PROGRAMMING, DATA STRUCTURES AND ALGORITHMS

BACHELOR IN MANAGEMENT INFORMATION SYSTEMS
Professor: IGNACIO LARRU MARTÍNEZ
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Academic year: 17-18
Degree course: FIRST
 Semester: 2º
Category: BASIC
Number of credits: 6.0
Language: English

PREREQUISITES
This course builds on the Programming 0.1 seminar

SUBJECT DESCRIPTION
Welcome to the Programming, Data Structures and Algorithms course. This course aims to strengthen your abilities as future leaders with one of the most important yet mostly missing skills for managers: the art of programming and algorithmic design. Managers with programming experience are able to be involved in the decision-making process of their developers. They can also understand whether or not each developer is performing well. In this course, we will focus on structuring algorithms and implementing them in one of the most widely used programming languages: Java. Java is one of the most commonly used language in building robust software and provides a solid programming background in terms of understanding how software is built. We will learn how to leverage this programming knowledge in a business context, equipping ourselves for the digital world we live in.

This course also lays the foundation for learning other important programming languages. Programming is an art and the entire career of many people worldwide. After taking this course, you will learn how to excel in Java even further or to start learning a new programming language from scratch. Java is greatly structured to be an easy-to-learn, yet a powerful programming language. I will make sure I help you as much as I can in this journey. And remember, programming is all about creativity so try to enjoy it as much as you can!

OBJECTIVES AND SKILLS
The main objective of this course is to familiarize yourselves with the basic principles of programming. It is a highly practical course, in which you will be asked to write small and larger parts of code in order to solve particular business problems. In fact, you will be asked to implement in groups a program which will provide a solution to a business problem.

At the end of this course, you should be able to:
· Understand what an algorithm is and how it differs from a program
· Work on Eclipse Java Integrated Development Environment (IDE) in order to produce, compile and run your own Java code.
· Have a thorough understanding about Variables and Primitives in Java
· Work with Java Operators using Boolean Algebra
· Work with arrays in Java
· Record User input
· Implement and use basic mathematic functions in Java
· Implement conditional and iterative thinking and use it in problem solving
· Identify what is a Java method, build your own methods
· Write and read information from files and use this information in your Java code
· Create your own objects, classes and work with class constructors
· Obtain a deep understanding about the concept of inheritance and the polymorphism of an object
· Search and sort information using Java programming
· Create your own java program which will be capable of solving a particular business problem
· Present your business solution and implementation in order to appeal to a business audience

In summary, you will get into the logic of writing your own program in Java, aiming to address a business challenge. You will be able both to develop high quality code and understand code written by others. This two-fold skill will make you capable leaders which can supervise and evaluate projects implemented by your teams.

**METHODOLOGY**

This course is highly tied to practical applications therefore all sessions will include a lot of practice, such as writing our own algorithms in Java but also trying to understand what an algorithm is trying to achieve. Therefore, it is essential that you have your own laptop with Eclipse installed with you during the sessions so that we can implement the algorithms together in class, step-by-step.

The sessions include regular sessions and review sessions. During the former, we will combine learning new concepts in algorithmic design and applying them in practical problems. That requires writing our own small or bigger programs in Java. During the latter, we will be reviewing what we learned in the previous block of sessions so that we can proceed forward with new concepts. In programming it is essential that we learn, building on previously acquired knowledge since there are a lot of dependencies. Therefore, I would encourage you to make sure you ask and solve any questions you might have from previous sessions. Furthermore, during the review sessions we will include discussion about the solutions of individual assignments, as well as monitoring your progress in the group project and providing guidance.

In terms of practice, we will be using real-world business problems to which we will be providing algorithmic solutions. One of these problems will be used in each group project, in which you will be asked to wear the hat of a solution architect and design and implement a particular solution in Java.

<table>
<thead>
<tr>
<th>Teaching methodology</th>
<th>Weighting</th>
<th>Estimated time a student should dedicate to prepare for and participate in</th>
</tr>
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<tbody>
<tr>
<td>Lectures</td>
<td>26.67 %</td>
<td>40 hours</td>
</tr>
<tr>
<td>Activity</td>
<td>Percentage</td>
<td>Hours</td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
<tr>
<td>Discussions</td>
<td>6.67 %</td>
<td>10 hours</td>
</tr>
<tr>
<td>Exercises</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Group work</td>
<td>33.34 %</td>
<td>50 hours</td>
</tr>
<tr>
<td>Other individual studying</td>
<td>13.34 %</td>
<td>20 hours</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0 %</td>
<td>150 hours</td>
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PROGRAM

SESSIONS 1 - 4
Review of Basic Java Syntax (primitive types, loops, if/else and arrays)
Readings: The art and science of Java Chapters 1-6.
These sessions will help us review the content from the previous coding seminar as a jumpstart into the course

SESSIONS 5 - 6
How can we record user input? What are Strings and Characters structures? How can they be useful? Can we write/read on/from files in Java?
- Readings: The art and science of Java Sections 8.1-8.3 and 12.4.

SESSION 7
Eclipse as a Java IDE Tool. In this session we will learn the basic Eclipse concepts like projects, packages, updates, perspectives, etc...

SESSION 8
What is a data structure of an array? Why is this structure convenient for our programs?
Readings: The art and science of Java Sections 11.1-11.3.

SESSIONS 9 - 10
What is a method in Java? Why are methods a good way of structuring our Java code?
- Readings: The art and science of Java Sections 5.1-5.3.

SESSIONS 11 - 12
Algorithmic thinking in Java
Once we have mastered methods we will employ them to implement basic search algorithms (bubble, quicksort and linear search) in Java using arrays as the data structures to be sorted. These two sessions will also help us understand the algorithmic nature of programming and the art of splitting a complex task in small steps before implementation.

SESSIONS 13 - 14
What are classes and objects in Java? How do they differ? Why are the essential for writing structured code?
- Readings: The art and science of Java Section 2.5

SESSIONS 15 - 16
What is scope of a class? What is the difference between Public and Private?
- Readings: The art and science of Java Sections 6.3, 6.4.
SESSIONS 17 - 22
OOP Relationships from composition to inheritance and interfaces

What is inheritance and polymorphism in Java? What difference does it make?
- Readings: The art and science of Java Section 6.6.

SESSIONS 23 - 25
Review Excercises sessions. Once we are familiarized with OOP concepts we will review them with various excercises

SESSION 26
What is an ArrayList? How does it relate to the Array structure?
This session marks the start of the third block of the course were we will review JAVA’s main libraries from JAVA Collections to JAVA Math and JAVA I/O

SESSION 27
Hashtables and Vectors
In this session we will finish the Collections framework by learning how to use Hashtables and Vectors

SESSION 28
Collections review excercises - In this sessin we will program jointly code that uses objects from the Collections library

SESSION 29
What is the Math library in Java? How can we implement common mathematic functions?
Examples using math in Java.

SESSION 30
Midterm exam

SESSIONS 31 - 33
Exceptions
In these sessions we will learn the concept of an Exception and how it can be used to make our Java programs more resilient

SESSIONS 34 - 37
Java I/O library - Files
In these sessions we will learn how to include persistent storage structures in our programs throught the Java I/O library
SESSIONS 38 - 40
Searching algorithms in Java

SESSIONS 41 - 43
Model View Controller Design in Java
In these sessions we will learn how to include the main design pattern in Java into our programs

SESSIONS 44 - 46
Workgroup sessions
In these sessions you will work together with your group to code the final group assignment in class using all of the concepts we have seen in class.

SESSIONS 47 - 49
Final exam review sessions
In these sessions we will review for the final exam by fulfilling different coding assignments by pairs

SESSION 50
Final Exam
BIBLIOGRAPHY

COMPULSORY

Title: Invitation to Computer Science, 5th Edition (Chapters 1 and 2)
Author: G. Michael Schneider and Judith L. Gersting
ISBN / ISSN: 0324788592
Medium: PRINT or ELECTRONIC

Title: The Art and Science of Java
Author: Eric S. Roberts
Publisher / Edition / Year: Pearson New International Edition[ALB1], 2013
ISBN / ISSN: 978-1-292-02603-9
Medium: PRINT or ELECTRONIC

EVALUATION CRITERIA

Throughout this course, you will be asked to read material related to the sessions, participate in discussions, complete individual assignments, participate in in-class quizzes, implement a group project (creating a Java program which provides a solution to a business challenge) and present the outcome of this project in class. Specifically, grading will be based on the following criteria:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>10 %</td>
<td></td>
</tr>
<tr>
<td>Intermediate Tests</td>
<td>20 %</td>
<td>Midterm test</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50 %</td>
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</tr>
<tr>
<td>Workgroups</td>
<td>20 %</td>
<td>Workgroup sessions</td>
</tr>
</tbody>
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A. Class participation – discussion

You are expected to attend every class and participate in the discussions and class activities (games, etc.). The basic criteria in grading your participation are: a) your presence in each session, b) your (quality) contributions to the group discussion. Lively discussions in the classroom are always encouraged, however, make sure that you provide constructive comments which contribute to the learning experience of the whole class.

B. Midterm Exam

There will be a midterm test to cover basic OOP coding principles

C. Group project implementation

A major part of this course’s learning experience consists of a group project which will be focusing on designing and implementing an algorithmic solution to a business problem. The definition of the problem as well as the main requirements will be provided to you during the workgroups sessions, so that you have only to focus on designing and implementing the best solution. Remember, creativity is always rewarded!

D. Final exam

At the end of the course you will have to pass an individual exam
PROFESSOR BIO

Professor: **IGNACIO LARRU MARTÍNEZ**

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Ignacio Larrú is a freelance Java and Python developer and technology investment director in KFund a venture capital fund in Spain. A former investment banker Ignacio was head of Big Data projects at Ticketbis. His work involves advising companies on the design and implementation of information systems and statistical models for both descriptive and predictive analytics.

Previously Ignacio has been the founder (and coder...) of a wide array of different start-ups ranging from online retailers to complex software in the civil sector. He started his career as an IT consultant with PricewaterhouseCoopers developing software applications for leading financial institutions.

Ignacio holds a Master of Telecommunications Engineering from Universidad Politécnica de Madrid and a Master in Business Administration from IESE business School

OTHER INFORMATION

INTEGRITY & ETHICS

In this course I strictly enforce the university's policies on scholarship and grades. Implicit in handing in homework, assignments, papers, and exams is that they represent your own work (or the result of sanctioned collaboration).

CODE OF CONDUCT IN CLASS

1. **Be on time**: Students arriving more than 5 minutes late will be marked as “Absent”.

Only students that notify in advance in writing that they will be late for a specific session may be granted an exception (at the discretion of the professor).

2. **If applicable, bring your name card and strictly follow the seating chart**. It helps faculty members and fellow students learn your names.

3. **Do not leave the room during the lecture**: Students are not allowed to leave the room during lectures. If a student leaves the room during lectures, he/she will not be allowed to re-enter and, therefore, will be marked as “Absent”.

Only students that notify that they have a special reason to leave the session early will be granted an exception (at the discretion of the professor).

4. **Do not engage in side conversation**. As a sign of respect toward the person presenting the lecture (the teacher as well as fellow students), side conversations are not allowed. If you have a question, raise your hand and ask it. If you do not want to ask it during the lecture, feel free to approach your teacher after class.

If a student is disrupting the flow of the lecture, he/she will be asked to leave the classroom and, consequently, will be marked as “Absent”.

5. **Use your laptop for course-related purposes only**. The use of laptops during lectures must be authorized by the professor. The use of Social Media or accessing any type of content not related to the lecture is penalized. The student will be asked to leave the room and, consequently, will be marked as “Absent”.

6. **No cellular phones**: IE University implements a “Phone-free Classroom” policy and, therefore, the use of phones, tablets, etc. is forbidden inside the classroom. Failing to abide by this rule entails expulsion from the room and will be counted as one absence.

7. **Escalation policy: 1/3/5.** Items 4, 5, and 6 above entail expulsion from the classroom and the consequent marking of the student as “Absent.” IE University implements an “escalation policy”: The first time a student is asked to leave the room for disciplinary reasons (as per items 4, 5, and 6 above), the student will incur one absence, the second time it will count as three absences, and from the third time onward, any expulsion from the classroom due to disciplinary issues will entail 5 absences.