

Algorithms and Programming

Course name: Algorithms and Programming (level 1)

Course code: AlgoProg1

Course level: Master (M1, S1)

ECTS Credits: 5.00

Course instructors: Ass. Prof. Philippe Colantoni (UJM)

Language of instruction: English

Aim and learning outcomes:

Understanding the concept of algorithm, analyzing computational complexity, understanding design principles of algorithms and their application to computing problems. Topics include complexity analysis techniques, the main design principles such as divide-and-conquer, dynamic programming, greedy approaches, and graph exploration techniques.

On completion of this course the students will be able to: - Design algorithms for classic problems. - Analyze and understand their complexity. - Being able to implement the algorithms in practice.

Course outline:

- Compilation and interpretation
- Introduction to complexity theory (asymptotic, recurrences, introduction to NP-completeness).
- Divide and conquer: characterisation, complexity, sorting algorithms and diverse problems.
- Greedy algorithms: characterisation and diverse problems
- Dynamic programming: characterisation and diverse problems
- Graphs and algorithms: definition, traversals, shortest paths, minimum spanning tree and diverse applications.

Lab sessions:

Implementation and empirical evaluation of algorithms.

Programming language: C++ (without OOP implementation)

Teaching methods: Lectures, lab classes and homework exercises.

Form(s) of Assessment: written exam (50%), practical works and project (50%)

Excellent - outstanding performance	A
Very Good - above the average standard but with some errors	B
Good - generally sound work with a number of notable errors	C
Satisfactory - fair but with significant shortcomings	D
Sufficient - performance meets the minimum criteria	E
Fail - some more work required before the credit can be awarded	FX
Fail - considerable further work is required	F

Literature and study materials:

Reference book:

J. Kleinberg and E. Tardos, "Algorithm Design", Pearson International Edition, 2006.

T. Cormen, C. Leiserson, and R. Rivest, "Introduction to Algorithms," The MIT Press, 1990.

Algorithmic and Programming (level 2)

Course name: Algorithms and Programming (level 2)

Course code: AlgoProg2

Course level: Master (M1, S1)

ECTS Credits: 5.00

Course instructor: Ass. Prof. Philippe Colantoni (UJM)

Language of instruction: English

Overview

The course fully covers the basics of programming in the C++ programming language and presents the fundamental notions and techniques used in object-oriented programming (OOP). It starts with universal basics, not relying on object concepts and gradually extends to advanced issues observed in the objective approach. The OpenCV library, an open source C++ library dedicated to computer vision, will be presented as example.

The course features extensive practical components including computer labs and practical projects that provide students with the opportunity to practice and refine their skills in OOP.

Learning outcomes

On successful completion of this course, students should have the skills and knowledge:

- To familiarize the trainee with the universal concepts of computer programming.
- To present the syntax and semantics of the “C++” language as well as basic data types offered by the language
- To discuss the principles of the object-oriented model and its implementation in the “C++” language
- To demonstrate the means useful in resolving typical implementation problems with the help of standard C++ language libraries.
- To be able to use (and extend) the OpenCV library.

Content

- Compilation and interpretation
- Basic data types and algorithm techniques (brute force, divide and conquer, dynamic programming; etc.)
- Dealing with classes and objects
- Defining overloaded operators
- Inheritance and polymorphism
- Introduction to the standard C++ library
- Introduction to OpenCV
- OpenCV data structures
- Computer vision with OpenCV

Teaching methods

- Lectures
- Practical works based on laboratory sessions:
 - to implement concepts introduced in the lectures
 - to practice on real computer vision applications

- to train students
- Project based on OpenCV

Study materials

- The C Programming Language, Dennis Ritchie and Brian Kernighan
- The C++ Programming Language (4th Edition), Addison-Wesley ISBN 978-0321563842. May 2013.
- The OpenCV Documentation and Tutorials, <http://docs.opencv.org>

Assumed Knowledge

- Entry-level computer programming experience in Python or C.
- Previous knowledge of digital image processing will be helpful.

Evaluation criteria

- Written exam 60%
- Project work 40%