Multimedia-Programmierung
Übung 3

Ludwig-Maximilians-Universität München

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Today

- Introduction to JavaFx

For this lecture

- Netbeans IDE with JavaFX

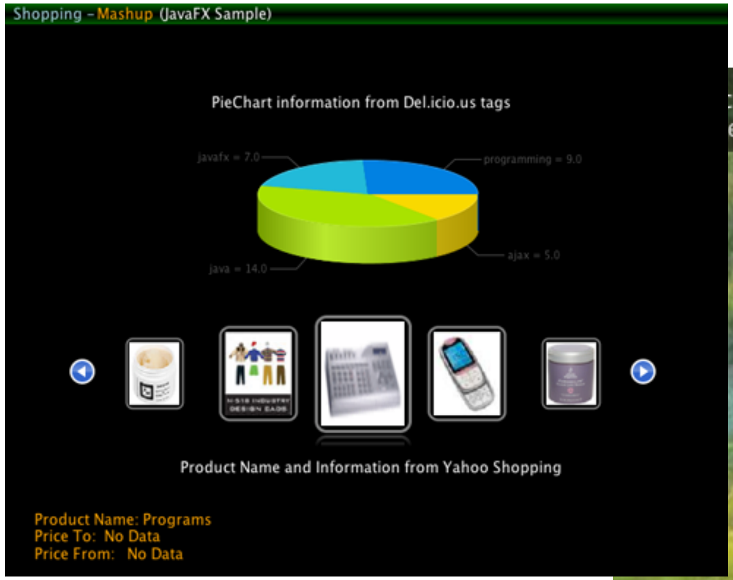
- Netbeans 6.8 is installed in CIP-Pool, use 6.9 at home, both version are good for JavaFX ☺
  http://javafx.com/downloads/all.jsp

- Recommended IDE:
  - Netbeans due to enhanced Python and JavaFX support

- Installation:
  - Install Netbeans (with JavaFX)

What is JavaFX?

- A software platform to develop rich internet applications
- Competitor of Adobe Flash, Microsoft Silverlight, Open Laszlo etc.
- Runs on every device that runs JRE or JavaME (desktop computers, mobile phones, PDAs ...)


Shopping - Mashup (JavaFX Sample)
PieChart information from Del.icio.us tags
javafx = 7.0
programming = 9.0
ajax = 5.0
java = 14.0
Product Name and Information from Yahoo Shopping
Product Name: Programs
Price To: No Data
Price From: No Data

k Bunny
empered rabbit finds his day spoiled by the rude actions of the... 09:57
00:32 / 09:57

© javafx.com

JavaFX Goodies

- Drag-to-install enables quick installation of JavaFX applications and launching them from the hard drive
- Graphic import from common tools (e.g. Photoshop and Illustrator) as well as direct import of SVG graphics
- Runs on Windows, Mac OS, Linux, Solaris, ...
- Advanced development support in Netbeans

JavaFX Overview

- Basics (Variables, Types, Sequences, Classes, Functions)
- Object Literals
- Binding

- UI Programming
  ⇒Scene, Stage, Node

- Example

Applications are written in JavaFX Script

- Scripting language for interactive graphical applications
- Object oriented
- Static typing
- Declarative

Define:

```
var a = "world";
println("hello {a}");
```

Output:

```
hello world
```

Variables

defining variables

- There are two types of variables in JavaFX Script
- Immutable variables defined with the “def” keyword
- Mutable variables defined with the “var” keyword

```
def a = 1;
```

```
var b = 2;
```

```
def a = 4;
a = 3;
```

a is defined immutable

trying to change its value results in an error

Variables
type inference

- Compiler “figures out” the type of the variable

```
var a = "world";
a = 3;
```

figures out that
a is a String

error: incompatible types, found: Integer, required: String
thus assigning an Integer value to a is not valid

Variables
naming types

- But you can always manually define the type if you like

```
var a:String = 4;
```

declares a as
a String

error: incompatible types, found: Integer, required: String
thus assigning an Integer value to a is not valid

Variables

on replace clause

- Executes any code when a variable is changed
- Optional parameters (e.g. to get the old value)

Define:

```
var a = 0 on replace { println("a is now {a}") }

a = 2;
```

Output:

```
a is now 0
a is now 2
```

Define:

```
var a = 0 on replace oldA {
    println("a was {oldA} and is now {a}")
  }

a = 2;
```

Output:

```
a was 0 and is now 0
a was 0 and is now 2
```

Pseudo-Variables

- Predefined variables for each script
- Immutable (def)
- __**PROFILE**__: either mobile, desktop or browser
- __**FILE**__: URL of the script file
- __**DIR**__: URL of the folder from which the script was loaded

Define:

```
println(__PROFILE__);
```

Output:

```
desktop
```

Types

- Functions, variables and any expression in JavaFX always have a type
- Types have default values (the value it has before it is set)
  - null for user defined classes
  - 0 for Integer
  - 0.0 for Number
  - false for Boolean
  - “” for String
  - Etc.

Define:

```
var a:Integer;
println(a);
```

Output:

```
0
```

String Type

- Any expression can be embedded into a string using {}

Define:

```
var cool = true;
var a = "mmp is the {if(cool) "coolest" else "worst"} lecture in the world";

println(a);
```

Output:

```
mmp is the coolest lecture in the world
```

Duration Type

- Built-in type of JavaFX to represent an amount of time
- Default value: 0.0ms
- Units: ms (milliseconds), s, (seconds) m (minutes), h(hours)

Define:

```
var a:Duration;
println(a);
```

Output:

```
0.0ms
```

Define:

```
var a:Duration = 1m;
var b:Duration = 20m;
println(a+b);
```

Output:

```
1260000.0ms
```

Sequences

aka arrays

- Represent a sequence of objects
- Constructed explicitly...

```
var a = [1,2,3];
```

…from other sequences

```
var positiveIntegers = [1,2,3,4,5];
var evenIntegers =
positiveIntegers[n | n mod 2 == 0];
```

- ... as ranges

```
var a = [1..5];
var a = [1..10 step 2];
```

…from a for loop

```
var lineNumbers:Text[]  =
for(n in [1..100]) {
     Text { content: "{n}" };
};
```

Sequences

working with sequences

- Adding elements

```
insert 4 into a;
```

- Insert at a specific position

```
insert 4 before a[1];
```

- Sequence size

```
sizeof a;
```

- Deleting elements

```
delete a[1];
```

- ...

Functions

defining script functions

- Script functions defined loosely in a script (as opposite to within a class)

Define:

```
function test() {
  2 + 4;
}

println(test());
```

last line is considered as the return value

Output:

```
6
```

```
function test():Integer {
  return 2 + 4;
}

println(test());
```

can also be explicitly stated

Output:

```
6
```

Functions
arguments 1

- Can be defined with or without type
- If no type is used, the type is inferred

Define:

```
function test(a,b) {
    println(a)
}

test("a","b");
```

Output:

```
a
```

```
function test(a:String,b:String) {
    println(a)
}

test("a","b");
```

```
a
```

Functions

arguments 2 - an example

```
function test(a,b) {
    a + b;
}

test("a","b");
```

a and b must be numbers

Error: test(a:Double, b:Double) ... cannot be applied to (String,String)

Always better to explicitly declare types manually!

Classes
defining classes

Define:

```
class Book {
   var name : String;
   var pages: Integer;
}

def mmp_book = Book {
   name: "MMP rocks"
   pages: 1088
}

println(mmp_book.pages);
```

Output:

```
1088
```

definition of instance variable

object literal is used to create an instance of a JavaFX class

Classes

init block

- The expressions in the init block are executed immediately after the instance is created

Define:

```
class Book {
   var name : String;
   var pages: Integer;

   init {
     println(name);
   }
}
```

init block

Classes

instance functions

Define:

```
class Book {
   var name : String;
   var pages: Integer;
   function print_book() {
       println("Title: {name}, Pages: {pages}");
   }
}

def mmp_book = Book {
   name: "MMP rocks"
   pages: 1088
}

mmp_book.print_book();
```

definition of an instance function

Output:

```
Title: MMP Rocks,
Pages: 1088
```

Classes
inheritance

Define:

```
class YeahBook extends Book {
   override function print_book() {
       super.print_book();
       println("yeah!");
   }
}

def mmp_book = YeahBook {
   name: "MMP rocks"
   pages: 1088
}

mmp_book.print_book();
```

override the superclass function

Output:

```
Title: MMP Rocks,
Pages: 1088
yeah!
```

Modifiers

- Functions, variables and classes can have different modifiers
- **Access modifiers**:
  - **package**: access within its package
  - **protected** (does not apply to classes): within package and from subclasses
  - **public**: can be accessed anywhere
- **var modifiers**:
  - **public-read**: variable can be read anywhere
  - **public-init**: variable can be read and set anywhere
- **Function modifiers**:
  - **abstract**: defines an abstract instance function
  - **bound**: bound function (see later)
  - **override**: used to override a function of a superclass

The run Function

- The run function is the entrance point to a script
- Arguments are passed to a script by the run function

```
function run(args:String[]) {
    // do something with args[0]
}
```

- Argument parameter can have any name
- Compiler creates a no-argument run function for scripts that do not provide it and puts all the code in it
- Loose expressions are not allowed in scripts with a run function

Data Binding

or: who needs the observer pattern

- Variables can be bound to expressions
- That is, whenever the expression changes, the variable will be updated accordingly
- Example:

Define:

```
var a = 1;
var b = 2;

var c = bind a + b;
println(c);
a = 2;
println(c);
```

Output:

```
3
4
```

Data Binding

binding to function calls

- Binding to a non-bound function only updates the variable if one of the arguments is changed

Define:

```
var b = 3;

function test(a) {
    return a * b;
}

var a = 4;
var c = bind test(a);
println(c);
a = 1;
println(c);
b = 1;
println(c);
```

parameter change causes update

changing b (used within the function) does not cause an update

Output:

```
12
3
3
```

Data Binding

binding to bound functions

- Binding to a non-bound function only updates the variable if one of the arguments is changed

Define:

```
var b = 3;

bound function test(a) {
    return a * b;
}

var a = 4;
var c = bind test(a);
println(c);
a = 1;
println(c);
b = 1;
println(c);
```

bound function

changing b causes an update now

Output:

```
12
3
1
```

Data Binding

binding object literal arguments

Define:

```
var text = "Test“;
class Book {
   var name : String;
   function print_book() {
       println("Title: {name}");
   }
}

def mmp_book = Book {
   name: bind text
}
mmp_book.print_book();
text = "Test2“;
mmp_book.print_book();
```

Output:

```
Title: Test
Title: Test2
```

UI Programming

- Attention: this is only a rough introduction. For more information please refer to the JavaFX tutorial and the API.

- Most UI elements are available in the desktop AND the mobile profile (e.g. user interface elements, charts, colors, text, transformations)
- Effects and Cursors are only available in the desktop profile

- Remember SVG? Defining UIs in JavaFX works similar!

Scene Graph

- JavaFX UIs are based on the scene graph concept
- Defines a hierarchy of graphical objects in a scene
- Tree-like data structure that consists out of nodes
- Nodes in JavaFX can be shapes, ui components, texts etc.
- Some nodes can have child-nodes while others can only be leafs

```
Stage {
    title: "I am the mighty window.“
    width: 200
    height: 200
    scene:Scene {
        content: [
            Button { text: "press me" }
        ]
    }
}
```

a boring one but a scene graph

UI Programming

Theater metaphor:

Stage – Scene - Node

Quelle: Wikimedia Commons – Author:Stephen Moorer

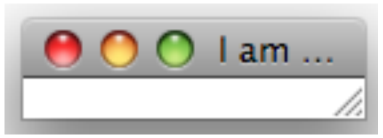
UI Programming
creating a stage

- The class Stage represents a screen (a window for desktop applications)
- Creating a simple window is quite easy

Define:

```
Stage {
    title: "I am the mighty window."
}
```

Output:



- http://java.sun.com/javafx/1.2/docs/api/javafx.stage/javafx.stage.Stage.html

UI Programming
modifying the stage

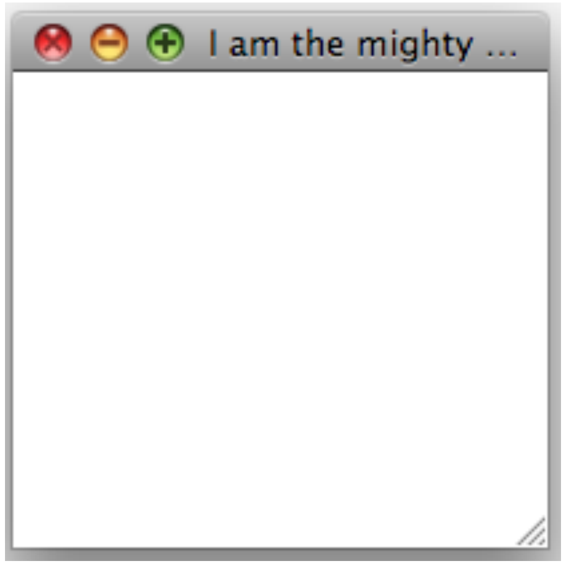
- Stage allows to easily manipulate the stage using the manifold instance variables
- E.g. adding width and height

Define:

```
Stage {
    title: "I am the mighty window.“
    width: 200
    height: 200
}
```

changing the size

Output:



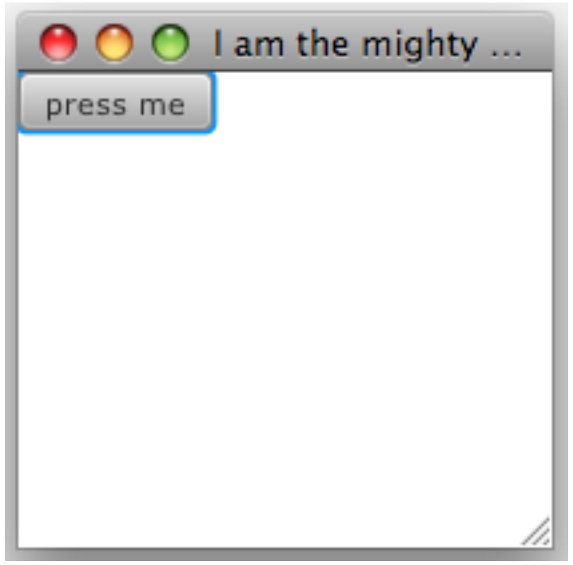
UI Programming
adding a Scene

- A scene holds the different graphical nodes of the UI
- Nodes are places in the content sequence
- Example scene holding a button:

Define:

```
Stage {
    title: "I am the mighty window.“
    width: 200
    height: 200
    scene:Scene {
        content: [
            Button { text: "press me" }
        ]
    }
}
```

Output:



UI Programming

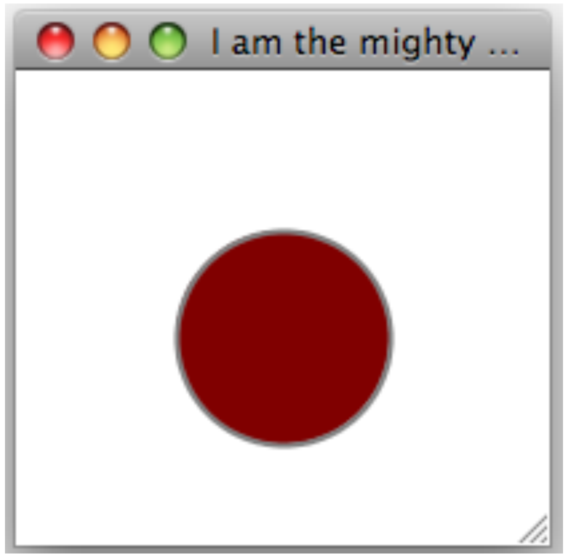
Forget the button, I want a circle!!

- Second example: Adding a circle to the scene.

Define:

```
Stage {
    ...
        content: [
            Circle {
                centerX: 100
                centerY: 100
                radius: 40
                fill: Color.MAROON
                stroke: Color.GREY
                strokeWidth: 2.0
            }
        ]
    ...
}
```

Output:



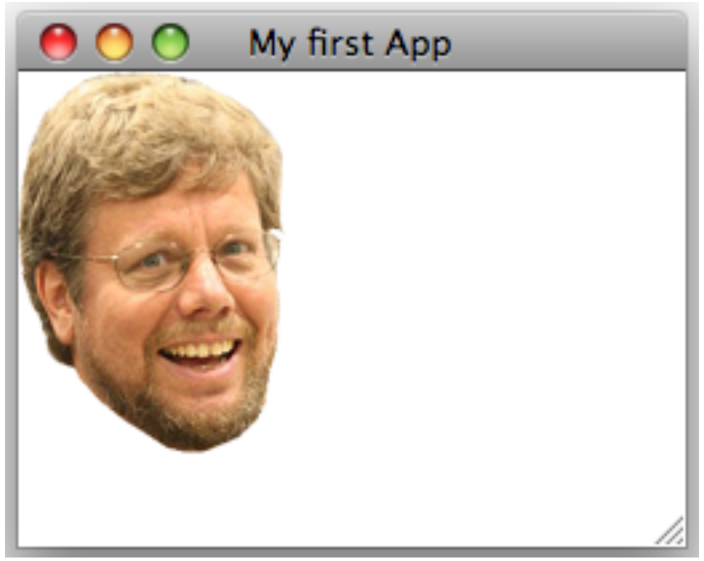
UI Programming
loading an image

- Third example: Adding an image to the scene.

Define:

```
Stage {
    ...
        content: [
            ImageView {
                image:Image {
                    url: "{__DIR__}head.png"
                    width: 100
                    preserveRatio: true
                }
            }
        ]
    ...
}
```

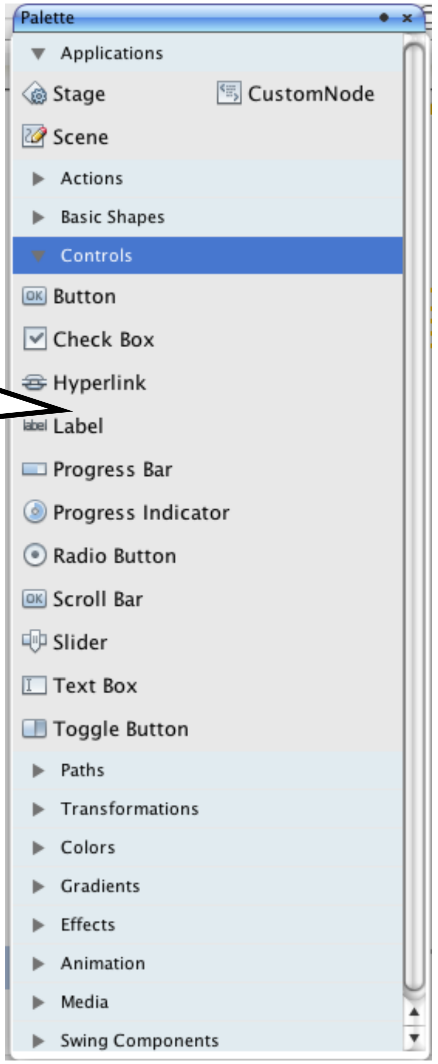
Output:



UI Programming
Netbeans your friendly helper

- Netbeans supports a simple drag&drop mechanism to add nodes to the scene graph

just drag the nodes to wherever you want to place them in your code



UI & Data Binding Example

observer for dummies

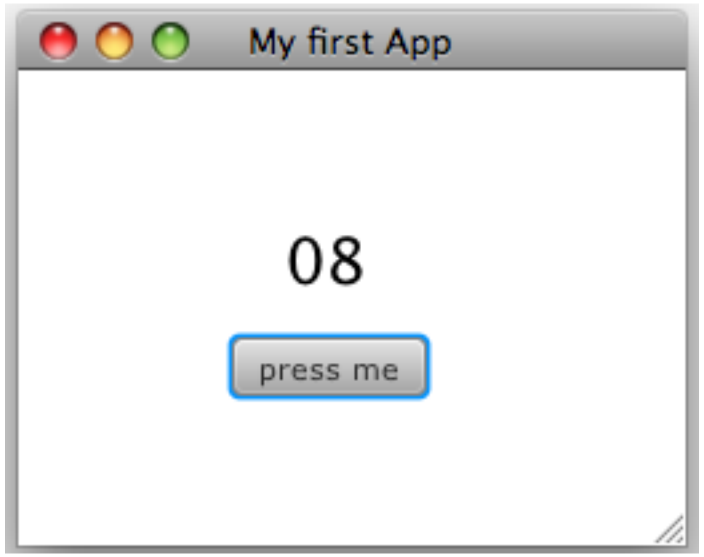
```
var counter = 0;
Stage {
    title: "My first App"
    width: 250
    height: 200

    scene: Scene {
        content: [
            Button {
                text: "press me"
                layoutX: 80, layoutY: 100
                action: function() { counter++; }
            }
           Text {
                font : Font { size: 24 }
                x: 100, y: 80
                content: bind "{if(counter<10) "0{counter}" else counter}"
            }
        ]
    }
}
```

if button is pressed, increase the value of counter

the content of the text field is bound to counter which automatically updates the display

UI & Data Binding Example 2

result



Useful Links

- JavaFX Overview
  http://download.oracle.com/javafx/index.html
- JavaFX Getting Started
  http://download.oracle.com/javafx/1.3/tutorials/core/getStarted/
- The JavaFX GUI Tutorial
  http://download.oracle.com/javafx/1.3/tutorials/ui/index.html
- JavaFX API
  http://download.oracle.com/docs/cd/E17802_01/javafx/javafx/1.3/docs/api/