Java

JavaFX

Overview

- Java GUI
  - Java 1.0 (1996) – AWT
    - using native GUI components
  - Java 1.2 (2000) – Swing
    - GUI completely in Java
  - JavaFX (2007)
    - new technology
    - running on the Java VM
    - but own language
      - declarative
    - intended as a competitor to Flash
    - failed
  - JavaFX 2.0 (2011)
    - only API (own language abandoned)
  - since JDK 7 update 6 a part of std library (JavaFX 2.2)
  - Java 8 – JavaFX 8
    - no further development of Swing
  - Java 11 – JavaFX decoupled from std library

Hello World

```
public class HelloWorld extends Application {

  @Override
  public void start(Stage stage) {
    Label message = new Label("Hello, JavaFX!");
    message.setFont(new Font(100));
    stage.setScene(new Scene(message));
    stage.setTitle("Hello");
    stage.show();
  }

  // no main()
}
```

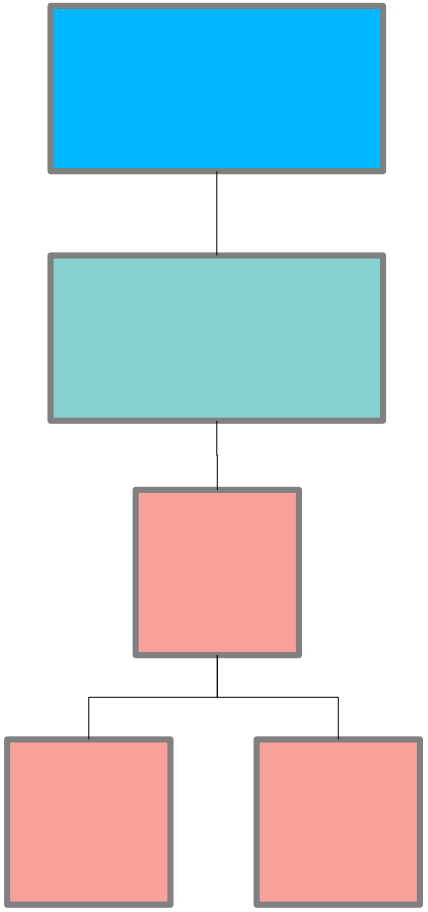
no J prefix

Hello World

- explicit main() necessary in older version

```
public class MyApp extends Application {
    public static void main(String[] args) {
        launch(args);
    }
    ...
}
```

Application structure



Stage

Scene

Scene graph

Events

- similar as in Swing/AWT
- BUT typically – listening on property changes
  - i.e. not listening directly on components
    - there are exceptions, e.g. buttons

```
Slider slider = new Slider(10, 100, 100);
Label message = new Label("Hello, JavaFX!");

slider.valueProperty().addListener(property ->
message.setFont(new Font(slider.getValue())));
```

Properties of components

- interface Property<T>
  - void addListener(InvalidationListener listener)
  - void addListener(ChangeListener<? super T> listener)
  - void bind(ObservableValue<? extends T> observable)
  - void bindBidirectional(Property<T> other)
  - …
- implementace
  - class ObjectProperty<T>
  - class IntegerProperty
  - class BooleanProperty
  - class StringProperty
  - ...

Properties – implementation ex.

```
private StringProperty text =
                        new SimpleStringProperty("");

public final StringProperty textProperty() {
  return text;
}

public final void setText(String newValue){
  text.set(newValue);
}

public final String getText() {
  return text.get();
}
```

Properties – listeners

- `InvalidationListener`
  - called if the current property value is not valid anymore
  - allows for “lazy” evaluation

```
void invalidated(Observable observable)
```

- `ChangeListener`
  - called if the current property value has changed
  - it is necessary to evaluate the new value
  - does not allow for “lazy” evaluation

```
void changed(ObservableValue<? extends T>
                observable, T oldValue, T newValue)
```

Properties – binding

- automated updating of a property when another one is changed
  - internally implemented via listeners

```
text1.textProperty().bind(text2.textProperty());

text1.textProperty().bindBidirectional(
                                text2.textProperty());
```

- class Bindings
  - static methods for easy creation of bindings

Layout

- creating layout of components
  - JavaFX Scene Builder
    - GUI build visually by “clicking”
  - “manually”
    - creating instances of components
  - definition in FXML

- similar as in Swing
  - panes instead of layout managers

Layout

- BorderPane (as BorderLayout)
- HBox
- VBox
- GridPane (as GridBagLayout)
- TilePane (as GridLayout)
- …

```
VBox pane = new VBox();
pane.getChildren().addAll(button1, button2,);
pane.setPadding(new Insets(10));
```

FXML

```
<?import java.net.*?>
<?import javafx.geometry.*?>
<?import javafx.scene.control.*?>
<?import javafx.scene.layout.*?>
<?import javafx.scene.text.*?>

<GridPane
    fx:controller="fxmlexample.FXMLExampleController"
    xmlns:fx="http://javafx.com/fxml" alignment="center"
    hgap="10" vgap="10">
<padding><Insets top="25" right="25" bottom="10"
                                        left="25"/></padding>
  <Text text="Welcome"
        GridPane.columnIndex="0" GridPane.rowIndex="0"
        GridPane.columnSpan="2"/>

   <Label text="User Name:"
        GridPane.columnIndex="0" GridPane.rowIndex="1"/>
   ...
```

FXML

- usage

```
public void start(Stage stage) {
  try {
    Parent root = FXMLLoader.load(getClass().
                              getResource("file.fxml"));
    stage.setScene(new Scene(root));
    stage.show();
  } catch (IOException ex) {
    ex.printStackTrace();
     System.exit(0);
  }
}
```

FXML

- adding listeners/bindings

a)

```
<TextField id="username" …

TextField username =
                (TextField) root.lookup("#username");
```

b)

```
<GridPane xmlns:fx="http://javafx.com/fxml" hgap="10"
vgap="10" fx:controller="LoginDialogController">
<Button fx:id="okButton" text="Ok" />

public class LoginDialogController implements
Initializable {
  @FXML private TextField username;
  @FXML private Button okButton;
  public void initialize(URL url, ResourceBundle rb){
    okButton.disableProperty().bind(...
```

CSS

- visual appearance of UI can be set via CSS

```
Scene scene = new Scene(pane);
scene.getStylesheets().add("scene.css");
```

- JavaFX specific attributes are used

```
#pane {
    -fx-padding: 0.5em;
    -fx-hgap: 0.5em;
    -fx-vgap: 0.5em;
    -fx-background-image: url("bg.jpg")
}
```

Animace apod.

- ScaleTransition

```
ScaleTransition st =
   new ScaleTransition(Duration.millis(3000));
st.setByX(1.5);
st.setByY(1.5);
st.setNode(button);
st.setCycleCount(Animation.INDEFINITE);
st.setAutoReverse(true);
st.play();
```

- FadeTransition
- RotateTransition
- DropShadow
- ...

Component overview

- Accordion
- Button
- CheckBox
- ChoiceBox
- ColorPicker
- ComboBox
- DatePicker
- Label
- ListView
- Menu
- MenuBar
- PasswordField
- ProgressBar
- RadioButton
- Slider
- Spinner
- SplitMenuButton
- SplitPane
- TableView
- TabPane
- TextArea
- TextField
- TitledPane
- ToggleButton
- ToolBar
- TreeTableView
- TreeView

Charts

- BarChart
- BubbleChart
- LineChart
- PieChart
- ScatterChart
- StackedAreaChart
- StackedBarChart

Other

- WebView
  - rendering HTML
  - based on WebKit
- playing video
- ...

Threads

- similarly as in Swing
  - single-threaded UI
- UI thread
  - all UI changes from this thread

    Platform.runLater(Runnable runnable)

  - long-running operations -> own thread
- javafx.concurrent
  - Worker interface
    - similar to the SwingWorker class
  - Task, Service, ScheduledService
    - implementations of the Worker interface
    - Service executes Tasks

JavaFX Task<V>

- implements java.util.concurrent.FutureTask<T>

- executing

```
Thread th = new Thread(task);
th.setDaemon(true);
th.start();
```

  - or

```
ExecutorService.submit(task);
```

- one-time action
  - cannot be reused

JavaFX Task<V>

- property
  - ReadOnlyObjectProperty<Throwable> **exception**
  - ReadOnlyStringProperty **message**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onCancelled**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onFailed**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onRunning**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onScheduled**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onSucceeded**
  - ReadOnlyDoubleProperty **progress**
  - ReadOnlyBooleanProperty **running**
  - ReadOnlyObjectProperty<Worker.State> **state**
  - ReadOnlyStringProperty **title**
  - ReadOnlyDoubleProperty **totalWork**
  - ReadOnlyObjectProperty<V> **value**
  - ReadOnlyDoubleProperty **workDone**

JavaFX Service<V>

- non-visual component
- executes tasks
  - uses Executor (by default ThreadPoolExecutor)

```
class MyService extends Service<String> {
    protected Task createTask() {
        return new Task<String>() {
            …
        };
    }
}

new MyService().start();
```

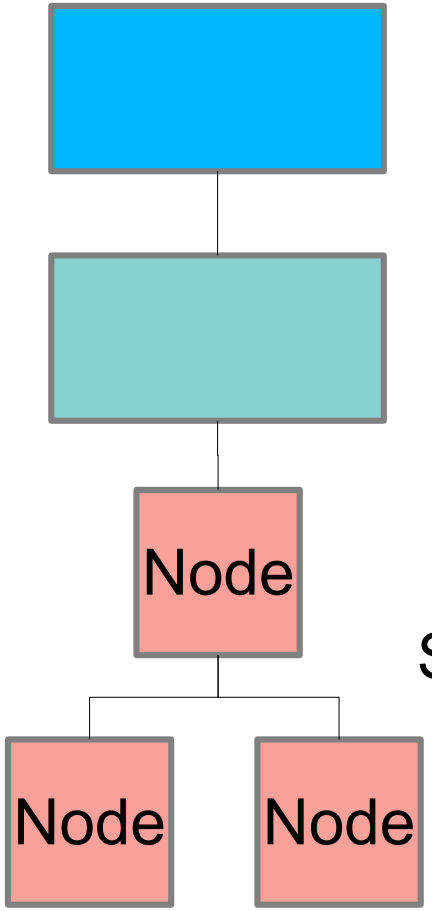
JavaFX Service<V>

- vlastnosti
  - ReadOnlyObjectProperty<Throwable> **exception**
  - ObjectProperty<Executor> **executor**
  - ReadOnlyStringProperty message
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onCancelled**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onFailed**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onReady**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onRunning**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onScheduled**
  - ObjectProperty<EventHandler<WorkerStateEvent>> **onSucceeded**
  - ReadOnlyDoubleProperty **progress**
  - ReadOnlyBooleanProperty **running**
  - ReadOnlyObjectProperty<Worker.State> **state**
  - ReadOnlyStringProperty **title**
  - ReadOnlyDoubleProperty **totalWork**
  - ReadOnlyObjectProperty<V> **value**
  - ReadOnlyDoubleProperty **workDone**

ScheduledService<V>

- automatically restarts itself after an execution

Application



Scene graph

- Nodes
  - Button
  - Label
  - …
  - Line
  - Circle
  - Rectangle
  - ...

Canvas

- an image that can be drawn on using a set of graphics commands

```
Canvas canvas = new Canvas(250,250);
GraphicsContext gc = canvas.getGraphicsContext2D();

gc.setFill(Color.BLUE);
gc.fillRect(75,75,100,100);
```

Games

- Canvas + AnimationTimer

SceneBuilder

- a visual tool for UI creation
  - Starting with Oracle Java SE 8u40, Oracle does not provide a separate set of accompanying JavaFX Scene Builder binaries…
- download
  - http://gluonhq.com/products/scene-builder/

JFXPanel

- javafx.embed.swing.JFXPanel
- Swing component
- content of the component – JavaFX
- warning – „event-dispatching“ threads
  - Swing and JavaFX do not share the thread