UNIVERSITÉ Concordia UNIVERSITY

CENTRE FOR CONTINUING EDUCATION

DESKTOP APPLICATION DEVELOPMENT WITH JAVA – CEJV569

Lecture #6

JavaFX

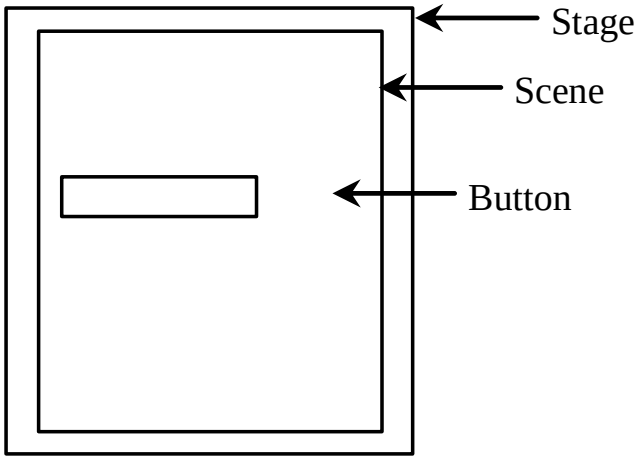
Event-Driven Programming

Basic Structure of JavaFX

Application

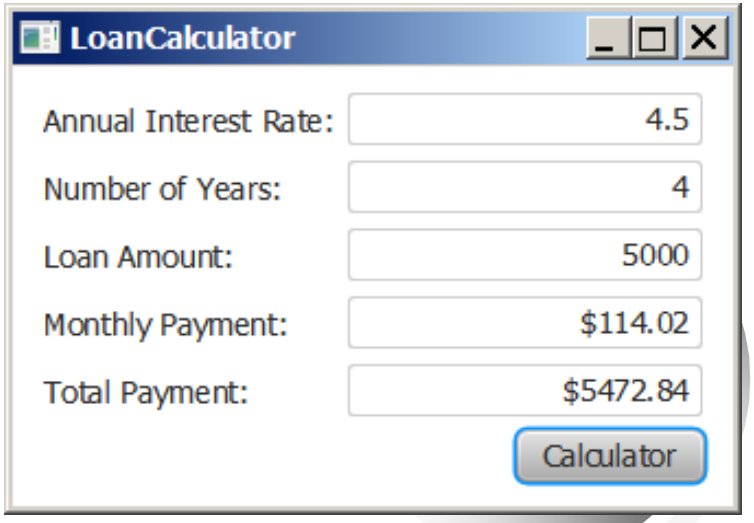
Override the start(Stage) method

Stage, Scene, and Nodes



Motivations

- Suppose you want to write a GUI program that lets the user enter a loan amount, annual interest rate, and number of years and click the *Compute Payment* button to obtain the monthly payment and total payment.
- How do you accomplish the task?
- You have to use *event-driven programming* to write the code to respond to the button-clicking event.



Procedural vs. Event-Driven Programming

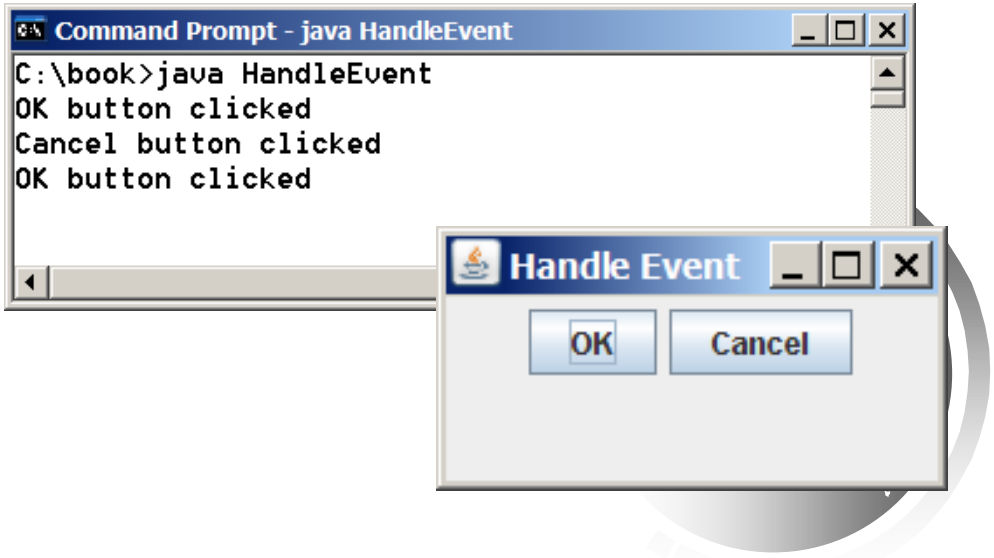
- *Procedural programming* is executed in procedural order.

- In event-driven programming, code is executed upon activation of events.

Taste of Event-Driven Programming

The example displays a button in the frame. A message is displayed on the console when a button is clicked.

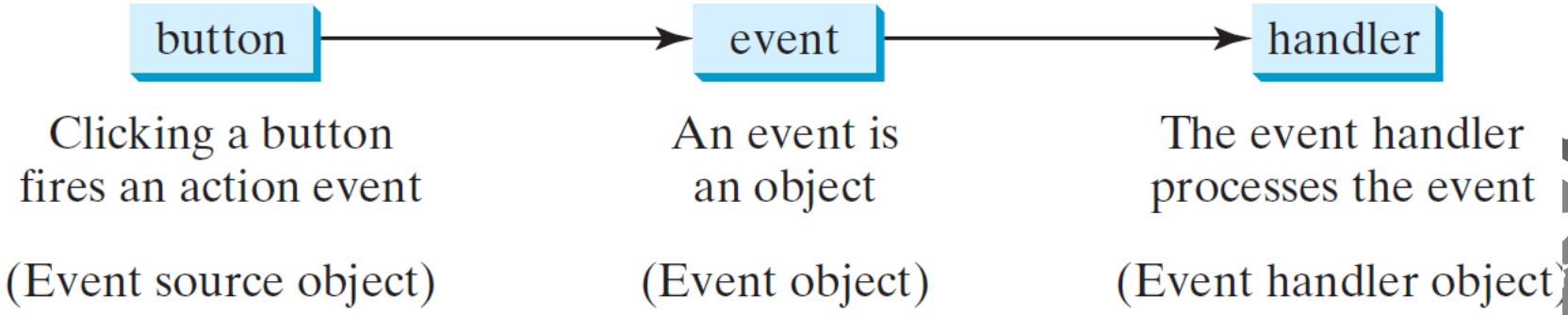
HandleEvent



Handling GUI Events

Source object (e.g., button)

Listener object contains a method for processing the event.



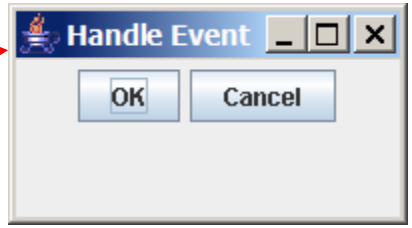
animation

Trace Execution

```
public class HandleEvent extends Application {
  public void start(Stage primaryStage) {
    …
    OKHandlerClass handler1 = new OKHandlerClass();
    btOK.setOnAction(handler1);
    CancelHandlerClass handler2 = new CancelHandlerClass();
    btCancel.setOnAction(handler2);
    …
    primaryStage.show(); // Display the stage
  }
}

class OKHandlerClass implements EventHandler<ActionEvent> {
  @Override
  public void handle(ActionEvent e) {
    System.out.println("OK button clicked");
  }
}
```

1. Start from the main method to create a window and display it



animation

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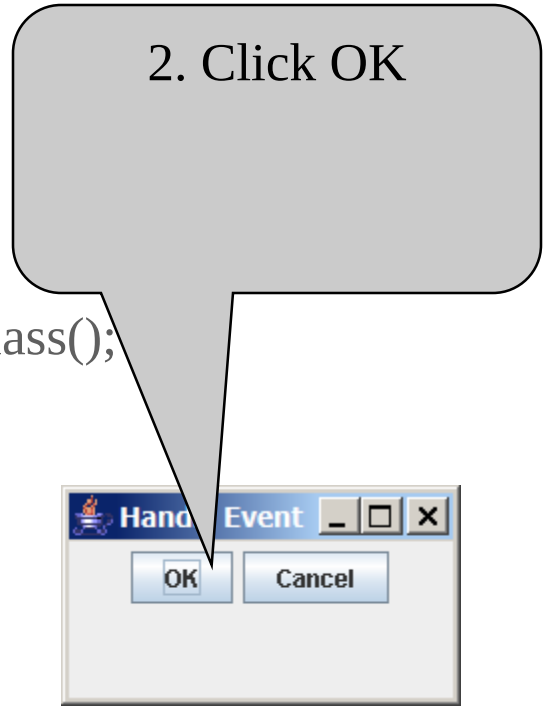

animation

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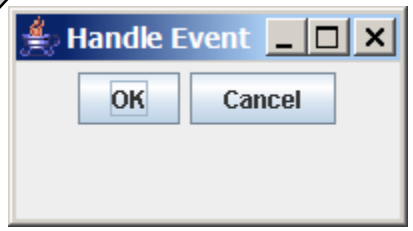
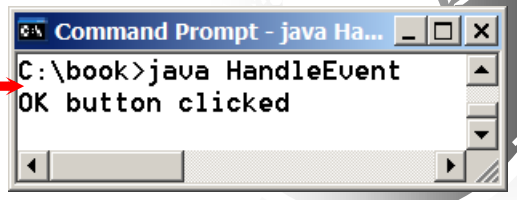
```

3. Click OK. The JVM invokes the listener's handle method



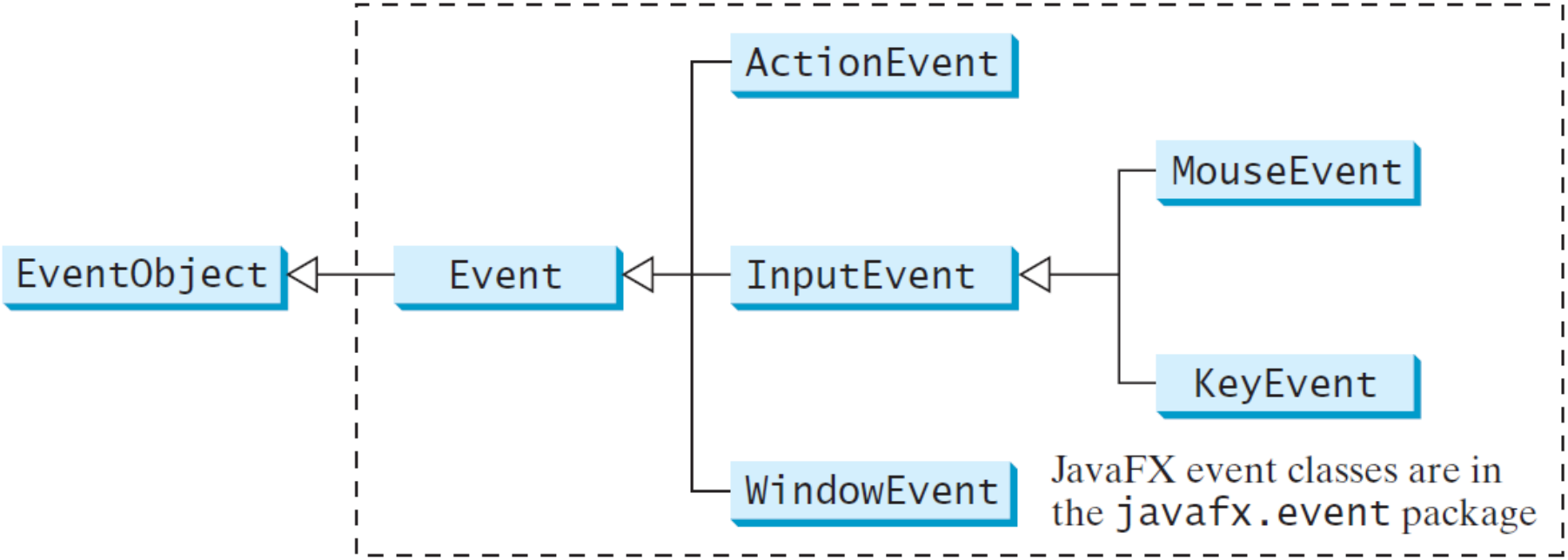


Events

- An *event* can be defined as a type of signal to the program that something has happened.

- The event is generated by external user actions such as mouse movements, mouse clicks, or keystrokes.

Event Classes



Event Information

- An event object contains whatever properties are pertinent to the event.
- You can identify the source object of the event using the getSource() instance method in the EventObject class.
- The subclasses of EventObject deal with special types of events, such as button actions, window events, component events, mouse movements, and keystrokes.

Selected User Actions and Handlers

User Action	*Source Object*	*Event Type Fired*	*Event Registration Method*
Click a button	`Button`	`ActionEvent`	`setOnAction(EventHandler<ActionEvent>)`
Press Enter in a text field	`TextField`	`ActionEvent`	`setOnAction(EventHandler<ActionEvent>)`
Check or uncheck	`RadioButton`	`ActionEvent`	`setOnAction(EventHandler<ActionEvent>)`
Check or uncheck	`CheckBox`	`ActionEvent`	`setOnAction(EventHandler<ActionEvent>)`
Select a new item	`ComboBox`	`ActionEvent`	`setOnAction(EventHandler<ActionEvent>)`
Mouse pressed	`Node, Scene`	`MouseEvent`	`setOnMousePressed(EventHandler<MouseEvent>)`
Mouse released			`setOnMouseReleased(EventHandler<MouseEvent>)`
Mouse clicked			`setOnMouseClicked(EventHandler<MouseEvent>)`
Mouse entered			`setOnMouseEntered(EventHandler<MouseEvent>)`
Mouse exited			`setOnMouseExited(EventHandler<MouseEvent>)`
Mouse moved			`setOnMouseMoved(EventHandler<MouseEvent>)`
Mouse dragged			`setOnMouseDragged(EventHandler<MouseEvent>)`
Key pressed	`Node, Scene`	`KeyEvent`	`setOnKeyPressed(EventHandler<KeyEvent>)`
Key released			`setOnKeyReleased(EventHandler<KeyEvent>)`
Key typed			`setOnKeyTyped(EventHandler<KeyEvent>)`

The Delegation Model: Example

```
Button btOK = new Button("OK");
OKHandlerClass handler = new OKHandlerClass();
btOK.setOnAction(handler);
```

Inner Class Listeners

- A listener class is designed specifically to create a listener object for a GUI component (e.g., a button).
- It will not be shared by other applications.
- So, it is appropriate to define the listener class inside the frame class as an inner class.

Inner Classes

Inner class: A class is a member of another class.

Advantages: In some applications, you can use an inner class to make programs simple.

An inner class can reference the data and methods defined in the outer class in which it nests, so you do not need to pass the reference of the outer class to the constructor of the inner class.

Inner Classes, cont.

```java
public class Test {
  ...
}

public class A {
  ...
}
```

(a)

```java
public class Test {
  ...

  // Inner class
  public class A {
    ...
  }
}
```

(b)

```java
// OuterClass.java: inner class demo
public class OuterClass {
  private int data;

  /** A method in the outer class */
  public void m() {
    // Do something
  }

  // An inner class
  class InnerClass {
    /** A method in the inner class */
    public void mi() {
      // Directly reference data and method
      // defined in its outer class
      data++;
      m();
    }
  }
}
```

(c)

Inner Classes (cont.)

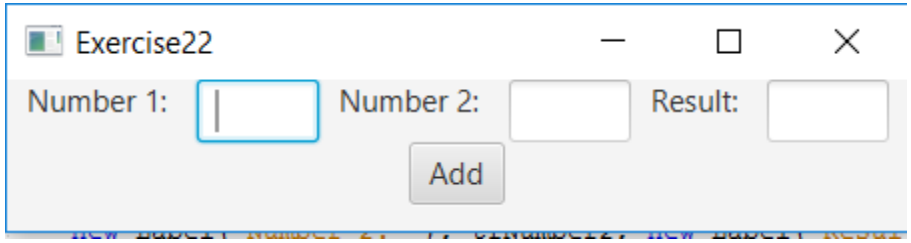
- Inner classes can make programs simple and concise.
- An inner class supports the work of its containing outer class and is compiled into a class named *OuterClassName*$*InnerClassName*.class.
  - For example, the inner class InnerClass in OuterClass is compiled into *OuterClass$InnerClass*.class .

Inner Classes (cont.)

- An inner class can be declared public, protected, or private subject to the same visibility rules applied to a member of the class.

Exercise 22

Create a simple calculator



Anonymous Inner Classes (cont.)

- Inner class listeners can be shortened using anonymous inner classes.
- An *anonymous inner class* is an inner class without a name.
- It combines declaring an inner class and creating an instance of the class in one step.
- An anonymous inner class is declared as follows:

```
new SuperClassName/InterfaceName() {
  // Implement or override methods in superclass or interface
  // Other methods if necessary
}
```

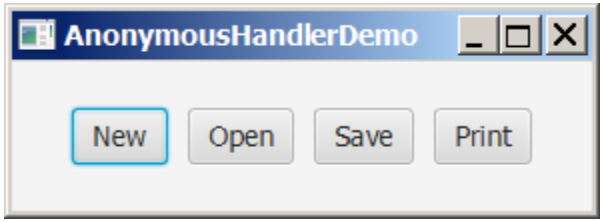
Anonymous Inner Classes (cont.)

```java
public void start(Stage primaryStage) {
  // Omitted

  btEnlarge.setOnAction(
    new EnlargeHandler());
}

class EnlargeHandler
    implements EventHandler<ActionEvent> {
  public void handle(ActionEvent e) {
    circlePane.enlarge();
  }
}
```

(a) Inner class `EnlargeListener`

```java
public void start(Stage primaryStage) {
  // Omitted

  btEnlarge.setOnAction(
    new class EnlargeHandlner
      implements EventHandler<ActionEvent>() {
      public void handle(ActionEvent e) {
        circlePane.enlarge();
      }
    });
}
```

(b) Anonymous inner class



AnonymousHandlerDemo

Simplifying Event Handing Using Lambda Expressions

Lambda expression is a new feature in Java 8. Lambda expressions can be viewed as an anonymous method with a concise syntax. For example, the following code in (a) can be greatly simplified using a lambda expression in (b) in three lines.

```
btEnlarge.setOnAction(
  new EventHandler<ActionEvent>() {
    @Override
    public void handle(ActionEvent e) {
      // Code for processing event e
    }
  }
});
```

(a) Anonymous inner class event handler

```
btEnlarge.setOnAction(e -> {
  // Code for processing event e
});
```

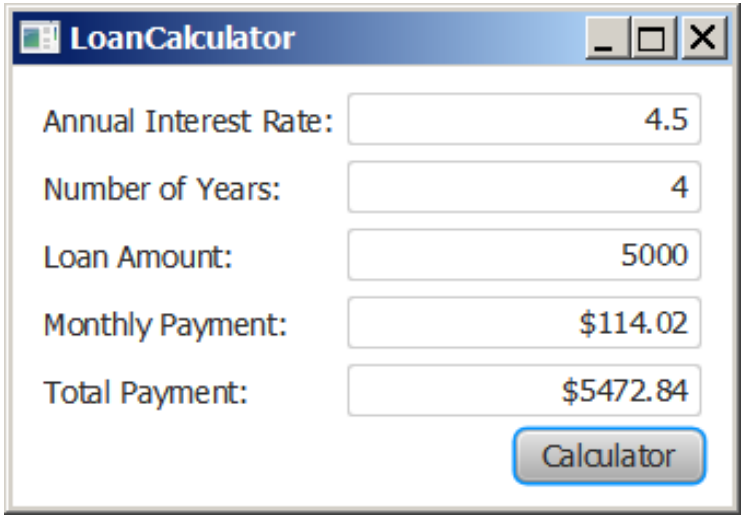
(b) Lambda expression event handler

Single Abstract Method Interface (SAM)

- The statements in the lambda expression is all for that method.
- If it contains multiple methods, the compiler will not be able to compile the lambda expression.
- So, for the compiler to understand lambda expressions, the interface must contain exactly one abstract method.
- Such an interface is known as a *functional interface*, or a *Single Abstract Method* (SAM) interface.

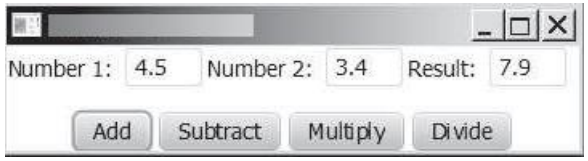
AnonymousHandlerDemo

Problem: Loan Calculator

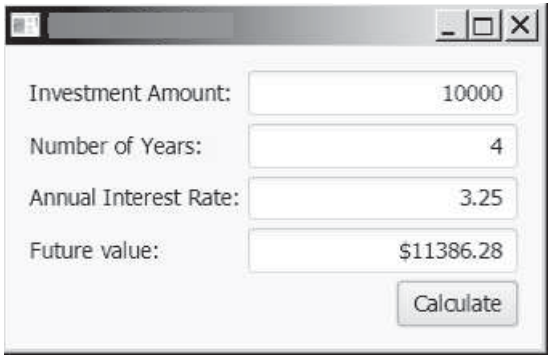


Exercise 23

- Create a simple calculator

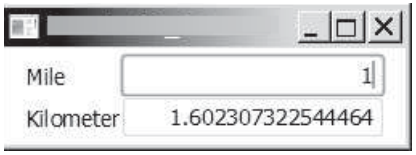


- Create an investment-value calculator



Exercise 24

- Create a miles/kilometers converter



- Text viewer