# Recomended pass through the study plan

## Name of the pass: Master specialization Design and Programming of Embedded Systems, in Czech, 2020

Faculty/Institute/Others:
Department:
Pass through the study plan: Master specialization Design and Programming of Embedded Systems, in Czech, 2020
Branch of study guranteed by the department: Welcome page
Guarantor of the study branch:
Program of study: Informatika
Type of study: Follow-up master full-time
Note on the pass: Jako volitelné předměty lze zapisovat povinné předměty sousedních specializací.

**Coding of roles of courses and groups of courses:**
**P - compulsory courses of the program, PO - compulsory courses of the branch, Z - compulsory courses, S - compulsory elective courses, PV - compulsory elective courses, F - elective specialized courses, V - elective courses, T - physical training courses**

**Coding of ways of completion of courses (KZ/Z/ZK) and coding of semesters (Z/L):**
**KZ - graded assesment, Z - assesment, ZK - examination, L - summer semester, Z - winter semester**

Number of semester: 1

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| NI-KOP | **Combinatorial Optimization** *Jan Schmidt, Jiří Vyskočil, Petr Fišer **Jan Schmidt** Jan Schmidt (Gar.)* | Z,ZK | 6 | 2P+2C | Z | PP |
| NI-MPI | **Mathematics for Informatics** *Štěpán Starosta, Jan Spěvák **Štěpán Starosta** Štěpán Starosta (Gar.)* | Z,ZK | 7 | 3P+2C | Z | PP |
| NI-TES | **Systems Theory** *Jiří Vyskočil, Stefan Ratschan **Stefan Ratschan** Stefan Ratschan (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PS |
| NI-EHW | **Embedded Hardware** *Jan Schmidt **Jan Schmidt** Jan Schmidt (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PS |
| NI-ESW | **Embedded Software** *Miroslav Skrbek, Hana Kubátová **Miroslav Skrbek** Hana Kubátová (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PS |
| NI-V.2021 | **Čistě volitelné magisterské předměty** *NI-AOA,NI-ATH,..... (see the list of groups below)* | Min. cours. 0 Max. cours. 79 | Min/Max 0/366 | | | V |

Number of semester: 2

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| NI-PDP | **Parallel and Distributed Programming** *Pavel Tvrdík **Pavel Tvrdík** Pavel Tvrdík (Gar.)* | Z,ZK | 6 | 2P+2C | L | PP |
| NI-VSM | **Selected statistical Methods** *Daniel Vašata, Pavel Hrabák, Jana Vacková, Jitka Hrabáková, Ivo Petr, Petr Novák **Pavel Hrabák** Pavel Hrabák (Gar.)* | Z,ZK | 7 | 4P+2C | L | PP |
| NI-BVS | **Embedded Security** *Martin Novotný **Martin Novotný** Martin Novotný (Gar.)* | Z,ZK | 5 | 2P+2C | L | PS |
| NI-BKO | **Error Control Codes** *Pavel Kubalík **Pavel Kubalík** Pavel Kubalík (Gar.)* | Z,ZK | 5 | 2P+1C | L | PS |
| NI-SIM | **Digital Circuit Simulation and Verification** *Martin Kohlík **Martin Kohlík** Martin Kohlík (Gar.)* | Z,ZK | 5 | 2P+1C | L | PS |
| NI-V.2021 | **Čistě volitelné magisterské předměty** *NI-AOA,NI-ATH,..... (see the list of groups below)* | Min. cours. 0 Max. cours. 79 | Min/Max 0/366 | | | V |

Number of semester: 3

| Code | Name of the course / Name of the group of courses<br>*(in case of groups of courses the list of codes of their members)*<br>*Tutors,* ***authors*** *and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| NI-MPR | **Master Project**<br>***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 7 | | Z,L | PP |
| NI-TSP | **Testing and Reliability**<br>*Petr Fišer* ***Martin Daňhel*** *Petr Fišer (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PS |
| NI-V.2021 | **Čistě volitelné magisterské předměty**<br>*NI-AOA,NI-ATH,..... (see the list of groups below)* | Min. cours. 0<br>Max. cours. 79 | Min/Max 0/366 | | | V |

Number of semester: 4

| Code | Name of the course / Name of the group of courses<br>*(in case of groups of courses the list of codes of their members)*<br>*Tutors,* ***authors*** *and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| NI-DIP | **Diploma Thesis**<br>*Zdeněk Muzikář* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 30 | 270ZP | L,Z | PP |

## List of groups of courses of this pass with the complete content of members of individual groups

| Kód | Name of the group of courses and codes of members of this group (for specification see here or below the list of courses) | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| **NI-V.2021** | **Čistě volitelné magisterské předměty** | **Min. cours. 0**<br>**Max. cours. 79** | **Min/Max** 0/366 | | | **v** |

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|---|---|---|---|---|---|
| NI-AOA | Completing a professional event | NI-ATH | AlgorithmicTheories of Games | NI-AFP | Applied Functional Programming |
| NI-APH | Architecture of computer games | NI-VGA | Video Games Architecture | NI-BPS | Wireless Computer Networks |
| NIE-BLO | Blockchain | NI-CTF | Capture The Flag | NI-DPH | Game Design |
| NI-DSW | Design Sprint | NI-PSD | Public Services Design | NI-DID | Digital drawing |
| NI-DZO | Digital Image Processing | NI-DDM | Distributed Data Mining | NI-PAM | Efficient Preprocessing and Para ... |
| NI-ESC | Experimental Project Course | NI-GLR | Games and reinforcement learning | NI-GNN | Graph Neural Networks |
| NI-GRI | Grid Computing | NI-HCM | Mind Hacking | NI-HSC | Side-Channel Analysis in Hardwar ... |
| NI-HMI2 | History of Mathematics and Infor ... | NI-IBE | Information Security | NI-IVS | Intelligent embedded systems |
| NI-IKM | Internet and Classification Meth ... | NI-IAM | Internet and Multimedia | NI-IOT | Internet of Things |
| FITE-EHD | Introduction to European Economi ... | NI-KTH | Combinatorial Theories of Games | NI-FMT | Finite model theory |
| NI-CCC | Creative Coding and Computationa ... | NI-KYB | Cybernality | NI-LSM2 | Statistical Modelling Lab |
| NI-LOM | Linear Optimization and Methods | NI-MPL | Managerial Psychology | NI-MSI | Mathematical Structures in Compu ... |
| NI-MZI | Mathematics for data science | FIT-ITI | Modern IT infrastructure | NI-MOP | Modern Object-Oriented Programmi ... |
| NI-NLM | Neural Language Models | NI-NMS | Neural Networks, Machine Learnin ... | NI-NMU | New media in art and design |
| NI-OLI | Linux Drivers | NIE-PML | Personalized Machine Learning | NI-ARI | Computer arithmetic |
| NI-PG1 | Computer Grafics 1 | NI-PIV | Computer Vision | NI-EDW | Enterprise Data Warehouse System ... |
| NI-PVR | Advanced Virtual Reality | NI-AML | Advanced machine learning | NI-IOS | Advanced techniques in iOS appli ... |
| NI-APT | Advanced Program Testing | NI-PVS | Advanced embedded systems | NI-DNP | Advanced .NET |
| NI-PYT | Advanced Python | NIE-PDL | Practical Deep Learning | NI-GOL | Programming of distributed syste ... |
| NI-PSL | Programming in Scala | NI-RUB | Programming in Ruby | NI-ROZ | Pattern Recognition |
| NI-PLS1 | Programming Language Seminar | NI-PLS3 | Programming Language Seminar | NI-PLS2 | Programming Language Seminar |
| NI-PLS4 | Programming Language Seminar | NI-SCE1 | Computer Engineering Seminar Mas ... | NI-SCE2 | Computer Engineering Seminar Mas ... |
| NI-SZ1 | Knowledge Engineering Seminar Ma ... | NI-SZ2 | Knowledge Engineering Seminar Ma ... | PI-SCN | Seminars on Digital Design |
| NI-MLP | Machine Learning in Practice | FIT-SEP | World Economy and Business | NI-SEP | World Economy and Business |
| NI-TVR | Virtual Reality Technology | NI-TS1 | Theoretical Seminar Master I | NI-TS2 | Theoretical Seminar Master II |
| NI-TS3 | Theoretical Seminar Master III | NI-TS4 | Theoretical Seminar Master IV | NI-TKA | Category Theory |
| NI-TNN | Theory of Neural Networks | NI-CPX | Complexity Theory | FI-TOP | Academic writing |
| NI-DVG | Introduction to Discrete and Com ... | NI-VOL | Elections | NI-VYC | Computability |
| NI-VPR | Research Project | NI-ZS10 | Master internship abroad for 10 ... | NI-ZS20 | Master internship abroad for 20 ... |
| NI-ZS30 | Master internship abroad for 30 ... | | | | |

## List of courses of this pass:

| Code | Name of the course | Completion | Credits |
|---|---|---|---|
| FI-TOP | Academic writing | Z | 2 |
| Publishing is an important and required part of research activity. It is not only about obtaining research results but also about applying them in the form of publication. Writing scientific publications can be useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the course, students will learn how to write a scientific article, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an article and reviewing someone else's article. The course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Dates will be determined based on the availability of enrolled students. | | | |
| FIT-ITI | Modern IT infrastructure | Z,ZK | 5 |
| with a very limited and time-invariable range of software or hardware, this subject tries to explain the issue as a whole and in the context of the time. A modern data or computing center is understood here as a complex whole, the individual parts of which must be reconciled from different aspects of the view using current technologies. The proposed solution should thus be capable of continuous and economically optimal operation. | | | |
| FIT-SEP | World Economy and Business | Z,ZK | 4 |
| This course is presented in Czech. The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite. | | | |
| FITE-EHD | Introduction to European Economic History | Z,ZK | 3 |
| The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economy through the description of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic history. From large economic area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institutions is deciphered. The course does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and organizations in history. Class meetings will consist of a mixture of lecture and discussion. | | | |
| NI-AFP | Applied Functional Programming | KZ | 5 |
| This course is presented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional programming languages are on the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, mastering this paradigm becomes a necessary competence of a software engineer: the theory and especially the practice. | | | |
| NI-AML | Advanced machine learning | Z,ZK | 5 |
| The course introduces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of recommendation systems, image processing, control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with the methods discussed. | | | |
| NI-AOA | Completing a professional event | Z | 1 |
| The subject is participation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, concluded with a workshop, a test, drafting a report, etc.Such an event must be approved in advance by the vice-dean for pedagogical activities or the vice-dean for science and research and is presented within the FIT through a website, infomail, etc. | | | |
| NI-APH | Architecture of computer games | Z,ZK | 4 |
| Students will gain a basic understanding of the various issues in the field of computer games development, especially from a technical point of view, but also from design and philosophical perspective. They will get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base components that form an integral part of most games. They will also understand the basics of pathfinding, networking and scripting and apply them in practical exercises (labs). An important part of the course is an implementation of a simple game, with a strong focus on nontrivial game mechanics. | | | |
| NI-APT | Advanced Program Testing | Z,ZK | 5 |
| Testing a program is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The goal of the course is to present advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution. | | | |
| NI-ARI | Computer arithmetic | Z,ZK | 4 |
| Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementation units. | | | |
| NI-ATH | AlgorithmicTheories of Games | Z,ZK | 4 |
| Traditional game theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studies the behaviour of agents (players) of a certain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game theory is to find the equilibria, which are the states of the game where no player wants to deviate from his strategy. Due to the recent development of computers, internet, social networks, online auctions, advertising, multiagent systems and other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of efficient computation of various solution concepts. In this course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods of their computation. | | | |
| NI-BKO | Error Control Codes | Z,ZK | 5 |
| The goal of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted via channels. | | | |
| NI-BPS | Wireless Computer Networks | Z,ZK | 4 |
| Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad-hoc networks, multicast and broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowledge of security mechanisms for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools. | | | |
| NI-BVS | Embedded Security | Z,ZK | 5 |
| Students gain basic knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of cryptographic primitives in hardware and software (in embedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources for securing internal functions of computer systems. | | | |
| NI-CCC | Creative Coding and Computational Art | KZ | 4 |
| Students work on practical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows the basic graphics courses (MGA, BLE,) and introduces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization techniques with artistic methods using modern technologies. The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture and Metropolitan Planning) and IIM (Institute of Intermedia FEL). | | | |

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| NI-CPX | Complexity Theory | Z,ZK | 5 |
| Students will learn about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the theory concerning practical (in)tractability of difficult problems. | | | |
| NI-CTF | Capture The Flag | KZ | 4 |
| The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber security. | | | |
| NI-DDM | Distributed Data Mining | KZ | 4 |
| Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands on experience with large scale data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations and will be capable to propose approaches to parallelize other algorithms. The course is prezented in czech language. | | | |
| NI-DID | Digital drawing | Z | 2 |
| The course will introduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, perspective and color theory, which they will practically apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course is fit for anyone who wants to practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice gained knowledge. | | | |
| NI-DIP | Diploma Thesis | Z | 30 |
| NI-DNP | Advanced .NET | Z,ZK | 4 |
| Students will acquire an overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET MAUI (WPF, UWP), Blazor and also will get notions of Azure DevOps and GIT. Students will get practical experience in semestral work where they will create a client-server application utilizing technologies ASP.NET Core, Entity Framework Core and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT. | | | |
| NI-DPH | Game Design | Z,ZK | 5 |
| The course complements the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on game design. It is intended for people interested in deeper knowledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanics design, storytelling, and game development cycle. The students will get an overview of game development from the designer's perspective, from theoretical concepts to practical implementation applied to semestral projects. | | | |
| NI-DSW | Design Sprint | Z | 2 |
| Students will work on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to validated prototype in 5 days. During the course the students will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting with research and finishing with testing the prototypes (plus final presentation). | | | |
| NI-DVG | Introduction to Discrete and Computational Geometry | Z,ZK | 5 |
| The course intends to introduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar with the most fundamental notions of this discipline, and to be able to solve simple algorithmic problems with a geometric component. | | | |
| NI-DZO | Digital Image Processing | Z,ZK | 4 |
| This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both easy to implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the domain of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurring in frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhancement, interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matting. | | | |
| NI-EDW | Enterprise Data Warehouse Systems | Z,ZK | 5 |
| The Enterprise Data Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods and will gain practical knowledge not only in designing warehouses and various architectures, but also their deployment and maintenance. This course also includes an introduction to the area of reporting and data visualization. | | | |
| NI-EHW | Embedded Hardware | Z,ZK | 5 |
| The course brings basic laws that govern digital design and basic techniques to use them. It deals with both large and small scale systems. This is the base of advanced embedded systems, that profit from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discussed, including standardized means of internal communication, parallelism extraction and utilization in special structures and system architectures. | | | |
| NI-ESC | Experimental Project Course | KZ | 8 |
| "The Design Project course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principles, methodologies, and tools used in designing technology-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design projects, collaborate with industry experts, and learn to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their skills in user-centered design and user experience evaluation, as well as gain experience working in a team to design and prototype a functional solution." | | | |
| NI-ESW | Embedded Software | Z,ZK | 5 |
| Embedded software course acquainted students with the specifics of software development for embedded systems. The course covers the areas from the basic techniques of programming in C language and code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing, up to sophisticated techniques combined with artificial intelligence. | | | |
| NI-FMT | Finite model theory | Z,ZK | 4 |
| The aim of the course is to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiability of logical properties of database systems. Since its inception in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as descriptive complexity theory, the Constraint Satisfaction Problem (CSP), the theory of algorithmic meta-theorems and combinatorics. | | | |
| NI-GLR | Games and reinforcement learning | Z,ZK | 4 |
| The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligence. This course is intended to give you both theoretical and practical background so you can participate in related research activities. Presented in English. | | | |
| NI-GNN | Graph Neural Networks | Z,ZK | 4 |
| The course introduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural networks for creating vector representations of nodes, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last part of the course also covers graph generation and interpretability of graph neural networks. In the exercises, students will try out selected techniques and problems. | | | |
| NI-GOL | Programming of distributed systems in GO | KZ | 5 |
| NI-GRI | Grid Computing | Z,ZK | 5 |
| Grid computing and gain knowledge about the world-wide network and computing infrastructure. | | | |
| NI-HCM | Mind Hacking | ZK | 5 |
| Cognitive security is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, information systems and assets, the domain of cognitive security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive security is growing in importance in | | | |

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| | the context of information warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Internet environment have real societal impacts such as disruption of social cohesion, threats to democracy or war. | | |
| NI-HMI2 | History of Mathematics and Informatics | ZK | 3 |
| | This course is presented in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithms, transformations, recursive functions, eliptic curves, etc.) note on possibilities of applications of some mathematical methods in informatics and its development. | | |
| NI-HSC | Side-Channel Analysis in Hardware | Z,ZK | 4 |
| | This course is dedicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical attacks. Students get familiar with various kinds of side channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and get familiar with higher-order attacks. They also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel information leakage. | | |
| NI-IAM | Internet and Multimedia | Z,ZK | 4 |
| | The NI-IAM course is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acquisition of AV signals (input), presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical use case scenarios of real-time audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effect of various components on the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the scene up to the presentation for audience. | | |
| NI-IBE | Information Security | ZK | 2 |
| | Students learn information and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and international standards in this area. They understand methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., penetration testing). | | |
| NI-IKM | Internet and Classification Methods | Z,ZK | 4 |
| | In this course, the students get acquainted with classification methods used in four important internet, or generally network applications: in spam filtering, in recommendation systems, in malware detection systems and in intrusion detection systems. However, they will learn more than only how classification is performed when solving these four kinds of problems. On the background of these applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycle with 2-hour lectures and 2-hour exercises. During the exercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult their semester tasks. | | |
| NI-IOS | Advanced techniques in iOS applications | KZ | 4 |
| | Students will learn the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the basics from the beginners class BI-IOS. | | |
| NI-IOT | Internet of Things | Z,ZK | 4 |
| | The subject is focused on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is familiarization with available development elements (Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth). | | |
| NI-IVS | Intelligent embedded systems | KZ | 4 |
| | Intelligent embedded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The course is an advance version of the Intelligent embedded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot programming and advance application development. Lectures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students develop advanced applications combining knowledge of various courses like nature inspired algorithms, data mining algorithms, image recognition and web technologies | | |
| NI-KOP | Combinatorial Optimization | Z,ZK | 6 |
| | The students will gain knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not only to select and implement but also to apply and evaluate heuristics for practical problems. | | |
| NI-KTH | Combinatorial Theories of Games | Z,ZK | 4 |
| | Traditional game theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studies the behaviour of agents (players) of a certain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game theory is to find the equilibria, which are the states of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player full-information combinatorial games, was by Conway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea is to evaluate games such that otherwise incompatible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The third most important step is the work of Beck, who established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force traversal of the game tree, which is no efficient. Beck introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory of combinatorial and positional games. We focus on theoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course requires independent work, ability to mathematically analyse, think and proof. The course is also suitable for bachelors student in the third year, who attended introduction to graph theory, as well as for PhD students looking for research topics. | | |
| NI-KYB | Cybernality | ZK | 5 |
| | Students get acquainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the classification of attacks and have an overview of systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker activities and behavior. The course will also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams). | | |
| NI-LOM | Linear Optimization and Methods | Z,ZK | 5 |
| | Students learn the applications of optimization methods in computer science, economics, and industry. They are aware of practical importance of linear and integer programming. They are able to work with optimization software and are familiar with languages used in programming of that software. They get skills in formalization of optimization problems in computer science (such as scheduling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, travelling salesman problems, etc.), issues from economics, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems. They get orientation in algorithms in linear programming. | | |
| NI-LSM2 | Statistical Modelling Lab | KZ | 5 |
| | The topic of LSM2 is advanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the presence of clutter, or video tracking. We aim at the state-of-the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli) filters. | | |
| NI-MLP | Machine Learning in Practice | Z,ZK | 5 |
| | Applying machine learning methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client to, ideally, technical implementation. The course guides students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practically. The aim is to experience real data processing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear and understandable report. | | |
| NI-MOP | Modern Object-Oriented Programming in Pharo | KZ | 4 |
| | Object-oriented programming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where its ability to natural abstraction is used to build complex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills of design and implementation of object systems in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development needs and areas of interest. In addition to deepening object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work on interesting projects and OO technologies in terms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvement in the Pharo Consortium. | | |

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| NI-MPI | Mathematics for Informatics | Z,ZK | 7 |
| The course comprises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis, smooth optimization and multi-variate integration. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last topic includes selected numerical algorithm and their stability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear presentation and argumentation. | | | |
| NI-MPL | Managerial Psychology | ZK | 2 |
| NI-MPR | Master Project | Z | 7 |
| 1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. The external supervisor enters the information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.cz/student/studijni/formulare). The completed and signed form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester. | | | |
| NI-MSI | Mathematical Structures in Computer Science | Z,ZK | 4 |
| Mathematical semantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott model of lambda calculus. Introduction to category theory. | | | |
| NI-MZI | Mathematics for data science | Z,ZK | 4 |
| In this course, students are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in data science. The studied topics include mainly: linear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality principle, gradient methods) and selected notions from probability theory and statistics. | | | |
| NI-NLM | Neural Language Models | Z | 5 |
| In this course, students will learn the technical foundations of the Transformer architecture as well as the practical aspects of using language models. The goal of the course is to teach students how to use language models to solve problems, make informed risk assessments, and work critically with the scientific literature. | | | |
| NI-NMS | Neural Networks, Machine Learning and Randomness | Z,ZK | 4 |
| Stochastic methods, i.e. methods based on randomness, are extremely important for the construction and training of neural networks as well as a number of other machine learning models. The course "Neural networks, machine learning and randomness" will discuss in sufficient depth a number of specific types of neural networks that rely substantially on randomness, as well as a number of specific stochastic methods for neural networks and machine learning. In the final two topics, it explains the general stochastic approach to training neural networks and shows that, in addition to the use of randomness in neural networks and machine learning, machine learning models, including neural networks, are used in one of the most important applications of randomness stochastic optimization methods, which include e.g. popular evolutionary algorithms. | | | |
| NI-NMU | New media in art and design | ZK | 3 |
| The course introduces students to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game and sound. The main goal is to familiarize the student with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especially in lectures devoted to specific art projects. | | | |
| NI-OLI | Linux Drivers | Z,ZK | 4 |
| The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerful processors and FPGAs increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for master's students. The course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience. | | | |
| NI-PAM | Efficient Preprocessing and Parameterized Algorithms | Z,ZK | 4 |
| There are many optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necessary to solve these problems exactly in practice. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one can find a common property (parameter) of the inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exponentially in this (small) parameter and polynomially in the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial time preprocessing of the input, which is not possible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solution method. We will present a plethora of parameterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (presumably) does not exist. We will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes. | | | |
| NI-PDP | Parallel and Distributed Programming | Z,ZK | 6 |
| 21st century in computer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores. Parallel computing systems are becoming a ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platforms. Students get acquainted with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication operations, and languages and environments for parallel programming of shared and distributed memory computers. They get acquianted with fundamental parallel algorithms and on selected problems, they will learn the techniques of design of efficient and scalable parallel algorithms and methods of performance evaluation of their implementations. The course includes a semester project of practical programming in OpenMP and MPI for solving a particular nontrivial problem. | | | |
| NI-PG1 | Computer Grafics 1 | ZK | 4 |
| The course builds on graphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge. The course is designed for those interested in advanced computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of the course is the study of scientific articles and their subsequent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas and topics of computer graphics. | | | |
| NI-PIV | Computer Vision | Z,ZK | 5 |
| The Computer Vision course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing.Students will get acquainted with the basic principles of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoretical knowledge as well as on practical applications and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, color representations, object detection and recognition and segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (including CNN, RCNN, YOLO, ViT), motion detection, visual expressiveness (saliency). | | | |
| NI-PLS1 | Programming Language Seminar | Z | 2 |
| The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which we discuss scientific papers about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the discussions. The reading group is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages. | | | |
| NI-PLS2 | Programming Language Seminar | Z | 2 |
| The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which we discuss scientific papers about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the discussions. The reading group is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages. | | | |

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| NI-PLS3 | Programming Language Seminar | Z | 2 |
| The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which we discuss scientific papers about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the discussions. The reading group is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages. | | | |
| NI-PLS4 | Programming Language Seminar | Z | 2 |
| The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which we discuss scientific papers about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the discussions. The reading group is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages. | | | |
| NI-PSD | Public Services Design | KZ | 4 |
| The course will introduce students to specifics of UX, Service design and development for public sector. We will look into the design and development process from the perspective of suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration with client representatives. Course is aimed at students-designers as well as clients. | | | |
| NI-PSL | Programming in Scala | Z,ZK | 4 |
| The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language features - e.g.pattern matching and advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and libraries e.g. Play, Cassandra, Scalaz, etc. | | | |
| NI-PVR | Advanced Virtual Reality | KZ | 4 |
| The course introduces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D models in Blender, and among other things, it introduces students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will also deal with creating applications in available 3D engines (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply the knowledge gained in this subject in virtual reality, or directly create a complex game for VR. | | | |
| NI-PVS | Advanced embedded systems | Z,ZK | 4 |
| The course is focused on ARM processors and microcontrollers and their usage in wide range of applications. The course includes a series of advanced topics like security support, working with mass storage devices, motor control, system control and industrial communication. The students obtain both theoretical and also practical experiences with embedded systems. | | | |
| NI-PYT | Advanced Python | KZ | 4 |
| The goal of this course is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Python (BI-PYT) left of. The course is very hands-on and it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursework. The course is lead by external teachers from Red Hat. | | | |
| NI-ROZ | Pattern Recognition | Z,ZK | 5 |
| The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the statistical approach to pattern recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, and their numerical aspects. | | | |
| NI-RUB | Programming in Ruby | KZ | 4 |
| This course is presented in Czech. | | | |
| NI-SCE1 | Computer Engineering Seminar Master I | Z | 4 |
| The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. | | | |
| NI-SCE2 | Computer Engineering Seminar Master II | Z | 4 |
| The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. | | | |
| NI-SEP | World Economy and Business | Z,ZK | 4 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite. | | | |
| NI-SIM | Digital Circuit Simulation and Verification | Z,ZK | 5 |
| The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level Modeling) levels and with the properties of proper tools. The course covers recent verification methods, too. | | | |
| NI-SZ1 | Knowledge Engineering Seminar Master I | Z | 4 |
| On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research labs around the world. Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machine learning and AI conferences and summer schools, as well as FIT's own Summer Research Program (VyLet). | | | |
| NI-SZ2 | Knowledge Engineering Seminar Master II | Z | 4 |
| On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research labs around the world. Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machine learning and AI conferences and summer schools, as well as FIT's own Summer Research Program (VyLet). | | | |
| NI-TES | Systems Theory | Z,ZK | 5 |
| Today, humankind has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However, the costs of managing this complexity and of ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of models that describe only those aspects of the systems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and algorithms that form the basis for the modeling and analysis of complex systems. | | | |
| NI-TKA | Category Theory | Z,ZK | 4 |
| NI-TNN | Theory of Neural Networks | Z,ZK | 5 |
| In this course, we study neural networks from the point of view of the theory of function approximation and from the point of view of probability theory. At first, we recall basic concepts pertaining to artificial neural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission, network topology, somatic and synaptic mappings, network training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transformation into a canonical topology, and in connection with somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with training, we pay attention to the problem of overtraining and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most important optimization methods | | | |

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| | employed for neural network training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within the topic approximation approach to neural networks, we first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Kolmogorov theorem, Vituškin theorem). Afterwards, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappings computed by neural networks being dense in important Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect to a finite measure, spaces of functions with continuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on expectation and training based on a random sample, and with probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see how it is possible to get an estimate of the conditional expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak law of large numbers and get acquainted with an analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the central limit theorem, get acquinted with its analogy for neural networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can be employed to search for the topology of the network. | | |
| NI-TS1 | Theoretical Seminar Master I | Z | 4 |
| | Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. | | |
| NI-TS2 | Theoretical Seminar Master II | Z | 4 |
| | Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. | | |
| NI-TS3 | Theoretical Seminar Master III | Z | 4 |
| | Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. | | |
| NI-TS4 | Theoretical Seminar Master IV | Z | 4 |
| | Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. | | |
| NI-TSP | Testing and Reliability | Z,ZK | 5 |
| | Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with built-in-self-test equipment. They will be able to compute, analyze, and control the reliability and availability of the designed circuits. | | |
| NI-TVR | Virtual Reality Technology | Z,ZK | 3 |
| | Students will be introduced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD, ...) and the possibilities of controlling virtual avatars (position tracking, hand tracking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of using virtual and augmented reality will be presented. | | |
| NI-VGA | Video Games Architecture | Z,ZK | 5 |
| | The course covers a wide range of topics, procedures and methodologies related to the development of computer games - from a technical point of view, but also from a design and philosophical point of view. In the lectures, students will be guided through the history of development, the structure of game engines, component and functional architecture typical of game development, physics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected technological topics in greater detail, including ways of implementing some game mechanics, in the form of practical demonstrations. | | |
| NI-VOL | Elections | Z,ZK | 5 |
| | We will cover the basics of (committee) elections and, in general, opinion aggregation. | | |
| NI-VPR | Research Project | Z | 5 |
| | Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. | | |
| NI-VSM | Selected statistical Methods | Z,ZK | 7 |
| | The course leads the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with multivariate normal distribution, application of entropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with random processes with focus on Markov chains. The high point of the course is the Queuing theory and its application in networks. | | |
| NI-VYC | Computability | Z,ZK | 4 |
| | Classical theory of recursive functions and effective computability. | | |
| NI-ZS10 | Master internship abroad for 10 credits | Z | 10 |
| | Each student can once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line. | | |
| NI-ZS20 | Master internship abroad for 20 credits | Z | 20 |
| | Each student can once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line. | | |
| NI-ZS30 | Master internship abroad for 30 credits | Z | 30 |
| | The course is prezented in chzech language. Each student can once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line. | | |
| NIE-BLO | Blockchain | Z,ZK | 5 |
| | Students will understand the foundations of blockchain technology, smart contract programming, and gain an overview of most notable blockchain platforms. They will be able to design, code and deploy a secure decentralized application, and assess whether integration of a blockchain is suitable for a given problem. The course places an increased emphasis on the relationship between blockchains and information security. It is concluded with a defense of a research or applied semester project, which prepares the students for implementing or supervising implementation of blockchain-based solutions in both academia and business. | | |

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| NIE-PDL | Practical Deep Learning | KZ | 5 |
| This course is designed to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine learning framework. Throughout the course, students will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields such as computer vision and natural language processing. | | | |
| NIE-PML | Personalized Machine Learning | Z,ZK | 5 |
| Personalized machine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristics and behaviors of individual entities. While PML is commonly used in applications such as recommender systems, which recommend items to users based on their personal interests, its principles can be applied to a wide range of other fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theoretical, algorithmic, and practical perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial communities. | | | |
| PI-SCN | Seminars on Digital Design | ZK | 4 |
| This subject deals with problems of realization and implementation of digital circuits - both combinational and sequential. Basic means of description of digital circuits and basic logic synthesis and optimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial problems emerging in EDA. | | | |

For updated information see http://bilakniha.cvut.cz/en/FF.html
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