II.2315 / II.2415 – Advanced Algorithmics and Programming

General information

Module Title: Advanced Algorithms and Programming
Module ID: II.2315 / II.2415
Module leader: Ammar KHEIRBEK
ECTS: 4 credits
Average amount of work per student: from 100 to 150 hours, including 42 hours in person
Teamwork: yes
Keywords: Algorithms, programming, complexity, Java, Graphs, Optimization

Presentation

Many problems, most of which are of great practical importance (routing in a network, optimal task scheduling, shortest path), call for advanced notions in modeling and algorithmics. The development of solutions to these problems can be facilitated by in-depth knowledge of a programming language and associated design and programming techniques.

Educational objectives

The Advanced Algorithmics and Programming module aims to prepare the engineering student to acquire skills in a wide range of fields where algorithmics and modeling play a predominant role.

- Estimating and comparing the complexities of algorithms
- Modeling complex algorithmic problems

Prerequisite

- Java programming, notions of algorithms, complexity, object-oriented programming.

Content/Program

- Algorithm design
- Linear data structures (arrays and matrices, stacks, queues, hash arrays)
- Complexity classes
- Algorithm design
- Optimization, Probabilistic Algorithms
- Tree structures
- Graph theory (flow problems, logistics, shortest path, ...)
- Complex Algorithmic Problem Breakdown/Solving
- Advanced concepts of the Java language and its development environment (Eclipse)
    - Functional programming
    - Modules
    - Profiling

Tools used

- Java Development Environment
- Code sharing tools (git)

Pedagogical methods

Learning methods

The module is divided into two parts. Six sessions take place according to a course/tutorial scheme and introduce fundamental concepts in algorithmics (complexity, optimization) and

graph theory; the other eight sessions are courses or practical work devoted to advanced programming techniques in Java. The concepts and skills acquired are evaluated by an exam.

Evaluation methods

The evaluation of this module is based on:

- 6 Labs evaluated (30%)
- A project in pairs (20%)
- A quiz (10%)
- A final exam (40%)

Language of work

The materials and the course are in English. Submissions can be written in French or English.

Bibliography, Webography, Other sources

- Java First Language
- Advanced Algorithms and Data Structures, Marcello la Rocca, ©2021 by Manning Publications
- Introduction to Algorithms, Third Edition, By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press, 2009
- Data Structures & Problem Solving Using Java, fourth edition, By mark allen Weiss, Copyright c 2010 Pearson Education, Inc.
- Data Structures and Algorithms in Java, 4th edition, By Michael T. Goodrich, Roberto Tamassia, The MIT Press.
- Several online resources.