

MSc/ICY Software Workshop

Introduction – Simple Computation, Variables, Types, static Methods

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Overview

- 1 Pocket calculator computations, base types, simple strings, variables, static methods, JavaDoc
Fri: 1st Lab Lecture (login, editor, javac, javadoc)
- 2 Classes, objects, methods, JUnit tests
Fri: 2nd Lab Lecture (Eclipse)
- 3 Conditionals, 'for' Loops, arrays, ArrayList
- 4 Exceptions, assertions, I/O, Patterns, printf
- 5 Interfaces, functions
- 6 Sub-classes, inheritance, abstract classes
- 7 Inheritance (Cont'd), packages
- 8 Graphics
- 9 Graphical User Interfaces
- 10 Graphical User Interfaces (Cont'd)
- 11 Revision

Changes possible

- Lectures:

- Wednesdays 10:00-12:00, 203 Haworth
- planned Fridays 9:00-11:00 **UG Lab Computer Science**
Weeks 6 & 10 (4 Nov & 2 Dec), Aston Webb C, Main LT

- Tutorials:

- Tuesdays, 1 hour, see separate sheet.
Attendance to the tutorials is compulsory.
- Different groups streamed according to background knowledge and self-assessment.

- Labs:

- Mondays 13:00-15:00
- Thursdays 11:00-14:00

This module is a 40cr module over two terms. ~50% of the module mark are on the 20cr of this term.

The overall mark is computed as:

- 70% Examination in May/June 2017
- 20% Continuous Assessment Term 1 and Term 2
- 10% Team Project in Term 2

This term the Continuous Assessment is partly in form of Worksheets which must be submitted via Canvas, and partly in form of In-Class tests.

MSc students need an overall mark of at least 50, ICY students an overall mark of at least 40 in order to pass this module.

Continuous Assessment

Assignment	Hand out	Hand in	%	Marking
WS 1	Wk1	Wk2 6 Oct	0	-
WS 2	Wk2	Wk4 20 Oct	9	Tests
	Wk3			
WS 3	Wk4	Wk6 3 Nov	9	Tests
	Wk5			
WS 4	Wk6	Wk8 17 Nov	9	Tests
Test 1	(4 Nov)	Wk6 (4 Nov)	9	Paper
	Wk7			
WS 5	Wk8	Wk10 1 Dec	9	Viva
	Wk9			
WS 6	Wk10	WkS1 9 Jan	9	Viva
Test 2	(2 Dec)	Wk10 (2 Dec)	9	Paper
	Wk11			

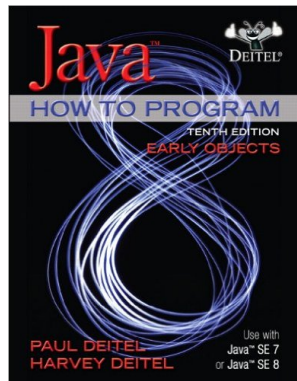
[Changes possible but not planned]. All Worksheet hand-ins are at 2pm sharp. Late submission invokes a penalty of 5 marks. No hand-in after 24 hours.

Plagiarism

- You can and are advised to cooperate in your revision, in the Friday lab lectures, and in understanding the exercises.
- You **must not collaborate** in writing the code for the Worksheets and also **must not cheat** in the two in-class tests.
- The University's Code of Practice on plagiarism is at www.birmingham.ac.uk/Documents/university/legal/plagiarism.pdf, and the School guidance notes are at <http://www.cs.bham.ac.uk/internal/taught-students/plagiarism>

Reading

In order for the lectures being most effective you are expected to have read the corresponding material **BEFORE** the lectures!



Paul Deitel,
Harvey Deitel
Java - How to Program
Tenth Edition

Week 1: Chapters 1 & 2

Week 2: Chapter 3

[Note: There are other books which cover the same material. You are free to choose a different book for your reading. However, I will indicate the reading according to the book above.]

The Java programming language

Java is

- platform independent
- object-oriented
- strictly typed

We will learn in more depth what this means in the course of the next few weeks.

A simple program

In a few simple steps to a HelloWorld program:

- ❶ Open a file `HelloWorld.java` in an editor like jedit or gedit
- ❷ Write the program starting with
`public class HelloWorld`
Note that the name of the class here must match the filename.
- ❸ Save the file.
- ❹ Compile the program on the command line by
`javac HelloWorld.java`
This generates a file `HelloWorld.class`.
- ❺ Run the program on the command line by
`java HelloWorld`
- ❻ Extract documentation on the command line by
`javadoc HelloWorld.java`

The full HelloWorld program

```
/**
 * Java is an object-oriented programming language.
 * Everything is put in classes. The file name
 * HelloWorld.java has to match the name of the class.
 *         public class HelloWorld
 * We ignore for now the meaning of "public class" and
 * the line "public static void main(String[] args)".
 *
 * System.out.println(...); prints the argument
 * to standard output (the terminal here).
 * Objects such as "Hello World!" are called strings.
 */

public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

Comments

- Java is to be understood by **computers and humans**.
- **Computers** translate programs into a level (by an interpreter or by a compiler) that can be executed command by command in the order given by the programmer.
- **Humans** translate programs into something that is meaningful to them.
- If somebody reads somebody else's code (or even their own code after a while) then they may have problems to understand it. What is done in the program? Why is it done? How is it done? When will it work and when not? Does it come with a Best-Before date? Who owns the copyright? Where may it be applied and where not? All relevant information should be written in the program as **comments**.
- In Java, everything between `/*` and `*/` is a comment.
- Everything between an opening `/**` and `*/` is considered by JavaDoc.

Strings

- If a String contains " then it is represented by \".
- Strings can be put together (concatenated) by +.
E.g. "Hello" + "World" is the string "HelloWorld".
- We can print Strings by something like
`System.out.println("Hello World");`

Variables

- All variables must be **declared** with a type such as `public int x;`.
- It is possible to declare several variables of the same type in a single step `public int x, y, z, u, v;`
- Before a variable is used it must be **initialized**, that is, it must be given an initial value. E.g., by the assignment `x = 3;`. The value can be overwritten by a new assignment, e.g., by writing after the first assignment a second such as `x = 4;`. (In such a case the previous value is irrecoverably gone.)

Variables (Cont'd)

Think of variables as names plus their values, represented in a table as follows:

name	x	y	z	u	v
val	-	-	-	-	-

After an assignment `var = term;` the term on the right hand side is evaluated with respect to the current values in the table.

The assignment `x = 3;` means that the table is updated, any old value of `x` (or no value in this case) is overwritten by the new value. If the old value is still needed, it must be copied before the assignment, since after the assignment the value is lost.

name	x	y	z	u	v
val	3	-	-	-	-

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

name	x	y	z	u	v
val	3	16	-	-	-

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

name	x	y	z	u	v
val	3	16	-	-	-

After the assignment $y = 2*(y+x*x)$;

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

name	x	y	z	u	v
val	3	16	-	-	-

After the assignment $y = 2*(y+x*x)$;

name	x	y	z	u	v
val	3	50	-	-	-

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

name	x	y	z	u	v
val	3	16	-	-	-

After the assignment $y = 2*(y+x*x)$;

name	x	y	z	u	v
val	3	50	-	-	-

After the assignments $z = x+y$; $u = 3*z$; $x = 0$; the table is:

Variables (Cont'd)

name	x	y	z	u	v
val	3	-	-	-	-

After the assignment $y = 2*(x+5)$; the table is computed by evaluating the expression $2*(x+5)$ in the OLD TABLE and then overwriting the current value of y by the result.

name	x	y	z	u	v
val	3	16	-	-	-

After the assignment $y = 2*(y+x*x)$;

name	x	y	z	u	v
val	3	50	-	-	-

After the assignments $z = x+y$; $u = 3*z$; $x = 0$; the table is:

name	x	y	z	u	v
val	0	50	53	159	-

Variables (Cont'd)

name	x	y	z	u	v
val	0	50	53	159	-

If variables are needed for this evaluation which do not have a value yet – indicated by the hyphen in the table – then the assignment fails and an error occurs. E.g. `v = v+1;` would fail since `v` has currently no value. However, `x = x+1;` succeeds since the expression on the right hand can be evaluated.

Types

Java has 8 different **base types**, 4 for the representation of integers, 2 for floating point numbers, 1 for boolean values, and 1 for characters.

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Integers are implemented in a cyclic way (such as a clock):

byte range -128 to 127

short range -32,768 to 32,767

int range -2,147,483,648 to 2,147,483,647

```
long    range -9,223,372,036,854,775,808 to
         9,223,372,036,854,775,807
```

Floating point numbers (reals) are approximated by 4 or 8 bytes

float 4 bytes, 6-7 significant decimal digits
3.4028235E38

double 8 bytes

The type `bool` contains two elements: `true` and `false`.

The type `char` is used to represent characters such as `'a'`, `'b'`, `'c'`, and `'\u00A3'` (for the pound symbol). They are enclosed in single quotes.

Assume the computation of the areas of squares:

- $7.932 * 7.932$
- $8.2 * 8.2$
- $13.87 * 13.87$
- $123.89 * 123.89$

In order to avoid the repetition of the values we would like to write a method that computes the values as

- `square(7.932)`
- `square(8.2)`
- `square(13.87)`
- `square(123.89)`

Methods (Cont'd)

```
public static int square(int x) {  
    return x * x;  
}
```

- `public` means that the method can be called by anybody who can access the class.
- `static` we ignore for now.
- the first `int` is the return type.
- `square` is the name of the method with which it is “called.”
- the second `int` is the type of the parameter `x`.
- `x` is the name of the parameter.
- `return` specifies what the method gives back as value.

This method is called by something like `square(4)`.

What Next?

- 1 Lab lecture UG lab CS on Friday
- 2 Follow the pages on
<https://birmingham.instructure.com/courses/21955>
- 3 Discussions possible on
<https://www.facebook.com/groups/346033342153057/>
- 4 More Examples