Outline

3 Multimedia Programming with JavaFX

Literature:

docs.oracle.com/javafx

JavaFX - Idea and History

- Chris Oliver, 2006 (?): “Form follows function” (F3)
  - Working for company “SeeBeyond”, but personal project
- Acquisition of SeeBeyond by Sun, 2005
  - F3 is not in the center of interest, apparently
  - First announcement of JavaFX (ex F3) May 2007 (JavaOne conference)
- Builds on Java runtime environment:
  - Common programming model for multimedia applications across many platforms, including mobile devices
- In Versions 1.X, JavaFX was built on JavaScript language (not Java!)
- JavaFX 2.0 (October 2011): JavaFX as native Java library
  (and introduction of declarative FXML language)
- Since Java SE7 update 6 and JavaFX 2.2:
  JavaFX contained in Java SE standard distribution
- Current version (renumbered): JavaFX 8 (March 2014)

JavaFX Application

- JavaFX program always extends the class
  `javafx.application.Application`
- JavaFX runtime carries out the following steps:
  - Construct on instance of the application class
  - Calls **`init()`** method (override if needed)
  - Calls **`start(javafx.stage.Stage)`** abstract method
    - » Needs to be overridden
  - Waits for the application to finish
  - Calls **`stop()`** method (override if needed)
- Standard template for a JavaFX application:

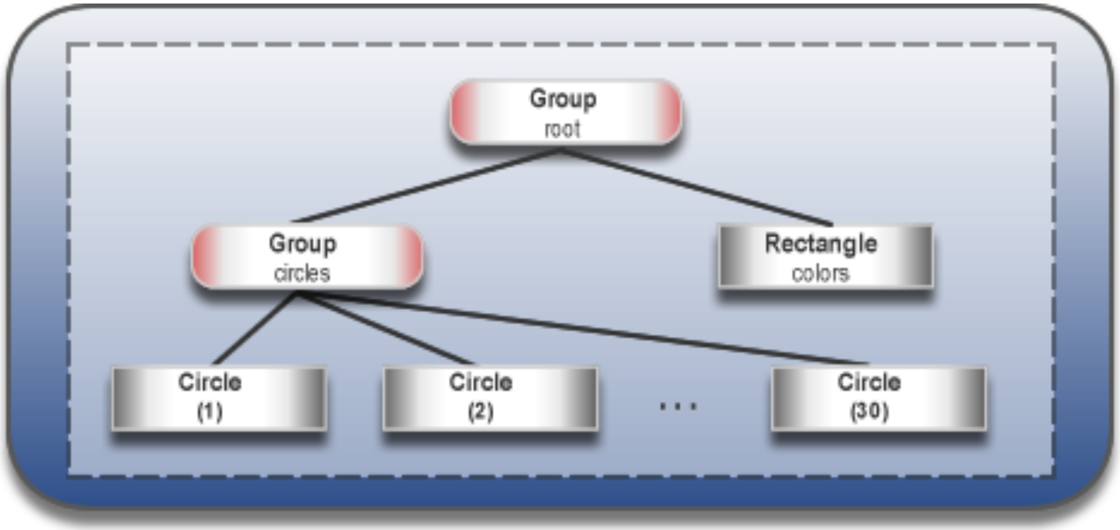
```
public class MyApp extends Application {
    public void start(Stage stage) {
    …
    }
}
```

JavaFX Stage

- Stage *(Bühne):*
  - Frequently used metaphor for the space for animated program behavior
- **`javafx.stage.Stage`** class:
  - Top-level container for JavaFX application
  - Elements are visible/audible only if assigned to stage
  - Primary stage is constructed by platform (parameter of **`start()`**)
  - There may be several stages
- Stage has a title
  - **`setTitle()`**
- Stage contents are organized in the contained scene:
  - **`setScene(javafx.scene.Scene)`**
- Stage contents have to be made visible explicitly:
  - **`show()`**

JavaFX Scene

- JavaFX elements are always organized in a *scene graph*
  - *Frequently used concept also in other platforms*
- Scene graph is a *directed acyclic graph (DAG)*
  - Leaf nodes are media object representations:
    `Rectangle, Text, ImageView, MediaView,` …
  - Superclass of all contained objects: **`Node`**
    - » *Composite* design pattern, see later
  - Branching class: **`Group (extends Node)`**



Skeleton Code for Slideshow in JavaFX

```
public class JFXSlideshowBasic extends Application {

    @Override
    public void start(Stage primaryStage) {

        Color background = Color.rgb(255,228,95);

        final ImageView picture = new ImageView();
        picture.setX(50);
        picture.setY(50);
        picture.setImage(…);

        Group root = new Group(picture);
        Scene scene = new Scene(root, 356, 356, background);

        primaryStage.setTitle("Simple Slide Show with JavaFX");
        primaryStage.setScene(scene);
        primaryStage.sizeToScene();
        primaryStage.show();
   }
}
```

QUIZ

- Give a graphical picture of the scene graph for the code skeleton just shown!

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Observable Properties

- Program variable *x* depending on the value of another variable *y*
  x = f(y)
  - Example: Bill amount depending on tax rate
  - Example: Image displayed depending on current index in show
- What happens if value of *y* changes?
  - If *y* is a standard variable?
  - If *y* is a writable and observable value?
  - Idea: Re-evaluate *x* as soon as *y* changes
- Java implementation:
  - Writable and observable values: Analogous to *Java Bean* properties
  - Re-evaluation through *Observer* pattern: Registering a *change listener*
- More advanced concept: *Binding* within expressions

Example: Observable Property “slideindex”

```
public class JFXSlideshowBasic extends Application {

  @Override
  public void start(Stage primaryStage) {
  …

  final ImageView picture = new ImageView();
  picture.setImage(imagearray[0]);

  final IntegerProperty slideindex =
     new SimpleIntegerProperty();
  slideindex.addListener(new ChangeListener(){
     @Override
     public void changed
         (ObservableValue o, Object oldVal, Object newVal){
       picture.setImage(imagearray[slideindex.getValue()]);
     }
  });
…
}
```

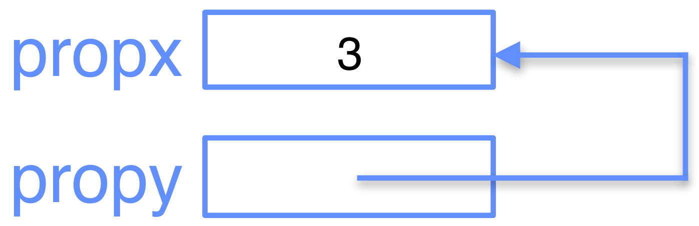
Simple Example for Binding in JavaFX

```
final IntegerProperty propx = new SimpleIntegerProperty();
final IntegerProperty propy = new SimpleIntegerProperty();

propy.bind(propx);
propx.setValue(3);
…
System.out.println
  ("Value of propy is "+propy.getValue());
```

Result:

```
Value of propy is 3
```



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Concept: Timeline and Key Frames

- From JavaFX (Ver. 1!) documentation:
  "`Timeline` provides the capability to update the property values along the progression of time."
- Some variables take new values at certain points in time
  - Example slide index in slide show
- ***Timeline***:
  - Defines a sequence of ***key frames***
  - Each key frame defines a certain configuration of values
    - Writable property + concrete value for it
  - Each key frame is associated to a point in time
- Timelines are suitable to express animations
  - ***Interpolation*** of values (see later)
- A timeline is a sequential time container.

JavaFX Timeline

- **`class Timeline extends Animation`**
  - Property **`cycleCount`**: Repetition counter, may be **`INDEFINITE`**
  - Property **`KeyFrames`**: List of **`KeyFrame`** objects
  - Adding key frames to a timeline object:
    - » By obtaining the keyframe list and adding to that
- Main methods for timelines:
  - **`play()`**
  - **`playFromStart()`**
  - **`stop()`**

JavaFX KeyFrame

- `KeyFrame` object constructor needs:
  - `Duration` object (time in ms from beginning)
  - `KeyValue` object
- `KeyValue` object constructor needs:
  - Writable property (***not*** a normal variable)
    - » e.g. `IntegerProperty`, not `int`
  - Suitable concrete value
- E.g.:

```
new KeyFrame(
   new Duration(8000),
   new KeyValue(slideindex, 2)
)
```

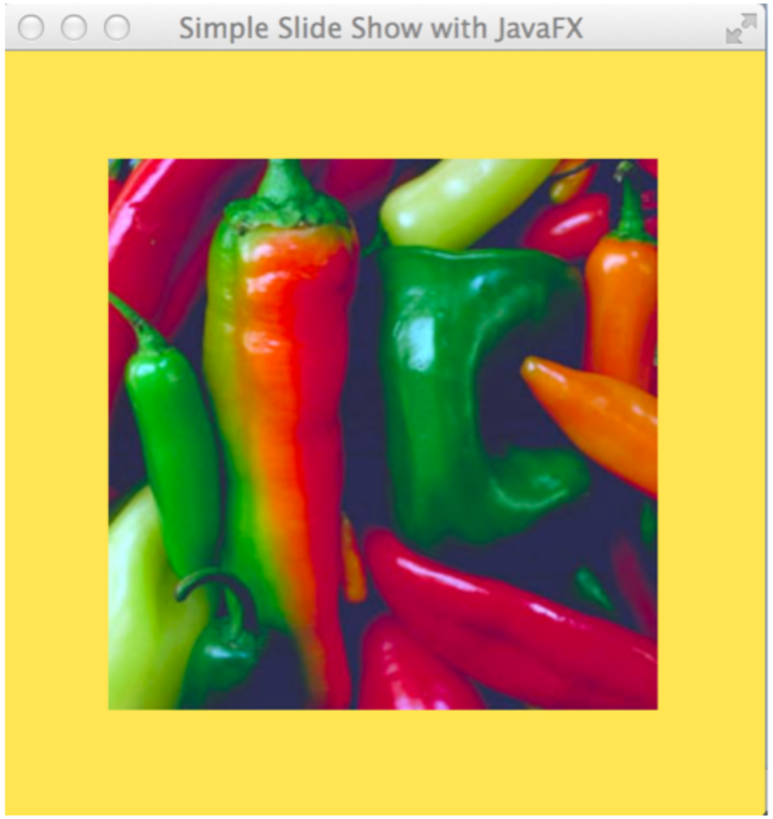
Example: Timeline for Slideshow

Duration	Value for slideindex
0	0
4000	1
8000	2
16000	3
24000	4

```
Timeline timeline =
  new Timeline();
List<KeyFrame> keyframes =
  timeline.getKeyFrames();
for(int i=0;
    i<imagearray.length; i++) {
  keyframes.add(
    new KeyFrame(
      new Duration(i*4000),
      new KeyValue(
        slideindex,
        i
      )
    )
  );
}
```

Slideshow with JavaFX (1)

```
package jfxslideshowbasic;

import java.util.List;
import javafx.animation.*;
import javafx.application.Application;
import javafx.beans.property.*;
import javafx.beans.value.*;
import javafx.scene.*;
import javafx.scene.image.*;
import javafx.scene.paint.*;
import javafx.stage.Stage;
import javafx.util.Duration;


public class JFXSlideshowBasic extends Application {

    @Override
    public void start(Stage primaryStage) {

        Color background = Color.rgb(255,228,95);

        final Image[] imagearray = {
            new Image("file:pics/tiger.jpg", true),
            new Image("file:pics/elephant.jpg", true),
            new Image("file:pics/jbeans.jpg", true),
            new Image("file:pics/peppers.jpg", true),
            new Image("file:pics/butterfly.jpg", true),
        };
 ...
```



Slideshow with JavaFX (2)

```
…
        final ImageView picture = new ImageView();
        picture.setX(50);
        picture.setY(50);
        picture.setImage(imagearray[0]);

        final IntegerProperty slideindex = new SimpleIntegerProperty();
        slideindex.addListener(new ChangeListener(){
            @Override public void changed(ObservableValue o, Object oldVal, Object newVal){
                picture.setImage(imagearray[slideindex.getValue()]);
            }
        });

        Group root = new Group(picture);
        Scene scene = new Scene(root, 356, 356, background);

        Timeline timeline = new Timeline();
        List<KeyFrame> keyframes = timeline.getKeyFrames();
        for(int i=0; i<imagearray.length; i++) {
            keyframes.add(new KeyFrame(new Duration(i*4000), new KeyValue(slideindex, i)));
        }

        primaryStage.setTitle("Simple Slide Show with JavaFX");
        primaryStage.setScene(scene);
        primaryStage.sizeToScene();
        primaryStage.show();
        timeline.play();
    }
}
```

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Slideshow in JavaFX - Interactive Version

```
scene.setOnKeyPressed(new EventHandler<KeyEvent>() {
  @Override
  public void handle(KeyEvent ke) {
    int currentslide = slideindex.getValue();
    if (ke.getCode() == KeyCode.RIGHT) {
      if (currentslide+1 < imagearray.length) {
        slideindex.setValue(currentslide+1);
      }
    }
    if (ke.getCode() == KeyCode.LEFT) {
      if (currentslide+1 > 0) {
        slideindex.setValue(currentslide-1);
      }
    }
}
```

Using JavaFX “Convenience Methods” for event handling

QUIZ

- What are the conceptual differences between the Pygame and JavaFX versions of the same program?