Introduction and Overview

Software Design and Programming
Software and Programming III

KLM

Department of Computer Science and Information Systems
Birkbeck, University of London

keith@dcs.bbk.ac.uk

Spring term 2017

Welcome to the module

Course materials available on
`http://moodle.bbk.ac.uk`

What is this course about? I

What is this course about? II

Part I

- Java — fill in the blanks (what you don't know and need to for this module). Inner classes, Java 8 features, etc.
- Scala — the basics to proficient
- SOLID — Single responsibility, Open-closed, Liskov substitution, Interface segregation and Dependency inversion
- Meta object protocols
- Reflection

What is this course about? III

Part II

- Functional approach to programming compared to Object-Oriented
- Higher-order functions, currying and closures
- Further functional programming

What is this course about? IV

Part III

- Introduction to Design Patterns — The GoF patterns ++
  The examples will be in Java and Scala

What is this course about? V

Part IV

- Concurrent and distributed programming — through Akka and actors

What is this course about? VI

Part V

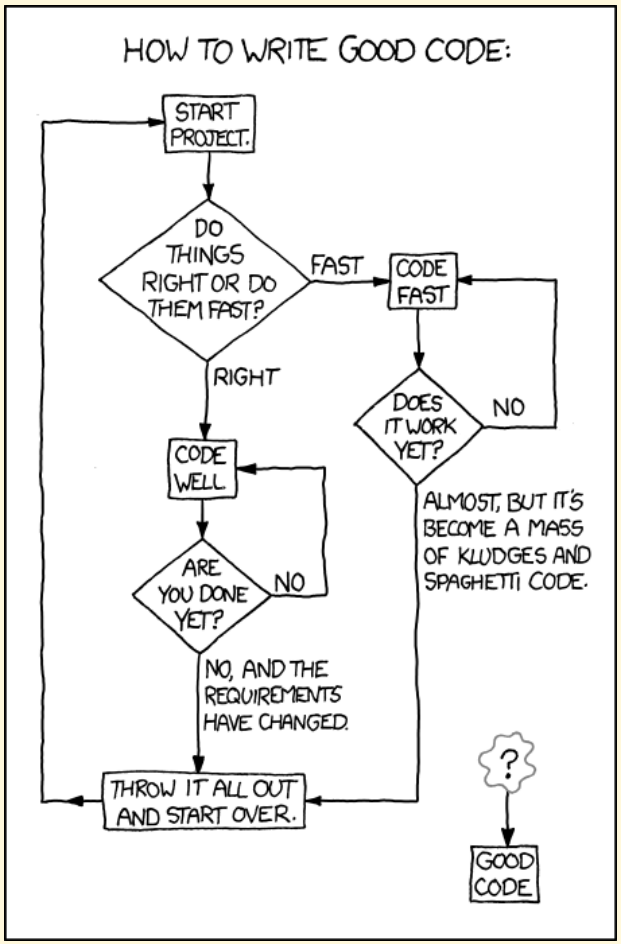
- Databases — JDBC, JPA, Slick, etc.
- GUI — JavaFX/ScalaFX and Swing
- Reactive — RxJava/RxScala

What is this course about? VII

- We will also cover appropriate *build* tools, e.g., Gradle and SBT
- We will presume that you will cover the IDE aspects of tooling

How to write good code? I

This class teaches a style of software design that can help you reach the box labelled *Good Code*



From the web comic, **xkcd**: `http://xkcd.com/844/`

How to write good code? II

Software Design is not completely a black art. . . there are design techniques that lead to better results when applied in support of creative expression

Check the website regularly. . .

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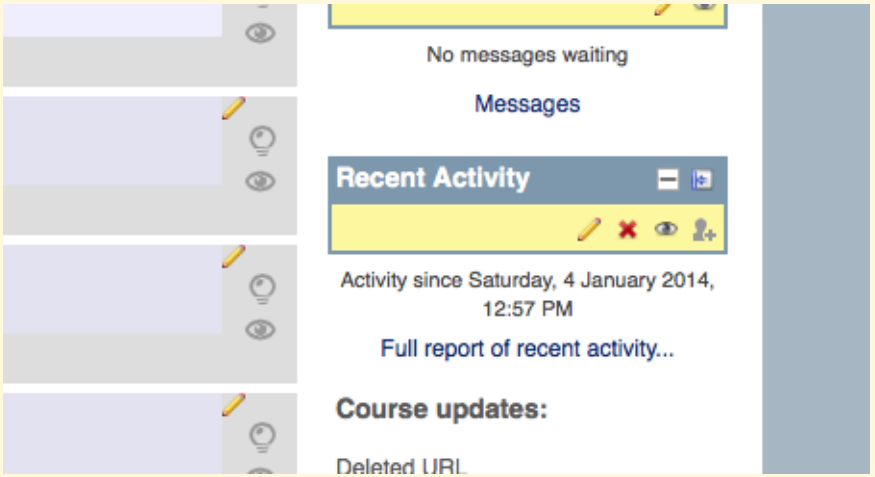

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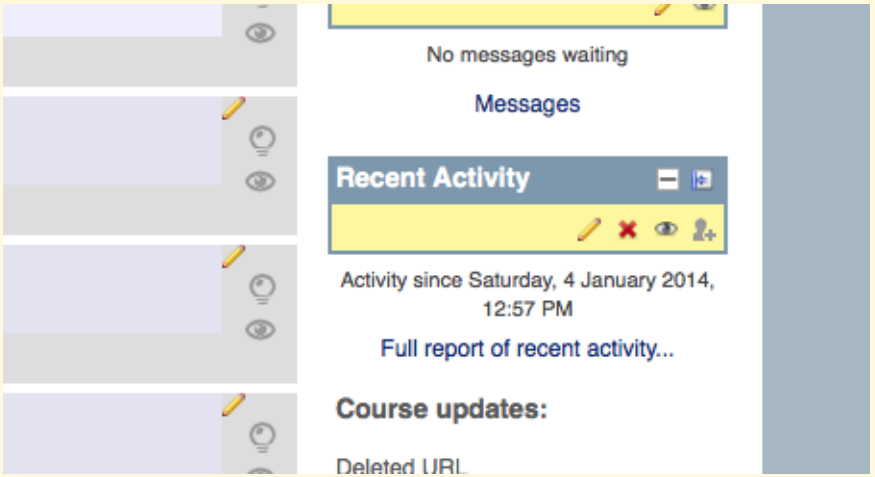

- The Moodle website is your source for the class schedule, homework assignments, announcements, etc.

Teaching Philosophy I

- We want you to participate!

Teaching Philosophy II

- *Learning by Doing* (the PiJ philosophy)

Goals of the Class

- Provide students with knowledge and skills in both Object-Oriented and Functional programming models:

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  - concepts
  - analysis, design and implementation techniques
  - design methods (software life cycles)
- Students should view software development as a software engineering process that has well-defined stages with each stage requiring specific tools and techniques

Discussion I

- How many people have used an object-oriented programming language before?

Discussion II

How many people are comfortable starting from scratch and creating:

- a script?
- a desktop application?
- a web service?
- a mobile application?
- a system of systems? (i.e. desktop plus web service)
- a database-backed application?

Discussion III

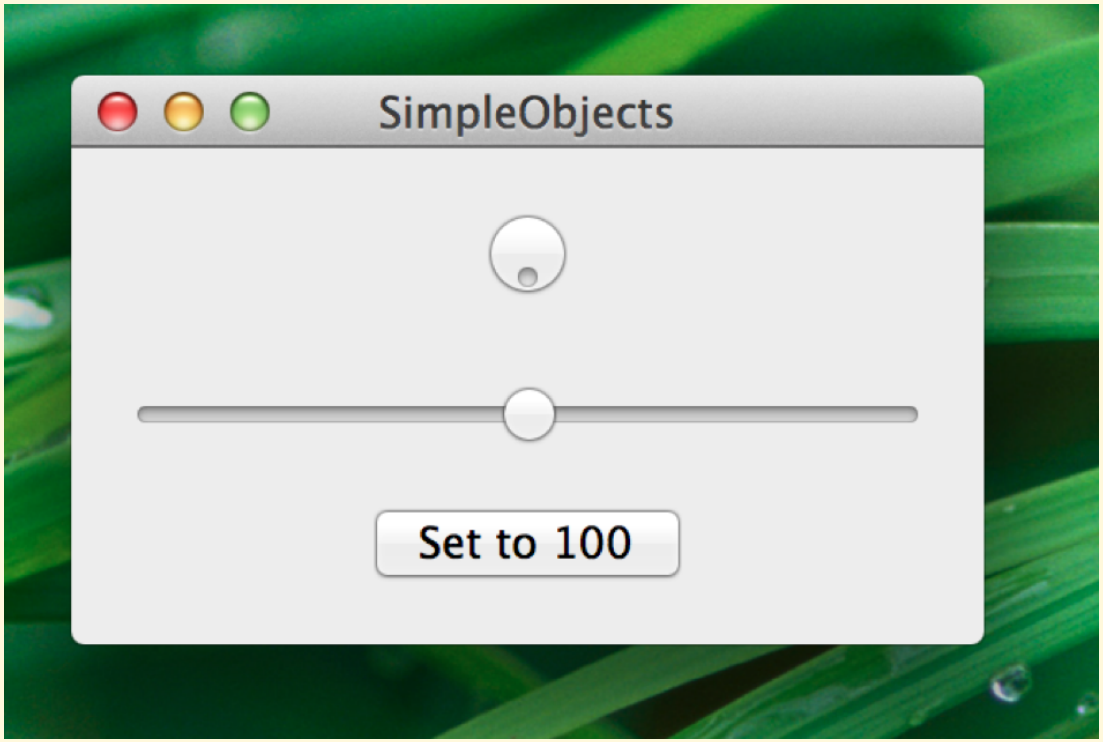
- When you create a program from scratch:
  - do you use OO techniques?
  - OO design heuristics?
  - design patterns?
- If not, what style of software design do you use?
- What styles of software design are you aware of?

Discussion IV

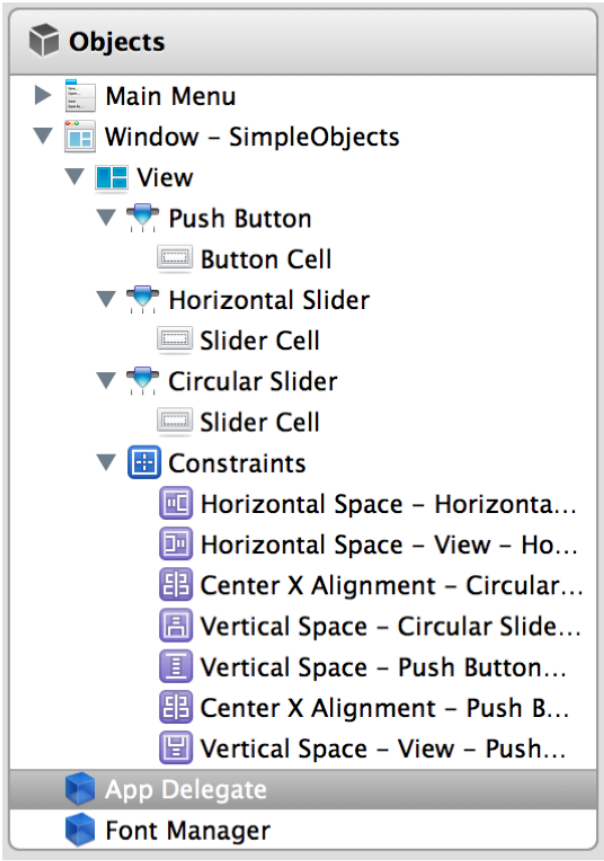
- What is design?
- What comes before design?
- What comes after design?
- Do these questions make sense in software development?
- What would make the process of software design object-oriented?

Discussion V

How many objects do you think are working together to create the application shown on the right?



. . . a lot!



19 objects + AppDelegate = 20 objects

(Let's ignore what's hiding in the Main Menu object...)

A bit of history about this module...

The module used to behave like two sub-courses

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  11 lectures – first part of term

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Has the Module changed since last year?

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Simple answer

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Simple answer — **YES**

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We are always updating our material and syllabus to include changes that happen in industry and academia.

A (Very) Brief History of Object-Oriented everything ☺ I

- All the major concepts were developed in the 1960s as part of a language called Simula
- Alan Kay and his group developed a programming language named Smalltalk in the late 1960s and early 1970s
- In the early 1980s Bjarne Stroustrup developed an extension to the C language that eventually evolved to the language C++
- Explosion of the research in object-oriented programming techniques began

A (Very) Brief History of Object-Oriented everything ☺ II

- In the first major conference on object-oriented programming, in 1986, there were dozens of languages
- These included Eiffel, **Objective-C**, Actor, Object Pascal, and various Lisp dialects
- In the 1990s Object-oriented programming became mainstream and then Java happened
- Then even Microsoft caught the bug (C#)
- . . . and now we are now quite so sure. . . *Polyglot* languages

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  - We cannot teach you all you need to know
  - We can point you in the right direction and give you a good, hard push — but the rest is up to you!

Elegance in programming I

Consider the following problem:

- You are given a stack of cards, supposedly containing the numbers 1 through 100...
- ...but there are only 99 cards
- How do you determine which card is missing?

Elegance in programming II

One possible solution:

- Go through all the cards looking for 1, then do it again looking for 2, etc.
- But this is inefficient!
- Is there a *better* way?

That is the type of question we wish to address in this course

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- ...

Topics we will try to cover... I

- The software development process
- Principles of programming and programming languages
- The object model and how it is realised in various object-oriented languages
  (e.g., Java, Groovy, Ruby, Scala, C++, ...)
- Further development of the ideas of inheritance and polymorphism (including a revision of Generics)

Topics we will try to cover... II

- Consolidation of Java language features: inner classes, annotations, closures, etc. Project Lombok, Java 9...
- The rise of *Functional Programming* languages
- The use of an Integrated Development Environment (IDE): e.g., editing, debugging, compilation, etc.
- Modularity, versioning and packaging (e.g., OSGi, Project Jigsaw)

Topics we will try to cover... III

- An introduction to Design Patterns and Anti-Patterns
- Interface separation and Dependency Injection
- Code refactoring and code analysis
- process based programming (e.g., *actors* as an alternative to *threads*)
- Graphical User Interfaces in Java
  (e.g., Swing and JavaFX)
- Persistence in object-oriented languages

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- . . . (amongst other topics)

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You can build a kennel in a few hours

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You can build a house in a year or so (maybe less, maybe more)

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- House building requires more skills: plumbing, bricklaying, electrical work, carpentry, etc.
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- It's easier if you aren't doing it all by yourself

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- Communication is essential
- A "paper trail" is essential

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  - I know what I'd prefer!

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OR

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via the primer (or any other means)

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  - JDK9 is being delayed again ...

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- Two of the most important features *size* and *reliability*
- Processors in embedded systems are very small, possessing small memory, thus the language must be able to translate into very concise encoding
- Embedded systems should almost never fail and should respond to exceptional and erroneous conditions

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  - Groovy
  - Scala

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- We need a better programming language for the JVM (or maybe a combination of languages like .NET)
  - Runs on the JVM
  - More productive, more fun, less verbose syntax
  - With modern language features
  - Seamless interoperability with Java programs
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  - Scala
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Java as a Platform (JVM)

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  - Scala
  - JRuby
  - Clojure

Textbooks - do you really want one?

See the list on the Moodle *shared resources* site

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- we will discuss other software as, and when, required (e.g., Scala and Groovy)

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- No new material will be presented in the lab sessions; some demos and tooling, but no new language features
- The "lab sheets" can be done at home — but need to be completed before the next session

Course Evaluation I

This depends on whether you are taking the undergraduate or postgraduate version of the module

Postgraduate

- By two hour written examination (80%)
- By practical coursework (20%)

Undergraduate

- By two hour written examination (75%)
- By practical coursework (25%)

Course Evaluation II

The practical coursework consists of a *portfolio* of work comprising several programming assignments submitted as one portfolio and the exercises for the module

- an individual piece of work
- one carried out as a pair
- one carried out as a group
- the exercises for the module

As always, see Moodle for further details.

Course Evaluation III

There are also supplemental exercises which you should also attempt

- which are not assessed,
- for which we provide outline solutions

so therefore you can judge your own progress!

Course Evaluation IV

oh, and unless I forget...

- Submission will be via Moodle using a Github repository
- The late policy is as stated in the degree handbook;
- Coursework portfolio due by ...I forget (check Moodle)
- Cutoff date is two weeks after the due date

How to get a good grade? I

How to get a good grade? II

- Start your assignments early!
  - This is the first and most important way to improve your grade
  - Programming takes a lot of time
  - Its not easy to predict how long a program will take
- Do as many exercises as you can (oh, and don't look at the answers, if they are provided, until you've had a good go at the problem)

How to get a good grade? III

- Test your programs thoroughly
  - One or two simple tests are not enough
  - We often provide simple but incomplete tests, just to get you started
  - We will do thorough testing, even if you dont!
- Read the assignments carefully
  - Do what is assigned, not *something like* what is assigned

How to get a good grade? IV

- Learn to use your tools (e.g., eclipse, IntelliJ, JUnit, FindBugs, Maven, Lombok, etc.)
- Use comments and good style right from the beginning, not as a last-minute addition
- Review and understand the (video) lectures

Who to ask when it all goes horribly wrong!

If you have questions about the course:

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- Check with a teaching assistant, if they are available
- Make use of the forums
- Ask or email Keith (not good on the phone)

Keith and email. . .

Feel free to send me email at:

`keith@dcs.bbk.ac.uk`

I get lots of spam, including several virus-carrying messages a week, so I run several filters.

To avoid my spam and virus filters so please put **SDP 2017** or **SP3 2017** somewhere in the subject line

The End