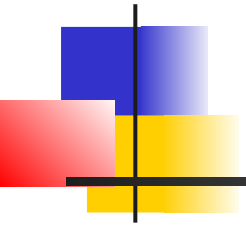
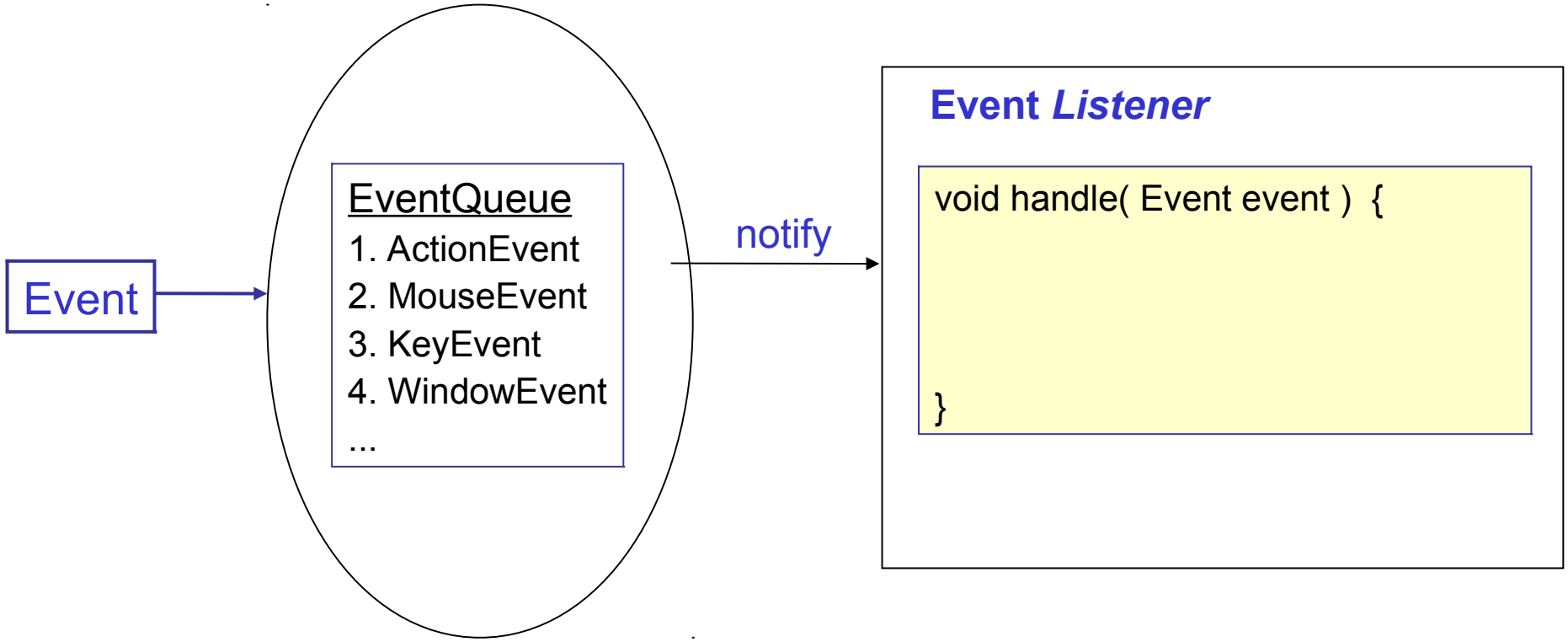


# Event Handling in JavaFX

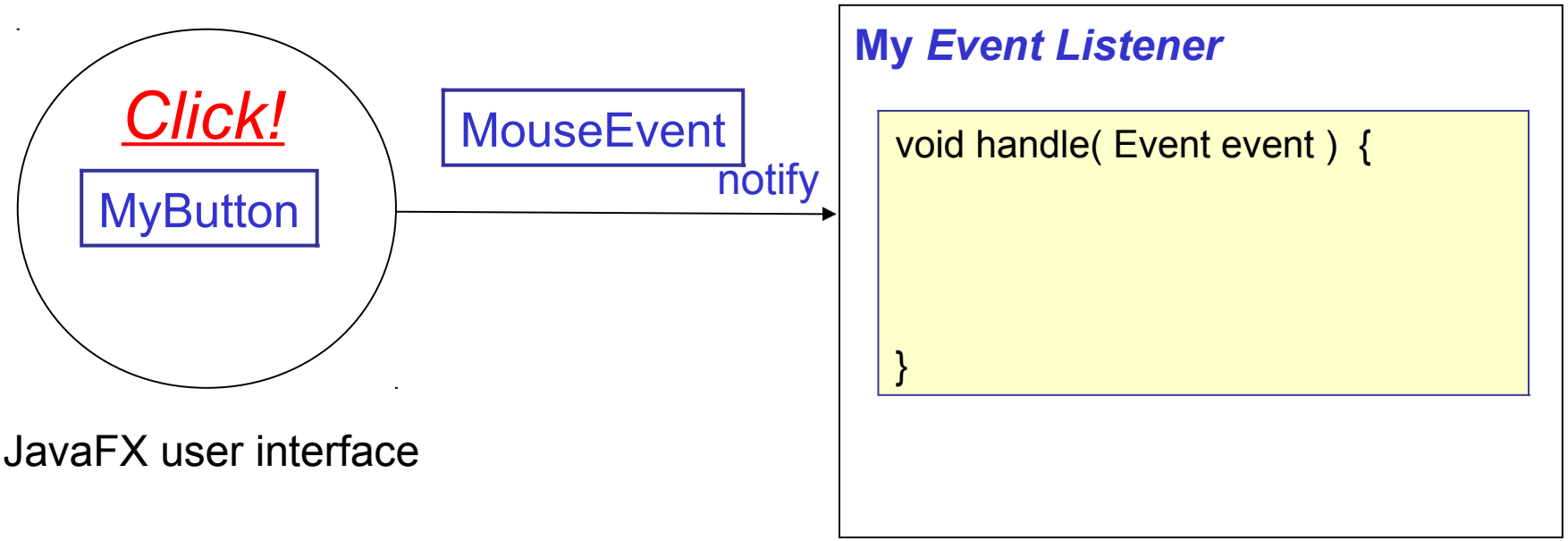
# Event Driven Programming

- Graphics applications use ***events***.
- An event dispatcher receives events and ***notifies*** interested objects.



# Example

1. User clicks mouse on a button -- that's an *Event*.
2. JavaFX creates a MouseEvent object.
   - the MouseEvent describes what happened (which mouse button was presses, which field it was in).
3. JavaFX looks for a registered "*Event Listener*", and calls it using the MouseEvent as parameter.



# Responding to Behavior

Your application must ***do something*** when an event occurs.

Things you need to know

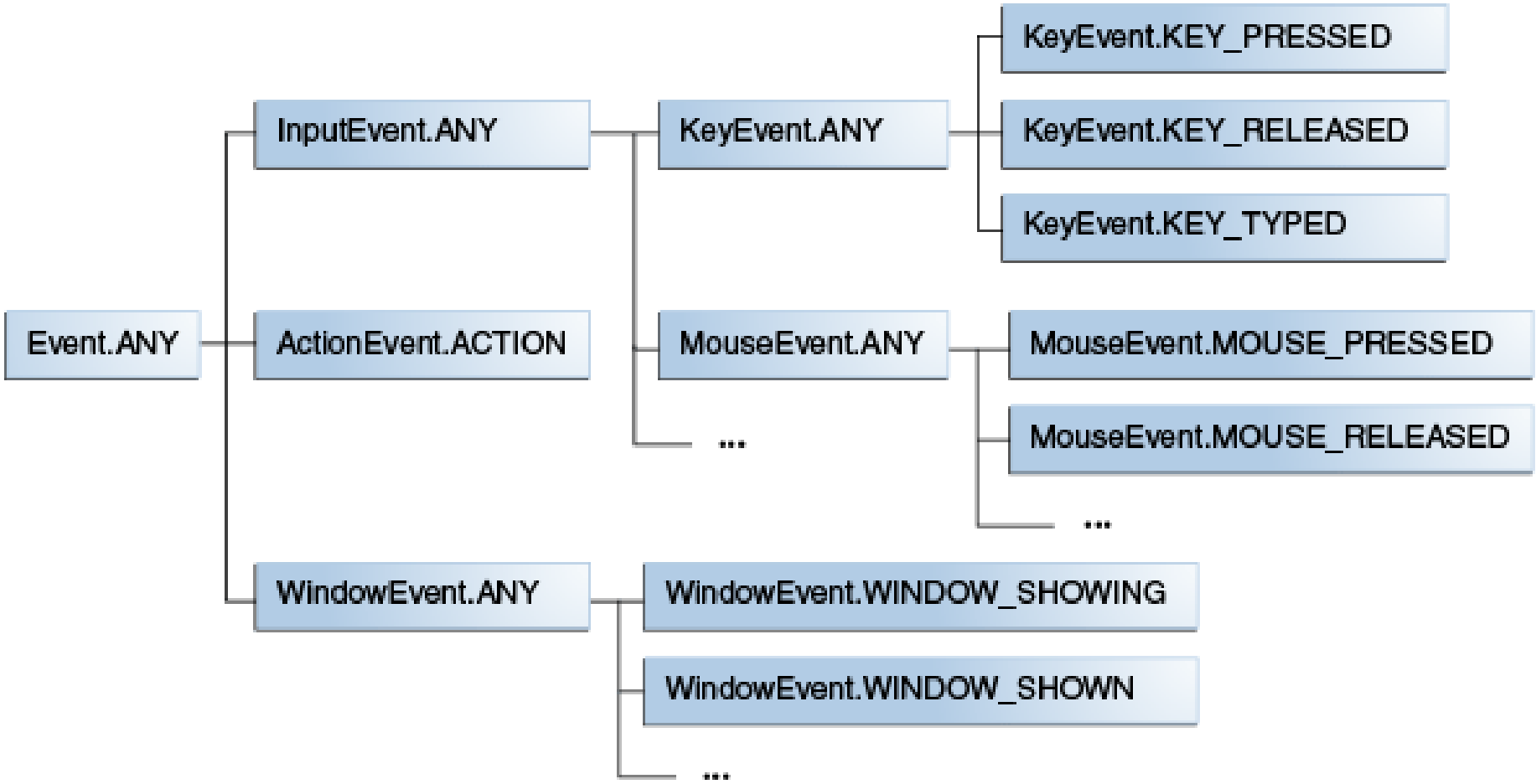
- what kinds of events are there?
- what user (or software) action causes what event?
- how do you write an event handler?
- how do you add event handler to a component?

# Check the Event class API

All Events are subclasses of Event.

```
Event
    ActionEvent
    InputEvent
        KeyEvent
        MouseEvent
    WebEvent
    WindowEvent
```

# Types of Events




From Oracle's JavaFX Tutorial:

https://docs.oracle.com/javase/8/javafx/events-tutorial/processing.htm

# Source of Events

A component or node can be "source" of many kinds of events.

Some event types are different for each node or component.

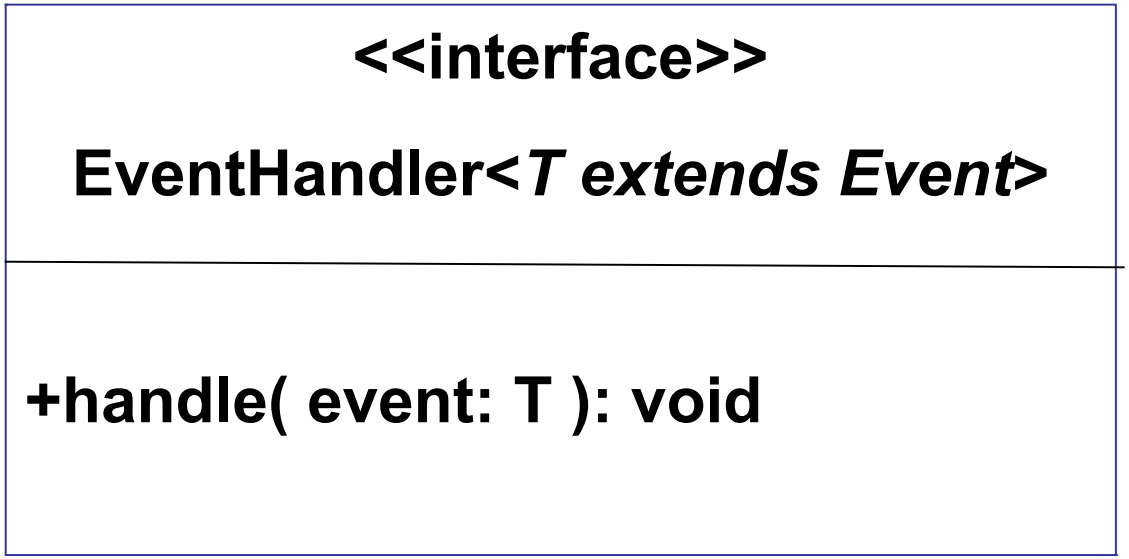
Its not complicated! Mostly you can *guess* event types.

| | |
|---|---|
| Button | ActionEvent (button press) |
| TextField | ActionEvent<br>KeyEvent (Key Press, Key Release, Key Typed). |
| Any kind of Node | MouseEvent: MousePress, MouseReleased, MouseClicked, MouseDragged, etc.<br>Rotation events, Touch events |

# What is an EventHandler?

JavaFX has just *one interface* for all kinds of Event Handlers. This is a lot simpler than Swing and AWT.

You have to write code to implement this interface.



# Example: ENTER or Button click

1. User types his name and clicks a button (or ENTER)

Event type is: **`ActionEvent`**

```
class ButtonHandler
      implements EventHandler<ActionEvent>
{
   public void handle(ActionEvent evt) {
      String text = nameField.getText();
      // greet user using Alert dialog box
      alert("Hello, "+text);
      nameField.setText("");  // clear input
   }
}
```

# How to Add Event Handler

There are two ways.

1) **`addEventHandler`** - the general way

2) **`setOnXxxxx`** - convenience methods for specific event type, such as:

```
setOnAction( EventHandler<ActionEvent> e )

setOnKeyTyped( EventHandler<KeyEvent> e )

setOnMouseClicked( EventHander<MouseEvent> e )

setOnMouseMoved( EventHander<MouseEvent> e )
```

...

# 2 Ways to Add Event Handler (demo)

```
// 1. use addEventHandler:
button.addEventHandler(
  ActionEvent.ALL,  new ButtonHandler( ) )

// 2. use setOnAction
button.setOnAction( new ButtonHandler( ) )
```

Notice that the EventHandler is the same.

The result will be the same, too.

Both add Event Handler for ActionEvents.

# You can re-use event handlers

For clarity, or to *reuse* the same event handler on many components, assign new event handler to a reference variable first.

Then use the variable in **`setOnAction(...)`**.

```
ButtonHandler greetHandler =
                    new ButtonHandler();
// Now apply handler to components
button.setOnAction( greetHandler );
nameField.setOnAction( greetHandler );
```

# Don't Create Duplicate Handlers

It is bad programming to create two objects to do the same thing (greet the user).

```
// don't do this
button.setOnAction( new ButtonHandler() );
nameField.setOnAction( new ButtonHandler() );
```

# 4 Ways to Define an EventHandler

1. Define an (inner) class that implements EventHandler.
   We just did that.

2. Write it as *anonymous class*.

3. Write it as a *method* and use a *method reference*.
   Method reference is new in Java 8.
   Works because Event Handler has only 1 method.

4. Write it as a *lambda expression* and use a reference variable to add it.

# Event Handler as Anonymous Class

You must specify what interface you are implementing, including type parameter.

```
EventHandler<ActionEvent> buttonHandler =
  new EventHandler<ActionEvent>() {
    // anonymous class definition:
    public void handle(ActionEvent evt) {
      String text = nameField.getText();
      //TODO greet user using Alert box
      nameField.setText("");  // clear input
    }
 };
button.setOnAction( buttonHandler );
```

# Avoid inline definition & use

This is hard to understand and hard to maintain.
Avoid it. Define the anonymous class *first*, then use it.

```
// This is harder to understand, especially
// when the anonymous class is long.
button.setOnAction(
  new EventHandler<ActionEvent>() {
    public void handle(ActionEvent evt) {
      String text = nameField.getText();
      //TODO greet user using Alert box
      nameField.setText("");  // clear input
    }
  } );
```

# Method as Event Handler?

Using SceneBuilder to assign event handlers
we did not write inner classes or anonymous classes.
We just wrote a method, like this:

```
@FXML
public void greetTheUser(ActionEvent evt) {
    String text = nameField.getText();
    //TODO greet user using Alert box
    nameField.setText("");  // clear input
 }
```

SceneBuilder let us use a method as Event Handler, instead of object.

***How?***

# Method References

Java 8 allows a *method reference* to be used as something that implements an interface. The syntax is:

**`object::methodname`**

```
Runnable nike = this::doit; // method reference
nike.run();                 // calls doit()

// this "looks like" a Runnable.run() method
// so we can use it as method reference.
public void doit( ) {
   System.out.println("Just do it.");
}
```

# Method Reference as EventHandler

Write a method with the required method signature, but any name you like.

```
// Assign event handler using method reference
  button.setOnAction( this::greetAction );

  // this method signature "looks like" an
  // EventHandler, but the name is different
  public void greetAction(ActionEvent evt) {
     String text = nameField.getText();
     //TODO greet user using Alert box
     nameField.setText("");  // clear input
  }
```

# Lambda Expressions

Lambda Expression is an inline method definition, without a method name.

EventHandler<ActionEvent> buttonHandler =

```
    (event) -> {
            String text = nameField.getText();
            //TODO greet user using Alert box
            nameField.setText("");
          } ;
button.setOnAction( buttonHandler );
```

# 5th Way to Define Event Handler

You can define the controller itself as "implements EventHandler<T>" and use "setOnAction( this )".

```
class GreetController
      implements EventHandler<ActionEvent> {
    @FXML
    public void initialize() {
       button.setOnAction( this );
    ...

    public void handle(ActionEvent event) {
       // handle it.
```

This technique is not usually the best choice. You usually have many components which need custom event handlers.

# Event Handling Exercise

- Draw a Sequence Diagram of logic for creating and using an ActionEvent handler.

# Event Dispatching

When an event occurs, JavaFX does:

1. Determine the event **target**.

2. Event Capture: pass the event down from the root node to the target.

Along the way, EventFilters may be invoked.

3. Event Handling (Event Bubbling): starting at the target, any event handler is invoked. The event "bubbles" back up the tree until it is consumed.

See:

https://www.tutorialspoint.com/javafx/javafx_event_handling.htm

# References


Event Handling in Oracle *JavaFX Tutorial.* *This has the most complete explanation of event types and event handling*

https://docs.oracle.com/javase/8/javafx/events-tutorial/events.htm

Event Handling in *Tutorialspoint JavaFX Tutorial.*

https://www.tutorialspoint.com/javafx/javafx_event_handling.htm - example of event capture, event filter, and event handler.

JavaFX Events

http://zetcode.com/gui/javafx/events/

# Code for `alert()`

```
/**
 * Display a dialog box with a string message.
 * @param message the message to show.
 */
public void alert(String message) {
    Alert alert = new Alert(AlertType.INFORMATION);
    alert.setContentText( message );
    alert.show( );
}
```