Multimedia-Programmierung
Übung 3

Ludwig-Maximilians-Universität München
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Today

• Introduction to

“No more Python :'-('”
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 ...)

© 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:

```java
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

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

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

trying to change its value results in an error

```
a is defined immutable
```
Variables

* type inference

- Compiler “figures out” the type of the variable

```javascript
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:

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

Output:
```
a is now 0
a is now 2
```

Define:

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

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:
```java
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:

```javascript
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 ...

... 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}" };
};
```

... from other sequences

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

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

last line is considered as the return value

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

Output:

6

Output:

6
Functions
arguments 1

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

Define:

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

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

Output:

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

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

Output: a
Functions

arguments 2 - an example

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

test("a","b");

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

a and b must be numbers

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:

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

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

init block
Classes
instance functions

Define:

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

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

mmp_book.print_book();
```

Output:

Title: MMP Rocks, Pages: 1088

definition of an instance function
Classes
inheritance

Define:

```java
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();
```

Output:

Title: MMP Rocks, Pages: 1088 yeah!

override the superclass function
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

```java
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:

```javascript
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:

```javascript
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);
```

Output:

```
12
3
3
```

- parameter change causes update
- changing b (used within the function) does not cause an update
Data Binding
binding to bound functions

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

Define:

```javascript
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);
```

Output:

```
12
3
1
```

bound function
changing b causes an update now
Data Binding
binding object literal arguments

Define:

```javascript
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

```java
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:

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

Output:

changing the size
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:

```java
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
        }
    ]
    ...
}
```
UI Programming

loading an image

• Third example: Adding an image to the scene.

Define:

```javascript
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}" 
      }
    ]
  }
}
UI & Data Binding Example 2

result

08

press me
Useful Links

- JavaFX Overview

- JavaFX Getting Started
  [http://download.oracle.com/javafx/1.3/tutorials/core/getStarted/](http://download.oracle.com/javafx/1.3/tutorials/core/getStarted/)

- The JavaFX GUI Tutorial

- JavaFX API
  [http://download.oracle.com/docs/cd/E17802_01/javafx/javafx/1.3/docs/api/](http://download.oracle.com/docs/cd/E17802_01/javafx/javafx/1.3/docs/api/)