

## Study plan

### Name of study plan: Specialization Web and Software Engineering, in Czech, Version 2016, 2017 and 2018

Faculty/Institute/Others:

Department: Department of Software Engineering

Branch of study guaranteed by the department: Web and Software Engineering

Garantor of the study branch: doc. Ing. Tomáš Vitvar, Ph.D.

Program of study: Informatics (in Czech)

Type of study: Follow-up master full-time

Required credits: 96

Elective courses credits: 24

Sum of credits in the plan: 120

Note on the plan:

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 54

The role of the block: PP

Code of the group: MI-PP.2016

Name of the group: Compulsory Courses of Master Study Program, Version 2016, in Czech

Requirement credits in the group: In this group you have to gain 54 credits

Requirement courses in the group: In this group you have to complete at least 6 courses

Credits in the group: 54

Note on the group: Opakovaně do studia zapsaní studenti s uznatelnou zkouškou z PAR mohou požádat o uznání zkoušky z předmětu PDP.# Opozdilcům: Student, kterému chybí PPR, si zapíše PDP a získá z něj zápočet.# Do studia opakovaně zapsaným studentů: student se zkouškou z PPR má právou na uznání zápočtu z PDP.

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
MI-DIP	<b>Diploma Project</b> Miroslav Balík Miroslav Balík (Gar.)	Z	23	0+0	L,Z	PP
MI-MPR	<b>Master Project</b> Miroslav Balík Miroslav Balík (Gar.)	Z	7	0+0	Z,L	PP
MI-MPI	<b>Mathematics for Informatics</b> Martin Holeňa, Štěpán Starosta, Tomáš Kalvoda Štěpán Starosta Štěpán Starosta (Gar.)	Z,ZK	7	3+2	Z	PP
MI-PDP.16	<b>Parallel and Distributed Programming</b> Pavel Tvrdlík Pavel Tvrdlík Pavel Tvrdlík (Gar.)	Z,ZK	5	2+2	L	PP
MI-PAA	<b>Problems and Algorithms</b> Petr Fišer, Jan Schmidt Petr Fišer Jan Schmidt (Gar.)	Z,ZK	5	2+2	Z	PP
MI-SPI.16	<b>Statistics for Informatics</b> Daniel Vašata, Petr Novák, Pavel Hrabák Pavel Hrabák Pavel Hrabák (Gar.)	Z,ZK	7	4+2	L	PP

#### Characteristics of the courses of this group of Study Plan: Code=MI-PP.2016 Name=Compulsory Courses of Master Study Program, Version 2016, in Czech

MI-DIP	Diploma Project	Z	23
MI-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. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 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.			
MI-MPI	Mathematics for Informatics	Z,ZK	7
Students are introduced to fields of mathematics necessary for better understanding of some topics they will meet in specialized courses later on.			
MI-PDP.16	Parallel and Distributed Programming	Z,ZK	5
Due to the development of cloud, web, and communication technologies and due to the shift of the Moore law into parallelization of CPUs, parallel and distributed applications are becoming dominant. Students get acquainted with architectures of parallel and distributed computing systems and their models and with languages and environments for their programming. They learn the pattern designs for parallel and distributed programming and important parallel algorithms.			

MI-PAA	Problems and Algorithms	Z,ZK	5
Students are able to evaluate discrete problems by complexity and by the purpose of optimisation (on-line tasks, multicriterial optimisation). They understand principles and properties of heuristics and exact algorithms and, therefore, are able to select, apply, and experimentally evaluate a suitable heuristics for a practical problem.			
MI-SPI.16	Statistics for Informatics	Z,ZK	7
The students will learn the basics of the probability theory, elements of information theory and stochastic processes, and some methods of computational statistics. They will understand the methods for statistical processing of large volumes of data. They will get skills in using computational methods and statistical software for these tasks.			

Name of the block: Compulsory courses of the specialization

Minimal number of credits of the block: 5

The role of the block: PO

Code of the group: MI-PO-WSI.2016

Name of the group: Compulsory Courser of Specialization Web and Software Engineering, in Czech, Version 2016

Requirement credits in the group: In this group you have to gain 5 credits

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 5)

Credits in the group: 5

Note on the group:

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
MI-MDW.16	<b>Web Services and Middleware</b> Tomáš Vitvar, Jaroslav Kuchař <b>Tomáš Vitvar</b> Tomáš Vitvar (Gar.)	Z,ZK	5	2+1	Z	PO

Characteristics of the courses of this group of Study Plan: Code=MI-PO-WSI.2016 Name=Compulsory Courser of Specialization Web and Software Engineering, in Czech, Version 2016

MI-MDW.16	Web Services and Middleware	Z,ZK	5
Students learn new trends and technologies in the area of service-oriented architectures, web services, middleware, and cloud computing, including their theoretical background.			

Name of the block: Povinné předměty zaměření

Minimal number of credits of the block: 32

The role of the block: PZ

Code of the group: MI-PZ-ISM-ADM+IKM

Name of the group: Addition to compulsory subjects of master specialisation Information systems and management

Requirement credits in the group: In this group you have to gain at least 4 credits (at most 9)

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 2)

Credits in the group: 4

Note on the group:

Student musí úspěšně absolvovat jeden z těchto dvou předmětů.

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
MI-IKM	<b>Internet and Classification Methods</b> Martin Holeňa <b>Martin Holeňa</b> Martin Holeňa (Gar.)	Z,ZK	4	1+1	L	PZ
MI-ADM.16	<b>Data Mining Algorithms</b> Daniel Vašata, Pavel Kordík, Karel Klouda <b>Daniel Vašata</b> Pavel Kordík (Gar.)	Z,ZK	5	2+1	L	PZ
MI-PDM	<b>Practical Data Mining</b> Daniel Vašata, Pavel Kordík, Magda Friedjungová, Karel Klouda <b>Ivo Petr</b> Pavel Kordík (Gar.)	Z,ZK	5	2+1	L	PZ

Characteristics of the courses of this group of Study Plan: Code=MI-PZ-ISM-ADM+IKM Name=Addition to compulsory subjects of master specialisation Information systems and management

MI-IKM	Internet and Classification Methods	Z,ZK	4
This course is presented in Czech.			
MI-ADM.16	Data Mining Algorithms	Z,ZK	5
The course is suitable for those who want to familiarize themselves with the exceedingly interesting and useful discipline of data mining. The course covers the most useful algorithms that can be easily applied in any field of science.			
MI-PDM	Practical Data Mining	Z,ZK	5
Students are introduced to the basic methods of discovering knowledge in data. In particular, they learn the basic techniques of data preprocessing, data visualization, statistical techniques of data transformation, and fundamental principles of knowledge discovery methods. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Data mining software is extensively used in the module. Students will be able to apply basic data mining tools to common problems (classification, regression, clustering).			

Code of the group: MI-PZ-WSI-ISM.2016

Name of the group: Compulsory Courses of Specialization Information Systems and Management, version 2016, in Czech

Requirement credits in the group: In this group you have to gain 28 credits

Requirement courses in the group: In this group you have to complete 6 courses

Credits in the group: 28

Note on the group: Pro studenty opakovaně zapsané a pro opozdilce do studia: # Předmět MI-MBI teď nahrazuje původní MI-RIC, případně MI-SIN. Pro případné uznání předmětu MI-MBI musí student mít v minulosti úspěšně absolvované dva předměty MI-RIC a MI-SIN. Ty mu pak nelze uznat samostatně. # Máte-li uznaný předmět MI-FRI, můžete požádat o uznání zápočtu z předmětu MI-MBI a pak složit rozdílovou zkoušku. # K této skupině existuje doplněk se dvěma předměty MI-IKM a MI-ADM.16, z nichž musíte splnit alespoň jeden.  
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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
MI-MEP.16	<b>Modelling of Business Processes</b> Robert Pergl, Marek Skotnica Robert Pergl Robert Pergl (Gar.)	Z,ZK	5	2+1	Z	PZ
MI-PIS.16	<b>Advanced Information Systems</b> Petr Kroha, Petr Špaček, Tomáš Krátký Petr Špaček Petr Špaček (Gar.)	Z,ZK	5	2+1	L	PZ
MI-PCM.16	<b>Project And Change Management</b> Pavel Krejčí, Petra Pavlíčková Petra Pavlíčková Petra Pavlíčková (Gar.)	KZ	3	1+2	Z,L	PZ
MI-MBI.16	<b>Management of Business Informatics</b> David Buchtela, Petra Pavlíčková David Buchtela David Buchtela (Gar.)	Z,ZK	5	3+1	L	PZ
MI-SMI.16	<b>Strategic Management of Informatics</b> Petra Pavlíčková Igor Čermák Petra Pavlíčková (Gar.)	Z,ZK	5	3+1	Z	PZ
MI-TES.16	<b>Systems Theory</b> Martin Daňhel, Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2+1	Z	PZ

Characteristics of the courses of this group of Study Plan: Code=MI-PZ-WSI-ISM.2016 Name=Compulsory Courses of Specialization Information Systems and Management, version 2016, in Czech

MI-MEP.16	Modelling of Business Processes Students will learn the principles, definitions, characteristics and components of business process modeling, collaborative modeling, and enterprise modeling, and their interrelations in real life business settings.	Z,ZK	5
MI-PIS.16	Advanced Information Systems Students learn the notion of business process logic and its formalization, with business process roles, business rules, and data processing, with the notion of service oriented company, enterprise services and service solution of business logic. They get acquainted with these notions also for the other types of ISs. They learn about agility and adaptivity and using of artificial intelligence methods for implementation of these ideas in ISs. They understand modern object-oriented methodologies for modelling of business processes, business rules, processed data, and enterprise ISs. They will get the rules and technologies for successful implementation of IS.	Z,ZK	5
MI-PCM.16	Project And Change Management This course is presented in Czech.	KZ	3
MI-MBI.16	Management of Business Informatics This course is presented in Czech.	Z,ZK	5
MI-SMI.16	Strategic Management of Informatics The course focuses on the strategic management of information systems. Students will learn the process of creation and implementation of an information strategy, IT governance, the importance of ICT for business and interrelations between information strategies and global business strategies. Furthermore, they gain the knowledge in the areas of economic management of IS/IT, management of investments and ROI, assessment of IT investments and management of human resources in IT (the role of CIO, CEO, CFO). The part of the course is the role of project management, risk management and quality assessment of informatics.	Z,ZK	5
MI-TES.16	Systems Theory 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.	Z,ZK	5

Name of the block: Compulsory elective economic-management courses

Minimal number of credits of the block: 2

The role of the block: VE

Code of the group: MI-PV-EM.2016

Name of the group: Compulsory Elective Master Economics and Management Courses , in Czech, Ver. 2016

Requirement credits in the group: In this group you have to gain at least 2 credits (at most 6)

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 2)

Credits in the group: 2

Note on the group: Opakovaně do studia zapsaným studentům: Má-li student uznaný předmět PRM, nelze ho uznat jako náhradu za nový předmět PCM (student musí vypracovat projekt).

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
MI-IBE	<b>Information Security</b> Igor Čermák Igor Čermák Igor Čermák (Gar.)	ZK	2	2+0	Z	VE
MI-MPX	<b>Management practice</b> David Buchtela David Buchtela (Gar.)	Z	4	0+0	Z,L	VE
MI-PCM.16	<b>Project And Change Management</b> Pavel Krejčí, Petra Pavlíčková Petra Pavlíčková Petra Pavlíčková (Gar.)	KZ	3	1+2	Z,L	VE
MI-SEP	<b>World Economy and Business</b> Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2+1	Z	VE

**Characteristics of the courses of this group of Study Plan: Code=MI-PV-EM.2016 Name=Compulsory Elective Master Economics and Management Courses , in Czech, Ver. 2016**

MI-PCM.16	Project And Change Management This course is presented in Czech.	KZ	3			
MI-IBE	Information Security 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).	ZK	2			
MI-MPX	Management practice The Student can once, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the operational, tactical or strategic level of management (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is assessed well in advance the course guarantor. In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relatives of the student (e.g. as a member of the top management).	Z	4			
MI-SEP	World Economy and Business 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.	Z,ZK	4			

Name of the block: Compulsory elective humanities courses

Minimal number of credits of the block: 3

The role of the block: VH

Code of the group: MI-PV-HU.2016

Name of the group: Compulsory Elective Master Humanity Courses, Inclusive of Non-garanted Courses, Ver. 2016, in Czech

Requirement credits in the group: In this group you have to gain at least 3 credits (at most 6)

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 2)

Credits in the group: 3

Note on the group:

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
FI-FIL	<b>Philosophy</b> Peter Zamarovský Michal Valenta Peter Zamarovský (Gar.)	ZK	2	2+0	Z,L	VH
MI-HMI2	<b>History of Mathematics and Informatics</b> Alena Šolcová Alena Šolcová Alena Šolcová (Gar.)	ZK	3	2+1	Z	VH
FI-HTE	<b>History of Technology and Economics</b> Marcela Efmertová Michal Valenta Marcela Efmertová (Gar.)	ZK	2	2+0	Z,L	VH
FI-HPZ	<b>Humanities subject from a study abroad</b> Miroslav Balík	Z	3	0+0	Z,L	VH
MI-KYB.16	<b>Cybernality</b> Jan Kolouch Jan Kolouch (Gar.)	ZK	5	2+0	Z	VH
FI-MPL	<b>Managerial Psychology</b> Jan Fiala, Marek Procházka Jan Fiala Jan Fiala (Gar.)	ZK	2	2+0	Z,L	VH
MIE-STR	<b>Strategy in the ICT industry on case studies</b> Jiří Donát	ZK	2	2+0	L	VH
FI-KSA	<b>Cultural and Social Anthropology</b> Alena Libánská, Tomáš Houdek Tomáš Houdek Alena Libánská (Gar.)	ZK	2	2+0	L,Z	VH
FI-ULI	<b>Introduction to Linguistics for Computer</b> Václav Cvrček Michal Valenta Václav Cvrček (Gar.)	ZK	2	2+0	L	VH
FI-GNO	<b>Introduction to Gnoseology</b> Ivo Janoušek Michal Valenta Ivo Janoušek (Gar.)	ZK	2	2+0	L	VH

**Characteristics of the courses of this group of Study Plan: Code=MI-PV-HU.2016 Name=Compulsory Elective Master Humanity Courses, Inclusive of Non-garanted Courses, Ver. 2016, in Czech**

FI-FIL see A0B16	Philosophy	ZK	2
MI-HMI2 This course is presented in Czech.	History of Mathematics and Informatics	ZK	3
FI-HTE The course introduces the scientific disciplines of history and technology , economic and social history of the Czech lands and Czechoslovakia in comparison with the development of the European region 19 to 21 century .	History of Technology and Economics	ZK	2
FI-HPZ A "Humanities subject that has been studied abroad" is covered by the Humanities subject from a study abroad in Compulsory Humanities Module that is required in the curriculum. The substitution is approved by the Vice-Dean for study affairs on behalf of the Dean at the request of the student.	Humanities subject from a study abroad	Z	3
MI-KYB.16 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).	Cybernality	ZK	5
FI-MPL	Managerial Psychology	ZK	2
MIE-STR Abstract: The goal of this course is to give students an overview of the most important success factors in a dynamic market of ICT and allow them to think about their own career in the context of real life case studies of contemporary ICT industry. Students will learn the principles of strategic management of companies operating in converging sectors influenced by ICT on real-life case studies discussed directly with entrepreneurs and senior executives of these firms. Two categories of companies will be invited for interactive discussion of their strategy and vision: start-up companies represented by their founders, and the ICT industry?s biggest companies such as Google, Microsoft, IBM, Cisco, represented by their senior managers. On the basis of these experiences, students will be able to make their own conclusions on how to succeed in their professional life.	Strategy in the ICT industry on case studies	ZK	2
FI-KSA The one-semester course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversity of the world - examples from anthropological research from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, health, history, death, etc ...) will be shown. The course is an interesting alternative to other humanities, taught at FIT.	Cultural and Social Anthropology	ZK	2
FI-ULI This course is presented in Czech.	Introduction to Linguistics for Computer	ZK	2
FI-GNO Předmět studenty uvádí do teorie poznání, systémovým pohledem nahlíží na pole kultury, na vztahy a rozdíly mezi přírodními a humánními obory, vědou a uměním. Rozbořením dějin modernismu a myšlenkových proudů 20. století jsou ukázány proměny paradigmat a převrat k postmodernismu, analýzou paralelismů ve vědě a umění odhaleny mechanismy tvůrčích procesů. V návaznosti na teorii přírodních jazyků a sémiotiky je vedena diskuze i o kognitivních procesech, v historickém přehledu nastíněna hlediska estetického vnímání. Samostatnou kapitolou jsou modely spojených přírodních soustav a systémů, v závěru přednášek je pozornost věnována filozofii vědy a otázkám udržitelného rozvoje. Předmět přednáší a garantuje Ing. Ivo Janoušek CSC.	Introduction to Gnoseology	ZK	2

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: MI-V.2017

Name of the group: Purely Elective Master Courses, Version 2017

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

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
MI-IKM	<b>Internet and Classification Methods</b> Martin Holeňa <b>Martin Holeňa</b> Martin Holeňa (Gar.)	Z,ZK	4	1+1	L	v
MI-AFP	<b>Applied Functional Programming</b> Robert Pergl, Marek Suchánek, Jan Slifka <b>Robert Pergl</b> Robert Pergl (Gar.)	KZ	5	2+1	L	v
MI-APH	<b>Architecture of computer games</b> Adam Vesecký <b>Adam Vesecký</b> Adam Vesecký (Gar.)	Z,ZK	4	2+1	Z	v
MI-BML	<b>Bayesian Methods for Machine Learning</b> Kamil Dedecius, Ondřej Tichý <b>Ondřej Tichý</b> Kamil Dedecius (Gar.)	KZ	5	2+1	L	v
MI-BPS	<b>Wireless Computer Networks</b> Alexandru Moucha <b>Alexandru Moucha</b> Alexandru Moucha (Gar.)	Z,ZK	4	2+1	L	v
MI-DSP	<b>Database Systems in Practes</b> Ondřej Zýka <b>Michal Valenta</b> Ondřej Zýka (Gar.)	Z,ZK	4	2+1	L	v
MI-DZO	<b>Digital Image Processing</b> Daniel Sýkora <b>Daniel Sýkora</b> Daniel Sýkora (Gar.)	Z,ZK	4	2+1	L	v
MI-DDM	<b>Distributed Data Mining</b> Tomáš Borovička, Ondřej Stuchlík <b>Tomáš Borovička</b> Tomáš Borovička (Gar.)	KZ	4	0+3	L	v
MI-PAM	<b>Efficient Preprocessing and Parameterized Algorithms</b> Ondřej Suchý <b>Jan Janoušek</b> Ondřej Suchý (Gar.)	Z,ZK	4	2+1	L	v
MI-GLR	<b>Games and reinforcement learning</b> Juan Pablo Maldonado Lopez <b>Pavel Kordík</b> Juan Pablo Maldonado Lopez (Gar.)	Z,ZK	4	2+2	L	v

MI-HMI2	<b>History of Mathematics and Informatics</b> <i>Alena Šolcová Alena Šolcová Alena Šolcová (Gar.)</i>	ZK	3	2+1	Z	v
MI-IVS	<b>Intelligent embedded systems</b> <i>Miroslav Skrbek Miroslav Skrbek Miroslav Skrbek (Gar.)</i>	KZ	4	1+3	L	v
MI-IOT	<b>Internet of Things</b> <i>Jan Janeček Peter Macejko Jan Janeček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-ATH	<b>Combinatorial Theories of Games</b> <i>Tomáš Valla Jan Janoušek Tomáš Valla (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-LOM.16	<b>Linear Optimization and Methods</b> <i>Michal Černý, Michal Rada Michal Černý Michal Černý (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-MSI	<b>Mathematical Structures in Computer Science</b> <i>Jan Starý Jan Starý Jan Starý (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-MZI	<b>Mathematics for data science</b> <i>Daniel Vašata, Štěpán Starosta, Karel Klouda Daniel Vašata Štěpán Starosta (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-MPC	<b>Modern programming in C ++</b> <i>Daniel Langr Daniel Langr Daniel Langr (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-MAI	<b>Multimedia and Internet</b> <i>Sven Ubik, Jiří Melnikov Jiří Melnikov Sven Ubik (Gar.)</i>	Z,ZK	3	2+1	L	v
MI-OLI	<b>Linux Drivers</b> <i>Martin Daňhel, Miroslav Skrbek Martin Daňhel Miroslav Skrbek (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-ARI	<b>Computer arithmetic</b> <i>Alois Pluháček Alois Pluháček Alois Pluháček (Gar.)</i>	Z,ZK	4	2+1	Z,L	v
MI-IOS	<b>Advanced techniques in iOS applications</b> <i>Dominik Veselý, Martin Půlpitel Martin Půlpitel Martin Půlpitel (Gar.)</i>	KZ	4	2+2	L	v
MI-PVS	<b>Advanced embedded systems</b> <i>Miroslav Skrbek Miroslav Skrbek Miroslav Skrbek (Gar.)</i>	Z,ZK	4	2+2	Z	v
MI-DNP	<b>Advanced .NET and projective programming</b> <i>Marek Skotnica, David Šenkýř, Ondřej Dvořák Ondřej Dvořák Ondřej Dvořák (Gar.)</i>	Z,ZK	4	2+1	Z	v
MI-PYT	<b>Advanced Python</b> <i>Michal Valenta Miroslav Hrončok (Gar.)</i>	KZ	4	0+3	Z	v
MI-PRC	<b>Programming in CUDA</b> <i>Ivan Šimeček Ivan Šimeček Ivan Šimeček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-PSL	<b>Enterprise Java</b> <i>Jiří Daněček Michal Valenta Jiří Daněček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-RUB	<b>Programming in Ruby</b> <i>Tomáš Bartoň Petr Pulc (Gar.)</i>	KZ	4	0+3	Z	v
MI-LCF	<b>Compiler system LLVM</b> <i>Petr Máj</i>	Z,ZK	4		Z	v
MI-AIT	<b>Case Studies of IT Business</b> <i>Zuzana Šochová Zuzana Šochová Zuzana Šochová (Gar.)</i>	ZK	2	2+0	Z	v
MI-ROZ.16	<b>Pattern Recognition</b> <i>Michal Haindl Michal Haindl Michal Haindl (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-RRI	<b>Risk Management in Informatics</b> <i>Zdeněk Blažek Zdeněk Blažek Zdeněk Blažek (Gar.)</i>	ZK	3	2+0	L	v
MI-SCE1	<b>Computer Engineering Seminar Master I</b> <i>Martin Novotný Hana Kubátová (Gar.)</i>	Z	4	0+2	L,Z	v
MI-SCE2	<b>Computer Engineering Seminar Master II</b> <i>Matěj Bartík Hana Kubátová (Gar.)</i>	Z	4	0+2	L,Z	v
PI-SCN	<b>Seminars on Digital Design</b> <i>Petr Fišer Petr Fišer Petr Fišer (Gar.)</i>	ZK	4	2+1	Z,L	v
MI-SCR	<b>Statistical Analysis of Time Series</b> <i>Kamil Dedecius Karel Klouda Kamil Dedecius (Gar.)</i>	Z,ZK	4	2+1	Z	v
MI-TS1	<b>Theoretical Seminar Master I</b> <i>Tomáš Valla, Ondřej Suchý Jan Janoušek Ondřej Suchý (Gar.)</i>	Z	4	0+2	Z	v
MI-TS2	<b>Theoretical Seminar Master II</b> <i>Jan Janoušek Ondřej Suchý (Gar.)</i>	Z	4	0+2	L	v
MI-TS3	<b>Theoretical Seminar Master III</b> <i>Jan Janoušek Ondřej Suchý (Gar.)</i>	Z	4	0+2	Z	v
MI-TS4	<b>Theoretical Seminar Master IV</b> <i>Tomáš Valla, Ondřej Suchý Jan Janoušek Tomáš Valla (Gar.)</i>	Z	4	0+2	L	v
MI-VEM	<b>Scientific thinking</b> <i>Alena Libánská, Petr Klán Petr Klán Petr Klán (Gar.)</i>	KZ	2	1+1	L	v
MI-MCS	<b>Multicore Systems</b> <i>Jiří Kašpar Tomáš Zahradnický Pavel Tvrdek (Gar.)</i>	KZ	4	1+2	Z	v
MI-VYC	<b>Computability</b> <i>Jan Starý Jan Starý Jan Starý (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-ZS10	<b>Master internship abroad for 10 credits</b> <i>Miroslav Balík Miroslav Balík (Gar.)</i>	Z	10	0+0	Z,L	v
MI-ZS20	<b>Master internship abroad for 20 credits</b> <i>Miroslav Balík Miroslav Balík (Gar.)</i>	Z	20	0+0	Z,L	v
MI-ZS30	<b>Master internship abroad for 30 credits</b> <i>Miroslav Balík Miroslav Balík (Gar.)</i>	Z	30	0+0	Z,L	v

Characteristics of the courses of this group of Study Plan: Code=MI-V.2017 Name=Purely Elective Master Courses, Version 2017

MI-IKM	Internet and Classification Methods	Z,ZK	4
This course is presented in Czech.			
MI-HMI2	History of Mathematics and Informatics	ZK	3
This course is presented in Czech.			
MI-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.			
MI-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. They will have a grasp of component-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).			
MI-BML	Bayesian Methods for Machine Learning	KZ	5
The subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studies the construction of appropriate models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden variables (true object position from noisy observations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose, a number of real world examples and applications will be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging. The students will try to solve some of them.			
MI-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.			
MI-DSP	Database Systems in Praxes	Z,ZK	4
MI-DZO	Digital Image Processing	Z,ZK	4
This course presents a comprehensive overview of modern methods for processing digital images and video. It mainly deals with practical algorithms used in professional image processing tools that are both easy to implement and have an interesting theoretical basis. Seemingly boring theorems from calculus, discrete mathematics, statistics and computer science come to life in visually attractive applications.			
MI-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.			
MI-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.			
MI-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.			
MI-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			
MI-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).			
MI-ATH	Combinatorial Theories of Games	Z,ZK	4
This course is presented in Czech.			
MI-LOM.16	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.			
MI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages. Data types as continuous lattices, Scott topology. Procedures as continuous mappings. Lambda calculus and functional languages. Introduction to category theory.			
MI-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.			
MI-MPC	Modern programming in C ++	Z,ZK	5
Students learn how to use the modern features of contemporary versions of the C++ programming language for software development. The course focuses on programming effectivity and efficiency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor time requirements.			
MI-MAI	Multimedia and Internet	Z,ZK	3
The course will cover principles and technologies for processing and network transmissions of multimedia signals, stereoscopy and visualizations in high definition. Lectures will include application areas of networked multimedia, transmission formats, interfaces, codecs, technologies for acquisition and reproduction of multimedia data and technologies for visualizations and distributed collaboration using networking and immersive environments.			

MI-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.			
MI-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.			
MI-IOS	Advanced techniques in iOS applications	KZ	4
MI-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.			
MI-DNP	Advanced .NET and projective programming	Z,ZK	4
Students acquire a knowledge about advanced design of applications on a .NET platform. They gain skills of WPF (Windows Presentation Foundation), WCF/WebAPI (Windows Communication Foundation) and Entity Framework. They are able to apply these skills on a development and design of advanced .NET applications.			
MI-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.			
MI-PRC	Programming in CUDA	Z,ZK	4
The students gain a good overview of present parallel architectures in GPUs. Students also get hands-on experience with programming these systems.			
MI-PSL	Enterprise Java	Z,ZK	4
The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information systems which are connected to a database and are accessed through the web interface.			
MI-RUB	Programming in Ruby	KZ	4
This course is presented in Czech.			
MI-LCF	Compiler system LLVM	Z,ZK	4
MI-AIT	Case Studies of IT Business	ZK	2
This course is presented in Czech.			
MI-ROZ.16	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.			
MI-RR1	Risk Management in Informatics	ZK	3
Information security is very often considered as one of main objectives to secure targets of information processing. However, to focus on this info security as a matter of protection of IT systems against viruses, malware etc. very often means misunderstanding and underestimating of real threats which are around us and which are more dangerous than viruses and other malware. The necessity to continue with business after disaster is also slightly ignored. International standards which are focused on informatics and information security just during last years started to anticipate necessity of risk management. There is no commonly accepted methodology used for this task. Threats which are currently possible to see worldwide, invoke pressures to prepare plans for business continuity management even in the case of dramatic political changes, natural disasters etc.			
MI-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.			
MI-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.			
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.			
MI-SCR	Statistical Analysis of Time Series	Z,ZK	4
The course deals with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange prices, employment) and industrial problems (modelling of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a convenient process model, estimate its parameters, analyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the main principles based on practical real-world examples. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward transfer of students' knowledge from the academic to the real world.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			

MI-VEM	Scientific thinking	KZ	2
The objective of the course is to get acquainted with scientific methods and discovery of order and laws of the universe, including the aspects of human life. The subject combines scientific methods in natural sciences, mathematics, computer science and humanities. Another aim is to introduce rules and requirements of scientific communication via research papers and posters.			
MI-MCS	Multicore Systems	KZ	4
Students understand architecture of systems based on multicore processors with multiple threads per core, structure and usage of cache hierarchy with shared last level. They learn parallel algorithm classification, parallel programming technics, simulation and monitoring tools for measurement and optimization of parallel algorithms. After this course, students can design MTMD programs (Multiple Threads Multiple Data), measure and analyze latency and throughput of parallel algorithms and optimize them for contemporary multicore systems.			
MI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability. Recursive functions, Turing machines, and their equivalence. Church's thesis. Universal machine, normal form. Halting Problem and fixed points. Relations to logic: (in)completeness and (un)decidability.			
MI-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.			
MI-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.			
MI-ZS30	Master internship abroad for 30 credits	Z	30
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.			

Code of the group: MI-WSI-ISM-VO.2017

Name of the group: Elective Vocational Courses for Master Specialisation MI-WSI-ISM, version 2017

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Všechny povinné předměty oborů a zaměření s výjimkou tohoto zaměření

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
MI-ADP.16	<b>Architecture and Design Patterns</b> Petr Špaček <b>Petr Špaček</b> Petr Špaček (Gar.)	Z,ZK	5	2+1	Z	v
MI-AVY	<b>Automata in Text Pattern Matching</b> Ondřej Guth, Bořivoj Melichar <b>Ondřej Guth</b> Bořivoj Melichar (Gar.)	Z,ZK	4	2+1	L	v
MI-BPR	<b>Security and Secure Programming</b> <b>Tomáš Zahradnický</b>	Z,ZK	4	2+1	Z	v
MI-BHW.16	<b>Security and Hardware</b> Martin Novotný <b>Martin Novotný</b> Martin Novotný (Gar.)	Z,ZK	5	2+2	L	v
MI-BKO.16	<b>Error Control Codes</b> Pavel Kubalík, Alois Pluháček <b>Pavel Kubalík</b> Pavel Kubalík (Gar.)	Z,ZK	5	2+1	L	v
MI-DSV.16	<b>Distributed Systems and Computing</b> Jan Janeček <b>Jan Janeček</b> Jan Janeček (Gar.)	Z,ZK	5	2+1	Z	v
MI-DDW.16	<b>Web Data Mining</b> Milan Dojčinovský, Jaroslav Kuchař <b>Jaroslav Kuchař</b> Milan Dojčinovský (Gar.)	Z,ZK	5	2+1	L	v
MI-EVY	<b>Efficient Text Pattern Matching</b> <b>Jan Holub</b>	Z,ZK	4	2+1	Z	v
MI-FME.16	<b>Formal Methods and Specifications</b> Stefan Ratschan <b>Stefan Ratschan</b> Stefan Ratschan (Gar.)	Z,ZK	5	2+1	L	v
MI-FLP	<b>Functional and Logical Programming</b> Jan Janoušek <b>Jan Janoušek</b> Jan Janoušek (Gar.)	Z,ZK	4	2+1	L	v
MI-GEN	<b>Code Generators</b> Jan Janoušek <b>Jan Janoušek</b> Jan Janoušek (Gar.)	Z,ZK	4	2+1	L	v
MI-HWB.16	<b>Hardware Security</b> Jiří Buček, Róbert Lórencz <b>Jiří Buček</b> Róbert Lórencz (Gar.)	Z,ZK	5	2+2	L	v
MI-KOD.16	<b>Data Compression</b> Jan Holub <b>Jan Holub</b> Jan Holub (Gar.)	Z,ZK	5	2+1	L	v
MI-MKY.16	<b>Mathematics for Cryptology</b> Štěpán Starosta, Ivo Petr <b>Petr</b> Štěpán Starosta (Gar.)	Z,ZK	5	3+1	L	v
MI-MVI.16	<b>Computational Intelligence Methods</b> Pavel Kordík, Zdeněk Buk, Miroslav Čepek <b>Martin Šlapák</b> Martin Šlapák (Gar.)	Z,ZK	5	2+1	Z	v

MI-MVI	<b>Computational Intelligence Methods</b> <i>Pavel Kordík</i>	Z,ZK	4	2+1	Z	v
MI-MTI.16	<b>Modern Internet Technologies</b> <i>Alexandru Moucha, Viktor Černý Alexandru Moucha Alexandru Moucha (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-NFA.16	<b>Design for the FPGA and ASIC Technology</b> <i>Jan Schmidt Jan Schmidt Jan Schmidt (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-NUR.16	<b>User Interface Design</b> <i>Pavel Žikovský, Jiří Hunka Jiří Hunka Pavel Žikovský (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-NON	<b>Nonlinear Continuous Optimization and Numerical Methods</b>	Z,ZK	4	2+1	Z	v
MI-NSS.16	<b>Normalized Software Systems</b> <i>Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Jan Verelst (Gar.)</i>	ZK	5	2+0	L	v
MI-PAP.16	<b>Parallel Computer Architectures</b> <i>Ivan Šimeček Ivan Šimeček Ivan Šimeček (Gar.)</i>	Z,ZK	5	2+1	L	v
MI-EDW.16	<b>Enterprise Data Warehouse Systems</b> <i>Stanislav Kuznetsov, Magda Friedjungová, Daniel Arnošt Stanislav Kuznetsov Daniel Arnošt (Gar.)</i>	Z,ZK	5	2+1	L	v
MI-PAL	<b>Advanced Algorithms</b> <i>Luděk Kučera Luděk Kučera Luděk Kučera (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-KRY.16	<b>Advanced Cryptology</b> <i>Jiří Buček, Róbert Lórencz Róbert Lórencz (Gar.)</i>	Z,ZK	5	2+2	Z	v
MI-POA.16	<b>Advanced Computer System Architectures</b> <i>Pavel Tvrdlík, Jiří Kašpar Ondřej Žižka Pavel Tvrdlík (Gar.)</i>	Z,ZK	5	2+1	L	v
MI-PDB.16	<b>Advanced Database Systems</b> <i>Michal Valenta Michal Valenta Michal Valenta (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-PDD.16	<b>Data Preprocessing</b> <i>Marcel Jiřina Daniel Vašata Marcel Jiřina (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-REV.16	<b>Reverse Engineering</b> <i>Josef Kokeš Tomáš Zahradnický Josef Kokeš (Gar.)</i>	Z,ZK	5	1+2	Z	v
MI-RUN	<b>Runtime Systems</b> <i>Marcel Hlopko</i>	Z,ZK	4	2+1	Z	v
MI-SWE.16	<b>Semantic Web</b> <i>Jakub Klímek Jakub Klímek Jakub Klímek (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-SIB.16	<b>Network Security</b> <i>Tomáš Čejka, Simona Buchovecká Tomáš Čejka Tomáš Čejka (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-SYP	<b>Parsing and Compilers</b> <i>Jan Janoušek</i>	Z,ZK	4	2+1	Z	v
MI-SYB.16	<b>System Security</b> <i>Jiří Buček, Róbert Lórencz, Jiří Smitka, Simona Buchovecká Simona Buchovecká Róbert Lórencz (Gar.)</i>	Z,ZK	5	2+2	L	v
MI-SOC.16	<b>Systems on Chip</b> <i>Hana Kubátová Hana Kubátová Hana Kubátová (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-CPX	<b>Complexity Theory</b> <i>Luděk Kučera, Ondřej Suchý Luděk Kučera Luděk Kučera (Gar.)</i>	Z,ZK	5	3+1	Z	v
MI-TSP.16	<b>Testing and Reliability</b> <i>Martin Daňhel, Petr Fišer Petr Fišer Petr Fišer (Gar.)</i>	Z,ZK	5	2+2	Z	v
MI-VMM.16	<b>Retrieval from Multimedia</b> <i>Tomáš Skopal Tomáš Skopal Tomáš Skopal (Gar.)</i>	Z,ZK	5	2+1	Z	v
MI-W20.16	<b>Web 2.0</b> <i>Tomáš Vitvar, Jaroslav Kuchař Jaroslav Kuchař Tomáš Vitvar (Gar.)</i>	Z,ZK	5	2+1	L	v

**Characteristics of the courses of this group of Study Plan: Code=MI-WSI-ISM-VO.2017 Name=Elective Vocational Courses for Master Specialisation MI-WSI-ISM, version 2017**

MI-ADP.16	Architecture and Design Patterns	Z,ZK	5
The objective of this course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as well as with understanding of the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge of object-oriented programming and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. In the second part the students will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems, and some advanced software architectures used in large-scale distributed systems.			
MI-AVY	Automata in Text Pattern Matching	Z,ZK	4
Students learn algorithms for searching in texts using finite automata. They become acquainted with the searching problems taxonomy and learn the principles of automata constructions for solving these problems. They will be able to apply the gained knowledge in the design of applications required text pattern matching, such as data streaming, DNA sequencing, etc.			
MI-BPR	Security and Secure Programming	Z,ZK	4
Students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Students will also be briefly introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and countermeasures to these attacks.			
MI-BHW.16	Security and Hardware	Z,ZK	5
Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, random number generators, smart cards, and resources for securing of internal functions of computer systems.			
MI-BKO.16	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.			

MI-DSV.16	Distributed Systems and Computing	Z,ZK	5
Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures.			
MI-DDW.16	Web Data Mining	Z,ZK	5
Students will learn latest methods and technologies for Web data acquisition, analysis and utilization of the discovered knowledge. Students will gain an overview of Web mining techniques for Web crawling and search, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overview of most recent developments in the field of social web and recommendation systems.			
MI-EVY	Efficient Text Pattern Matching	Z,ZK	4
Students get knowledge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both access time and memory complexity. They will be able to use the knowledge in design of applications that utilize pattern matching.			
MI-FME.16	Formal Methods and Specifications	Z,ZK	5
Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software.			
MI-FLP	Functional and Logical Programming	Z,ZK	4
Students will be acquainted with principles of functional and logic programming. They will be able to write their programs in Lisp and Prolog programming languages.			
MI-GEN	Code Generators	Z,ZK	4
Students will become acquainted with both theoretical and practical aspects of back-end of an optimizing programming language compiler.			
MI-HWB.16	Hardware Security	Z,ZK	5
The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards against abuse of the system using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge about the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer.			
MI-KOD.16	Data Compression	Z,ZK	5
Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression.			
MI-MKY.16	Mathematics for Cryptology	Z,ZK	5
Students become familiar with parts of mathematics necessary for deeper understanding of the methods used in symmetric and asymmetric cryptography. They learn the mathematical principles on which security of encryption systems, cryptanalysis methods, cryptography over elliptic curves, and quantum cryptography are based.			
MI-MVI.16	Computational Intelligence Methods	Z,ZK	5
Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to many problems. They will learn how these methods work and how to apply them to problems related to data mining, control, intelligent games, optimizations, etc.			
MI-MVI	Computational Intelligence Methods	Z,ZK	4
Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to many problems. They will learn how these methods work and how to apply them to problems related to data mining, control, intelligent games, optimizations, etc.			
MI-MTI.16	Modern Internet Technologies	Z,ZK	5
Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems.			
MI-NFA.16	Design for the FPGA and ASIC Technology	Z,ZK	5
Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them.			
MI-NUR.16	User Interface Design	Z,ZK	5
Students will understand the theoretical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procedures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs.			
MI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	4
Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such methods to real-world problems. They will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They will learn to solve systems of linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement these algorithms sequentially as well as in parallel.			
MI-NSS.16	Normalized Software Systems	ZK	5
Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman's Law of Increasing Complexity (see, e.g., <a href="http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution">http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution</a> ). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures. Normalized Systems theory consists first of a set of principles which indicate where violations of stability and entropy-related issues occur in any given software architecture. These principles indicate that very fine-grained modular structures are required in order to control them. In the second part of the theoretical framework, it is shown how software architectures can be constructed based on a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors and triggers, while controlling for violations of the stability and entropy-related principles, allowing them to realize new levels of evolvability in software architectures. Recently, Normalized Systems theory was also applied to the modular structures in business processes and enterprise architectures, with the goal of constructing a foundational theory for Enterprise Engineering.			
MI-PAP.16	Parallel Computer Architectures	Z,ZK	5
The students gain a good overview of present parallel architectures and processors: parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems.			
MI-EDW.16	Enterprise Data Warehouse Systems	Z,ZK	5
MI-PAL	Advanced Algorithms	Z,ZK	4
The students will learn the most important advanced algorithms in different domains of the computer science that are not covered by modules of the Bachelor program Informatics and other modules of the Master program. They will also learn how to cope with problems that, according to the present knowledge, are not solvable optimally in polynomially bounded time.			

MI-KRY.16	Advanced Cryptology	Z,ZK	5
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions.			
MI-POA.16	Advanced Computer System Architectures	Z,ZK	5
The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment.			
MI-PDB.16	Advanced Database Systems	Z,ZK	5
Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge necessary to design distributed DB systems. They will understand the area of conceptual design of data warehouses.			
MI-PDD.16	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
MI-REV.16	Reverse Engineering	Z,ZK	5
This course is presented in Czech.			
MI-RUN	Runtime Systems	Z,ZK	4
Student become familiar - theoretically and practically - with runtime systems and virtual machines for various programming languages.			
MI-SWE.16	Semantic Web	Z,ZK	5
Students learn standards used for processing and sharing knowledge mainly in the area of web. They get used to designing and using knowledge models, knowledge representation, and practical aspects as publishing, sharing, exchange, and acquisition of knowledge on the web. The presentation is based on the idea of the semantic web, including its standards and technologies (RDF, RDFS, OWL) and formal models.			
MI-SIB.16	Network Security	Z,ZK	5
The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems.			
MI-SYP	Parsing and Compilers	Z,ZK	4
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.			
MI-SYB.16	System Security	Z,ZK	5
Students will familiarize themselves with the actual ICT security needs in all ICT disciplines. Students will gain knowledge of typical network attacks and protection against them, together with essential communication encryption techniques. They will learn how to work with certain aspects of encryption techniques - passwords and certificates. After that, students will learn the basics of anti-virus, anti-spam and heuristic analyses used in modern anti-virus solutions or Unified Threat Management (UTM) based solutions. They will also learn the principles of securing websites, web applications and databases. Upon completion of the module, students will have a broad overview of IT security and will be able to apply it to the integration of various software systems and applications.			
MI-SOC.16	Systems on Chip	Z,ZK	5
Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design.			
MI-CPX	Complexity Theory	Z,ZK	5
Students will learn about the fundamental classes of problems in the complexity theory and different models of algorithms and about implications of the theory concerning practical (un)solvability of difficult problems.			
MI-TSP.16	Testing and Reliability	Z,ZK	5
Students 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 easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
MI-VMM.16	Retrieval from Multimedia	Z,ZK	5
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of feature extraction from multimedia objects, indexing, and structure of distributed search engines.			
MI-W20.16	Web 2.0	Z,ZK	5
Students will learn new trends and technologies on the Web including theoretical foundations. Students will gain an overview about Web applications architectures, concepts and technologies about programmable Web (REST Architectures, Mashups), basic mechanisms for knowledge representation on the Web (microformats, meta-data, ontologies, open linked data, etc.), mechanisms about collective intelligence (collaborative filtering, predictions of users' behaviours), social networks, and security.			

Code of the group: MI-V-ISM

Name of the group: Elective Master Courses for Specialization Information Systems and Management, Presented in Czech

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

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
MI-IKM	<b>Internet and Classification Methods</b> Martin Holeňa Martin Holeňa Martin Holeňa (Gar.)	Z,ZK	4	1+1	L	v
MI-ADM	<b>Data Mining Algorithms</b> Petr Matyáš	Z,ZK	4	2+1	L	v

MI-AVY	<b>Automata in Text Pattern Matching</b> <i>Ondřej Guth, Bořivoj Melichar Ondřej Guth Bořivoj Melichar (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-BPS	<b>Wireless Computer Networks</b> <i>Alexandru Moucha Alexandru Moucha Alexandru Moucha (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-BPR	<b>Security and Secure Programming</b> <i>Tomáš Zahradnický</i>	Z,ZK	4	2+1	Z	v
MI-BHW	<b>Security and Hardware</b> <i>Róbert Lórencz</i>	Z,ZK	4	2+2	L	v
MI-DSP	<b>Database Systems in Practes</b> <i>Ondřej Zýka Michal Valenta Ondřej Zýka (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-DZO	<b>Digital Image Processing</b> <i>Daniel Sýkora Daniel Sýkora Daniel Sýkora (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-DSV	<b>Distributed Systems and Computing</b> <i>Peter Macejko</i>	Z,ZK	4	2+1	Z	v
MI-DDW	<b>Web Data Mining</b> <i>Vojtěch Svátek</i>	Z,ZK	4	2+1	L	v
MI-PAM	<b>Efficient Preprocessing and Parameterized Algorithms</b> <i>Ondřej Suchý Jan Janoušek Ondřej Suchý (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-EVY	<b>Efficient Text Pattern Matching</b> <i>Jan Holub</i>	Z,ZK	4	2+1	Z	v
MI-EDW	<b>Enterprise Data Warehouse Systems</b> <i>Stanislav Kuznetsov</i>	Z,ZK	4	2+1	L	v
MI-FME	<b>Formal Methods and Specifications</b> <i>Michal Valenta</i>	Z,ZK	4	2+1	L	v
MI-FLP	<b>Functional and Logical Programming</b> <i>Jan Janoušek Jan Janoušek Jan Janoušek (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-GLR	<b>Games and reinforcement learning</b> <i>Juan Pablo Maldonado Lopez Pavel Kordík Juan Pablo Maldonado Lopez (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-GEN	<b>Code Generators</b> <i>Jan Janoušek Jan Janoušek Jan Janoušek (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-IOT	<b>Internet of Things</b> <i>Jan Janeček Peter Macejko Jan Janeček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-SAS	<b>IT in the SaaS Era</b> <i>Jiří Donát</i>	Z,ZK	4	2+2	Z	v
MI-ATH	<b>Combinatorial Theories of Games</b> <i>Tomáš Valla Jan Janoušek Tomáš Valla (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-KOD	<b>Data Compression</b> <i>Jan Holub</i>	Z,ZK	4	2+1	L	v
MI-LOM	<b>Linear Optimization and Methods</b> <i>Michal Černý</i>	Z,ZK	4	2+1	Z	v
MI-MPR	<b>Master Project</b> <i>Miroslav Balík Miroslav Balík (Gar.)</i>	Z	7	0+0	Z,L	v
MI-MSI	<b>Mathematical Structures in Computer Science</b> <i>Jan Starý Jan Starý Jan Starý (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-MVI	<b>Computational Intelligence Methods</b> <i>Pavel Kordík</i>	Z,ZK	4	2+1	Z	v
MI-SCA	<b>Embedded Microcontrollers in Smartcards: Efficient Implementations and Side-Channel Attacks</b> <i>Tomáš Zahradnický</i>	KZ	3	2+2	L	v
MI-MTI	<b>Modern Internet Technologies</b> <i>Alexandru Moucha</i>	Z,ZK	4	2+1	Z	v
MI-MAI	<b>Multimedia and Internet</b> <i>Sven Ubik, Jiří Melnikov Jiří Melnikov Sven Ubik (Gar.)</i>	Z,ZK	3	2+1	L	v
MI-NFA	<b>Design for the FPGA and ASIC Technology</b> <i>Jan Schmidt</i>	Z,ZK	4	2+1	Z	v
MI-NUR	<b>User Interface Design</b> <i>Pavel Žikovský</i>	Z,ZK	4	2+1	Z	v
MI-NON	<b>Nonlinear Continuous Optimization and Numerical Methods</b>	Z,ZK	4	2+1	Z	v
MI-NSS	<b>Normalized Software Systems</b> <i>Robert Pergl</i>	ZK	3	2+0	L	v
MI-PAP	<b>Parallel Computer Architectures</b> <i>Ivan Šimeček</i>	Z,ZK	4	2+1	L	v
MI-LIF	<b>Liferay Portal</b> <i>Michal Valenta</i>	Z,ZK	4	2+2	Z	v
MI-CIO	<b>IT Support to Business and CIO Role</b> <i>Jan Dohnal</i>	ZK	3	3+0	Z	v
MI-PAL	<b>Advanced Algorithms</b> <i>Luděk Kučera Luděk Kučera Luděk Kučera (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-KRY	<b>Advanced Cryptology</b>	Z,ZK	4	2+2	Z	v
MI-POA	<b>Advanced Computer System Architectures</b> <i>Ondřej Žižka</i>	Z,ZK	4	2+1	L	v
MI-PDB	<b>Advanced Database Systems</b> <i>Michal Valenta</i>	Z,ZK	4	2+1	L	v

MI-DNP	<b>Advanced .NET and projective programming</b> <i>Marek Skotnica, David Šenkýř, Ondřej Dvořák <b>Ondřej Dvořák</b> Ondřej Dvořák (Gar.)</i>	Z,ZK	4	2+1	Z	v
MI-PRC	<b>Programming in CUDA</b> <i>Ivan Šimeček <b>Ivan Šimeček</b> Ivan Šimeček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-PSL	<b>Enterprise Java</b> <i>Jiří Daněček <b>Michal Valenta</b> Jiří Daněček (Gar.)</i>	Z,ZK	4	2+1	L	v
MI-RUB	<b>Programming in Ruby</b> <i>Tomáš Bartoň <b>Petr Pulc</b> (Gar.)</i>	KZ	4	0+3	Z	v
MI-PDD	<b>Data Preprocessing</b> <i>Jan Motl</i>	Z,ZK	4	2+1	Z	v
MI-AIT	<b>Case Studies of IT Business</b> <i>Zuzana Šochová <b>Zuzana Šochová</b> Zuzana Šochová (Gar.)</i>	ZK	2	2+0	Z	v
MI-RTS	<b>Real-Time Systems</b> <i>Hana Kubátová</i>	Z,ZK	4	2+1	Z	v
MI-REV	<b>Reverse Engineering</b> <i>Martin Jirkal</i>	Z,ZK	3	1+2	L	v
MI-ROZ	<b>Pattern Recognition</b> <i>Michal Haindl</i>	Z,ZK	4	2+1	Z	v
MI-RUN	<b>Runtime Systems</b> <i>Marcel Hlopko</i>	Z,ZK	4	2+1	Z	v
MI-RRI	<b>Risk Management in Informatics</b> <i>Zdeněk Blažek <b>Zdeněk Blažek</b> Zdeněk Blažek (Gar.)</i>	ZK	3	2+0	L	v
MI-SWE	<b>Semantic Web</b> <i>Peter Vojtáš</i>	Z,ZK	4	2+1	Z	v
MI-SIM	<b>Digital Circuit Simulation</b> <i>Jiří Douša</i>	Z,ZK	4	2+1	Z	v
MI-SIB	<b>Network Security</b> <i>Tomáš Herout</i>	Z,ZK	4	2+1	Z	v
FI-ST1	<b>Network Technology 1</b>	Z	3		Z	v
FI-ST2	<b>Network Technology 2</b>	Z	4	0+4	L	v
MI-SYP	<b>Parsing and Compilers</b> <i>Jan Janoušek</i>	Z,ZK	4	2+1	Z	v
MI-SOC	<b>Systems on Chip</b> <i>Hana Kubátová</i>	Z,ZK	4	2+1	Z	v
MI-TS1	<b>Theoretical Seminar Master I</b> <i>Tomáš Valla, Ondřej Suchý <b>Jan Janoušek</b> Ondřej Suchý (Gar.)</i>	Z	4	0+2	Z	v
MI-TS2	<b>Theoretical Seminar Master II</b> <i>Jan Janoušek <b>Ondřej Suchý</b> (Gar.)</i>	Z	4	0+2	L	v
MI-TS3	<b>Theoretical Seminar Master III</b> <i>Jan Janoušek <b>Ondřej Suchý</b> (Gar.)</i>	Z	4	0+2	Z	v
MI-TS4	<b>Theoretical Seminar Master IV</b> <i>Tomáš Valla, Ondřej Suchý <b>Jan Janoušek</b> Tomáš Valla (Gar.)</i>	Z	4	0+2	L	v
MI-CPX	<b>Complexity Theory</b> <i>Luděk Kučera, Ondřej Suchý <b>Luděk Kučera</b> Luděk Kučera (Gar.)</i>	Z,ZK	5	3+1	Z	v
MI-TSP	<b>Testing and Reliability</b> <i>Petr Fišer</i>	Z,ZK	4	2+2	Z	v
MI-MCS	<b>Multicore Systems</b> <i>Jiří Kašpar <b>Tomáš Zahradnický</b> Pavel Tvrđík (Gar.)</i>	KZ	4	1+2	Z	v
MI-VYC	<b>Computability</b> <i>Jan Starý <b>Jan Starý</b> Jan Starý (Gar.)</i>	Z,ZK	4	2+2	L	v
MI-VMW	<b>Retrieval of Multimedia Content on the Web</b> <i>David Hoksza</i>	Z,ZK	4	2+1	Z	v
MI-W20	<b>Web 2.0</b> <i>Tomáš Vitvar</i>	Z,ZK	4	2+1	L	v

**Characteristics of the courses of this group of Study Plan: Code=MI-V-ISM Name=Elective Master Courses for Specialization Information Systems and Management, Presented in Czech**

MI-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. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 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.				
MI-IKM	Internet and Classification Methods		Z,ZK	4
This course is presented in Czech.				
MI-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.				
MI-DSP	Database Systems in Practes		Z,ZK	4

MI-DZO	Digital Image Processing	Z,ZK	4
This course presents a comprehensive overview of modern methods for processing digital images and video. It mainly deals with practical algorithms used in professional image processing tools that are both easy to implement and have an interesting theoretical basis. Seemingly boring theorems from calculus, discrete mathematics, statistics and computer science come to life in visually attractive applications.			
MI-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.			
MI-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.			
MI-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).			
MI-ATH	Combinatorial Theories of Games	Z,ZK	4
This course is presented in Czech.			
MI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages. Data types as continuous lattices, Scott topology. Procedures as continuous mappings. Lambda calculus and functional languages. Introduction to category theory.			
MI-MAI	Multimedia and Internet	Z,ZK	3
The course will cover principles and technologies for processing and network transmissions of multimedia signals, stereoscopy and visualizations in high definition. Lectures will include application areas of networked multimedia, transmission formats, interfaces, codecs, technologies for acquisition and reproduction of multimedia data and technologies for visualizations and distributed collaboration using networking and immersive environments.			
MI-DNP	Advanced .NET and projective programming	Z,ZK	4
Students acquire a knowledge about advanced design of applications on a .NET platform. They gain skills of WPF (Windows Presentation Foundation), WCF/WebAPI (Windows Communication Foundation) and Entity Framework. They are able to apply these skills on a development and design of advanced .NET applications.			
MI-PRC	Programming in CUDA	Z,ZK	4
The students gain a good overview of present parallel architectures in GPUs. Students also get hands-on experience with programming these systems.			
MI-PSL	Enterprise Java	Z,ZK	4
The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information systems which are connected to a database and are accessed through the web interface.			
MI-RUB	Programming in Ruby	KZ	4
This course is presented in Czech.			
MI-AIT	Case Studies of IT Business	ZK	2
This course is presented in Czech.			
MI-RR1	Risk Management in Informatics	ZK	3
Information security is very often considered as one of main objectives to secure targets of information processing. However, to focus on this info security as a matter of protection of IT systems against viruses, malware etc. very often means misunderstanding and underestimating of real threats which are around us and which are more dangerous than viruses and other malware. The necessity to continue with business after disaster is also slightly ignored. International standards which are focused on informatics and information security just during last years started to anticipate necessity of risk management. There is no commonly accepted methodology used for this task. Threats which are currently possible to see worldwide, invoke pressures to prepare plans for business continuity management even in the case of dramatic political changes, natural disasters etc.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-MCS	Multicore Systems	KZ	4
Students understand architecture of systems based on multicore processors with multiple threads per core, structure and usage of cache hierarchy with shared last level. They learn parallel algorithm classification, parallel programming technics, simulation and monitoring tools for measurement and optimization of parallel algorithms. After this course, students can design MTMD programs (Multiple Threads Multiple Data), measure and analyze latency and throughput of parallel algorithms and optimize them for contemporary multicore systems.			
MI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability. Recursive functions, Turing machines, and their equivalence. Church's thesis. Universal machine, normal form. Halting Problem and fixed points. Relations to logic: (in)completeness and (un)decidability.			
MI-AVY	Automata in Text Pattern Matching	Z,ZK	4
Students learn algorithms for searching in texts using finite automata. They become acquainted with the searching problems taxonomy and learn the principles of automata constructions for solving these problems. They will be able to apply the gained knowledge in the design of applications required text pattern matching, such as data streaming, DNA sequencing, etc.			

MI-BPR	Security and Secure Programming	Z,ZK	4
Students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Students will also be briefly introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and countermeasures to these attacks.			
MI-EVY	Efficient Text Pattern Matching	Z,ZK	4
Students get knowledge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both access time and memory complexity. They will be able to use the knowledge in design of applications that utilize pattern matching.			
MI-FLP	Functional and Logical Programming	Z,ZK	4
Students will be acquainted with principles of functional and logic programming. They will be able to write their programs in Lisp and Prolog programming languages.			
MI-GEN	Code Generators	Z,ZK	4
Students will become acquainted with both theoretical and practical aspects of back-end of an optimizing programming language compiler.			
MI-MVI	Computational Intelligence Methods	Z,ZK	4
Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to many problems. They will learn how these methods work and how to apply them to problems related to data mining, control, intelligent games, optimizations, etc.			
MI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	4
Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such methods to real-world problems. They will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They will learn to solve systems of linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement these algorithms sequentially as well as in parallel.			
MI-PAL	Advanced Algorithms	Z,ZK	4
The students will learn the most important advanced algorithms in different domains of the computer science that are not covered by modules of the Bachelor program Informatics and other modules of the Master program. They will also learn how to cope with problems that, according to the present knowledge, are not solvable optimally in polynomially bounded time.			
MI-RUN	Runtime Systems	Z,ZK	4
Student become familiar - theoretically and practically - with runtime systems and virtual machines for various programming languages.			
MI-SYP	Parsing and Compilers	Z,ZK	4
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.			
MI-CPX	Complexity Theory	Z,ZK	5
Students will learn about the fundamental classes of problems in the complexity theory and different models of algorithms and about implications of the theory concerning practical (un)solvability of difficult problems.			
MI-ADM	Data Mining Algorithms	Z,ZK	4
In this course, we discuss most popular data mining algorithms and optimization techniques such as decision trees, support vector machines, multilayered perceptrons etc. We also explain theoretically basic elements of statistical learning that are essential for all data engineers.			
MI-BHW	Security and Hardware	Z,ZK	4
Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, (pseudo)random number generators, smart cards, and resources for securing of internal functions of computer systems.			
MI-DSV	Distributed Systems and Computing	Z,ZK	4
Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures.			
MI-DDW	Web Data Mining	Z,ZK	4
A student learns in detail about various search and data mining methods and will be able to select, in the context of a given application, a suitable method of automatic web data processing and to control the process of its usage.			
MI-EDW	Enterprise Data Warehouse Systems	Z,ZK	4
MI-FME	Formal Methods and Specifications	Z,ZK	4
Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software.			
MI-SAS	IT in the SaaS Era	Z,ZK	4
This course is presented in Czech.			
MI-KOD	Data Compression	Z,ZK	4
Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression.			
MI-LOM	Linear Optimization and Methods	Z,ZK	4
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.			
MI-SCA	Embedded Microcontrollers in Smartcards: Efficient Implementations and Side-Channel Attacks	KZ	3
Practical implementation of cryptographic schemes on an embedded microcontroller. Attacking them by means of side-channel analysis.			
MI-MTI	Modern Internet Technologies	Z,ZK	4
Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems.			
MI-NFA	Design for the FPGA and ASIC Technology	Z,ZK	4
Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them.			

MI-NUR	User Interface Design	Z,ZK	4
Students will understand the theoretical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procedures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs.			
MI-NSS	Normalized Software Systems	ZK	3
Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman's Law of Increasing Complexity (see, e.g., <a href="http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution">http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution</a> ). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures. Normalized Systems theory consists first of a set of principles which indicate where violations of stability and entropy-related issues occur in any given software architecture. These principles indicate that very fine-grained modular structures are required in order to control them. In the second part of the theoretical framework, it is shown how software architectures can be constructed based on a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors and triggers, while controlling for violations of the stability and entropy-related principles, allowing them to realize new levels of evolvability in software architectures. Recently, Normalized Systems theory was also applied to the modular structures in business processes and enterprise architectures, with the goal of constructing a foundational theory for Enterprise Engineering.			
MI-PAP	Parallel Computer Architectures	Z,ZK	4
The students gain a good overview of present parallel architectures and processors: parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems.			
MI-LIF	Liferay Portal	Z,ZK	4
This course is presented in Czech.			
MI-CIO	IT Support to Business and CIO Role	ZK	3
After completing the module, students will know best practices of ICT management. They will understand ICT competencies and attitudes required for business support.			
MI-KRY	Advanced Cryptology	Z,ZK	4
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions.			
MI-POA	Advanced Computer System Architectures	Z,ZK	4
The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment.			
MI-PDB	Advanced Database Systems	Z,ZK	4
Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge about database engines from NoSQL family and about theoretical basis for these engines - CAP theorem. Exact lectures list slightly changes each year according to state of the art.			
MI-PDD	Data Preprocessing	Z,ZK	4
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
MI-RTS	Real-Time Systems	Z,ZK	4
MI-REV	Reverse Engineering	Z,ZK	3
This course is presented in Czech.			
MI-ROZ	Pattern Recognition	Z,ZK	4
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.			
MI-SWE	Semantic Web	Z,ZK	4
Students learn standards used for processing and sharing knowledge mainly in the area of web. They get used to designing and using knowledge models, knowledge representation, and practical aspects as publishing, sharing, exchange, and acquisition of knowledge on the web. The presentation is based on the idea of the semantic web, including its standards and technologies (RDF, RDFS, OWL) and formal models.			
MI-SIM	Digital Circuit Simulation	Z,ZK	4
Students gain information regarding the usage of basic tools for the design and simulation of VLSI (very large scale integration) digital circuits (VHDL, Verilog). They also get some knowledge about advanced tools System Verilog & SystemC.			
MI-SIB	Network Security	Z,ZK	4
The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems.			
FI-ST1	Network Technology 1	Z	3
This course is presented in Czech.			
FI-ST2	Network Technology 2	Z	4
This course is presented in Czech.			
MI-SOC	Systems on Chip	Z,ZK	4
Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design.			
MI-TSP	Testing and Reliability	Z,ZK	4
Students 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 easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
MI-VMW	Retrieval of Multimedia Content on the Web	Z,ZK	4
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of feature extraction from multimedia objects, indexing, and structure of distributed search engines.			
MI-W20	Web 2.0	Z,ZK	4
Students will learn new trends and technologies on the Web including theoretical foundations. Students will gain an overview about Web applications architectures, concepts and technologies about programmable Web (REST Architectures, Mashups), basic mechanisms for knowledge representation on the Web (microformats, meta-data, ontologies, open linked data, etc.), mechanisms about collective intelligence (collaborative filtering, predictions of users' behaviours), social networks, and security.			

## List of courses of this pass:

Code	Name of the course	Completion	Credits
FI-FIL	Philosophy see A0B16	ZK	2
FI-GNO	Introduction to Gnoseology Předmět studenty uvádí do teorie poznání, systémovým pohledem nahlíží na pole kultury, na vztahy a rozdíly mezi přírodními a humánními obory, vědou a uměním. Rozbořením dějin modernismu a myšlenkových proudů 20. století jsou ukázány proměny paradigmat a převrat k postmodernismu, analýzou paralelismů ve vědě a umění odhaleny mechanismy tvůrčích procesů. V návaznosti na teorii přírodních jazyků a sémiotiky je vedena diskuze i o kognitivních procesech, v historickém přehledu nastíněna hlediska estetického vnímání. Samostatnou kapitolou jsou modely spojených přírodních soustav a systémů, v závěru přednášek je pozornost věnována filozofii vědy a otázkám udržitelného rozvoje. Předmět přednáší a garantuje Ing. Ivo Janoušek CSc.	ZK	2
FI-HPZ	Humanities subject from a study abroad A "Humanities subject that has been studied abroad" is covered by the Humanities subject from a study abroad in Compulsory Humanities Module that is required in the curriculum. The substitution is approved by the Vice-Dean for study affairs on behalf of the Dean at the request of the student.	Z	3
FI-HTE	History of Technology and Economics The course introduces the scientific disciplines of history and technology, economic and social history of the Czech lands and Czechoslovakia in comparison with the development of the European region 19 to 21 century.	ZK	2
FI-KSA	Cultural and Social Anthropology The one-semester course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversity of the world - examples from anthropological research from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, material culture, language, health, history, death, etc ...) will be shown. The course is an interesting alternative to other humanities, taught at FIT.	ZK	2
FI-MPL	Managerial Psychology	ZK	2
FI-ST1	Network Technology 1 This course is presented in Czech.	Z	3
FI-ST2	Network Technology 2 This course is presented in Czech.	Z	4
FI-ULI	Introduction to Linguistics for Computer This course is presented in Czech.	ZK	2
MI-ADM	Data Mining Algorithms In this course, we discuss most popular data mining algorithms and optimization techniques such as decision trees, support vector machines, multilayered perceptrons etc. We also explain theoretically basic elements of statistical learning that are essential for all data engineers.	Z,ZK	4
MI-ADM.16	Data Mining Algorithms The course is suitable for those who want to familiarize themselves with the exceedingly interesting and useful discipline of data mining. The course covers the most useful algorithms that can be easily applied in any field of science.	Z,ZK	5
MI-ADP.16	Architecture and Design Patterns The objective of this course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as well as with understanding of the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge of object-oriented programming and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. In the second part the students will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems, and some advanced software architectures used in large-scale distributed systems.	Z,ZK	5
MI-AFP	Applied Functional Programming 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.	KZ	5
MI-AIT	Case Studies of IT Business This course is presented in Czech.	ZK	2
MI-APH	Architecture of computer games Students will gain a basic understanding of the various issues in the field of computer games development, especially from a technical point of view. They will have a grasp of component-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).	Z,ZK	4
MI-ARI	Computer arithmetic Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementation units.	Z,ZK	4
MI-ATH	Combinatorial Theories of Games This course is presented in Czech.	Z,ZK	4
MI-AVY	Automata in Text Pattern Matching Students learn algorithms for searching in texts using finite automata. They become acquainted with the searching problems taxonomy and learn the principles of automata constructions for solving these problems. They will be able to apply the gained knowledge in the design of applications required text pattern matching, such as data streaming, DNA sequencing, etc.	Z,ZK	4
MI-BHW	Security and Hardware Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, (pseudo)random number generators, smart cards, and resources for securing of internal functions of computer systems.	Z,ZK	4
MI-BHW.16	Security and Hardware Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, random number generators, smart cards, and resources for securing of internal functions of computer systems.	Z,ZK	5

MI-BKO.16	<b>Error Control Codes</b> 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.	Z,ZK	5
MI-BML	<b>Bayesian Methods for Machine Learning</b> The subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studies the construction of appropriate models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden variables (true object position from noisy observations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose, a number of real world examples and applications will be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging. The students will try to solve some of them.	KZ	5
MI-BPR	<b>Security and Secure Programming</b> Students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Students will also be briefly introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and countermeasures to these attacks.	Z,ZK	4
MI-BPS	<b>Wireless Computer Networks</b> 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.	Z,ZK	4
MI-CIO	<b>IT Support to Business and CIO Role</b> After completing the module, students will know best practices of ICT management. They will understand ICT competencies and attitudes required for business support.	ZK	3
MI-CPX	<b>Complexity Theory</b> Students will learn about the fundamental classes of problems in the complexity theory and different models of algorithms and about implications of the theory concerning practical (un)solvability of difficult problems.	Z,ZK	5
MI-DDM	<b>Distributed Data Mining</b> 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.	KZ	4
MI-DDW	<b>Web Data Mining</b> A student learns in detail about various search and data mining methods and will be able to select, in the context of a given application, a suitable method of automatic web data processing and to control the process of its usage.	Z,ZK	4
MI-DDW.16	<b>Web Data Mining</b> Students will learn latest methods and technologies for Web data acquisition, analysis and utilization of the discovered knowledge. Students will gain an overview of Web mining techniques for Web crawling and search, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overview of most recent developments in the field of social web and recommendation systems.	Z,ZK	5
MI-DIP	<b>Diploma Project</b>	Z	23
MI-DNP	<b>Advanced .NET and projective programming</b> Students acquire a knowledge about advanced design of applications on a .NET platform. They gain skills of WPF (Windows Presentation Foundation), WCF/WebAPI (Windows Communication Foundation) and Entity Framework. They are able to apply these skills on a development and design of advanced .NET applications.	Z,ZK	4
MI-DSP	<b>Database Systems in Prctes</b>	Z,ZK	4
MI-DSV	<b>Distributed Systems and Computing</b> Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures.	Z,ZK	4
MI-DSV.16	<b>Distributed Systems and Computing</b> Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures.	Z,ZK	5
MI-DZO	<b>Digital Image Processing</b> This course presents a comprehensive overview of modern methods for processing digital images and video. It mainly deals with practical algorithms used in professional image processing tools that are both easy to implement and have an interesting theoretical basis. Seemingly boring theorems from calculus, discrete mathematics, statistics and computer science come to life in visually attractive applications.	Z,ZK	4
MI-EDW	<b>Enterprise Data Warehouse Systems</b>	Z,ZK	4
MI-EDW.16	<b>Enterprise Data Warehouse Systems</b>	Z,ZK	5
MI-EVY	<b>Efficient Text Pattern Matching</b> Students get knowledge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both access time and memory complexity. They will be able to use the knowledge in design of applications that utilize pattern matching.	Z,ZK	4
MI-FLP	<b>Functional and Logical Programming</b> Students will be acquainted with principles of functional and logic programming. They will be able to write their programs in Lisp and Prolog programming languages.	Z,ZK	4
MI-FME	<b>Formal Methods and Specifications</b> Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software.	Z,ZK	4
MI-FME.16	<b>Formal Methods and Specifications</b> Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software.	Z,ZK	5
MI-GEN	<b>Code Generators</b> Students will become acquainted with both theoretical and practical aspects of back-end of an optimizing programming language compiler.	Z,ZK	4
MI-GLR	<b>Games and reinforcement learning</b> 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.	Z,ZK	4
MI-HMI2	<b>History of Mathematics and Informatics</b> This course is presented in Czech.	ZK	3

MI-HWB.16	Hardware Security	Z,ZK	5
The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards against abuse of the system using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge about the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer.			
MI-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).			
MI-IKM	Internet and Classification Methods This course is presented in Czech.	Z,ZK	4
MI-IOS	Advanced techniques in iOS applications	KZ	4
MI-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).			
MI-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			
MI-KOD	Data Compression	Z,ZK	4
Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression.			
MI-KOD.16	Data Compression	Z,ZK	5
Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression.			
MI-KRY	Advanced Cryptology	Z,ZK	4
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions.			
MI-KRY.16	Advanced Cryptology	Z,ZK	5
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions.			
MI-KYB.16	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).			
MI-LCF	Compiler system LLVM	Z,ZK	4
MI-LIF	Liferay Portal This course is presented in Czech.	Z,ZK	4
MI-LOM	Linear Optimization and Methods	Z,ZK	4
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.			
MI-LOM.16	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.			
MI-MAI	Multimedia and Internet	Z,ZK	3
The course will cover principles and technologies for processing and network transmissions of multimedia signals, stereoscopy and visualizations in high definition. Lectures will include application areas of networked multimedia, transmission formats, interfaces, codecs, technologies for acquisition and reproduction of multimedia data and technologies for visualizations and distributed collaboration using networking and immersive environments.			
MI-MBI.16	Management of Business Informatics This course is presented in Czech.	Z,ZK	5
MI-MCS	Multicore Systems	KZ	4
Students understand architecture of systems based on multicore processors with multiple threads per core, structure and usage of cache hierarchy with shared last level. They learn parallel algorithm classification, parallel programming technics, simulation and monitoring tools for measurement and optimization of parallel algorithms. After this course, students can design MTMD programs (Multiple Threads Multiple Data), measure and analyze latency and throughput of parallel algorithms and optimize them for contemporary multicore systems.			
MI-MDW.16	Web Services and Middleware	Z,ZK	5
Students learn new trends and technologies in the area of service-oriented architectures, web services, middleware, and cloud computing, including their theoretical background.			
MI-MEP.16	Modelling of Business Processes	Z,ZK	5
Students will learn the principles, definitions, characteristics and components of business process modeling, collaborative modeling, and enterprise modeling, and their interrelations in real life business settings.			
MI-MKY.16	Mathematics for Cryptology	Z,ZK	5
Students become familiar with parts of mathematics necessary for deeper understanding of the methods used in symmetric and asymmetric cryptography. They learn the mathematical principles on which security of encryption systems, cryptanalysis methods, cryptography over elliptic curves, and quantum cryptography are based.			

MI-MPC	Modern programming in C ++	Z,ZK	5
Students learn how to use the modern features of contemporary versions of the C++ programming language for software development. The course focuses on programming effectivity and efficiency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor time requirements.			
MI-MPI	Mathematics for Informatics	Z,ZK	7
Students are introduced to fields of mathematics necessary for better understanding of some topics they will meet in specialized courses later on.			
MI-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. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 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.			
MI-MPX	Management practice	Z	4
The Student can once, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the operational, tactical or strategic level of management (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is assessed well in advance the course guarantor. In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relatives of the student (e.g. as a member of the top management).			
MI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages. Data types as continuous lattices, Scott topology. Procedures as continuous mappings. Lambda calculus and functional languages. Introduction to category theory.			
MI-MTI	Modern Internet Technologies	Z,ZK	4
Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems.			
MI-MTI.16	Modern Internet Technologies	Z,ZK	5
Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems.			
MI-MVI	Computational Intelligence Methods	Z,ZK	4
Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to many problems. They will learn how these methods work and how to apply them to problems related to data mining, control, intelligent games, optimizations, etc.			
MI-MVI.16	Computational Intelligence Methods	Z,ZK	5
Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to many problems. They will learn how these methods work and how to apply them to problems related to data mining, control, intelligent games, optimizations, etc.			
MI-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.			
MI-NFA	Design for the FPGA and ASIC Technology	Z,ZK	4
Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them.			
MI-NFA.16	Design for the FPGA and ASIC Technology	Z,ZK	5
Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them.			
MI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	4
Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such methods to real-world problems. They will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They will learn to solve systems of linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement these algorithms sequentially as well as in parallel.			
MI-NSS	Normalized Software Systems	ZK	3
Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman's Law of Increasing Complexity (see, e.g., <a href="http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution">http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution</a> ). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures. Normalized Systems theory consists first of a set of principles which indicate where violations of stability and entropy-related issues occur in any given software architecture. These principles indicate that very fine-grained modular structures are required in order to control them. In the second part of the theoretical framework, it is shown how software architectures can be constructed based on a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors and triggers, while controlling for violations of the stability and entropy-related principles, allowing them to realize new levels of evolvability in software architectures. Recently, Normalized Systems theory was also applied to the modular structures in business processes and enterprise architectures, with the goal of constructing a foundational theory for Enterprise Engineering.			
MI-NSS.16	Normalized Software Systems	ZK	5
Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman's Law of Increasing Complexity (see, e.g., <a href="http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution">http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution</a> ). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures.			

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MI-NUR	User Interface Design	Z,ZK	4
Students will understand the theoretical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procedures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs.			
MI-NUR.16	User Interface Design	Z,ZK	5
Students will understand the theoretical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procedures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs.			
MI-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.			
MI-PAA	Problems and Algorithms	Z,ZK	5
Students are able to evaluate discrete problems by complexity and by the purpose of optimisation (on-line tasks, multicriterial optimisation). They understand principles and properties of heuristics and exact algorithms and, therefore, are able to select, apply, and experimentally evaluate a suitable heuristics for a practical problem.			
MI-PAL	Advanced Algorithms	Z,ZK	4
The students will learn the most important advanced algorithms in different domains of the computer science that are not covered by modules of the Bachelor program Informatics and other modules of the Master program. They will also learn how to cope with problems that, according to the present knowledge, are not solvable optimally in polynomially bounded time.			
MI-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.			
MI-PAP	Parallel Computer Architectures	Z,ZK	4
The students gain a good overview of present parallel architectures and processors:parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems.			
MI-PAP.16	Parallel Computer Architectures	Z,ZK	5
The students gain a good overview of present parallel architectures and processors:parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems.			
MI-PCM.16	Project And Change Management	KZ	3
This course is presented in Czech.			
MI-PDB	Advanced Database Systems	Z,ZK	4
Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge about database engines from NoSQL family and about theoretical basis for these engines - CAP theorem. Exact lectures list slightly changes each year according to state of the art.			
MI-PDB.16	Advanced Database Systems	Z,ZK	5
Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge necessary to design distributed DB systems. They will understand the area of conceptual design of data warehouses.			
MI-PDD	Data Preprocessing	Z,ZK	4
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
MI-PDD.16	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
MI-PDM	Practical Data Mining	Z,ZK	5
Students are introduced to the basic methods of discovering knowledge in data. In particular, they learn the basic techniques of data preprocessing, data visualization, statistical techniques of data transformation, and fundamental principles of knowledge discovery methods. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Data mining software is extensively used in the module. Students will be able to apply basic data mining tools to common problems (classification, regression, clustering).			
MI-PDP.16	Parallel and Distributed Programming	Z,ZK	5
Due to the development of cloud, web, and communication technologies and due to the shift of the Moore law into parallelization of CPUs, parallel and distributed applications are becoming dominant. Students get acquainted with architectures of parallel and distributed computing systems and their models and with languages and environments for their programming. They learn the pattern designs for parallel and distributed programming and important parallel algorithms.			
MI-PIS.16	Advanced Information Systems	Z,ZK	5
Students learn the notion of business process logic and its formalization, with business process roles, business rules, and data processing, with the notion of service oriented company, enterprise services and service solution of business logic. They get acquainted with these notions also for the other types of ISs. They learn about agility and adaptivity and using of artificial intelligence methods for implementation of these ideas in ISs. They understand modern object-oriented methodologies for modelling of business processes, business rules, processed data, and enterprise ISs. They will get the rules and technologies for successful implementation of IS.			
MI-POA	Advanced Computer System Architectures	Z,ZK	4
The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment.			
MI-POA.16	Advanced Computer System Architectures	Z,ZK	5
The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment.			

MI-PRC	Programming in CUDA The students gain a good overview of present parallel architectures in GPUs. Students also get hands-on experience with programming these systems.	Z,ZK	4
MI-PSL	Enterprise Java The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information systems which are connected to a database and are accessed through the web interface.	Z,ZK	4
MI-PVS	Advanced embedded systems 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.	Z,ZK	4
MI-PYT	Advanced Python 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.	KZ	4
MI-REV	Reverse Engineering This course is presented in Czech.	Z,ZK	3
MI-REV.16	Reverse Engineering This course is presented in Czech.	Z,ZK	5
MI-ROZ	Pattern Recognition 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.	Z,ZK	4
MI-ROZ.16	Pattern Recognition 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.	Z,ZK	5
MI-RR1	Risk Management in Informatics Information security is very often considered as one of main objectives to secure targets of information processing. However, to focus on this info security as a matter of protection of IT systems against viruses, malware etc. very often means misunderstanding and underestimating of real threats which are around us and which are more dangerous then viruses and other malware. The necessity to continue with business after disaster is also slightly ignored. International standards which are focused on informatics and information security just during last years started to anticipate necessity of risk management. There is no commonly accepted methodology used for this task. Threats which are currently possible to see worldwide, invoke pressures to prepare plans for business continuity management even in the case of dramatic political changes, natural disasters etc.	ZK	3
MI-RTS	Real-Time Systems	Z,ZK	4
MI-RUB	Programming in Ruby This course is presented in Czech.	KZ	4
MI-RUN	Runtime Systems Student become familiar - theoretically and practically - with runtime systems and virtual machines for various programming languages.	Z,ZK	4
MI-SAS	IT in the SaaS Era This course is presented in Czech.	Z,ZK	4
MI-SCA	Embedded Microcontrollers in Smartcards: Efficient Implementations and Side-Channel Attacks Practical implementation of cryptographic schemes on an embedded microcontroller. Attacking them by means of side-channel analysis.	KZ	3
MI-SCE1	Computer Engineering Seminar Master I 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.	Z	4
MI-SCE2	Computer Engineering Seminar Master II 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.	Z	4
MI-SCR	Statistical Analysis of Time Series The course deals with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange prices, employment) and industrial problems (modelling of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a convenient process model, estimate its parameters, analyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the main principles based on practical real-world examples. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward transfer of students' knowledge from the academic to the real world.	Z,ZK	4
MI-SEP	World Economy and Business 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.	Z,ZK	4
MI-SIB	Network Security The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems.	Z,ZK	4
MI-SIB.16	Network Security The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems.	Z,ZK	5
MI-SIM	Digital Circuit Simulation Students gain information regarding the usage of basic tools for the design and simulation of VLSI (very large scale integration) digital circuits (VHDL, Verilog). They also get some knowledge about advanced tools System Verilog & SystemC.	Z,ZK	4

MI-SMI.16	Strategic Management of Informatics	Z,ZK	5
The course focuses on the strategic management of information systems. Students will learn the process of creation and implementation of an information strategy, IT governance, the importance of ICT for business and interrelations between information strategies and global business strategies. Furthermore, they gain the knowledge in the areas of economic management of IS/IT, management of investments and ROI, assessment of IT investments and management of human resources in IT (the role of CIO, CEO, CFO). The part of the course is the role of project management, risk management and quality assessment of informatics.			
MI-SOC	Systems on Chip	Z,ZK	4
Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design.			
MI-SOC.16	Systems on Chip	Z,ZK	5
Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design.			
MI-SPI.16	Statistics for Informatics	Z,ZK	7
The students will learn the basics of the probability theory, elements of information theory and stochastic processes, and some methods of computational statistics. They will understand the methods for statistical processing of large volumes of data. They will get skills in using computational methods and statistical software for these tasks.			
MI-SWE	Semantic Web	Z,ZK	4
Students learn standards used for processing and sharing knowledge mainly in the area of web. They get used to designing and using knowledge models, knowledge representation, and practical aspects as publishing, sharing, exchange, and acquisition of knowledge on the web. The presentation is based on the idea of the semantic web, including its standards and technologies (RDF, RDFS, OWL) and formal models.			
MI-SWE.16	Semantic Web	Z,ZK	5
Students learn standards used for processing and sharing knowledge mainly in the area of web. They get used to designing and using knowledge models, knowledge representation, and practical aspects as publishing, sharing, exchange, and acquisition of knowledge on the web. The presentation is based on the idea of the semantic web, including its standards and technologies (RDF, RDFS, OWL) and formal models.			
MI-SYB.16	System Security	Z,ZK	5
Students will familiarize themselves with the actual ICT security needs in all ICT disciplines. Students will gain knowledge of typical network attacks and protection against them, together with essential communication encryption techniques. They will learn how to work with certain aspects of encryption techniques - passwords and certificates. After that, students will learn the basics of anti-virus, anti-spam and heuristic analyses used in modern anti-virus solutions or Unified Threat Management (UTM) based solutions. They will also learn the principles of securing websites, web applications and databases. Upon completion of the module, students will have a broad overview of IT security and will be able to apply it to the integration of various software systems and applications.			
MI-SYP	Parsing and Compilers	Z,ZK	4
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.			
MI-TES.16	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.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-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 potentials of the teachers of the seminar.			
MI-TSP	Testing and Reliability	Z,ZK	4
Students 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 easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
MI-TSP.16	Testing and Reliability	Z,ZK	5
Students 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 easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
MI-VEM	Scientific thinking	KZ	2
The objective of the course is to get acquainted with scientific methods and discovery of order and laws of the universe, including the aspects of human life. The subject combines scientific methods in natural sciences, mathematics, computer science and humanities. Another aim is to introduce rules and requirements of scientific communication via research papers and posters.			
MI-VMM.16	Retrieval from Multimedia	Z,ZK	5
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of feature extraction from multimedia objects, indexing, and structure of distributed search engines.			
MI-VMW	Retrieval of Multimedia Content on the Web	Z,ZK	4
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of feature extraction from multimedia objects, indexing, and structure of distributed search engines.			

MI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability. Recursive functions, Turing machines, and their equivalence. Church's thesis. Universal machine, normal form. Halting Problem and fixed points. Relations to logic: (in)completeness and (un)decidability.			
MI-W20	Web 2.0	Z,ZK	4
Students will learn new trends and technologies on the Web including theoretical foundations. Students will gain an overview about Web applications architectures, concepts and technologies about programmable Web (REST Architectures, Mashups), basic mechanisms for knowledge representation on the Web (microformats, meta-data, ontologies, open linked data, etc.), mechanisms about collective intelligence (collaborative filtering, predictions of users' behaviours), social networks, and security.			
MI-W20.16	Web 2.0	Z,ZK	5
Students will learn new trends and technologies on the Web including theoretical foundations. Students will gain an overview about Web applications architectures, concepts and technologies about programmable Web (REST Architectures, Mashups), basic mechanisms for knowledge representation on the Web (microformats, meta-data, ontologies, open linked data, etc.), mechanisms about collective intelligence (collaborative filtering, predictions of users' behaviours), social networks, and security.			
MI-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 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.			
MI-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 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.			
MI-ZS30	Master internship abroad for 30 credits	Z	30
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 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.			
MIE-STR	Strategy in the ICT industry on case studies	ZK	2
Abstract: The goal of this course is to give students an overview of the most important success factors in a dynamic market of ICT and allow them to think about their own career in the context of real life case studies of contemporary ICT industry. Students will learn the principles of strategic management of companies operating in converging sectors influenced by ICT on real-life case studies discussed directly with entrepreneurs and senior executives of these firms. Two categories of companies will be invited for interactive discussion of their strategy and vision: start-up companies represented by their founders, and the ICT industry's biggest companies such as Google, Microsoft, IBM, Cisco, represented by their senior managers. On the basis of these experiences, students will be able to make their own conclusions on how to succeed in their professional life.			
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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