IKT617 Formal Descriptions and Related Tools

5 credits - Grimstad - 1 semester - autumn - AP

Study programme

PhD programme in ICT

Language of instruction

English

Learning outcomes

After completing the course, the student is expected to:

- have an overview of research questions and research methods in formal methods and software engineering as they are applied to mobile communication systems
- be able to discuss research issues from this field and how these issues relate to their own specialisation

Content

1) Modelling and meta-modelling for describing a domain precisely: approach, tools, state of the art.
2) Notations, architectures and models for describing and analysing distributed communicating distributed systems, e.g. process algebras, mobile calculi, event-based vs. state-based formalisms.
3) Notations, architectures and models for describing and analysing languages, e.g. abstract state machines, object constraint language, MOF, grammars. This is embedded in the use of a meta-modelling environment.

Teaching methods

Lectures (2 hours per week) and project.

Examination

Oral examination. Pass/Fail

Offered as a free-standing course

Yes

Faculty

Faculty of Engineering and Science

IKT622 Introduction to Mobile Fading Channels

5 credits - Grimstad - 1 semester - autumn - MP

Study programme

PhD programme in ICT

Language of instruction

English

Learning outcomes

After completing the course, the student is expected to:

- have overview and background information of main results, research questions, and research methods
- be able to discuss channel modelling issues and how these issues relate to their own specialisation
- be able to apply their work within the context of mobile communications and to work together with specialists in the area of wireless communications

Content

The course gives an introduction to the modelling, analysis, and simulation of mobile fading channels. It provides a fundamental understanding of basic concepts used in the area of mobile fading channel modelling. The most important single-input single-output (SISO), and multiple-input multiple-output (MIMO) fading channels are treated. Besides knowledge of statistics, also basic knowledge of mobile communications and systems theory is assumed.

The course will cover the following:

- Introduction to mobile fading channels
- Review of random variables and stochastic processes
- Path loss models
- Frequency-non-selective fading channels (Rayleigh channels, Rice channels, Nakagami channels)
- Introduction to the theory of sum-of-sinusoids models
- Methods for the computation of the model parameters
- Frequency-selective fading channels (WSSUS models, DGUS models, COST 207 models)
- Modelling and simulation of MIMO channels
- Modelling and simulation of mobile-to-mobile channels

Teaching methods

Lectures:
Mobile fading channels (1 week)
Simulation projects on selected topics (1 week)

Examination

Oral examination. Pass/Fail

Offered as a free-standing course

Yes

Faculty

Faculty of Engineering and Science

IKT623 Principles of Artificial Intelligence (AI)

5 credits - Grimstad - 1 semester - spring - OCG

Study programme

PhD programme in ICT

Language of instruction

English

Learning outcomes

After completing the course, the student is expected to:

- obtain insight into the theory, foundations, implementation and applications of Artificial Intelligence (AI)
- be trained to solve, using AI-based tools, research problems within the other areas in which UiA has expertise, such as communications and security

Content

The course will provide insight into the theory, foundations, implementation and applications of Artificial Intelligence (AI). It will bestow the students with the ability to use AI-methodologies in any application domain. The topics that will be covered will include: Recent approaches to machine learning and data mining, knowledge based systems, inference methods, fuzzy systems, heuristic search, and natural language processing. Finally, the student will be required to undertake a project involving recent industrial applications.

Teaching methods

Lectures, exercises and project work.

Examination requirement

Approved project report.

Examination

Oral examination. Pass/Fail

Offered as a free-standing course

Yes

Faculty

Faculty of Engineering and Science

IKT624 ISO/IEC 27000 Family of Security Standards

5 credits - Grimstad - 1 semester - autumn - JJG

Study programme
PhD programme in ICT

Language of instruction
English

Learning outcomes
After completing the course, the student is expected to have knowledge of the basics of information security management.

Content
The ISO/IEC 27001 standard defines principles for information security managing systems according to best practice in quality improvement. ISO/IEC 27002 is the code of practice for information security management. Other parts of the IOS/IEC 27000 family of standards provide guidelines for implementation, security metrics and information security risk assessment.

The course will cover the following:

- Information security management systems
- Information security management as continuous improvement
- Integration of security in total quality management
- The structure of the ISO/IEC 27001 and 27002 standards
- Controls and best practice
- Measurement and metrics
- Information security risk management

Teaching methods
Lecture, exercises and project work.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT625 Simulation and Performance Evaluation of Computer and Communication Networks
5 credits - Grimstad - 1 semester - spring - FL/FR

Study programme
PhD programme in ICT

Language of instruction
English

Learning outcomes
After completing the course, the student is expected to:

- have deeper practical knowledge for mobile, wireless communication networks and their performance by means of simulation
- be able to design and implement algorithms or protocols within related research topics using a given simulation tool, and evaluate the performance of the designed algorithms or protocols through simulations
- understand common simulation techniques
- have learned how to plan, set up, and run simulations
- have learned how to implement algorithms and protocols in a given simulation tool
- be able to evaluate the performance of the implemented network and algorithms
- be able to interpret simulation results properly

Content
The course studies the impact of wireless communications systems on the performance of end-to-end protocols and applications. Examples of challenges are constantly changing wireless link quality, effects of local link layer error handling on end-to-end TCP/IP protocols, handling of user and device mobility, and adjusting to restricted resources on the terminal side.

Simulation techniques are introduced as one of three approaches to the performance analysis of a technical system. All three approaches, i.e., mathematical analysis, measurements in real systems and simulation, are introduced and their advantages and disadvantages are discussed. It is shown that in the area of communication networks, simulation provides a good trade-off between the advantages of mathematical analysis and measurements and is therefore employed quite often in practice.

Teaching methods
Simulation of wireless communications: lectures and exercises
Simulation projects on selected topics

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT626 Main Results and Research Topics in Security

5 credits - Grimstad - 1 semester - spring - VO

Study programme

PhD programme in ICT

Language of instruction

English

Learning outcomes

After completing the course, the student is expected to:

- have overview and background information of main results, research questions and research methods within security in communication systems
- be able to discuss security issues and how these issues relate to their own specialisation
- be able to work with security-related problems of mobile communication and computing related to their own specialisation

Content

The course will cover selected topics among the following:

- Cryptography: classic cryptosystems, symmetric key cryptography, public key cryptography, hash functions, random numbers, information hiding, and cryptanalysis
- Access control: authentication and authorisation, password based security, ACLs and capabilities, multilevel and multilateral security, Bell-LaPadula and Biba's models, RBAC
- Protocols: simple authentication protocols, session keys, perfect forward secrecy, timestamps, SSL, IPSec, Kerberos.
- Software: flaws and malware, buffer overflows, viruses and worms.
- Generic archetypes in mobile security
- Some other selected areas of security will be also considered (vary from year to year)

The actual content will vary from year to year.

Teaching methods

Lectures, guided self-study, paper/article writing tasks and project work.

Examination requirement

Approved project report.

Examination

Oral examination. Pass/Fail

Offered as a free-standing course

Yes

Faculty

Faculty of Engineering and Science

IKT631 Learning in Random Environments

5 credits - Grimstad - 1 semester - spring - OCG

Study programme

PhD programme in ICT

Language of instruction

English

Learning outcomes

After completing the course, the student is expected to:

- have insight into Learning Automata (LA) methods and their applications especially concentrating on the areas of security and communications
- be able to solve research problems within security and communications using LA-based tools

Content

The heart of the course will involve deterministic and stochastic learning automata with fixed and variable structures. We will study their operation in random environments and the various norms of learning. The learning algorithms studied will be the linear and non-linear learning schemes of the continuous and discretised families with ergodic and non-ergodic properties. Estimator algorithms will also be examined. We will also discuss machines which can rank actions. Finally, the student shall conduct a project dealing with recent (up to within the last few months) applications of learning automata in security and communications.

Teaching methods

Lectures, exercises and project work.

Examination requirement

Approved project report.

Examination

Oral examination. Pass/Fail

Offered as a free-standing course

Yes

Faculty

Faculty of Engineering and Science

IKT700 Advanced Mobile Network and Service Architectures
5 credits - Grimstad - 1 semester - spring - FL/FR

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT625 or equivalent

Learning outcomes
After completing the course, the student is expected to:
- be able to understand the driving forces behind the changes in the current mobile communications world
- know relevant mobile services architectures and technologies

Content
The mobile industry is moving from a highly optimised infrastructure with few services such as voice, SMS, and MMS to a more sophisticated, service driven, and flexible architecture.

The course starts with a high level, operator centric business model as a basis for the requirements driving the functional architecture within the operator domain, as well as requirements arising from interconnection with other domains (e.g., user/user terminal, peer operators, access service providers, application and content providers).

The students will be introduced to a range of relevant mobile services architectures, standards and solutions, e.g., from 3GPP, OMA, OASIS, Liberty Alliance, IETF and W3C.

To complete the overall end-to-end view, we look into the technology of today's and tomorrows mobile devices. Know-how about important upcoming technology trends and limitations is important to create powerful applications.

Teaching methods
Mobile end-to-end service layer architectures
Mobile device technology
Project study

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT701 Dynamics of Computer Security Incident Response Teams (CSIRTs)
5 credits - Grimstad - 1 semester - autumn - JJG

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT624 or equivalent

Learning outcomes
After completing the course, the student is expected to:
- have thorough insight into current research topics in CSIRTs
- be able to do research work related to incident response handling, CSIRTs and IDS (Intrusion Detection Systems)

Content
The course will cover the following:
- In-depth review of current implementations of Computer Security Incident Response Teams (CSIRTs).
- Model-based analysis of selected CSIRTs based on cases from literature and/or organisations (if available).
- The role of CSIRTs as emergent Cyber Security Reporting Systems.

Teaching methods
Lectures, seminars, guided self-study, system dynamics modelling, writing assignments.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT702 Selected Topics in Security for ICT

5 credits - Grimstad - 1 semester - autumn - VO

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT626 or equivalent

Learning outcomes
After completing the course, the student is expected to:

- understand the main technologies, mechanisms and architectural approaches to security for both current and future mobile systems
- be able to work with security-related problems of mobile communication and computing

Content
The course will cover selected topics among the following:

- PKI in mobile systems. The smartcard as a mobile device. Secure mobile tokens
- Architectural approaches and mechanisms providing access security in mobile networks
- Security in personal area networks
- Software security issues arising in future mobile communication systems

The actual content will vary from year to year.

Teaching methods
Lectures, self study and project work.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT703 Mobile Fading Channels
5 credits - Grimstad - 1 semester - spring - MP

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT622 or equivalent

Learning outcomes
After completing the course, the student is expected to:
- be able to model, analyse and simulate channels of various kinds
- understand the theory behind channel modelling and simulation

Content
A precise knowledge of mobile radio channels is indispensable for the development, evaluation, and test of present and future mobile radio communication systems. After all, from digital modulation techniques over channel coding to network aspects, nearly all relevant components of mobile radio systems are determined by the propagation characteristics of the channel. This course deals with the modelling, analysis, and simulation of mobile fading channels. It provides a fundamental understanding of many issues that are currently being investigated in the area of mobile fading channel modelling. Several classes of single-input single-output (SISO), and multiple-input multiple-output (MIMO) fading channels are treated in detail. Furthermore, the description of efficient methods for the simulation of mobile radio channels is in the centre of attention.

The course will cover the following:
- Review of random variables and stochastic processes
- Fundamentals of stochastic and deterministic channel models
- Frequency-nonselective fading channels (Rayleigh channels, Rice channels, generalised Rice channels, Nakagami channels, various types of Suzuki channels, classical and modified Loo model)
- Frequency-selective fading channels (WSSUS models, DGUS models, COST 207 models)
- MIMO fading channels
- Methods for the computation of the model parameters
- Design of fast channel simulators
- Test and performance analysis of channel simulators
- Modelling and simulation of mobile-to-mobile channels
- Modelling and simulation of shadowing
- Design of bit and block error models

Teaching methods
Lectures

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT706 Using Semantics to Generate Code
5 credits - Grimstad - 1 semester - spring - AP

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT617 or equivalent

Learning outcomes
After completing the course, the student is expected to:

- have an overview of the use of formal notations to define semantics for languages
- be able to specify and implement transformations between several languages and notations

Content
The course provides an overview of modern ways to define semantics of modelling languages and language constructs and how to use this for generating modelling tools.

It will cover all aspects of modelling languages, i.e. structure in terms of abstract grammars and MOF-metamodels, static constraints using logic in the sense of PC1 or OCL, representation in terms of graphics and textual grammars, and dynamic behaviour described using denotational and operational techniques.

Teaching methods
Lectures (2 hours per week) and project.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT709 Advanced Protocols for Mobile Communications

5 credits - Grimstad - 1 semester - autumn - FL

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT625 or equivalent

Learning outcomes
After completing the course, the student is expected to:

- have in-depth knowledge in emerging mobile and wireless communication networks which are based on or triggered from IP protocols
- be able to master the state-of-the-art technologies within a selected number of topics in mobile and wireless communications, covering mainly layer 2 mechanisms and layer 3 protocols
- be able to identify a suitable direction covered by this course as his/her potential research topic

Content
Routing protocols in IP networks, OSPF, wireless OSPF; QoS architectures in the Internet and QoS provisioning in UMTS; Multicast in multi-hop wireless networks; Medium access and networking mechanisms in cognitive radio networks; Layer 2 and layer 3 issues in cooperative communication networks; Capacity and throughput analysis of wireless networks; Topology control in multi-hop wireless networks; Performance simulation of multi-hop wireless networks.

Teaching methods
Lectures, student presentations, group discussions, self-tuition, etc.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT710 (or IKT731) Learning in Random Environments

5 credits - Grimstad - 1 semester - last time spring 2010 - OCG

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT623 or equivalent

Learning outcomes
After completing the course, the student is expected to:

- have insight into Learning Automata (LA) methods and their applications especially concentrating on the areas of security and communications
- be able to solve research problems within security and communications using LA-based tools

Content
The heart of the course will involve deterministic and stochastic learning automata with fixed and variable structures. We will study their operation in random environments and the various norms of learning. The learning algorithms studied will be the linear and non-linear learning schemes of the continuous and discretised families with ergodic and non-ergodic properties. Estimator algorithms will also be examined. We will also discuss machines which can rank actions. Finally, the student shall conduct a project dealing with recent (up to within the last few months) applications of learning automata in security and communications.

Teaching methods
Lectures, exercises and project work.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT711 Principles of Pattern Recognition
5 credits - Grimstad - 1 semester - spring - OCG

Study programme
PhD programme in ICT

Language of instruction
English

Recommended previous knowledge
IKT623 or equivalent

Learning outcomes
After completing the course, the student is expected to:

- have advanced theoretical and practical skills in statistical and syntactic pattern recognition
- be able to solve research problems within security and communications using statistical- and syntactic pattern recognition based tools

Content
This course will introduce students to the principles of statistical and syntactic pattern recognition. After a brief review of the principles of probability, random variables and vectors, we will study Bayes decision theory and criteria for classification. We will then consider the theory of maximum likelihood and Bayesian learning for parametric pattern recognition. After that, we will focus our attention to non-parametric methods such as classification using nearest neighbour rules and discriminant functions. The use of these in Neural Network Classifiers will be highlighted. The course will also introduce students to various features used in speech, shape and character recognition.

With regard to syntactic pattern recognition we will briefly study the use of distance and probabilistic criteria in classifying strings, substrings, subsequences and trees as used in speech recognition and in matching RNA sequences. We will finally consider probabilistic classification of linear and syntactic patterns.

The student shall conduct a project dealing with recent (up to within the last few months) applications of statistical and syntactic pattern recognition in security and communications.

Teaching methods
Lectures (1 week), exercises and project.

Examination requirement
Approved project report.

Examination
Oral examination. Pass/Fail

Offered as a free-standing course
Yes

Faculty
Faculty of Engineering and Science

IKT712 Special Syllabus

Ref. is made to the template for course description IKT712 Special syllabus that may be found on "Documents" at www.uia.no/tekreal/phd/ict.

IKT715 Advanced Topics on Selected Areas in ICT
5 credits - Grimstad

Study programme
PhD programme in ICT

Language of instruction
English

Learning outcomes
This course is designed to provide candidates with the state-of-the-art technologies within a specifically selected research topic in the field of ICT. After completing the course, the candidate should have good knowledge about the newest development within the selected topic, as well as in-depth understanding of the fundamental technologies behind this topic. Another outcome of this course could be the identification of a potential research theme as part of the candidate's PhD study.

Contents
The contents of this course will be tailored every time when it is given, according to the expertise of the lecturer who might be a visiting professor from another university, as well as the expectation of the candidates who take this course. An internal professor at UiA will be the responsible person and will take part in the instruction of the course.

Teaching methods
Lectures, student presentations, group discussions, exercises, self-tuition etc.

Examination requirement
Participation of the lectures, compulsory exercises and/or guided reading, approved project report.

Examination
Oral exam. Pass/Fail

Reading list
A collection of papers within the selected specific topic, proposed by the lecturer(s) of this course

Offered as a free-standing module
Yes

Faculty
Faculty of Engineering and Science

Ref. is made to the template for course description IKT715 Advanced Topics on Selected Areas in ICT that may be found on "Documents" at www.uia.no/tekreal/phd/ict.