Study plan

Name of study plan: Mgr. programme, for the phase of study without specialisation, ver. for 2020 and higher

Faculty/Institute/Others: Department: Branch of study guaranteed by the department: Welcome page Garantor of the study branch: Program of study: Informatika Type of study: Follow-up master full-time Required credits: 63 Elective courses credits: 57 Sum of credits in the plan: 120 Note on the plan: Tato verze studijního plánu je ur ena pro ro níky, které byly p ijaty ke studiu od akademického roku 2020/2021 do prezen ní formy studia magisterského programu. . Garant: prof. Ing. Jan Holub, PhD., email: jan.holub@fit.cvut.cz

Name of the block: Compulsory courses in the program Minimal number of credits of the block: 63 The role of the block: PP

Code of the group: NI-PP.2020

Name of the group: Compulsory Courses of Master Study Program, Version 2020, in Czech Requirement credits in the group: In this group you have to gain 63 credits Requirement courses in the group: In this group you have to complete 6 courses Credits in the group: 63

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
NI-DIP	Diploma Thesis Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	30	270ZP	L,Z	PP
NI-KOP	Combinatorial Optimization Jan Schmidt, Ji í Vysko il, Petr Fišer Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	6	2P+2C	Z	PP
NI-MPR	Master Project Zden k Muziká Zden k Muziká (Gar.)	Z	7		Z,L	PP
NI-MPI	Mathematics for Informatics Št pán Starosta, Jan Sp vák Št pán Starosta Št pán Starosta (Gar.)	Z,ZK	7	3P+2C	Z	PP
NI-PDP	Parallel and Distributed Programming Pavel Tvrdík Pavel Tvrdík Pavel Tvrdík (Gar.)	Z,ZK	6	2P+2C	L	PP
NI-VSM	Selected statistical Methods Jitka Hrabáková, Petr Novák, Daniel Vašata, Ivo Petr, Pavel Hrabák, Jana Vacková Pavel Hrabák Pavel Hrabák (Gar.)	Z,ZK	7	4P+2C	L	PP

Characteristics of the courses of this group of Study Plan: Code=NI-PP.2020 Name=Compulsory Courses of Master Study Program, Version 2020, in Czech

NI-DIP	Diploma Thesis	Z	30				
NI-KOP	Combinatorial Optimization	Z,ZK	6				
The students will gain I	nowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not	only to select and	implement but				
also to apply and evaluate heuristics for practical problems.							
NI-MPR	Master Project	Z	7				
1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out							
during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. The external							
supervisor enters the in	nformation on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.	cz/student/studijn	i/formulare). The				
completed and signed	form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT t	opic that the stude	ent has reserved				
is rather general, the in	nmediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so tha	t the FTT will be o	complete and				
approvable at the end	of the semester.						
NI-MPI	Mathematics for Informatics	Z,ZK	7				
The course comprises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis, smooth optimization and							
multi-variate integration	n. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The las	topic includes se	lected numerical				
algorithm and their stal	pility analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear	presentation and	argumentation.				

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Z.ZK

6

21st century in computer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores. Parallel computing systems are becoming a ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platforms. Students get acquainted with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication operations, and languages and environments for parallel programming of shared and distributed memory computers. They get acquainted with fundamental parallel algorithms and on selected problems, they will learn the techniques of design of efficient and scalable parallel algorithms and methods of performance evaluation of their implementations. The course includes a semester project of practical programming in OpenMP and MPI for solving a particular nontrivial problem.

NI-VSM Selected statistical Methods

Z,ZK

The course leads the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with multivariate normal distribution, application of entropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with random processes with focus on Markov chains. The high point of the course is the Queuing theory and its application in networks.

Name of the block: Compulsory courses in the specialization Minimal number of credits of the block: 0 The role of the block: PS

Code of the group: NI-PRO-NPVS.20

Name of the group: Profiling Courses of Spec. Design and Programming of Embedded Systems, v. 2020, 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
NI-BVS	Embedded Security Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	L	PS
NI-BKO	Error Control Codes Pavel Kubalík Pavel Kubalík Pavel Kubalík (Gar.)	Z,ZK	5	2P+1C	L	PS
NI-SIM	Digital Circuit Simulation and Verification Martin Kohlík Martin Kohlík Martin Kohlík (Gar.)	Z,ZK	5	2P+1C	L	PS
NI-TES	Systems Theory Ji í Vysko il, Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-TSP	Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.)	Z,ZK	5	2P+2C	Z	PS
NI-EHW	Embedded Hardware Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-ESW	Embedded Software Hana Kubátová, Miroslav Skrbek Miroslav Skrbek Hana Kubátová (Gar.)	Z,ZK	5	2P+1C	Z	PS

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-NPVS.20 Name=Profiling Courses of Spec. Design and Programming of Embedded Systems, v. 2020, in Czech

NI-BVS	Embedded Security	Z,ZK	5				
Students gain basic kno	wledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of cry	ptographic primit	ives in hardware				
and software (in embed	ded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resou	ces for securing i	nternal functions				
of computer systems.							
NI-BKO	Error Control Codes	Z,ZK	5				
The goal of the course	s to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted vi	a channels.					
NI-SIM	Digital Circuit Simulation and Verification	Z,ZK	5				
The aim of the course is	to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Le	vel Modeling) lev	els and with the				
properties of proper tools. The course covers recent verification methods, too.							
NI-TES	Systems Theory	Z,ZK	5				
Today, humankind has t	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 ensur	ing the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage o	f models that des	cribe 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 fo	rm the basis for				
the modeling and analy	sis of complex systems.						
NI-TSP	Testing and Reliability	Z,ZK	5				
Students will gain know	edge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to	orepare a test set	with the help of				
the intuitive path sensiti	zation and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with	built-in-self-test e	equipment. They				
will be able to compute,	analyze, and control the reliability and availability of the designed circuits.						
NI-EHW	Embedded Hardware	Z,ZK	5				
The course brings basic	, laws that govern digital design and basic techniques to use them. It deals with both large and small scale systems. This is ${ m tr}$	ne base of advand	ed embedded				
systems, that profit from	n their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discussed	ed, including stan	dardized means				
of internal communicati	on, parallelism extraction and utilization in special structures and system architectures.						
NI-ESW	Embedded Software	Z,ZK	5				
Embedded software cou	rse acquainted students with the specifics of software development for embedded systems. The course covers the areas from the	e basic techniques	of programming				
in C language and code	optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing,	up to sophisticate	ed techniques				
combined with artificial	intelligence.						

Name of the block: Elective vocational courses in the branch/specialization Minimal number of credits of the block: 0 The role of the block: VO

Code of the group: NI-PRO-SP.20

Name of the group: Elective Vocational Courses for Master Spec. Design and Programming of Embedded Systems, v. 2020

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Pro stud. plán studentů, kteří si ještě nezvolili specializaci.

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-EPC	Effective C++ programming Daniel Langr Daniel Langr (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-GEN	Code Generators Petr Máj, Jan Janoušek Petr Máj Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MPJ	Modelling of Programming Languages	Z,ZK	5	2P+1C	Z	VO
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	VO
NI-OSY	Operating Systems and Systems Programming Petr Zemánek, Tomáš Martinec Petr Zemánek Petr Zemánek (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-RUN	Runtime Systems Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-SYP	Parsing and Compilers Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-APR	Selected Methods for Program Analysis Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	VO

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-SP.20 Name=Elective Vocational Courses for Master Spec. Design and Programming of Embedded Systems, v. 2020

NI-ADM	Data Mining Algorithms	Z,ZK	5				
The course focuses on	algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the stude	nts should know r	nachine learning				
basics. The emphasis is	put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation	systems) and mo	dels (e.g., kernel				
methods).							
NI-EPC	Effective C++ programming	Z,ZK	5				
Students learn how to u	se the modern features of contemporary versions of the C++ programming language for software development. The course f	ocuses on progra	mming effectivity				
and efficiency in the for	m of writing maintainable and portable source code and creating correct programs with low memory and processor time requ	irements.					
NI-GEN	Code Generators	Z,ZK	5				
Advanced techniques of	translating programs written in high-level programming languages are essential for understanding the field of systems progr	amming. This pri	marily involves				
understanding the algor	understanding the algorithms and techniques used to translate more complex programming constructs of modern languages employed in systems programming. Students will become						
familiar with both the th	familiar with both the theoretical and practical aspects of implementing the back-end of optimizing compilers for programming languages.						
NI-MVI	Computational Intelligence Methods	Z,ZK	5				
Students will understan	d 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 wo	rk and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.						
NI-MPJ	Modelling of Programming Languages	Z,ZK	5				
	ation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserv						
	e semantics of programming languages. The students will learn the language models with emphasis on functional languages, st						
the basics of the lambda	a calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with sema	intic modeling and	d execution tools.				
NI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5				
	ced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such met						
	element method and the finite difference method used for solving ordinary and partial differential equations in engineering. T						
	ns that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to impleme	nt these algorithr	ns sequentially				
as well as in parallel.			.				
NI-OSY	Operating Systems and Systems Programming	Z,ZK	5				
	em programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kerne						
	memory management, file operations and architecture of modern file systems, device drivers and network programming. The						
	ipgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portabil						
	ime operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within Is	abs, students will	work on projects				
tocused on developmen	t of LINUX kernel modules.						

NI-RUN	Runtime Systems	Z,ZK	5
This course is an introdu	ction to the world of virtual machines (VM) for high-level programming languages. There are two goals: Give you hands-on experi	ence in design and	d implementation
of a compiler and a VM	from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC comp	ilation Memory ma	anagement
Just-in-time compilation	and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implement	tations of real-wor	ld VMs, including
Dynamic optimizations,	speculations, and deoptimizations Language implementation frameworks Read-world VMs		
NI-SYP	Parsing and Compilers	Z,ZK	5
The module builds upor	the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of	of various variants	and applications
of LR parsing and are i	ntroduced to special applications of parsers, such as incremental and parallel parsing.		
NI-APR	Selected Methods for Program Analysis	Z,ZK	5
This course introduces	you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and dy	namic analysis. Ir	Static Analysis,
we will look at the art o	f reasoning about computer programs without running them. We will look at the analyses for program understanding, optimize	ations, error detec	tion. In Dynamic
Analysis, we will look a	t the analyses considering individual program runs using a concrete environment and inputs.		

Code of the group: NI-PRO-MI.20

Name of the group: Elective Vocational Courses for Master Specialization Informatics Management, v.2020, in Czech

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Pro stud. plán studentů, kteří si ještě nezvolili specializaci.

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-AM1	Middleware Architectures 1 Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MEP	Modelling of Enterprise Processes Robert Pergl, Marek Suchánek Robert Pergl Robert Pergl (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	VO
NI-BUI	Business Informatics Petra Pavlí ková Petra Pavlí ková Petra Pavlí ková (Gar.)	Z,ZK	5	2P+2C	L	VO
NI-PIS	Enterprise Information Systems Vlastimil Jinoch, Martin Závrbský, Martin Mach, Martin Hasaj David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-PAS	Advanced Aspects of Business David Buchtela, Št pánka Havlíková, Dominik Vítek, Ji í Maršál, Jana Soukupová, Zden k Ku era David Buchtela Zden k Ku era (Gar.)	Z,ZK	4	2P+1C	z	VO
NI-DSS	Decision Support Systems Petra Pavlí ková, Robert Pergl, David Buchtela David Buchtela Robert Pergl (Gar.)	Z,ZK	5	2P+1C	z	VO
NI-TSW	Software Product Development Petra Pavlí ková Ond ej Pluha Petra Pavlí ková (Gar.)	КZ	4	1P+2C	Z	VO

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-MI.20 Name=Elective Vocational Courses for Master Specialization Informatics Management, v.2020, in Czech

NI-MVI 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 now these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc. Z,ZK 5 NI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5 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 near 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.	NI-ADM Data Mining Algorithms	Z,ZK	5
nethods). Image: 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 now these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc. Z,ZK 5 NI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5 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 near 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.	The course focuses on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the students	should know m	achine learning
NI-MVI 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 now these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc. Z,ZK 5 NI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5 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 near 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.	basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation syst	stems) and mod	lels (e.g., kernel
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 now these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc. VI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5 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 inear 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.	methods).		
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NI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5 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 vill 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 near 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.	Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to ma	any problems. T	hey will learn
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 vill 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 near 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.	how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.		
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near algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement these algorithms sequentially is well as in parallel.	Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such method	ds to real-world	problems. They
as well as in parallel.	will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They	y will learn to so	lve systems of
	linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement the	these algorithm	s sequentially
VI-AM1 Middleware Architectures 1 Z,ZK 5	as well as in parallel.		
	NI-AM1 Middleware Architectures 1	Z,ZK	5
Students will study new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information system architecture, web service	Students will study new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information system	m architecture,	web service
architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous communications and high availability	architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous comm	munications and	high availability
if applications.	of applications.		
VI-MEP Modelling of Enterprise Processes Z,ZK 5	NI-MEP Modelling of Enterprise Processes	Z,ZK	5
The subject is focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approach for (re)engineering and	The subject is focused an introduction to the discipling of Enterprise Engineering. Students learn the importance of a proper methodological approach f	for (re)engineer	ing and
mplementation of processes, organisation structures and information support in big enterprises and institutions.	The subject is locused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approach is	ior (re)engineer	ing and

NI-BUI	Business Informatics	Z,ZK	5		
The aim of the course is	to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas	of business proce	ss management,		
ICT services and archite	ectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT manage	ment, and lifecycl	e management		
of ICT services and res	ource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governa	ance, the importar	nce of ICT for		
business and the contex	kt of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme	ent, revenue and i	nvestment		
management, IT investr	nent evaluation and human resources management in IT (roles CIO, CEO, CFO).				
NI-PIS	Enterprise Information Systems	Z,ZK	5		
The course is focused of	n the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage of	of big data (BigDa	ta) and their use		
in BI (Business Intellige	n BI (Business Intelligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunications sectors will be explained on				
real examples. Furthern	nore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the	business strategy	v of the company.		
Students will be acquain	nted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and oper-	ation of informatio	on systems in the		
company / organization.					
NI-PAS	Advanced Aspects of Business	Z,ZK	4		
The aim of the course is	to provide students with advanced (compared to the bachelor's degree) knowledge and skills needed to establish and run ti	heir own business	or business		
management, especially	y in law, administration (necessary steps and documents), business economics, foreign trade and related aspects.				
NI-DSS	Decision Support Systems	Z,ZK	5		
The aim of the course is	to provide students with knowledge and skills in decision support systems, their classification (Powerova), selected principle	s of data-oriented	, model-oriented		
and knowledge-oriented	l decision support systems. Students will also gain knowledge of multicriterial decision-making methods and game theory. They	will also learn abo	out the principles		
of conceptually and onte	ologically oriented decision support systems and the basics of distribution, optimization and evolution methods and algorithm	IS.			
NI-TSW	Software Product Development	KZ	4		
The course is presented	d in Czech.		1		

Code of the group: NI-PRO-PSS.20

Name of the group: Elective Vocational Courses for Master Spec. Computer Systems and Networks, v.2020, in Czech

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Pro stud. plán studentů, kteří si ještě nezvolili specializaci.

Note on the group	Pro stud. plán studentů, kteř	í si ještě nez	volili spe	ecializac	i.	
Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-DSV	Distributed Systems and Computing Pavel Tvrdík Jan Fesl Pavel Tvrdík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-EPC	Effective C++ programming Daniel Langr Daniel Langr (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MTI	Modern Internet Technologies Viktor erný, Alexandru Moucha Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	VO
NI-GPU	GPU Architectures and Programming Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-SIB	Network Security Ji í Dostál, Simona Forn sek, Martin Šutovský, Martin Holec Simona Forn sek Ji í Dostál (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-VCC	Virtualization and Cloud Computing Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-MCC	Multicore CPU Computing Daniel Langr, Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	Z	VO

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-PSS.20 Name=Elective Vocational Courses for Master Spec. Computer Systems and Networks, v.2020, in Czech

NI-ADM	Data Mining Algorithms	Z,ZK	5		
The course focuses on	algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the stude	nts should know n	nachine learning		
basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation systems) and models (e.g., kernel					
methods).					
NI-EPC	Effective C++ programming	Z,ZK	5		
Students learn how to u	se the modern features of contemporary versions of the C++ programming language for software development. The course f	ocuses on prograi	mming effectivity		
and efficiency in the for	m of writing maintainable and portable source code and creating correct programs with low memory and processor time requ	uirements.			
NI-MVI	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 wo	k and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.				

	nlinear Continuous Optimization and Numerical Methods			1	Z,ZK	5
	o nonlinear continuous optimization, principles of the most popular methods of optimize ent method and the finite difference method used for solving ordinary and partial differ				-	-
	at arise from discretization of the continuous problems by direct and iterative algorithm	-	-			-
as well as in parallel.						
	tributed Systems and Computing				Z,ZK	5
	ethods for coordination of processes in distributed environment characterised by nondete					
data and services, and safet	Igorithms that assure correctness of computations realized by a group of loosely coupl v in case of failures	ed processes and	a mechanish	ns that supp	oort nign availa	adility of both
	dern Internet Technologies			7	Z,ZK	5
	dern Internet Technologies" is designed on four major pillars of networking: 1. Unified	Communication a	nd Collabora			-
	ever types of protocols for whatever purposes. This architecture is able to be protocol i				•	
	n of Extremely Scalable Networks - This provides the insights of network architectures					
	aradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic			-		
	roviders to create private channels of communication between customers, with guaran They allow traffic to be carried at the optimal speed and allow for graceful degradation	-				
	PU Architectures and Programming	or corrido param			z,zk	5
	e of the internal architecture of modern massively parallel GPU processors. They will lea	arn to program the	em mainly in			
which is already a widesprea	d programming technology of GPU processors. As an integral part of the effective comp	utational use of the	ese hierarch	ical comput	ational structu	res, students
	rogramming techniques and methods of programming multiprocessor GPU systems.					
	twork Security				Z,ZK	5
	tualization and Cloud Computing			1	Z,ZK	5
, , , , , , , , , , , , , , , , , , ,	of architectures of large computer systems that are used in data centers and computer principles, tools and technologies that serve to facilitate and automate configuration,		•	0		•
	nodern computer systems. Theoretically and practically, they will get acquainted with o	-	-	-	-	-
1.	nputer systems and with specific technologies of cloud systems. Finally, they will learn the					
	tinuous integration and development).					
	Iticore CPU Computing			1	z,zk	5
	in detail with hardware support and programming technologies for the creation of paral		-			
-	es, which are today the most common computing nodes of powerful (super)computer s d to reduce the performance drop due to the widening gap between the computational	-	-	-		-
	are readed programs, students will also learn the basics of the art of creating these applie	-		ee and me		s in oughput.
Code of the group	o: NI-PRO-SL20					
• •	p: Elective Vocational Courses for Master Speciali	zation Sof	twara F	Indined	aring v2	2020 in
		241011 001		Ingine	51111g, v.2	<u>-020</u> , m
Czech						
Requirement crea	•					
Requirement cou	rses in the group:					
Credits in the gro	up: 0					
Note on the group	•	í si ještě nez	volili spe	ecializac	i.	
	Name of the course / Name of the group of courses					
Code	(in case of groups of courses the list of codes of their	Completion	Crodite	Scono	Semester	Role
Code	members)	completion	Credits	Scope	Semester	NOIE
	Tutors, authors and guarantors (gar.)					
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata	Z,ZK	5	2P+1C	L	vo
	Pavel Kordík (Gar.)	_,			_	
	Architecture and Design patterns	7 71/	_	00.40	-	
NI-ADP	Filip K ikava, Jan Kurš, Jan Zimolka, Tomáš Chvosta, Ji í Borský Jan Kurš Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	VO
	Middleware Architectures 1			0.5 (0)		
NI-AM1	Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-FME	Formal Methods and Specifications Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-NUR	User Interface Design	Z,ZK	5	2P+1C	Z	VO
NI-NON	Josef Pavlí ek Josef Pavlí ek Josef Pavlí ek (Gar.) Nonlinear Continuous Optimization and Numerical Methods			2P+1C		
	Jaroslav Kruis Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5		Z,L	VO
NI-NSS	Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Robert Pergl (Gar.)	ZK	5	2P	L	VO

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-SI.20 Name=Elective Vocational Courses for Master Specialization Software Engineering, v.2020, in Czech

Enterprise Information Systems Vlastimil Jinoch, Martin Závrbský, Martin Mach, Martin Hasaj David Buchtela

Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta (Gar.)

David Buchtela (Gar.)

NI-PIS

NI-PDB

Z,ZK

Z,ZK

5

5

2P+1C

2P+1C

L

Ζ

VO

VO

NI-ADM Data Mining Algorithms	Z.ZK	5
The course focuses on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the studer	_,	-
basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation s		
methods).	systems, and mo	
NI-MVI 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		-
how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.	many problems.	They will learn
	Z.ZK	5
NI-NON Nonlinear Continuous Optimization and Numerical Methods Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such methods	,	-
will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. The		
linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement		
as well as in parallel.	ni these algorith	no sequentially
	7 71/	5
	Z,ZK	-
Students will study new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information sys		
architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous co	mmunications an	d high availability
of applications.	7 71/	
NI-PIS Enterprise Information Systems	Z,ZK	5
The course is focused on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage c		,
in BI (Business Intelligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication and the life surface and		•
real examples. Furthermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the		
Students will be acquainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and operative	ation of mormatic	on systems in the
company / organization.	7 71/	
NI-ADP 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		
the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledg		
and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design problem		•
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syste	ms, and some ac	ivanced software
architectures used in large-scale distributed systems.	7 71/	
NI-FME 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 th	hat allow to prove
basic properties of software.		
NI-NUR User Interface Design	Z,ZK	5
Students will understand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, for		
notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able		
NI-NSS Normalized Software Systems	ZK	5
Students will learn the foundations of normalized systems theory that studies the evolvability of modular structures based on concepts from engineer	ring, such as stat	pility from system
theory and entropy from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related is		
architecture. In the second part of the course, students learn how to construct software architectures using 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 handling violations of the stabi	ility and entropy-r	elated principles.
This knowledge allows students to realize new levels of evolvability in software architectures.		
NI-PDB Advanced Database Systems	Z,ZK	5
Students orient themselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of datab		
databases), with the related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CY	PHER, Gremlin)	The last part of
the course deals with performance evaluation of database machines.		

Code of the group: NI-TI-PRO.20

Name of the group: Elective Vocational Courses for Master Specialization Knowledge Engineering, v.2020, in Czech

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group	Pro stud. plán studentů, kteř	í si ještě nez	volili spe	ecializac	i.	
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
	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
	Efficient Text Pattern Matching Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	Z	VO
	Graph theory and combinatorics Michal Opler Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	5	2P+2C	L	VO
	Data Compression Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	L	VO
	Computational Intelligence Methods Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	VO

NI-SYP Parsing and Compilers Jan Janoušek Jan Janoušek Jan Janoušek (Gar.) Z,ZK	5	2P+1C	Z	VO
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Characteristics of the courses of this group of Study Plan: Code=NI-TI-PRO.20 Name=Elective Vocational Courses for Master Specialization Knowledge Engineering, v.2020, in Czech

NI-ADM	Data Mining Algorithms	Z,ZK	5			
The course focuses on	algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the studen	s should know n	nachine learning			
basics. The emphasis is	put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation s	ystems) and mo	dels (e.g., kernel			
methods).						
NI-MVI	Computational Intelligence Methods	Z,ZK	5			
Students will understand	d methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to r	nany problems.	They will learn			
how these methods wor	k and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.					
NI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5			
Students will be introduc	ed to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such meth	ods to real-world	d problems. They			
will also learn the finite	element method and the finite difference method used for solving ordinary and partial differential equations in engineering. Th	ey will learn to s	olve systems of			
linear algebraic equation	ns that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implemen	t these algorithm	ns sequentially			
as well as in parallel.						
NI-SYP	Parsing and Compilers	Z,ZK	5			
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 ir	troduced to special applications of parsers, such as incremental and parallel parsing.					
NI-EVY	Efficient Text Pattern Matching	Z,ZK	5			
Students get knowledge	of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both acc	ess time and me	mory complexity.			
They will be able to use	the knowledge in design of applications that utilize pattern matching.					
NI-GAK	Graph theory and combinatorics	Z,ZK	5			
The goal of the class is	to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorithm	s. The emphasis	s will be not only			
on undestanding the bas	ic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected l	opics from graph	and hypergraph			
coloring, Ramsey theory	r, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory	will be also app	lied in the fields			
of combinatorics on wor	ds, formal languages and bioinformatics.					
NI-KOD	Data Compression	Z,ZK	5			
Students are introduced	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 ov	erview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, stu	idents learn the	fundamentals of			
lossy data compression	methods used in image, audio, and video compression.					

Code of the group: NI-PRO.20

Name of the group: Choose (so far as optional) profiling subjects for the intended specialization, version 2020 Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Meanwhile, as an elective, choose the profiling courses of some of the specializations of your study plan

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-ADP	Architecture and Design patterns Filip K ikava, Jan Kurš, Jan Zimolka, Tomáš Chvosta, Ji í Borský Jan Kurš Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-AM1	Middleware Architectures 1 Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-AM2	Middleware Architectures 2 Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-BML	Bayesian Methods for Machine Learning Ond ej Tichý, Kamil Dedecius Ond ej Tichý Kamil Dedecius (Gar.)	КZ	5	2P+1C	L	VO
NI-BVS	Embedded Security Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	L	VO
NI-BKO	Error Control Codes Pavel Kubalík Pavel Kubalík Pavel Kubalík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-DSV	Distributed Systems and Computing Pavel Tvrdík Jan Fesl Pavel Tvrdík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-DDW	Web Data Mining Jaroslav Kucha, Milan Doj inovski Jaroslav Kucha Jaroslav Kucha (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-EPC	Effective C++ programming Daniel Langr Daniel Langr (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-EVY	Efficient Text Pattern Matching Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-FME	Formal Methods and Specifications Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	L	VO

	Codo Conorotoro				_	
NI-GEN	Code Generators Petr Máj, Jan Janoušek Petr Máj Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-GAK	Graph theory and combinatorics Michal Opler Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	5	2P+2C	L	VO
NI-KOD	Data Compression Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MEP	Modelling of Enterprise Processes Robert Pergl, Marek Suchánek Robert Pergl Robert Pergl (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-MPJ	Modelling of Programming Languages	Z,ZK	5	2P+1C	Z	VO
NI-MTI	Modern Internet Technologies Viktor erný, Alexandru Moucha Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-NUR	User Interface Design Josef Pavlí ek Josef Pavlí ek (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	vo
NI-NSS	Normalized Software Systems Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Robert Pergl (Gar.)	ZK	5	2P	L	vo
NI-OSY	Operating Systems and Systems Programming Petr Zemánek, Tomáš Martinec Petr Zemánek Petr Zemánek (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-BUI	Business Informatics	Z,ZK	5	2P+2C	L	vo
NI-PIS	Petra Pavlí ková Petra Pavlí ková Petra Pavlí ková (Gar.) Enterprise Information Systems Vlastimil Jinoch, Martin Závrbský, Martin Mach, Martin Hasaj David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-PAS	David Buchlela (Gar.) Advanced Aspects of Business David Buchlela, St pánka Havlíková, Dominik Vítek, Ji í Maršál, Jana Soukupová, Zden k Ku era David Buchtela Zden k Ku era (Gar.)	Z,ZK	4	2P+1C	Z	VO
NI-PDB	Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-GPU	GPU Architectures and Programming Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	L	vo
NI-PDD	Data Preprocessing Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-RUN	Runtime Systems Filip K ikava Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	L	vo
NI-SWE	Semantic Web and Knowledge Graphs Milan Doj inovski, Jakub Klímek Milan Doj inovski Milan Doj inovski (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-SIM	Digital Circuit Simulation and Verification Martin Kohlík Martin Kohlík Martin Kohlík (Gar.)	Z,ZK	5	2P+1C	L	vo
NI-SIB	Ji í Dostál, Simona Forn sek, Martin Šutovský, Martin Holec Simona Forn sek Ji í Dostál (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-SCR	Statistical Analysis of Time Series Kamil Dedecius Kamil Dedecius (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-SYP	Parsing and Compilers Jan Janoušek Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-DSS	Jain Janousek Jain Janousek Jain Janousek (gai.) Decision Support Systems Petra Pavlí ková, Robert Pergl, David Buchtela David Buchtela Robert Pergl (Gar.)	Z,ZK	5	2P+1C	z	VO
NI-TES	Ji í Vysko il, Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-TSP	Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.)	Z,ZK	5	2P+2C	Z	vo
NI-TSW	Petr Fiser Martin Da nei Petr Fiser (Gar.) Software Product Development Petra Pavlí ková Ond ej Pluha Petra Pavlí ková (Gar.)	KZ	4	1P+2C	Z	vo
NI-UMI	Artificial intelligence	Z,ZK	5	2P+1C	Z	vo
NI-EHW	Pavel Surynek Pavel Surynek Pavel Surynek (Gar.) Embedded Hardware	Z,ZK	5	2P+1C	Z	vo
NI-ESW	Jan Schmidt Jan Schmidt Jan Schmidt (Gar.) Embedded Software	Z,ZK	5	2P+1C	Z	VO
NI-VCC	Hana Kubátová, Miroslav Skrbek Miroslav Skrbek Hana Kubátová (Gar.) Virtualization and Cloud Computing	Z,ZK	5	2P+1C		VO
NI-APR	Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.) Selected Methods for Program Analysis	Z,ZK	5	2P+1C	Z	vo
	Filip K ikava Filip K ikava Filip K ikava (Gar.) Selected Topics in Optimization and Numerical mathematics	,				
NI-PON	Karel Klouda, Št pán Starosta, Daniel Vašata Daniel Vašata Št pán Starosta (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-VMM	Retrieval from Multimedia Ji í Novák, Tomáš Skopal Jaroslav Kucha Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	Z	vo
NI-MCC	Multicore CPU Computing Daniel Langr, Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	Z	vo

Characteristics of the courses of this group of Study Plan: Code=NI-PRO.20 Name=Choose (so far as optional) profiling subjects for the intended specialization, version 2020

	7.71/	5
NI-BVS Embedded Security	Z,ZK	5
Students gain basic knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of c		
and software (in embedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resource and computer systems.	inces for securing i	Internal functions
of computer systems.	7 71/	
NI-BKO Error Control Codes	Z,ZK	5
The goal of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted v	1	ï
NI-SIM Digital Circuit Simulation and Verification	Z,ZK	5
The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction L	evel Modeling) lev.	els and with the
properties of proper tools. The course covers recent verification methods, too.		
NI-TES Systems Theory	Z,ZK	5
Today, humankind has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However	ver, the costs of m	anaging 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 des	scribe 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 for	orm the basis for
the modeling and analysis of complex systems.		
NI-TSP Testing and Reliability	Z,ZK	5
Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to	1 '	
the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems wit		
will be able to compute, analyze, and control the reliability and availability of the designed circuits.		,
NI-EHW Embedded Hardware	Z,ZK	5
The course brings basic laws that govern digital design and basic techniques to use them. It deals with both large and small scale systems. This is in	,	-
systems, that profit from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discuss		
of internal communication, parallelism extraction and utilization in special structures and system architectures.	sed, menduling stan	
	7 71/	_
NI-ESW Embedded Software	Z,ZK	5
Embedded software course acquainted students with the specifics of software development for embedded systems. The course covers the areas from the	-	
in C language and code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing	i, up to sophisticat	ed techniques
combined with artificial intelligence.	7	ï
NI-ADM Data Mining Algorithms	Z,ZK	5
The course focuses on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the stude		-
basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation	systems) and mo	dels (e.g., kernel
methods).		
NI-EPC Effective C++ programming	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 progra	mming effectivity
and efficiency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor time req	uirements.	
NI-GEN Code Generators	Z,ZK	5
Advanced techniques of translating programs written in high-level programming languages are essential for understanding the field of systems programs	1 '	marilv involves
understanding the algorithms and techniques used to translate more complex programming constructs of modern languages employed in systems p		-
familiar with both the theoretical and practical aspects of implementing the back-end of optimizing compilers for programming languages.	5	
NI-MVI 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	1	-
how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.	many problems.	mey will learn
	7 71/	
NI-MPJ Modelling of Programming Languages	Z,ZK	5
The analysis, transformation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preser		
This course explores the semantics of programming languages. The students will learn the language models with emphasis on functional languages, st	-	
the basics of the lambda calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with semi		1
NI-NON Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5
Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such me		
will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. T	,	,
linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement	ent these algorithn	ns sequentially
as well as in parallel.		
NI-OSY Operating Systems and Systems Programming	Z,ZK	5
The course covers system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kern	el data structures.	. Key topics are:
process management, memory management, file operations and architecture of modern file systems, device drivers and network programming. The	course also addr	esses kernel
development process, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portabi	lity. Specifics of ke	ernel architecture
in embedded and real-time operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within	labs, students will	work on projects
focused on development of LINUX kernel modules.		
NI-RUN Runtime Systems	Z,ZK	5
This course is an introduction to the world of virtual machines (VM) for high-level programming languages. There are two goals: Give you hands-on exper	rience in design an	d implementation
of a compiler and a VM from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC comp	bilation Memory m	anagement
Just-in-time compilation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implement	tations of real-wor	ld VMs, including
Dynamic optimizations, speculations, and deoptimizations Language implementation frameworks Read-world VMs		
NI-SYP Parsing and Compilers	Z,ZK	5
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge	1	-
of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.		
NI-APR Selected Methods for Program Analysis	Z,ZK	5
This course introduces you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and d		-
we will look at the art of reasoning about computer programs without running them. We will look at the analyses for program understanding, optimiz		
Analysis, we will look at the analyses considering individual program runs using a concrete environment and inputs.	anons, entri delet	
	7 71/	
NI-AM1 Middleware Architectures 1		5
Students will study new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information sy		
architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous of	ommunications and	u nign availability
of applications.		

NI-MEP	Modelling of Enterprise Processes	Z,ZK	5
The subject is focused	on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approad	ch for (re)enginee	ing and
implementation of proc	esses, organisation structures and information support in big enterprises and institutions.		
NI-BUI	Business Informatics	Z,ZK	5
The aim of the course is	to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas	of business proces	ss management,
	ectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT manage		- 1
	ource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governa		
	xt of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme	ent, revenue and ir	nvestment
-	ment evaluation and human resources management in IT (roles CIO, CEO, CFO).		
NI-PIS	Enterprise Information Systems	Z,ZK	5
	on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage c		
	nce). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication and the second statement of the second system in the second system and the impact on the		
	nore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the nted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and opera		
company / organization			
NI-PAS	Advanced Aspects of Business	Z,ZK	4
	s to provide students with advanced (compared to the bachelor's degree) knowledge and skills needed to establish and run th		-
	y in law, administration (necessary steps and documents), business economics, foreign trade and related aspects.		
NI-DSS	Decision Support Systems	Z,ZK	5
The aim of the course is	s to provide students with knowledge and skills in decision support systems, their classification (Powerova), selected principle	s of data-oriented	model-oriented
and knowledge-oriented	d decision support systems. Students will also gain knowledge of multicriterial decision-making methods and game theory. They	will also learn abo	out the principles
of conceptually and ont	ologically oriented decision support systems and the basics of distribution, optimization and evolution methods and algorithm	S.	
NI-TSW	Software Product Development	KZ	4
The course is presente	d in Czech.		
NI-DSV	Distributed Systems and Computing	Z,ZK	5
	to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of comput		
-	asic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms the	at support high av	ailability of both
	safety in case of failures.		
NI-MTI	Modern Internet Technologies	Z,ZK	5
-	t "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration	-	
-	whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, vid		
-	Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundre is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching an		
	ice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela		
-	ies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of f		510001). 4.
NI-GPU	GPU Architectures and Programming	Z,ZK	5
	ledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in the		-
-	spread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchical		-
· ·	ion programming techniques and methods of programming multiprocessor GPU systems.		
NI-SIB	Network Security	Z,ZK	5
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
	ledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and	· · ·	-
-	zation principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to effi	-	
performance parameter	rs of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effect	ive technology too	ay for the
management of comple	x computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical ski	lls in the use of mo	dern integration
and development tools	(Continuous integration and development).		
NI-MCC	Multicore CPU Computing	Z,ZK	5
Students will get acqua	inted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations on		sors with shared
and virtually shared me	mories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain knowle	edge of architectur	ally specific
optimization techniques	used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs	and memory inter	face throughput.
On specific non-trivial r	nultithreaded programs, students will also learn the basics of the art of creating these applications.		
NI-ADP	Architecture and Design patterns	Z,ZK	5
The objective of this co	urse is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis	s as well as with u	nderstanding of
-	and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledg	-	
, e	commonly used object-oriented design patterns that represent the best practices for solving common software design problem		
	principles of software architecture design and analysis. This includes the classical architectural styles, component based syste	ems, and some ad	vanced software
	rge-scale distributed systems.		
NI-FME	Formal Methods and Specifications	Z,ZK	5
	scribe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some	e sontware tools the	at allow to prove
basic properties of soft NI-NUR		7 71/	5
	User Interface Design	Z,ZK	-
	d the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, for . They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able		
NI-NSS		ZK	5
	Normalized Software Systems or normalized systems heaving that studies the evolvability of modular structures based on concepts from engineer	1	
	n thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related is	-	
	and part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements	-	-
	on systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stab		
-	students to realize new levels of evolvability in software architectures.	,, _E ,	
NI-PDB	Advanced Database Systems	Z,ZK	5
	lves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of datab		
	ated new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CY		
	erformance evaluation of database machines.	,	

NI-EVY Efficient Text Pattern Matching	Z,ZK	5					
Students get knowledge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both a	ccess time and me	mory complexity.					
They will be able to use the knowledge in design of applications that utilize pattern matching.							
NI-GAK Graph theory and combinatorics	Z,ZK	5					
The goal of the class is to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorith	•						
on undestanding the basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selecte		,					
coloring, Ramsey theory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory	ory will be also app	blied in the fields					
of combinatorics on words, formal languages and bioinformatics.		_					
NI-KOD 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 d	-						
used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, s	students learn the	fundamentals of					
lossy data compression methods used in image, audio, and video compression.							
NI-AM2 Middleware Architectures 2	Z,ZK	5					
Students will learn new trends and technologies on the Web including theoretical foundations. They will gain an overview of Web application archite	ctures, concepts a	nd technologies					
for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.							
NI-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 students and the subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory.							
models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidd	•	· ·					
from noisy observations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpos							
and applications will be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imagin	ng. The students w	ill try to solve					
some of them.							
NI-DDW 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 gai		-					
techniques for Web crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an over	erview of most rece	ent developments					
in the field of social web and recommendation systems.							
NI-PDD 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 information from various d							
time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of character	eristics from image	es or from web					
pages.							
NI-SWE Semantic Web and Knowledge Graphs	Z,ZK	5					
The students will learn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web	•						
practices for modelling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowled	ge graphs and the	ir systematic					
quality assurance.	1						
NI-SCR Statistical Analysis of Time Series	Z,ZK	5					
The course deals with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange pri							
problems (modelling of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a c		,					
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		· ·					
real-world examples. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward transformed to a software backages in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to provide easy and straightforward transformed to a software backage in order to be a so	ansier of students	knowledge from					
the academic to the real world.	7 71						
NI-UMI Artificial intelligence	Z,ZK	5					
The course covers search and inference algorithms in major formal paradigms used in artificial intelligence such as logic theories, constraint progra	imming and autom	ated planning.					
The main principles and practical applications of discussed techniques will be illustrated.							
NI-PON Selected Topics in Optimization and Numerical mathematics	Z,ZK	5					
The course focuses on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge							
in the course Mathematics for informatics. The methods are explained and described along with the details on how they are implemented on computed and any provide the second	iters. Hence, the re	elevant concepts					
of numerical matematics, mainly numerical linear algebra, are explained too.	Z,ZK	F					
NI-VMM Retrieval from Multimedia	1	5 from multimodia					
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods o objects, indexing, and structure of distributed search engines.	i leature extraction	nom multimedia					
טובטוס, ווועבאוווץ, מויט סוועטעוב טו עוסוווטעובע סבמוטו בווטוובס.							

Code of the group: NI-PRO-PB.20

Name of the group: Elective Vocational Courses for Master Specialization Computer Security, v.2020, in Czech

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Pro stud. plán studentů, kteří si ještě nezvolili specializaci.

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-AIB	Algorithms of Information Security Martin Jure ek, Róbert Lórencz, Olha Jure ková Martin Jure ek Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-HWB	Hardware Security Jií Bu ek Jií Bu ek Jií Bu ek (Gar.)	Z,ZK	5	2P+2C	L	VO

NI-MKY	Mathematics for Cryptology Martin Jure ek, Róbert Lórencz Róbert Lórencz (Gar.)	Z,ZK	5	3P+1C	L	vo
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	VO
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	VO
NI-KRY	Advanced Cryptology Ji í Bu ek, Róbert Lórencz Ji í Bu ek Róbert Lórencz (Gar.)	Z,ZK	5	2P+2C	Z	VO
NI-REV	Reverse Engineering Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	1P+2C	Z	VO
NI-SIB	Network Security Ji í Dostál, Simona Forn sek, Martin Šutovský, Martin Holec Simona Forn sek Ji í Dostál (Gar.)	Z,ZK	5	2P+1C	L	VO
NI-SBF	System Security and Forensics Simona Forn sek, Marián Svetlík Simona Forn sek Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	VO
Specialization Comp NI-ADM Da The course focuses on algor basics. The emphasis is put	e courses of this group of Study Plan: Code=NI-PRO-PB.20 Nam uter Security, v.2020, in Czech ata Mining Algorithms prithms used in the fields of machine learning and data mining. However, this is not an int t on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learni	roductory cours	e, and the	Z students shou	,ZK	5 achine learning
methods).						
1 1	omputational Intelligence Methods				,ZK	5
	ethods and techniques of computational intelligence that are mostly nature-inspired, para	-	and applica	ble to many p	roblems. Th	ney will learn
	nd how to apply them to problems related to data mining, control, intelligen games, optim	nizations, etc.				
NI-NON NO	onlinear Continuous Optimization and Numerical Methods			Z	,ZK	5
	to nonlinear continuous optimization, principles of the most popular methods of optimization					
	nent method and the finite difference method used for solving ordinary and partial differe					
, s	hat arise from discretization of the continuous problems by direct and iterative algorithms	s. They will also	learn to im	plement these	algorithms	s sequentially
as well as in parallel.						
NI-SIB Ne	etwork Security			Z	,ZK	5
NI-AIB AI	gorithms of Information Security			Z	,ZK	5
Students will get acquainted	with the algorithms of secure key generation and cryptographic error (not only biometric)	data processing	g. Furtherm	ore, students	will learn th	e mathematica
principles of cryptographic p	protocols (identification, authentication, and signature schemes). Another part of the cou	rse is dedicated	l to malwar	e detection ar	nd the use of	of machine
learning in detection system	ns. The last topic includes practical steganographic methods and attacks on steganograp	hic systems.				
NI-HWB Ha	ardware Security			Z	,ZK	5
	owledge needed for the analysis and design of computer systems security solutions. Stu	idents get an ov	erview of s			of the system
	ey will be able to safely use and integrate hardware components into systems and test th					
-	ors, PUF, random number generators, smart cards, biometric devices, and devices for in				-	0
NI-MKY M	athematics for Cryptology			7	,ZK	5
	nowledge of algebraic procedures solving the most important mathematical problems co	ncerning the se	curity of cir		· I	-
	system of polynomial equations over a finite field, the problem of factorization of large n	-				
	ved on elliptic curves. Students will further become familiar with modern encryption syste					
	dvanced Cryptology			7	,ZK	5
	entials of cryptanalysis and the mathematical principles of constructing symmetric and as	symmetric ciphe	rs They wi			
	. They will have an overview of cryptanalysis methods, elliptic curve cryptography and qu		-			
s .	creation of their own software solutions.	anian oryptogr	apriy, write	and by ball app		logiation of
	everse Engineering			7	,ZK	5
	d with the essentials of reverse engineering of computer software. They will learn how pro	naceae start or	d what har			
	rstand how executable files are organized and how they interact with 3rd party libraries.		-	-		
	Students will also understand principles of disassemblers and obfuscation techniques. A	-				
	work and which methods can be used to detect it. One of the lectures will be dedicated to	-				-
	ars, where students will solve practically oriented tasks from the real world.					
				-	71/	F
	/stem Security and Forensics		adala - 1		,ZK	5
-	th aspects of system security (principles of end station security, principles of security pol					
-	h forensic analysis as a tool for investigating security incidents (techniques used by mali	cious software/a	attackers a	na torensic an	aiysis techi	niques and the
importance of operating sys	stem/operating system artifacts or file system for attack analysis and detection).					
Name of the bloc	ck: Elective courses					

Minimal number of credits of the block: 0 The role of the block: V

Code of the group: NI-PRO-ZI.20 Name of the group: Elective Vocational Courses for Master Specialization Knowledge Engineering, v.2020, in Czech Requirement credits in the group: Requirement courses in the group: Credits in the group: 0 Note on the group: All compulsory subjects of specializations with the exception of this specialization.

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	V
NI-BML	Bayesian Methods for Machine Learning Ond ej Tichý, Kamil Dedecius Ond ej Tichý Kamil Dedecius (Gar.)	KZ	5	2P+1C	L	V
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-PDD	Data Preprocessing Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SCR	Statistical Analysis of Time Series Kamil Dedecius Kamil Dedecius Kamil Dedecius (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-UMI	Artificial intelligence Pavel Surynek Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-PON	Selected Topics in Optimization and Numerical mathematics Karel Klouda, Št pán Starosta, Daniel Vašata Daniel Vašata Št pán Starosta (Gar.)	Z,ZK	5	2P+1C	L	V

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-ZI.20 Name=Elective Vocational Courses for Master Specialization Knowledge Engineering, v.2020, in Czech

NI-ADM	Data Mining Algorithms	Z,ZK	5
The course focuses on	algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the stude	nts should know n	nachine learning
basics. The emphasis is	put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation	systems) and more	dels (e.g., kernel
methods).			
NI-MVI	Computational Intelligence Methods	Z,ZK	5
Students will understand	d 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 wor	k and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.		
NI-BML	Bayesian Methods for Machine Learning	KZ	5
The subject is focused of	on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it stud	ies the construction	on of appropriate
models providing descri	ption of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidde	n variables (true o	object position
	etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose		
and applications will be	presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imagin	g. The students w	ill try to solve
some of them.			
NI-PDD	Data Preprocessing	Z,ZK	5
Students learn to prepa	re raw data for further processing and analysis. They learn what algorithms can be used to extract information from various da	ta sources, such a	as images, texts,
time series, etc., and lea	arn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characte	ristics from image	s or from web
pages.			
NI-SCR	Statistical Analysis of Time Series	Z,ZK	5
The course deals with the	ne practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange pric	es, employment)	and industrial
problems (modelling of	signals and processes) to computer networks (network components load, attacks detection). The students learn to select a co	nvenient process	model, estimate
	its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the		•
	th the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward tra	nsfer of students'	knowledge from
the academic to the rea	l world.		
NI-UMI	Artificial intelligence	Z,ZK	5
The course covers sear	ch and inference algorithms in major formal paradigms used in artificial intelligence such as logic theories, constraint prograr	nming and autom	ated planning.
The main principles and	practical applications of discussed techniques will be illustrated.		
NI-PON	Selected Topics in Optimization and Numerical mathematics	Z,ZK	5
The course focuses on c	ptimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge o	f continuous optin	nization obtained
in the course Mathemat	ics for informatics. The methods are explained and described along with the details on how they are implemented on comput	ers. Hence, the re	elevant concepts
of numerical matematic	s, mainly numerical linear algebra, are explained too.		

Code of the group: NI-PRO-WI.20

Name of the group: Elective Vocational Courses for Master Specialization Web Engineering, v.2020, in Czech Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

All compulsory subjects of specializations with the exception of this specialization.

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-AM1	Middleware Architectures 1 Jaroslav Kucha, Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-AM2	Middleware Architectures 2 Jaroslav Kucha, Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	L	V
NI-DDW	Web Data Mining Jaroslav Kucha , Milan Doj inovski Jaroslav Kucha Jaroslav Kucha (Gar.)	Z,ZK	5	2P+1C	L	V

NI-PDB	Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SWE	Semantic Web and Knowledge Graphs Milan Doj inovski, Jakub Klímek Milan Doj inovski (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-VCC	Virtualization and Cloud Computing Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.)	Z,ZK	5	2P+1C	L	V
NI-VMM	Retrieval from Multimedia Ji í Novák, Tomáš Skopal Jaroslav Kucha Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	Z	V

Characteristics of the courses of this group of Study Plan: Code=NI-PRO-WI.20 Name=Elective Vocational Courses for Master Specialization Web Engineering, v.2020, in Czech

NI-AM1	Middleware Architectures 1	Z,ZK	5
Students will study new	trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information sys	tem architecture,	web service
architecture and aplication	on servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous co	mmunications and	high availability
of applications.			
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
Students will gain knowl	edge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and	l organizations. Th	ney will get
acquainted with virtualiz	ation principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to effi	ciently operate ar	nd optimize the
performance parameters	s of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effecti	ve technology too	day for the
management of complex	computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skil	Is in the use of mo	odern integration
and development tools (Continuous integration and development).		
NI-PDB	Advanced Database Systems	Z,ZK	5
Students orient themsel	ves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of datab	ase machines (sc	called NoSQL
databases), with the rela	tted new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CY	PHER, Gremlin).	The last part of
the course deals with pe	rformance evaluation of database machines.		
NI-AM2	Middleware Architectures 2	Z,ZK	5
Students will learn new	rends and technologies on the Web including theoretical foundations. They will gain an overview of Web application architec	tures, concepts a	nd technologies
for microservices, distru	buted cache and databases, smart contracts, realtime communication and web security.		
NI-DDW	Web Data Mining	Z,ZK	5
Students will learn lates	methods and technologies for web data acquisition, analysis and utilization of the discovered knowledge. Students will gain	an overview of W	eb mining
techniques for Web craw	ing, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an over	view of most rece	nt developments
in the field of social web	and recommendation systems.		
NI-SWE	Semantic Web and Knowledge Graphs	Z,ZK	5
The students will learn t	ne most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web t	chnologies, meth	ods and best
practices for modelling, i	ntegration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge	e graphs and thei	r systematic
quality assurance.			
NI-VMM	Retrieval from Multimedia	Z,ZK	5
The student obtains gen	eral knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of I	eature extraction	from multimedia
objects, indexing, and st	ructure of distributed search engines.		
	NUN (000 (

Code of the group: NI-V.2021 Name of the group: Purely Elective Master Courses Requirement credits in the group: Requirement courses in the group: Credits in the group: 0 Note on the group: In addition to the courses listed here, you can enroll as an elective any course that is offered within your study program and form of study that you did not enroll as a compulsory subject in the

your study program and form of study that you did not enroll as a compulsory subject in the program/branch/specialization or a compulsory elective course.Courses of this group that a student has completed in the bachelor study at CTU cannot be re-completed.
Name of the course / Name of the group of courses

Code	(in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-AOA	Completing a professional event Zden k Muziká	Z	1			V
NI-ATH	AlgorithmicTheories of Games Dušan Knop, Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+2C	L	V
NI-AFP	Applied Functional Programming Robert Pergl, Marek Suchánek, Daniel N mec Robert Pergl Robert Pergl (Gar.)	КZ	5	2P+1C	L	V
NI-APH	Architecture of computer games Adam Vesecký Adam Vesecký (Gar.)	Z,ZK	4	2P+1C	Z	V
NI-VGA	Video Games Architecture Jan Matoušek	Z,ZK	5	2P+1C	Z	V
NI-BPS	Wireless Computer Networks Ji í Kašpar, Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	4	2P+1C	L	V
NIE-BLO	Blockchain Róbert Lórencz, Jakub R ži ka, Josef Gattermayer, Marek Bielik Josef Gattermayer Róbert Lórencz (Gar.)	Z,ZK	5	1P+2C	Z	V

	Capture The Flag					,
NI-CTF	Ji í Dostál, Martin Šutovský, Ivana Trummová, Ladislav Marko, František Ková Ji í Dostál Ji í Dostál (Gar.)	ΚZ	4	3C	Z	V
NI-DPH	Game Design Adam Vesecký	Z,ZK	5	2P+1C	L	V
NI-DSW	Design Sprint Ond ej Brém, Michal Manda Michal Manda David Pešek (Gar.)	Z	2	30B	Z	v
NI-PSD	Public Services Design Ond ej Brém, David Pešek David Pešek Ond ej Brém (Gar.)	ΚZ	4	1P+2C		V
NI-DID	Digital drawing Denisa Nová ková, Eliška Novotná Denisa Nová ková Denisa Nová ková (Gar.)	Z	2	4C	Z,L	V
NI-DZO	Digital Image Processing	Z,ZK	4	2P+1C	L	V
NI-DDM	Distributed Data Mining Tomáš Borovi ka	ΚZ	4	3C	L	V
NI-PAM	Efficient Preprocessing and Parameterized Algorithms Ond ej Suchý Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	4	2P+1C	L	v
NI-ESC	Experimental Project Course Jan Matoušek, Ond ej Brém Ond ej Brém Ond ej Brém (Gar.)	KZ	8	0P#30R#52C	L	v
NI-GLR	Games and reinforcement learning Juan Pablo Maldonado Lopez	Z,ZK	4	2P+2C	L	v
NI-GNN	Graph Neural Networks Miroslav epek Miroslav epek (Gar.)	Z,ZK	4	1P+1C	L	V
NI-GRI	Grid Computing André Sopczak, Petr Fiedler Pavel Tvrdík André Sopczak (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-HCM	Mind Hacking Marcel Ji ina, Josef Holý Marcel Ji ina Marcel Ji ina (Gar.)	ZK	5	2P+1C	Z	V
NI-HSC	Side-Channel Analysis in Hardware Vojt ch Miškovský, Petr Socha Petr Socha Vojt ch Miškovský (Gar.)	Z,ZK	4	2P+2C	Z	v
NI-HMI2	History of Mathematics and Informatics Alena Šolcová Alena Šolcová Alena Šolcová (Gar.)	ZK	3	2P+1C	Z	V
NI-IBE	Information Security Igor ermák	ZK	2	2P	Z	V
NI-IVS	Intelligent embedded systems Miroslav Skrbek Miroslav Skrbek (Gar.)	KZ	4	1P+3C	L	V
NI-IKM	Internet and Classification Methods Martin Hole a Martin Hole a Martin Hole a (Gar.)	Z,ZK	4	1P+1C	L	V
NI-IAM	Internet and Multimedia	Z,ZK	4	2P+1C	L	V
NI-IOT	Internet of Things Jan Jane ek	Z,ZK	4	2P+1C	L	v
FITE-EHD	Introduction to European Economic History Tomáš Evan	Z,ZK	3	2P+1C	L	V
NI-KTH	Combinatorial Theories of Games Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+1C	L	V
NI-FMT	Finite model theory Tomáš Jakl Tomáš Jakl (Gar.)	Z,ZK	4	2P+1C	L	V
NI-CCC	Creative Coding and Computational Art Radek Richtr, Josef Kortán Radek Richtr Radek Richtr (Gar.)	KZ	4	1P+2C	Z,L	v
NI-KYB	Cybernality	ZK	5	2P	Z	V
NI-LSM2	Statistical Modelling Lab Kamil Dedecius Kamil Dedecius (Gar.)	KZ	5	3C	Z,L	V
NI-LOM	Linear Optimization and Methods Dušan Knop Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MPL	Managerial Psychology Jan Fiala Jan Fiala Jan Fiala (Gar.)	ZK	2	2P	Z,L	V
NI-MSI	Mathematical Structures in Computer Science	Z,ZK	4	2P+1C	L	V
NI-MZI	Mathematics for data science Št pán Starosta	Z,ZK	4	2P+1C	L	V
FIT-ITI	Modern IT infrastructure	Z,ZK	5	2P+1C	Z,L	V
NI-MOP	Modern Object-Oriented Programming in Pharo Jan Blizni enko Robert Pergl Robert Pergl (Gar.)	KZ	4	3C	Z	V
NI-NLM	Neural Language Models	Z	5	2P+1C	L	V
NI-NMS	Neural Networks, Machine Learning and Randomness	Z,ZK	4	1P+1C	Z	V
NI-NMU	New media in art and design Zden k Svejkovský Zden k Svejkovský (Gar.)	ZK	3	2P+0C	Z	V
NI-OLI	Linux Drivers Jaroslav Borecký, Miroslav Skrbek Jaroslav Borecký Miroslav Skrbek (Gar.)	Z,ZK	4	2P+2C	L	V
NIE-PML	Personalized Machine Learning Rodrigo Augusto Da Silva Alves Karel Klouda Rodrigo Augusto Da Silva	Z,ZK	5	2P+1C	Z	v

NI-ARI	Computer arithmetic Pavel Kubalík Pavel Kubalík Alois Pluhá ek (Gar.)	Z,ZK	4	2P+1C	Z,L	v
NI-PG1	Computer Grafics 1 Radek Richtr Radek Richtr Radek Richtr (Gar.)	ZK	4	2P+1C	L	V
NI-PIV	Computer Vision Radek Richtr	Z,ZK	5	2P+2C	Z	v
NI-EDW	Enterprise Data Warehouse Systems Jakub Krej í, Robert Kotlá Jakub Krej í Magda Friedjungová (Gar.)	Z,ZK	5	1P+1C	L	v
NI-PVR	Advanced Virtual Reality Petr Pauš Petr Pauš Petr Pauš (Gar.)	KZ	4	2P+1C	Z	v
NI-AML	Advanced machine learning Zden k Buk, Miroslav epek, Rodrigo Augusto Da Silva Alves, Petr Šimánek, Vojt ch Rybá Miroslav epek Miroslav epek (Gar.)	Z,ZK	5	2P + 1C	L	v
NI-IOS	Advanced techniques in iOS applications Rostislav Babá ek, Jakub Olejník, Igor Rosocha Martin P Ipitel Martin P Ipitel (Gar.)	KZ	4	2P+2C	L	v
NI-APT	Advanced Program Testing Pierre Donat-Bouillud Pierre Donat-Bouillud (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-PVS	Advanced embedded systems Miroslav Skrbek	Z,ZK	4	2P+2C	Z	v
NI-DNP	Advanced .NET David Šenký, Nikolas Jíša David Šenký Nikolas Jíša (Gar.)	Z,ZK	4	2P+1C	Z	v
NI-PYT	Advanced Python Miroslav Hron ok	KZ	4	3C	Z	v
NIE-PDL	Practical Deep Learning	KZ	5	2P+1C	Z	v
NI-GOL	Martin Barus, Yauhen Babakhin Karel Klouda Karel Klouda (Gar.) Programming of distributed systems in GO	KZ	5	0P+3C	Z	V
NI-PSL	Programming in Scala Ji í Dan ek Ji í Dan ek Ji í Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	v
NI-RUB	Programming in Ruby Cyril erný Cyril erný Cyril erný (Gar.)	KZ	4	3C	Z	v
NI-ROZ	Pattern Recognition Radek Richtr, Michal Haindl Michal Haindl (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-PLS1	Programming Language Seminar	Z	2	0P+1C	Z	v
NI-PLS3	Pierre Donat-Bouillud Programming Language Seminar Pierre Donat-Bouillud	Z	2	0P+1C	Z	v
NI-PLS2	Programming Language Seminar	Z	2	0P+1C	L	v
NI-PLS4	Pierre Donat-Bouillud Programming Language Seminar Pierre Donat-Bouillud, Filip K ikava Pierre Donat-Bouillud Pierre Donat-Bouillud (Gar.)	Z	2	0P+1C	L	v
NI-SCE1	Computer Engineering Seminar Master I	Z	4	2C	L,Z	v
NI-SCE2	Hana Kubátová Miroslav Skrbek Hana Kubátová (Gar.) Computer Engineering Seminar Master II	Z	4	2C	L,Z	v
NI-SZ1	Hana Kubátová Hana Kubátová Hana Kubátová (Gar.) Knowledge Engineering Seminar Master I	Z	4	2C	L,Z	v
NI-SZ2	Pavel Kordík Magda Friedjungová (Gar.) Knowledge Engineering Seminar Master II	Z	4	2C	L,Z	v
PI-SCN	Pavel Kordík Magda Friedjungová (Gar.) Seminars on Digital Design	ZK	4	2P+1C	_, Z,L	v
NI-MLP	Petr Fišer Petr Fišer Petr Fišer (Gar.) Machine Learning in Practice	Z,ZK	5	2P+1C	,_ Z	v
FIT-SEP	Jan Hu in Daniel Vašata Daniel Vašata (Gar.) World Economy and Business	Z,ZK	4	2P+2C	 	v
_	Tomáš Evan World Economy and Business					
NI-SEP	Tomáš Evan Tomáš Evan Tomáš Evan (Gar.) Virtual Reality Technology	Z,ZK	4	2P+1C	Z,L	V
NI-TVR	Tomáš Nová ek Tomáš Nová ek Tomáš Nová ek (Gar.)	Z,ZK	3	1P+1C	L,Z	V
NI-TS1	Theoretical Seminar Master I Dušan Knop, Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	V
NI-TS2	Theoretical Seminar Master II Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	L	V
NI-TS3	Theoretical Seminar Master III Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	v
NI-TS4	Theoretical Seminar Master IV Ond ej Suchý, Tomáš Valla Tomáš Valla Ond ej Suchý (Gar.)	Z	4	2C	L	V
NI-TKA	Category Theory Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+1C	L	v
NI-TNN	Theory of Neural Networks Martin Hole a Martin Hole a Martin Hole a (Gar.)	Z,ZK	5	2P+1C	L	v
NI-CPX	Complexity Theory Dušan Knop, Ond ej Suchý Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	5	3P+1C	Z	v
FI-TOP	Academic writing Tomáš Nová ek	Z	2	10B	Z	v

NI-DVG	Introduction to Discrete and Computational Geometry Maria Saumell Mendiola Maria Saumell Mendiola Maria Saumell Mendiola (Gar.)	Z,ZK	5	2P+1C	L	v
NI-VOL	Elections Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	L	V
NI-VYC	Computability Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+2C	L	V
NI-VPR	Research Project Št pán Starosta Št pán Starosta (Gar.)	Z	5		Z,L	V
NI-ZS10	Master internship abroad for 10 credits Zden k Muziká Zden k Muziká (Gar.)	Z	10		Z,L	V
NI-ZS20	Master internship abroad for 20 credits Zden k Muziká Zden k Muziká (Gar.)	Z	20		Z,L	V
NI-ZS30	Master internship abroad for 30 credits Zden k Muziká Zden k Muziká (Gar.)	Z	30		Z,L	V
Characteristics of the	courses of this group of Study Plan: Code=NI-V.2021 Name=P	urely Electiv	e Master	Courses	5	
The subject is participation in must be approved in advance	npleting a professional event a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, con- by the vice-dean for pedagogical activities or the vice-dean for science and research pritemicTheoretics of Company			FIT through	a website, info	omail, etc.
Traditional game theory is a b (players) of a certain competi which are the states of the ga multiagent systems and other	orithmicTheories of Games branch of mathematics, which has broad applications in economy, biology, politics and tive process by designinng a mathematical model and investigating the strategies. The me where no player wants to deviate from his strategy. Due to the recent development of r concepts the algorithmic point of view is gaining attention. In addition to existential qu rse we introduce the basics of game theory of many players, solution concept (usually	e traditional task of of computers, inte uestions we study	of classical rnet, social the proble	ry studies th game theory networks, or ms of efficier	is to find the nline auctions nt computation	equilibria, , advertising,
This course is presented in C the rise nowadays and the fu	Dlied Functional Programming zech. Functional programming represents one of the traditional programming paradign nctional paradigm becomes an important construct of traditionally imperative language software engineer: the theory and especially the practice.			ctional progr		
Students will gain a basic und perspective. They will get a gr part of most games. They will	hitecture of computer games erstanding of the various issues in the field of computer games development, especially asp of component-oriented and functional-oriented architecture, game mechanics, dec also understand the basics of pathfinding, networking and scripting and apply them ir ame, with a strong focus on nontrivial game mechanics.	ision-making pro	cesses and	, but also from base compo	nents that for	m an integral
1	eo Games Architecture nge of topics, procedures and methodologies related to the development of computer of	names - from a te	chnical noi		,ZK	5 design and
philosophical point of view. In game development, physics,	the lectures, students will be guided through the history of development, the structure graphics, artificial intelligence and multiplayer. The exercises will then cover selected to e form of practical demonstrations.	e of game engines	, compone	nt and functi	onal architect	ure typical of
NI-BPS Wir	eless Computer Networks modern technologies, protocols, and standards for wireless networks. They will unders		mashaniam		,ZK	4
broadcast mechanisms, and	data flow control mechanisms. They will also learn about principles of communication skills of configuration of wireless network elements and simulation of wireless network	in sensor network	ks. They get			
Students will understand the t code and deploy a secure de relationship between blockch	ckchain ioundations of blockchain technology, smart contract programming, and gain an overvie centralized application, and assess whether integration of a blockchain is suitable for a ains and information security. It is concluded with a defense of a research or applied s of blockchain-based solutions in both academia and business.	a given problem. T	The course	n platforms. T places an in	creased empl	nasis on the
	oture The Flag roduce students to CTF competitions and let them gain practical experience in the fiel	d of cvber securit	v.		KZ	4
NI-DPH Gai The course complements the interested in deeper knowled	me Design NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) cours ge of the principles used for games design, such as: level design, gameplay design, cl ents will get an overview of game development from the designer's perspective, from th	e, while focusing haracter design, g	primarily or game mech	n game desig anics desigr	, storytelling,	and game
Students will work on projects the course the students will g testing the prototypes (plus fi		-		ing with rese	arch and finis	hing with
The course will introduce sture suppliers (devs and designes Course is aimed at students-	blic Services Design dents to specifics of UX, Service design and development for public sector. We will loo r) as well as clients. In small teams students will work on projects from partner organiz designers as well as clients.	-		pment proce	client represe	ntatives.
The course will introduce stue they will practically apply in the practice or learn drawing and	ital drawing dents to the basic principals of digital drawing and graphical design. Students will gain neir own design works. Students will also gain experience in drawing and painting with painting. The course is organized as a thematic practices covering parts of theory and	digital and analo	g tools. The	course is fit e gained kn	for anyone w owledge.	ho wants to
This course presents a comp implement and have an intere of digital image processing. T frequency domain, abstractio	ital Image Processing rehensive overview of modern methods for interactive editing of digital images and vid sting theoretical basis. Visually attractive applications provide better understanding of b his course will introduce algorithms solving the following practical applications: edge-a n, hybrid images, gradient domain editing, seamless image stitching and cloning, digit e image deformation, free-form image registration, texture synthesis, interactive segm	basic theoretical basic theoretical basic theoretical basic aware editing, ton all photo-montage	ackground t e mapping, e, color-to-g	ical algorith hat is also va HDR compr ray conversi	aluable outsid ession, de-blu on, context er	e the domain irring in ihancement,

NI-DDM Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hand	ds on experience	with large scale
data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementation	ns and will be capa	able to propose
approaches to parallelize other algorithms. The course is prezented in czech language.		
NI-PAM Efficient Preprocessing and Parameterized Algorithms	Z,ZK	4
There are many optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often nece	ssary to solve the	se 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 cor	mmon property
(parameter) of the inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exp	onentially in this (s	small) parameter
and polynomially in the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomia	al time preprocess	ing 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 solut	ion method. We w	vill 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	s not exist. We
will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes.		
NI-ESC Experimental Project Course	KZ	8
"The Design Project course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principles	s, methodologies,	and tools used
in designing technology-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design	projects, collabor	rate with industry
experts, and learn to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their sk	ills in user-centere	ed design and
user experience evaluation, as well as gain experience working in a team to design and prototype a functional solution."		
NI-GLR Games and reinforcement learning	Z,ZK	4
The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intellig	gence. This course	e is intended to
give you both theoretical and practical background so you can participate in related research activities. Presented in English.		
NI-GNN Graph Neural Networks	Z,ZK	4
The course introduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural r	networks for creati	ing vector
representations of nodes, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last	part of the course	e also covers
graph generation and interpretability of graph neural networks. In the exercises, students will try out selected techniques and problems.		
NI-GRI Grid Computing	Z,ZK	5
Grid computing and gain knowledge about the world-wide network and computing infrastructure.		
NI-HCM Mind Hacking	ZK	5
Cognitive security is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks,	information syste	ms and assets,
the domain of cognitive security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive security	curity is growing ir	n importance in
the context of information warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Inter	net environment h	nave real societal
impacts such as disruption of social cohesion, threats to democracy or war.		
NI-HSC Side-Channel Analysis in Hardware	Z,ZK	4
This course is dedicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical atta	icks. Students get	familiar with
various kinds of side channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and	nd get familiar with	h higher-order
attacks. They also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel inform	nation leakage.	
NI-HMI2 History of Mathematics and Informatics	ZK	3
This course is presented in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithm	ms, transformation	ns, recursive
functions, eliptic curves, etc.) note on possibilities of applications of some mathematical methods in informatics and its development.		
NI-IBE Information Security	ZK	2
Students learn information and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and internat		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., pen	etration testing).	
NI-IVS Intelligent embedded systems	KZ	4
Intelligent embedded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. T	he course is an ac	dvance version
of the Intelligent embedded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot progra	-	
development. Lectures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, studen	nts develop advan	ced applications
combining knowledge of various courses like nature inspired algorithms, data mining algorithms, image recognition and web technologies		1
NI-IKM Internet and Classification Methods	Z,ZK	4
In this course, the students get acquainted with classification methods used in four important internet, or generally network applications: in spam filte	-	
in malware detection systems and in intrusion detection systems. However, they will learn more than only how classification is performed when solvi	•	•
On the background of these applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycl		
exercises. During the exercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult the		
NI-IAM Internet and Multimedia	Z,ZK	4
The NI-IAM course is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes a	-	
presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practice		
audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the		
the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recordin	g the scene up to	the presentation
for audience.	7 71/	4
NI-IOT Internet of Things	Z,ZK	4
The subject is focused on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is for the strongly growing computer support of various devices. Its goal is for the strongly growing computer support of various devices.	amiliarization with	available
development elements (Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth).	7 71/	2
FITE-EHD Introduction to European Economic History	Z,ZK	3
The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global effective periods in history. As European economic history in this process is for uses producing about forming of the global effective periods in history.		
of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the econom	-	-
area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial insi	-	
does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and meetings will consist of a mixture of lecture and discussion.	a organizations IN	matory. CIdSS

NI-KTH Combinatorial Theories of Games	Z,ZK	4
Traditional game theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stu		-
(players) of a certain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game	-	-
which are the states of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player wants to deviate from his strategy.	-	
games, was by Conway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea	-	
otherwise incompatible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The the	•	•
work of Beck, who established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force		
is no efficient. Beck introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory		
games. We focus on theoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course is		
to mathematically analyse, think and proof. The course is also suitable for bachelors student in the third year, who attended introduction to graph the	ory, as well as for	PhD students
looking for research topics.		
NI-FMT Finite model theory	Z,ZK	4
The aim of the course is to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiability	y of logical proper	ties of database
systems. Since its inception in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as	descriptive comp	lexity theory, the
Constraint Satisfaction Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.		
NI-CCC Creative Coding and Computational Art	KZ	4
Students work on practical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows t	I	-
BLE,) and introduces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization techniqu		
modern technologies. The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture an		-
(Institute of Intermedia FEL).		anning) and nin
NI-KYB Cybernality	ZK	5
	1	-
Students get acquainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the		
have an overview of systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker a	activities and bena	avior. The course
will also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams).		
NI-LSM2 Statistical Modelling Lab	KZ	5
The topic of LSM2 is advanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the pre	sence of clutter, c	or video tracking.
We aim at the state-of-the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli) filters.		
NI-LOM Linear Optimization and Methods	Z,ZK	5
Students learn the applications of optimization methods in computer science, economics, and industry. They are aware of practical importance of line	ar and integer pro	gramming. 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 o		
science (such as scheduling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, trav		-
issues from economics, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems. T		
in linear programming.	.,	
NI-MPL Managerial Psychology	ZK	2
NI-MSI Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scot	t model of lambda	a calculus
		a calculus.
Introduction to category theory.		
	Z,ZK	4
Introduction to category theory.	Z,ZK	4
Introduction to category theory. NI-MZI Mathematics for data science	Z,ZK	4 ne studied topics
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NI-ARI Computer arithmetic	Z,ZK	4
Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementation units.		
NI-PG1 Computer Grafics 1	ZK	4
The course builds on graphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge from these courses is deepened by state-of-the-art knowledge from the second state-of-the-art kno	-	-
interested in advanced computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral particular texture of the students will gain practical knowledge with realistic texturing and raytracing methods. An integral particular texture of the students will gain practical knowledge with realistic texturing and raytracing methods. An integral particular texture of the students will gain practical knowledge with realistic texturing and raytracing methods. An integral particular texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of the students will gain practical knowledge with realistic texture of textur		-
articles and their subsequent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other are		
NI-PIV Computer Vision	Z,ZK	5
The Computer Vision course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data proc		-
the basic principles of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on the	-	
practical applications and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering		-
and recognition and segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision	I (Including CININ, RCINI	N, YOLO, VII),
motion detection, visual expressiveness (saliency).	7 71/	-
NI-EDW Enterprise Data Warehouse Systems	Z,ZK	5 tiaal kaawladaa
The Enterprise Data Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence me not only in designing warehouses and various architectures, but also their deployment and maintenance. This course also includes an introduce		-
visualization.		ning and data
NI-PVR Advanced Virtual Reality	KZ	4
The course introduces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of	1 1	•
things, it introduces students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications an		-
in available 3D engines (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to ap		
in virtual reality, or directly create a complex game for VR.	pi) ille illeniedge galli	
NI-AML Advanced machine learning	Z,ZK	5
The course introduces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the		-
processing, control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students wi		
NI-IOS Advanced techniques in iOS applications	KZ	4
Students will learn the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know		-
BI-IOS.		beginners class
NI-APT Advanced Program Testing	Z,ZK	5
Testing a program is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues	· · · ·	-
advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution.	s. The goal of the course	is to present
NI-PVS Advanced embedded systems	Z,ZK	4
The course is focused on ARM processors and microcontrollers and their usage in wide range of applications. The course includes a series of	· · · · ·	-
working with mass storage devices, motor control, system control and industrial communication. The students obtain both theoretical and also	-	
systems.		
NI-DNP Advanced .NET	Z.ZK	4
Students will acquire an overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET	, , ,	
get notions of Azure DevOps and GIT. Students will get practical experience in semestral work where they will create a client-server applicatio		
Entity Framework Core and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT.	<u>j</u>	,
NI-PYT Advanced Python	KZ	4
The goal of this course is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming i	1 1	-
very hands-on and it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral co		
teachers from Red Hat.		-
NIE-PDL Practical Deep Learning	KZ	5
This course is designed to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source ma	1 1	
the course, students will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fie	elds such as computer vi	ision and natural
language processing.		
NI-GOL Programming of distributed systems in GO	KZ	5
NI-PSL Programming in Scala	Z,ZK	4
The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language	I I I	matching and
advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frame		-
Scalaz, etc.	-	-
NI-RUB Programming in Ruby	KZ	4
This course is presented in Czech.	1	-
NI-ROZ Pattern Recognition	Z,ZK	5
The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of	· · · ·	-
recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimat		-
NI-PLS1 Programming Language Seminar	Z	2
The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group	1 – 1	
about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of the present and actively participating students are expected to present a paper of the present and actively participating students are expected to present a paper of the present and actively participating students are expected to present a paper of the present and actively participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the participating students are expected to present a paper of the paper of		
is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		001
NI-PLS3 Programming Language Seminar	Z	2
The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group	I I	
about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of their interest and actively participating students are expected to present a paper of the paper of t		
is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		
NI-PLS2 Programming Language Seminar	Z	2
The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group	1 1	
about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participa		
is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		
NI-PLS4 Programming Language Seminar	Z	2
The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group	1 1	
about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participa	te in the discussions. Th	e reading group
is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		

NI-SCE1 Computer Engineering Seminar Master I	Ì	Z	4	
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliabil	ا itv and resistanc		-	
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected sup	-			
articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each				
semester.				
NI-SCE2 Computer Engineering Seminar Master II		Z	4	
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliabil	ity and resistanc	e to failures and a	attacks. Students	
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected sup	ervisor. Part of th	he subject is worl	k with scientific	
articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of t		-		
semester.				
NI-SZ1 Knowledge Engineering Seminar Master I		Z	4	
On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being coo	ked in top resea	rch labs around t	he world.	
Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and pr	ofit from) top mad	chine learning and	d AI conferences	
and summer schools, as well as FIT's own Summer Research Program (VyLet).	, .	Ū		
NI-SZ2 Knowledge Engineering Seminar Master II		Z	4	
On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being coo	ked in top resea	rch labs around t	he world.	
Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and pr	-			
and summer schools, as well as FIT's own Summer Research Program (VyLet).				
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 mean	ns of description		and basic logic	
synthesis and optimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with	combinatorial p	roblems emergin	g in EDA.	
NI-MLP Machine Learning in Practice		Z,ZK	5	
Applying machine learning methods to real projects in practice involves many other necessary tasks - from understanding the intention	s of the client to.		-	
The course guides students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically			•	
data processing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of		-	-	
FIT-SEP World Economy and Business		Z,ZK	4	
This course is presented in Czech. The course introduces students of technical university to the international business. It does that p	l redominantly by	,	-	
and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse				
corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowled				
readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.	ige in the form o			
NI-SEP World Economy and Business		Z,ZK	4	
This course is presented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introd	luces students o	· ·	-	
international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get			-	
necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, w		-		
Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor levels		-		
NI-TVR Virtual Reality Technology		Z,ZK	3	
Students will be introduced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD,) and the p	l ossibilities of co	,	-	
tracking, hand tracking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced		-		
reality will be presented.	,,,	g		
NI-TS1 Theoretical Seminar Master I		Z	4	
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. I	ا t is mostly a clas	_	•	
are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral par	-		-	
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.				
NI-TS2 Theoretical Seminar Master II		Z	4	
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. I	l t is mostly a clas			
are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral par				
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.				
NI-TS3 Theoretical Seminar Master III		Z	4	
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. I	l t is mostly a clas			
are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral par	-		-	
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.				
NI-TS4 Theoretical Seminar Master IV		Z	4	
	t in monthy a alan			
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. I are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral par				
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			nunc papers anu	
		7 71/	4	
NI-TKA Category Theory		Z,ZK	4	
NI-TNN Theory of Neural Networks		Z,ZK	5	
In this course, we study neural networks from the point of view of the theory of function approximation and from the point of view of p				
pertaining to artificial neural Networks, such as neurons and connections between them, types of neurons from the point of view of si	-			
synaptic mappings, network training, and the role of time in neural networks. In connection with network topology, we get acquainted				
and in connection with somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in co				
problem of overtraining and to the fact that training is actually a specific optimization task, recalling the most typical objective function				
employed for neural network training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks to expressing functions of many variables using functions of few				
to neural networks, we first notice the connection of neural networks to expressing functions of many variables using functions of few theorem). Afterwards, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the		-		
being dense in important Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integra		• • •		
functions with continuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training	-			
random sample, and with probabilistic assumptions about training data with which those two kinds of neural networks can be employe			-	
of the conditional expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong			•	
acquainted with an analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, w		-	-	
with its analogy for neural networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how the				
		, .,		
topology of the network.				

NI-CPX	Complexity Theory	Z.ZK	5
-	ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th	,	-
(in)tractability of difficul		, ,	51
FI-TOP	Academic writing	Z	2
Publishing is an import	ant and required part of research activity. It is not only about obtaining research results but also about applying them in the for	m of publication.	Writing scientific
	eful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the c		-
write a scientific article,	what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting a	an article and rev	ewing someone
else's article. The cours	se will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester.	Dates will be dete	ermined based
on the availability of en	rolled students.		
NI-DVG	Introduction to Discrete and Computational Geometry	Z,ZK	5
The course intends to i	ntroduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar w	ith the most fund	amental notions
of this discipline, and to	be able to solve simple algorithmic problems with a geometric component.		
NI-VOL	Elections	Z,ZK	5
We will cover the basic	s of (committee) elections and, in general, opinion aggregation.		
NI-VYC	Computability	Z,ZK	4
Classical theory of recu	irsive functions and effective computability.		
NI-VPR	Research Project	Z	5
Student obtains the cre	dits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en.		
NI-ZS10	Master internship abroad for 10 credits	Z	10
Each student can once	within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research inst	tution. 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 inte	rnship. Auxiliary
courses MI-ZS10, MI-Z	S20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 we	eks of full-time e	mployment with
a foreign institution. The	e 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-	ine.		
NI-ZS20	Master internship abroad for 20 credits	Z	20
	within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research inst		
	vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and		
	S20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 we		
	e 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-			
NI-ZS30	Master internship abroad for 30 credits	Z	30
	d in chzech language. Each student can once within his / her master's degree have a foreign internship at a foreign university	•	
	fore the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must pro-		
	e internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS		
	employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This	amount can be c	ivided into two
subjects if the internshi	p exceeds the academic year's dead-line.		

List of courses of this pass:

Code	Name of the course	Completion	Credits	
FI-TOP	Academic writing	Z	2	
Publishing is an im	portant and required part of research activity. It is not only about obtaining research results but also about applying them in the form o	of publication. Writi	ng scientific	
publications can be	e useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the cou	rse, students will le	earn how to	
write a scientific art	icle, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an a	article and reviewir	ng someone	
else's article. The	course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Da	ates will be determine	ined based	
	on the availability of enrolled students.			
FIT-ITI	Modern IT infrastructure	Z,ZK	5	
with a very limited a	Ind time-invariable range of software or hardware, this subject tries to explain the issue as a whole and in the context of the time. A mo	dern data or comp	uting center	
is understood here	e as a complex whole, the individual parts of which must be reconciled from different aspects of the view using current technologies. T	The proposed solu	tion should	
	thus be capable of continuous and economically optimal operation.			
FIT-SEP	World Economy and Business	Z,ZK	4	
This course is pre	sented in Czech. The course introduces students of technical university to the international business. It does that predominantly by co	omparing individua	I countries	
and key regions of	vorld economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as	indexes of econom	nic freedom,	
corruption and eco	nomic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of di	scussions based o	on individual	
	readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.			
FITE-EHD	Introduction to European Economic History	Z,ZK	3	
The course introdu	ices a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global eco	nomy through the	description	
of the key periods	in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic	history. From large	economic	
area of Roman Em	pire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial instituti	ons is deciphered.	The course	
does not cover de	tailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and o	rganizations in his	tory. Class	
	meetings will consist of a mixture of lecture and discussion.			
NI-ADM	Data Mining Algorithms	Z,ZK	5	
The course focuses	s on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the students s	should know mach	ine learning	
basics. The empha	basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation systems) and models (e.g., kernel			
	methods).			

NI-ADP	Architecture and Design patterns	Z,ZK	5
-	is course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as		-
-	ues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge o		
-	h the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. I o the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems		
will be introduced t	architectures used in large-scale distributed systems.	, and some advanc	eu sonware
NI-AFP	Applied Functional Programming	KZ	5
	sented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional p	I I	-
the rise nowadays	s and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, master	ing this paradigm b	becomes a
	necessary competence of a software engineer: the theory and especially the practice.		
NI-AIB	Algorithms of Information Security	Z,ZK	5
-	equainted with the algorithms of secure key generation and cryptographic error (not only biometric) data processing. Furthermore, stude		
principles of cry	ptographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware detec learning in detection systems. The last topic includes practical steganographic methods and attacks on steganographic syste		I Machine
NI-AM1	Middleware Architectures 1	Z.ZK	5
	dy new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information syste	I ' I	-
architecture and ap	plication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous comm	unications and hig	h availability
	of applications.		
NI-AM2	Middleware Architectures 2	Z,ZK	5
Students will learn	new trends and technologies on the Web including theoretical foundations. They will gain an overview of Web application architecture	es, concepts and te	echnologies
	for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.		-
NI-AML	Advanced machine learning	Z,ZK	5
	ces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of rec control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with t	-	-
NI-AOA	Completing a professional event	Z	1
-	icipation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, concluded with a workshop, a test, drafti	_	-
	d in advance by the vice-dean for pedagogical activities or the vice-dean for science and research and is presented within the FIT three		
NI-APH	Architecture of computer games	Z,ZK	4
	basic understanding of the various issues in the field of computer games development, especially from a technical point of view, but also		
	vill get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base co		-
part of most gam	es. They will also understand the basics of pathfinding, networking and scripting and apply them in practical exercises (labs). An impo implementation of a simple game, with a strong focus on nontrivial game mechanics.	rtant part of the co	ourse is an
NI-APR	Selected Methods for Program Analysis	Z.ZK	5
	Loces you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and dynamic and dyn	I ' I	-
	art of reasoning about computer programs without running them. We will look at the analyses for program understanding, optimization	-	-
	Analysis, we will look at the analyses considering individual program runs using a concrete environment and inputs.		
NI-APT	Advanced Program Testing	Z,ZK	5
Testing a program	n is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The go	al of the course is	to present
NI-ARI	advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution.	774	4
INI-ARI	Computer arithmetic Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementa	Z,ZK	4
NI-ATH	AlgorithmicTheories of Games	Z,ZK	4
	theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stud	. ' .	1
	tain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t		
	es of the game where no player wants to deviate from his strategy. Due to the recent development of computers, internet, social network		-
• •	is and other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of el	•	
	concepts. In this course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods of		
NI-BKO	Error Control Codes al of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transm	Z,ZK	5
NI-BML	Bayesian Methods for Machine Learning	KZ	. 5
	sed on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studies	I I	-
-	description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden		
from noisy observa	ations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose, a	number of real wor	ld 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 the	ry to solve
	some of them.		
NI-BPS	Wireless Computer Networks	Z,ZK	4
	n about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad nisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowle		
broaddadt moona	for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitab		oonamonio
NI-BUI	Business Informatics	Z,ZK	5
The aim of the cou	rse is to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas of b	usiness process m	anagement,
	architectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT manageme	-	-
	ind resource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governan	-	
business and th	e context of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme management, IT investment evaluation and human resources management in IT (roles CIO, CEO, CFO).	m, revenue and inv	vestment
NI-BVS	Embedded Security	Z,ZK	5
	Embedded Security c knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of crypto	I ' I	1
-	nbedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources		
	of computer systems.		
NI-CCC	Creative Coding and Computational Art	KZ	4
-	practical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows the		
BLE,) and introdu	uces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization technique	s with artistic meth	nods using

(Institute of Intermedia FEL).		ing) and invi
NI-CPX Complexity Theory	Z,ZK	5
Students will learn about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the	theory concerning	1
(in)tractability of difficult problems.		
NI-CTF Capture The Flag	KZ	4
The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber se		
NI-DDM Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands of data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations a	-	-
approaches to parallelize other algorithms. The course is prezented in czech language.	ind will be capable	to propose
NI-DDW 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 We	1
techniques for Web crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overview	w of most recent de	evelopments
in the field of social web and recommendation systems.		-
NI-DID Digital drawing	Z	2
The course will introduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, persp they will practically apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course		-
practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practic		
NI-DIP Diploma Thesis	Z	30
NI-DNP Advanced .NET	Z,ZK	4
Students will acquire an overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET MAUI (WI		and also will
get notions of Azure DevOps and GIT. Students will get practical experience in semestral work where they will create a client-server application utilizing	technologies ASF	NET Core,
Entity Framework Core and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT.		
NI-DPH Game Design	Z,ZK	5
The course complements the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on game of interested in deeper knowledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanics d	-	
development cycle. The students will get an overview of game development from the designer's perspective, from theoretical concepts to practical impler		•
projects.		
NI-DSS Decision Support Systems	Z,ZK	5
The aim of the course is to provide students with knowledge and skills in decision support systems, their classification (Powerova), selected principles of		
and knowledge-oriented decision support systems. Students will also gain knowledge of multicriterial decision-making methods and game theory. They will		ne principles
of conceptually and ontologically oriented decision support systems and the basics of distribution, optimization and evolution methods a	-	
NI-DSV Distributed Systems and Computing Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing	Z,ZK	5
	processes and cor	minumoation
	upport high availa	bility of both
channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that s data and services, and safety in case of failures.	support high availa	bility of both
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NI-EVY	Efficient Text Pattern Matching	Z,ZK	5
Students get knowl	edge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both acces They will be able to use the knowledge in design of applications that utilize pattern matching.	s time and memory	complexity.
NI-FME	Formal Methods and Specifications	Z,ZK	5
	to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some so		
	basic properties of software.		
NI-FMT	Finite model theory	Z,ZK	4
	rse is to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiability of inception in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as de-		
,	Constraint Satisfaction Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.	,	27
NI-GAK	Graph theory and combinatorics	Z,ZK	5
-	ss is to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorithms. e basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected top		
e e	heory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory v	a 1	
	of combinatorics on words, formal languages and bioinformatics.		
NI-GEN	Code Generators	Z,ZK	5
	jues of translating programs written in high-level programming languages are essential for understanding the field of systems prograr algorithms and techniques used to translate more complex programming constructs of modern languages employed in systems progr		-
understanding the	familiar with both the theoretical and practical aspects of implementing the back-end of optimizing compilers for programming lan	-	will become
NI-GLR	Games and reinforcement learning	Z,ZK	4
The field of reinfor	cement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelliger		ntended to
	give you both theoretical and practical background so you can participate in related research activities. Presented in Englis		4
NI-GNN The course intre	Graph Neural Networks oduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural r	Z,ZK etworks for creatin	4 a vector
	of nodes, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last p		•
	graph generation and interpretability of graph neural networks. In the exercises, students will try out selected techniques and pro		
NI-GOL	Programming of distributed systems in GO	KZ	5
NI-GPU	GPU Architectures and Programming nowledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in the CU	Z,ZK	5 nvironmont
-	videspread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchical com		
	will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.		
NI-GRI	Grid Computing	Z,ZK	5
NI-HCM	Grid computing and gain knowledge about the world-wide network and computing infrastructure. Mind Hacking	ZK	5
Cognitive security	5	I I	-
	is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, infinitive security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive security	ormation systems a	and assets,
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NI-IVS Intelligent embedded systems		
Intelligent and added as stand as an interval data in the Control of t	KZ	4
Intelligent embedded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence		
of the Intelligent embedded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot pro-		
levelopment. Lectures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, stud	-	applications
combining knowledge of various courses like nature inspired algorithms, data mining algorithms, image recognition and web		<i>г</i>
NI-KOD 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 used in practice. The evention explore principles of integer and of attributed lightness, and context data compression methods. In addition	•	• I
used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, lossy data compression methods used in image, audio, and video compression.	students learn the lund	amentais or
	771/	6
NI-KOP Combinatorial Optimization The students will gain knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able n	ot only to select and imp	6
also to apply and evaluate heuristics for practical problems.	or only to select and imp	
	Z,ZK	5
NI-KRY Advanced Cryptology Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will k		-
random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which t	-	-
their own systems or to the creation of their own software solutions.	ney can apply to the line	gration of
NI-KTH Combinatorial Theories of Games	Z.ZK	4
Traditional game theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory	· · · ·	
(players) of a certain competitive process by designing a mathematical model and investigating the strategies. The traditional task of classical g	-	-
which are the states of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-	-	
games, was by Conway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The in		
otherwise incompatible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. T	-	
vork of Beck, who established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-for		
s no efficient. Beck introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the the	eory of combinatorial and	d positional
pames. We focus on theoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The cours	e requires independent	work, ability
to mathematically analyse, think and proof. The course is also suitable for bachelors student in the third year, who attended introduction to graph	theory, as well as for Phl	D students
looking for research topics.		
NI-KYB Cybernality	ZK	5
Students get acquainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understa	nd the classification of a	ttacks and
nave an overview of systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacke	r activities and behavior.	The course
will also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT a	nd CERT teams).	
NI-LOM Linear Optimization and Methods	Z,ZK	5
Students learn the applications of optimization methods in computer science, economics, and industry. They are aware of practical importance of lin	near and integer program	nming. They
are able to work with optimization software and are familiar with languages used in programming of that software. They get skills in formalization o	f optimization problems i	n computer
science (such as scheduling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, t	ravelling salesman probl	ems, etc.),
ssues from economics, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problem	s. They get orientation in	algorithms
in linear programming.		
NI-LSM2 Statistical Modelling Lab	KZ	5
The topic of LSM2 is advanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the p		eo tracking.
We aim at the state-of-the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Berr		
NI-MCC Multicore CPU Computing	Z,ZK	5
Students will get acquainted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations	on multicore processors	with shared
and virtually shared memories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain kn	-	
ptimization techniques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPU		throughput.
On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications		
NI-MEP Modelling of Enterprise Processes	Z,ZK	5
The subject is focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological a		ing and
implementation of processes, organisation structures and information support in big enterprises and institutions		
NI-MKY Mathematics for Cryptology	Z,ZK	5
Students will gain deeper knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphe	-	
on the problem of solving a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of o		roblem of
factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems bas		
NI-MLP Machine Learning in Practice	Z,ZK	5
Applying machine learning methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client		
	tically. The aim is to expe	
The course guides students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practice data processing and learn have to describe the whole process from exploration to evolution of the model performance in the form of a close	r and understandable re-	
data processing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear		
data processing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear NI-MOP Modern Object-Oriented Programming in Pharo	KZ	4
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NI-MPR	Master Project	Z	7
1. At the beginning	of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial ta	sks that should be	carried out
during the semeste	r. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of	of the semester. 2. T	he external
	he information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.cz/s		-
	ned form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT topic		
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 t approvable at the end of the semester.	ne FII will be com	plete and
NI-MSI	Mathematical Structures in Computer Science	Z.ZK	4
	emantics of programming languages. Data types as continuous lattices, Scott topology. Procedures as continuous mappings. The Scot	1 / 1	-
	Introduction to category theory.		
NI-MTI	Modern Internet Technologies	Z,ZK	5
	ubject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration -		
TCP/IP is able to c	arry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video	and data to achieve	e seamless
	. 2. Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundreds of		
	there is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching and		
-	ow service providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela eration Technologies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in		0001). 4.
NI-MVI	Computational Intelligence Methods	Z,ZK	5
	erstand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to m		-
	how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations,		Will loann
NI-MZI	Mathematics for data science	Z,ZK	4
	ents are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in da		
	near algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality princ		
	selected notions from probability theory and statistics.		
NI-NLM	Neural Language Models	Z	5
In this course, stud	ents will learn the technical foundations of the Transformer architecture as well as the practical aspects of using language models. The	e goal of the course	e is to teach
	students how to use language models to solve problems, make informed risk assessments, and work critically with the scientific li		
NI-NMS	Neural Networks, Machine Learning and Randomness	Z,ZK	4
	ds, i.e. methods based on randomness, are extremely important for the construction and training of neural networks as well as a num		-
	Irse "Neural networks, machine learning and randomness" will discuss in sufficient depth a number of specific types of neural networks, and machine learning is the second machine learning is the second machine learning in the final type to second machine learning.		
	I as a number of specific stochastic methods for neural networks and machine learning. In the final two topics, it explains the general In shows that, in addition to the use of randomness in neural networks and machine learning, machine learning models, including ne		•
	of the most important applications of randomness stochastic optimization methods, which include e.g. popular evolutionary algo		
NI-NMU	New media in art and design	ZK	3
	luces students to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game ar		-
	lent with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especially		
	art projects.		
NI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5
	roduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such method		-
	finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They		-
linear aigebraic eo	quations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement as well as in parallel.	these algorithms se	equentially
NI-NSS	Normalized Software Systems	ZK	5
	the foundations of normalized systems theory that studies the evolvability of modular structures based on concepts from engineering	1 1	-
	from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related issu	-	-
architecture. In the	second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements. The	ese elements provi	de the core
functionality of infor	mation systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stability	and entropy-related	d principles.
	This knowledge allows students to realize new levels of evolvability in software architectures.		
NI-NUR	User Interface Design	Z,ZK	5
	stand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, forma		
· · · · ·	ocesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able	-	
NI-OLI	Linux Drivers g system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining po		4 and FPGAs
-	ability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development	-	
	urse provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practic		
NI-OSY	Operating Systems and Systems Programming	Z,ZK	5
The course covers	system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kernel d	ata structures. Key	topics are:
process manage	ment, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c	ourse also address	es kernel
	ss, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability.	-	
in embedded and r	eal-time operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within labs focused on development of LINUX kernel modules.	, students will work	on projects
		774	1
NI-PAM	Efficient Preprocessing and Parameterized Algorithms primization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necess	Z,ZK	4 problems
-	. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one	-	-
	nputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity expone		
and polynomially in	n the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial tir	ne preprocessing o	of the input,
	sible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solution		
	eterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (pr		t exist. We
	will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation	I I	4
NI-PAS	Advanced Aspects of Business	Z,ZK	4
	burse is to provide students with advanced (compared to the bachelor's degree) knowledge and skills needed to establish and run the management, especially in law, administration (necessary steps and documents), business economics, foreign trade and related		มนอกเสรร

NI-PDB	Advanced Database Systems	Z,ZK	5
	emselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of database	·	
databases), with th	he related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CYPH	IER, Gremlin). The	last part of
	the course deals with performance evaluation of database machines.	771	-
NI-PDD Students learn to p	Data Preprocessing repare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data s	Z,ZK	5
	and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteris		. .
	pages.		
NI-PDP	Parallel and Distributed Programming	Z,ZK	6
21st century in co	mputer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores	3. Parallel computin	g systems
-	biquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platfor	-	
	es of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication oper		~
	parallel programming of shared and distributed memory computers. They get acquianted with fundamental parallel algorithms and or so of design of efficient and scalable parallel algorithms and methods of performance evaluation of their implementations. The course		
learn the technique	practical programming in OpenMP and MPI for solving a particular nontrivial problem.	includes a semeste	a project or
NI-PG1	Computer Grafics 1	ZK	4
The course builds of	on graphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge. The	ne course is designe	ed for those
	ced computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of the		
	subsequent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas and		graphics.
NI-PIS	Enterprise Information Systems	Z,ZK	5
	sed on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage of bi		
	telligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunications thermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the bus		
•	quainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and operation		
	company / organization.	· · · · · · · · · · · · · · · · · · ·	
NI-PIV	Computer Vision	Z,ZK	5
The Computer Vision	on course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing. St	udents will get acqu	ainted with
	les of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoretic	•	
	ns and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, color re		
and recognition a	nd segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (includi motion detection, visual expressiveness (saliency).	ing CNN, RCNN, Y	JLO, VIT),
NI-PLS1	Programming Language Seminar	Z	2
-	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which	. – .	
-	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the d		
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		
NI-PLS2	Programming Language Seminar	Z	2
The Programming	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which	we discuss scienti	fic papers
about programming	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the d		ading group
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		
NI-PLS3	Programming Language Seminar		2
-	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the d		
about programming	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		sanig group
NI-PLS4	Programming Language Seminar	Z	2
	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which	we discuss scienti	fic papers
about programming	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the d	liscussions. The rea	ading group
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		
NI-PON	Selected Topics in Optimization and Numerical mathematics	Z,ZK	5
	s on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge of co	-	
in the course Math	ematics for informatics. The methods are explained and described along with the details on how they are implemented on computers of numerical matematics, mainly numerical linear algebra, are explained too.	. Hence, the relevan	it concepts
NI-PSD	Public Services Design	KZ	4
	oduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p	1 1	
	and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration	•	· ·
	Course is aimed at students-designers as well as clients.		
NI-PSL	Programming in Scala	Z,ZK	4
	uces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feature		-
advance standard I	ibrary. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and	I libraries e.g. Play, (Cassandra,
	Scalaz, etc.	L/7	1
NI-PVR	Advanced Virtual Reality ces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D model	KZ	4 mong other
	s students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will also		-
-	ines (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply the kn	-	
	in virtual reality, or directly create a complex game for VR.		
NI-PVS	Advanced embedded systems	Z,ZK	4
	used on ARM processors and microcontrollers and their usage in wide range of applications. The course includes a series of advance	-	
working with mass	s storage devices, motor control, system control and industrial communication. The students obtain both theoretical and also practica	experiences with e	embedded
	systems.	L/7	1
NI-PYT	Advanced Python urse is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Python	(BI-PYT) left of Th	4 e course is
-	it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursework		
,	teachers from Red Hat.		,

NI-REV	Reverse Engineering	Z,ZK	5
Students will get ac	quainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before	ore and after the m	ain function
	will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated		-
	ten in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be de		
debuggers and de	bugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer	malware scene. Th	ne focus of
	the course is on the seminars, where students will solve practically oriented tasks from the real world.	7 71/	
NI-ROZ	Pattern Recognition	Z,ZK	5
	odule is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the st		-
-	dents will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, ar		
NI-RUB	Programming in Ruby This course is presented in Czech.	KZ	4
NI-RUN		Z,ZK	5
	Runtime Systems roduction to the world of virtual machines (VM) for high-level programming languages. There are two goals: Give you hands-on experienc		-
	a VM from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC compile	• •	
	ation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implementation		0
	Dynamic optimizations, speculations, and deoptimizations Language implementation frameworks Read-world VMs		io, molaanig
NI-SBF	System Security and Forensics	Z,ZK	5
	familiar with aspects of system security (principles of end station security, principles of security policies, security models, authenticat		
-	niliar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and forensi		
_	importance of operating system/operating system artifacts or file system for attack analysis and detection).		
NI-SCE1	Computer Engineering Seminar Master I	Z	4
	nputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to	b failures and attacl	ks. Students
are approached in	dividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the	subject is work wi	th scientific
articles and other p	rofessional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teacher	rs. The topics are n	ew for each
	semester.		
NI-SCE2	Computer Engineering Seminar Master II	Z	4
	nputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to		
are approached in	dividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the	subject is work wi	th scientific
articles and other p	rofessional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teacher	rs. The topics are n	ew for each
	semester.		
NI-SCR	Statistical Analysis of Time Series	Z,ZK	5
The course deals	with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange prices	s, employment) and	d industrial
	g of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a conve	-	
	yze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the mai		•
real-world example	s. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward transfe	er of students' know	vledge from
	the academic to the real world.		
NI-SEP	World Economy and Business	Z,ZK	4
	resented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students c		
	ness. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about dif	-	
	business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course	-	
	Network Security		
NI-SIB		Z,ZK	5
NI-SIM	Digital Circuit Simulation and Verification	Z,ZK	5
I ne aim of the cou	rse is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level	wodeling) levels a	ind with the
	properties of proper tools. The course covers recent verification methods, too.	7 71/	
NI-SWE	Semantic Web and Knowledge Graphs	Z,ZK	5
	earn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web tech	-	
	elling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge quality assurance.	graphs and their s	ystematic
NI-SYP	Parsing and Compilers	Z,ZK	5
	ipon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of va		
	of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.		applications
NI-SZ1	Knowledge Engineering Seminar Master I	Z	4
	you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research		-
			conferences
	learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin		conferences
NI-S72	learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet).	ne learning and Al o	
NI-SZ2 On this seminar	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II	ne learning and Al o	4
On this seminar	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research	ne learning and Al o Z arch labs around th	4 e world.
On this seminar	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II	ne learning and Al o Z arch labs around th	4 e world.
On this seminar	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resear learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin	ne learning and AI o Z arch labs around th ne learning and AI o	4 e world.
On this seminar Additionally, you wil NI-TES	I learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resear learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet).	Eventian and Al of Eventian and Al	4 e world. conferences 5
On this seminar Additionally, you wil NI-TES Today, humankin	I learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resear learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Systems Theory	Eventian and Al of a constraint of the second of the secon	4 e world. conferences 5 aging this
On this seminar Additionally, you wil NI-TES Today, humankin complexity and of e	I learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resear learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Systems Theory d has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However	Example 2 Constraints and Al of Constraints around the learning and Al of Constraints around the learning and Al of Constraints around the costs of man odels that describe	4 e world. conferences 5 aging this e only those
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On this seminar Additionally, you wil NI-TES Today, humankin complexity and of e aspects of the syste NI-TKA NI-TNN	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resear learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin and summer schools, as well as FIT's own Summer Research Program (VyLet). Systems Theory d has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However nsuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of m erms that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and alg the modeling and analysis of complex systems. Category Theory	The learning and Al of a constraint of	4 e world. conferences 5 aging this e only those he basis for 4 5
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On this seminar Additionally, you wil NI-TES Today, humankin complexity and of e aspects of the syste NI-TKA NI-TKN In this course, we s pertaining to artifici synaptic mappings	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet). Systems Theory d has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However nsuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of m erms that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and all the modeling and analysis of complex systems. Category Theory Theory of Neural Networks tudy neural networks from the point of view of the theory of function approximation and from the point of view of probability theory. At al neural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission, network training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transforma	The learning and Al of a constraint of of a constrai	4 e world. conferences 5 aging this e only those he basis for 4 5 sic concepts somatic and al topology,
On this seminar Additionally, you wil NI-TES Today, humankin complexity and of e aspects of the syste NI-TKA NI-TKN In this course, we s pertaining to artifici synaptic mappings and in connectior	Ilearn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet). Knowledge Engineering Seminar Master II you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machinand summer schools, as well as FIT's own Summer Research Program (VyLet). Systems Theory d has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However, nsuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of mems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and all the modeling and analysis of complex systems. Category Theory Theory of Neural Networks from the point of view of the theory of function approximation and from the point of view of signal transmission, at neural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission, signal transmission	The learning and Al of a constraint of the learning and A	4 e world. conferences 5 aging this e only those he basis for 4 5 sic concepts somatic and al topology, ion to the

employed for neural network training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within the topic approximation approach to neural networks, we first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Kolmogorov theorem, Vituškin theorem). Afterwards, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappings computed by neural networks being dense in important Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect to a finite measure, spaces of functions with continuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on expectation and training based on a random sample, and with probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see how it is possible to get an estimate of the conditional expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak law of large numbers and get acquainted with an analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the central limit theorem, get acquinted with its analogy for neural networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can be employed to search for the topology of the network. NI-TS1 Theoretical Seminar Master I Ζ 4 Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. NI-TS2 Theoretical Seminar Master II Ζ 4 Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. NI-TS3 7 Theoretical Seminar Master III Λ Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. Theoretical Seminar Master IV 7 4 NI-TS4 Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. NI-TSP Testing and Reliability Z,ZK 5 Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with built-in-self-test equipment. They will be able to compute, analyze, and control the reliability and availability of the designed circuits. NI-TSW ΚZ Software Product Development 4 The course is presented in Czech. NI-TVR Z.ZK Virtual Reality Technology 3 Students will be introduced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD, ...) and the possibilities of controlling virtual avatars (position tracking, hand tracking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of using virtual and augmented reality will be presented. NI-UMI Artificial intelligence Z.ZK 5 The course covers search and inference algorithms in major formal paradigms used in artificial intelligence such as logic theories, constraint programming and automated planning. The main principles and practical applications of discussed techniques will be illustrated. Virtualization and Cloud Computing NI-VCC Z.ZK 5 Students will gain knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and organizations. They will get acquainted with virtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficiently operate and optimize the performance parameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effective technology today for the management of complex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills in the use of modern integration and development tools (Continuous integration and development). NI-VGA Video Games Architecture Z.ZK 5 The course covers a wide range of topics, procedures and methodologies related to the development of computer games - from a technical point of view, but also from a design and philosophical point of view. In the lectures, students will be guided through the history of development, the structure of game engines, component and functional architecture typical of game development, physics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected technological topics in greater detail, including ways of implementing some game mechanics, in the form of practical demonstrations. NI-VMM 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. NI-VOL Elections Z,ZK 5 We will cover the basics of (committee) elections and, in general, opinion aggregation. NI-VPR **Research Project** Ζ 5 Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. NI-VSM Selected statistical Methods Z,ZK 7 The course leads the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with multivariate normal distribution, application of entropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with random processes with focus on Markov chains. The high point of the course is the Queuing theory and its application in networks. NI-VYC Computability Z,ZK 4 Classical theory of recursive functions and effective computability. NI-ZS10 Master internship abroad for 10 credits Ζ 10 Each student can once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line. NI-ZS20 Master internship abroad for 20 credits Ζ 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 years dead-line.		
NI-ZS30	Master internship abroad for 30 credits	Z	30
The course is prez	ented in chzech language. Each student can once within his / her master's degree have a foreign internship at a foreign university or	other foreign scier	ntific 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	le evidence of the	professional
content and extent of	of the internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KO	S. Every 10 credits	correspond
to 4 weeks of full-t	ime employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This ar	nount can be divid	ed into two
	subjects if the internship exceeds the academic year's dead-line.		
NIE-BLO	Blockchain	Z,ZK	5
Students will under	stand the foundations of blockchain technology, smart contract programming, and gain an overview of most notable blockchain platfor	ns. They will be abl	e to design,
code and deploy a	secure decentralized application, and assess whether integration of a blockchain is suitable for a given problem. The course places a	an increased emph	asis on the
relationship betwe	en blockchains and information security. It is concluded with a defense of a research or applied semester project, which prepares the	students for imple	menting or
	supervising implementation of blockchain-based solutions in both academia and business.		
NIE-PDL	Practical Deep Learning	KZ	5
This course is des	igned to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine lea	rning framework.	hroughout
the course, student	s will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields such a	as computer vision	and natural
	language processing.		
NIE-PML	Personalized Machine Learning	Z,ZK	5
Personalized mad	hine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristic	s and behaviors of	individual
entities. While PML	is commonly used in applications such as recommender systems, which recommend items to users based on their personal interest	s, its principles car	n be applied
to a wide range of o	ther fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theore	tical, algorithmic, a	ind practical
perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial communities.			
PI-SCN	Seminars on Digital Design	ZK	4
This subject deals	with problems of realization and implementation of digital circuits - both combinational and sequential. Basic means of description of	digital circuits and	basic logic
synthesis and optimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial problems emerging in EDA.			

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2025-07-17, time 05:50.