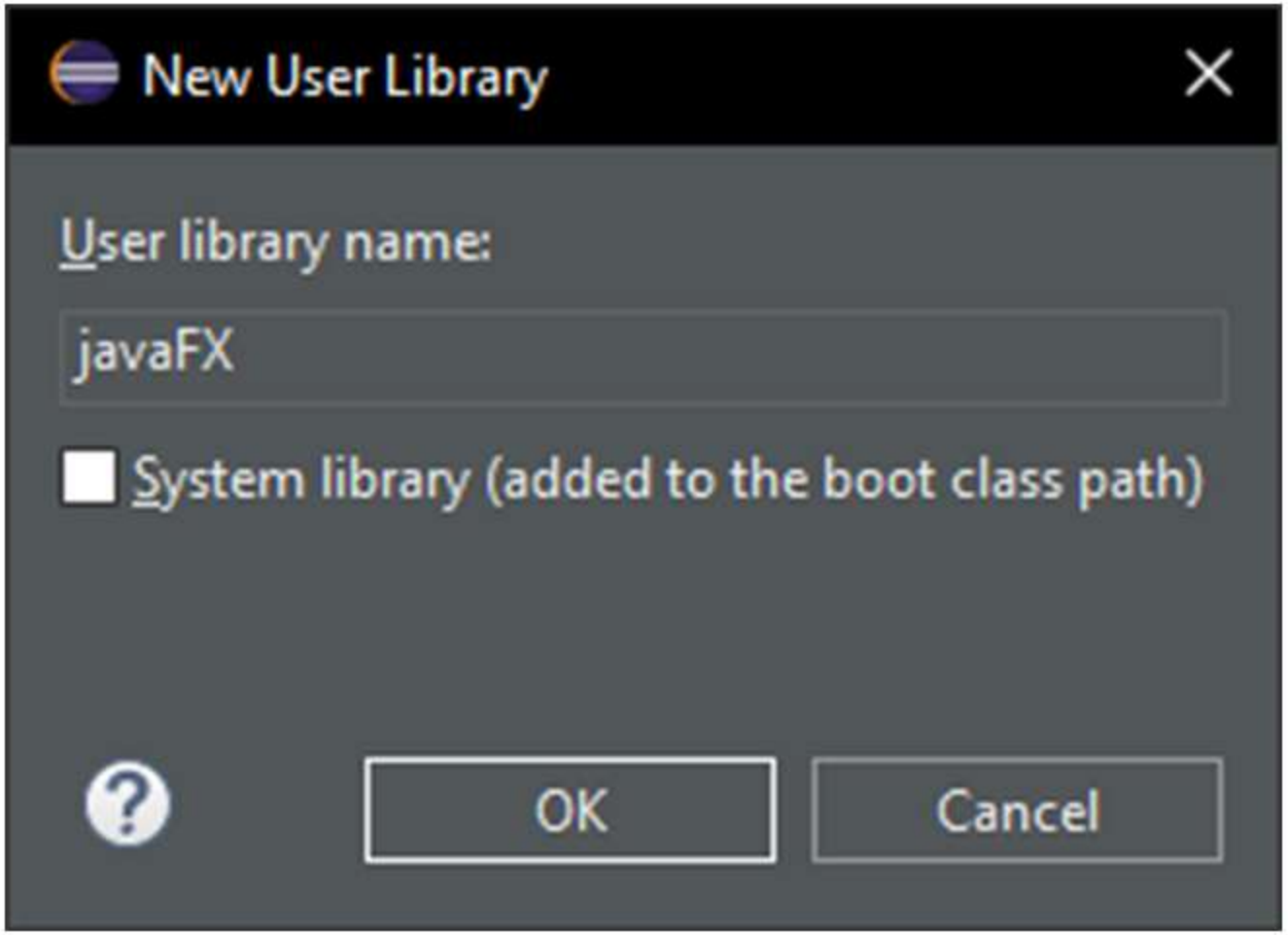
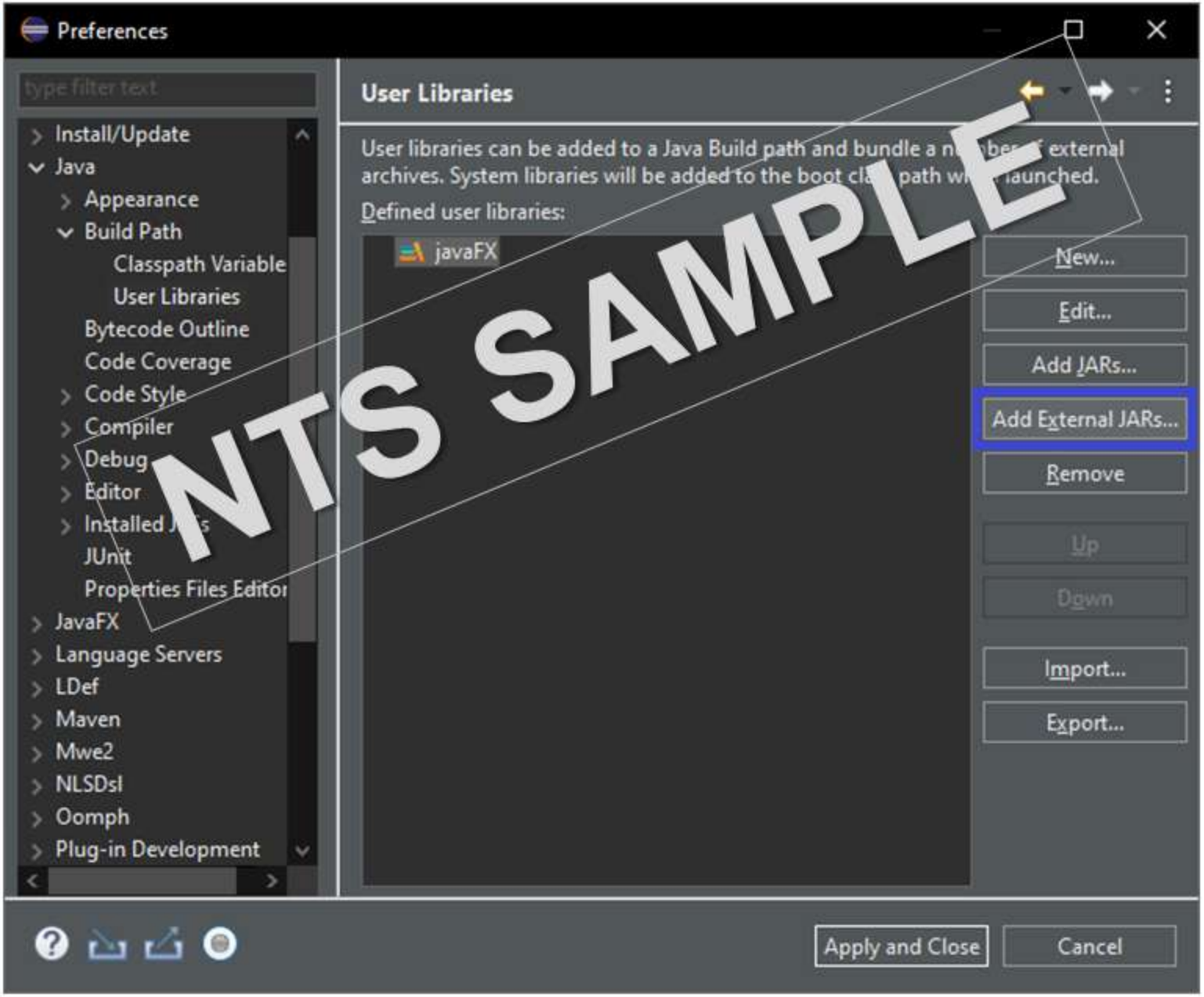
There is no active editor that provides an outline.
Problems
Declaration
Console
Terminal
No consoles to display at this time.
NTS SAMPLE


Preferences
type filter text
Install/Update
Java
Appearance
Build Path
Classpath Variable
User Libraries
Bytecode Outline
Code Coverage
Code Style
Compiler
Debug
Editor
Installed JREs
JUnit
Properties Files Editor
JavaFX
Language Servers
LDef
Maven
Mwe2
NLSDsl
Oomph
Plug-in Development
User Libraries
User libraries can be added to a Java Build path and bundle a number of external archives. System libraries will be added to the boot class path when launched.
Defined user libraries:
New...
Edit...
Add JARs...
Add External JARs...
Remove
Up
Down
Import...
Export...
Apply and Close
Cancel
NTS SAMPLE


New User Library
User library name:
javaFX
System library (added to the boot class path)
OK
Cancel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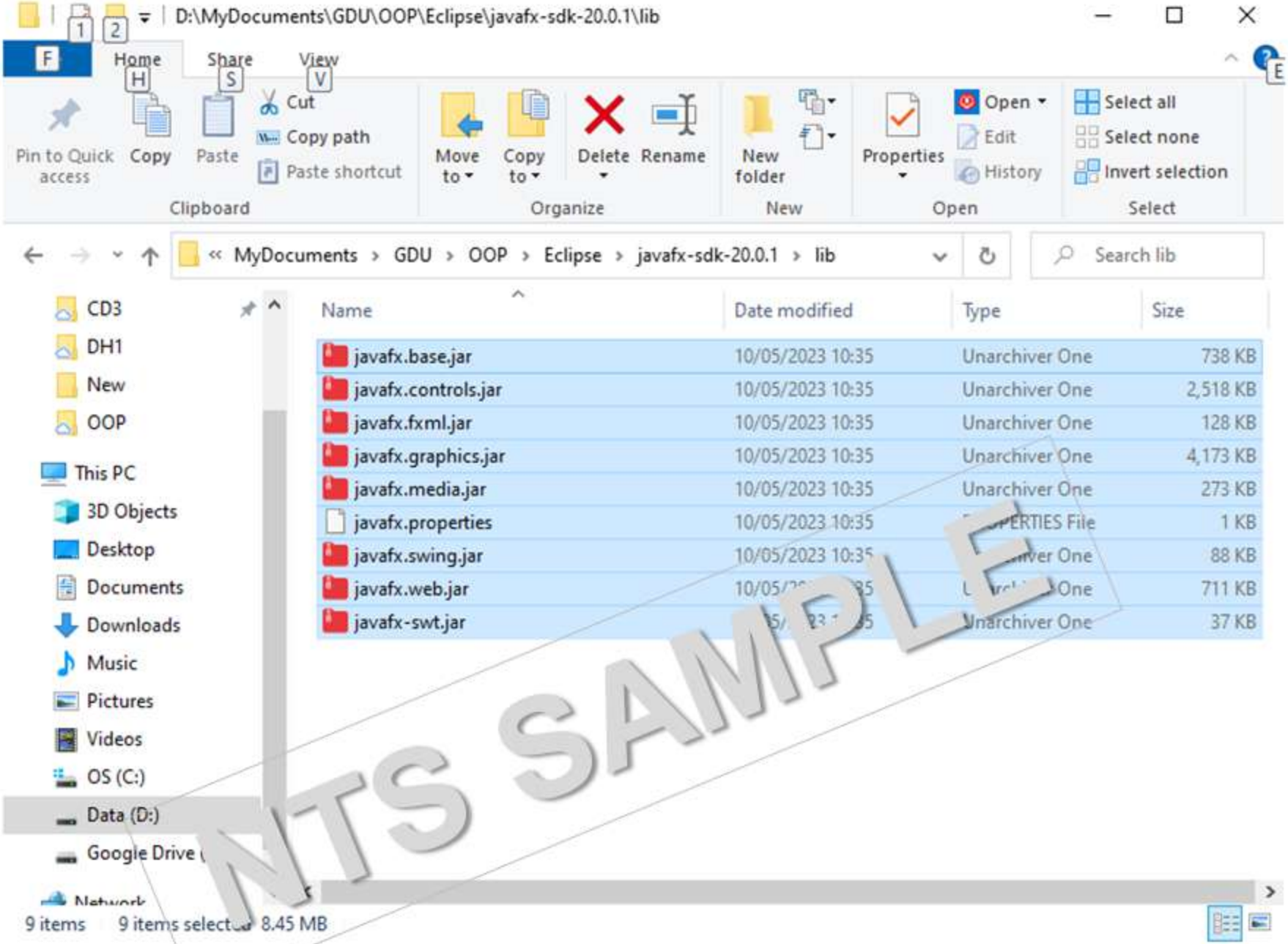
New...
Edit...
Add JARs...
Add External JARs...
Remove
Up
Down
Import...
Export...
Apply and Close
Cancel
NTS SAMPLE


D:\MyDocuments\GDU\OOP\Eclipse\javafx-sdk-20.0.1\lib
Home
Share
View
Pin to Quick access
Copy
Paste
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Copy path
Paste shortcut
Clipboard
Move to
Copy to
Delete
Rename
Organize
New folder
New
Properties
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Edit
History
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Select all
Select none
Invert selection
Select
MyDocuments › GDU › OOP › Eclipse › javafx-sdk-20.0.1 › lib
Search lib
CD3
DH1
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OOP
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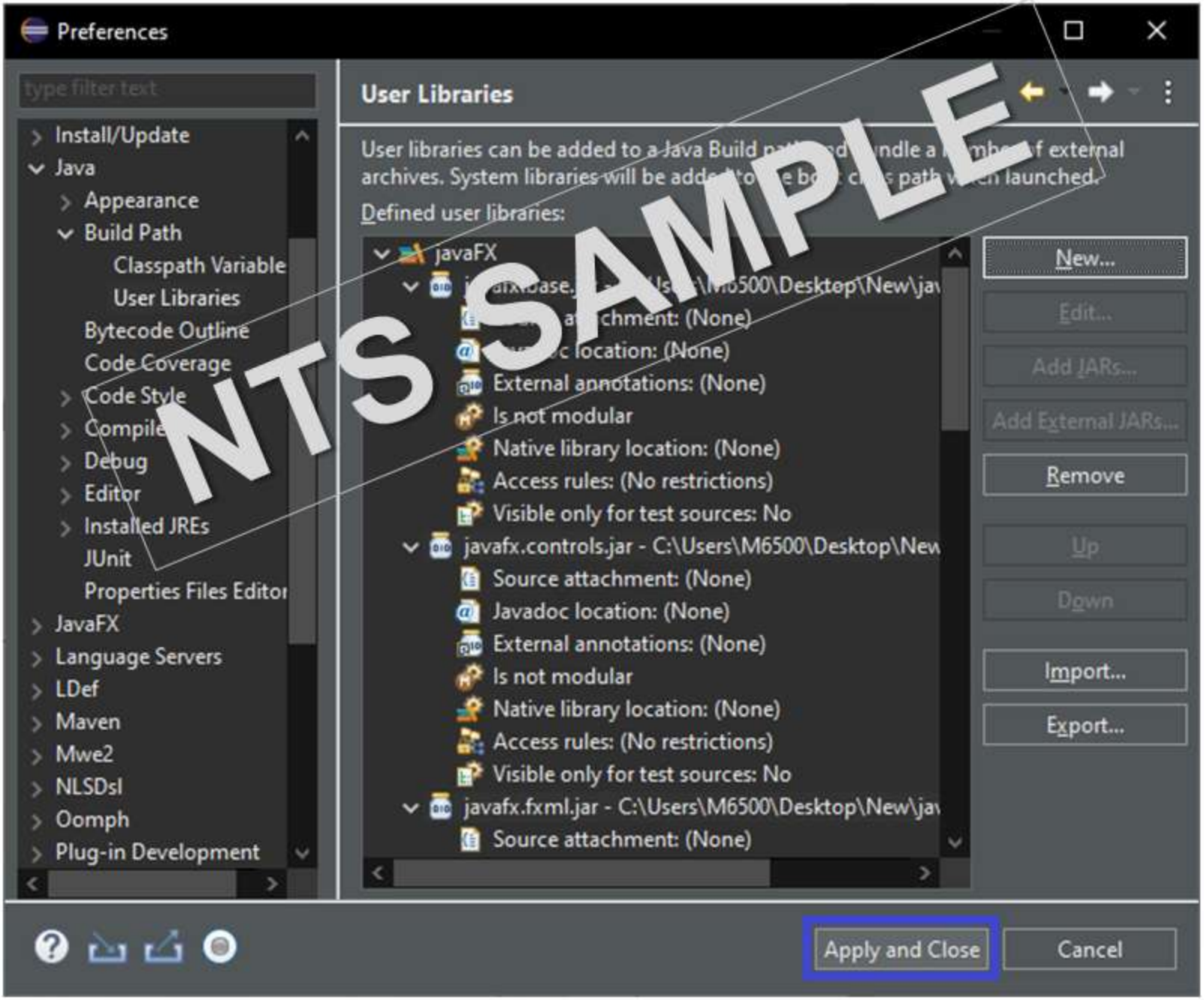
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
OS (C:)
Data (D:)
Google Drive
Name
Date modified
Type
Size
javafx.base.jar 10/05/2023 10:35 Unarchiver One 738 KB
javafx.controls.jar 10/05/2023 10:35 Unarchiver One 2,518 KB
javafx.fxml.jar 10/05/2023 10:35 Unarchiver One 128 KB
javafx.graphics.jar 10/05/2023 10:35 Unarchiver One 4,173 KB
javafx.media.jar 10/05/2023 10:35 Unarchiver One 273 KB
javafx.properties 10/05/2023 10:35 PROPERTIES File 1 KB
javafx.swing.jar 10/05/2023 10:35 Unarchiver One 88 KB
javafx.web.jar 10/05/2023 10:35 Unarchiver One 711 KB
javafx-swt.jar 10/05/2023 10:35 Unarchiver One 37 KB
9 items
9 items selected 8.45 MB
NTS SAMPLE


Preferences
type filter text
Install/Update
Java
Appearance
Build Path
Classpath Variable
User Libraries
Bytecode Outline
Code Coverage
Code Style
Compile
Debug
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Installed JREs
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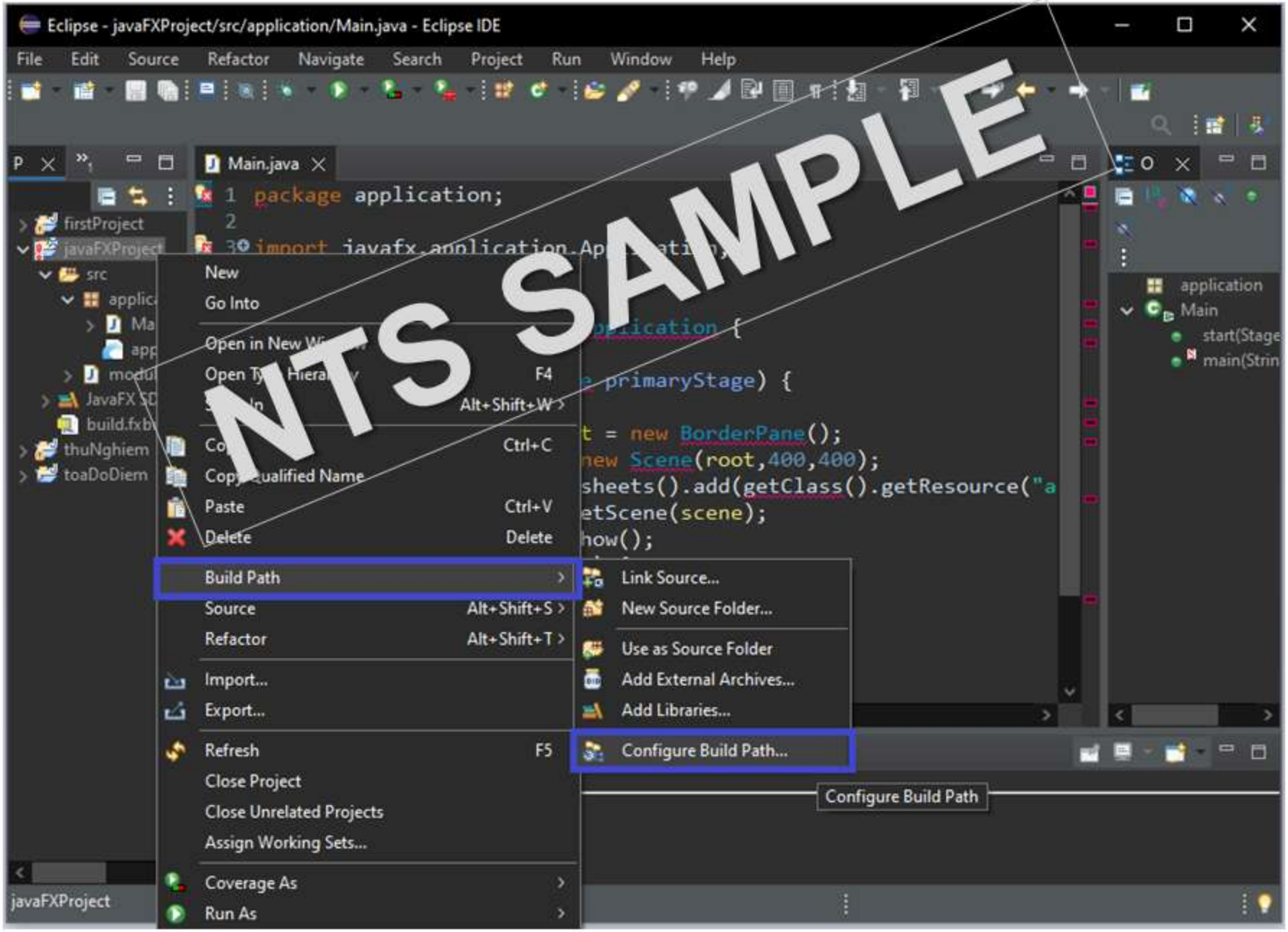
Properties Files Editor
JavaFX
Language Servers
LDef
Maven
Mwe2
NLSDsl
Oomph
Plug-in Development
User Libraries
User libraries can be added to a Java Build path and bundle a number of external archives. System libraries will be added to the boot class path when launched.
Defined user libraries:
javaFX
External annotations: (None)
Is not modular
Native library location: (None)
Access rules: (No restrictions)
Visible only for test sources: No
javafx.controls.jar - C:\Users\M6500\Desktop\New
Source attachment: (None)
Javadoc location: (None)
External annotations: (None)
Is not modular
Native library location: (None)
Access rules: (No restrictions)
Visible only for test sources: No
javafx.fxml.jar - C:\Users\M6500\Desktop\New\jav
Source attachment: (None)
New...
Edit...
Add JARs...
Add External JARs...
Remove
Up
Down
Import...
Export...
Apply and Close
Cancel


Eclipse - javaFXProject/src/application/Main.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Main.java
1 package application;
2
firstProject
javaFXProject
src
New
Go Into
Open in New Window
Open Type Hierarchy F4
Show In Alt+Shift+W
Copy Ctrl+C
Copy Qualified Name
Paste Ctrl+V
Delete Delete
Build Path
Source Alt+Shift+S
Refactor Alt+Shift+T
Import...
Export...
Refresh F5
Close Project
Close Unrelated Projects
Assign Working Sets...
Coverage As
Run As
Link Source...
New Source Folder...
Use as Source Folder
Add External Archives...
Add Libraries...
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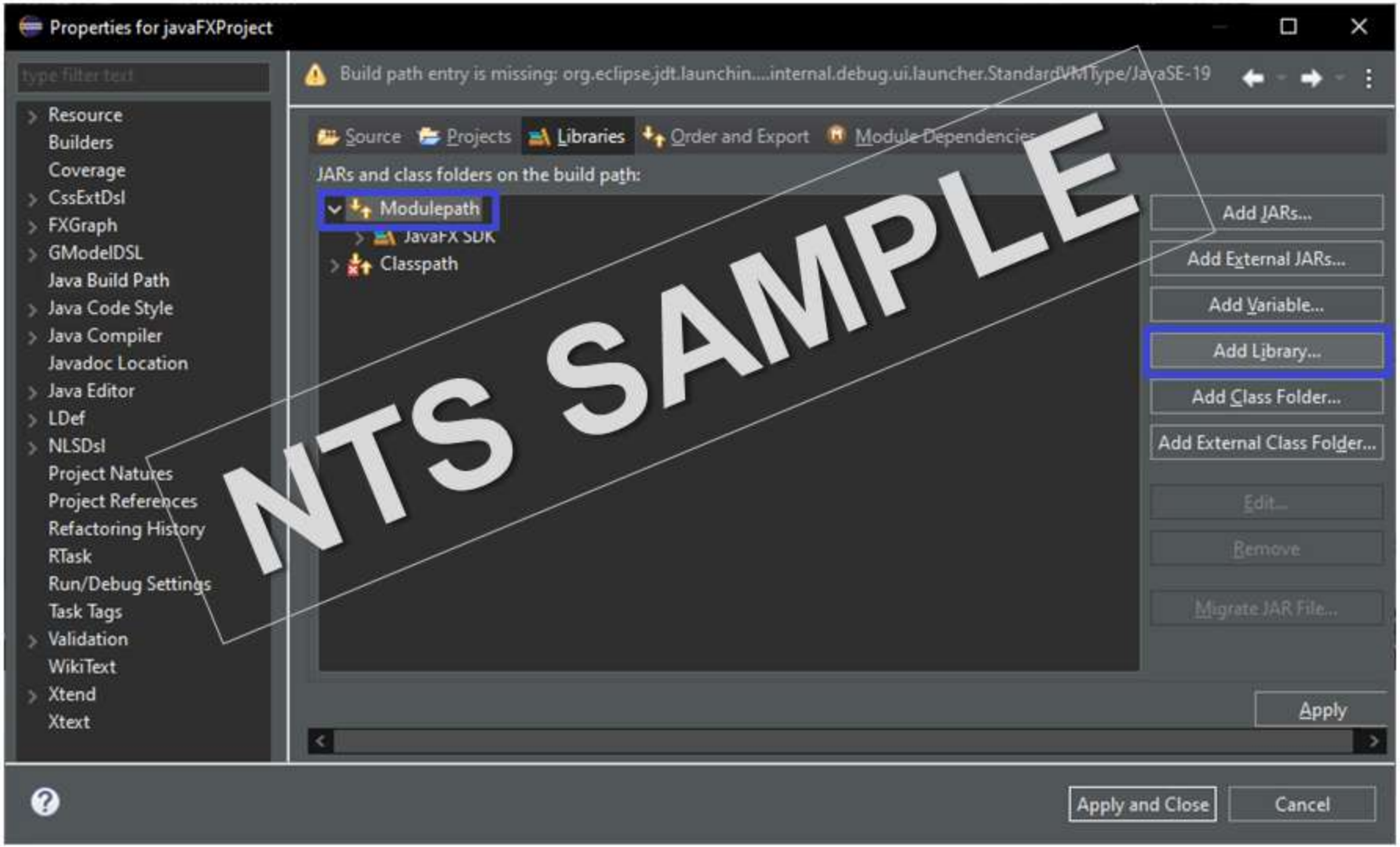
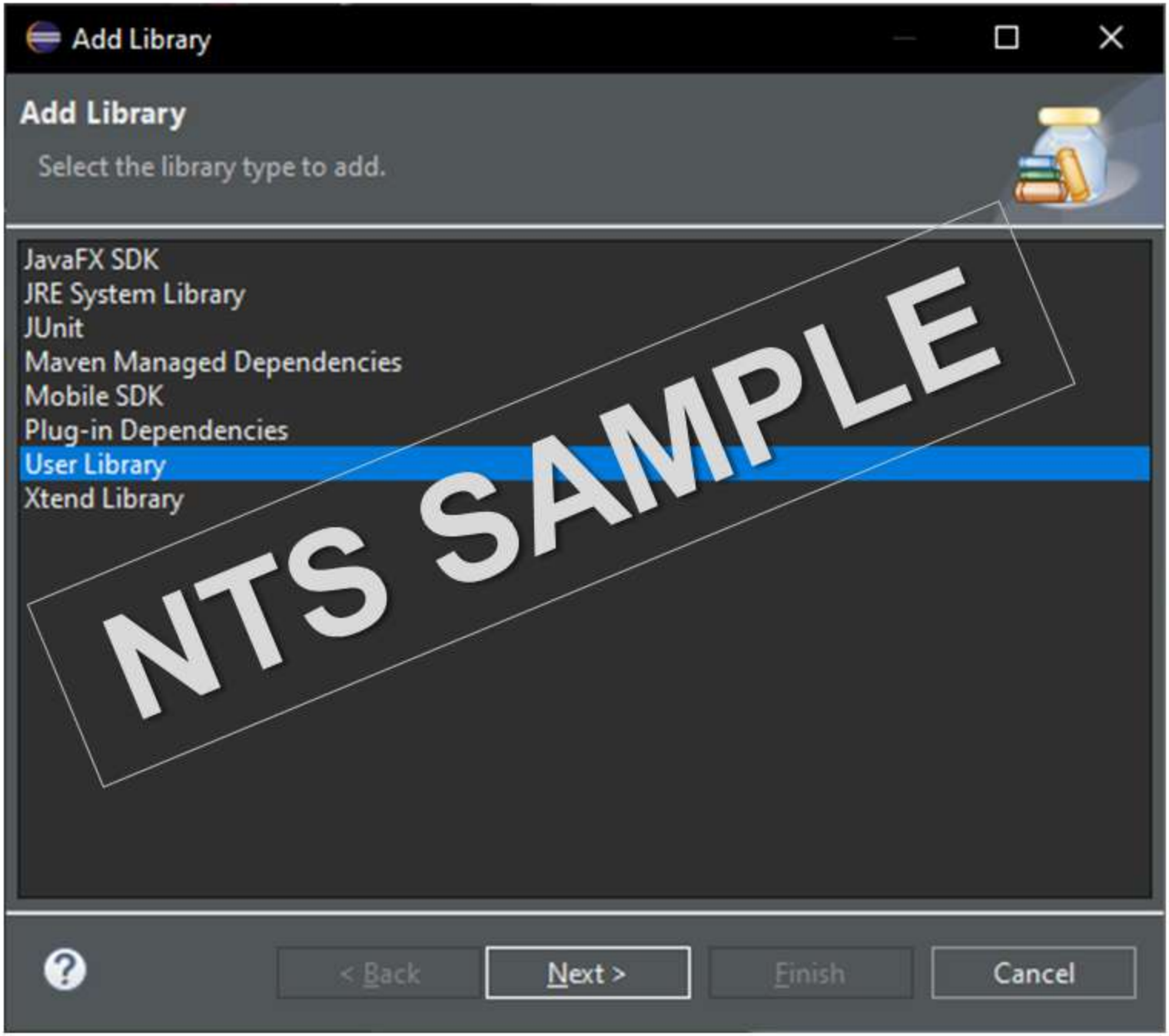
NTS SAMPLE


Properties for javaFXProject
type filter text
Resource
Builders
Coverage
CssExtDsl
FXGraph
GModelDSL
Java Build Path
Java Code Style
Java Compiler
Javadoc Location
Java Editor
LDef
NLSDsl
Project Natures
Project References
Refactoring History
RTask
Run/Debug Settings
Task Tags
Validation
WikiText
Xtend
Xtext
Build path entry is missing: org.eclipse.jdt.launchin....internal.debug.ui.launcher.StandardVMType/JavaSE-19
Source
Projects
Libraries
Order and Export
Module Dependencies
JARs and class folders on the build path:
Modulepath
JavaFX SDK
Classpath
Add JARs...
Add External JARs...
Add Variable...
Add Library...
Add Class Folder...
Add External Class Folder...
Edit...
Remove
Migrate JAR File...
Apply
Apply and Close
Cancel
NTS SAMPLE


Add Library
Add Library
Select the library type to add.
JavaFX SDK
JRE System Library
JUnit
Maven Managed Dependencies
Mobile SDK
Plug-in Dependencies
User Library
Xtend Library
NTS SAMPLE
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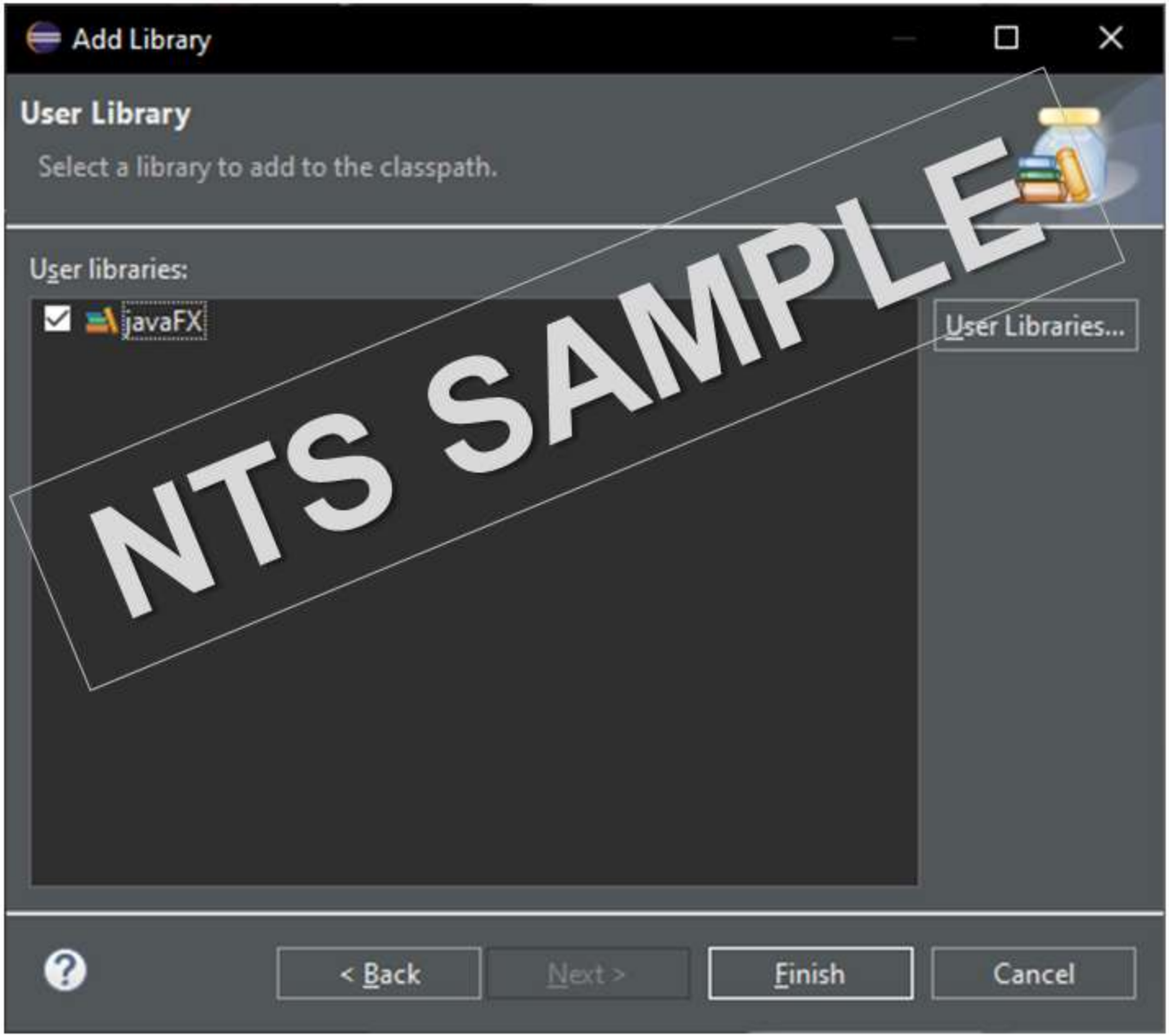
Add Library
User Library
Select a library to add to the classpath.
User libraries:
javaFX
User Libraries...
NTS SAMPLE
< Back
Next >
Finish
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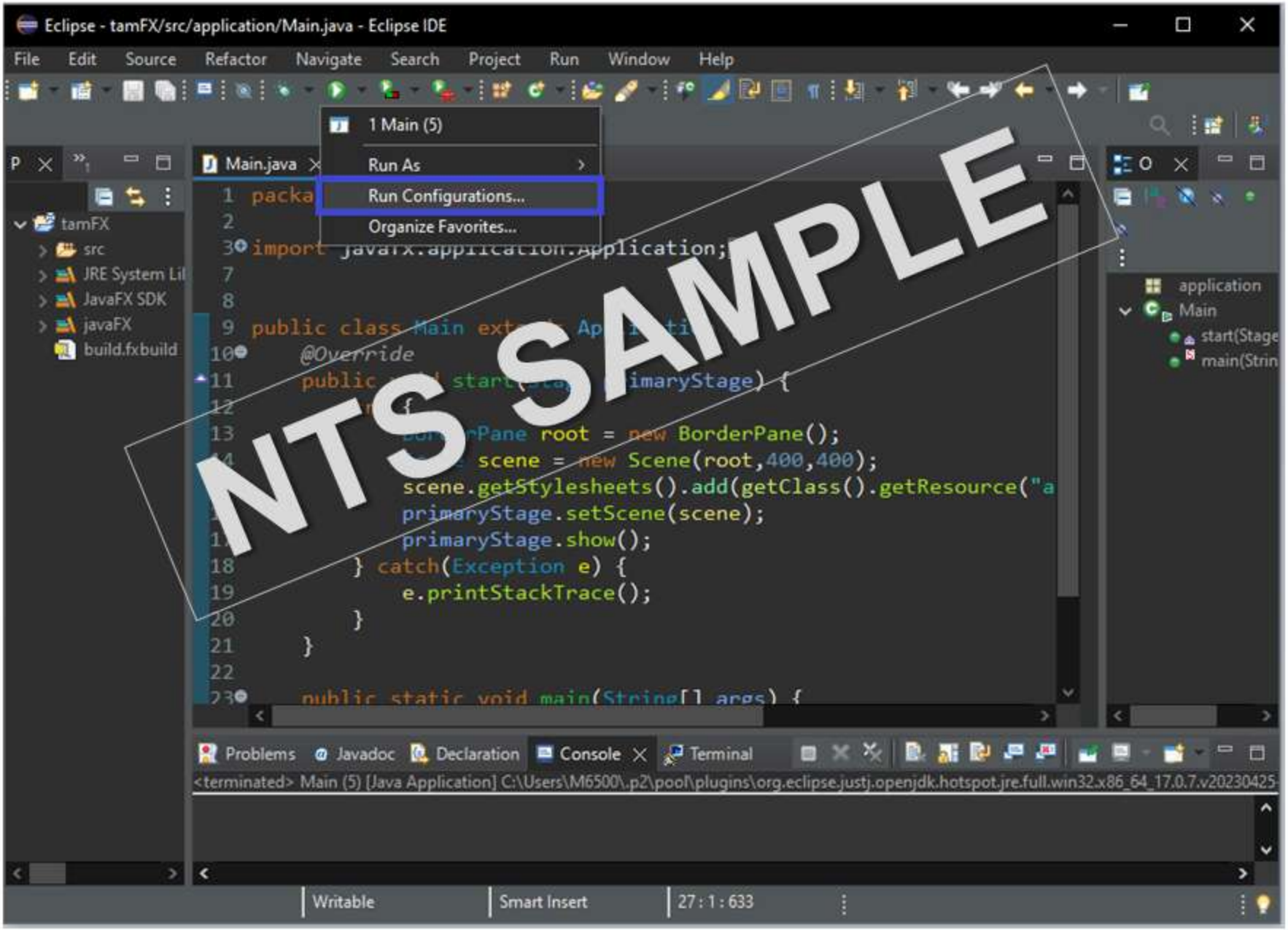
Eclipse - tamFX/src/application/Main.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
1 Main (5)
Run As
Run Configurations...
Organize Favorites...
Main.java
tamFX
src
JRE System Lil
JavaFX SDK
javaFX
build.fxbuild
import javafx.application.Application;
public class Main ext
@Override
public
Pane root = new BorderPane();
scene = new Scene(root,400,400);
scene.getStylesheets().add(getClass().getResource("a
primaryStage.setScene(scene);
primaryStage.show();
} catch(Exception e) {
e.printStackTrace();
}
}
public static void main(String[] args) {
application
Main
start(Stage
main(Strin
Problems Javadoc Declaration Console Terminal
<terminated> Main (5) [Java Application] C:\Users\M6500\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.7.v20230425
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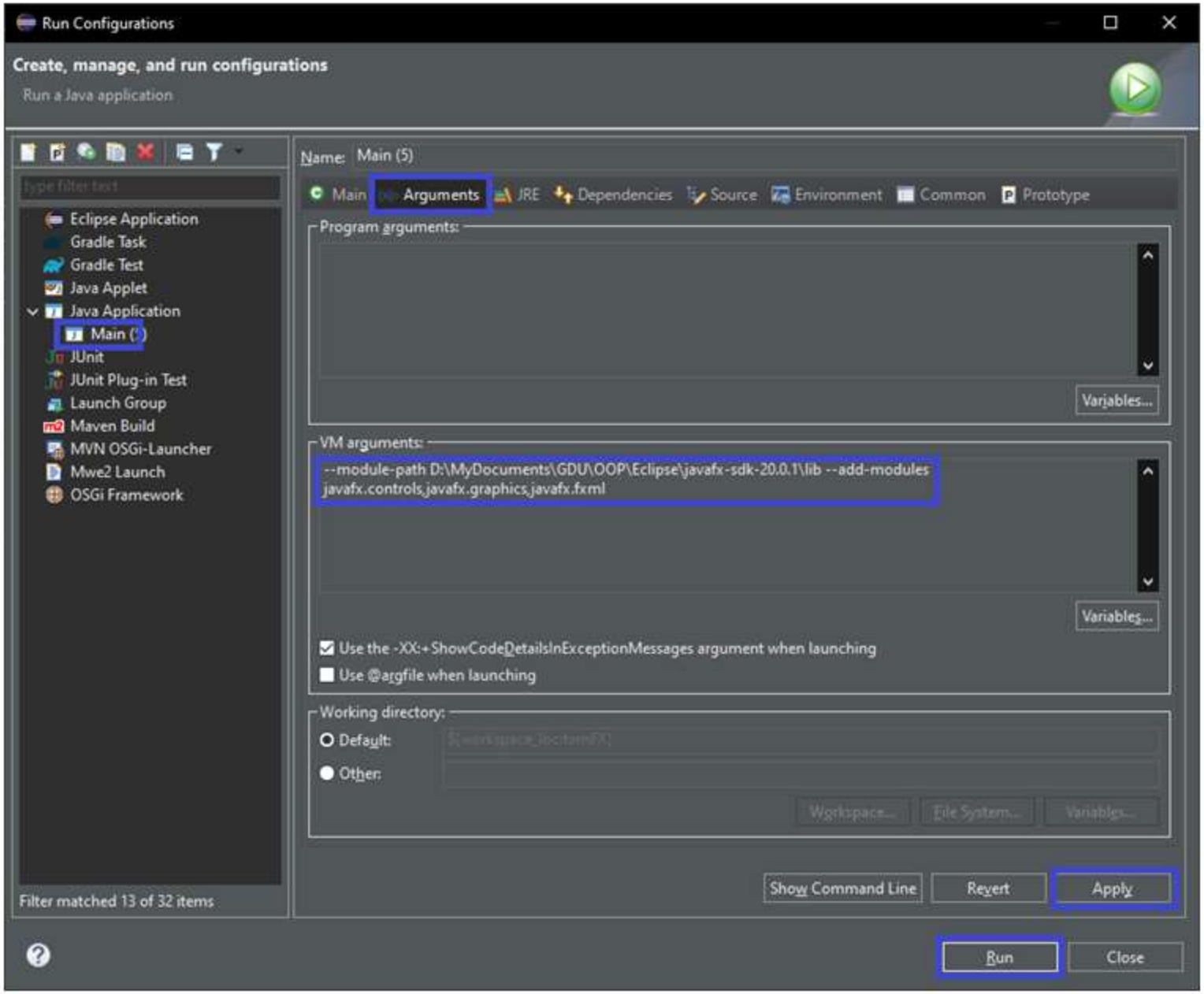
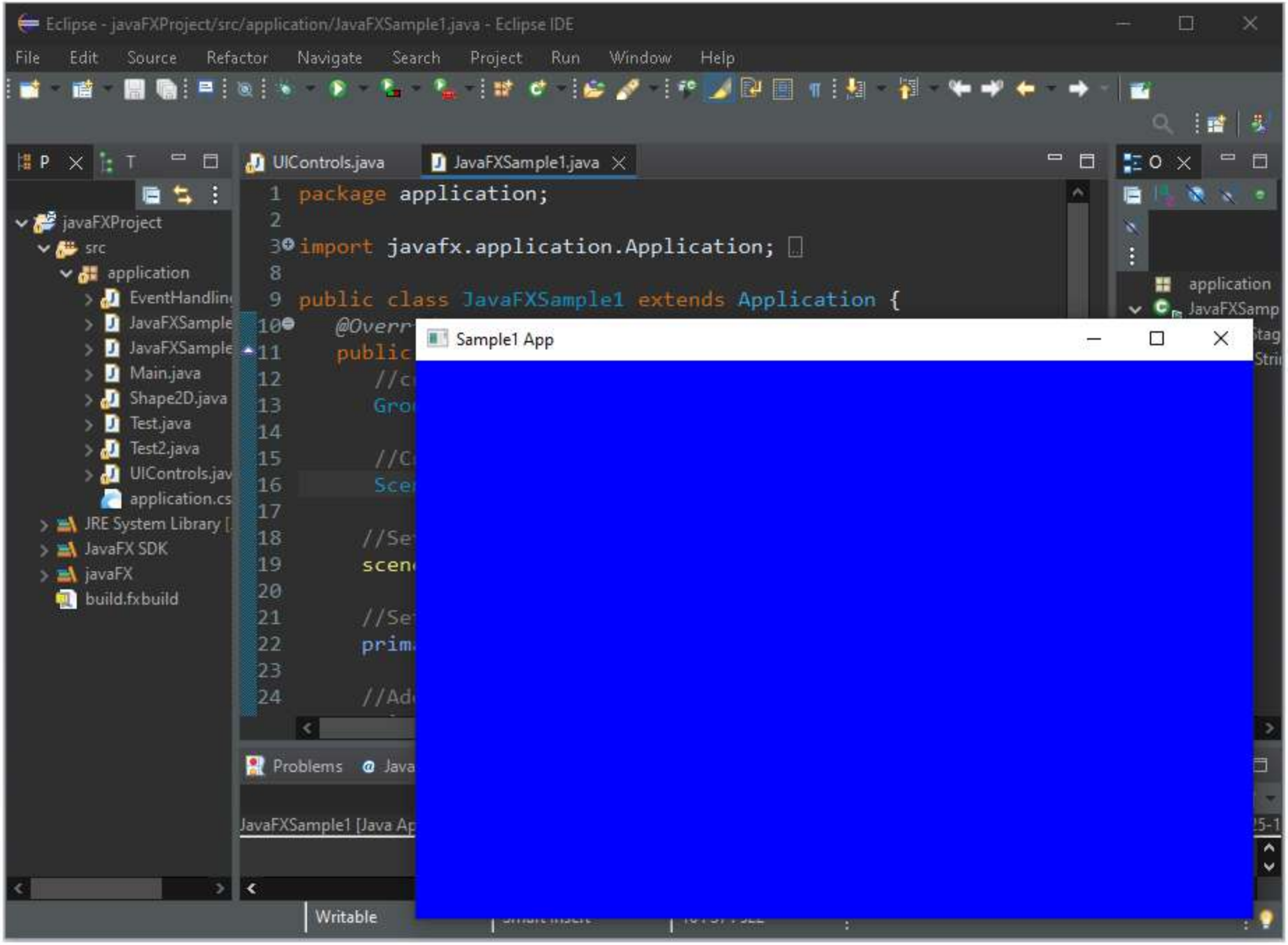
27 : 1 : 633

--module-path "D:\MyDocuments\GDU\OOP\Eclipse\javafx-sdk-20.0.1\lib" --add-modules javafx.controls,javafx.graphics,javafx.fxml




Eclipse - javaFXProject/src/application/JavaFXSample1.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
UIControls.java
JavaFXSample1.java
1 package application;
3 import javafx.application.Application;
9 public class JavaFXSample1 extends Application {
javaFXProject
src
application
EventHandling
JavaFXSample
JavaFXSample
Main.java
Shape2D.java
Test.java
Test2.java
UIControls.jav
application.cs
JRE System Library
JavaFX SDK
javaFX
build.fxbuild
Sample1 App
Problems
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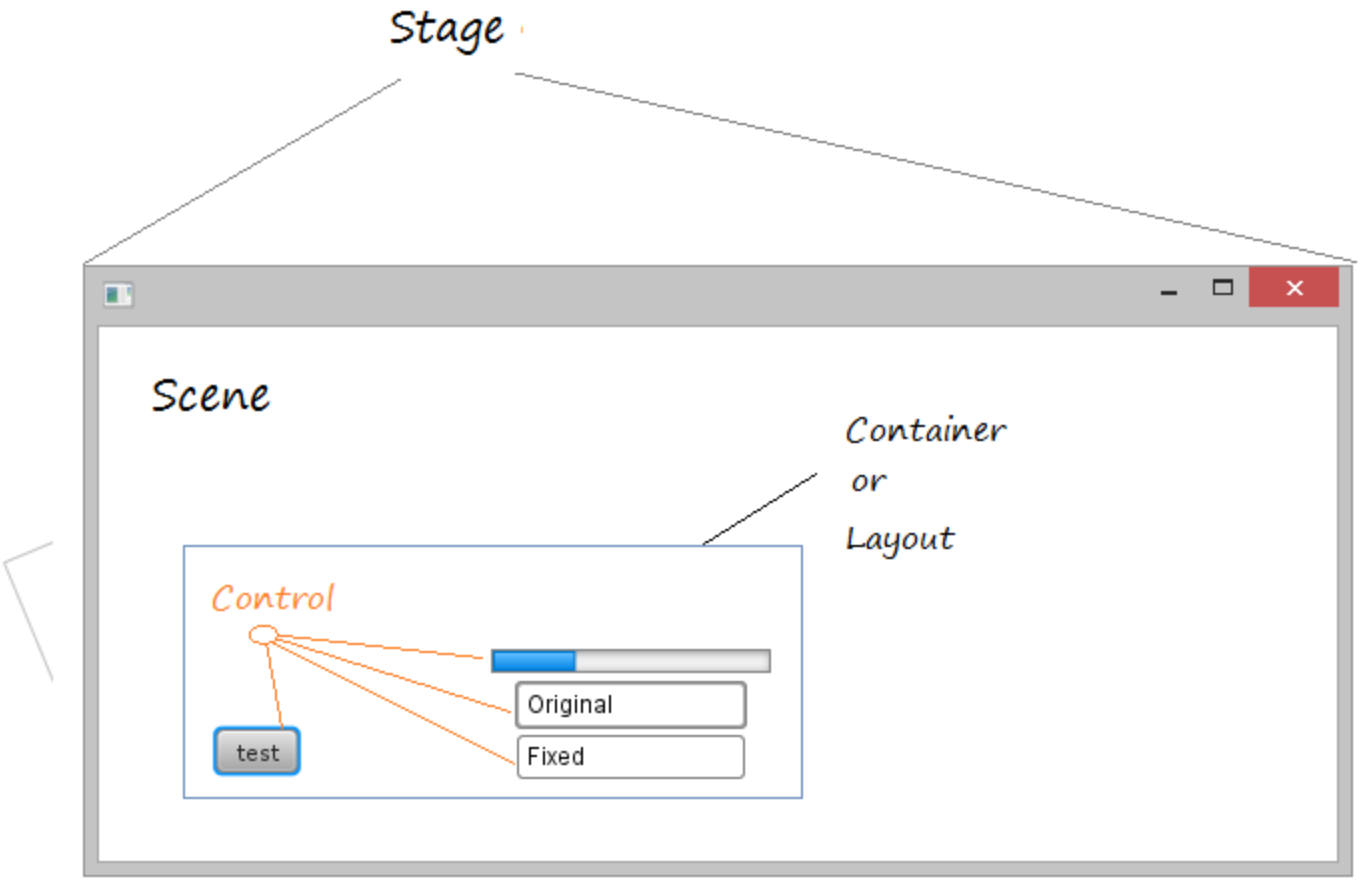
Writable

Creating a JavaFX Application

- Format:

```
public class JavafxSample extends Application {
   @Override
   public void start(Stage primaryStage) throws Exception {
      /*
      Code for JavaFX application.
      (Stage, scene, scene graph)
      */
   }
   public static void main(String args[]){
      launch(args);
   }
}
```

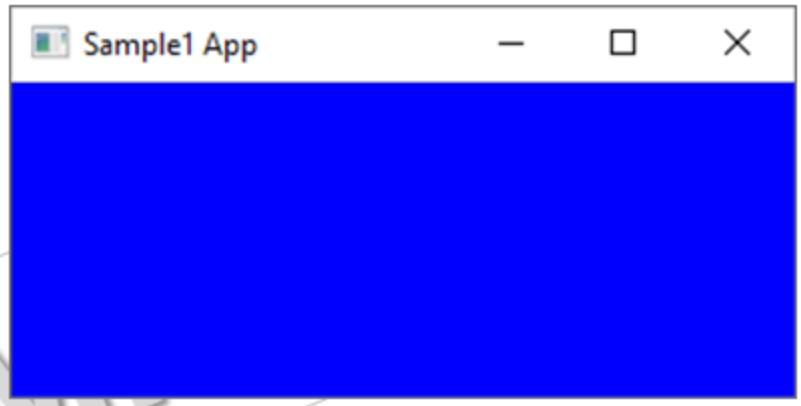
Relationship



The relationship between Stage, Scene, Container and Controls

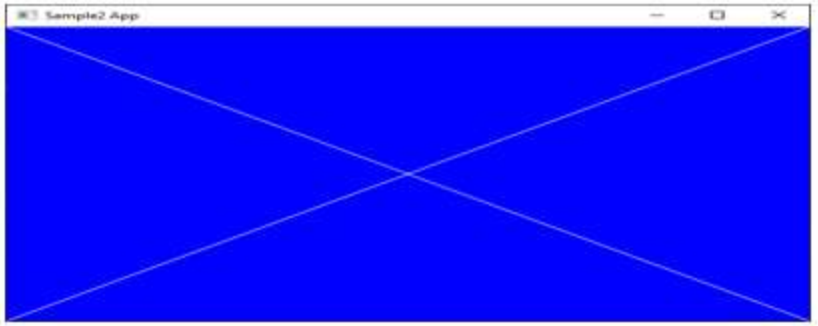
Example01: an empty JavaFX window

```
package application;

import javafx.application.Application;
import javafx.scene.*;
import javafx.scene.paint.Color;
import javafx.stage.Stage;

public class JavaFXSample1 extends Application {
   @Override
   public void start(Stage stage1) throws Exception {
            // Preparing a scene
            Group group = new Group();  //Creating a Group object
            Scene scene = new Scene(group ,600, 400); // Creating a Scene, height and width
            scene.setFill(Color.BLUE);  //Setting color to the scene

            //Setting a stage
            stage1.setTitle("Sample1  App"); // Setting the title to Stage
            stage1.setScene(scene);  //Adding the scene to Stage
            stage1.show(); //Displaying the contents of the stage
  }
  public static void main(String args[]){
            launch(args);
  }}
```



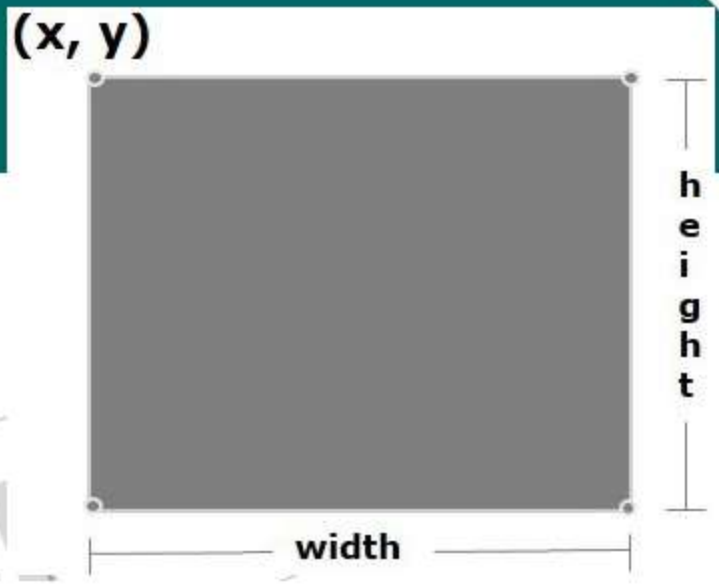
Example02: a line

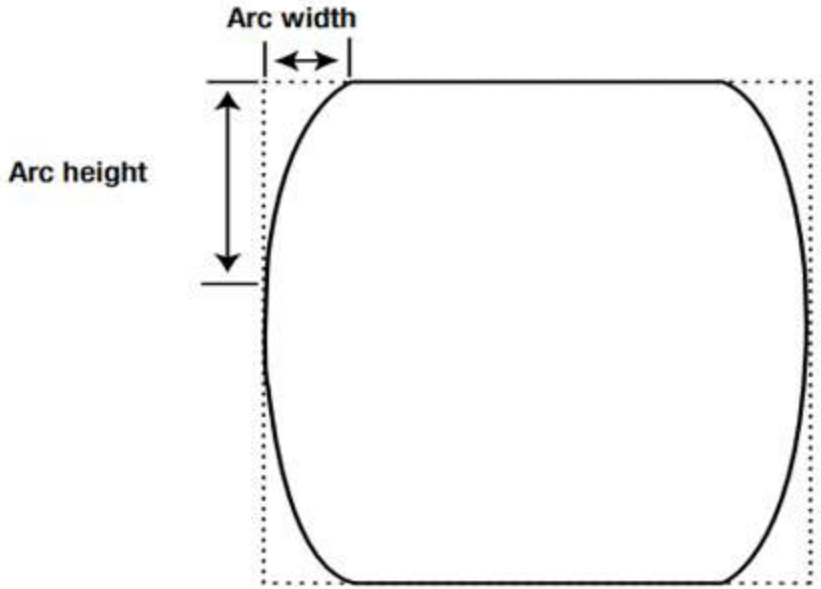
```
public class JavaFXSample2 extends Application {
   @Override
   public void start(Stage stage1) throws Exception {
      // Preparing a scene
      Line line = new Line(0, 0, 600, 400);  //Creating a line object
      line.setStroke(Color.WHITE);

      Group group = new Group(line);
      Scene scene = new Scene(group, 600, 400);
      scene.setFill(Color.BLUE);

      //Setting a stage
      stage1.setTitle("Sample2 App");
      stage1.setScene(scene);
      stage1.show();
   }
   public static void main(String args[]){
            launch(args);
   }
}
```



2D shape

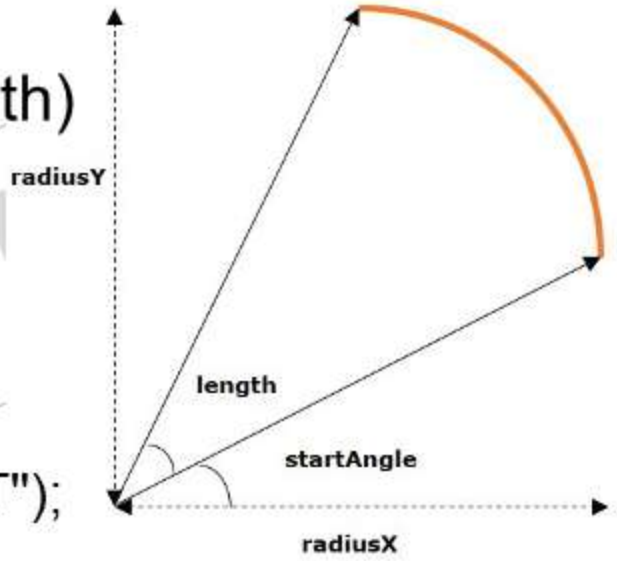
- Package: javafx.scene.shape
- Line(x1,y1,x2,y2). Ex:
  - Line line = new Line(0,10, 70,10);
  - line.setStroke(Color.***WHITE***);
  - line.setStrokeWidth(10);
- Rectangle(x,y,width,height)
  - setStroke(Color.***BLUE***);
  - setStrokeWidth(7);
  - setFill(Color.***GRAY***);
  - setArcWidth(15);
  - setArcHeight(10);
- Example03





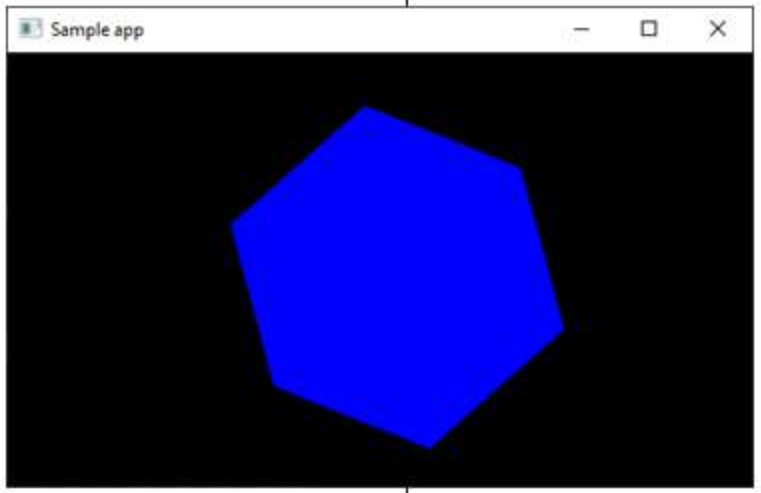
2D shape

- Circle(x,y,R)
- Arc(x,y,radiusX,radiusY,startAngle,length)
- Ellipse(x,y,radiusX,radiusY)
- Polygon(x1,y1,x2,y2,…,xn,yn)
- Text(x,y, “String”). Ex:
  - Text t = new Text(30,70,"Thử nghiệm TEXT");
  - t.setStroke(Color.BLUE);
  - t.setFill(Color.WHITE);
  - t.setStrokeWidth(2);
  - t.setFont(Font.font(
    "Serif",FontWeight.BOLD, FontPosture.REGULAR,47));



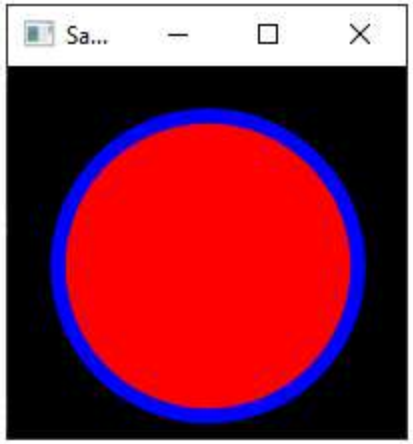
Rotate Transition

```
//import javafx.animation.RotateTransition;
//import javafx.util.Duration;

Polygon shape = new Polygon(
200, 50, 320, 50, 370, 150, 320, 250, 200, 250, 150, 150);
shape.setFill(Color.BLUE);
RotateTransition rotate = new RotateTransition();
rotate.setDuration(Duration.millis(6000));
rotate.setNode(shape);
rotate.setByAngle(-360);
rotate.setCycleCount(5);
rotate.setAutoReverse(false);
rotate.play();
```

Scale transition

```
//Creating scale transition
Circle shape = new Circle(100,100,30);
shape.setStroke(Color.BLUE);
shape.setStrokeWidth(3);
shape.setFill(Color.RED);

ScaleTransition scale = new ScaleTransition();
scale.setDuration(Duration.millis(3000));
scale.setNode(shape);

//Setting the dimensions for scaling
scale.setByY(1.5);
scale.setByX(1.5);

scale.setCycleCount(5);
scale.setAutoReverse(true);
scale.play();
```

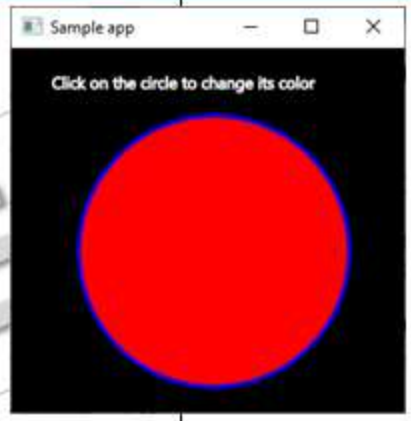



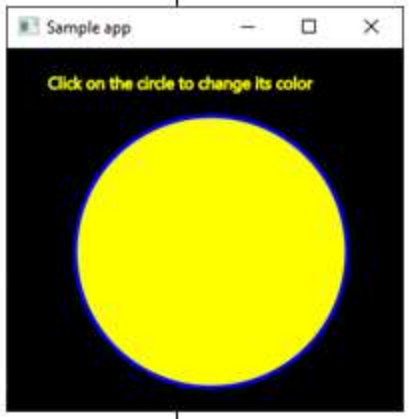
Event Handling

- Types of Events
  - **Foreground Events:** require the direct interaction of a user
  - **Background Events:** don't require the interaction of end-user (software failure, timer expiry, ...)
- Events in JavaFX
  - **Mouse Event:** click, press, release, move, ...
  - **Key Event:** press, release, type
  - **Drag Event:** drag entered, drag dropped, drag entered target, ...
  - **Window Event:** window hiding, window shown, ...

MouseEvent.MOUSE_CLICKED (Example04)

```
//import javafx.scene.input.MouseEvent;
Text t = new Text(30,30,"Click  on the circle to change its color");
t.setStroke(Color.WHITE);

Circle shape = new Circle(150,150,100);
shape.setStroke(Color.BLUE);
shape.setStrokeWidth(3);
shape.setFill(Color.RED);

//Creating the mouse event handler
EventHandler<MouseEvent> event = new EventHandler<MouseEvent>() {
   @Override
    public void handle(MouseEvent e) {
         shape.setFill(Color.YELLOW);
         text.setStroke(Color.YELLOW);
     }};
//Registering the event filter
shape.addEventFilter(MouseEvent.MOUSE_CLICKED, event);

//Creating a Group
Group root = new Group(shape,t);
// See Example04
```





KeyEvent.KEY_TYPED

```
// import javafx.scene.input.KeyEvent;
Text t = new Text(30,30,"Input a letter R/G/B: ");

TextField tF = new TextField();
tF.setLayoutX(150);
tF.setLayoutY(10);

Circle shape = new Circle(150,150,100);
shape.setStroke(Color.BLUE);
shape.setStrokeWidth(3);
shape.setFill(Color.GREY);

//Handling the key typed event
EventHandler<KeyEvent> e1 = new
EventHandler<KeyEvent>(){
   @Override
    public void handle(KeyEvent e) {
          String c = tF.getText();
          if (c.trim().toUpperCase().equals("R"))
                shape.setFill(Color.RED);
          if (c.trim().toUpperCase().equals("G"))
                shape.setFill(Color.GREEN);
          if (c.trim().toUpperCase().equals("B"))
                shape.setFill(Color.BLUE);
 }
 };
//Adding an event handler to the text feld
tF.addEventHandler(KeyEvent.KEY_TYPED,
e1);

//Handling the mouse clicked event(on circle)
EventHandler<MouseEvent> e2 = new
EventHandler<MouseEvent>(){
   @Override
    public void handle(MouseEvent e) {
                shape.setStroke(Color.GOLD);
    }
 };
//Adding the event handler to the circle
shape.addEventHandler(MouseEvent.MOUSE_
CLICKED, e2);

//Creating a Group object
Group group = new Group(shape, tF, t);
```

Button.setOnAction

```
// import javafx.event.ActionEvent;

 Button button = new Button("Show Time");
 button.setLayoutX(20);
 button.setLayoutY(20);

 Label label = new Label("");
 label.setLayoutX(100);
 label.setLayoutY(20);
 label.setFont(Font.font("Serif",FontWeight.BOLD,  FontPosture.REGULAR,27));
 label.setTextFill(Color.BLUE);
```

```
button.setOnAction(new  EventHandler<ActionEvent>() {
   @Override
    public void  handle(ActionEvent event) {
        label.setText(new  Date().toString());
    }
 });

Group group = new Group(button,label);
```

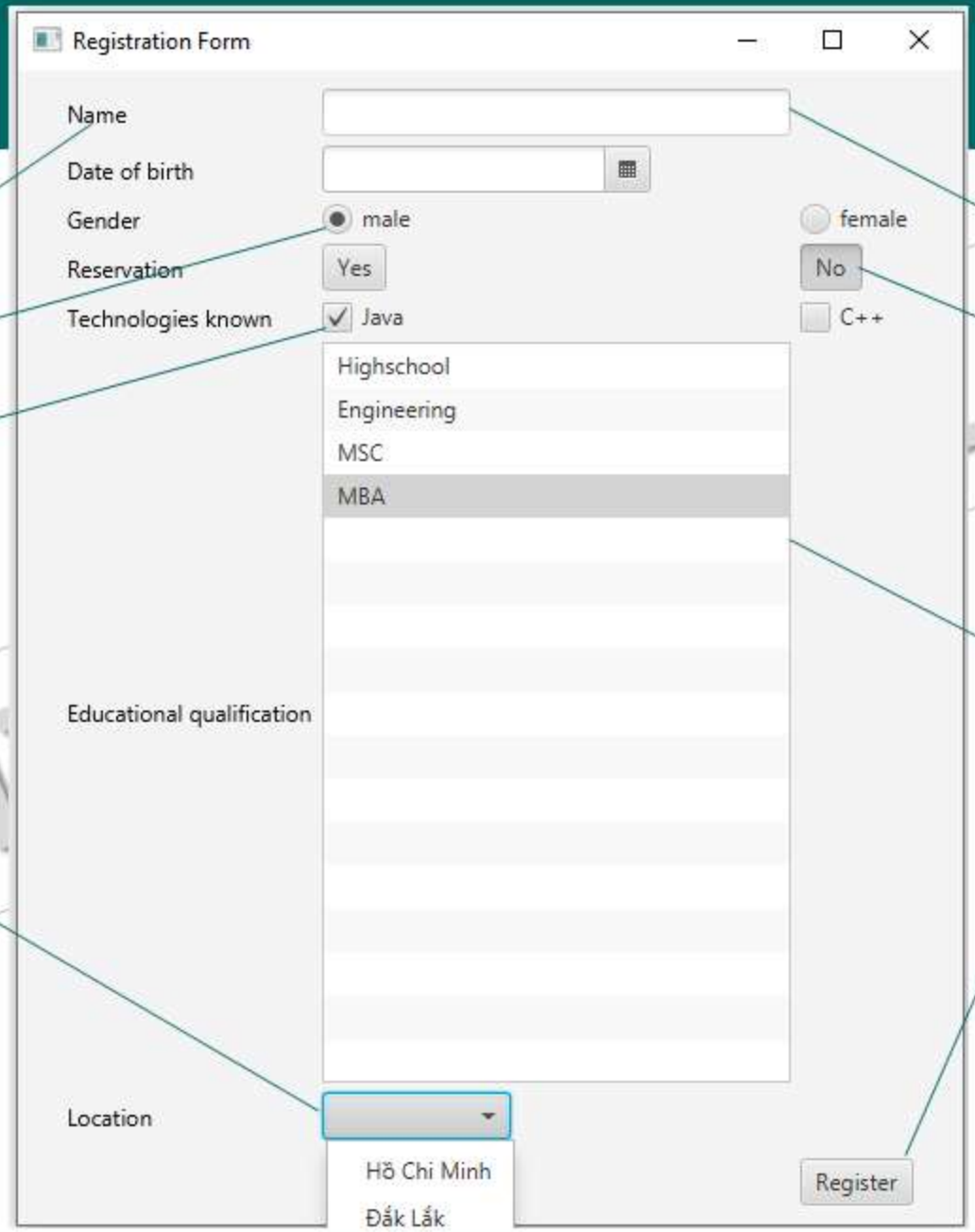
UI Controls

- **UI elements:** these are the core visual elements
- **Layouts:** define how UI elements should be organized on the screen
- **Behavior:** these are events which occur

UI Elements


Node 1
Node 2
String
Node 3
Accordion
Check Boxes
Yellow
Orange
Blue
Color Button
Button
Graphic Button
Hyperlink
Hyperlink
Radio Buttons
Cat
Dog
Horse
Toggle Button
Options
Choice Box
Row 1
Row 2
Horizontal List View
Row 1
Row 2
Long Row 3
Simple List View
60%
Done
Progress Bar
Progress Indicator
Scroll Bar
First
Jacob
Isabella
Ethan
Table
Tab 1
Tab 2
Tab
Graphic Label
Advanced Label
Simple Label
Simple Label
Some text
Text Field
Options
Tool Bar
Root node
Child Node 1
Child Node 2
Child Node 3
Tree View

Example05



Text / Label

RadioButton

CheckBox

TextField

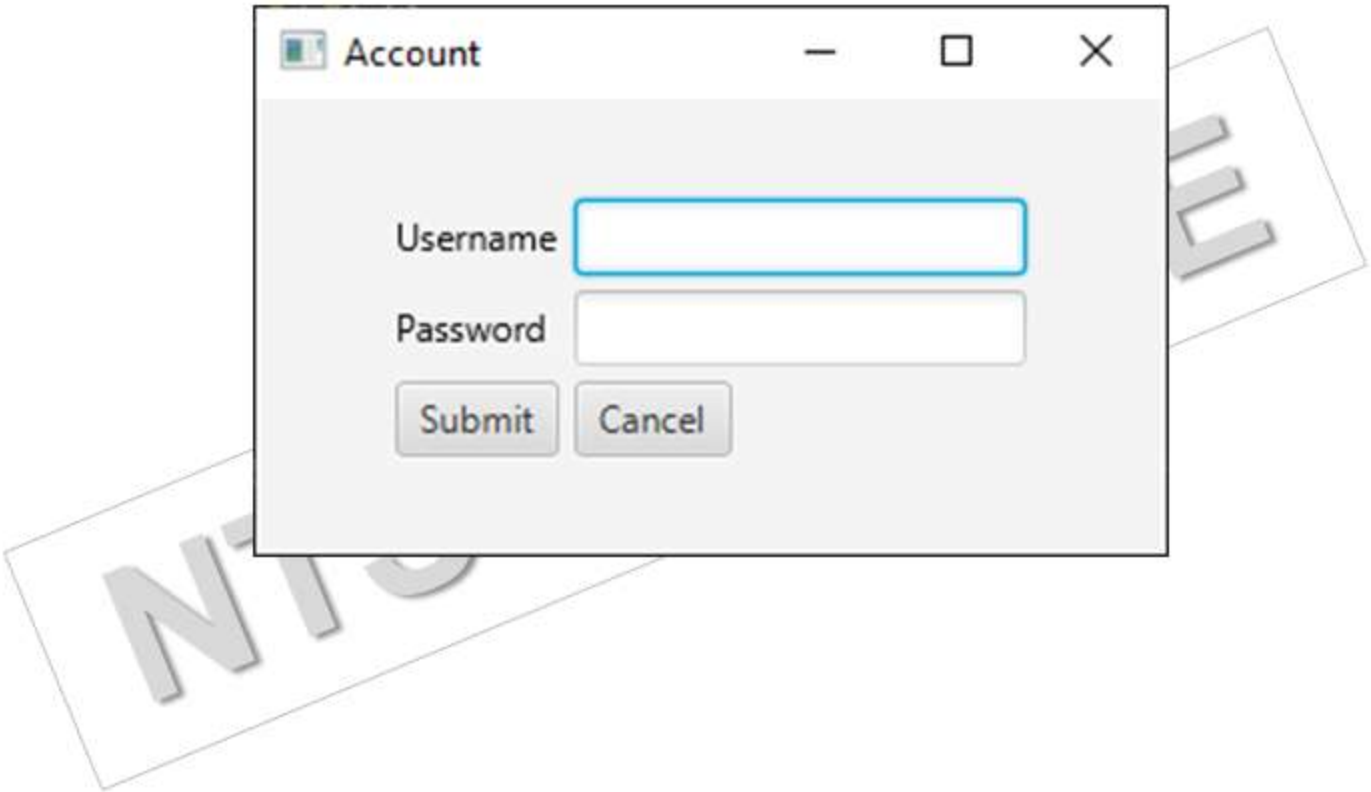
ToggleButton

ListView

ChoiceBox

Button

Example06



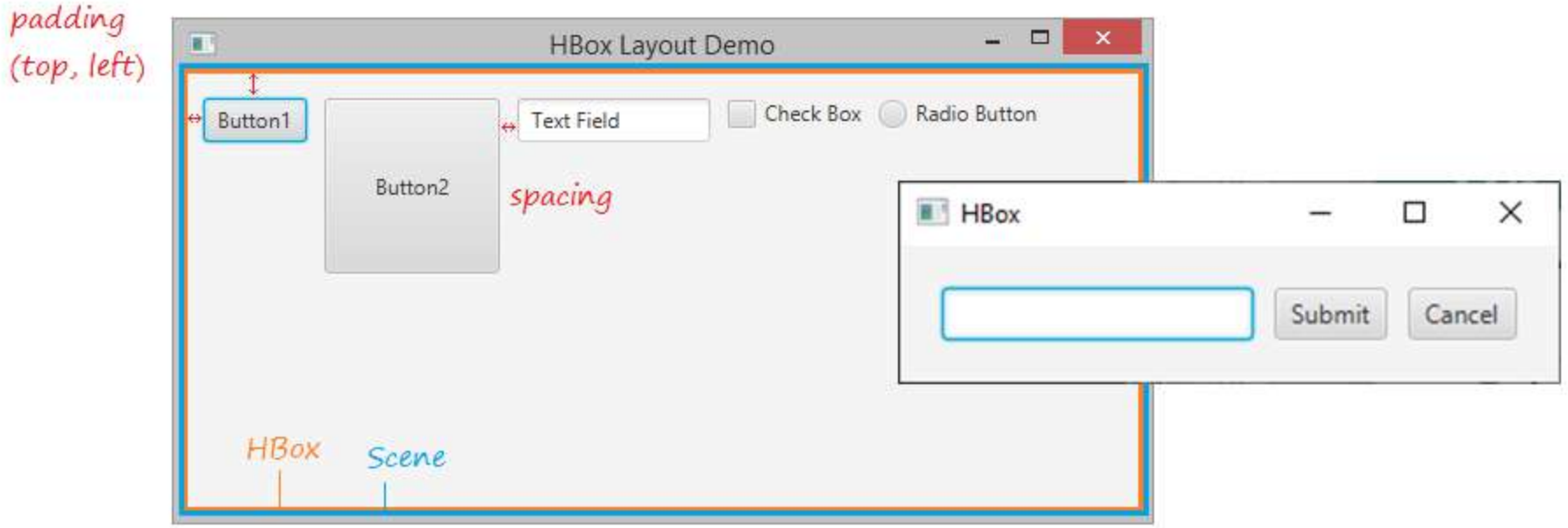
Containers - Layout Panes

- Layout of the container:
  - arrangement of the components in order
  - placing all the components at a particular position
- JavaFx layout: **HBox**, **VBox**, **Border Pane**, Stack Pane, Text Flow, Anchor Pane, Title Pane, **Grid Pane**, **Flow Panel** …

Hbox layout

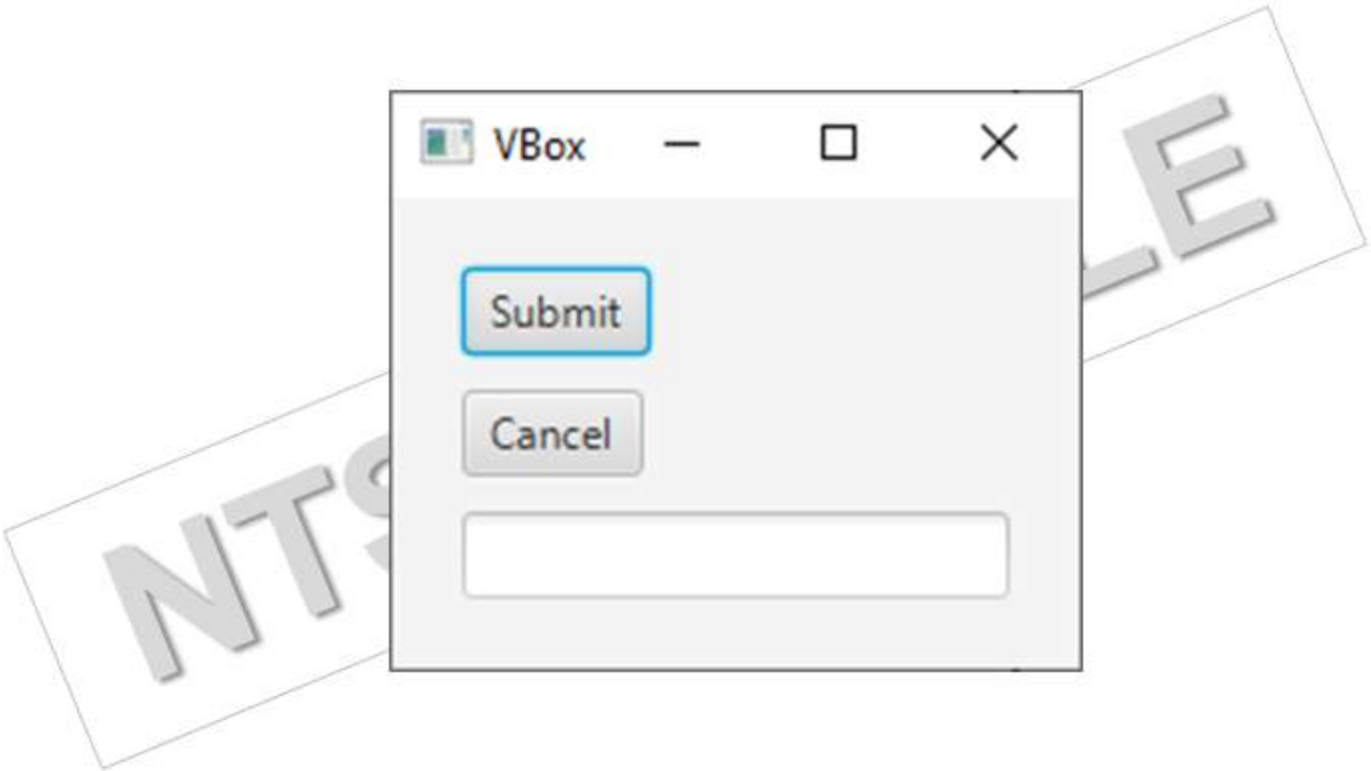
- All the nodes are set in a single horizontal row
- package javafx.scene.layout
- Example07:

```
HBox hBox = new HBox();
hBox.setSpacing(30); //setting the space
hBox.setPadding(new Insets(20,20,20,20));// padding: top, right, bottom, left
```

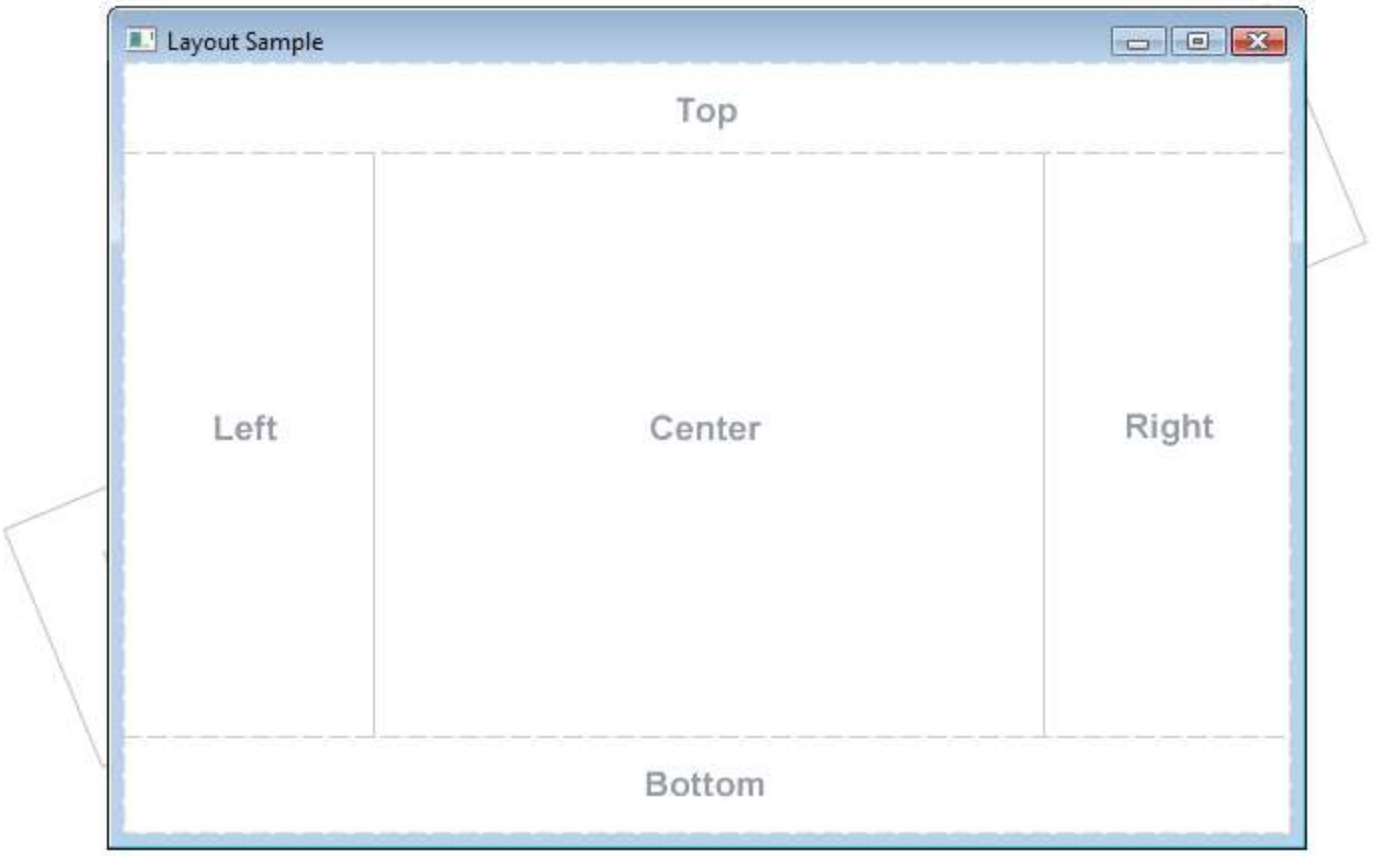



Vbox layout

- Example08

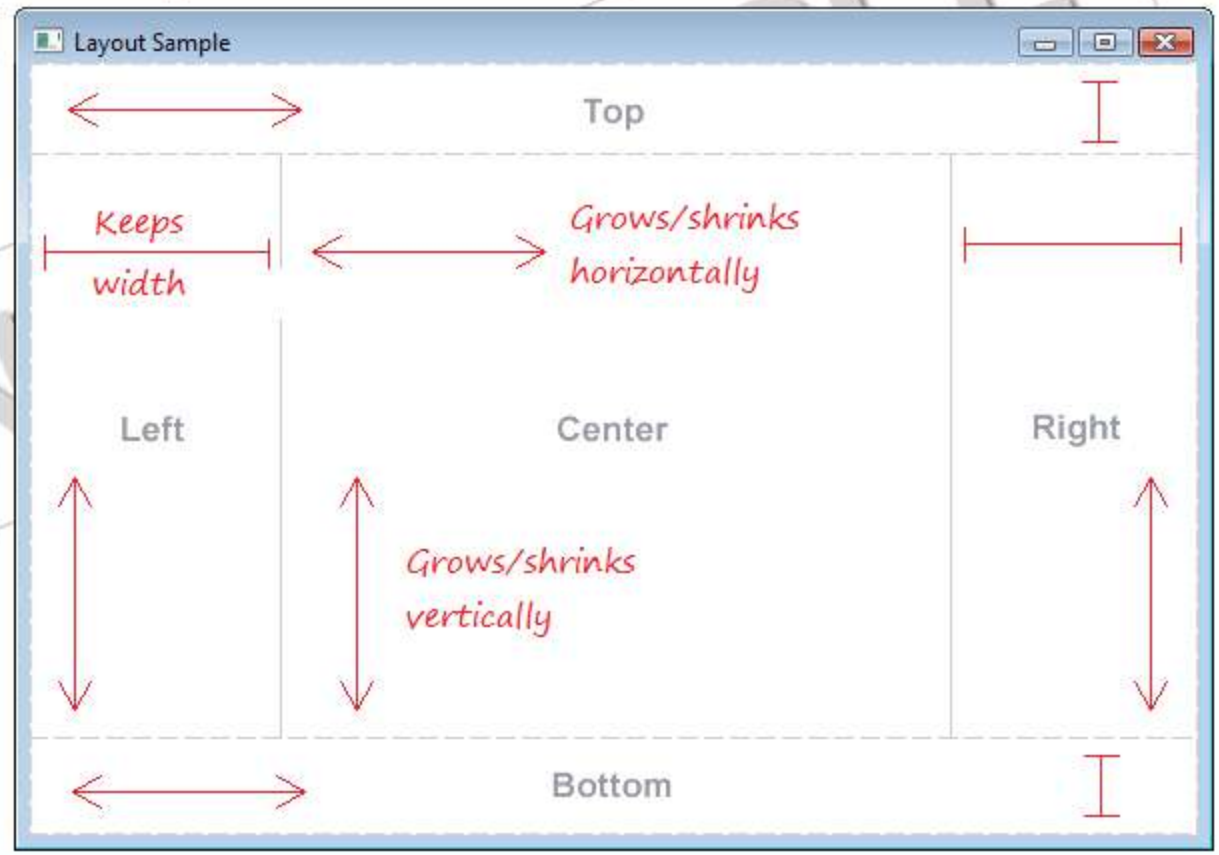


BorderPane layout

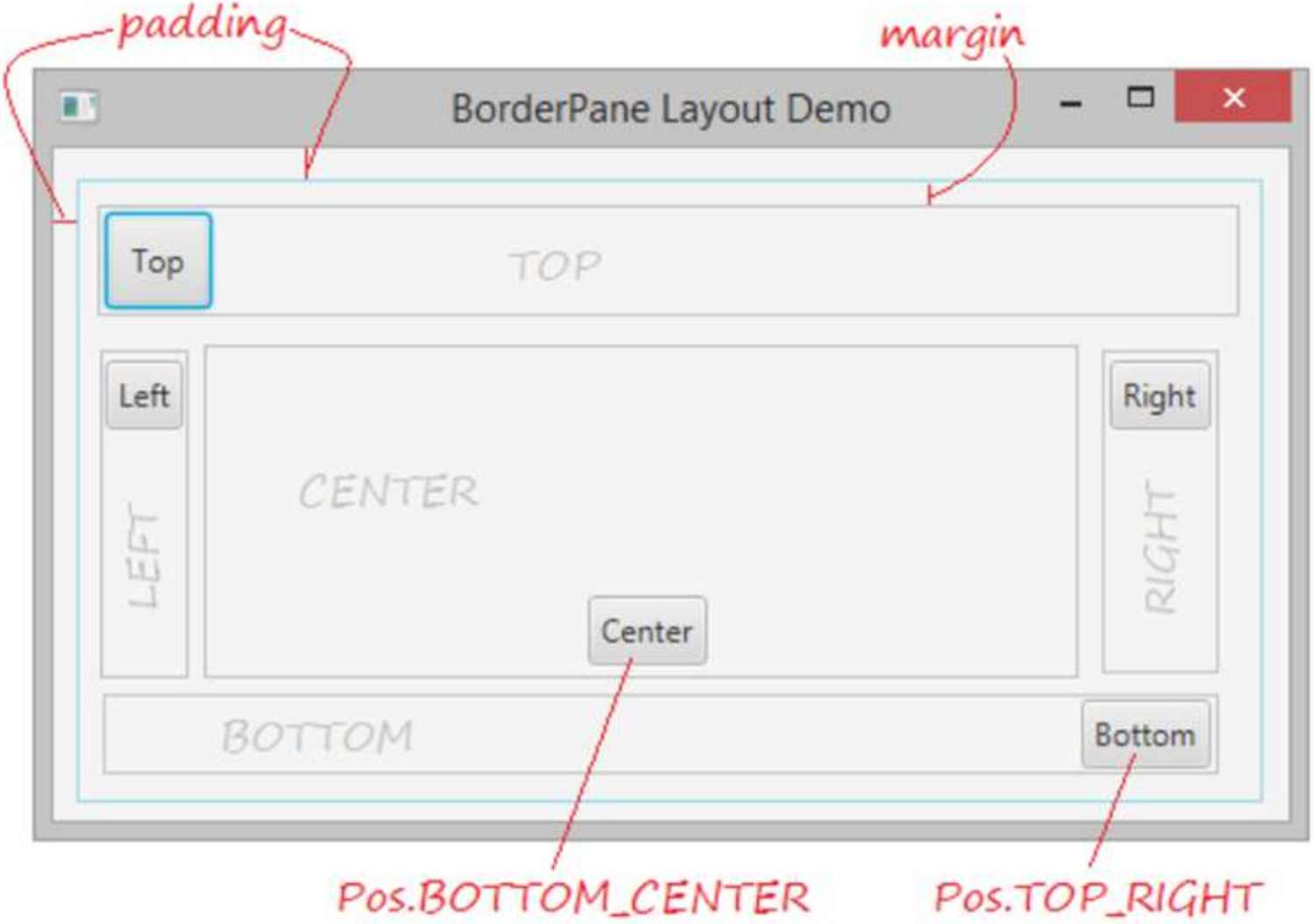


BorderPane layout

- Top/Bottom area: expand horizontally
- Left/Right area: expand vertically
- Center area: expand in both directions

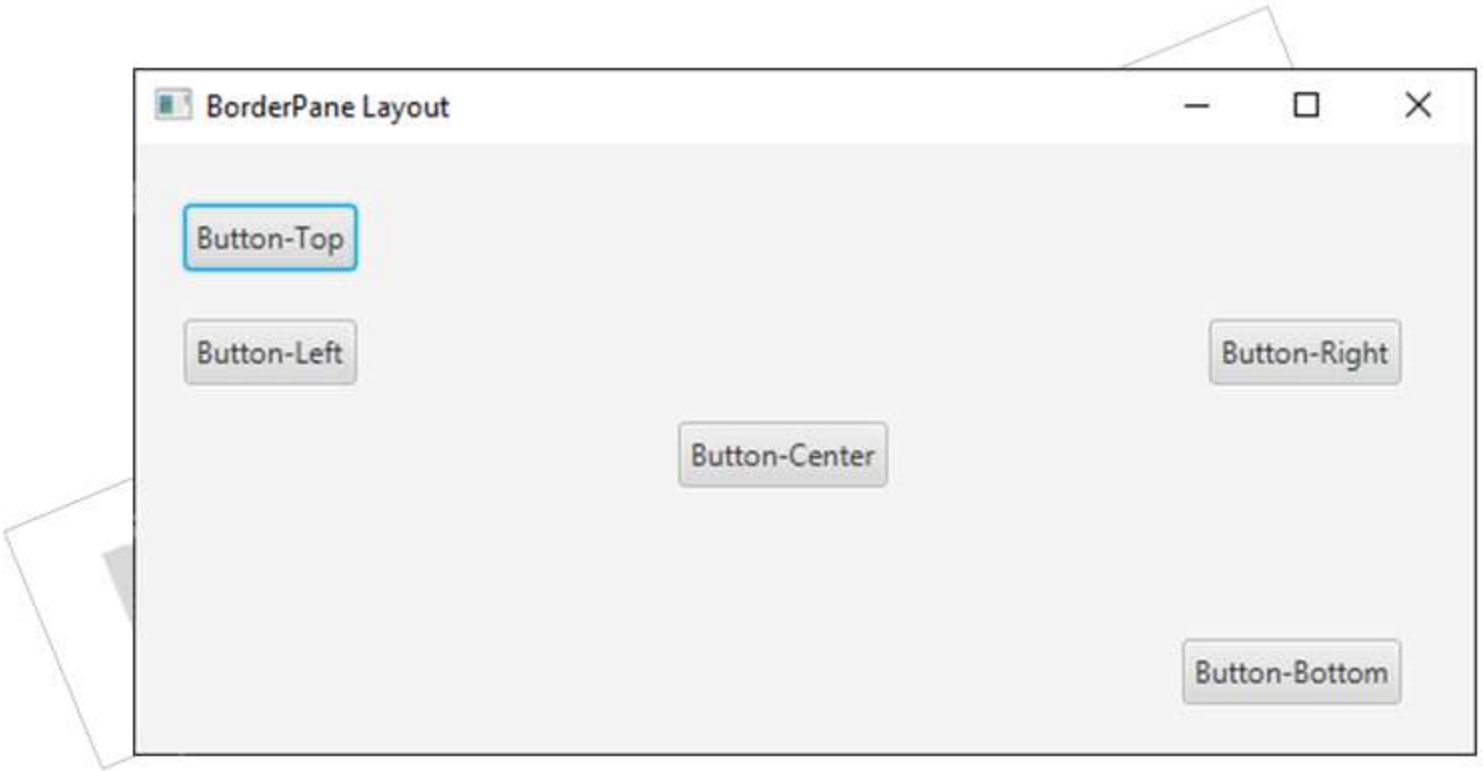


BorderPane layout

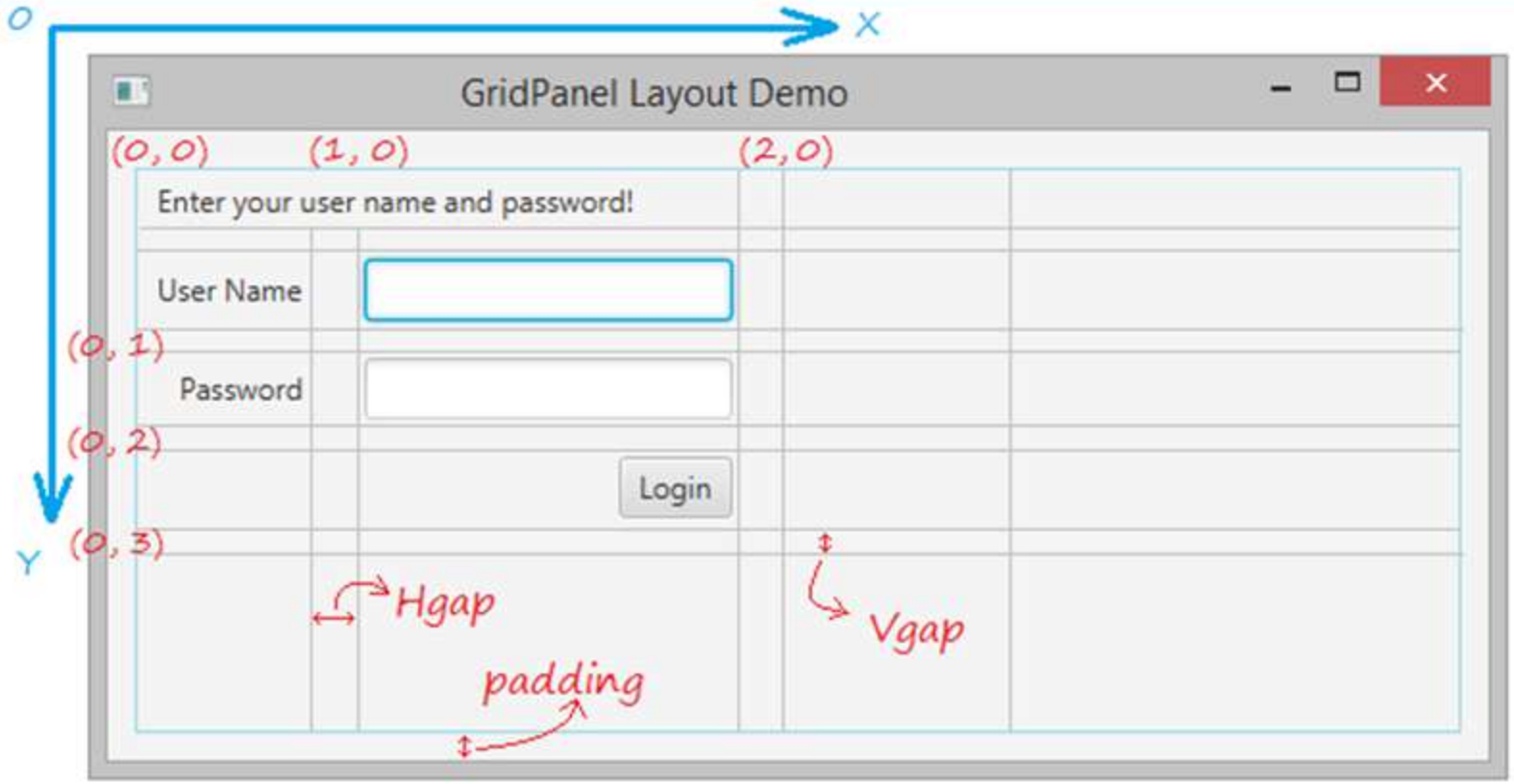


BorderPane layout

- Example09

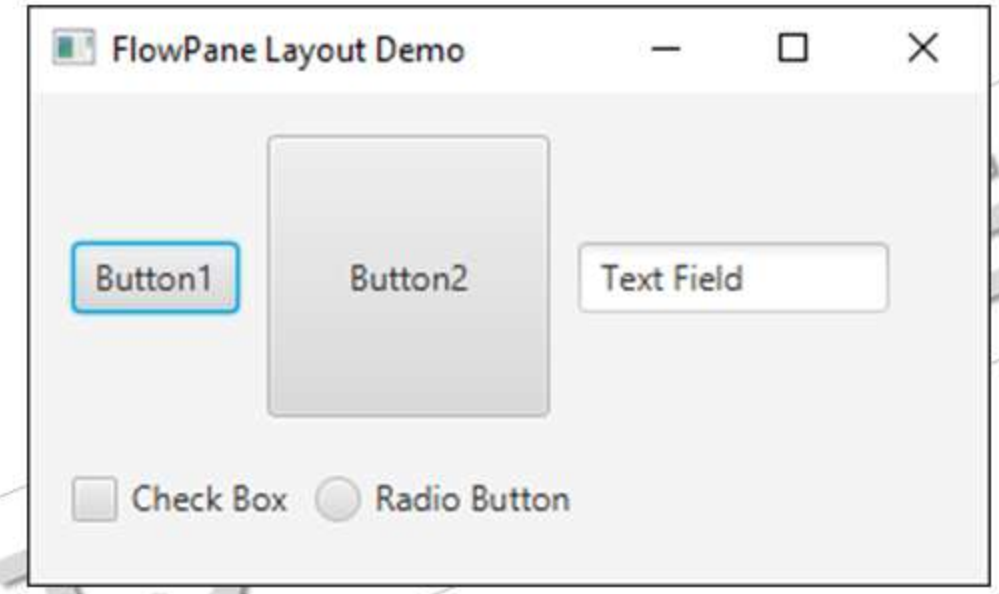


GridPane



- Divide its surface into a grid
- Including rows and columns.
- A subcomponent can lie on a cell or a merged cell
- Example10

FlowPane Layout



- Arrange the consecutive subcomponents on a row
- And automatically pushes the subcomponents down to next line
- Example11

Scene Builder (Reference)

- https://gluonhq.com/products/scene-builder/

Q&A