

Network & Operating Systems for Data Science

Network & Operating Systems for Data Science	
Offered by	Department of Mathematics and Computer Science
Language	English
Primarily interesting for	For Data Science students who want to pursue the educational minor to obtain a second degree teaching qualification for teaching Computer Science at high school level
Prerequisites	Required courses: 2IT60 Logic and set theory - 2IP90 Programming Recommended courses: -
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Content and composition

This package provides courses to students in the Data Science major, who wish to pursue the educational minor and obtain a second degree teaching qualification for teaching Computer Science at high school level. In three subsequential courses – so they have to be followed in the set order – you will get the required level of knowledge on network and operating systems to be allowed to teach Computer Science at high schools.

Students from generations AY2020 or earlier follow JBI050, other include 2INCO in their package.

Course code	Course name	Level classification
2IC30	Computer systems	1.
2INCO	Operating systems	2.
JBI050*	Data management for data analytics	2.
2IC60	Computer networks and security	3.

*JBI050 is applicable only for generation AY 2020 or earlier

Course description

2IC30, Computer systems

Introduction to Computer Systems, on the structure and working of general-purpose machines that can execute computer programs, spanning the conceptual gap between simple switches on the one hand and the abstract machine that constitutes a "computer" on the other.

At the end of the course, students understand how both combinatorial and sequential digital circuits can be constructed using elementary logical gates. They understand how a data path of a simple processor with registers, busses and an ALU can be constructed and how assembly instructions can be implemented on this structure. They can write simple assembly programs and know how higher order languages can be translated to assembly programs. They understand the imbedding of a processor in a computer, including notions such as caches, multi-threading, networking, the operating system and virtual memory.

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2INCO, Operating systems

Most devices such as standard desktop computers, phones, but also fridges, cars or planes, make use of an operating system of sort to manage the execution of several concurrent processes and ensure correct, safe and efficient operation. The Operating systems course introduces the most relevant concepts for understanding how operating systems work. It provides insights and theoretical background on how to manage concurrent processes, implement basic synchronization and communication protocols, manage memory and file systems, and presents tools to analyze how those techniques may impact the correctness and timing of applications.

At the end of the course, the students are able to:

- explain the most relevant concepts and techniques used in operating systems;
- identify problems with concurrent processes execution, atomicity and interference, and the effects they have on programs' correctness;
- implement simple synchronization and communication protocols between threads and processes;
- analyze synchronization and communication protocols between threads and processes to check whether they respect invariants and avoid deadlocks;
- apply memory and file system management techniques on example systems.

Through the course the student will also gain experience with programming in C.

JB1050, Data management for data analytics*

As we enter an era of big data and data science, core knowledge and skills in data modeling and data management are now recognized as essential in many disciplines. The primary goal of JB1050 is to master the core best-practices of data management systems, applied towards using contemporary tools to support effective data analytics. In particular, this course focuses on preparing students to meet contemporary data modeling and data management challenges which arise in applications in their own fields of study.

After this course, students will be able to

- understand the basics of conceptual data modeling in the Entity Relationship model and UML, and translating a natural language specification of a conceptual model into a relational database schema;
- understand the relational database model;
- understand and create advanced SQL and Datalog queries for retrieving relevant data, potentially spanning multiple database tables and involving recursion and aggregation of data;
- will acquire the ability to design, based on a problem description in a variety of application domains, a database suited to solve this problem; and,
- will be able to quickly master and make practical use of contemporary frameworks and technologies for relational data management.

2IC60, Computer networks and security

A computer network is a facilitator of distributed applications and comes with security threats. We cover the organization of computer networks (e.g. the Internet), basics of security and network and security protocols. Students learn to explain solutions to standard problems and to analyze protocols with respect to correctness, performance, reliability and security. Concepts are realized using the underlying protocols studied.

At the end of the course, students are expected to be able to

- explain how computer networks are organized
- describe the Internet structure and explain how standard problems are solved in that context
- analyze simple protocols with respect to correctness, performance, reliability and security
- recognize and describe security requirements of networking scenarios
- identify security technologies that can help alleviate security issues
- combine these technologies in a basic network security design
- study literature concerning computer networks and security and provide critical evaluation in writing.