



## Curriculum: Information Processing Science Course Descriptions

### 810029Y Orientation Studies, 3 ECTS

What does a credit mean? Need I register for exams and how? What is the difference between a major and minor subject? Why is it necessary to plan studies? What do study paths mean and how are they built in the degree programme in information processing science? How do I use e-mail? The course will give you an answer to these and many other questions connected with the early stages of your studies. The course aims at lowering the threshold at the start of academic studies and to provide a basis for successful studies and goal-directed study planning.

*Methods:* Lectures 15 h, exercises 39 h, work in small groups 15 h, homework 8 h

*Timing and target group:* Periods a and b. The course is compulsory for the 1st year students.

*Person in charge:* Heli Alatalo

### 902002Y English for Information Processing Science 1, 2 ECTS

*Status:* Compulsory for most degree programmes; c.f. the Faculty of Natural Sciences' study guide for the language requirements for each particular degree programme.

*Prerequisites:* English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise.

*Core Skills Practised:* Reading in order to understand general natural scientific texts, as well as texts or textbooks of the students' own field; applying different reading strategies to extract global or detailed information according to the reading purpose; understanding word formation in order to expand vocabulary, both general scientific and field specific; deducing lexical meanings from context, understanding basic grammatical structures of scientific English, as well as text structure and cohesion markers for improved comprehension.

*Content and Methods:* The course is carried out in multi-mode, with instruction and student tasks taking place either in class or in the Optima learning environment.

*Alternatives for Course Completion*

1. Students with grades *laudatur* or *eximia* in their A1 English school leaving examination can be exempted from this course and will be granted the credits by the Faculty of Natural Sciences
2. Students actively participate in the instruction according to the timetable given by their departments and perform all the tasks expected of them either in class, at home or in Optima during the course. After all the tasks have been completed, the students can take the end of course exam.

*Literature:* Teaching materials include extracts from the students' own set books and articles from scientific magazines as well as various online sources.

*Person in charge:* Aila Syrjäkari-Roberts (Language Centre)

### 902004Y English II Scientific Communication, 2 ECTS

*Status:* See the Natural Sciences Faculty study guide for the language requirements for each particular degree program.

**NOTE:** This course is a requirement for all students who take English as their foreign language, including those who have received exemption for either of the Reading for Academic Purposes courses, 902002Y or 902003Y.

*Prerequisites:* Reading for Academic Purposes must have been completed.

*Core skills practised:* Communicating fluently and accurately in matters connected to the student's academic field as well as in everyday conversational situations, developing pronunciation and actively using field-related vocabulary, understanding conversations and field-related lectures, presenting a field-specific topic in clear and organized speech.

*Content and Methods:* Oral/aural fluency is practised through interactive tasks that require pair work communication and small group discussions.

*Alternatives for course completion:* An optional exemption test is offered twice per year. It is suggested that interested students should take this test the term before their course starts. Those who pass the test get credit for the course and those who do not, must attend the course. The student can only participate once. Note that this test is not compulsory and those who feel that their language skills are weak or wish to participate in the course can enroll without taking the test.

*Person in charge:* Jolene Gear

## Basic Studies

### 810124P Computer Architecture, 5 ECTS

Course introduces computing platform for application programs. Platform formed by computer hardware, communication interfaces, and software layers close to hardware. Complexity of the platform is hidden by abstraction layers and their structure, mechanisms, execution semantics, functionality and critical characteristics (performance, security, and power consumption) and compatibility. Main target architectures are personal computers, laptops, notepads, and cell phones. Course implementation: lectures 40h, exercises 33h, preparation for written exam 60h. Part of the lectures is digital video recordings. Exercises comprise of labs (18h) and preparation exercises 15h.

*Timing:* periods b and c (from November to April)

*Predecessor:* Introduction to Information Processing Science 4 ECTS (810136P)

*Target group:* Mandatory for all first year students

*Literature:* Comer, D.E., Essentials of Computer Architecture. Pearson/Prentice Hall. ISBN 0-13-196426-7. 369 p. 2005. Lecture notes and digital video recordings are distributed via Internet-based Optima learning environment. Lecture notes



are also available in a printed form. For foreign students lectures in Finnish can be substituted with a book exam in English

*Person in charge:* Prof. Petri Pulli

### **811171P Humans as Users and Developers of Information Technology, 3 ECTS**

The orientation of the course is to prove how theories related to humans' behavior and action contributes to understand human as a user and developer and how those can be applied when developing information technology solutions. The course gives a pinch "science" to studies in first stage.

*Content:* 1. Introduction 2. Introduction to cognitive psychology 3. Human as programmer 4. Human as systems analyst 5. Human and designing user interaction and user interface 6. Individual acceptance of information and software systems 7. Current questions.

*Methods:* Lectures 20 h, familiarizing literature material, examination.

*Literature:* Lecture material.

*Connections with other courses:* No compulsory preceding courses.

*Timing and target group:* Period a, 1. year, compulsory to all Information Processing Science students, also other can participate.

*Person in charge:* Juhani Iivari

*Web address:* <http://www.tol.oulu.fi/kurssit/itkk>

### **811172P Introduction to Digital Media, 4 ECTS**

The course topics include introduction to the research, concepts, contents, applications and implementations of digital media systems. Digital media is understood as a combination of hypertext and digital images, graphic, audio, animation and combinations of these. The course work will facilitate understanding of the role of the Internet as a communication tool for individuals, communities and organizations. The course will establish a basic competence for other digital media courses and will support students in understanding the role of digital media in the field of information processing science.

*Methods:* The course includes 30 hours of lectures produced in the form of contact or distant education or digital documents and 30 hours of supervised exercises. The students carry out the course assignments under the supervision of tutors. The course can be passed in one of two ways: either by completing A, the assignments and an examination based on the lectures, or B. the final word graded by numbers.

*Timing and target group:* Period a. Compulsory, 1st year, recommended course for minor subject studies.

*Supplementary literature:* All the supplementary materials for the lectures, self-study and exercise materials including the links and reference information, are available in digital form on the course Web site.

*Person in charge:* Minna Isomursu

*Web address:* <http://www.tol.oulu.fi/kurssit/dmp>

### **810136P Introduction to Information Processing Science, 4 ECTS**

The course introduces the conception of an information society and information technology development trends, and how teaching and research are focused in this field of science. Course also trains basic scientific working skills of listening, reading, critical and creative thinking, searching and organising material, and writing. Course comprises of lectures addressing essential topics within information processing science, current research issues, and lectures about the work in the field and in companies utilising and/or developing information systems.

*Course implementation:* lectures 40h, exercises 10h, essay 40h, preparation for written exam 20h. Part of the lectures is digital video recordings. Exercise comprise of essay writing instruction and feedback sessions.

*Timing:* periods a and b (from September to December)

*Target group:* Mandatory for all students entering in information processing science curricula.

*Literature:* Lecture notes and digital video recordings are distributed via Internet-based Optima learning environment.

Lecture notes are also available in a printed form. For foreign students lectures in Finnish can be substituted with a book exam in English.

*Person in charge:* Prof. Petri Pulli

### **811170P Introduction to Information Systems Design, 5 ECTS**

The aim of the course is for the student to learn to: a) identify information systems and understand their importance in various work practices, b) collect information to determine requirements for information system, c) understand work practices and methods related to systems design, d) describe information systems as parts of some activity and read such descriptions, e) describe the internal structure of an information system and read such descriptions, f) construct a system specification based on the above descriptions to provide the basis for technical design, and g) evaluate the quality of information systems. The course is divided into five main themes: 1. Introduction, 2. Information system as a part of its organizational context, 3. Modeling the content and functionality of an information system, 4. Modeling an information system at the technical level, 5) Special issues.

*Methods:* Lectures 30 h, exercises 7\*3 h, an assignment to be carried out based on them and an examination.

*Learning materials and literature:* Lecture materials, supported and supplemented by Hoffer, J.A., George, J.F. and Valacich, J.S., Modern Systems Analysis & Design; 4th edition, Prentice-Hall, 2005.

*Connections with other courses:* Recommended as preceding courses: Introduction to Information Processing Sciences, Humans as Users and Developers of Information Technology, Computer Systems and Introduction to Programming.

*Timing and target group:* Period b. 1st year. Compulsory.



*Person in charge:* Juhani Iivari

### **811122P Introduction to Programming, 5 ECTS**

The course provides a basis for programming studies and software engineering. The course introduces the basic concepts of programming (algorithmic problem solving, stepwise refinement, control structures, modular programming, data types, classes, objects, strings, arrays, files and class hierarchies), solving of small-scale problems and implementation of programs in Java.

*Methods:* lectures 40 h, exercises 24 h and examination.

*Learning materials and literature:* Lecture handout. Arto Wikla: Ohjelmoinnin Perusteet Java-kielellä, OtaDATA, 1998. Koskimies Kai: Pieni Oliokirja, Suomen Atk-kustannus Oy, 1997. Lewis John and Loftus William: Java Software Solutions; Foundations of Program Design, Addison-Wesley, 1998.

*Timing and target group:* Period a. Compulsory. 1st year.

*Person in charge:* Ilkka Räsänen (ilkka.rasanen@oulu.fi)

*Web address:* <http://www.tol.oulu.fi/~ilkka>

### **811192P Introduction to Programming in the Language C, 5 ECTS**

The course provides a basis for programming studies and software engineering. The course introduces the basic concepts of programming (algorithmic problem solving, stepwise refinement, control structures, modular programming, data types, strings, arrays, structures, pointers, macros, files), solving of small-scale problems and implementation of programs in C-language.

*Methods:* lectures 40 h, exercises 24 h, examination.

*Learning materials and literature:* Lecture handout. Jeri R. Hanly and Elliot B. Koffman; Proglem Solvin and Design in C; Addison-Wesley.

*Timing and target group:* Period a. Mainly for students of technical department.

*Person in charge:* Ilkka Räsänen (ilkka.rasanen@oulu.fi)

*Web address:* <http://www.tol.oulu.fi/~ilkka>

### **811174P Introduction to Software Business, 5 ECTS**

The course provides an overview of the present state and the future of the software business both in Finland and globally. The course familiarizes students with the software business both in its immediate areas and in individual companies and their products and services. Software companies are familiar with considering various business strategies, models and various developmental phases in marketing, production and financing. Students will also enter into discussions focusing on special questions about software and producing services, developing shared networks and managing entrepreneurship in software.

*Methods:* Lectures 27 h, exercises 10 h, assignment done in groups and examination. The assignment must be passed before participating in the examination. Literature and assignment material are given in the beginning of the course.

*Timing and target group:* Period c, compulsory, 1st year.

*Person in charge:* Juhani Warsta

### **810135P Introduction to UNIX, 3 ECTS**

Unix is a common operating system for servers. Especially, thanks to Linux, its use on desktops is also growing rapidly again. It is therefore important to master the basic skills of using Unix. The course introduces the basics and important features of Unix-like operating systems. The main focus is on daily use situations and problem solving. Having completed the course, the students will know how to manage files and processes and construct simple tools to support their work. The main working environment for this course is Linux.

*Methods:* lectures 10 h, exercises 12 h and several assignments. To pass the course the student shall carry out the assignments.

*Learning materials and literature:* Materials on the course Web page.

*Connections with other courses:* The course provides a readiness to take the course titled, the Unix Operating System (810325A).

*Timing and target group:* Period b. Optional. 1st or 2nd year.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/unix/perusteet/>

### **811111P Logic, 3 ECTS**

The targets of the examination are inferences and their application in information processing science.

*Contents:* 1. Introduction, 2. Propositional logic, 3. Sets, 4. Predicate logic.

*Methods:* Lectures 30 h, exercises 16 h, homework and/or group work ~30 h.

*Literature:* Lecture material or suitable sections from the following books: Nimal Nissanke, Introductory Logic and Sets for Computer Scientists, Addison Wesley, 1999; Grigori Mints, A Short Introduction to Modal Logic, CSLI Lecture Notes Number 30, 1992; George J. Klir, Ute St.Clair, Bo Yuan, Fuzzy Set Theory, Foundations and Applications, Prentice Hall PTR, 1997.

*Connections with other courses:* No compulsory preceding courses.

*Timing and target group:* Period b, compulsory, 1st year.

*Person in charge:* Martti Luodonpää

*Web address:* [www.tol.oulu.fi/~martti](http://www.tol.oulu.fi/~martti)

### **811173P Principles of Information Security, 4 ECTS**

Rapid technical developments have enabled the migration of various private and public services to computerized information systems and information networks. Hence society's reliance on these devices has increased. Growth of Internet use has brought up also some negative side-effects in the form of harmful or even malicious patterns of behavior affecting Internet users. Obviously this means new requirements for level of information security and privacy. The course starts by survey of history in this field, and introduces basic concepts and guiding principles. User's point of view deals with secure e-mail, web access, firewalls and virus protection; organizational point of view deals with risk management and information security politics. The technical part of the course module gives an overview of encryption methods, authentication and access control as well as secure databases and software security. Towards the end of the course, the focus is turned on the weakest link of the information security chain, i.e. human behavior.

*Methods:* Lectures 30 h, exercises 30 h, familiarizing lecture- and exercise material 40 h, examine 5 h.

*Literature:* Lecture- and exercise material.

*Connections with other courses:* No preceding courses.

*Timing and target group:* Period b, 1st year, compulsory.

*Persons in charge:* Juha Kortelainen and Mikko Siponen

### **811175P Programming Assignment I, 2 ECTS**

Programming is best learned by practicing it; experimenting with and pondering over what happens during the execution of a program. The purpose of Programming Assignment courses is to provide time for that learning process and to enable students to utilize the knowledge given in theory courses in practice. In addition, students can be sure that s/he has attained a satisfactory level of knowledge in order to continue with the next programming course. The purpose of Programming Assignment I is that students can independently solve a small-scale algorithmic problem and implement a solution in Java programming language by applying the principles learned in the Introduction to Programming course.

*Methods:* Assignment about 50 h.

*Literature:* Introduction to Programming (811122P) course material.

*Connections with other courses:* The knowledge from the Introduction to Programming (811122P) course is prerequisite course. The course prepares students for participation in the Object-oriented software development (811378A) course.

*Timing and target group:* Period b, compulsory, 1st year.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/ohjelmointityo/>

### **030005P Sources of Scientific Information, 1 ECTS**

Information Processing Science acquisition of information/Tellus. Content: Sources of information and information retrieval process, exercises.

*Methods:* Classroom teaching and network teaching. Passing the course requires participation in classroom teaching and completing exercises.

*Connections with other courses:* The prerequisite course is, Introduction to Information Processing Science (810136P).

*Followers:* Before beginning the Bachelor Thesis.

*Timing and target group:* Period c, 2nd year, compulsory. The course is performed in parallel with Introduction to Research (811382A).

*Person in charge:* Jani Sassali

### **Subject (Intermediate) Studies**

#### **811361A 3D Graphics, 5 ECTS**

The course deals with the different forms and applications of 3D graphics, focusing on topics such as visual design, modeling and animation and the process of making 3D films and games. The course aims at deepening the student's knowledge of the means of visual production in 3D graphics and at offering opportunities to produce 3D graphics.

*Methods:* Lectures 30 h, exercises 30 h, assignment 60 h (the assignment consists of an essay and a 3D modeling animation project).

*Learning materials and literature:* Lecture handout and other materials to be announced during the course.

*Connections with other courses:* The following courses are recommended as prerequisite studies for the 3D Graphics course: Introduction to Digital Media, Time-Based Multimedia, Digital Image Processing and Graphic Design.

*Timing and target group:* 3rd to nth years. Period a. Optional.

*Course startup:* The course will be offered for the first time in the autumn of 2003.

*Person in charge:* Tomi Kujanpää

#### **812317A Legislation on Digital Information, 4 ECTS**

The course aims at providing the student with an idea of digital information legislation binding on Finland that is essential from the viewpoint of studies in information processing science, as well as of certain international agreements and their meaning. The course has a special focus on intellectual property rights (copyrights and industrial rights), regulation of electronic commerce and electronic contract processes, and data protection. Contents: 1. Legal regulation of digital information in Finnish legislation and future legislative projects. 2. Legal regulation of digital information in the EU and future legislative projects. 3. International agreements binding on Finland to regulate digital information.

*Methods:* Lectures + exercises (30 h), assignment, examination.





*Timing and target group:* Period c. Compulsory in the Software Business and Digital Media programmes, 3rd to nth years.

*Literature:* To be announced during the lectures and on the Web page of the course.

*Person in charge:* Pekka Salonpää (pekka.salonpaa@oulu.fi)

*Web address:* <http://www.tol.oulu.fi/~salonpaa/dtll.htm>

### **811386A Algorithms, 5 ECTS**

A computer is a great tool, but it has its limits. A computer is not capable of solving all problems and for some tasks it is far too slow. In this course, we take a look at algorithms and their computational complexity. Graph and string algorithms, data structures and number-theoretic problems are used as examples. Finally, we get acquainted with NP-complete problems and their approximation algorithms.

*Methods:* Lectures 36 h, exercises 18 h, examination plus independent work about 75 h. Credit will be awarded upon passing an examination.

*Literature:* Applicable parts of Cormen T. H., Leiserson C. E., Rivest R. L., Stein C.: Introduction to Algorithms, MIT Press (McGraw-Hill), 1989 or newer. Additional literature will be announced in lectures and on the course home page.

*Connections with other courses:* Introduction to programming, Introduction to data structures and Logic or similar skills is required. The participants must be familiar with mathematical notation.

*Timing and target group:* Period a, for 2nd-nth year students. Obligatory for students in the software production programme; recommended for those interested in programming, computer networks or cryptography.

*Person in charge:* Marko Rinta-Aho

### **811383A Bachelor thesis, 7 ECTS**

The course aims at developing skills in research problem definition and report writing. The bachelor's thesis is a small-scale thesis that is mainly based on a literature based review on a given topic. Students who continue on to do a master's thesis can choose their topic so that they can use the results later as the literature survey part of the master's thesis.

*Connections with other courses:* approx. 60 ECTS major subject studies shall be completed before starting the thesis. In connection with the bachelor thesis, the student shall also take a written maturity test related to the topic of the thesis. In addition to showing complete mastery of the topic through written language, this test measures the student's familiarity with the issues discussed in the thesis.

*Methods:* Research work and thesis writing under supervisor's guidance

*Timing and target group:* No time limit, compulsory, 3rd year.

*Persons in charge:* Professors and other thesis supervisors.

### **812336A Basics of C++ programming language, 6 ECTS**

After passing the course, the student is expected to be able to manage the syntax of the C++ programming language, knows how to implement software designed with object oriented design methods using the C++ language, as well as knows the basics of the C++ standard. Additionally, the student is expected to be familiar with the different programming paradigms of C++: the procedural, modular, object based, object oriented and generic paradigms. The student also knows the most important classes, data types and libraries of the standard.

*Methods:* Lectures 40 h, exercises 30 h, examination, exercise work

*Literature:* Course literature consists mainly of Finnish lecture materials and a tutorial. Exercise material is available in English. A list of English books suitable for the course will be announced at the beginning of the course.

*Related courses:* compulsory preceding courses are the Object-Oriented Software Development (811378A) and Programming Assignment II (811377A). Recommended preceding courses are Programming in C (812316A) and Programming Assignment II (811377A). Basics of C++ Programming Language must be passed before Advanced C++ Programming (812643S) and Mobile Systems Programming (811359A).

*Timing and target group:* 2nd study year, Period b. Compulsory in Software Engineering and Mobile Services programmes, recommended for other students.

*Person in charge:* Antti Juustila

*WWW site:* <http://www.tol.oulu.fi/kurssit/c++>

### **811380A Basics of Databases, 5 ECTS**

Having completed the course, the student will understand the purpose of databases, conceptual modeling of information (ER-modelling) and the design and use of relational databases.

*Methods:* Lectures 48 h, exercises 24 h, demonstrations 21 h, assignment (compulsory), examination (compulsory).

*Literature:* Elmasri R., Navatehe S.B.: Fundamentals of database systems, 4th edition. (Parts) 2nd year, Period B.

*Language of lectures and exercises:* Finnish. Students can also read the course book and take an exam written in English.

*Person in charge:* Juha Iisakka

### **813319A Business Opportunity Creation in Software Industry, 5 ECTS**

Creating new business and regeneration of existing businesses in today's dynamic software business environment requires finding new and productive business ideas. The goal of the course is to learn how to look at, create and execute business ideas for new software businesses or to enlarge an existing software business.

*Methods:* (1) Becoming acquainted with creating business ideas in fieldwork. (2) Lectures according same content. (3)



Group project.

*Timing and target group:* Period b, compulsory in Software Business program, doesn't require preceding studies (recommended preceding course is Dimensions of Software Entrepreneurship 813318A), conforms also to other program students.

*Literature:* 1. Gunther McGrawth, R. & I. MacMillan (2000). The entrepreneurial mindset: strategies for continuously creating opportunity in an age of uncertainty. Harvard Business School Press. 2. Article summary.

*Person in charge:* Vesa Puhakka

### **812316A Programming in C, 4 ECTS**

This course provides basics of C language (control structures, functions, arrays, strings, data types, records, files, libraries and directives, bitwise operations) and how to solve small scale problems and how to implement them by using C language.

*Methods:* 20 h lectures. 30 h exercises. Examination and exercise work.

*Learning materials and literature:* Lecture material is in www (in Finnish). J.R. Hanly, E. B. Koffman: Problem Solving and Program Design in C, Addison-Wesley, 1996.

*Prerequisites:* Requires knowledge from either "Introduction to programming" (81122P) or "Principles of programming" (81119P).

*Timing and focus group:* Period b. This course is for everyone who is interested in C-language.

*Person in charge:* Ilkka Räsänen (ilkka.rasanen@oulu.fi)

*Web address:* [http://www.tol.oulu.fi/~ilkka/C\\_ohjelmointi.html](http://www.tol.oulu.fi/~ilkka/C_ohjelmointi.html)

### **815340A Data Security in Wireless Communication, 5 ECTS Credits**

Wireless data communication is rapidly becoming more common and it will be used to an increasing extent in everyday functions such as commerce and information acquisition. The course focuses on security problems that are not encountered in conventional network environments.

*Methods:* Lectures 40 h, examination.

*Learning material and literature:* Lecture material and Nichols – Lekkas: Wireless Security, McGraw –Hill 2002.

*Connections with other courses:* The course must be preceded by Principles of Information Security 811173P and Network Security 811354A.

*Timing and target group:* Period c. Optional.

*Person in charge:* Ari Vesanen

*Web address:* [http://www.tol.oulu.fi/~avesanen/Langaton TT/](http://www.tol.oulu.fi/~avesanen/Langaton_TT/)

### **811384A Database Systems, 6 ECTS**

A database management system (DBMS) is a collection of programs that enable users to create and maintain a database. A DBMS and database together constitute a database system. The course further develops the skills of manipulating a transaction-based database provided by the course Basics of Databases. The course introduces transaction processing, concurrency control and recovery techniques in databases and explains the role of indexing in improving the performance of relational databases. The course acquaints the student with distributed databases, object-oriented databases and XML-databases. The students practice the use of object-oriented databases and XML-databases in exercises. The course also acquaints the student with new development trends such as data warehouses for decision making, data mining in data warehouses and the importance of metadata in management of data warehouses.

*Methods:* 1st alternative: lectures 32 h, exercises 30 h, homework 20 h, essay+seminar 40 h, assignment 40 h. 2nd alternative: lectures 32 h, exercises 30 h, homework 20 h, examination 40, assignment 40 h.

*Literature:* Elmasri R., Navathe S.B., Fundamentals of Database Systems, 4th edition, Addison-Wesley, 2003, chapter 9 and chapters 13-29, Lahdenmäki T., Leach M., Relational Database Index Design and the Optimizers, chapters 1-6, John Wiley&Sons, 2005.

*Connections with other courses:* A compulsory requirement is completion of Basics of Databases (811380A)

*Timing and target group:* Period c. Compulsory. 3rd year.

*Person in charge:* Ilkka Tervonen

### **811343A Digital Image Processing, 4 ECTS**

The students learn how to use digital techniques to produce graphic elements and images especially for screen display. They learn how to digitise images and to produce, edit and convert graphics and save them in different formats for different uses. Creative image manipulation is also performed in the course on the basis of the supplied ideas.

*Contents:* 1. Basics of digital images, 2. Bitmap graphics, 3. Vector graphics, 4. Image formats and their uses, 5.

Technical image processing, 6. Methods of creative image processing, 7. Colour systems and the use of colour palettes.

*Methods:* Lectures 40 h, exercises 40 h, assignment 40 h.

*Learning materials and literature:* Lecture materials and other supplementary literature to be announced during the lectures.

*Connections with other courses:* The course must be preceded by Introduction to Digital Media. The Individual as a User of Information Technology also recommended.

*Timing and target group:* Period b Targeted for the 2nd and 3rd year students of information processing science, recommended in the Digital Media specialisation programme, while students in other degree programmes can take the course with a special permission.

*Person in charge:* Eeva Leinonen



### **813318A Dimensions of Software Entrepreneurship, 5 ECTS**

The course aims to show how to discern software entrepreneurship and new essential subtexts in software business creation. The main content of the course is following: (1) Software entrepreneurship as an event and the concept of enterprise, (2) The software entrepreneur as an individual, teamwork and the software business acting environment, (3) Processes of the software entrepreneur, (4) New software business' trade models and strategies, (5) Behavior based on entrepreneurship in the software business.

*Methods:* (1) Familiarizing software entrepreneurship work in the field. (2) Lectures according to the content above. (3) Group project.

*Timing and target group:* Period a, compulsory in the Software Business programme. No prerequisite courses. Also suitable for other programme students.

*Literature:* 1. Timmons, J. & S. Spinelli (2003). New Venture Creation: Entrepreneurship for the 21st Century. McGraw-Hill: Irwin. Lecture material.

*Person in charge:* Vesa Puhakka

### **811342A Graphic Design, 4 ECTS**

This course introduces the basics of two-dimensional surface design and visual design, typography, and the basic principles of layout and the use of colours. The students learn to analyse wholes formed by images, signs and text and also know how to use the methods of visual expression, layout and typography in their own work. A small-scale digital publication will be designed during the course. Contents: 1. Historical foundations of graphic style, 2. Typography, 3. Shapes and proportions, 4. Language of signs and symbols, 5. Visual expression, 6. Foundations of the theory of colours, 7. Page layout models.

*Methods:* Lectures 40 h, exercises 27 h, analytical exercises 20 h, assignment 20 h.

*Learning materials and literature:* Material is in Optima, course literature is announced in the beginning of the course.

*Connections with other courses:* The prerequisite course is Introduction to Digital Media (811172P) and preferably also by Humans as Users and Developers of Information Technology (811171P).

*Timing and target group:* Period c. Aimed for the 2nd and 3rd year students in Information Processing Science. Compulsory in the Digital Media programme. Students in other degree programmes can take the course with a special permission.

*Person in charge:* Katja Halvari and Tanja Kangas

### **815348A ICT Standardization, 6 ECTS**

The course gives an introduction to the world of standards, i.e. an international approach to stimulate development, manufacturing and deployment of ICT (information and communications technology) and allow open competition in the growing ICT market. The course will present different standardization organizations ranging from official international standardization bodies to industrial alliances and adhoc task groups. The course will also look at the dark side, e.g. the politics and power play behind standards. Case studies include: mobile system standards NMT, GSM, WCDMA and emerging 4G standardization.

*Methods:* Lectures (30 h), exercises (12 h), project (70 h) and exam (50 h). Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. Exercises train the students to work and contribute in a standardization task force. Project teams are formed of 2-3 students. A list of topics is presented on important standards with some base reference material. Students carry out additional information searches, source correlation and background research. The goal is to write and present a report providing a history of the development of the standard, key elements of the standards, analysis of those who were contributing to the standard and why, and an analysis of the future direction of the standard. The course uses the Optima Web-based learning environment for material and project coordination.

*Timing and target group:* Period a-b, mandatory for Mobile Services orientation, 3rd-4th year. The course will be organized for the first time in autumn 2006.

*Prerequisites:* Mobile Internet Service Architecture.

*References:* Knut Blind, The economics of standards: theory, evidence, policy. Publisher: Edward Elgar. 2004. ISBN 1843767937. Lecture slides, seminar material.

*Person in charge:* Seamus Hickey

### **811360A Information Security and the Law, 3 ECTS**

The course focuses on legal regulation of information security and data protection and on information security as a legal concept and principle. Having completed the course, the student will understand the meaning of Finnish and EU legislation for information security and data protection. The student is capable of understanding the relation between information technology and the law by analysing information security as a judicial objective. The student understands the interaction between information security on one hand and the protection of privacy and property on the other hand. The student also identifies main characteristics related to the legal regulation of the networked information society. Main topics include: 1. Information security and data protection as a legal concept. 2. The importance of information security and the protection of privacy and property in the networked information society. 3. Information security as a technical and judicial objective. 4. Regulation of information security and privacy and property protection in Finland, the other Nordic countries, EU jurisdiction and globally.

*Methods:* Lectures 20 h, examination.

*Timing:* Period a. Optional.



*Literature:* To be announced during the lectures and on the course Web page. The course must be preceded by Legislation on Digital Information (812317A).

*Person in charge:* Pekka Salonpää

*WWW address:* <http://www.tol.oulu.fi/~salonpaa/titulaki.html>

### **811327A Information Security Management, 5 ECTS**

In present-day organizations executing information security is lifeline for competitiveness and function. This course offers student knowledge of what things includes in information security management in organizations. The course enlarges the questions and methods in information security management including the next subjects: managing information risks, securing continuity in business, information security politics, information security directions, information security education, information security awareness, information security culture in organization, standards of managing information security and other methods. After passing the course student has an understanding of how to execute information security management well in organization and what challenges are related to that.

*Methods:* Lectures 30 h, assignment 40 h, familiarizing lecture- and exercise materials 60 h, examination 30 h.

*Literature:* Literature is announced in the beginning of the course (the course is assembled of scientific publications).

*Connection with other courses:* Preceding course is Principles of Information Security (811173P).

*Timing and target group:* Period x, optional, 2nd - 4th year.

*Person in charge:* Tapio Kuivalainen

### **811358A Information Society, 2 ECTS**

Finnish society is considered as one of the pioneers in the information society development. The course introduces different information society theories through literature. The course aims to give student devices to following and understanding information society development. The course gives basic knowledge to all who studies information processing science.

*Methods:* Examination in set literature (independent familiarizing 40 h, examination).

*Literature:* Frack Webster – Theories of the Information Society (2002). The book can be found as an e-book from ebrary throughout library's websites.

*Timing and target group:* Examination dates twice a term and a summer examination date. May be chosen freely by information processing science and minor subject students.

*Person in charge:* Pekka Salonpää

### **812625A Information Systems Design Exercise, 6 op**

A practical information systems design exercise is carried out in groups of 3 to 4 students. The focus is on phases of information systems design before software design. The exercise work is carried out using a chosen information systems design methodology (currently Contextual Design). Having completed the course, the student a) understands the connections between information systems design and redesign of user and customer organization work practices b) knows how to apply the above mentioned information systems design methodology in practice, and c) possesses the basic skills to study information systems design methodologies in more depth in the Information Systems Design Methodologies course.

*Methods:* Introductory lectures, supervised exercise work, seminars.

*Requirements:* Participation in the lectures and in the exercise work, presentation of the exercise work in the closing seminar and an individual learning diary.

*Literature:* Depends on the methodology chosen, currently Beyer, H. – Holtzblatt, K. (1998): Contextual Design: Defining Customer-Centered Systems. San Francisco: Morgan Kaufmann Publishers, Inc.

*Connections with other courses:* The preceding compulsory courses are: Introduction to Information Systems Design (811170P), Object-Oriented Software Development (811378A).

*Timing and target group:* Periods a + b. 3rd year. Mandatory in Information Systems program

*Person in charge:* Netta Iivari

### **812324A Information Systems Design Methods, 4 ECTS**

The course expands and deepens the ideas involving the problems of information systems development that have emerged from Introduction to Information Systems Design and Object-Oriented Analysis and Design, and in the Information Systems Design assignment. A special focus is on the development of information systems from the viewpoint of the activities of the organization that is utilizing them and of the work of the users of the system. Having completed the course, the student a) knows the main characteristics of the most important information systems design methods and b) knows how to evaluate the usability of the methods in different design situations. Course content: 1. Introduction, 2. Process models, 3. Modeling approaches, 4. Summary and comparisons.

*Methods:* Lectures 30 h, examination, self study and/or group work 75 hours. The web pages of the course provide up-to-date information before course begins.

*Connections with other courses:* The preceding compulsory courses are Introduction to Data Management, Object-Oriented Analysis and Design (812346A), Information Systems Design (812625A) assignment and Software Engineering.

*Timing and target group:* Period c, from 3rd to nth years. Mandatory for Information Systems Line majors.

*Literature:* See course web pages.

*Person in charge:* Mika Koivuluoma

*Web address:* <http://www.tol.oulu.fi/kurssit/tjsm>





### **811357A Information Technology and Working Life, 2 ECTS**

Which new challenges and opportunities has information technology introduced into working life? What does information work mean and who are information workers?

*Methods:* Examination to be taken based on set literature.

*Literature:* Blom, Raimo & Melin, Harri & Pyöriä, Pasi: Tietotyö ja työelämän muutos: palkkatyön arki tietoyhteiskunnassa, Gaudeamus, 2001.

*Timing and target group:* Examination dates twice a term and a summer examination. The course may be chosen freely by information processing science students and minor subject students.

*Person in charge:* Risto Nuutinen

### **811355A Information Technology Ethics, 3 ECTS**

*Contents:* Introduction, history, basics and problems within the theories of moral philosophy, discussion and solving of selected problems in information technology ethics by means of the theories of moral philosophy, for example.

*Methods:* Opening lectures 12 h and a book examination.

*Learning materials and literature:* Lecture handout; Johnson, D. G., (1994; 2001), Computer Ethics, Prentice Hall. Upper Saddle River and parts of Weckert, J., & Adeney, D., (1997), Computer and Information Ethics. Greenwood Press. Westport, Connecticut, London.

*Timing and target group:* Period a. Optional.

*Person in charge:* Mikko Siponen

### **812335A Interaction Design, 6 ECTS**

The course is a follow-up course of "Introduction to Human-Computer Interaction", 811379A. The course provides guidelines and models for how to design user interfaces and various user interface elements. The focus of is mainly windows style software applications but also web pages and the user interfaces of electronic devices are discussed.

*Methods:* Lectures 20 h, exercises 80 h, examination.

*Learning materials:* Announced during the course.

*Connections with other courses:* Introduction to Human-Computer Interaction (811379A)

*Timing and target group:* Period c, 2nd - 3rd year students.

*Person in charge:* Timo Jokela

### **811338A Internet and the Information Networks, 5 ECTS**

This course introduces the student to the basics of data communications, the protocols, the development of the Internet into a global information network, the services available on the Internet and the tools needed to produce and use them. Upon completion of the course the student has the basic ability to produce and publish digital content using Web based tools. Another goal is to evaluate the developmental trends underlying the Internet, learn to know the strategies of the changing information society and information technology and understand data security from an individual's point of view. The Internet is seen not only as a global source of knowledge, but also as an information transmission channel and learning environment for working groups, organizations, communities and learners. The course provides a basis for taking other courses in the Digital Media specialization programme.

*Methods:* The course includes 30 hours of lectures offered in contact and/or distance teaching as well as 30 hours of supervised exercises. The student shall carry out the course assignments under the supervision of the tutors and store them in a Web based learning environment. Requirements for passing the course: A. Final examination on the basis of the lecture and exercise materials produced for the leaning environment and B. Approved completion of the assignments.

*Supplementary literature:* All the supplementary materials for the lectures, self-study and exercise materials including the links and references are available in digital form in the Web based learning environment or elsewhere on distribution media to be announced separately. Recommended reference materials include basic literature and Internet materials on data communications and Web technologies. Castells Manuel & Himanen Pekka. Suomen tietoyhteiskuntamalli, translated into Finnish by Jukka Kemppinen, SITRA ja WSOY 2001

*Timing and target group:* Period b. Compulsory in the Digital Media programme. A recommended course for minor subject students in data processing sciences.

*Person in charge:* Juha Kortelainen

### **811382A Introduction to Research, 2 ECTS**

The general orientation of the course is to prepare students for scientific thinking and scientific writing. The goal is that the student knows the role of the university as a major contributor to the fields of science and the common terms in scientific discussion. Also, the goal is to teach students the basics of scientific argumentation and coach them to analyze and evaluate scientific articles.

*Contents:* History of scientific research. The origins, trends and status of the university as a research institution. Studies, postgraduates and research as a duty. Mechanisms of scientific discussion. Scientific text writing as a basic unit of scientific discussion. Structure of scientific argumentation.

*Methods:* Lectures 20 h, homework 25 h, seminars 10 h.

*Connections with other course:* The prerequisite course is Introduction to the Information Processing Science (810136P). The course has to be passed before the beginning of Bachelor of Science thesis.

*Timing and target group:* Compulsory, 2nd year, Period c. The course is to be taken at the same time as Sources of



Scientific Information (030004P) organized by the Science and Technology Library, Tellus.  
*Person in charge:* Kari Kuutti

### **811337A Introduction to Compilers, 6 ECTS**

The course provides the basis for knowledge concerning the formal syntax of programming languages and for the systematic solution of syntax-oriented programming tasks. Contents: 1. Introduction 2. Regular languages and element analysis 3. Context independent languages and syntax analysis 4. Semantic analysis 5. Code creation.

*Methods:* Assignment and examination.

*Learning materials and literature:* David A. Watt and Deryck F. Brown, Programming Language Processors in Java: Compilers and Interpreters, Prentice Hall, 2000, or other learning materials as agreed.

*Connections with other courses:* Preceding courses: Introduction to Programming and Data Structures or equivalent knowledge.

*Timing and target group:* Optional.

*Persons in charge:* Martti Luodonpää

### **811376A Introduction to Data Structures, 3 ECTS**

How can ideas that are developed in solving problems be described with a program language? To become familiarize with most common data structures and those processing algorithms provides good tips to solve this question. The study module also settles the meaning of abstractions and complexity in solving programming tasks. Contents: 1. Introduction, 2. Algorithms, 3. Arrays, 4. Stacks, queues and linked lists, 5. Graphs, 6. Trees.

*Methods:* Lectures 28 h, exercises 18 h, examination and independent and/or group work about 30 h.

*Literature:* Lecture material or Cormen, Thomas H., Leiserson, Charles E. and Rivest, Ronald L., Introduction to Algorithms, MIT Press (McGraw-Hill), 1989 or newer edition (when applicable)

*Connections with other courses:* The compulsory preceding courses are Introduction to Programming (811122P) and Programming Assignment I (811175P) or students must possess corresponding knowledge.

*Timing and target group:* Period c, compulsory, 1st year.

*Person in charge:* Martti Luodonpää

### **811379A Introduction to Human-Computer Interaction, 5 ECTS**

This course provides basic knowledge concerning the characteristics and design of user interfaces. The course includes: types of user interfaces, interface paradigms and interaction elements; user interface design rules, basics of usability engineering and usability evaluation techniques, universal design and user support.

*Methods:* Lectures 20 h, exercises 27 h, examination.

*Learning materials:* Selected chapters from Dix & al: Human-Computer Interaction, 3rd edition; other material and more details announced during the course.

*Timing and target group:* Period a, 2nd year students.

*Person in charge:* Timo Jokela

### **811387A Mac OS X Programming, 4 ECTS**

Apple Mac OS X is a modern operating system that combines the traditional and demonstrably stable UNIX platform with the latest GUI innovations. The elegant and efficient object-based programming interface called Cocoa, along with the graphical design tools Apple provides, enables rapid application development. This course focuses on developing graphical document-based applications using the Objective-C programming languages. It will also provide an introduction to other features integral to Mac OS X that help with the development process. After taking the course, a student will have general knowledge about Mac OS X and its functionality as a software development platform. The course is one of several parallel programming environment courses.

*Methods:* lectures and exercises 50 h, own work 50 h.

*Literature:* Apple Developer Connection (<http://developer.apple.com/>) and the material on the Web site of the course.

*Connections with other courses:* The compulsory preceding course is Object-Oriented Analysis and Design (811378A). Object-Oriented programming (812314A) is also recommended as a preceding course.

*Timing and target group:* Period c, optional, 2nd year. Compulsory in the Software Production program.

*Person in charge:* Virtu Halttunen

*Web address:* <http://www.tol.oulu.fi/kurssit/macosex/>

### **815349A Mobile Internet Service Architecture, 8 ECTS**

The course is an introduction to the general architecture of the mobile Internet and its core enablers and services. The MISA course delivers a comprehensive knowledge base for mobile service understanding, creation and management. The topics included are: Principles, Service Software Architecture, Service Enablers, All-IP vision, IPv6, Mobile IP, Quality of Service, SIP, Mobile VPN, Wireless Access, Application Layer Technologies, Service Development Tools and Standardization. Lectures also review the current and emerging technologies and their deployment. The exercises demonstrate examples of different maturity technologies and their implementations.

*Activities:* lectures (36 h) exercise (120 h) exam (60). Parts of the lectures are online digital presentations. Exercises include 10 hours of laboratory demonstrations and 110 hours of a student project. Attendance at 3 of the 5 laboratory exercises is compulsory (2 hours / lab, 1 lab / week). The students are organized into project groups of 2-3 students per team). English is the recommended language for student reports; however Finnish can be used as well.



*References:* Nokia: Mobile Internet Technical Architecture Vol 1-3, IT Press. ISBN 951-826-671-9. (partially). Camarillo, Gonzalo, and Miguel-Angel Garcia-Martin: The 3G IP multimedia subsystem (IMS): merging the Internet and the cellular worlds. John Wiley & Sons, 2004. ISBN 0-470-87156-3. 406 p. (partially). Lecture notes.

*Prerequisites:* Internet and Computer Networks (811338A).

*Timing:* Periods a-b.

*Person in charge:* Peter Antoniac

### **811359A Mobile Systems Programming, 5 ECTS**

The course introduces the students to the special characteristics of mobile systems and to their programming. The Symbian and mobile Java environments will be used in the exercises.

*Methods:* Lectures 24 h, two assignments, an examination.

*Learning materials and literature:* Lecture materials.

*Connections with other courses:* The course must be preceded by Software Engineering.

*Timing and target group:* Periods b + c. Optional.

*Person in charge:* Antti Juustila

*Web address:* <http://www.tol.oulu.fi/kurssit/mobo/>

### **811362A Multimedia Techniques, 4 ECTS**

The course deals with a variety of multimedia techniques as part of the target system from the viewpoint of the process of creating multimedia. The techniques discussed during the course are connected with the processing and production of images, animations, video and sound. The course aims at giving the student knowledge and the means to produce and edit multimedia elements using different techniques.

*Methods:* Lectures 30 h, exercises 30 h, assignment 60 h.

*Learning materials and literature:* Lecture handouts and other materials to be announced during the lecture.

*Connections with other courses:* The course must be preceded by the Introduction to Digital Media (811172P); it is also recommended that Internet and Information Networks (811338A) should precede this course.

*Timing and target group:* Period c. 1st year. Optional.

*Person in charge:* Tomi Kujanpää

### **811363A Narrative Analysis and Design, 5 ECTS**

This course introduces the narrative and applies it to content creation in digital media. The course aims to survey strategies of expression arrangement and presentation and to offer tools for their structural analysis. Another goal is to develop critical expression and to reinforce the ability to identify different working methods and viewpoints connected with the design and implementation of various works in digital form. The narrative of space and conceptually structural design of digital media in games and environmental design are studied, as are the significant relationships of time and place shifts and their utilization in link structures and user interfaces.

*Method:* Active participation in joint meetings (40 h), an applied assignment (40 h) and an essay analyzing the application (40 h).

*Learning materials:* Lecture materials and other supplementary materials to be distributed.

*Timing and target group:* Period c. Optional starting from the 2nd year. Intended for students of information processing science, especially Digital Media, and those majoring in literature. Registration in advance is required.

*Person in charge:* Pekka Koskinen

### **812337A Net Culture, 4 ECTS**

The net culture affects more or less everyone practicing information technology from software developers to script writers. Cultural understanding is an essential way to perceive development trends in information technology, and to see the decent definers along with technical definers on software development. The course pursues to validate student ability to chart events developing in the net, from new distributive methods to memetic cultural cases.

*Methods:* The course uses an applied study group-model: The backbone of the course is based on 3-5 case-studies that are chosen to fix events that are developed in the net and that are essential at that moment. These events are considered from various points of view, exposing ethical, economical, social and technical questions, and encouraging contemplation of researchable material and assignments directed at information retrieval. The study module consists of lectures, group work and examination, which can be compensated for with a literary essay that has to be separately arranged with the person in charge.

*Connections with other courses:* The prerequisite course is Introduction to Digital Media (811339A).

*Timing and target group:* Period b, 2nd-nth year, compulsory to Digital Media program.

*Person in charge:* Minna Isomursu

*Web address:* <http://www.tol.oulu.fi/kurssit/verkkokulttuurit/>

### **811354A Network Security, 5 ECTS**

Security risks and threats represent a major obstacle to the expanding utilization of information networks and to the diversification of the services provided by them. The increased use of networks has also brought along with it questionable and even criminal activities and both individual people and various organizations have suffered from the damage caused by data system break-ins and viruses. This course introduces modern solutions to the problems of network security. Students become familiar with the structure of networks, basic concepts of information security, encryption, cryptographic algorithms and protocols as well as security strategies on different levels of the network. The



security issues related to applications (e-mail, electronic commerce) and firewalls are also covered during the course.

*Methods:* Lectures 40 h, demonstrations 20 h, examination.

*Learning materials and literature:* Lecture materials.

*Connections with other courses:* Mastery of the basics of information security.

*Timing and target group:* Period b. 2nd to nth years. Optional.

*Person in charge:* Juha Kortelainen

### **811356A New Media Communication, 5 ECTS**

The course considers new media and more generally the digital media culture from the viewpoint of communication. This course provides a theoretical capability to analyze and understand the phenomena and meanings of new media and the digital media culture. Media arts and virtual communities, among others, are subjected to an analysis.

*Methods:* Lectures 40 h, exercises 40 h, examination or essay.

*Learning materials and literature:* Lecture materials and other distributed supplementary materials.

*Connections with other courses:* The course must be preceded by Introduction to Digital Media and Introduction to Information Processing Sciences.

*Timing and target group:* Period a. Compulsory in the Digital Media programme from 2nd year upwards. Students in other degree programmes can take the course with a special permission.

*Person in charge:* Kari Kuutti

### **811349A New Media Design, 4 ECTS**

This course is about the processes and techniques of content design in digital media, or as it is often defined, new media. The students are guided to realise the potential of new media and then encouraged to think how to design and plan content for those. The students are required to produce a design document (or relevant) for their new media content/application. The design is not only about writing only, but includes drawing, discussions, brainstorming, storyboarding, design games, and numerous other innovative methods.

*Methods:* Lectures 20 h, exercises 40 h, assignment 60 h.

*Learning materials and literature:* Lecture materials + additional readings

*Connections with other courses:* The course must be preceded by Introduction to Digital Media. Students can implement their design during the following module (Multimedia Techniques 811362A)

*Timing and target group:* Period b. Targeted for 2nd students. Mandatory for the Digital Media students.

*Person in charge:* Tony Manninen

### **812346A Object-Oriented Analysis and Design, 4 ECTS**

The course introduces, among other UML-notation, object based software developmental process, software architectures and components, design models and software frames that are related to objects. Having completed the course, the student understands object-oriented analysis and design models, modeling techniques, design principles and the use of design patterns. Also, the student knows how to enforce design patterns and steps in practice.

*Literature:* To be announced during the opening lecture.

*Methods:* Lectures 26 h, exercises 24 h. To pass the course the student needs to take the examination.

*Connections with other courses:* The preceding compulsory course is Object-Oriented Software Development (811378A).

*Timing and target group:* 2nd year, Period a, compulsory in the software engineering program.

*Person in charge:* Jouni K. Kokkonen ([jouni.kokkonen@oulu.fi](mailto:jouni.kokkonen@oulu.fi))

### **812347A Object-Oriented Programming, 4 ECTS**

Improved maintainability and reusability are the key benefits of object-oriented software. Furthermore, productivity of software development increases because ready-made components and class libraries can be utilized during implementation. The course provides information on achieving these benefits in practice by using inheritance, polymorphism, design patterns and other advanced object-oriented techniques from the programming viewpoint.

*Methods:* Lectures and demos 32 h, exercises 24 h, homework ~40 h, examination.

*Literature:* Timothy Budd: An Introduction to Object-Oriented Programming, 3rd edition, chapters 10 – 27 and lecture material.

*Connections with other courses:* The course must be preceded by Object-Oriented Software Development (811378A) and Programming Assignment I (811175P). Programming Assignment II (811377A) is also recommended.

*Timing and target groups:* Period c, compulsory in the Software Engineering programme, 2nd year.

*Person in charge:* Lasse Harjumaa

*Web address:* <http://www.tol.oulu.fi/kurssit/olio-ohjelmointi/>

### **811378A Object-Oriented Software Development, 5 ECTS**

Object orientation is the leading paradigm in modern software engineering. Object technologies are used to improve the quality and productivity of software development. However, it is not possible to achieve these benefits without a proper understanding of the principles of object orientation. This course introduces the concepts and meaning of object orientation. Design and implementation issues concerning objects, classes, encapsulation, class relations, inheritance and polymorphism are discussed during the course.

*Methods:* Lectures 32 h, laboratories 24 h, homework. 60 h, examination.

*Literature:* UML Distilled: A Brief Guide to the Standard Object Modeling Language, 3rd Edition, chapters 1, 3, 5 - 6, 9 and Timothy Budd: An Introduction to Object-Oriented Programming, 3rd edition, chapters 1 - 5, 8, 14 - 17.





*Connections with other courses:* The course must be preceded by Introduction to programming (811122P).

*Timing and target group:* Period c, mandatory, 1st year.

*Person in charge:* Lasse Harjumaa

*Web address:* <http://www.tol.oulu.fi/kurssit/osok/>

### **812304A Organisations and Information Systems, 6 ECTS**

Upon completion of the course, the student knows how to analyse information systems from the organisations' point of view, understands the prerequisites for successful information activities in organisations and is capable of analysing the development of information systems. Contents: 1. Organisational foundations of information systems, 2. Introduction to organisation theory and decision making, 3. Information and knowledge formation in the activities of organisations, 4. Information systems and change in organisations, 5. Knowledge management, 6. Information technology in support of decision making.

*Methods:* Lectures 27 h. Passing the course requires an examination.

*Connections with other courses:* Introduction to Information Systems Design is recommended as a preceding course.

*Timing and target group:* Period c. Compulsory, second year.

*Literature:* To be announced on the course Web page.

*Person in charge:* Ari Heiskanen

### **813353A Electronic Issues, 4 ECTS**

The course familiarizes students with information systems that support organizations' business and trade. After passing the course student has an understanding of among others characteristics of good mart and birth of user experience.

*Methods:* Lectures 24 h and examination.

*Literature:* Literature is announced during the course.

*Connections with other courses:* Preceding compulsory course is Introduction to Information Systems Design (811170P).

*Timing and target group:* Period b. Compulsory in Digital Media and Information Systems specialization programmes. 2nd year.

*Person in charge:* Seppo Pahnla

### **815301A Parallel Programming, 5 ECTS**

Parallel programming refers to the construction of programs in which several tasks are performed at the same time in distinction from "normal" sequential programming. This introduces new kinds of problems for software design. First, the principles of parallelism are considered, followed by multi-threaded programming in which parallelism is contained in the same program. Finally, an introduction is provided to the basics of distributed programming. The programs are mostly constructed using Java. An effort is made, however, to introduce the principles in such a way that they also benefit students who need to construct parallel programs in other languages.

*Methods:* Lectures 36 h, exercises 27 h, examination.

*Learning material and literature:* Lecture material, and Ben-Ari, M.: Principles of Concurrent and Distributed Programming, Prentice Hall 1990, and Hartley, Stephen J.: Concurrent Programming: The Java Programming Language Oxford University Press 1998, and Lea, Doug: Concurrent Programming in Java, Design Principles and Patterns Second Edition, Addison-Wesley 2000.

*Connections with other courses:* The course must be preceded by Introduction to Programming (811122P) and Programming Assignment I (811175P). Introduction to Data Structures (811376A), Object-oriented software development (811378A) and Programming Assignment II (811377A) are recommended as preceding courses.

*Timing and target group:* Period b. Optional. 3rd year.

*Person in charge:* Ari Vesanen

*Web address:* [http://www.tol.oulu.fi/~avesanen/Rinn\\_Ohjelm/](http://www.tol.oulu.fi/~avesanen/Rinn_Ohjelm/)

### **815338A Principles of Programming Languages, 5 ECTS**

The course aims at providing an overview of the most important programming languages and the paradigms connected with their classification. First, general principles for the evaluation of programming languages and connection independent definition and description models are presented. The basic structures of imperative, object-oriented and parallel programming are discussed based on selected languages. An introduction is also provided to the most important alternative programming paradigms, functional and logic programming. Having completed the course, the student knows the general principles and structure of programming languages and understands their effects on the implementation and use of the languages.

*Methods:* Lectures 36 h, exercises 24 h, examination.

*Learning materials and literature:* Lecture material, Robert W. Sebesta, Concepts of Programming Languages, 4th Edition, Addison-Wesley 1999 (or more recent).

*Connections with other courses:* The participants are required to have completed Introduction to Programming (811122P) or to have experience in a general programming language acquired in some other way. Previous completion of Introduction to Data Structures (811376A) is also recommended.

*Timing and target group:* Period c. Optional. 1st year.

*Person in charge:* Ari Vesanen

*Web address:* <http://www.tol.oulu.fi/kurssit/okp/>

### **813324A Productization of Software Business, 5 ECTS**



The course aims to teach students what software products and production expert services produced by software businesses are and what that productization process means in the real world. The essential content of the course is: 1. What productization is and where it is needed, 2. Productization of software products and expert services, 3. Productization strategy and process from a technical and commercial point of view, 4. A software product's commercialization process – marketing plan, delivery channels, refining the product strategy, product launching, 5. The benefits attained by productization from the organization's, client's and staff's point of view.

*Methods:* Familiarizing productization process of software business, lectures accordingly the content above and group project.

*Connections with other courses:* The recommended preceding course is Introduction to Software Business (811174P); preceding marketing studies are also recommended.

*Timing and target group:* Period a, mandatory in the Software Business program; also conforms to other programs.

*Literature:* Announced at the beginning of the course.

*Person in charge:* Juhani Warsta

### **811377A Programming Assignment II, 2 ECTS**

Programming can only be learned through practice, experimenting and pondering over what happens during the execution of a program. The purpose of Programming Assignment courses is to provide time for that learning process, and to enable students to apply the knowledge given in theory courses in practice. In addition, student can be sure that s/he has attained a satisfactory level of knowledge in order to continue to the next programming course. The purpose of the Programming Assignment II is that student can independently design and implement smallish software according to the object paradigm learned in the Object-oriented Software Development course.

*Methods:* Assignment about 50 h.

*Literature:* Object-oriented software development (811378A) course material.

*Connections with other courses:* The compulsory preceding course is Programming Assignment I (811175P). The Object-oriented software development (811378A) course is also needed. The course prepares students to participate in the Software Engineering (811335A) course.

*Timing and target group:* Period a, compulsory, 2nd year. The course can be taken already in the summer between 1st and 2nd year.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/ohjelmointityo/>

### **811381A Programming Assignment III, 3 ECTS**

The course allows the practical implementation of the topics learned during previous, more theoretically-oriented courses. It aims to integrate the basics from Object-oriented programming, databases, and user interface design and implementation. This integration and practical implementation is realized in the form of developing a database-oriented application that has a user interface designed for good usability.

*Prerequisites:* Skills and knowledge for databases (course 811318A) and basics for user interface design. Programming assignment 2 must be passed. The course will be given in Finnish, but additional readings can also be provided in English.

*Person in charge:* Jouni Lappalainen

*Web address:* <http://www.tol.oulu.fi/kurssit/ot3/>

### **811385A Programming Assignment IV, 2 ECTS**

During this course a web-based addition is designed and implemented to the system developed during the Programming Assignment 3 course.

*Prerequisites:* Simultaneous passing of the Programming Assignment 3. All teaching and all forms of taking this course are included in the PA3-course. The Basics of HTML. The course will be given in Finnish, but additional readings can also be provided in English.

*Person in charge:* Jouni Lappalainen

### **814311A Progressive Sandwich Training, 8 ECTS**

The purpose of the training is to make it easier for the students to adapt into working life, to get necessary working experience and to give a possibility to widen professional skills at the same time. Duties may be related to designing, executing and maintaining information systems and softwares; marketing and productization systems; entrepreneurship and internationality; producing contents to systems and mobile systems. In the other words training must be suited for specialization programs that department educates. At least half of the training shall consist of demanding IT professional tasks and the other half may consist of less demanding IT functions. The training can be divided into several periods, in which case the competence required will increase as the student proceeds in the studies. It is important for students to connect education knowledge and working experience together. The own reflection is a part of the foundation of learning and developing own profession and specialist. Because of that passing the course student has to write a training report that purpose is to develop skills to describe working tasks and working experience clearly.

*Methods:* 75 working days (about 600 hours) of training in IT functions as required above. The training shall be certified by the training site. Testimonial may involve besides basic information also employer's brief description of the tasks and the completion. Study attainments are attached along. Student establishes a taut training report of the training (3-7 pages), where student tells what has been done, where, with what tools, working environment and things like that has included in training. What meaning working training has learning work and studies? How progressive sandwich training

has helped to understand thyself and way to act? How learned skills can be exploited or from which course student should have had more knowledge or would have had if the employment had continued?

*Timing and target group:* Voluntary for students majoring in information processing science. Timing is free. The department organizes notices and briefings related to progressive sandwich training.

*Persons in charge:* Hilikka Poutanen (basic students) and Kari Pankkonen (retraining and Masters programmes)

### **811365A Project I, 10 ECTS**

The course has an integrative nature and covers the content areas of the previous courses in the degree programme. The environment where a project is implemented is determined on the basis of the project-specific assignment. As a rule, an effort is made to choose an environment that is typical of programming or digital media production. Projects are arranged in the autumn and spring terms. Having completed this course, students know how to a) apply into practice the theory of production project management that they have previously learned, b) act as members of a project group, c) communicate through speech and writing with external and internal project parties, and d) have experience in the planning, implementing in practice and final testing of an approach to a problem.

*Literature:* Literature of prerequisite courses and project instructions.

*Methods:* Supervised project work (approx. 200 h) in a realistic setting.

*Connections with other courses:* The compulsory prerequisite courses are: Introduction to Programming, Object-Oriented Programming, Data Structures, Introduction to Information Systems Design, Introduction to Project Work, Introduction to Data Management, and an examination or assignment on Software Engineering or participation in 80 % of the exercises. Timing and target group: Compulsory. 3rd to nth year.

*Person in charge:* Teemu Kilpi and Kai Lindberg

*Web address:* A link to additional information can be found on the home page of the person in charge.

<http://www.tol.oulu.fi/~tkil/>

### **811330A Project Management, 5 ECTS**

*Methods:* Students function as responsible project managers as a responsible project manager in Project I, managing the project's planning and internal supervision and being responsible for reporting on the project. A project supervisor, who is a staff member and the person in charge of the course, is appointed by the department and supervises the manager's work. Additionally, small-scale seminars are arranged among the managers as necessary both before and during the project, discussing the project's problems and solutions to them.

*Connections with other courses:* The course must be preceded by Project I.

*Timing and target group:* Recommended for the 4th year.

*Person in charge:* Teemu Kilpi, email: Teemu.Kilpi@oulu.fi

*Web address:* A link to additional information to be found on the homepage of the person in charge of the course.

<http://www.tol.oulu.fi/~tkil/>

### **811391A Requirements Construction, 4 ECTS**

The study module aims at giving a comprehensive picture of information system's and software's requirements construction that covers "hard" (semiformal) and "soft" methods. The course integrates and complements other subject related courses from a requirements construction point of view. Content: 1. Introduction, 2. Requirements construction processes, 3. Modeling and prototyping, 4. Requirements construction techniques, 5. Summary and comparison.

*Methods:* Lectures 40 h, student's independent assignment (familiarizing the literature and written exercises) 65 h. The course requirements, methods, literature and lecture material are announced on the course's web-site.

*Connections with other courses:* The compulsory prerequisite courses are: Introduction to Information Systems Design (811170P), Introduction to Human-Computer Interaction (811379A), Software Engineering (811335A), Basics of Databases (811380A) and Object-Oriented Analysis and Design (811334A).

*Timing and target group:* Recommended in the Information Systems and Software Engineering programs, 3rd-4th year.

*Person in charge:* Sari Tuovila

*Web address:* [www.tol.oulu.fi/kurssit/vm](http://www.tol.oulu.fi/kurssit/vm)

### **813325A Sales Strategies in Software Business, 5 ECTS**

The orientation of the course is to learn software product and project selling in practice and sales management. The essential content of the course: 1. What is selling and how does it fit as a part of the company's marketing, 2. The special characteristics of software products and projects, 3. Selling software products and projects, 4. Managing software product and project sales, 5. Selling in practice.

*Methods:* Becoming acquainted with practical selling in a software company, lectures mentioned above and group project.

*Connection with other courses:* It is recommended to take Introduction to Software Business (811174P) as a preceding course; preceding studies in marketing and production are recommended.

*Timing and target group:* Period b, compulsory in the Software Business programme, suitable also for other programmes.

*Literature:* Literature to be announced at the beginning of the course.

*Person in charge:* Juhani Warsta

### **815352A Secure System Design, 4 ECTS**

The course introduces common problems in secure information systems' development and gives examples of how to overcome these challenges by using selected methods. The course supplements other courses related to software



engineering and information system design by teaching how information security can be integrated into the development process. During the course students learn how to model information security threats by using abuse scenarios and abuse cases. The course is recommended to students in the software production and information systems training programs. Having completed the course the student I) understands how information security is handled during the development process, II) understands the modeling process of security requirements and III) knows how to apply abuse scenarios and abuse cases during development.

*Methods:* Lectures 30 h, exercises 30 h or independent assignment, examination 60 h

*Literature:* The course material is based on scientific articles published in conferences or journals.

*Timing and target group:* period b, optional, 2nd to nth year

*Person in charge:* Juhani Heikka

### **814340A Small Group Tutoring, 2 ECTS**

Second to fifth year students can function as small group tutors in their degree programmes. A small group tutor will guide a group of approx. ten students gathered from the 1st year students. The experiences in tutoring and guidance are also useful abilities for IT professionals in practical working life. For the 1st year students, participation in the small groups is part of the Orientation Studies. The tutors are trained by the Faculty of Sciences, the department of Information Processing Science and student guild Blanko ry.

*Methods:* Small group tutoring 10 -15 h for the 1st year students, participation in tutor training.

*Timing and target group:* Tutor training during period c, small group tutoring during periods a and b. Optional. 2nd to 5th years.

*Person in charge:* Heli Alatalo

### **815347A Software Architectures, 6 ECTS**

Software architectures are the keys to effective and efficient software products and projects. This course specifically takes the product viewpoint. Main topics include: 1. Software architectures 2. Architectural styles, views, patterns and qualities. 3. Good and poor software architectures. 4. Architecture evaluation and selection. 5. Practical software architectures and their characteristics. 6. Achieving reusability, interoperability, and change resilience. 7. Components and frameworks. 8. Distributed architectures. 9. Elements of middleware. 10. CORBA, EJB and DCOM. 11. Distributed and real-time software architectures, business-oriented software architectures, product lines.

*Methods:* Lecture (30 h), exercises (18 h), assignment, independent work, and examination.

*Literature:* (1) Bass, L., P. Clements, and R. Kazman, Software Architecture in Practice. Addison-Wesley Longman, Inc., 1998. (2) Shaw, M., and D. Garlan, Software Architecture. Perspectives on an Emerging Discipline. Prentice Hall, 1997. (3) Hofmeister, C., R. Nord, and D. Soni, Applied Software Architecture. Addison-Wesley, 2000.

*Connection with other courses:* The compulsory prerequisite course is Software Engineering (811335A).

*Timing and Target Group:* Period b. The course is compulsory for students majoring in Software Business and Software Engineering. 3rd year students and more advanced.

*Person in charge:* Lech Krzanik

*WWW address:* <http://www.tol.oulu.fi/~krzanik/sa/>

### **813315A Software Business Planning, 5 ECTS**

The course aims at familiarizing students with business planning from business idea to carefully planned business plan with its various elements. At the end of the course, the students should be able to write a business plan on their own. During the lectures they are told how to write a business plan in theory, during the exercises they are instructed on in how to practically write a business plan. Contents: The lectures start with an introduction to gaming business. In the following lectures, the students will learn what is important when writing a business plan. The starting point is the business idea, which is the basis when planning to start up a business. A general description of the purpose and use of the business plan follows. The students will be introduced to the elements of a business plan and what to consider when writing one. At the end of each lecture the students will be presented a part of an example business plan that concerns the part(s) of a business plan presented in the lecture. The lecture will introduce the business plan on a general basis (for various types of businesses), but will also include some information especially important for writing a business plan for a software business.

*Course requirements:* In order to pass the course, the student has to take part in the exercises and pass the exam. Their mark results from the following:

50% lecture exam

40% written business plan

10% business presentation plan exercises

*Timing and target group:* The course is aimed at 2nd year students of Information Processing Science

*Material:* Starting up – achieving success with professional business planning

<http://www.newventure.nl/files/startingup3.pdf>

Hurdle – the book on business planning. A step-by-step guide to create a thorough, concrete and concise business plan

<http://www.bplans.com/ho/HurdleBook.pdf>

*Persons in charge:*

\*) Karin Fritzer, [karin.fritzer@oulu.fi](mailto:karin.fritzer@oulu.fi)

\*) Sari Vilminko, [sari.vilminko@oulu.fi](mailto:sari.vilminko@oulu.fi)

\*) Sakari Sipola, [sakari.sipola@tols16.oulu.fi](mailto:sakari.sipola@tols16.oulu.fi)





### **811335A Software Engineering, 6 ECTS**

Software engineering is application of a systematic, disciplined, quantifiable approach to the development and maintenance of software. This course deepens the skills provided by the preceding courses, such as Introduction to Information Systems Design and Object-oriented Software Development. The design methods learned during the previous courses are applied in connection with the process of software production. Having completed the course, the student will understand software engineering as part of the design of information systems and products containing software, know different process model alternatives for software processes, know the phases of a software production processes and the tasks contained therein and know the focus areas in different phases. The student will also be able to apply an object-oriented approach to software design and construction in a CASE environment.

*Literature:* Pressman, R.S.: Software Engineering, A Practitioner's Approach (chapters 1-15, 21-31), 6th Edition, McGraw-Hill, 2005.

*Methods:* Lectures 40 h, exercises 40 h, exam 40 h, assignment 40 h. Course requirements include the examination and the assignment that is started and guided during the exercises. Optionally, the examination can be substituted by an essay. However, this must be agreed upon with the lecturer personally.

*Connections with other courses:* Prerequisites for this course are Object-oriented Software Development and Programming Assignment I. It is also recommended that the courses Introduction to Information Systems Design and Programming Assignment II should be completed before participating in this course. Completion of this course or participation in 80 % of the exercises is a requirement for attending to Project I.

*Timing and target group:* Period b. Compulsory. 2nd year.

*Person in charge:* Ilkka Tervonen

*Web address:* <http://www.tol.oulu.fi/~tervo/OTE.html>

### **811328A Software Product Management, 5 ECTS**

The course aims at providing a picture of software product management. Contents: position of product management in relation to software production as a whole, basic concepts of product management, product management practices in the light of case companies, change processing and product management, software product management as part of a company's total product management.

*Methods:* Lectures 36 h, exercises 36 h, examination.

*Connections with other courses:* The course must be preceded by Software Engineering (811335A).

*Timing and target group:* Period c. Compulsory in the Software Business specializations programme, recommended in the Software Production programme. 3rd to nth year.

*Person in charge:* Jukka Kääriäinen

### **813323A Software Quality and Quality Techniques, 3 ECTS**

There is no single definition for software quality; stakeholders view it from different perspectives. Software quality techniques, such as reviewing and testing, are tools for producing high quality software products. The course introduces different perspectives for software quality and provides an introduction to software quality assurance standards, quality techniques and defect classification. The course focuses on reviewing and inspection in particular, but also process improvement with patterns is introduced. The students practice conventional and web-based inspection in small teams and reading techniques of class models in individual inspection.

*Methods:* Lectures 20 h, exercises 18 h, homework (preparation for inspections and keeping a study diary) 40 h.

*Connections with other courses:* Participation requires mastery of the contents of Software Engineering (811335A) and knowledge of object-oriented diagrams (class diagram).

*Timing and target group:* Period b. Compulsory in the Software Production program. 3rd to 5th year.

*Person in charge:* Ilkka Tervonen

*Web address:* <http://www.tol.oulu.fi/~tervo/LaTe.html>

### **813322A Software Testing, 3 ECTS**

The course aims at familiarizing students with the basic concepts of planning and reporting testing and testing software in different phases of the software development process. Also, different testing techniques and testing automation are examined. Students study testing planning and different testing techniques using software tools. After passing the course student can administer the basic concepts and testing processes related to testing, knows various phases of testing, knows how testing can be executed and also can plan and report the testing. Added to this the student also knows how the different applications can be tested and how to automate the testing.

*Literature:* Announced in the first lecture.

*Methods:* Lectures 18 h, exercises 18 h. The course requires writing a lecture- and exercise diary as well as possible other separately settled activities.

*Connections with other courses:* Prerequisite for participating is reasonable knowledge of software development and Java programming language.

*Timing and target group:* 3rd year, period b, compulsory in Software Engineering program.

*Person in charge:* Jouni K Kokkonen (jouni.kokkonen@oulu.fi).

*Web address:* <http://www.tol.oulu.fi/~jiikoo/testaus.html>

### **811388A Symbian programming, 4 ECTS**

The goal of the course is to enhance the student's understanding of the common characteristics as well as special features of different hardware and operating system platforms, especially with the Symbian Operating System (OS). In

the course the Symbian OS is viewed from the perspective of application programmers. The student will not gain full understanding of the Symbian OS, but will understand the overall structure, underlying principles and the special features of the Symbian OS. The course work methods focus on practical exercises and demonstrations. The course is one of the department's Programming environment courses. Methods: Lectures 20 h, exercises 18 h, exercise work.

*Literature:* Lecture material, Harrison: Symbian OS C++ for Mobile Phones, John Wiley & Sons, 2003. Jo Stichbury: Symbian OS Explained, John Wiley & Sons, 2004.

*Related courses:* Prerequisite preceding course is the Basics of C++ Programming Language (812336A); recommended preceding course is the Operating systems (offered by the Department of Electrical and Information Engineering at the Faculty of Technology).

*Timing and target group:* period a, free, 3.-4. year. Compulsory in the Software Engineering program.

*Person in charge:* Antti Juustila

*WWW address:* <http://www.tol.oulu.fi/kurssit/Symbian>

### **814337A Systems integration, 2 ECTS**

Systems integration has become a core strategic capability for businesses seeking competitive advantage in technologically complex, globalized environment. Study module familiarizes to organization's teleinformatic overall architecture in which aim is to learn to understand relations of business and technology that aims to cost efficiency. The course covers design principles of integration solution and architecture models that support them. Systems integration - thinking forward-looking developments are considered by history, the point of project's view and the real examples.

*Completion:* Lecture discusses (4\*2 h) and literature examination.

*Literature:* Sami Tähtinen: JÄRJESTELMÄINTEGRAATIO, Tarve, Vaihtoehdot, Toteutus, Talentum 2005. The Business of Systems Integration (Paperback) by Andrea Prencipe, Andrew Davies, Mike Hobday . Publisher: Oxford University Press, USA; New Ed edition (June 30, 2005), other publications join in subject.

*Connections with other courses:* Recommended preceding course is Introduction to Information Systems Design (811170P).

*Timing and target group:* Period b, 2.-n. year, voluntary.

*Person in charge:* Kaisu Juntunen

### **812320A Time-Based Multimedia, 5 ECTS**

The course familiarizes to meaning of time in media systems design. How media elements are working in time? How time can be used in narrative digital media? Student familiarizes himself with principles of designing and executing media entirety that includes graphic, voice, animation and video. In exercises students are learnt how to edit and connect different media forms and make a small-scale time-based work.

*Methods:* Lectures 20 h, exercises 40 h, assignment 60 h.

*Material and literature:* Lecture material, literature is announced during the course and on the course website.

*Connections with other courses:* Preceding compulsory course is Introduction to Digital Media (811172P); recommended preceding courses are Digital Image Processing (811343A) and Graphic Design (811342A).

*Timing and target group:* Period c, directed to Information Processing Science students 3rd – 5th year, recommended in Digital Media specialization programme. Students in other degree programmes can take the course with a special permission.

*Person in charge:* Laura Vallius

### **811390A UNIX Programming, 4 ECTS**

UNIX is a popular operating system on servers in particular, but its utilization on workstations is increasing strongly again. This is largely due to Linux, the free UNIX compatible operating system. The course introduces the main features of UNIX-like operating systems in programming. The main focus is on process architecture, interprocess communication, and file management. In addition, Autotools are utilized and a graphical user interface built with GNOME desktop environment. The working environment is Linux. The course is one of several parallel programming environment courses.

*Methods:* Lectures and exercise about 50 h, assignments about 50 h.

*Literature:* Gay, W.: Advanced UNIX Programming, and Warkus, M.: The Official GNOME 2 Developer's Guide, as well as the material on course website.

*Connections with other courses:* The prerequisite courses are Operating systems (Electrical and Information Engineering 521453A) and C-programming (812316A).

*Timing and target group:* Period a, voluntary, 2nd and 3rd year, compulsory in Software Engineering programme.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/unix-ohjelmointi/>

### **813352A Usability Testing, 4 ECTS**

What is usability testing and how is it implemented? In this course students get acquainted with usability testing methods by doing a practical exercise in groups of 3 to 4 students. The practical exercise includes planning and implementing usability tests of chosen technology in a usability testing laboratory or in the field. A report outlining the main findings and suggestions for improvements is written and presented in a closing seminar. Having completed the course, the student knows how to plan and implement a usability testing process, produce test scenarios and choose test persons, plan the test situation and test tasks, is capable of carrying out the usability tests and analyzing the findings, and knows how to



present and report the test results.

*Methods:* Introductory lectures, supervised practical exercise, seminars.

*Requirements:* Participation in the lectures and in the practical exercise, presentation of the exercise work in closing seminar.

*Literature:* Dumas, J. S. & Redish, J. C. (1993): A Practical Guide to Usability Testing. Ablex Publishing Corporation.

Rubin, J. (1994): Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. Chichester: John Wiley & Sons, Inc

*Compulsory previous courses:* Humans as Users and Developers of Information Technology (811171P), Introduction to Human-Computer Interaction (811379A)

*Timing and target group:* Period c. 3rd year. Recommended in the Information Systems program.

*Person in charge:* Netta Iivari

### **811345A Web Information Systems Design, 5 ECTS**

*Course description:* The course aims to familiarize students with essential Web information systems design methods and –techniques. Web information systems mean hypermedia information systems that are implemented in inter/extra/intranet environments using Web technology. Besides services using with browser Web information systems are also programmatically used throughout interfaces (Web services, semantic Web). The course provides theoretical and practical completions to web information systems design and controlling implementation.

*Methods:* Lectures 30 h, exercises 30 h, assignment and examination. The course is approved upon completion of the examination and assignment.

*Connections with other courses:* The compulsory preceding course is New Media Design (811349A). Recommended preceding course is Object-Oriented Software Development (811378A).

*Timing and target group:* Period c. Compulsory in the Digital Media and the Information Systems specialisation programme. 3rd year.

*Literature:* The material completes and supports Lowe David & Hall Wendy, Hypermedia & the Web: An Engineering Approach, John Wiley & Sons. Richard Vidgen, David Avison, Bob Wood and Trevor Wood-Harper. Developing Web Information Systems, Butterworth-Heinemann, 2002.

*Person in charge:* Seppo Pahlila (seppo.pahlila@oulu.fi)

### **811389A Windows Programming, 4 ECTS**

The course describes programming Windows using the Win32 application programming interface (API). The basic principles of Windows programming (registering a window class, processing window messages, using resources and controls) are explained. Memory management and file handling are introduced from the programmer's perspective. Having completed the course, the student is able to construct a simple multiple-window application using Win32 API. The course is one of several parallel programming environment courses.

*Learning material and literature:* Lecture material, Petzold, Charles: Programming Windows 95, Microsoft Press 1996 (or more recent edition).

*Methods:* Lectures 20 h, exercises 27 h, assignment.

*Connections with other courses:* The course must be preceded by Operating Systems (521453A, Electrical Engineering) and Programming in C 812316A.

*Timing and target group:* Period c, Optional, Compulsory in the Software Engineering programme, 2nd-3rd year.

*Person in charge:* Ari Vesanen

*Web address:* <http://www.tol.oulu.fi/~avesanen>

### **812338A Audio Design and Processing, 4 ECTS**

The importance of audio in the field of digital media has been increasing recent years. Audio differs clearly from other media forms and thus requires its own special know-how. The essential issues are production of presentations and expressions, analysis of them and nuanced use of audio alongside or instead of visual media. When the capabilities and possibilities of audio are not understood, its strengths are often ignored. The course aims at creating a basic understanding of the nature of audio, and examines working methods to design and process audio.

*Methods:* Lectures 20 h, exercises 40 h, assignment 40 h.

*The connections with other courses:* The prerequisite course is Introduction to Digital Media (811172P). The recommended preceding courses are New Media Design (811349A) and Multimedia Techniques (811362A).

*Timing and target group:* Period b, optional, 2nd-5th year and up.

*Person in charge:* Tony Manninen

### **812340A Real Time Software Design, 4 ECTS**

The course gives the student the specific ability to develop software for time critical applications, ranging from simple household appliances to safety critical control systems at a nuclear plant. The student will learn to identify time-critical elements in a system. The student will be instructed on real-time design methodology from the initial requirement phase to the final execution phase, whether the project is a small team effort, or part of a large distributed design group. The students will acquire an object oriented approach to solve the problems found in real-time systems. The students will be aware of the specific problems facing the real-time software designer, and become familiar with the main design patterns to solve those problems. The students will become familiar with tools, mechanisms and platforms for Java and C languages that support real-time systems.

*Activities:* lectures (20 h), exercises (22 h), assignment (70), and exam (50). Exercises allow the students to practice the



analysis and design of real-time systems in UML. The exercises will also give the students practice in the application of design patterns for synchronization, scheduling, safety and reliability. The assignment can be completed in two ways: The first option is to present a report and presentation on a given area of real-time systems. The students will be provided with a list of topics and some initial material on each topic. The students will need to review the given material, carry out additional research and must provide an analysis of the problem presented in the topic. The second option will require the students to provide a specific analysis and design tasks for a given experimental real-time system.

Assignments can be carried out individually or as part of a small group. Under specific circumstances, the exam can be substituted by successfully carrying out a more comprehensive assignment. The course uses the Optima Web-based learning environment for lecture, assignment and exercise material.

*Timing:* Period b + c, mandatory for Mobile Services orientation, 2nd or 3rd year.

*Prerequisites:* Introduction to Embedded Systems (812339A). Object-oriented software development (811378A)

*References:* Douglass B.P. 1998, Real-Time UML – Developing Efficient Objects for Embedded Systems, Addison-Wesley ISBN 0-201-49837-5. Concurrent programming in Java, 2nd Edition, Doug Lea, Addison-Wesley ISBN 0-201-31009-0. Lecture slides.

*Person in charge:* Seamus Hickey

## Advanced Studies

### 812643S Advanced C++, 4 ECTS

The objective of the course is to give students the tools to implement and design good quality large-scale C++ programs efficiently. After the course the students can apply the paradigms of generic programming and metaprogramming, use STL library, design patterns and C++ idioms, and have the ability to extend standard libraries, such as IOStreams, and standard-like libraries, such as boost. Emphasis is on practical C++ programming based on research and experimentation done by the students. The results of the assignments will be reported in seminars.

*Methods:* Lectures 32h, exercises 24h, seminars.

*Timing and target group:* 4th year, period c. Software Engineering (optional, recommended), postgraduates.

*Literature:* C++ Templates (Vandevoorde, Josuttis), Modern C++ Design (Alexandrescu), C++ Standard Library Tutorial and Reference (Josuttis), other material given during the course.

*Person in charge:* Toni Räisänen

*Web address:* <http://www.tol.oulu.fi/kurssit/ec++/>

First implementation on 2007 (Study year 2006/07).

### 815651S Business Applications in Mobile Networks, 7 ECTS

Including the wireless and mobile features in ICT (Information and Communications Technology) based services creates new opportunities to improve existing business models and processes, and enables also completely new solutions both inside and between enterprises. In the course the effects of mobility are considered with respect to internet based business model types, interactive communications services, business process re-engineering and increasing the productivity. Business applications and services in mobile environments are presented including examples and case studies from industry. Formal methods and tools applied in developing and analyzing business processes and workflows are reviewed.

*Methods:* lectures (40 h), exercises (150 h). Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. The exercises include (1) personal seminar presentations and (2) student projects in teams. Project teams are formed of 2-3 students. Project results are documented as reports presented in the exercise seminars. Course uses Optima Web-based learning environment for material and project coordination. Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. Reports and presentations are recommended to be in English but can be also in Finnish.

*Prerequisites:* Mobile Internet Service Architecture (81660A). Supporting studies in economics and information industries are recommended.

*References:* Nokia: Mobile Internet Technical Architecture, Vol. I-III, Infopress, 2002. Eisenmann, Thomas: Internet Business Models, McGraw-Hill, 2002.

Harmon, Paul: Business Process Change, A Manager's Guide to Improving, Redesigning, and Automating Processes, Morgan Kaufmann Publishers, 2003.

Lecture slides, Articles, Seminar material.

*Timing and target group:* Period b-c, mandatory for Mobile Services orientation, 4th– 5th year.

*Person in charge:* Olli Martikainen

### 813608S Case Studies in Software Business, 6 ECTS

The course aims at familiarising the student with the software industry and business using case examples and literature. The focus is on the logic of the industry and the business strategies of the companies. The course first introduces briefly the concepts of industrial logic and business strategy as well as the current state and future perspectives of Finnish software industry. The strategies and development of different types of software houses are examined with the help of literature and assignments. There is a special emphasis on strategies that support the growth and internationalization of software companies. The assignments aim at acquainting the students not only with identifying the important factors of strategic management and changes in them but also with acquiring, analyzing and utilizing information on the software industry and companies.

*Methods:* Lectures and processing the assignments (totalling 27 h), an assignment that is carried out independently and





an examination.

*Connections with other courses:* The information processing science students are required to have completed Introduction to Software Business (811340A), while students in other degree programmes are required to have equivalent basic knowledge.

*Timing and target group:* Period c. 4th to 5th years. Compulsory in the Software Business programme.

*Person in charge:* Veikko Seppänen

*Web address:* <http://www.tol.oulu.fi/kurssit/813608S/>

### **815618S Component-Based Software Production, 6 ECTS**

Main topics include: 1. Effective processes for component based software production. 2. Domain engineering versus application engineering. 3. Product management. 4. Component project management. 5. Product line development. 6. Quality assurance. 7. Developing and exploiting commercial off-the-shelf components. 8. Maturity of the component process. 9. Running a component-based engineering business. The examples focus on JB/EJB, XML, and related technologies.

*Activities:* Lectures (30 h), exercises (18 h), assignment, demonstration, independent work, and test.

*Reference:* (1) Jacobson, I., M. Griss, and P. Jonsson, Software Reuse. Architecture, Process and Organization for Business Success. Addison-Wesley Longman, 1997. (2) Weiss, D., and D. Lai, Software Product Line Engineering: A Family-based Software Development Process. Addison-Wesley Longman, 1999.

*Compulsory prerequisites:* 811335A Software Engineering.

*Category and target group:* period c, compulsory for students majoring in Software Engineering, 3rd year students and more advanced.

*Responsible:* Lech Krzanik

*Web address:* <http://www.tol.oulu.fi/~Ekrzanik/cbsd.htm>

### **815616S Computer-Supported Cooperative Work (CSCW), 3 ECTS**

The aim of the course is to introduce students to the digital media based field of Computer-Supported Cooperative Work both as an area of research and applications. A new group of applications has emerged between traditional information systems automating work routines and personal information processing aimed at supporting interpersonal communication, coordination and collaboration. The associated field of research focuses on studying user support problems in collaborative work. New and changing modes and practices of collaboration are increasingly realized through digital media. Therefore, one of the central problem areas in CSCW is to better understand technologically mediated collaborative work. Research on technologically mediated collaboration requires theoretical and methodological diversification to the more traditional research of information systems' use and design, as well as foregrounding the question of how to integrate work research and CSCW application design in more meaningful ways. The course provides a general picture of the history and current state of CSCW research by outlining some important theoretical themes and scientific discourses. The course also provides an introduction to the most significant types of existing CSCW applications.

*Requirements:* Lecture discussions (approx. 20 h), exercises (approx. 20 h), personal work (approx. 45 h), seminars (approx. 20 h), or a literature examination (materials to be announced during the course) and a personal assignment.

*Methods:* Lecture discussions, exercises, group tutoring sessions, assignment seminar.

*Learning materials:* Lecture handout and articles to be announced separately during the course.

*Timing and target group:* Period b. Recommended in the Information Systems, Software Production and Digital Media specialization programmes. 4th to 5th year.

*Person in charge:* Helena Karasti

### **813653S Issues in Electronic Business, 4 ECTS**

Using research literature, the course discusses important issues in developing information systems that support the business activities and commerce of organizations. Having completed the course, the student has an understanding of the characteristics of a good trading place, the emergence of a user experience, virtual organizations and the meaning of wireless technologies in electronic commerce.

*Literature:* The literature for the opening examination will be announced on the course Web page before the course is arranged.

*Methods:* Passing the initial examination, followed by lectures 20 h, exercises 20 h, research paper.

*Course requirements:* Passing the initial examination, research paper and its presentation.

*Connections with other courses:* The course must be preceded by Introduction to Information Systems Design (811170P) and New Media Design (811349A).

*Timing and target group:* The implementation and timing is due to the resources. Recommended for the Information systems, Digital media and Software business programmes. 3rd to 4th year.

*Person in charge:* Harri Oinas-Kukkonen

### **811664S Games and Virtual Environments, 5 ECTS**

The students will learn basic methods and tools for game design. This design knowledge will be put into practice in the form of a game production project. During the project, students establish virtual game studios and proceed towards their goals following creative, innovative and entrepreneurship-like approaches. Topics of the course include: game idea creation and refinement, game design principles and methods, pitching and promoting the game idea, documenting game design, game production process, and planning the game production.



*Methods:* Lectures 30 h, assignment (a game review, game design and implementation as a group project) 70 - 90 h.

*Learning materials and literature:* Lecture handouts and other material to be announced during the course.

*Connections with other courses:* Recommended prerequisite courses: Introduction to Programming (811122P), Introduction to Digital Media (811172P), Time-Based Multimedia (812320A), Virtual Reality (815624S).

*Timing and target group:* Period a. 3rd year onwards. Optional.

*Person in charge:* Tony Manninen

### **812644S Information System Applications, 5 ECTS**

The course introduces a selected application area or an application type through scientific literature and available software applications. The area and/or type may vary annually. After completing the course the student: (a) has a perspective on the selected application domain and/or application type, in particular from the consumer's and organization's viewpoints, (b) is able to analyze the critical success factors for information system applications for the focus area/type, and (c) is able to understand the challenges in the application design and development in the focus area/type. Examples of application areas are health care information systems, different business applications such as banking insurance, and governmental information systems. Potential application types are electronic commerce, business intelligence and customer relationship management systems.

*Methods:* Lectures, seminar presentation, and examination.

*Literature:* Lecture materials.

*Connections with other courses:* Organizations and Information Systems and Information Systems Design Methods are recommended as preceding courses.

*Timing and target group:* Period b (tentatively), 4th to 5th year. The course is recommended for students in the Information Systems study line.

*Person in charge:* Katja Leiviskä

### **813601S Information Systems Theory, 10 ECTS**

The course integrates the advanced theoretical studies in the information systems study program, and introduces the student to conducting scientific research as well as authoring, reviewing, and presenting scientific papers. The course will tackle key topics in information systems research, the basics of scientific communication, and the structure of scientific papers. The course will help students read and discuss scientific papers in a constructively critical manner, understand the authoring process of a scientific paper, and practice both authoring a paper and presenting it.

*Methods:* Lectures 45h and seminars 30h (compulsory), lecture notes (approximately 15h), reading and presenting a scientific paper (approximately 15h), original research, and authoring and presenting a paper founded on the research (approximately 150h), reviewing and commenting on fellow students papers (approximately 30h). {The course can be passed also by literature exam at dates decided by the person in charge.}

*Literature:* The literature will be announced during the course. The material consists of central references in the field. The literature for the literature exam will be announced separately.

*Timing and target group:* The course will be organized annually, running from September till March. The course is compulsory in the Information Systems study program.

*The courses required as prerequisites:* Project I (811365A), Information System Design Methods (812324A), Organisations and Information Systems (812304A), as well as a minimum of 150 credit points suitable for a Master's study program in the Department. Students in other study lines who wish to apply will refer to the person in charge.

*Person in charge:* Harri Oinas-Kukkonen.

*Web address:* <http://www.tol.oulu.fi/kurssit/tietojate/>

### **813616S International Software Company, 6 ECTS**

The course enlarges the student's knowledge of software companies' internalization strategies, operation forms related internalization, choosing distributional channels and formation, and controlling partner networks. The course also considers the requirements of management of international/soon-to-be international companies. The study module also examines legal questions about internalization and its influences on application production. During the course, software companies' growth into international markets will be introduced.

*Methods:* Lectures (27 h) and exercises (10 h) consist of individual summaries related to the subject and their presentation.

*Connections with other courses:* Information Processing Science students have to pass Introduction to Software Business (811174P), and other training program students have to have corresponding knowledge.

*Timing and target group:* Period b, compulsory in the Software Business program, 4th-nth year.

*Person in charge:* Juhani Warsta

*Lecture material:* in Optima

### **812641S Location and Context Based Services, 5 ECTS**

This course introduces Location and Context Based Services (LCBS) platforms, interfaces and applications. This course commences with an introduction to cellular wireless transmissions and mobile networks, satellite based radio networks and applications, proceeds with critical topics in LCBS like mobile positioning, spatial analysis, environment sensor data (proximity sensors, lightning, temperature, noise, etc.), users state (sitting, walking, sleeping, etc.), authentication, security and brief introduction to personalization and profiling. It also covers mobile commerce such as mobile service marketing and billing. At the end of this course a number of selected advanced topics will be discussed to deepen the students' knowledge in LCBS. After finishing this course, students will know LCBS applications, underlying technologies,



interfaces, and architectures. Students will also learn the pros and cons of different approaches in LCBS as well as the forthcoming approaches in LCBS and its challenges.

*Methods:* lectures (30 h), exercises (12 h), seminar presentation (50 h), and exam preparation (40h). This course contains 10 lectures of 3 hours each; 4 exercises of 3 hours each. Students will be divided into teams (~2 students per team). Each student team will give a presentation on a selected LCBS topic. Students also have to pass a written exam.

*Timing and target group:* Period c, mandatory for Mobile Services orientation, 4th year.

*Prerequisites:* Internet and Computer Networks (811338A); Mobile Internet Service Architecture (815349A).

*Recommended accompanying course:* Personalization and profiling for mobile (812642S).

*References:* Andrew Jagoe, Mobile location based services, Prentice Hall, 2002, 452 p., ISBN: 0130084565; Lecture notes; selected papers and web links.

*Person in charge:* Xiaosong Zheng

### **812632S Management of Structured Information, 4 ECTS**

The idea underlying structured information is to represent not only its content, but also its meaning. The SGML standard marked the beginning of the modern era of structured documentation in 1986, but it was not until XML was developed for the needs of the Internet in 1998 that structuredness became a widely utilized concept and an object of very active research. As a result of this, a large number of different techniques have grown rapidly such that they can be used in addition to information management and documentation, in application integration, among other things. The course deals with the principles of structured information management and application areas that are topical from a research perspective. Available technologies and tools are also analyzed, with a special focus on the utilization in software production of the XML standard family that has been brought up in recent research results. The main emphasis is on the students conducting and presenting their own research.

*Methods:* Lectures 6 h, seminars 12 h, exercises/demonstrations 12 h and seminar paper.

*Learning materials and literature:* International publications on the topic.

*Connections with other courses:* Recommended as a preceding course: Introduction to data Management (811318A).

*Timing and target group:* Period c. Optional. 3rd to nth year, limited number of participants.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/rtk/>

### **813620S Managing Software Business in Software Industry, 5 ECTS**

Operational environments in software business are typically complex and in a continual state of change. The challenge is to direct employees' know-how and creativity to product growth and new value to the organization. This puts software business management challenges in a position where traditional rational models are insufficient. The course aims at giving management tools for this ambiguous environment, whose essential challenges are skillfully leading personal and creative humans and also acting in an invariably changing, non-predictable and even hostile environment.

*Methods:* 1. Familiarizing software business management in the field. (2) Lectures according to above content. (3) Group project.

*Connections with other courses:* The recommended preceding courses are: Creation Business Possibilities in Software Industry (813319A), Designing software business and Dimensions of Software Entrepreneurship (813318A).

*Timing and target group:* Period a, compulsory in the Software Business program. Compatible also with other programs. The language of instruction is English.

*Literature:* 1. Educational material, 2. Article compendium.

*Person in charge:* Vesa Puhakka

### **813606S Master's Thesis, 35 ECTS**

The course integrates the entire degree programme and specialization line. Having completed the thesis, the students know how to a) define a problem within information processing sciences as a starting-point for research, b) apply scientific methods to solve the problem, c) synthesize research results and evaluate their reliability, d) and are capable of participating in IT research and development and in postgraduate studies.

*Methods:* Research work and production of a thesis. Having completed the Master's thesis, the student shall write a maturity test in Finnish or Swedish on the topic of the thesis, showing perfect command of language and familiarity with the issues discussed in the thesis.

*Connections with other courses:* The thesis plan and thesis itself are presented in the Thesis Seminar (813602S).

*Timing and target group:* The timing is free and the course can be divided between several terms. Compulsory. 3rd to 5th year.

*Persons in charge:* professors and other thesis supervisors.

### **815639S Methods of Secure Information Systems Design, 6 ECTS**

The course deepens the knowledge formed in the preceding data security courses (e.g. Data Security Management) on the problems involving secure information systems development and data security management and the methods connected with them. The course also supplements the courses related to software and information systems design (such as Software Engineering, Object-Oriented Analysis and Design, Information Systems Design Methods) by teaching techniques in which various data security methods can be integrated into existing software and information systems design methods. The course is therefore highly appropriate for students in the Software Production or Information Systems programmes. Having completed the course, the student understands how the design methods of data security management and secure information systems can be integrated into information systems and software development, ii)



identifies the differences between different design method generations for data security management/secure information systems, iii) knows how to apply different methods, and iv) knows how to evaluate the usability of the methods in different situations. Contents: 1. first generation – normative standards (check lists, data security management standards, data security oriented maturity standards, risk management); 2. second generation mechano-technical control point methods; 3. third generation techno-functional modeling methods (structural modeling, spiral approach, object-oriented modeling methods); 4. fourth generation socio-technical methods; 5. fifth generation methods (such as method engineering approaches to data security management/secure information systems design). For each generation, the main methods are discussed, including possible notations, principles, theoretical foundations, problems, strengths and weaknesses.

*Methods:* Lectures 36 h, exercises, assignment and independent study of literature for the examination. The examination and assignment are required for a student to pass the course. Examples/tasks are carried out in the exercises, searching for solutions using different methods.

*Learning materials and literature:* To be announced in more detail at the start of the course. The materials consist of journal publications in the field and lecture handouts.

*Connections with other courses:* Recommended studies: Introduction to Data Security, Object-Oriented Analysis and Design, and Introduction to Information Systems Design or Software Engineering.

*Timing and target group:* Period c. 2nd to nth year.

*Person in charge:* Mikko Siponen

### **813605S Minor Subject Thesis, 21 ECTS**

The course aims at deepening the student's knowledge of an area of information processing science.

*Methods:* Research, scientific writing, writing a thesis and presenting it in the Thesis Seminar course, for instance.

*Timing and target group:* The timing is free. For minor subject students.

*Person in charge:* Professors and other thesis supervisors.

### **815650S Mobile Augmented Reality, 5 ECTS**

Augmented reality means overlaying synthetic images on top of objects from the physical world. The field of augmented reality provides the methods to interact with a virtual environment without removing the real environment that is naturally surrounding the user. Traditionally, augmented reality has been confined to laboratory environments, but recent advances in interface devices, mobile computing and communications are enabling mobile and personal augmented reality systems and applications. The course addresses key enabling technologies and methods including advanced displays, interaction devices, image processing, calibration, occlusion, as well as different uses and applications. The laboratory exercises address calibration, interaction and applications.

*Methods:* lectures 30 hours, exercises 60 hours, and exam (40). Exercises include 10 hours of laboratory work for which attendance is required 3 out of 5 times. The students need to pass the laboratory assignments, write and present an assigned report or contribution on novel applications, and pass the exam in order to complete the course.

*Prerequisites:* Virtual Reality (815624S) and Mobile Internet Service Architecture (815349A). Also recommended is Location and context based services (812641S).

*References:* Woodrow Barfield (Editor) and Thomas Caudell (Editor), Fundamentals of Wearable Computers and Augmented Reality. Mahwah, NJ 2001. ISBN 0805829024. 797 p. (partially) Reinhold Behringer (Editor), Gundrun Klinker (Editor), David W. Mizell (Editor) and Gudrun J. Klinker (Editor), Augmented reality: placing artificial objects in real scenes 1999. ISBN 1568810989. 236 p. (partially). Lecture notes.

*Timing:* Period c

*Person in charge:* Peter Antoniac

### **815645S Mobile Research, 10 ECTS**

The course integrates theoretical and practical studies in Mobile Services orientation and introduces the students to research and development (R&D), scientific publication and international co-operation in the field. The professional reading, writing, presentation and reviewing of standards, patents and scientific papers are exercised. In the introductory lectures the national and global telecommunication industry is reviewed including the development of major technologies, firms and alliances. The role and interrelations of innovations and technology, intellectual property rights and international co-operation are described and formal scenario and reference models are presented. The course also gives examples and case studies from the industry including mobile services and applications and their utilization.

*Methods:* lectures (60 h), exercises (200 h). Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. The exercises include (1) personal seminar presentations based on scientific (or other) articles and (2) writing a research article (or other report) on a given topic in student teams. Student teams are formed of 2-3 students. The written articles are presented in the exercise seminars. The course uses the Optima Web-based learning environment for material and project co-ordination. Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. Reports and presentations are recommended to be in English but may also be in Finnish.

*Prerequisites:* Mobile Internet Service Architecture (815349A).

*References:* Lemola, Tarmo (toim.): Näkökulmia teknologiaan, Gaudeamus, 2000.

Eisenmann, Thomas: Internet Business Models, McGraw-Hill, 2002.

Saviotti, P. and Walsh, V.: Economics and Technological Change, Rowman & Littlefield, 1987 or newer. Collection of articles, standards and patents. Lecture slides. Seminar material.





*Timing and target group:* Period a-c, mandatory for Mobile Services orientation, 4th – 5th year.

*Person in charge:* Olli Martikainen and Petri Pulli

### **815635S Open Source Seminar, 4 ECTS**

Open Source Software (OSS) is one of the most discussed phenomena in software engineering. It influences on both the way to produce software and choices made by end-user organizations. Today, the most well-known open source projects are Linux operating system, OpenOffice suite, Mozilla/Firefox web browser, and Apache web server. OSS can be approached from various viewpoints, like from social, legal, economical, software engineering and security viewpoints. The course introduces the principles of Open Source Software paradigm and current research problems. The purpose is to study from various viewpoints, for example, what OSS is and is not, the history and organizing of Open Source Software projects, ways to move over to the development and employment of OSS, as well as licensing models and conceivable risks. The emphasis is in students' own research work and its presentation.

*Methods:* Lectures and seminar about 30 h, preparation to seminars about 20 h, seminar paper about 55 h.

*Literature:* International publications about the subject.

*Connections with other courses:* The compulsory preceding courses are Software Engineering (811335A) and Introduction to research (811382A). The course prepares students to carry out Project I and II accordingly to OSS principles, or to compose a Master's Thesis about OSS.

*Timing and target group:* Period b, voluntary, 4th to 5th year and postgraduates, limited amount of participants.

*Person in charge:* Henrik Hedberg

*Web address:* <http://www.tol.oulu.fi/kurssit/oss/>

### **813611S Personal Software Process, 6 ECTS**

Do you know how talented you are as a software professional, and how you can develop your talent in a systematic way? Or how can you arrive at a faultless software product with the minimum cost? If you do not know these things yet and are looking for challenges, Personal Software Process (PSP) is just the right kind of demanding and practically oriented course for you. PSP is a method developed by the Software Engineering Institute (SEI) to enable software professionals to improve the quality and predictability of their work and shorten the system production time. Having completed the course, the student is consciously in control of the work process, knows how to set personal goals for improvement, is capable of measuring and analysing target performance, and knows how to tailor the process to achieve the set goals. The PSP method is applied in practice in the form of 8 to 10 programming tasks. The course also deals with the software professional's job description, the planning and management of time resources, commitments and work processes and the connected quality assurance.

*Methods:* Lectures 30 h, exercises 40 h, 8-10 programming tasks 90 h.

*Learning materials and literature:* Humphrey, W.S.: A Discipline for Software Engineering, Addison-Wesley, 1995. Other course materials will be announced separately.

*Connections with other courses:* The course must be preceded by 811122P Introduction to Programming. Basic knowledge of statistics and project management is useful during the course.

*Timing and target group:* Period a. 2nd to nth years.

*Person in charge:* Jouni Lappalainen

*Web address:* <http://www.tol.oulu.fi/kurssit/psp/>

### **812642S Personalization, profiling and segmentation for mobile, 5 ECTS**

The course presents the theory and practice of content and device personalization, customer profiling and customer segmentation for mobile telecommunications. The course addresses major applications in internationalization, localization and privacy as well as mass-tailoring and customer relation management (CRM). The course exercises address diverse examples of personalization, profiling and segmentation approaches developed and used by major players of the telecommunication business (operators, device manufacturers, vendors, and content providers) and related research.

*Methods:* lectures (30 h), exercise (80 h) and seminars (20 h). Part of the lectures will be implemented as digital recordings and visiting expert presentations or interviews. Exercises are carried out as assignments for student groups of 2-3 persons conducting additional research, and writing and presenting a report in a seminar. Active participation is required. The course uses the Optima web-based learning environment for material and project coordination.

*Timing and target group:* Period a-b, mandatory for Mobile Services orientation, 4th year. The course will be organized for the first time in autumn 2007.

*Connections with other courses:* Prerequisite courses are Mobile Internet Service Architecture (815349A) and Location and Context based Services (812641S).

*Literature:* Ralph, D. & Searby S. (ed.): Location and Personalisation: Delivering Online and Mobility Services, The Institution of Electrical Engineer, 2004, ISBN 0863413382, 227 p. Barnes, S: Mbusiness: The Strategic Implications of Mobile Communications, Elsevier, 2003, ISBN 0750656239, 264 p. Lecture slides, seminar material.

*Person in charge:* Petri Pulli

### **815654S Persuasive Web Information Systems, 5 ECTS**

The course will help the student to recognize how the Web and mobile services as well as other IT systems can and will be used to influence human attitudes and behavior. After passing the course the student is able to have a constructively critical view towards methods and techniques that are used for persuasion. On the one hand the student may use these in an ethical manner in developing such applications that aim at changes in human behavior and/or attitudes. Proper



examples of these include motivating workers to do their work better or safer, or embracing healthy living habits. On the other extreme are e.g. games that inflict addiction. The both sides of persuasion are discussed in the course. This course applies social psychology as a reference science for designing information systems.

*Methods:* Lectures 24 h, familiarizing research literature, examination.

*Literature:* Announced during the course.

*Connections with other courses:* The prerequisite courses are Web Information Systems Design (811345A) and Interaction design (812335A).

*Timing and target group:* Period b, 4th year. Recommended voluntary course for Information Systems and Digital Media program's students. Students from other programs may participate in the course, if resources allow.

*Person in charge:* Harri Oinas-Kukkonen

### **812631A Project II, 8 ECTS (former Project II (812631S) and Project Seminar (812610S))**

The course integrates everything you have studied as your "professional" and shows how empirical research is done as well as practices in scientific conference. The course consists of two consecutive parts, project and seminar, which both endures one term. The topics of the project comes from different practical development- and research needs as companies', public administration's and research group's assignments. In the beginning of the project, besides practical targets of the development, the research targets, problems and procedures for collection of empirical research knowledge are defined. In seminar part students write a scientific article based on the material collected in project. The results of the research are presented in "conference" arranged in the end of the seminar. In the conference students also will learn how to evaluate other's research critically.

*Methods:* Project: research- and development work about 250 h. Seminar: writing the research article and preparing the conference presentation, critical reviewing of other group's article, participating conference, total 80-90 h.

*Connections with other courses:* The compulsory preceding courses: Bachelor's Thesis in Information Processing Science. Under other discipline students, who have passed their Bachelor's Thesis, the needed information science further studies are defined separately.

*Timing and target group:* The course endures one term and it can be started on fall or autumn, compulsory, 4th-5th year.

*Person in charge:* Samuli Saukkonen

### **813621S Research Methods, 5 ECTS**

This course is designed as an introduction to the central empirical research methods in the field of information systems. It covers qualitative, quantitative and constructive research. The course aims at giving guidance particularly to students preparing for their Master's theses.

Tentative course outline: 1. Introduction to empirical research, 2. Nature, process and methodology of qualitative research, 3. Qualitative data gathering, 4. Qualitative data analysis, 5. Presenting empirical data and reporting qualitative research, 6. Evaluation of qualitative research, 7. Case study, 8. Ethnography, 9. Action research, 10. Nature, process and methodology of quantitative research, 11. Introduction to quantitative analysis methods, 12. Measurement, instruments and their reliability and validity, 13. Quantitative data gathering, 14. Quantitative data analysis, 15. Presenting and evaluating results, 16. Survey – an example of carrying out research, 17. Introduction to constructive research, 18. Phases and methods of constructive research, 19. Types of constructs, 20. Presenting a construct, 21. Validating a construct, 22. Evaluation of constructive research, 23. Summary

*Methods:* Lectures (approximately 45 h), exercises (approximately 60 h), assignments (approximately 30 h).

*Learning materials:* Lecture handouts together with literature to be announced during the course.

*Timing and target group:* Period a and b, 4th year students

*Person in charge:* Helena Karasti

### **814644S Research on Digital Media, 10 ECTS**

Study module integrates theoretical studies in Digital Media programme and leads to making scientific research, scientific argumentation and scientific evaluation and presentation of articles. Students will familiarize to digital media research in the essentialist subject matters on department side.

Those information processing science students can participate to the course whose programme is digital media and who have at least 160 ECTS. Other students may participate according to available resources. They have to apply for participation.

*Methods:* Lectures 45 h (including also visiting lectures) and seminars 30 h (compulsory), own work (read up on literature, practical work, seminar lecture) 200 h. The course can also be passed by literature examination.

*Timing and target group:* Period a+b+c, 4th year. The course is compulsory in Digital Media programme, whose students have priority. Participation to first lecture is necessary.

*Connections with other courses:* The compulsory preceding studies at least 160 ECTS studies that belong in degree.

*Literature:* Literature is given during the course. Material consists of essential literature of the field.

*Person in charge:* Kari Kuutti

Registration and more material in Optima!

### **815603S2 Social network analysis based information systems, 4 ECTS**

Social networks are a way of describing dynamic communications patterns. Virtually anything that communicates from computers to people winds up with patterns of relationships to which we give meaning. For instance, Google gives pages in certain network positions higher rank than others and that meaning corresponds with our meaning: we generally



agree the pages are more important. This does not just apply to the Web: prestige, power, influence and more in human groups can be predicted and modeled with social networks. This class gives some of the theories of the meaning of configurations of social networks, how to analyze them using software for visualization and analysis, and how social networks are formed, using simulation software. Students will have a general understanding of social networks, Social Network Analysis (SNA), and network simulation and be able to apply this to tasks in computer science, business, sociology and other fields. The class does not require any special mathematical knowledge and will touch on the psychological and social aspects of networks as well as the nuts and bolts of network analysis and simulation. Contents: Session 1 - Introduction, Session 2 - Getting Started. Session 3 - Brokerage, Session 4 - Ranking, Session 5 - Roles, Session 6 – Network Simulation/The Future

*Methods:* 6 Lectures (24 h), personal assignment (100 h)

*Timing and target group:* 3rd year students and more advanced.

*Connections with other courses:* The prerequisite course is Organizations and Information Systems (812304A).

*Literature:* Provided in the lectures

*Person in charge:* Harri Oinas-Kukkonen (lectures by Don Steiny)

### **815623S Software Development with Business Objects, 6 ECTS**

Development of reusable and interoperable component software focusing on organization. Main topics include: Business objects - a fundamental component model for industrial applications. The object-oriented development cycle for business objects with UML, patterns, styles, Java, CORBA and XML. Business objects facilities and common business objects. Standardization of business objects and business component platforms. Sample solutions with JavaBeans/Enterprise JavaBeans, MS solutions. Business objects domains and frameworks. Business process modeling and re-engineering with business objects.

*Methods:* Lecture (30 h), exercises (18 h), assignment, demonstrations, independent work, and test.

*References:* (1) Eeles, P., and O. Sims, Building Business Objects. Wiley, 1998. (2) Herzum, R., and O. Sims, Business Component Factory. Wiley, 2000.

*Connections with other courses:* Prerequisite: Software Engineering (811335A). Strongly recommended: Software Architectures (815621S).

*Timing and target group:* period c, optional, 3rd year students and more advanced.

*Person in charge:* Lech Krzanik

*WWW-address:* <http://www.tol.oulu.fi/~Ekrzanik/cbsd.htm>

### **815608S Software Engineering Research, 10 ECTS**

The course integrates the advanced theoretical studies in the Software Production programme and provides an introduction to scientific research and to the writing, presentation and evaluation of articles. The course introduces the most important and topical themes of software engineering research. The student learns the practises of scientific communication and the structure of scientific articles, learns to read scientific articles critically and to present constructive criticism, understands the process of writing a scientific article, and practises both writing an article and oral presentation.

*Methods:* Lectures 45 h and seminars 30 h (compulsory participation), getting to know and present an existing article (approx. 10 h), writing and presenting an article of one's own (approx. 60 h), supervision of and acting as an opponent to articles and presentations made by others (approx. 20 h). The course can also be passed by taking an examination, but only by a special arrangement in exceptional cases. The literature for the examination will be announced separately.

*Learning material and literature:* To be announced during the course. The material consists of important literature in the field.

*Timing and target group:* Arranged once a year from September to March. Compulsory in the Software Production programme.

*Connections with other courses:* The prerequisite for the course are Project I and at least 100 credits of studies contributing to the degree.

*Person in charge:* Markku Oivo

### **813612S Software Process Improvement, 5 ECTS**

The course provides basic knowledge of software process development needed in professional software development. It expands the previous understanding of quality ideology mostly based on individual techniques (such as reviewing) for systematic quality improvement and management in software businesses. The course introduces the best-known process-centred approaches and methods of software quality improvement as well as the most recent development results. The course covers the following topics: software processes, quality and quality standards, quality of organizational level, process quality, approaches to process improvement, process and software measurement, quality improvement on the company level, and examples of practical applications.

*Methods:* Lectures 30 h, supervised assignment 24 h and independent study of set literature. The course is approved on the basis of the examination and assignment. The assignment is carried out under supervision using a process improvement method based on self-evaluation.

*Learning materials and set literature:* To be announced during the course. The material consists of important publications and research results in the field.

*Timing and target group:* Period c. 4th to 5th year.

*Person in charge:* Markku Oivo



### **815627S Strategies of User-Centred Design, 6 ECTS**

The goal of the course is to provide in-depth knowledge of user-centred design. The course covers selected user-centred design methodologies and the basics of usability maturity models.

*Methods:* Examination 160 h.

*Connections with other courses:* The course must be preceded by Interaction Design (812335A), and Information Systems Design Exercise (812625A).

*Learning materials:* Announced on the web page on the course. (Note: the material may change from year to year)

*Timing and target group:* 4th to nth years. Recommended in the Software Production, Software Business and Digital Media specialization programmes.

*Person in charge:* Timo Jokela

### **813602S Thesis Seminar, 2 ECTS**

The course integrates the entire degree programme. From an individual student's point of view, the course supports the planning, writing and evaluation of the Master's thesis. The course includes lectures related to the writing of the thesis on issues such as choice of topic, research methods and their use, structure of the thesis, scientific presentation and research carried out in the Department of Information Processing Science.

*Methods:* Active participation in at least seven seminar sessions is required. The sessions last about three hours at a time and are arranged as agreed during each term. A more detailed schedule is provided on the department's notice-board. The students present their own research plans and their unfinished theses in the seminar sessions, before their official evaluation. When a thesis is presented, an opponent will also prepare a statement on it.

*Connections with other courses:* The course is connected with the writing of a Master's thesis or minor subject thesis.

*Timing and target group:* Autumn and spring terms. Compulsory. 4th to 5th year.

*Persons in charge:* Jouni Similä

*Web address:* <http://www.hci.oulu.fi/~gradu/>

### **815624S Virtual Reality, 4 ECTS**

The course introduces virtual reality and its applications. The course offers basic understanding of the key concepts and philosophical discussions on the nature and ethics of virtual reality. Some of the topics covered include: communicating virtual reality into human perception systems, the basic principles of human perception, structures and case applications of virtual reality systems, restrictions and future perspectives of virtual reality systems. The course aims at providing an illustrative picture of the basic features of virtual reality and its applications.

*Methods:* Lectures 30 h, assignments 40 - 60 h and an examination.

*Learning materials and literature:* Lecture handouts, additional reading and Kalawsky R.S (1993) The Science of Virtual Reality and Virtual Environments. Addison-Wesley. Pp. 1-202 and 311-343, totalling 234 pages.

*Timing and target group:* 3rd to 5th year, lectured not held regularly, recommended for Digital Media students.

*Person in charge:* Tony Manninen