



Computer Science MSc

Vrije Universiteit Amsterdam - Faculteit der Exacte Wetenschappen - M Computer Science - 2013-2014

Computer Science is concerned with notions, methods and skills connected to the operation and applications of computers. The technical side of Computer Science includes subjects as programming, operating systems, computer networks, data structures, the theoretical foundations of computer science and the use of mathematics and logic. In the heart of Computer Science we find methodological disciplines like software engineering, conceptual modelling and specification methods. Furthermore there is a rich assortment of applications, like parallel computing, visualisation, security, databases, internet and web, electronic commerce, artificial intelligence, multimedia, protocol validation and managerial aspects. Students who want to follow the Master Program in Computer Science are supposed to possess already a solid basis in this field at the Bachelor level, especially in computer architecture, computer networks, software engineering and the theoretical foundations of computer science.

The following 4 tracks in the Computer Science program are given in close collaboration with the UvA.

- * Computer Systems and Security
- * Foundations of Computing and Concurrency
- * High-Performance Computing
- * Internet and Web Technology

The program is set up in such a way that you can still follow the majority of the courses at the VU, if you prefer. VU and UvA courses are scheduled on different weekdays, to prevent travel overhead.

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Research Variant Internet and Web Technology

The Internet and the World Wide Web play an ever more central role in our society. This specialisation is concerned with large-scale computer systems, especially computer networks and the Internet. Important topics are: Internet and Web protocols, distributed systems, network security, development tools for network applications, peer-to-peer technology, etc.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

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Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Suggested elective courses](#)
- [Core track courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Suggested elective courses

Opleidingsdelen:

- [Suggested elective courses Foundations of Computing and Concurrency](#)
- [Suggested elective courses Programming](#)
- [Suggested elective courses Software Engineering](#)
- [Optional Courses](#)

Suggested elective courses Foundations of Computing and Concurrency

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103
Logical Verification	Periode 5	6.0	X_400115
Protocol Validation	Periode 5	6.0	X_400117
Recursion Theory	Periode 1	6.0	X_400534

Suggested elective courses Programming

Vakken:

Naam	Periode	Credits	Code
Computer Networks Practical	Periode 5+6	6.0	X_405072
Individual Systems Practical	Ac. Jaar (september)	6.0	X_405088
Operating Systems Practical	Periode 5+6	6.0	X_405071
Parallel Programming Practical	Periode 2+3	6.0	X_400162
Programming Concurrent Systems	Periode 2	6.0	X_418109

Suggested elective courses Software Engineering

Vakken:

Naam	Periode	Credits	Code
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Optional Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Selforganisation	Periode 2	6.0	X_400434

Binary and Malware Analysis	Periode 1	6.0	X_405100
Computer Networking	Periode 4	6.0	X_418102
Data Mining Techniques	Periode 5	6.0	X_400108
Developing Services for the Cloud	Periode 3	6.0	X_405074
Evolutionary Computing	Periode 1	6.0	X_400111
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Intelligent Web Applications	Periode 4	6.0	X_405055
Introduction to Computational Science	Periode 1	6.0	X_418111
Knowledge and Media	Periode 1	6.0	X_405065
Knowledge Engineering	Periode 2+3	6.0	X_405099
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Literature Study	Ac. Jaar (september)	6.0	X_400277
Multimedia Authoring	Periode 1	6.0	X_405098
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Systems Security	Periode 4	6.0	X_405108
The Social Web	Periode 4	6.0	X_405086

Core track courses

Vakken:

Naam	Periode	Credits	Code
Distributed Algorithms	Periode 2	6.0	X_400211
Distributed Systems	Periode 2	6.0	X_400130
Internet programming	Periode 1	6.0	X_405082
Performance of Networked Systems	Periode 4	6.0	X_405105
Service Oriented Design	Periode 1	6.0	X_405061
Web Services and Cloud-based Systems	Periode 5	6.0	X_418110

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant High-Performance Computing

High performance computing seeks to solve computing problems as fast and as efficiently as possible. The most important approach is to use a (large) number of computers instead of one, and let these computers work together, in parallel. In clusters and grids, the computers are typically distributed across an organization (a university, for example), a country, or even the globe. This has led to the term "High Performance Computing."

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Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Constrained choice Foundations of Computing and Concurrency \(6EC\)](#)
- [Suggested elective courses Programming](#)
- [Constrained Choice Software Engineering \(6EC\)](#)
- [Optional Courses](#)
- [Core track courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Constrained choice Foundations of Computing and Concurrency (6EC)

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103
Distributed Algorithms	Periode 2	6.0	X_400211
Logical Verification	Periode 5	6.0	X_400115
Protocol Validation	Periode 5	6.0	X_400117
Recursion Theory	Periode 1	6.0	X_400534

Suggested elective courses Programming

Vakken:

Naam	Periode	Credits	Code
Computer Networks Practical	Periode 5+6	6.0	X_405072
Individual Systems Practical	Ac. Jaar (september)	6.0	X_405088
Internet programming	Periode 1	6.0	X_405082
Operating Systems Practical	Periode 5+6	6.0	X_405071
Programming Concurrent Systems	Periode 2	6.0	X_418109

Constrained Choice Software Engineering (6EC)

Vakken:

Naam	Periode	Credits	Code
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Optional Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Selforganisation	Periode 2	6.0	X_400434
Advanced Topics in Computer Networks	Periode 5	6.0	X_418112

Advances in Computer Architecture	Periode 1	6.0	X_418047
Binary and Malware Analysis	Periode 1	6.0	X_405100
Computer Networking	Periode 4	6.0	X_418102
Data Mining Techniques	Periode 5	6.0	X_400108
Developing Services for the Cloud	Periode 3	6.0	X_405074
Evolutionary Computing	Periode 1	6.0	X_400111
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Intelligent Web Applications	Periode 4	6.0	X_405055
Knowledge and Media	Periode 1	6.0	X_405065
Knowledge Engineering	Periode 2+3	6.0	X_405099
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Literature Study	Ac. Jaar (september)	6.0	X_400277
Multimedia Authoring	Periode 1	6.0	X_405098
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Serious Games	Periode 1	6.0	X_405097
Systems Security	Periode 4	6.0	X_405108
The Social Web	Periode 4	6.0	X_405086

Core track courses

Vakken:

Naam	Periode	Credits	Code
Distributed Systems	Periode 2	6.0	X_400130
Introduction to Computational Science	Periode 1	6.0	X_418111
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Parallel Programming Practical	Periode 2+3	6.0	X_400162
Performance of Networked Systems	Periode 4	6.0	X_405105

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant Software Engineering

Some people define software engineering as: 'the application of a systematic, quantifiable approach to the development, execution and maintenance of software. It is a broad and comprehensive field, in which engineering plays an important part, next to psychological and managerial aspects. Keywords are evolution and complexity.

The field continually evolves, as the type of systems as well as the world at large changes. New developments such as outsourcing, global system development, service-orientation and the incorporation of off-the-shelf software profoundly influence the field.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

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Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Compulsory Optional Courses Theoretical Computer Science \(6EC\)](#)
- [Optional Courses](#)
- [Compulsory Courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Compulsory Optional Courses Theoretical Computer Science (6EC)

Compulsory choice Theoretical Computer Science at least 6 credits, recommended are the courses below.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103
Distributed Algorithms	Periode 2	6.0	X_400211
Logical Verification	Periode 5	6.0	X_400115

Optional Courses

Vakken:

Naam	Periode	Credits	Code
Binary and Malware Analysis	Periode 1	6.0	X_405100
Data Mining Techniques	Periode 5	6.0	X_400108
Developing Services for the Cloud	Periode 3	6.0	X_405074
Evolutionary Computing	Periode 1	6.0	X_400111
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Internet programming	Periode 1	6.0	X_405082
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Literature Study	Ac. Jaar (september)	6.0	X_400277
Multimedia Authoring	Periode 1	6.0	X_405098
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Scientific Writing in English	Periode 2, Periode 6	3.0	X_400592
Serious Games	Periode 1	6.0	X_405097
Systems Security	Periode 4	6.0	X_405108

Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Distributed Systems	Periode 2	6.0	X_400130
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant Multimedia

Multimedia is a rapidly developing application and research area. Because of the arrival of broadband Internet we speak of digital convergence, the combination of formerly disjoint media, as in interactive television. Connected with the efficient use of multimedia is the rich palette of research questions in the field of authoring, information retrieval, human computer interaction, software architecture and 3D-graphics. In the specialization Multimedia there is special attention for the use of 3D virtual environments for the disclosure of multimedia information. Depending on interest and expertise, authoring and design problems can have the focus, or more technical aspects in the field of software architecture communication and 3D graphics. In the specialization Multimedia there is special attention for the use of 3D virtual environments for the disclosure of multimedia information.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Suggested elective courses Software Engineering](#)
- [Compulsory Choice Theoretical Computer Science](#)
- [Recommended optional Courses](#)

- [Compulsory Courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Suggested elective courses Software Engineering

Each student must follow at least 6EC from the core track courses of Track Software Engineering

Vakken:

Naam	Periode	Credits	Code
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Compulsory Choice Theoretical Computer Science

Compulsory choice Theoretical Computer Science at least 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103
Distributed Algorithms	Periode 2	6.0	X_400211
Logical Verification	Periode 5	6.0	X_400115
Protocol Validation	Periode 5	6.0	X_400117

Recommended optional Courses

Vakken:

Naam	Periode	Credits	Code
Binary and Malware Analysis	Periode 1	6.0	X_405100
Data Mining Techniques	Periode 5	6.0	X_400108
Evolutionary Computing	Periode 1	6.0	X_400111
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Internet programming	Periode 1	6.0	X_405082
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Literature Study	Ac. Jaar (september)	6.0	X_400277
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Performance of Networked Systems	Periode 4	6.0	X_405105
Project Multimedia	Ac. Jaar (september)	6.0	X_400358
Scientific Writing in English	Periode 2, Periode 6	3.0	X_400592

Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Distributed Systems	Periode 2	6.0	X_400130
Knowledge and Media	Periode 1	6.0	X_405065
Multimedia Authoring	Periode 1	6.0	X_405098
Serious Games	Periode 1	6.0	X_405097

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant Foundations of Computing and Concurrency

This track aims at Computer Science students with a general interest in the application of formal methods in computing, concurrency and the design and verification of software systems. Some theoretical disciplines that play a central role are term rewriting, process algebra, distributed algorithms and type theory. Foundational disciplines include logic, recursion theory and complexity.

All these topics have a wide range of applications, of which we mention just a few. Tools developed from process algebra are used in protocol validation. Term rewriting is used in the execution of equational specifications and lies at the basis of functional programming and the analysis of infinitary processes. Distributed algorithms are of central importance for the efficient use of concurrent systems. Logic and type theory form the basis of proof checking, used in software verification.

In all of the above areas courses are offered. To mention a few examples: Distributed Algorithms, Logical Verification, Protocol Validation, Term Rewriting Systems, Concurrent System Design by Abstraction. The programme can be enhanced by choosing one or more appropriate mathematics courses.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

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Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Constrained Choices](#)
- [Constrained Choice Programming](#)
- [Constrained Choice Software Engineering \(6EC\)](#)
- [Recommended optional Courses](#)
- [Compulsory Courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041

Experimental Design and Data Analysis	Periode 5	6.0	X_405078
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Constrained Choices

Opleidingsdelen:

- [Constrained choice](#)
- [Constrained choice](#)
- [Constrained choice](#)

Constrained choice

Vakken:

Naam	Periode	Credits	Code
Logical Verification	Periode 5	6.0	X_400115
Protocol Validation	Periode 5	6.0	X_400117

Constrained choice

Vakken:

Naam	Periode	Credits	Code
Lambda Calculus	Periode 2	6.0	X_418108
Term Rewriting Systems		6.0	X_400121

Constrained choice

Vakken:

Naam	Periode	Credits	Code
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103

Constrained Choice Programming

Compulsory choice Practical Work Computer Science at least 6 credits, recommended are the courses below.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Vakken:

Naam	Periode	Credits	Code
Computer Networks Practical	Periode 5+6	6.0	X_405072
Individual Systems Practical	Ac. Jaar (september)	6.0	X_405088
Internet programming	Periode 1	6.0	X_405082
Operating Systems Practical	Periode 5+6	6.0	X_405071
Parallel Programming Practical	Periode 2+3	6.0	X_400162
Programming Concurrent Systems	Periode 2	6.0	X_418109

Constrained Choice Software Engineering (6EC)

Vakken:

Naam	Periode	Credits	Code
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Recommended optional Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Selforganisation	Periode 2	6.0	X_400434
Advanced Topics in Computer Networks	Periode 5	6.0	X_418112
Advances in Computer Architecture	Periode 1	6.0	X_418047
Binary and Malware Analysis	Periode 1	6.0	X_405100
Computer Networking	Periode 4	6.0	X_418102
Concurrent System Design by Abstraction		6.0	X_418104
Data Mining Techniques	Periode 5	6.0	X_400108
Developing Services for the Cloud	Periode 3	6.0	X_405074
Evolutionary Computing	Periode 1	6.0	X_400111

ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Intelligent Web Applications	Periode 4	6.0	X_405055
Introduction to Computational Science	Periode 1	6.0	X_418111
Knowledge and Media	Periode 1	6.0	X_405065
Knowledge Engineering	Periode 2+3	6.0	X_405099
Lambda Calculus	Periode 2	6.0	X_418108
Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Literature Study	Ac. Jaar (september)	6.0	X_400277
Multimedia Authoring	Periode 1	6.0	X_405098
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Performance of Networked Systems	Periode 4	6.0	X_405105
Serious Games	Periode 1	6.0	X_405097
Systems Security	Periode 4	6.0	X_405108
The Social Web	Periode 4	6.0	X_405086

Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Distributed Algorithms	Periode 2	6.0	X_400211
Recursion Theory	Periode 1	6.0	X_400534

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant Technical Artificial Intelligence

In this specialization the realisation of intelligent computer programs is the central subject. Artificial intelligence uses a great number of techniques from computer science and also plays a part in the development of these techniques, often inspired by human cognition. In this programme the student can choose between the existing techniques. Analysing, modelling and implementing of human knowledge, leading to a computer program that can reason with symbolic representations of this knowledge is the subject of Knowledge Technology. In Knowledge Discovery and Data Mining the computer is used for recognition of structures in raw data, from which conclusions can be drawn.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Master Coordinator:

dr. M. Hoogendoorn
 K room T-333
 T +31 (0) 20 598 7772
 E m.hoogendoorn@few.vu.nl

Opleidingsdelen:

- [Constrained Choice Mathematics](#)
- [Compulsory Optional Courses Theoretical Computer Science \(6EC\)](#)
- [Constrained Choice Software Engineering \(6EC\)](#)
- [Recommended optional Courses](#)
- [Compulsory Courses](#)
- [Mastercore](#)

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Compulsory Optional Courses Theoretical Computer Science (6EC)

Compulsory choice Theoretical Computer Science at least 6 credits, recommended are the courses below.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103
Distributed Algorithms	Periode 2	6.0	X_400211
Logical Verification	Periode 5	6.0	X_400115

Constrained Choice Software Engineering (6EC)

Vakken:

Naam	Periode	Credits	Code
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Recommended optional Courses

Vakken:

Naam	Periode	Credits	Code
Binary and Malware Analysis	Periode 1	6.0	X_405100
Data Mining Techniques	Periode 5	6.0	X_400108
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Internet programming	Periode 1	6.0	X_405082
Literature Study	Ac. Jaar (september)	6.0	X_400277
Multimedia Authoring	Periode 1	6.0	X_405098
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Performance of Networked Systems	Periode 4	6.0	X_405105
Scientific Writing in English	Periode 2, Periode 6	3.0	X_400592
Serious Games	Periode 1	6.0	X_405097
Systems Security	Periode 4	6.0	X_405108

Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Distributed Systems	Periode 2	6.0	X_400130
Evolutionary Computing	Periode 1	6.0	X_400111
Intelligent Web Applications	Periode 4	6.0	X_405055
Knowledge Engineering	Periode 2+3	6.0	X_405099
Model-based Intelligent Environments	Periode 1	6.0	X_405056
Neurale Netwerken	Periode 1	6.0	X_400132

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Research Variant Computer Systems and Security

Opleidingsdelen:

- [Suggested elective Courses \(18EC\)](#)
- [Constrained Choice Mathematics](#)
- [Recommended optional Courses](#)
- [Compulsory Courses](#)
- [Mastercore](#)

Suggested elective Courses (18EC)

Opleidingsdelen:

- [Suggested elective courses Foundations of Computing and Concurrency](#)
- [Suggested elective courses Programming](#)
- [Suggested elective courses Software Engineering](#)

Suggested elective courses Foundations of Computing and Concurrency

Compulsory choice Theoretical Computer Science at least 6 credits, recommended are the courses below.

Opleidingsdelen:

- [Choice 1 of 2](#)
- [Choice 1 of 2](#)

Vakken:

Naam	Periode	Credits	Code
Advanced Logic	Periode 4	6.0	X_405048
Distributed Algorithms	Periode 2	6.0	X_400211
Recursion Theory	Periode 1	6.0	X_400534

Choice 1 of 2

Vakken:

Naam	Periode	Credits	Code
Concurrency and Multithreading	Periode 1	6.0	X_405064
Concurrency Theory	Periode 1	6.0	X_418103

Choice 1 of 2

Vakken:

Naam	Periode	Credits	Code
Logical Verification	Periode 5	6.0	X_400115
Protocol Validation	Periode 5	6.0	X_400117

Suggested elective courses Programming

Each student must follow at least one of the following programming-related courses

Vakken:

Naam	Periode	Credits	Code
Computer Networks Practical	Periode 5+6	6.0	X_405072
Individual Systems Practical	Ac. Jaar (september)	6.0	X_405088
Internet programming	Periode 1	6.0	X_405082
Operating Systems Practical	Periode 5+6	6.0	X_405071
Parallel Programming Practical	Periode 2+3	6.0	X_400162

Suggested elective courses Software Engineering

Each student must follow at least 6EC from the core track courses of Track Software Engineering

Vakken:

Naam	Periode	Credits	Code
Service Oriented Design	Periode 1	6.0	X_405061
Software Architectuur	Periode 2	6.0	X_400170
Software Asset Management	Periode 1	6.0	X_400412
Software Testing	Periode 4	6.0	X_400439

Constrained Choice Mathematics

Compulsory choice of at least one Mathematics course of 6 credits, recommended are the courses below.

Vakken:

Naam	Periode	Credits	Code
Coding and Cryptography	Periode 1	6.0	X_405041
Experimental Design and Data Analysis	Periode 5	6.0	X_405078

Recommended optional Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Selforganisation	Periode 2	6.0	X_400434
Computer Networking	Periode 4	6.0	X_418102
Data Mining Techniques	Periode 5	6.0	X_400108
Developing Services for the Cloud	Periode 3	6.0	X_405074
Evolutionary Computing	Periode 1	6.0	X_400111
ICT4D: Information and communication technology for Development	Periode 5	6.0	X_405101
Industrial Internship	Ac. Jaar (september)	6.0	X_405080
Intelligent Web Applications	Periode 4	6.0	X_405055
Knowledge and Media	Periode 1	6.0	X_405065
Knowledge Engineering	Periode 2+3	6.0	X_405099
Lambda Calculus	Periode 2	6.0	X_418108

Large-Scale Computing Infrastructures	Periode 5	6.0	X_405106
Multimedia Authoring	Periode 1	6.0	X_405098
Neurale Netwerken	Periode 1	6.0	X_400132
Operating Systems	Periode 5	6.0	X_405067
Parallel Programming for High-performance Applications	Periode 1	6.0	X_400161
Performance of Networked Systems	Periode 4	6.0	X_405105
The Social Web	Periode 4	6.0	X_405086

Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Advanced Topics in Computer Networks	Periode 5	6.0	X_418112
Advances in Computer Architecture	Periode 1	6.0	X_418047
Binary and Malware Analysis	Periode 1	6.0	X_405100
Distributed Systems	Periode 2	6.0	X_400130
Programming Concurrent Systems	Periode 2	6.0	X_418109
Systems Security	Periode 4	6.0	X_405108

Mastercore

Vakken:

Naam	Periode	Credits	Code
History of digital cultures	Periode 3	6.0	X_418107
Master Project	Ac. Jaar (september)	36.0	X_400442
Seminar	Ac. Jaar (september)	6.0	X_405111

Expired courses

The course modules presented in the list below will no longer be offered in academic year 2014-2015.

Vakken:

Naam	Periode	Credits	Code
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Business Semantics	Periode 5	6.0	X_405079
Literature Study	Ac. Jaar (september)	6.0	X_400277

Advanced Logic

Vakcode	X_405048 (405048)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. R.D.A. Hendriks
Docent(en)	dr. R.D.A. Hendriks
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak

The objective is to obtain a good understanding of modal logic and its use in computer science and artificial intelligence.

Inhoud vak

A thorough introduction to modal logics, and its applications in computer science and artificial intelligence. We will select some themes from the book *Modal Logics for Open Minds*, by Johan van Benthem: basic modal logic and possible world semantics, bisimulation and invariance, modal definability, decidability, ... In particular we treat the modal logics most relevant to computer science and AI: temporal, dynamic and epistemic logic.

Onderwijsvorm

Weekly 2 lectures and 1 exercise class, for the duration of 7 weeks.

Toetsvorm

A written exam and assignments that can make half a point bonus.

Literatuur

Johan van Benthem, *Modal Logics for Open Minds*, CSLI Publications 2010.

Aanbevolen voorkennis

The bachelor course *Logica en Modelleren* (previously *Inleiding Logica*), or an equivalent introduction to first-order logic.

Doelgroep

mAI, mCS, mPDCS

Advanced Selforganisation

Vakcode	X_400434 (400434)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M.C. Schut

Docent(en)	dr. M.C. Schut
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

To understand, simulate and analyse the behaviour and self-organization of complex systems. The student is able to explain, implement and recognize basic principles and properties of such systems.

Inhoud vak

This course is about the understanding of the behavior and self-organization of complex systems: systems in which the interaction of the components is not simply reducible to the properties of the components. The general question we address is: how should systems of very many independent computational (e.g. robotic or software) agents cooperate in order to process information and achieve their goals, in a way that is efficient, self-optimizing, adaptive, and robust in the face of damage or attack? We will look at natural systems that solve some of the same problems that we want to solve, e.g. adaptive path minimization by ants, wasp and termite nest building, army ant raiding, fish schooling and bird flocking, coordinated cooperation in slime molds, synchronized firefly flashing, evolution by natural selection, game theory and the evolution of cooperation. The course includes a practical part in which students implement a simulation of a self-organizing complex system and conduct structured experimental analysis with this simulation.

Onderwijsvorm

Theory in lectures and practice in labs.

Toetsvorm

Report including description of simulation and experimental analysis.

Literatuur

Schut M.C., Scientific Handbook for Simulation of Collective Intelligence, 2007. Will be distributed in class.

Doelgroep

mAI, mBA, mCS, mPDCS

Overige informatie

More information available on BlackBoard. This is a project-oriented course and therefore students will be expected to have basic programming skills.

Advanced Topics in Computer Networks

Vakcode	X_418112 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/741751.html>

Overige informatie

Registration is required via <https://www.sis.uva.nl> until four weeks before the start of the semester.

Advances in Computer Architecture

Vakcode	X_418047 (418047)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Lesmethode(n)	Hoorcollege, Computerpracticum, Werkcollege
Niveau	500

Inhoud vak

The course description is available on:

<http://studiegids.uva.nl/web/uva/sgs/en/c/2018.html>

Doelgroep

mCS

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Binary and Malware Analysis

Vakcode	X_405100 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. J.M. Slowinska
Docent(en)	prof. dr. ir. H.J. Bos, dr. J.M. Slowinska
Lesmethode(n)	Hoorcollege
Niveau	600

Doel vak

Deepening insights in static and dynamic analysis, applied to binaries and malware

Inhoud vak

Binaries in general, and malware in particular, are very hard to analyse. Unlike with source code, you have no idea what the binary does, or even what the data structures look like - let alone what they mean!. Security analysts, forensic experts, and reverse engineers often have to dig their way through such programs to figure out what the code is all about, and where the interesting pieces of information are.

How do they do this? What techniques and tools can they fall back on, and, conversely, what techniques do the malware authors use to prevent

this?

This is a (tough) hands-on specialisation course for a small group of motivated students, who will learn essential analysis techniques and methods in both static and dynamic analysis. Not only will they pick apart real malware, they will also be working on a set of cool and very complicated challenges to find a secret buried deep inside a binary program.

For static analysis, we will look in depth at the generation of control flow graphs, and complications that may arise due to indirect calls and jumps (as well as deliberate obfuscation). For dynamic analysis, we will look at data and control flow tracking (dynamic information flow tracking)

Binary patching will be used to circumvent the binary's defenses. To do so, students need to know details about popular binary formats (ELF, PE, etc.), and work with all manner of state-of-art system tools to analyse the binaries (think IDA Pro, OllyDbg, taint analysis tools, etc.).

In addition, students will be exposed to programs that actively fight static and dynamic analysis.

Onderwijsvorm

Hoorcollege and practical

Literatuur

Slides and online material

Doelgroep

mCS-HPDC, mCS-IWT, mPDCS

Business Semantics

Vakcode	X_405079 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. P.G.M. De Leenheer
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Overige informatie

This course will no longer be offered in academic year 2013-2014.

For further information please contact Otto Schrofer

(Otto.Schrofer@vu.nl)

Coding and Cryptography

Vakcode	X_405041 (405041)
Periode	Periode 1
Credits	6.0
Voertaal	Engels

Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. R.M.H. de Jeu
Examinator	prof. dr. R.M.H. de Jeu
Docent(en)	prof. dr. R.M.H. de Jeu
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

To give an introduction the theory of error correcting codes and to cryptography.

Inhoud vak

This course provides a thorough introduction to the theory of error correcting codes, and to cryptography. It is aimed especially at students of Computer Science. For error correcting codes we shall include cyclic codes, BCH codes, Reed-Solomon codes and burst error correction. For cryptography we discuss some modern public key cryptography (e.g., RSA, ElGamal, DSA).

Onderwijsvorm

Lectures and exercise classes

Toetsvorm

Written exam and homework

Literatuur

We shall be working from "Coding theory and cryptography, the essentials" by Hankerson, Hoffman, Leonard, Lindner, Phelps, Rodger and Wall (second edition, revised and expanded).

Aanbevolen voorkennis

Some knowledge on linear algebra, on the integers modulo n , and on polynomials.

Doelgroep

mAI, mCS, mMath, mPDCS

Computer Networking

Vakcode	X_418102 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	O.W. Schrofer
Lesmethode(n)	Hoorcollege
Niveau	400

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/12057.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Computer Networks Practical

Vakcode	X_405072 (405072)
Periode	Periode 5+6
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. S. Voulgaris
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Put concepts of Computer Networks and Operating Systems into practice, in the context of smartphones.

Inhoud vak

This is a (tough) lab course, that involves low-level programming on Android smartphones. It requires very thorough understanding of operating systems and network concepts. It is done either individually or in groups of two.

Onderwijsvorm

Practical computer work

Toetsvorm

Practical computer work

Aanbevolen voorkennis

Computer Networks (X_400487)

Operating Systems (X_400011)

Good knowledge of Java!

Doelgroep

mCS-CSS, mCS-FCC, mCS-HPC, mCS-IWT, mPDCS

Concurrency and Multithreading

Vakcode	X_405064 (405064)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. W.J. Fokkink
Examinator	prof. dr. W.J. Fokkink
Docent(en)	prof. dr. W.J. Fokkink
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak

This course provides a comprehensive presentation of the foundations and programming principles for multicore machines.

Inhoud vak

Shared memory, mutual exclusion, synchronization operations, concurrent data structures, scheduling, transactional memory, multithreaded programming.

Onderwijsvorm

Lectures: 4 hours per week, exercise classes: 4 hours per week.

Toetsvorm

Written exam (which counts for 70% of the final mark) and one programming assignment (which counts for 30% of the final mark).

Literatuur

Maurice Herlihy, Nir Shavit, The Art of Multiprocessor Programming, Morgan Kaufmann, 2008.

Doelgroep

mAI-CIS, mAI-KTIIA, mAI-TAI, mCS-FMSV, mCS-HPDC, mCS-IWT, mCS-MM, mCS-SE, mCS-TAI, mPDCS

Overige informatie

The homepage of the course is at <http://www.cs.vu.nl/~tcs/cm/>

The lectures and written exam of the BSc and MSc variant of Concurrency and Multithreading coincide. The difference is that the BSc variant has a smaller programming assignment than the MSc variant.

The MSc variant of this course cannot be followed by students that included the BSc variant in their BSc program.

Concurrency Theory

Vakcode	X_418103 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	O.W. Schrofer
Lesmethode(n)	Hoorcollege, Werkcollege, Computerpracticum
Niveau	600

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/2090.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Concurrent System Design by Abstraction

Vakcode	X_418104 ()
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	O.W. Schrofer
Lesmethode(n)	Hoorcollege
Niveau	600

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/12922.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Data Mining Techniques

Vakcode	X_400108 (400108)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M. Hoogendoorn
Docent(en)	dr. M. Hoogendoorn
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

The aim of the course is that students acquire data mining knowledge and skills that they can apply in a business environment. How the aims are to be achieved: Students will acquire knowledge and skills mainly through the following: an overview of the most common data mining algorithms and techniques (in lectures), a survey of typical and interesting data mining applications, and practical assignments to gain "hands on" experience. The application of skills in a business environment will be simulated through various assignments of the course.

Inhoud vak

The course will provide a survey of basic data mining techniques and their applications for solving real life problems. After a general introduction to Data Mining we will discuss some "classical" algorithms like Naive Bayes, Decision Trees, Association Rules, etc., and some recently discovered methods such as boosting, Support Vector Machines, and co-learning. A number of successful applications of data mining will also be discussed: marketing, fraud detection, text and Web mining, possibly bioinformatics. In addition to lectures, there will be an extensive practical part, where students will experiment with various data mining algorithms and data sets. The grade for the course will be based on these practical assignments (i.e., there will be no final examination).

Onderwijsvorm

Lectures and compulsory practical work. Lectures are planned to be interactive: there will be small questions, one-minute discussions, etc.

Toetsvorm

Practical assignments (i.e. there is no exam). There will be three assignments mostly done in groups of three. There is a possibility to get a grade without doing these assignments: to do a real research project instead (which will most likely to involve more work, but it can also be more rewarding).

Literatuur

Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques (Third Edition). Morgan Kaufmann, January 2011
ISBN 978-0-12-374856-0

Aanbevolen voorkennis

Kansrekening en Statistiek of Algemene Statistiek (knowledge of statistics and probabilities) or equivalent. Recommended: Machine Learning.

Doelgroep

mBA, mCS, mAI, mBio

Developing Services for the Cloud

Vakcode	X_405074 ()
Periode	Periode 3
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. P. Lago
Docent(en)	dr. P. Lago
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Learn how to design and implement software services by using modern technologies and development environments; transforming SoaML models into code, experience implementation challenges of software services; troubleshooting in teams; deployment in the cloud.

Inhoud vak

Both service oriented computing and cloud computing are booming areas of rapid development and adoption. This module addresses major related technical aspects including how to transform a service oriented design into service implementations, how to deploy them in a remote cloud environment, how to effectively and critically use development tools. Group work and active participation is an essential part of the classes. form of tuition: Lectures and group work.

Onderwijsvorm

HC, WC, PR

Toetsvorm

Final presentation with demo. Teamwork.

Literatuur

Material distributed by lecturers.

Vereiste voorkennis

Service Oriented Design (X_405061).

Aanbevolen voorkennis

Knowledge of UML and SoaML; software engineering and Java programming.

Doelgroep

mCS-SE, mCS-IWT

Overige informatie

Applications must be sent to the coordinator at least four weeks before the module starts. The module will accommodate a limited number of students. Attendance is compulsory (all students bring their laptop!).

The students attending the module will be instructed to prepare required input material before the module starts.

Distributed Algorithms

Vakcode	X_400211 (400211)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. W.J. Fokkink
Docent(en)	prof. dr. W.J. Fokkink
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak

To obtain a good understanding of concurrency concepts and a large range of distributed algorithms.

Inhoud vak

Snapshots, graph traversal, termination detection, garbage collection, deadlock detection, routing, election, minimal spanning trees, anonymous networks, fault tolerance, failure detection, synchronization, consensus, mutual exclusion, self-stabilization, on-line scheduling.

Onderwijsvorm

4 hours per week HC

4 hours per week WC

Toetsvorm

Written examen (plus a take-home exercise sheet that can provide up to 0.5 bonus point).

Literatuur

Doelgroep

mAI, mCS, mPDCS

Overige informatie

The homepage of the course is at <http://www.cs.vu.nl/~tcs/da/>

Distributed Systems

Vakcode	X_400130 (400130)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ing. T. Kielmann
Docent(en)	dr. ing. T. Kielmann
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

After taking this course, you will be able to:

- understand to a large extent the intricacies related to designing and developing a distributed computer system.
- understand the tradeoffs between centralized, distributed, and fully decentralized solutions.
- be capable of successfully studying research papers on (advanced) distributed systems.

Inhoud vak

It is difficult to imagine a standalone modern computer system: every such system is one way or the other connected through a communication network with other computer systems. A collection of networked computer systems is generally referred to as a distributed (computer) system. As with any computer system, we expect a distributed system to simply work, and often even behave as if it were a single computer system. In other words, we would generally like to see all the issues related to the fact that data, processes, and control are actually distributed across a network hidden behind well-defined and properly implemented interfaces. Unfortunately, life is not that easy.

As it turns out, distributed systems time and again exhibit emergent behavior that is difficult to understand by simply looking at individual components. In fact, many aspects of a distributed system cannot even be confined to a few components, as is easily seen by just considering security.

In this course, we pay attention to the pillars on which modern distributed systems are built. Unfortunately, these pillars cannot be viewed independently from each other: each one is equally important for understanding why a distributed system behaves the way it does,

and depends on the way that other pillars have been constructed. In this sense, pillars form principles, in turn offering a view that one can take when studying distributed systems. We will consider the following principles:

- architectures
- processes
- communication
- naming
- coordination
- consistency and replication
- fault tolerance
- security

These principles will be discussed in the context of a few simplifying concepts that have been used to master the complexity of developing distributed systems: objects, files, documents, and events.

Onderwijsvorm

The course is taught as a series of lectures.

Toetsvorm

There is a written exam.

Literatuur

Andrew S. Tanenbaum, Maarten van Steen, "Distributed Systems, Principles and Paradigms", 2nd edition, Prentice-Hall (2007).

Vereiste voorkennis

Students should have taken a standard course on computer networks. Experience with (distributed) programming will be helpful.

Doelgroep

mCS, mPDCS, mAI, mIS

Evolutionary Computing

Vakcode	X_400111 (400111)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.E. Eiben
Docent(en)	prof. dr. A.E. Eiben
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

To learn about computational methods based on Darwinian principles of evolution. To illustrate the usage of such methods as problem solvers and as simulation, respectively modelling tools. To gain hands-on experience in performing experiments.

Inhoud vak

The course is treating various algorithms based on the Darwinian evolution theory. Driven by natural selection (survival of the fittest), an evolution process is being emulated and solutions for a given problem are being "bred". During this course all "dialects" within evolutionary computing are treated (genetic algorithms, evolutiestrategieën, evolutionary programming, genetic programming, and classifier systems). Applications in optimisation, constraint handling and machine learning are discussed. Specific subjects handled include: various genetic structures (representations), selection techniques, sexual and asexual genetic operators, (self-)adaptivity. If time permits, subjects in Artificial Life and Evolutionary Robotics will be handled. Hands-on-experience is gained by a compulsory programming assignment.

Onderwijsvorm

Oral lectures and compulsory programming assignment.

Toetsvorm

Written exam and programming assignment (weighted average).

Literatuur

Eiben, A.E., Smith, J.E., Introduction to Evolutionary Computing. Springer, 2003 ISBN 3-540-40184-9.
 Slides available from <http://www.cs.vu.nl/~gusz/ecbook/ecbook.html> .

Doelgroep

mBA, mAI, mCS, mPDCS

Experimental Design and Data Analysis

Vakcode	X_405078 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. E.N. Belitser
Docent(en)	dr. E.N. Belitser
Lesmethode(n)	Hoorcollege, Practicum
Niveau	400

Doel vak

In this course the student is acquainted with the most common experimental designs and regression models. Furthermore nonparametric tests and bootstrap methods are discussed. On completion of this course the student is able to:

- design experiments and analyse the results according to the design
- analyse data using the common anova designs
- analyse data using linear regression or a generalized linear regression model
- perform basic nonparametric tests
- perform bootstrap and permutation tests

Inhoud vak

Regression models try to explain or predict a dependent variable using measured independent variables. Statistical methods are needed if there

is random variation in the dependent variables. We will discuss multiple linear regression, analyses of variance (ANOVA), generalized linear regression models. All methods will be illustrated with practical examples. Especially in the case of ANOVA it is necessary that the study is well designed in order to draw sound conclusions from an experiment or survey. In this course a few well known designs (completely randomized, randomized block etc.) and the associated analyses of variance are discussed. The remainder of the course is dedicated to non-parametric testing methods and bootstrap methods:

- Wilcoxon test for (one and two samples)
- Kolmogorov-Smirnov test (two samples)
- rank correlation tests
- permutation and bootstrap tests

All analyses are carried out by a computer package, for which we need to know code but no formulas.

Onderwijsvorm

Lectures, computer class, discussion of the computer assignments.

Toetsvorm

Weekly computer assignments and final assignment. The final grade is based on the written reports of all these assignments.

Literatuur

literature (course reading)

- slides of the lectures;
- R manual;
- assignments;

For background reading one may look at:

- A first course in the design of experiments; a linear models approach, D.C. Weber and J.H. Skillings (focussing mostly on the mathematics)
- Linear models with R, J.J. Faraway (emphasis on the implementation in R)
- Extending the linear model with R, J.J. Faraway (emphasis on the implementation in R)

Aanbevolen voorkennis

introductory statistics. e.g. Empirical Methods

Doelgroep

mAI, mCS

Overige informatie

All assignments are to be solved using the statistical package R

(<http://www.r-project.org/>)

History of digital cultures

Vakcode	X_418107 ()
Periode	Periode 3
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	O.W. Schrofer
Niveau	400

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/14066.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

ICT4D: Information and communication technology for Development

Vakcode	X_405101 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. K.S. Schlobach
Docent(en)	dr. K.S. Schlobach
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak

In the developed world Computers are ubiquitous, and ICT has rapidly grown into a critical asset for economic, technological, scientific and societal progress. The main objectives of this course are:

1) to make the next generation of Computer Scientists aware of:

a) The importance of ICTs for the developing world and the unexpected way developing countries are leapfrogging into the information age

b) The opportunities and challenges that exist for an information scientist in the area of 'development4development'

c) The influence of context in a typical ICT4D project

d) The complexity of deploying an ICT project within a development context, and how to tackle this.

2) to equip the students with some initial project management, technological and programming skills specific to an ICT deployment in a developing country.

Positioned at the heart of the VU's vision of social relevance as one of the guiding principles, the core aim of the course is to raise the awareness that we as Computer Scientists can make a significant difference by sharing our expertise according to well established principles of international development.

Inhoud vak

The course will be given jointly by the Department of Computer Science and the Center for International Cooperation, and will consist of 4 modules: two practical ones, and two theoretical ones.

1) Analysing a development problem (CIS): this theoretical module will introduce the analytical methods required for an indepth understanding of a potential development support project. A number of invited speakers will introduce general requirements and strategies, as well as more focused on a particular potential project.

2) Developing a deployment plan (CIS): in this practical module the students will have to produce a specific deployment plan for an ICT project in a developing country.

3) From plan to project (CS): this theoretical module will provide

some initial technological knowledge required for running an ICT project in a developing country. It will give an overview over technology already applied, such as specific networks, connection types, hardware as well as specific software environments, but also introduce basic concepts in project management for ICT projects.

4) Turn projects into tools (CS): In this practical module the students will actually build a set of deployment tools according to the conditions specified in their deployment plan, including building the required infrastructure, setting up hardware, writing and installing required software, including appropriate documentation and user guidance.

Depending on current actual collaborations of CIS and the CS department a specific type of deployment will be chosen. Examination will be via 2 projects related to those concrete deployment activities of ICT in the development context

Onderwijsvorm

The course will be a combination of lectures (first 4 weeks) and project work (weeks 5-8).

Literatuur

Collection of papers.

Doelgroep

mAI, mCS

Individual Systems Practical

Vakcode	X_405088 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. S. Voulgaris
Niveau	500

Doel vak

Give very motivated students the opportunity to work on challenging, research-oriented projects, with a strong focus on serious systems work.

Inhoud vak

The content is to be negotiated individually with the professor supervising and grading it. Agreeing with a professor at the VU is absolutely necessary *before* the project starts. Showing up in retrospect, trying to earn some credits for work you did last summer or on a side-job, will certainly not qualify.

Only a few students (the ones that come up with a convincing project proposal) will be allowed to do it. Proposals that are not challenging enough, are not deep into systems work, or their nature prevents the clear assessment of the student's own contribution, will be declined.

Toetsvorm

Supervised systems work.

Doelgroep
mCS, mPDCS

Industrial Internship

Vakcode	X_405080 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ing. T. Kielmann
Niveau	500

Doel vak

Deepening insights by applying study contents in an industrial setting

Inhoud vak

Individual project work by which the student applies the study contents in an industrial setting. Before the start of the internship, the student has to get approval for the internship project by a VU Computer Science lecturer. The project has to focus on research or development aspects, by which the student can apply and validate the study contents within the specific constraints of an industrial setting. At the end of the internship, the student submits a written report to the lecturer, in which the work, the lessons learned, and the insights from applying study contents in an industrial setting are described.

Onderwijsvorm

individual project work in an industrial setting

Toetsvorm

written report

Aanbevolen voorkennis

The student should have completed at least 48 credits of his or her Master programme such that there are sufficient study contents to be applied in an industrial setting.

Doelgroep
mCS, mPDCS

Overige informatie

Various lecturers

Intelligent Web Applications

Vakcode	X_405055 (405055)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. A. Loizou
Docent(en)	dr. A. Loizou, dr. R.J. Hoekstra

Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

The aim of this course is to familiarize students with the technologies of Web 2.0 and Web 3.0, the Semantic Web. At the end of the course, students will have the ability to build full-fledged Web applications that use external (Semantic) web services, and are driven by Artificial Intelligence reasoning.

Inhoud vak

The course is structured in two parts. The first part consists of classes and assignments that introduce the various technologies needed to build an Intelligent Web application. These technologies are HTTP, HTML, CSS, JavaScript, Ajax, Linked Data, RDF, RDFS, OWL, SPARQL.

During the second part of the course, students work together in small groups to build a real Intelligent Web application.

Onderwijsvorm

There will be lectures and more hands-on interactive sessions where we show how the technologies are used, plus significant time for self-study and practical work. During the last weeks of the course, there will be no lectures as students will work on projects.

Toetsvorm

3 Individual Assignments:

- Information access and presentation
- Information integration and reasoning
- Project proposal report

Group project: Develop an Intelligent Web Application

Literatuur

General technical documentation, selected suggested literature.

Aanbevolen voorkennis

Familiarity with Web technology, and Semantic Web technology is an advantage, but not a strict requirement.

Internet programming

Vakcode	X_405082 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. S. Voulgaris
Examinator	dr. S. Voulgaris
Docent(en)	dr. S. Voulgaris
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Guide the student through the design and development of Network and Web applications.

Inhoud vak

The course discusses the principles for understanding, designing, and developing Internet applications. This includes programming the network (sockets, threads, RPC, RMI), programming the web interface (servlets, PHP, Javascript, AJAX), and setting up secure communication channels. Throughout the course, as well as in the context of the lab assignments, attention is paid to practical issues of applying these concepts.

Onderwijsvorm

Lectures combined with lab assignments

Toetsvorm

Final exam plus lab assignments

Literatuur

Course slides

Vereiste voorkennis

Knowledge of C, Java

Aanbevolen voorkennis

Good knowledge of both C and Java

Doelgroep

mAI, mCS, mPDCS

Introduction to Computational Science

Vakcode	X_418111 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/nl/c/10256.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Knowledge and Media

Vakcode	X_405065 (405065)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	P.T. Groth

Docent(en)	prof. dr. A.T. Schreiber
Lesmethode(n)	Werkcollege
Niveau	500

Doel vak

The goal of the course is to provide insight in the concepts of knowledge, ontologies and knowledge processes in relation to various ICT-based media.

Inhoud vak

This course treats the principles and theories that form the foundation of knowledge-intensive processes in relation to various multi-media applications. Knowledge processes are those processes that use knowledge (reasoning), document knowledge (representation), acquire knowledge or transfer knowledge (teaching). The relation between knowledge processes and (interactive) media will be explored. Various types of applications will be discussed, such as special purpose search engines, educational systems, serious gaming and mind tools.

Onderwijsvorm

Working lectures

Toetsvorm

Portfolio

Literatuur

Articles distributed through Blackboard

Doelgroep

UvA students and optional course for mCS, mAI and mIS

Knowledge Engineering

Vakcode	X_405099 ()
Periode	Periode 2+3
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. A.C.M. ten Teije
Docent(en)	dr. A.C.M. ten Teije
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

goals:

- 1) to be able to elicitate knowledge from experts by using several elicitation techniques
- 2) to be able to build all CommonKads models that play a role in the development of a knowledge based system, this includes the context of the KBS and the expertise model based
- 3) to be able to implement the expertise model as a prototype
- 4) to be able to reflect on your own process of modelling and building a knowledge based system, and to reflect on your product (=which are the models and the implementation)

Inhoud vak

Knowledge Engineering is a discipline that involves integrating knowledge into a program for solving a complex problem, which requires human expertise. Typical tasks are classification, diagnosis, planning etc. In the course we use CommonKADS as the methodology for the process of modeling the organisation, the context and the knowledge intensive tasks.

This methodology give clear guidelines and concrete templates for modeling the organisational aspects and the expertise model, which is the core model of knowledge based system. The notion of pattern-based knowledge modeling is a key issue in the knowledge modelling process.

The goal of the final project is to perform the entire knowledge technology process for a knowledge intensive problem of your own choosing, starting with context analysis, up to a (partial) implementation of the knowledge based system.

Onderwijsvorm

Lectures, assignments, group project

Toetsvorm

Assignment, project reports.

Literatuur

Schreiber, Akkermans, Anjewierden, de Hoog, Shadbolt, van de Velde, Wielinga: Knowledge Engineering & Management. The MIT Press, Cambridge MA, 2000, ISBN 0-262-19300-0.

Doelgroep

mAI, mIS, mCS-TAI

Lambda Calculus

Vakcode	X_418108 ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/en/c/2044.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Large-Scale Computing Infrastructures

Vakcode	X_405106 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ing. T. Kielmann

Docent(en)	dr. ing. T. Kielmann
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Students explore the field of large-scale computing infrastructures. They study its technological frontiers from scientific publications and get hands-on experience via programming assignments.

Inhoud vak

Cloud infrastructures like Amazon's EC2 or Microsoft's Azure provide seemingly limitless compute and storage capacity. The technology underlying these systems strongly relies on decades of work on high-performance computing platforms, such as cluster computing, computing grids, and supercomputers. We study aspects of computing in large scale, such as resource management and scheduling, remote data access, energy efficiency, failure resilience, performance of large systems, as well as suitable software architecture and programming models such as Map/Reduce.

Onderwijsvorm

Introductory lectures, followed by a seminar part and practical programming assignments. In the seminar part, students explore the technological frontiers of large-scale computing, published in top-quality scientific venues of the field. Students present their findings and write position papers about topics presented by other students in the class. With the practical programming assignments, students get hands-on experience with large-scale computing infrastructures.

Toetsvorm

Both parts contribute 50% each to the grade:

- seminar presentation and position paper
- programming assignments

Literatuur

Various scientific articles as available online

Aanbevolen voorkennis

Students should have basic knowledge about distributed systems and parallel application programming. Students must be able to program in Java and Python (or be able to get the needed skills on the fly).

Doelgroep

mPDCS, mCS

Literature Study

Vakcode	X_400277 (400277)
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Coördinator	dr. B. Crispo
Niveau	400

Inhoud vak

This course is only available for students of the Master Computer Science who started their program prior to the academic year 2013-2014.

As the title says the course consists of carrying out a literature study on a topic chose in agreement with your supervisor. Select a topic of your interest or a course that you particularly like. Contact the the person in charge of the research area/course you picked and discuss with him/her the possibility to carry out a literature study under his/her supervision. Once agreed on the topic the study is articulated in three phases:

1. You have, independently without help of your supervisor, to conduct a search of related bibliographic material (i.e. papers, reports, etc.)
2. Prepare a slide-show (using any technology and/or tool you feel more appropriate) that introduces the topic to an audience of computer scientist that are however not necessarily expert on the topic presented. Following the introduction the presentation should illustrate and explain the findings of your study.
3. Give a conference-style talk to present the content of your study supported by the slides you just prepared. The talk will be given to an audience of CS Master students and possibly scientific staff. The presentation will last 20 minutes with an additional time of 5-10 minutes for questions.
4. Write an essay (4/5 pages) reporting the findings of your study. You have to contact the teacher to arrange the schedule of your talk or for any further information about procedural matters. The presence of your supervisor at the talk is very welcome but not required.

Toetsvorm

Presentation, essay and bibliography.

Grading: You will be graded with respect to your presentation in term of both technical content and presentation skills, to the bibliography you selected and to the essay you wrote. Each of these aspects will account for 1/3 of the final grade.

Doelgroep

mCS

Overige informatie

Period: Variable

01-09-2013: This course has expired. For information please contact Otto Schrofer
(otto.schrofer@vu.nl)

Logical Verification

Vakcode	X_400115 (400115)
Periode	Periode 5
Credits	6.0

Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. F. van Raamsdonk
Docent(en)	dr. F. van Raamsdonk
Lesmethode(n)	Hoorcollege, Practicum
Niveau	500

Doel vak

Introduction to the proof assistant Coq and its foundations

Inhoud vak

A proof-assistant is used to check the correctness of a specification of a program or the proof of a theorem. The course is concerned with the proof-assistant Coq which is based on typed lambda calculus. In the practical work, we learn to use Coq. One of the exercises is concerned with the correctness proof of the specification of a sorting algorithm, from which a functional program is extracted. In the course, we focus on the Curry-Howard-De Bruijn isomorphism between proofs on the one hand and lambda-terms (which can be seen as functional programs) on the other hand. This is the basis of proof-assistants like Coq. We study various typed lambda calculi and the corresponding logics.

Onderwijsvorm

2 hours theory class, 2 hours practical work

Toetsvorm

Written exam and obligatory Coq exercises

Literatuur

Course notes

Vereiste voorkennis

An introduction course in logic.

Doelgroep

mCS, mAI, mMath

Overige informatie

The course is taught once every two years, the next opportunity will be in study year 2014-2015

Master Project

Vakcode	X_400442 (400442)
Periode	Ac. Jaar (september)
Credits	36.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	500

Doel vak

The Master Project is the place in the study where scientific and professional skills are trained most extensively. The Master Project; will always involve an element of originality or creativity, for

example in performing a design task or in contributing to the solution or the analysis of a scientific problem. Other important elements of the Master Project are the cooperation with professionals and possibly with other students, planning the project, and documenting and presenting the final results.

Inhoud vak

The Master project concludes the Master programme. It is either in the form of a graduation project in one of the research groups of the Department of Computer Science, or as an internship in a company. In most cases it will be performed as an individual project but it can be a group project as well.

For additional information and rules we refer to the website of Exact Sciences.

There you will also find links to the web pages of the research groups of the Department of Computer Science, with options for master projects.

Onderwijsvorm

The Master Project has always to be supervised by a staff member, in the case of an internship in cooperation with a supervisor in the company. Internships proposed by the student him/herself need approval in advance from a member; of staff, who will cooperate with supervising the project.

Toetsvorm

The final grade will be based on the quality of the research, the written thesis and an oral presentation.

Doelgroep

mCS

Overige informatie

You will find useful documentation on all aspects of internships and the Master Project at the website of the Internship Office. This office; can give you als advise about internships.

Model-based Intelligent Environments

Vakcode	X_405056 (405056)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M.C.A. Klein
Docent(en)	prof. dr. J. Treur, dr. M.C.A. Klein, dr. T. Bosse
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

The student will understand different ways in which computerized models can be used in intelligent support systems, and will develop a prototype of such a system based on approaches described in the literature.

Inhoud vak

During their bachelor and first year of the master, students have learned to model human processes using different techniques and at different levels of abstraction. In addition, they have learned to use such models for analysis of situations and reasoning about effective support. In this course, the modeling knowledge will be further deepened and applied to a specific domain or scenario. Scientific literature and applications of model-based reasoning will be studied. The student will develop a prototype of an application based on models relevant for a scenario chosen by the student. By building this prototype, the student shows that he/she masters the modeling approaches and is able to apply this in a specific domain or scenario.

Onderwijsvorm

Lectures and project.

Toetsvorm

Assignments.

Literatuur

Papers

Aanbevolen voorkennis

Introduction to Modeling and Simulation, Integrative Modeling

Multimedia Authoring

Vakcode	X_405098 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.P.W. Eliens
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

The course gives a practical introduction to multimedia authoring, in particular the development of rich media web applications.

Inhoud vak

In the course an extensive introduction to the use of flex/as3 (a programmatic way to produce flash applications) is given. Topics treated include the construction of visual objects, animation, interaction, asset management, positioning of objects in 2D and 3D space. Also the use of images, video and sound to augment the users experience will be treated. Ample attention will be given to the programmatic issues, including scripting and components, needed for the development of interactive applications.

The assignments include a media viewer with annotation editor, and a rich media application of moderate complexity, dependent on the level and experience of the student(s).

Onderwijsvorm

lectures and practicum

Toetsvorm

practicum assignments

Literatuur

online syllabus

Doelgroep

mCS, mAI and interested students

Overige informatie

For course information and registration, see <http://www.cs.vu.nl/~eliens/mma>

Neurale Netwerken

Vakcode	X_400132 (400132)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M. Hoogendoorn
Examinator	dr. M. Hoogendoorn
Docent(en)	dr. M. Hoogendoorn
Lesmethode(n)	Hoorcollege, Practicum
Niveau	500

Doel vak

The course provides an introduction to key concepts and algorithms for pattern recognition and neural networks. It strives towards providing insight both from a theoretical perspective as well as more practical settings. In the end, the student should be able to confidently apply the aforementioned techniques in real-life settings and understand their theoretical basis.

Inhoud vak

The course provides an introduction to key concepts and algorithms for pattern recognition and neural networks. It covers the following topics:

- classification, regression, and clustering problems,
- elements of statistical pattern recognition,
- methods for estimation of probability distributions,
- linear classifiers, including Support Vector Machines,
- single-layer and multi-layer networks,
- RBF-networks and kernel methods
- methods for dimensionality reduction
- methods for feature extraction and selection

Moreover, several real-life applications of pattern recognition, including recognition of speech, handwritten characters, images, etc., will be discussed in depth.

Onderwijsvorm

Lectures and compulsory programming assignments.

Toetsvorm

Programming assignments and written examination (weighted average).

Literatuur

Simon Haykin, Neural Networks and Learning Machines, Pearson Education, 3rd international edition, 2008

Doelgroep

mAI mBio, mBA, mCS

Overige informatie

More information will be available via Blackboard.

Operating Systems

Vakcode	X_405067 (405067)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	C. Giuffrida
Docent(en)	dr. S. Voulgaris, C. Giuffrida
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

Get an insight into the internals of operating systems for single-processor machines.

Inhoud vak

This course gives an introduction to the internals of Operating Systems. The following topics are covered: processes, synchronization, memory allocation, multi-programming, input / output, protection. The course focuses on the MINIX operating system as a testbed for experimentation.

Onderwijsvorm

Lectures

Toetsvorm

Written exam

Literatuur

Tanenbaum, A.S., Woodhull, A.S., Operating Systems, "Design and Implementation 3rd edition". Prentice-Hall, 2006.

Overige informatie

Students who have included the course Bedrijfssystemen (X_400011) in their Bachelor's program must not follow this course for their Master's program.

Operating Systems Practical

Vakcode	X_405071 (405071)
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Periode	Periode 5+6
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	ir. M.P.H. Huntjens
Docent(en)	ir. M.P.H. Huntjens
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Gain practical experience with the contents of the Operating Systems course.

Inhoud vak

This practical is divided into two separate exercises, each adding functionality to a different part of the MINIX 3 operating system. Both exercises are required to pass the class. The first exercise adds kernel functionality (process profiling), the second one adds file system functionality (defragmentation). Together, these courses cover a significant part of the content of the Operating Systems course.

Onderwijsvorm

Practical computer work

Toetsvorm

Practical computer work.

Doelgroep

mCS, mPDCS

Overige informatie

Students who have not taken the "bedrijfssystemen" or "operating systems" course at the VU are strongly advised to follow the Operating Systems course or study the internals of MINIX 3 in detail before the start of the course. All information about the course is available online at <http://www.cs.vu.nl/~bs/>.

Parallel Programming for High-performance Applications

Vakcode	X_400161 (400161)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. ir. H.E. Bal
Docent(en)	prof. dr. ir. H.E. Bal
Lesmethode(n)	Hoorcollege
Niveau	400

Inhoud vak

This lecture discusses how programs can be written that run in parallel on a large number of processors, with the goal of reducing execution time. The class has a brief introduction into parallel computing systems (architectures). The focus of the class, however, is on programming methods, languages, and applications. Both traditional techniques (like message passing) and more advanced techniques (like parallel object-oriented languages) will be discussed. Several parallel applications are discussed, including N-body simulations and search algorithms. About 4-5 lectures are devoted to an important new development: programming many-core machines such as Graphical Processing Units (GPUs). The class fits well with existing research projects within the department of Computing Systems. It is a good basis for M.Sc. projects in the area of parallel programming, which use the parallel computing systems of the department.

Onderwijsvorm

Class with separate practicum (6 ECTS).

Toetsvorm

Written exam.

Literatuur

To be announced.

Vereiste voorkennis

Knowledge about the first part of the class Parallel Programming is recommended (introduction into parallel programming, MPI, and Java).

Doelgroep

mAI, mBIO, mCS, mPDCS

Parallel Programming Practical

Vakcode	X_400162 (400162)
Periode	Periode 2+3
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. ir. H.E. Bal
Docent(en)	prof. dr. ir. H.E. Bal
Lesmethode(n)	Hoorcollege
Niveau	500

Inhoud vak

With this practicum, several parallel programs have to be written, using different programming environments, including Java, MPI, and CUDA/OpenCL (for GPUs). The programs must be tested on a parallel machine of the faculty (see <http://www.cs.vu.nl/das4>) and the performance (speedups) of the programs must be measured, analyzed, and, whenever necessary, optimized. A brief report must be written that explains the approach and discusses the measurements.

Onderwijsvorm

Practical computer work.

Toetsvorm

Practical computer work.

Aanbevolen voorkennis

Parallel Programming Course.

Doelgroep

mAI, mCS, mPDCS

Performance of Networked Systems

Vakcode	X_405105 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. R.D. van der Mei
Docent(en)	dr. ing. T. Kielmann, prof. dr. R.D. van der Mei
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

The student will acquire basic knowledge of:

- performance aspects of software and hardware systems,
- performance aspects of networked systems and services,
- performance engineering principles and methods,
- quantitative models for predicting and optimizing the performance of networked systems,
- quantitative models planning capacity of networked systems.

The student will gain experience in engineering and planning performance of networked systems, and will learn how to tackle practical performance problems arising in the ICT industry.

Inhoud vak

Over the past few decades the use of information and communication technology (ICT) has been experiencing tremendous growth, which is not likely to slow down in the near future. As a consequence, our information and communication systems are expected to process huge amounts of (digital) information, which puts a tremendous burden on our ICT infrastructure. At the same time, our modern society has become largely dependent on the well-functioning of our ICT systems; large-scale system failures and perceivable Quality of Service (QoS) degradation may completely disrupt our daily lives and have huge impact on our economy. Motivated by this, the course will focus on the following performance related issues of networked systems:

- How can we design and engineer networked systems for performance?
- How can we plan capacity in networked systems?
- How can we predict and optimize the performance of networked systems?

In addition to basic theory of performance models and engineering for networked systems, the application of the theory to solve practical

problems will play a central role.

Onderwijsvorm

Classroom lectures and practical homework assignments.

Toetsvorm

The assessment will be based on both homework assignments and a written exam.

Literatuur

A textbook, supplemented with a number of subject-matter research papers.

Textbook:

D.A. Menasce, V.A.F. Almeida and L.W. Dowdy
Performance by Design - Computer Capacity Planning by Example
Prentice Hall PTR, Upper Saddle River, NJ 07458
ISBN 0-13-090673-5

Doelgroep

mBA, mCS, mPDCS, mEct

Programming Concurrent Systems

Vakcode	X_418109 ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Inhoud vak

<http://studiegids.uva.nl/web/uva/sgs/en/c/9475.html>

Overige informatie

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Project Multimedia

Vakcode	X_400358 (400358)
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.P.W. Eliens
Docent(en)	prof. dr. A.P.W. Eliens
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

To gain experience with aspects of multimedia or game development in a project setting.

Inhoud vak

Working in a group, with a clear target, such as the development of an educational game, has our preference. Subject and focus of the project will be determined for each student individually, together with the supervisor. Possible projects include: the development of a cultural heritage application, the animation of (intelligent) humanoids in a virtual environment, or the realization of real-time visual effects in 3D.

Onderwijsvorm

Project

Toetsvorm

Application with documentation

Literatuur

Online material

Doelgroep

mCS

Overige informatie

For information, see www.cs.vu.nl/~eliens/projects

Protocol Validation

Vakcode	X_400117 (400117)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Lesmethode(n)	Hoorcollege, Practicum, Werkcollege
Niveau	500

Doel vak

Learning to use formal techniques for specification and validation of communication protocols.

Inhoud vak

This course is concerned with the specification and validation of protocols, using formal methods. The course is based on a specification language based on process algebra combined with abstract data types, called mCRL. This language and its toolset can be used for the specification of parallel, communicating processes with data. Model checking is a method for expressing properties of concurrent finite-state systems, which can be checked automatically. Interesting properties of a specification are: "something bad will never happen" (safety), and "something good will eventually happen" (liveness). In the lab we will teach the use of a tool for automated verification of the required properties of a specification.

Onderwijsvorm

4 hours per week HC

4 hours per week WC/PR (mixed)

During the practicum the mCRL tool and the CADP model checker will be used for the validation of protocols discussed during lectures.

Toetsvorm

Written exam, together with a practical homework assignment. The overall mark of the course is $(H+2W)/3$, where H is the mark for the homework assignment, and W is the mark for the written exam.

Literatuur

Wan Fokkink, Modelling Distributed Systems, Springer 2007.

Aanbevolen voorkennis

Logica en Modelleren

Doelgroep

mAI-CIS, mAI-KTIIA, mAI-TAI, mCS-FMSV, mCS-HPDC, mCS-IWT, mCS-MM, mCS-SE, mCS-TAI, mPDCS

Overige informatie

The homepage of the course is at <http://www.cs.vu.nl/~tcs/pv/> This course is taught every other year. It will be given in the Spring of 2014.

Recursion Theory

Vakcode	X_400534 (400534)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	400

Inhoud vak

<http://studiegids.uva.nl/xmlpages/page/2014-2015-en/search-course/course/2050>

Overige informatie

Opgave via <https://www.sis.uva.nl> tot 4 weken voor aanvang van het semester is verplicht

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>

Scientific Writing in English

Vakcode	X_400592 (400592)
Periode	Periode 2, Periode 6
Credits	3.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	M. van den Hoorn
Lesmethode(n)	Hoorcollege, Werkcollege

Doel vak

The aim of this course is to provide the writing student with the essential linguistic means for producing English academic texts which are effective, idiomatically and stylistically appropriate and grammatically correct.

Inhoud vak

The initial focus in the course lies on the form of scientific texts in the Exact Sciences:

- Abstract (or summary)
- Introduction
- Methods
- Results
- Discussion

General course outline

Introducing the topics

- Academic and technical writing in English
- The characteristics of different kinds of scientific texts
- How scientific writing is judged and assessed
- Where do you find your information and how do you present it?
- How to avoid committing plagiarism

Who am I writing for? What do I want to say?

- Your readership
- Key parts of an academic article: title, abstract, introduction, methods, results and discussion

Writing the actual article

- Paragraph and sentence construction: how do I link paragraphs together?
- Writing simple and complex sentences. Active and passive sentences.
- Argumentation : how do I put an argument? How do I frame my own opinion?

Should I use "I" or "we"?

Writing correct English

- Use of apostrophes and colons
- Word order, verb tenses, time and tense
- Avoiding mistakes typically made by Dutch writers
- Common spelling mistakes

You will be making considerable use of peer assessment: examining fellow students' written work and giving them feedback. This method provides useful insights into how a text might be improved. The process of providing someone else with feedback on their text is something that you will find very instructive.

Onderwijsvorm

The course is focused on self-tuition. The plenary sessions concentrate on the process of writing and the product of writing. Homework is part of the course. With each topic, participants work through a phased series of exercises that usually conclude with the requirement to write a short piece of text. The instructor will append extensive written remarks to this text.

Toetsvorm

There will be no examination. However, students will receive their credits only when they have participated in all classes (presence is

obligatory) and also when they have handed in the assignments satisfactorily. Students will receive a 'pass' when they have finished the course.

Literatuur

For this course you need the book *Effective Scientific Writing: an advanced learner's guide to better English* (A. Bolt & W. Bruins, ISBN 978 90 8659 6171). This book can be obtained at the VU bookstore, which is located in the VU main building. The costs are € 27,95 per book. For questions contact the Taalcentrum-VU at 020 - 598 9804.

Vereiste voorkennis

Bachelor Exact Sciences

Doelgroep

Optional for mAI, mCS, mIS, mBIO, mPDCS, mCh, mDDS, mPhys.

Seminar

Vakcode	X_405111 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. B. Crispo
Docent(en)	dr. B. Crispo
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

The course consists of carrying out a literature study on a topic chosen in agreement with a selected tutor.

Inhoud vak

The theoretical preparation of the course consists of one lecture on literature study design, where the student learns how to formulate a research question, how to translate it into a sound search query, how to identify the right on-line literature search engines, and how to perform a motivated selection of the literature for further analysis.

The actual literature study starts with a 'preparation phase' in which the student must identify a topic of interest or a course particularly appreciated. Contact the person in charge of the research area/course you picked and discuss with him/her the possibility to carry out a literature study under his/her supervision.

The preparation phase should be carried out (preferably) before the theory lecture.

When ready, the 'execution phase' of the literature study consists of designing the literature study and executing it under the supervision of the tutor. The outcome of the literature study is a final report, which must include: study design; overview of selected literature; analysis of the literature; discussion and conclusions. At the end of this phase, the student gives one final presentation to the research group of the tutor.

Toetsvorm

Final report. Final presentation.

Grading criteria: quality of study design; rationale for literature selection; quality of results (scientific quality of the analysis, discussion of the findings, reflection in the drawn conclusions, clear answer to main research question); quality of technical report (clarity, organization); correctness and completeness of references and citations; final presentation to the research group where he/she carries out the literature study; this is at the end (to present the final results) and should include research questions, study design, study execution, and discussion of analysis

Serious Games

Vakcode	X_405097 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.P.W. Eliens
Docent(en)	prof. dr. A.P.W. Eliens
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

Serious games are more and more considered to be an effective means to bring about awareness, acquire skills, change behavior, and influence social patterns. With elementary game development technology, the students will explore the potential of serious games in a social context, using casual game mechanics, and what recently has been identified as the dynamics of gamification.

Inhoud vak

The course will cover the following topics:

- * an introduction to game design
- * practical skills in game development
- * game mechanics and scoring mechanisms
- * elementary game and utility theory
- * media & communication theory
- * game interaction patterns
- * practical applications of serious games

Students are required to work in teams of 2-4 people, with as a goal the actual development of a serious game, with social network support.

Onderwijsvorm

lectures and practicum

Toetsvorm

essay and practicum assignment(s)

Literatuur

online reference material(s)

Aanbevolen voorkennis

preferably, but not obligatory, project interactive multimedia and multimedia authoring

Doelgroep

choice for master students CS, IS, and others, with an interest in multimedia and game development

Overige informatie

The course will be given in english. For information, see: www.cs.vu.nl/~eliens/serious

Service Oriented Design

Vakcode	X_405061 (405061)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. P. Lago
Docent(en)	dr. P. Lago
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak

Learn advanced design techniques applicable to large service-oriented software systems. Be able to select among them and apply them for a specific system. Be able to reason about and assess the design decisions.

Inhoud vak

The lectures explain the concepts related to the Service Orientation software paradigm and Service Oriented Architecture (SOA). The lectures provide the students with knowledge about how to identify the requirements for a service-oriented software system, how to map them on business services and transform them into complex networks of software services. Special emphasis is given to the design reasoning techniques for crucial decision making, service identification, SOA design and migration. Each year experts from academia and industry are invited to give guest lectures.

The students participate in small teams to piecemeal develop understanding of various service-oriented aspects, and work on an assigned SOA design project.

Onderwijsvorm

Lectures and group work.

Toetsvorm

Written reports of the assignments. Teamwork.

Literatuur

Material handed out by the lecturer and on Blackboard.

Aanbevolen voorkennis

Software modeling experience (knowledge of UML and SoaML preferred).
Programming.

Doelgroep

mAI, mCS

Overige informatie

Registration for this course is compulsory four weeks prior to the start. Further information on this module will be made available on the Blackboard system <http://bb.vu.nl>.

Software Architectuur

Vakcode	X_400170 (400170)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. J.C. van Vliet
Docent(en)	prof. dr. J.C. van Vliet
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

Get acquainted with the field of software and information architecture.
Understand the drivers behind architectural decisions. Be able to develop and reason about an architecture of a non-trivial system.

Inhoud vak

Students work in groups to develop an architecture for a fictitious system. They have to develop different representations (called views) of the architecture. These different representations emphasize different concerns of people that have a stake in the system. Each group will also be asked to assess ("test") the architecture of another group for certain quality attributes.

Onderwijsvorm

Group work with a number of assignments

Literatuur

Len Bass et al, Software Architecture in Practice, 3rd Edition, 2012

Doelgroep

mCS, mIS

Software Asset Management

Vakcode	X_400412 (400412)
Periode	Periode 1
Credits	6.0
Voertaal	Engels

Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. C. Verhoef
Docent(en)	prof. dr. C. Verhoef
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

Gain insight in IT costs, benefits, risks, and returns on information technology.

Inhoud vak

In this class we treat several techniques to aid in software cost estimation. We discuss how IT migrates from cost issue to strategic asset, and how to come to grips with this important production factor. We provide insight in how to support decision making on IT investment issues. Examples from the Financial and Insurance industry, and independent software vendors are discussed. With IT benchmarks we obtain insight in the risks of IT developmtn and the operational costs of IT. We introduce the notion of an IT portfolio, and how to perform quantitative analyses with it, to aid in justifying IT investments.

Onderwijsvorm

Seminar with presentations of staff and students.

Toetsvorm

Essay on selected topics from articles. You can do this individually or in a group of 3 persons max.

Literatuur

Articles and chapters from books.

Vereiste voorkennis

Software Engineering (400071), a little statistical background is helpful.

Aanbevolen voorkennis

Proficiency in software engineering and statistics.

Doelgroep

mCS, mIS, mBA, mAI

Software Testing

Vakcode	X_400439 (400439)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. N. Silvis-Cividjian
Examinator	dr. N. Silvis-Cividjian
Docent(en)	dr. N. Silvis-Cividjian
Lesmethode(n)	Hoorcollege, Practicum
Niveau	400

Doel vak

- Familiarization with basic terminology in software testing.
- Familiarization with techniques and tools used for test generation, execution and adequacy measurement.
- Familiarization with software testing literature in a specific area by independent reading of selected research publications.

Inhoud vak

Testing is a method to improve software quality. Realistically, software testing is a trade-off between budget, time and quality. It is impossible to test everything so choices have to be made. Students learn how to make these choices and systematically test a software product based only on its requirements or when the code is also available.

This course provides an introduction to software testing with an emphasis on technical activities like test generation, selection, execution and assessment. The course tries to answer a few questions like: How to design test cases? When to stop testing? What to test when a new version of the product is ready? How to test a safety critical software? How to predict how many faults are in a program? During their practical assignments the students have to test small and large object-oriented software using the techniques learned in class and a set of testing tools.

A few guest lectures showing examples of testing in industry are also planned.

Topics: boundary value analysis, equivalence partitioning, decision table testing, combinatorial test design, control flow testing, data flow testing, mutation testing, regression testing, inspections, safety and reliability testing, fault and failure prediction.

Onderwijsvorm

Lectures and compulsory practical assignments.

Toetsvorm

Practical assignments and written exam.

Literatuur

A. Mathur, Foundations of software testing, Pearson Education, Addison-Wesley, 2008, *ISBN: * 978-8131716601

Aanbevolen voorkennis

Programming skills in Java

Doelgroep

mCS, mAI

Overige informatie

All material is available in Blackboard. The course is taught in English.

Systems Security

Vakcode	X_405108 ()
Periode	Periode 4
Credits	6.0

Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. ir. H.J. Bos
Docent(en)	prof. dr. ir. H.J. Bos
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak

Introductory (but very tough) course on security with a scope that includes systems work. At the end of the course students will deeply understand the basic notion of memory corruption attacks (buffer overflows, format strings, etc), SQL injection, cross-site scripting attacks, and other vectors used by computer hackers. The course is very(!) hands-on.

Inhoud vak

The course covers a wide spectrum of security issues. We explicitly aim wider than cryptography, as we want to show students how hackers penetrate systems. Much of the course will be hands-on: in lab assignments, student will carry out and investigate attacks in a controlled environment. This involves programming at the both the highest and lowest levels (say SQL and assembly). However, we will plan to discuss cryptography and trust infrastructures.

Onderwijsvorm

Lectures and (very challenging) practical assignments.

Toetsvorm

Written exam (30%) and practical assignments (70%).

Literatuur

No set book. All material will be made available during the course.

Aanbevolen voorkennis

No formal requirements, except a keen interest and a lot of time. Programming experience in C very strongly recommended. Knowledge of assembly and computer architecture helps too.

Doelgroep

mCS, mPDCS.

Term Rewriting Systems

Vakcode	X_400121 (400121)
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. R.C. de Vrijer
Docent(en)	drs. J. Endrullis
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	600

Doel vak

Learning the fundamental notions of term rewriting and getting acquainted with some more advanced topics in the field

Inhoud vak

The course description is; available on <http://studiegids.uva.nl/web/uva/sgs/nl/c/14304.html>

Onderwijsvorm

Lectures and practice sessions

Toetsvorm

Written examination

Literatuur

Course notes will be provided

Vereiste voorkennis

Compulsory: Inleiding logica.

Advised: Inleiding theoretische informatica.

Doelgroep

mCS, mAI, mMath

Overige informatie

The course is taught once every two years, the next opportunity will be in study year 2014-2015

Term rewriting systems (TRSs) provide for a natural formalism for specifying rules of computation and investigating their properties. TRSs are of basic importance for functional programming and for the implementation of abstract data types. Applications can also be found in theorem proving, proof checking and logic programming. Some topics that will be covered in the course are:

- abstract reduction systems
- critical pairs and Knuth-Bendix completion
- orthogonality and reduction strategies
- termination (rpo's, monotone algebras)
- combinatory logic
- decidability issues
- infinitary rewriting

The Social Web

Vakcode	X_405086 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. L.M. Aroyo
Docent(en)	dr. L.M. Aroyo, V. Maccatrozzo MSc, C.R. Dijkshoorn MSc
Lesmethode(n)	Hoorcollege

Niveau	400
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Doel vak

In this course the students will learn theory and methods concerning communication and interaction in a Web context. The focus is on distributed user data and devices in the context of the Social Web.

Inhoud vak

This course will cover theory, methods and techniques for:

- personalization for Web applications
- Web user & context modelling
- user-generated content and metadata
- multi-device interaction
- usage of social-web data

Onderwijsvorm

- lectures
- practical sessions
- assignments including final paper

Toetsvorm

Weighted average of assignments and final paper

Literatuur

- course lecture slides
- selected articles, videos and Web links for each lecture

Doelgroep

VU: mIS
 UvA: master Information Studies - Human-Centered Multimedia
 mCS
 mAI

Web Services and Cloud-based Systems

Vakcode	X_418110 ()
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Doel vak

The objectives of the course are to prepare students to acquire a global knowledge on cloud systems. Two targets are set for this course:

- The ability to read and analyze the literature published in this field and also summarize and present the outcome to others.
- The ability to develop a small project in a group.

Inhoud vak

Introduce students to the principles of web services and cloud systems. Students will learn about the different paradigms of cloud systems (IaaS, PaaS, SaaS), and understand the mechanisms and technologies behind each mode to successfully harness cloud resources. A number of real use case studies of existing cloud systems, and service-based

applications on clouds will be covered during the lectures. The course will also cover more advanced topics such as security of clouds and multi-clouds.

Onderwijsvorm

The course will have both Lectures and Lab sessions.

Toetsvorm

The course will be assessed as follows: Literature study (40%), Participation in the paper readings (20 %), Lab Session (40%)

- Literature study (Report + Presentation): each group of 2 students will have to select a topic, read between 3 to 5 papers, write a report in the form of scientific paper (4 pages max) and prepare a presentation (20mn-30mn).

(A list of topics will be provided, including one paper as suggestion of a starting point)

- Reading Papers: every week one paper is discussed during the last 30 mn of the lecture. Three students will be given 5 mn each to present the paper followed by 15 mn discussion.

(Students are requested to send 3 questions about the paper, selected question will be discussed during the 15mn discussion.)

- Lab sessions: students work in group of two students, during the demonstration of the outcome of the labs (small project), both students are requested to be present. Questions will be asked to both students.

Literatuur

Course is based on Scientific publications and other Material available online.

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mCS

Overige informatie

This information was taken from:

<http://studiegids.uva.nl/web/uva/sgs/nl/c/741753.html>

Coordinator: Dr. A.S.Z.Belloum (UvA)

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via <https://www.sis.uva.nl>