Enterprise Programmering 2

Lesson 01: Introduction

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Course Info

- 12 lessons, once a week
- Check TimeEdit for possible changes of time and rooms
- During the course, do **NOT** send me private messages, but rather use the discussion forum of the course

Class Structure

- “Usually” 2+2
  - 2 hours of lecture: code (and very few slides…)
  - 2 hours in which you should do exercises and get help

- **IMPORTANT**: the 2 hours after lecture is not only for exercises. If you are falling behind, or you need some more revision, you can ask for my help on anything related to coding

Necessary Tools

- JDK **8**
- Git
- Maven
- An IDE (I **strongly** recommend IntelliJ IDEA Ultimate Edition)
- Docker
- A Bash command-line terminal
  - Mac/Linux: use the built-in one
  - Windows: I recommend GitBash

Git Repository

- https://github.com/arcuri82/testing_security_development_enterprise_systems

- Same as PG5100, but now look at the **“advanced”** folder

- Note: pull often, as new material will be added during the course

Goals/Topics

- Full details of **REST**ful APIs and **HTTP**
- Knowledge of other kinds of Web Services: **SOAP** and **GraphQL**
- **Microservice** Architecture
  - gateways, load balancers, etc.
- **Security** in distributed systems
- Message Oriented Middleware (e.g., AMQP)

If You Skip Class…

- Usually acceptable that a student skips 1-2 classes
- You are supposed to attend, although no strict checks
- If you skip too many classes, it is **YOUR** responsibility to catch up and find out what done in class

Exam

- 40% written exam
  - 3 hours
  - Theory questions
  - Not required to write code, but might be asked about what some code snippets do

- 60% group project
  - 2 months
  - 3 students per group

About Group Project

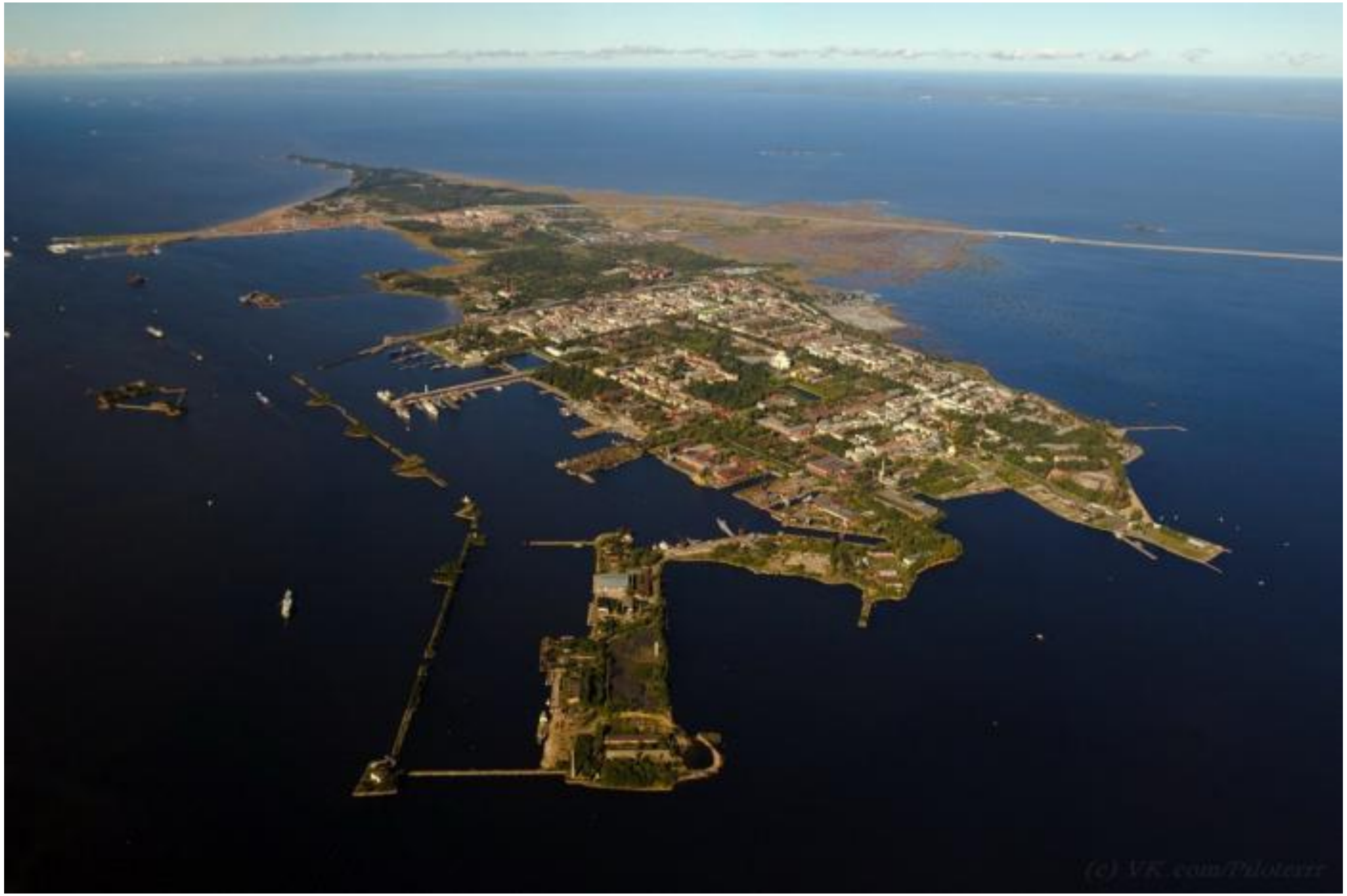
- Build an enterprise application using microservices
- Each student responsible to write *at least* one full web service
- *Choose your team mates wisely…*
- I will look at Git history… when I see significant differences, students in same group can get different grades
  - Example: student that only writes documentation and not a single line of code will get an **F** even if others in same group may get an **A**

Kotlin

About Kotlin

- Recent language: 2011
  - Java is from 1995
- Compile to JVM bytecode (and JavaScript)
- High compatibility with Java
  - Can reuse all tools (eg Maven) and libraries (eg Spring)
- Made by JetBrains (same as IntelliJ)
- As of May’17, Kotlin became an official language for Android development

Kotlin Island (St. Petersburg)



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Why?

- Java is a good, solid language, but is verbose and lacks many “modern” features, eg when compared to C#
  - Things got bit better with Java 8, but that’s 2014
  - Java still better than C# for enterprise development, but mainly due to its ecosystem (frameworks and libraries)
- Due to Google vs Oracle legal fight, Android development was stagnating in a Java 6 *wasteland*
  - Java 6 is from **2006,** eons in the software development world…
- Goal: provide a modern language that can be 100% interoperable with Java

Main Features

- Null safety:
  - **Compiler** does check if a call to “foo.bar()” might have “foo” null
  - If a variable can contain null, it has to be marked so

- **No F*KCING Checked Exceptions…**

- Removed a lot of *boilerplate*… code much shorter

```java
public class JavaBase {

    public boolean startWithFoo(String s) {
        if(s == null){
            return false;
        }

        String foo = "foo";

        return s.startsWith(foo);
    }
}
```

```
//"public" is default scope
class KotlinBase {

    //"public" is default scope
    fun startWithFoo(s: String)
            : Boolean  //return type is specified at the end after ":"
    {
        val foo = "foo"  //no need for ";" at the end

        //type is implicit at compilation time, but you can specify it
        //if you want, eg:
        //   val foo: String = "foo"

        /*
            Do not need to worry of "s.startsWith" throwing a NPE,
            because compiler checks that caller of "startWithFoo"
            is not null
         */

        return s.startsWith(foo)
    }
}
```

Types

- Specified after with “:”

- Can be left unspecified if compiler can infer them
  - val foo = “foo”

- Note: Kotlin **IS** statically typed

Var/Val

- “var” is for variables that can be modified

- “val” are values which are constant
  - equivalent to the use of “final” in Java

```
fun bar(){

    var foo = "foo"
    foo = "changed"
    //foo = null // doesn't compile

    //note the "?" after the type
    var bar : String? = "foo"
    bar = null
}
```

```
// note the ?
fun startWithFoo(s: String?) : Boolean {

    //doesn't compile
    //return s.startsWith("foo")

    //elvis operator
    return s?.startsWith("foo") ?: false
}
```

```
fun fiveNextIsFoo(link : Link?) : Boolean{

    return link?.next
            ?.next
            ?.next
            ?.next
            ?.next
            ?.s?.equals("foo")
        ?: false
}
```

```java
public boolean fiveNextIsFoo(Link link){
    if(link == null ||
            link.next == null ||
            link.next.next == null ||
            link.next.next.next == null ||
            link.next.next.next.next == null ||
            link.next.next.next.next.next == null ||
            link.next.next.next.next.next.s == null){
        return false;
    }

    //all checks above are necessary to guarantee this
    //instruction does not throw a NPE
    return  link.next.next.next.next.next.s.equals("foo");
}
```

```java
public boolean fiveNextIsFooWithCatch(Link link){

    try {
        return link.next.next.next.next.next.s.equals("foo");
    }catch (NullPointerException e){
        //this is more expensive, as exceptions need
        //to fill info from stacktrace
        return false;
    }
}
```

```
fun aboutStrings(){

    val multiLineString = """
        <foo>
           Some message
        </foo>
    """

    val x = 5
    val s = "Use \$ to interpolate, eg x=$x"
    print(s)
    //The print(s) does output the following:
    //Use $ to interpolate, eg x=5
}
```

```kotlin
class KotlinConstructor(val s: String, var x: Int) {

    fun foo() = s + x
}
```

```java
public class JavaConstructor {

    private final String s;
    private int x;

    public JavaConstructor(String s, int x) {
        this.s = s;
        this.x = x;
    }

    public String foo(){
        return s + x;
    }

    public String getS() {
        return s;
    }

    public int getX() {
        return x;
    }

    public void setX(int x) {
        this.x = x;
    }
}
```

Functional Programming

- Kotlin is not as good for FP as Scala, but provides more abstractions/utilities compared to Java
- All objects have the methods: **let**, **apply**, **run**, **also**
- Useful when using streams or trying to avoid creating local variables

let, apply, run, also

- They are functions that take a lambda as input
    - Note: in Kotlin, when input is a single lambda, no need for “()”

- Return a value: caller itself, or result of the lambda expression

- The meaning of “*this*” and “*it*” inside the lambda will vary based on the function

	Return Caller	Return Lambda Result
Caller as “it”	**also**	**let**
Caller as “this”	**apply**	**run**

```
fun createFoo() : Foo{

    val foo = Foo()
    foo.intialize()
    foo.doSomething()
    return foo
}


fun createFooWithFP() : Foo {

    return Foo().apply { intialize(); doSomething() }
}
```

```kotlin
fun getHttpBodyBlockNoFP(message: String): String? {

    val tokens =  message.split("\n")
    val emptyLineIndex = tokens.indexOfFirst({line ->
                                             line.isBlank() })

    if (emptyLineIndex < 0 ||
            emptyLineIndex == tokens.lastIndex){
        return null
    } else {
        return tokens.subList(emptyLineIndex + 1, tokens.size)
                     .joinToString("\n")
    }
}
```

```kotlin
fun getHttpBodyBlock(message: String): String? {

    return message.split("\n")
            .run {
                // this == message.split("\n")
                // indexOfFirst is called on List<String>
                indexOfFirst { it.isBlank() } // "it" represents element in list
                   .let {
                         // "this" has not changed, still pointing to List<String>
                         // "it" here is the index returned by indexOfFirst
                         // note that lastIndex is this.lastIndex, on List<String>
                         if (it < 0 || it == lastIndex) return null
                         // subList and size are called on "this", ie List<String>
                         else return subList(it + 1, size).joinToString("\n")
                   }
            }
    /*
       note the total lack of local variables...
       however it can become difficult to read...
    */
}
```

More

- There is more related to Kotlin

- But you do not need to learn all details to be able to be productive in Kotlin

- Throughout the course, I might introduce some more concepts based on the code examples I wrote

Kotlin Negative Sides

- Nothing is perfect, and you will always find different opinions
- Eg, *minor* things I do not like in Kotlin
  - No *ternary operator*, eg   “return x==5 ? 0 : 1 ”, although in Kotlin “if” is an expression, eg “return if(x==5) 0 else 1”
  - Poor handling of *static methods,* but that might change in future releases
  - Still rough edges regarding typing and generics
- Lot of “magic” in Kotlin, so not recommended for total beginners (ie Java is a better introductory language)

Kotlin Major Design Flaw

- In Kotlin, classes and methods are *final* by default
  - You need to use keyword *open* to specify they can be overridden
- *Final by default is a solution to a near non-existent problem*
- And unfortunately it creates a lot, a lot of problems
  - eg, when dealing with libraries like Spring and Hibernate
- Corollary: do not use Kotlin to write **libraries**. If a library is written in Kotlin, avoid using it if another equivalent library exists in Java

Kotlin and Maven

- We will compile Kotlin to JDK bytecode
- We will compile with Maven
- Need special plugin to compile Kotlin code
- This plugin will need special settings to handle libraries like Spring and Hibernate

Links

- Kotlin documentation: https://kotlinlang.org/docs/kotlin-docs.pdf

- Kotlin Koans: https://kotlinlang.org/docs/tutorials/koans.html

Data Formats

Data in Web Services

- Web Services will provide data and functionalities over the network
- Servers and clients can be written in different languages
  - Java, C#, JavaScript, Kotlin, Python, Go, PHP, etc.
- Data formats should be independent from the programming languages

XML

- Very popular in the *past*
- OKish for configuration files (eg, Maven *pom.xml*)
- Quite verbose for data over the network
- Not so much used any more (apart from SOAP services)

JSON

- **J**ava**S**cript **O**bject **N**otation (JSON)
- Less verbose than XML
- Very poor for configuration files (e.g., no comments)
  - YAML and XML are better
- *Can be used directly by JavaScript running in the browser*
- Practically the most common data format for web services nowadays

Git Repository Modules

- *NOTE: most of the explanations will be directly in the code as comments, and not here in the slides*

- **advanced/kotlin**
- **advanced/data-format**