## Study plan

# Name of study plan: Master specialization Management Informatics, in Czech, 2020

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: 107 Elective courses credits: 13 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: Ing. Petra Pavlí ková, Ph.D., email: petra.pavlickova@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-KOP	Combinatorial Optimization Jan Schmidt, Petr Fišer Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	6	2P+2C	Z	PP
NI-DIP	Diploma Project Zden k Muziká Zden k Muziká (Gar.)	Z	30		L,Z	PP
NI-MPR	Master Project Zden k Muziká	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 (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-KOP	Combinatorial Optimization	Z,ZK	6
•	n knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not	only to select and	implement but
also to apply and eva	luate heuristics for practical problems.		
NI-DIP	Diploma Project	Z	30
NI-MPR	Master Project	Z	7
1. At the beginning o	the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partia	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 semes	ter. 2. External
Master these (MT) s	pervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for th	e courses BIE-BA	AP, MIE-MPR,
MIE-DIP). Students,	hen, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award th	e assessment to t	the IS based on
the confirmation of the	e external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the he	ad of the departm	nent responsible
for the topic of the M	F. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student fo	r the upcoming se	mester should
aim at fine-tuning the	FT topic so that the FTT will be complete and approvable at the end of the semester.		
NI-MPI	Mathematics for Informatics	Z,ZK	7
The course comprise	s topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate anal	ysis, smooth optin	nization and
multi-variate integrat	on. 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 s	ability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear	presentation and	argumentation.

NI-PDP	Parallel and Distributed Programming

Z,ZK

6

21st century in computer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores. Parallel computing systems are becoming a ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platforms. Students get acquainted with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication operations, and languages and environments for parallel programming of shared and distributed memory computers. They get 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: Povinné p edm ty specializace Minimal number of credits of the block: 33 The role of the block: PS

### Code of the group: NI-PS-MI.20

Name of the group: Compulsory Courses of Master Specialization Informatics Management, Version 2020, in Czech

Requirement credits in the group: In this group you have to gain 33 credits Requirement courses in the group: In this group you have to complete 7 courses Credits in the group: 33

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-AM1	Middleware Architectures 1 Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-MEP	Modelling of Enterprise Processes Robert Pergl, Marek Suchánek, Marek Skotnica Robert Pergl Robert Pergl (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-BUI	Business Informatics Petra Pavlí ková Petra Pavlí ková Petra Pavlí ková (Gar.)	Z,ZK	5	2P+2C	L	PS
NI-PIS	Enterprise Information Systems Martin Závrbský, Martin Mach, Vlastimil Jinoch, Martin Hasaj David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+1C	L	PS
NI-PAS	Advanced Aspects of Business David Buchtela, Zden k Ku era David Buchtela Zden k Ku era (Gar.)	Z,ZK	4	2P+1C	Z	PS
NI-DSS	Decision Support Systems Petra Pavlí ková, Robert Pergl, David Buchtela David Buchtela Robert Pergl (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-TSW	Software Product Development Petra Pavlí ková Ond ej Pluha Petra Pavlí ková (Gar.)	KZ	4	1P+2C	Z	PS

# Characteristics of the courses of this group of Study Plan: Code=NI-PS-MI.20 Name=Compulsory Courses of Master Specialization Informatics Management, Version 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 aplicati	on servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous co	mmunications and	d high availability
of applications.			
NI-MEP	Modelling of Enterprise Processes	Z,ZK	5
The subject is focused of	on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approac	h for (re)enginee	ring and
implementation of proce	sses, 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 o	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 manager	ment, and lifecycl	e management
of ICT services and res	purce management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governa	nce, the importar	nce of ICT for
business and the contex	tt of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme	nt, 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 c	f big data (BigDa	ta) and their use
in BI (Business Intellige	nce). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication	ons sectors will be	e explained on
real examples. Furtherm	ore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the	business strategy	of the company.
Students will be acquair	ted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and opera	ation of informatio	n 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 th	neir own business	or business
management, especially	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 ab	out the principles
of conceptually and onte	plogically 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	i n Czech.		

Name of the block: Compulsory elective courses Minimal number of credits of the block: 11 The role of the block: PV

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

Name of the group: Compulsory Elective Courses for Master Specialization Management Informatics, version 2021

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

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

#### Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-AM2	Middleware Architectures 2 Jaroslav Kucha , Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	L	PV
NI-NUR	User Interface Design Josef Pavlí ek Josef Pavlí ek Josef Pavlí ek (Gar.)	Z,ZK	5	2P+1C	Z	PV
NI-NSS	Normalized Software Systems Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Robert Pergl (Gar.)	ZK	5	2P	L	PV
NI-PDB	Advanced Database Systems Michal Valenta, Yelena Trofimova Michal Valenta Michal Valenta (Gar.)	Z,ZK	5	2P+1C	Z	PV

# Characteristics of the courses of this group of Study Plan: Code=NI-PV-MI.20 Name=Compulsory Elective Courses for Master Specialization Management Informatics, version 2021

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 architec	ctures, concepts a	and technologies
for microservices, distru	buted cache and databases, smart contracts, realtime communication and web security.		
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	rmal user models,	, the fundamental
notions and procesures	. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able	to design advance	ced Uls.
NI-NSS	Normalized Software Systems	ZK	5
Students will learn the f	oundations of normalized systems theory that studies the evolvability of modular structures based on concepts from enginee	, ring, such as stat	bility from system
theory and entropy from	n thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related is	ssues occur in an	y given software
architecture. In the seco	and 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 informati	on systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stab	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 themse	ves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of datab	base machines (se	o called NoSQL
databases), with the rel	ated new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CV	(PHER, Gremlin)	. The last part of
the course deals with p	erformance evaluation of database machines.		

### Code of the group: NI-PV-KMK.20

Name of the group: Compulsory Elective Courses for Master Specialization Communication and management competencies

Requirement credits in the group: In this group you have to gain at least 6 credits

Requirement courses in the group: In this group you have to complete at least 2 courses Credits in the group: 6

Note on the group:

#### Pro specializace NI-MI.2020 a NI-SI.2020

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-CAP	Cultural and Social Anthropology Alena Libánská, Tomáš Houdek, Jakub Šenovský <b>Jakub Šenovský</b> Alena Libánská (Gar.)	ZK	2	2P	Z	PV
NI-HPZ	Master humanities from a study abroad Zden k Muziká	Z	2	0+0	Z,L	PV

NI-EMZ	Master Management economics course from a study abroad Zden k Muziká	Z	4	0+0	Z,L	PV
NI-MPX	Management practice David Buchtela David Buchtela (Gar.)	Z	4	5XD	Z,L	PV
NI-MPL	Managerial Psychology Jan Fiala Jan Fiala Jan Fiala (Gar.)	ZK	2	2P	Z,L	PV
NI-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+1C	Z,L	PV
NI-LNG	Introduction to Linguistics for IT Students Václav Cvr ek Václav Čvr ek Václav Cvr ek (Gar.)	ZK	2	2P	L	PV
NI-VEM	Scientific thinking Petr Klán, Tomáš Houdek, Helena Štorchová Petr Klán Petr Klán (Gar.)	KZ	2	1P+1C	L	PV
Specialization C	of the courses of this group of Study Plan: Code=NI-PV-KMK.20 Nam Communication and management competencies	e=Compuls	sory Ele		,	
anthropological resea	Cultural and Social Anthropology burse aims to acquaint students with the basics of social and cultural anthropology as a scientif arch from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization s presented in Czech.		0	e diversity of t		
NI-HPZ	Master humanities from a study abroad				7	2
—	anities that has been studied abroad" is covered by the Humanities from a study abroad in Con	npulsory Humai	nities Modu			_
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## Name of the block: Elective courses Minimal number of credits of the block: 0 The role of the block: V

Code of the grou	p: NI-V.2021					
Name of the grou	p: Purely Elective Master Courses, Version 2021					
Requirement cree	dits in the group:					
Requirement cou	rses in the group:					
Credits in the gro	up: 0					
Note on the grou	p: In addition to the courses listed here, you can enroll a your study program and form of study that you did no program/branch/specialization or a compulsory election has completed in the bachelor study at CTU cannot have a complete study at CTU	ot enroll as a ive course.C	compuls ourses c	sory sub	ject in the	
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-ATH		1				
	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.)	KZ	5	2P+1C	L	v
NI-APH	Architecture of computer games Adam Vesecký Adam Vesecký Adam Vesecký (Gar.)	Z,ZK	4	2P+1C	Z	V
BI-APS.21	Architectures of Computer Systems Pavel Tvrdík, Michal Štepanovský Michal Štepanovský Pavel Tvrdík (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-BPS	Wireless Computer Networks Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	4	2P+1C	L	V
BI-BEK.21	Secure Code Josef Kokeš, Viktor Fischer Róbert Lórencz Josef Kokeš (Gar.)	Z,ZK	5	2P+2C	L	V
BI-BLE	Blender Lukáš Ba inka Lukáš Ba inka Lukáš Ba inka (Gar.)	Z,ZK	4	2P+2C	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
NI-CTF	Capture The Flag Ji ( Dostál	KZ	4	3C	Z	V
NI-DPH	Game Design Adam Vesecký Adam Vesecký Adam Vesecký (Gar.)	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 David Pešek (Gar.)	KZ	4	1P+2C		V
NI-DID	Digital drawing Denisa S vová, Eliška Novotná Denisa S vová Denisa S vová (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	KZ	4	3C	L	V
NI-PAM	Efficient Preprocessing and Parameterized Algorithms Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	4	2P+1C	L	V
BI-EHA.21	Ethical Hacking Ji í Dostál, Tomáš Kiezler, Martin Kolárik, Martin Šutovský <b>Ji í Dostál</b> Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	L	V
NI-ESC	Experimental Project Course Jan Matoušek, Ond ej Brém, Jitka Aslan <b>Ond ej Brém</b> Ond ej Brém (Gar.)	KZ	8	0P+30R+52C	L	V
BI-FMU	Financial and Management Accounting David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+2C	Z	v
BI-FTR.1	Financial Markets Pavla Vozárová	Z,ZK	5	2P+2C	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 Jan Jane ek Jan Jane ek (Gar.)	Z,ZK	4	2P+1C	L	V
BI-JPO.21	Computer Units Pavel Kubalík Pavel Kubalík (Gar.)	Z,ZK	5	2P+2C	Z	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 J	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
			<u> </u>			L

NI-MPL	<b>Managerial Psychology</b> Jan Fiala <b>Jan Fiala</b> Jan Fiala (Gar.)	ZK	2	2P	Z,L	V
NI-MSI	Mathematical Structures in Computer Science Jan Starý Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+1C	L	V
NI-MZI	Mathematics for data science Št pán Starosta	Z,ZK	4	2P+1C	L	V
BI-MPP.21	Methods of interfacing peripheral devices Miroslav Skrbek Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-MOP	Modern Object-Oriented Programming in Pharo Marek Skotnica, Jan Blizni enko Robert Pergl Robert Pergl (Gar.)	KZ	4	3C	Z	V
NI-NMU	New media in art and design Zden k Svejkovský 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 Alves (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-ARI	Computer arithmetic Pavel Kubalík Pavel Kubalík Pavel Kubalík (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-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 (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 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 Nikolas Jiša Nikolas Jiša Nikolas Jiša (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 Martin Barus, Yauhen Babakhin Karel Klouda Martin Barus (Gar.)	KZ	5	2P+1C	Z	V
BI-PJP.21	Programming Languages and Compilers Jan Janoušek, Št pán Plachý, Tomáš Pecka Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	L	v
NI-PSL	Programming in Scala Jií Dan ek <b>Jií Dan ek</b> Jií Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	V
BI-PMA	Programming in Mathematica Zden k Buk Zden k Buk Zden k Buk (Gar.)	Z,ZK	4	2P+2C	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 Michal Haindl (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SCE1	Computer Engineering Seminar Master I Hana Kubátová Miroslav Skrbek Hana Kubátová (Gar.)	Z	4	2C	L,Z	V
NI-SCE2	Computer Engineering Seminar Master II Hana Kubátová Hana Kubátová Hana Kubátová (Gar.)	Z	4	2C	L,Z	V
NI-SZ1	Knowledge Engineering Seminar Master I Pavel Kordík Magda Friedjungová (Gar.)	Z	4	2C	L,Z	V
NI-SZ2	Knowledge Engineering Seminar Master II Pavel Kordík Magda Friedjungová (Gar.)	Z	4	2C	L,Z	V
PI-SCN	Seminars on Digital Design Petr Fišer <b>Petr Fišer</b> Petr Fišer (Gar.)	ZK	4	2P+1C	Z,L	V
BI-SOJ	Machine Oriented Languages	Z,ZK	4	2P+2C	L	V
NI-MLP	Machine Learning in Practice Jan Hu in Daniel Vašata Jan Hu in (Gar.)	Z,ZK	5	2P+1C	Z	V
BI-SVZ.21	Machine vision and image processing Lukáš Brchl, Marcel Ji ina, Jakub Novák Jakub Novák Marcel Ji ina (Gar.)	Z,ZK	5	2P+2C	L,Z	V
NI-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+1C	Z,L	V
BI-SRC.21	Real-time systems Hana Kubátová Jaroslav Borecký Hana Kubátová (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-TVR	Virtual Reality Technology 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 Guth, Ond ej Suchý, 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	<b>Category Theory</b> Jan Starý <b>Jan Starý</b> Jan Starý (Gar.)	Z,ZK	4	2P+1C	L	V
NI-TNN	Theory of Neural Networks 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
BI-CCN	Compiler Construction Christoph Kirsch Christoph Kirsch (Gar.)	Z,ZK	5	3P	L	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
BI-VHS.21	Virtual game worlds Radek Richtr Radek Richtr Radek Richtr (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-VOL	Elections Dušan Knop <b>Dušan Knop</b> Dušan Knop (Gar.)	Z,ZK	5	2P+1C	L	V
BI-VMM	Selected Mathematical Methods Tomáš Kalvoda Tomáš Kalvoda Tomáš Kalvoda (Gar.)	Z,ZK	4	2P+2C	L	V
NI-VYC	<b>Computability</b> Jan Starý <b>Jan Starý</b> Jan Starý (Gar.)	Z,ZK	4	2P+2C	L	V
NI-VPR	Research Project Št pán Starosta <b>Št pán Starosta</b> 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=Purely Elective Master Courses, Version 2021

NI-SEP         World Economy and Business         Z,ZK         4           This course is presented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students of technical university to the	
international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures,	
necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision	on.
Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.	
NI-ATH AlgorithmicTheories of Games Z,ZK 4	
Traditional game theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studies the behaviour of agents	
(players) of a certain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game theory is to find the equilibria	
which are the states of the game where no player wants to deviate from his strategy. Due to the recent development of computers, internet, social networks, online auctions, advertisi	ng,
multiagent systems and other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of efficient computation of various	ıs
solution concepts. In this course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods of their computation.	
BI-AG2.21 Algorithms and Graphs 2 Z,ZK 5	
This course, presented in Czech, introduces basic algorithms and concepts of graph theory as a follow=up on the introduction given in the compulsory course BI-AG1.21. It further	
delves into advances data structures and amortized complexity analysis. It also includes a very light introduction to approximation algorithms. For English version of the course see	:
BIE-AG2.21.	
NI-AFP Applied Functional Programming KZ 5	
This course is presented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional programming languages are	on
the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, mastering this paradigm becomes	3
necessary competence of a software engineer: the theory and especially the practice.	
NI-APH Architecture of computer games Z,ZK 4	
Students will gain a basic understanding of the various issues in the field of computer games development, especially from a technical point of view, but also from design and philosoph	cal
perspective. They will get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base components that form an integration of the second seco	jral
part of most games. They will also understand the basics of pathfinding, networking and scripting and apply them in practical exercises (labs). An important part of the course is an	
implementation of a simple game, with a strong focus on nontrivial game mechanics.	
BI-APS.21 Architectures of Computer Systems Z,ZK 5	
Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the	
pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction process	ing
not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the	
program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such as the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such as the principle state of the	ıch
systems.	
NI-BPS Wireless Computer Networks Z,ZK 4	
Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad-hoc networks, multicast and	
broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowledge of security mechanisms	;
for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools.	
BI-BEK.21 Secure Code Z,ZK 5	
The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat mode	ing
theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with	
administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of	
security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them.	

		·	
BI-BLE	Blender	Z,ZK	4
The course extends kn	owledge of opensource program Blender from BI-MGA (Multimedia and Graphics Applications) course. It is intended for those	e interested in 3D	graphics and
animation. It offers a co	mplete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graphi	cs applications) co	ourse.
NIE-BLO	Blockchain	Z,ZK	5
Students will understar	d the foundations of blockchain technology, smart contract programming, and gain an overview of most notable blockchain pla	tforms. They will b	e able to design,
	ure decentralized application, and assess whether integration of a blockchain is suitable for a given problem. The course plac	-	-
relationship between b	ockchains and information security. It is concluded with a defense of a research or applied semester project, which prepares	the students for ir	nplementing or
	ation of blockchain-based solutions in both academia and business.		
NI-CTF	Capture The Flag	KZ	4
	to introduce students to CTF competitions and let them gain practical experience in the field of cyber security.		
NI-DPH	Game Design	Z,ZK	5
	ts the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on gar	1 '	-
	owledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanic	-	
	e students will get an overview of game development from the designer's perspective, from theoretical concepts to practical in		<b>e</b> . <b>e</b>
projects.		plementation app	lieu to serriestrai
	Design Sprint	7	2
NI-DSW	Design Sprint		2
	rojects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to va		
	s will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting v	vith research and	finishing with
	plus final presentation).		
NI-PSD	Public Services Design	KZ	4
	ce students to specifics of UX, Service design and development for public sector. We will look into the design and developme	-	
	signesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaborati	on with client repr	resentatives.
Course is aimed at stu	dents-designers as well as clients.		
NI-DID	Digital drawing	Z	2
The course will introdu	ce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, p	erspective and co	lor theory, which
they will practically app	ly in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The cou	rse is fit for anyon	e who wants to
practice or learn drawing	ng and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice ga	ined knowledge.	
NI-DZO	Digital Image Processing	Z,ZK	4
This course presents a	comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical	algorithms that ar	e both easy to
implement and have an	interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that i	s also valuable ou	tside the domain
of digital image proces	sing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDI	२ compression, de	e-blurring in
frequency domain, abs	traction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray of	conversion, contex	kt enhancement,
interactive as-rigid-as-r	possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, a	dding depth, alph	a matting.
NI-DDM	Distributed Data Mining	KZ	4
	e-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain han		with large scale
	work Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementation	-	-
	ze other algorithms. The course is prezented in czech language.		
NI-PAM	Efficient Preprocessing and Parameterized Algorithms	Z,ZK	4
	zation problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often nece		-
	will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often	-	-
	ts from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exp		
	input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomia		
	the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solut		•
	red algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (		
· ·	e relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes.		
BI-EHA.21	Ethical Hacking	Z,ZK	5
	is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vu		1
-	r networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus		-
	nd the following process of penetration test documentation.	is on hands-on e	spenence with
-		V7	0
NI-ESC	Experimental Project Course	KZ	8
	urse offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principle	-	
	/-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design		
-	tegrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their sk	lins in user-centere	ed design and
	tion, as well as gain experience working in a team to design and prototype a functional solution."		
BI-FMU	Financial and Management Accounting	Z,ZK	5
	s explanation of basic terms in the theory of accounting, the principles of balancing the property amounts and liabilities in the		
	and accounting statements including opening and closing of bookkeeping. The course provides students with a legal modific		
	s based on current methods of double-entry bookkeeping for enterprising subjects in the Czech Republic. Principles of manage	jement accountino	g are base of
-	oduls in Business information systems.	<del> </del>	
BI-FTR.1	Financial Markets	Z,ZK	5
This course is presente	ed in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).		
NI-GLR	Games and reinforcement learning	Z,ZK	4
The field of reinforceme	ent learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intellig	jence. This course	e is intended to
give you both theoretic	al and practical background so you can participate in related research activities. Presented in English.		
NI-GNN	Graph Neural Networks	Z,ZK	4
	students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural r		1
	es, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last		-
	nterpretability of graph neural networks. In the exercises, students will try out selected techniques and problems.	-	
NI-GRI	Grid Computing	Z,ZK	5
	in knowledge about the world-wide network and computing infrastructure		

NI-HCM	Mind Hacking	ZK	5
	emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, e security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive sec		
	on warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Inter	, , ,	•
impacts such as disrup	tion of social cohesion, threats to democracy or war.		
NI-HSC	Side-Channel Analysis in Hardware	Z,ZK	4
	d to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical atta	-	
	nannels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks ar practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel inform	-	i nigher-order
NI-HMI2	History of Mathematics and Informatics	ZK	3
	ed in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithr		ns, recursive
	s, etc.) note on possibilities of applications of some mathematical methods in informatics and its development.		
NI-IBE	Information Security	ZK	2
	tion and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and internat r management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., pen		i this area. They
NI-IVS	Intelligent embedded systems	KZ	4
	stems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The	he course is an ac	dvance version
-	ded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot program	-	
	provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, studer of various courses like nature inspired algorithms, data mining algorithms, image recognition and web technologies	nts develop advan	ced applications
NI-IKM	Internet and Classification Methods	Z,ZK	4
	ents get acquainted with classification methods used in four important internet, or generally network applications: in spam filte		-
in malware detection s	stems and in intrusion detection systems. However, they will learn more than only how classification is performed when solvi	ng these four kind	ls of problems.
e e	hese applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycl		ures and 2-hour
<u>_</u>	xercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult thei Internet and Multimedia		4
NI-IAM	principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes a	Z,ZK	4 gnals (input)
	als (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practic	-	
audiovisual transmission	ons. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the	effect of various c	omponents on
	of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording	g the scene up to	the presentation
for audience.	Internet of Things	Z,ZK	4
-	on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is fa		-
-	(Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth).		
BI-JPO.21	Computer Units	Z,ZK	5
Students deepen their	basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detai	il with the internal	structure and
argonization of comput	ar units and processors and their interactions with the any ironment, including appelarating withmatic large units and uning any		
	er units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using app ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclu	propriate codes for	rimplementation
of multiplication. The or	er units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using app ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclu nd serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of cor	propriate codes for iding codes for err	r implementation or detection and
of multiplication. The or correction for parallel a the environment and th	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclu nd serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of cor e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro	propriate codes for Iding codes for err mmunication of th	r implementation or detection and e processor with
of multiplication. The or correction for parallel a the environment and th and programmable har	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclu nd serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of cor e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).	propriate codes for Iding codes for err mmunication of th oprogrammed pro	r implementation for detection and e processor with cessor simulator
of multiplication. The or correction for parallel a the environment and th and programmable har NI-KTH	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclue nd serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of con- e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).	propriate codes for iding codes for err mmunication of th oprogrammed pro	r implementation for detection and e processor with cessor simulator 4
of multiplication. The or correction for parallel a the environment and th and programmable har NI-KTH Traditional game theor	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, inclu nd serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of cor e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).	propriate codes for iding codes for err mmunication of th oprogrammed pro Z,ZK udies the behavio	r implementation for detection and e processor with cessor simulator 4 ur of agents
of multiplication. The or correction for parallel a the environment and th and programmable har <b>NI-KTH</b> Traditional game theor (players) of a certain or which are the states of	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, incluind serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of content e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).          Combinatorial Theories of Games       Vis a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory strompetitive process by designing a mathematical model and investigating the strategies. The traditional task of classical game the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player science.	propriate codes for ading codes for err mmunication of th oprogrammed pro Z,ZK udies the behavio e theory is to find layer full-informati	r implementation for detection and e processor with cessor simulator 4 ur of agents the equilibria, on combinatorial
of multiplication. The or correction for parallel a the environment and th and programmable har <b>NI-KTH</b> Traditional game theor (players) of a certain c which are the states of games, was by Conwa	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, incluind serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of content e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).          Combinatorial Theories of Games         v is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory strompetitive process by designing a mathematical model and investigating the strategies. The traditional task of classical game the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-ply, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea	propriate codes for iding codes for err mmunication of th oprogrammed pro Z,ZK udies the behavio e theory is to find layer full-informati i is to evaluate ga	r implementation for detection and e processor with cessor simulator 4 ur of agents the equilibria, on combinatorial mes such that
of multiplication. The or correction for parallel a the environment and th and programmable har <b>NI-KTH</b> Traditional game theory (players) of a certain c which are the states of games, was by Conwa otherwise incompatible	ganization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, incluind serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of corre e architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micro dware design kits (FPGA).          Combinatorial Theories of Games         v is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory strompetitive process by designing a mathematical model and investigating the strategies. The traditional task of classical game the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-ply, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The traditional tages. The traditional tages.	propriate codes for uding codes for err mmunication of th oprogrammed pro Z,ZK udies the behavio e theory is to find layer full-informati i is to evaluate ga hird most importa	r implementation for detection and e processor with cessor simulator 4 ur of agents the equilibria, on combinatorial mes such that nt step is the
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NI-MSI Mat	thematical Structures in Computer Science	Z,ZK	4
	ogramming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scot	tt model of lambda	a calculus.
Introduction to category theor		7 71/	
	thematics for data science itroduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used i	Z,ZK	4
	(matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin		-
selected notions from probabi		olpio, gradioni ini	
BI-MPP.21 Met	hods of interfacing peripheral devices	Z,ZK	5
	hods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Univ	,	SB). The course
	ripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of U	JSB devices, Linu	x and Windows
	velopment, and APIs of selected devices.		
	dern Object-Oriented Programming in Pharo	KZ	4
, , , , ,	is currently one of the most widespread paradigms of software creation, especially enterprise information systems, whe ern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the s		
	pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development	-	-
	programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to wo		
_	estral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involved	vement in the Pha	ro Consortium.
1	v media in art and design	ZK	3
	nts to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game a		-
art projects.	e largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especia	ally in lectures dev	oted to specific
	ux Drivers	Z,ZK	4
	s an important operating system for personal computer and also for embedded systems. Systems on chip and combining		•
	pheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development		
course provides knowledge of	f Linux operating system architecture, principles of development of various types drivers, including practical experience	L_	
NIE-PML Pers	sonalized Machine Learning	Z,ZK	5
	g (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteris		
	nly used in applications such as recommender systems, which recommend items to users based on their personal inte		
-	including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from the will focus on cutting-edge models that are of interest to both the research and commercial communities.	eoretical, algorithr	nic, and practical
	nputer arithmetic	Z,ZK	4
	ta representations used in digital devices and will be able to design arithmetic operations implementation units.	<u>_,_</u>	·
	nputer Grafics 1	ZK	4
	courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge	. The course is de	signed for those
	uter graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of t		-
	implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas and		
1 1	erprise Data Warehouse Systems uses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods	Z,ZK	5 tiaal kaawladaa
	uses and various architectures, but also their deployment and maintenance. This course also includes an introduction to		-
visualization.			and data
NI-PVR Adv	vanced Virtual Reality	KZ	4
1 1	ced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D mo	odels in Blender, a	and among other
<b>U</b> ,	o their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will a		0 11
	ly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply the	e knowledge gain	ed in this subject
in virtual reality, or directly cre NI-AML Adv		7 71/	5
	/anced machine learning Its to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of	Z,ZK	-
	connection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with the		
	anced techniques in iOS applications	KZ	4
	rends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all th	e basics from the	beginners class
BI-IOS.			
	vanced Program Testing	Z,ZK	5
	I to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The	goal of the course	e is to present
	chniques, beyond writing unit tests, especially fuzzing and symbolic execution.	7 71/	4
	ranced embedded systems M processors and microcontrollers and their usage in wide range of applications. The course includes a series of advar	Z,ZK	-
	evices, motor control, system control and industrial communication. The students obtain both theoretical and also practi		
systems.		·	
NI-DNP Adv	vanced .NET	Z,ZK	4
	view of platform .NET and will gain knowledge about technologies ASP.NET, Entity Framework, WPF, .NET MAUI and a	-	
	ill get practical experience in semestral work where they will create a client-server application utilizing technologies ASI	P.NET, Entity Fran	nework and
<u> </u>	and also Azure DevOps and GIT.	1/7	4
	<i>r</i> anced Python earn various advanced techniques and methods in Python. The course indirectly continues where Programming in Pyth	KZ	4 If The course is
-	tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursew		
teachers from Red Hat.			,
NIE-PDL Pra	ctical Deep Learning	KZ	5
This course is designed to pro	ovide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine	-	-
	lop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields su	ch as computer v	ision and natural
language processing.			

BI-PJP.21 Programming Languages and Compilers	Z,ZK	5
Students learn basic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers	GNU and LLVM. T	hey learn to
create a specification of a translation of a text that conforms a given syntax, to a target code and also to create a compiler based on the specification	n. The compiler ca	an translate not
only a programming language but any text in a language generated by a given LL input grammar.		
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 fea		•
advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks	and libraries e.g.	Play, Cassandra,
Scalaz, etc.		
BI-PMA Programming in Mathematica	Z,ZK	4
Students will be working with modern technical and scientific software. Students will learn how to use different programming styles (functional programming styles)	amming, rule-base	ed programming,
etc.), how to create dynamic interactive applications and visualisations, data processing and presentations.		
NI-RUB Programming in Ruby	KZ	4
This course is presented in Czech.		
NI-ROZ Pattern Recognition	Z,ZK	5
The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the		
recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, a	nd their numerical	
NI-SCE1 Computer Engineering Seminar Master I	Z	4
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistant		
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of	•	
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 tea	chers. The topics	are new for each
semester.		-
NI-SCE2 Computer Engineering Seminar Master II	Z	4
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistant		
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of	-	
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 tea	chers. The topics	are new for each
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 cooked in top rese		
Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma	chine learning an	d AI conferences
and summer schools, as well as FIT's own Summer Research Program (VyLet).		1
NI-SZ2 Knowledge Engineering Seminar Master II	Z	4
On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top rese		
Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma	chine learning an	d AI conferences
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 means of description	•	0
synthesis and optimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial		-
BI-SOJ Machine Oriented Languages	Z,ZK	4
Students of the course will gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal		
and efficient cooperation of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of vie	w linked to higher	level languages.
This knowledge will be used during reverse engineering, optimization, and evaluation of code security.		
NI-MLP Machine Learning in Practice	Z,ZK	5
Applying machine learning methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client to	, ideally, technical	implementation.
The course guides students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practice	-	-
data processing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear and un	derstandable repo	ort.
BI-SVZ.21 Machine vision and image processing	Z,ZK	5
Camera systems are becoming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluat	-	
introduces students to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical	use of camera sy	stems for solving
problems of practice that the graduates may encounter.		
BI-SRC.21 Real-time systems	Z,ZK	5
Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issu	es. Theoretical kn	owledge from
lectures will be experimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab	are the same as	in the BIE-VES
course.		
NI-TVR Virtual Reality Technology	Z,ZK	3
Students will be introduced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD,) and the possibilities of c	-	
tracking, hand tracking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of	of using virtual an	d augmented
reality will be presented.		
NI-TS1 Theoretical Seminar Master I	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla		-
are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course i	s a work with scie	ntific papers and
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.		
NI-TS2 Theoretical Seminar Master II	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla	ssical reading gro	-
are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course i		ntific papers and
other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	s a work with scie	
NI-TS3 Theoretical Seminar Master III		
	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla	Z Ssical reading gro	4 up. The students
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	Z Ssical reading gro	4 up. The students
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clar are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	Z ssical reading gro s a work with scie	4 up. The students ntific papers and
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course i other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.NI-TS4Theoretical Seminar Master IV	Z ssical reading gro s a work with scie	4 up. The students ntific papers and 4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarare treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.         NI-TS4       Theoretical Seminar Master IV         Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarate is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarate is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarate is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarate is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clarate is intended for students which want to come in deeper contact with contemporary theoretical computer science.	Z ssical reading gro s a work with scie Z ssical reading gro	4 up. The students ntific papers and 4 up. The students
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course i other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.NI-TS4Theoretical Seminar Master IV	Z ssical reading gro s a work with scie Z ssical reading gro	4 up. The students ntific papers and 4 up. The students

NI-TKA	Category Theory	Z,ZK	4
NI-TNN	Theory of Neural Networks	Z,ZK	5
In this course, we study	neural networks from the point of view of the theory of function approximation and from the point of view of probability theory	. At first, we recal	I basic concepts
	ural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission	-	
	vork training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transfor		
	omatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with tra		
	and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most		
	vork training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within		
	irst notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Ko	•	-
	e will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappi		
0 1	t Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect		, I
	s derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on exp		•
• •	h probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see ho		0
	tancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak la	-	-
	ogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the cent		
topology of the network.	al networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can be	e employed to sea	arch for the
NI-CPX	Complexity Theory	Z,ZK	5
Students will learn abou	t the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th	e theory concern	ing practical
(in)tractability of difficult	problems.		
BI-CCN	Compiler Construction	Z,ZK	5
This is an introductory c	lass on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles	of compilers for	students to
understand the design a	nd implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme	of the class.	
NI-DVG	Introduction to Discrete and Computational Geometry	Z,ZK	5
The course intends to in	troduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar $v$		amental notions
	be able to solve simple algorithmic problems with a geometric component.		
BI-VHS.21	Virtual game worlds	Z,ZK	5
	arn methods to create a complex virtual world. It is a follow-up course of basic courses of the PG specialization (BIE-MGA, BI		gain knowledge
	sign, of principles of writing dialogues and characters in order to create a functional virtual world. Within the labs they get practi		
work on the semester pr			
NI-VOL	Elections	Z,ZK	5
-	of (committee) elections and, in general, opinion aggregation.	_,(	Ũ
BI-VMM	Selected Mathematical Methods	Z,ZK	4
	netric properties of linear spaces with inner product. Next, we introduce and analyze the discrete Fourier transform (DFT) and		-
	erential calculus of functions involving multiple variables. We present methods for the localization of extreme values of function		
	Ind quadratic forms. In addition, we introduce the least square method. The last part of the course is devoted to optimization ar		
	l is analyzed in more detail.	,	p gg
NI-VYC	Computability	Z,ZK	4
	rsive functions and effective computability.	2,21	7
NI-VPR		Z	5
	Research Project distance of the details are at https://courses.fit.cvut.cz/NI-VPR/en.	Z	5
		7	10
	Master internship abroad for 10 credits	Z	10
	within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research inst		
	ce-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		
, i i i i i i i i i i i i i i i i i i i	maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects	s if the internship	exceeds the
academic year's dead-li			
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		
	ce-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		
	maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects	s if the internship	exceeds the
academic year's dead-li			
NI-ZS30	Master internship abroad for 30 credits	Z	30
The course is prezented	l in chzech language. Each student can once within his / her master's degree have a foreign internship at a foreign university	or other foreign s	cientific and/or
	re the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must pro-		
	internship. Auxiliary courses MI-ZS10, MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS	-	-
	mployment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This	amount can be d	ivided into two
subjects if the internship	exceeds the academic year's dead-line.		
Code of the ar	oup: NI-MI-VS.20		
	roup: Floative Vesstianal Courses for Mester Specialization Management	المراجع والمراجع	-

Name of the group: NI-MI-VS.20 Name of the group: Elective Vocational Courses for Master Specialization Management Informatics 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-AIB	Algorithms of Information Security Martin Jure ek, Róbert Lórencz, Olha Jure ková Róbert Lórencz Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-ADP	Architecture and Design patterns Filip K ikava, Jan Zimolka, Ji í Borský, Tomáš Chvosta Filip K ikava Filip K ikava (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-BML	Bayesian Methods for Machine Learning Kamil Dedecius, Ond ej Tichý Ond ej Tichý Kamil Dedecius (Gar.)	КZ	5	2P+1C	L	V
NI-BVS	Embedded Security Martin Novotný Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	L	V
NI-BKO	Error Control Codes Pavel Kubalík, Alois Pluhá ek Alois Pluhá ek Alois Pluhá ek (Gar.)	Z,ZK	5	2P+1C	L	V
NI-DSV	Distributed Systems and Computing           Pavel Tvrdík Jan Fesl Pavel Tvrdík (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-DDW	Web Data Mining Jaroslav Kucha, Milan Doj inovski Jaroslav Kucha Jaroslav Kucha (Gar.)	Z,ZK	5	2P+1C	L	V
NI-EPC	Effective C++ programming	Z,ZK	5	2P+1C	Z	V
NI-EVY	Daniel Langr Daniel Langr Daniel Langr (Gar.) Efficient Text Pattern Matching	Z,ZK	5	2P+1C	Z	V
NI-FME	Jan Holub Jan Holub Jan Holub (Gar.) Formal Methods and Specifications	Z,ZK	5	2P+1C	L	V
NI-GEN	Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)           Code Generators	Z,ZK	5	2P+1C	z	V
NI-GAK	Petr Máj, Jan Janoušek <b>Petr Máj</b> Jan Janoušek (Gar.) Graph theory and combinatorics	Z,ZK	5	2P+2C	L	V
NI-HWB	Tomáš Valla <b>Tomáš Valla</b> Tomáš Valla (Gar.) Hardware Security	Z,ZK	5	2P+2C	L	V
NI-KOD	Ji í Bu ek, Róbert Lórencz <b>Ji í Bu ek</b> Ji í Bu ek (Gar.) Data Compression	Z,ZK	5	2P+1C	L	V
NI-MKY	Jan Holub Jan Holub Jan Holub (Gar.) Mathematics for Cryptology	Z,ZK	5	3P+1C	L	V
NI-MVI	Martin Jure ek, Róbert Lórencz Róbert Lórencz (Gar.)           Computational Intelligence Methods	Z,ZK	5	2P+1C	Z	V
NI-MPJ	Pavel Kordík Pavel Kordík Pavel Kordík (Gar.) Modelling of Programming Languages	Z,ZK	5	2P+1C	Z	V
NI-MTI	Modern Internet Technologies Viktor erný, Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	5	2P+1C	z	V
NI-NUR	User Interface Design Josef Pavlí ek Josef Pavlí ek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-NON	Josef Pavil ek Josef Pavil ek (Gal.)           Nonlinear Continuous Optimization and Numerical Methods           Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-NSS	Normalized Software Systems	ZK	5	2P	L	V
NI-OSY	Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Robert Pergl (Gar.) Operating Systems and Systems Programming Date Zamának, Tamáš Martinas, Potr. Zamának, Date Zamának (Car.)	Z,ZK	5	2P+1C	Z	V
NI-KRY	Petr Zemánek, Tomáš Martinec <b>Petr Zemánek</b> Petr Zemánek (Gar.) Advanced Cryptology Ji í Bu ek, Róbert Lórencz, Simona Forn sek <b>Ji í Bu ek</b> Róbert Lórencz (Gar.)	Z,ZK	5	2P+2C	z	V
NI-PDB	Advanced Database Systems	Z,ZK	5	2P+1C	Z	V
NI-GPU	Michal Valenta, Yelena Trofimova Michal Valenta Michal Valenta (Gar.) GPU Architectures and Programming Ivan Šima ak Ivan Šima ak Ivan Šima ak (Gar.)	Z,ZK	5	2P+1C	L	V
NI-PDD	Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.) Data Preprocessing Marcel, Ii ina, Marcel, Ii ina, (Car.)	Z,ZK	5	2P+1C	Z	V
NI-REV	Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.) Reverse Engineering	Z,ZK	5	1P+2C	Z	V
NI-RUN	Ji í Dostál, Josef Kokeš, Róbert Lórencz <b>Ji í Dostál</b> Ji í Dostál (Gar.) Runtime Systems Filip K ikora Michael Vlacák <b>Filip K ikora</b> Michael Vlacák (Car.)	Z,ZK	5	2P+1C	L	V
NI-SWE	Filip K ikava, Michal Vlasák Filip K ikava Michal Vlasák (Gar.) Semantic Web and Knowledge Graphs Mian Dai inauglii (Jask Mian Dai inauglii (Jask	Z,ZK	5	2P+1C	Z	V
NI-SIM	Milan Doj inovski, Jakub Klímek Milan Doj inovski Milan Doj inovski (Gar.) Digital Circuit Simulation and Verification	Z,ZK	5	2P+1C	L	V
NI-SIB	Martin Kohlík Martin Kohlík Martin Kohlík (Gar.) Network Security Ji í Dostál, Simona Forn sek, Martin Šutovský Simona Forn sek Ji í Dostál (Gar.)		5	2P+1C	L	V

NI-SCR	Statistical Analysis of Time Series Kamil Dedecius Kamil Dedecius (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SLA	Sublinear algorithms Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SYP	Parsing and Compilers Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-SBF	System Security and Forensics Simona Forn sek, Marián Svetlík Simona Forn sek	Z,ZK	5	2P+1C	Z	V
NI-TES	Systems Theory Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-TSP	Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-UMI	Artificial intelligence Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-EHW	Embedded Hardware Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-ESW	Embedded Software Hana Kubátová, Miroslav Skrbek Miroslav Skrbek Hana Kubátová (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-APR	Selected Methods for Program Analysis Filip K ikava Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	L	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
NI-VMM	Retrieval from Multimedia Ji í Novák, Tomáš Skopal Jaroslav Kucha Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MCC	Multicore CPU Computing Daniel Langr, Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	Z	V

## Characteristics of the courses of this group of Study Plan: Code=NI-MI-VS.20 Name=Elective Vocational Courses for Master Specialization Management Informatics

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 architec	tures, concepts a	nd technologies
for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.		
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	mal user models,	the fundamental
notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able	to design advanc	ed Uls.
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 stab	ility from system
theory and entropy from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related is	sues occur in an	/ given software
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-re	ated 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.		
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	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 s	systems) and more	dels (e.g., kernel
methods).		
NI-AIB Algorithms 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. Furthermore, st	udents will learn t	ne mathematical
principles of cryptographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware dete	ction and the use	of machine
learning in detection systems. The last topic includes practical steganographic methods and attacks on steganographic systems.		
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	as well as with u	nderstanding of
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	ns. In the second p	part the students
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syste	ms, and some ad	vanced software
architectures used in large-scale distributed systems.		
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 studi	es the construction	n of appropriate
models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden	n variables (true d	bject position
from noisy observations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose	, a number of real	world examples
and applications will be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging	g. The students w	ill try to solve
some of them.		
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 cryptography and cryptanalysis.	yptographic primit	ives in hardware
and software (in embedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resour	rces for securing in	nternal functions
of computer systems.		
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 vi	a channels.	

NI-DSV Distributed Systems and Computing	Z,ZK	5
Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computer the students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computer the students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computer the students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computer the students are introduced by the students are introduced		
channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms to data and services, and safety in case of failures.	hat support high a	vailability of both
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		-
techniques for Web crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an over		-
in the field of social web and recommendation systems.		·
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	ocuses 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	Î	
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 ac	cess time and me	mory complexity.
They will be able to use the knowledge in design of applications that utilize pattern matching.           NI-FME         Formal Methods and Specifications	Z,ZK	5
NI-FME Formal Methods and Specifications Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use som		
basic properties of software.		
NI-GEN Code Generators	Z,ZK	5
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	1	-
on undestanding the basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected	d topics from graph	and hypergraph
coloring, Ramsey theory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory	ory will be also app	lied in the fields
of combinatorics on words, formal languages and bioinformatics.		
NI-HWB Hardware Security	Z,ZK	5
The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safegu	-	-
using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Stu the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the c	-	owiedge about
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 data	1 '	-
used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, s		-
lossy data compression methods used in image, audio, and video compression.		
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 ciphers.	-	
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 disc	rete logarithm. The	problem of
factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems based on lattices.	7 71/	
NI-MVI Computational Intelligence Methods Students will understand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to		5 They will learn
how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.	many problems.	ney will learn
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	udents are expect	ed to understand
the basics of the lambda calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with sema		execution tools.
NI-MTI Modern Internet Technologies	Z,ZK	5
SYNOPSIS The subject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration	•	
TCP/IP is able to carry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, vir		
integrated services. 2. Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundre of devices. Thus, there is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching ar		
technologies allow service providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, del		
Acceleration Technologies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of		,
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	thods to real-world	l problems. They
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 algorithm	is sequentially
as well as in parallel.	7 71/	Г
NI-OSY Operating Systems and Systems Programming The course covers system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kern	Z,ZK	5 Key topics are:
process management, memory management, file operations and architecture of modern file systems, device drivers and network programming. The		
development process, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portabi		
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-KRY Advanced Cryptology	Z,ZK	5
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know		
random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they their own systems or to the creation of their own software solutions.	can apply to the	megration of
NI-GPU         GPU Architectures and Programming		5
Students will gain knowledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in the	7 74	
which is already a widespread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchical	Z,ZK CUDA programm	
	CUDA programm	ng environment,
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.	CUDA programm	ng environment,
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.           NI-PDD         Data Preprocessing	CUDA programm computational stru Z,ZK	ng environment, actures, students 5
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.           NI-PDD         Data Preprocessing           Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data	CUDA programm computational stru Z,ZK ata sources, such	ng environment, actures, students 5 as images, texts,
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.         NI-PDD       Data Preprocessing         Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various dative series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of character	CUDA programm computational stru Z,ZK ata sources, such	ng environment, actures, students 5 as images, texts,
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.           NI-PDD         Data Preprocessing           Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data	CUDA programm computational stru Z,ZK ata sources, such	ng environment, actures, students 5 as images, texts,

NI-REV	Reverse Engineering	Z,ZK	5
	inted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens		
	understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is de		а с
	C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be drive work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trands on the computer of the latest transference of the latest trands on the computer of the latest transference of the latest tra		
	ing work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the compu minars, where students will solve practically oriented tasks from the real world.	ter maiware scene	e. The locus of
NI-RUN	Runtime Systems	Z,ZK	5
	of programming languages steadily rises, modern programs require greater and greater support during their runtime. This could	1	-
	support, such as runtime-effective program description, memory management support and garbage collection, just-in-time co		
other languages and s		,	
NI-SWE	Semantic Web and Knowledge Graphs	Z,ZK	5
	the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web t	1 2	hods and best
practices for modelling	integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge	ge graphs and the	ir systematic
quality assurance.			
NI-SIM	Digital Circuit Simulation and Verification	Z,ZK	5
	s 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
	ols. The course covers recent verification methods, too.		
NI-SIB	Network Security	Z,ZK	5
NI-SCR	Statistical Analysis of Time Series	Z,ZK	5
	the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange private and the practical use of the pract		
	signals and processes) to computer networks (network components load, attacks detection). The students learn to select a co		
	its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the oth the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward tra		-
the academic to the re-			knowledge nom
NI-SLA	Sublinear algorithms	Z,ZK	5
	methods to tackle algorithms working in sublinear space.	2,21	5
NI-SYP	Parsing and Compilers	Z,ZK	5
-	the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge	1	-
-	ntroduced to special applications of parsers, such as incremental and parallel parsing.		
NI-SBF	System Security and Forensics	Z,ZK	5
	ar with aspects of system security (principles of end station security, principles of security policies, security models, authentic		-
students will get familia	r with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and for	ensic analysis tec	hniques and the
importance of operatin	g system/operating system artifacts or file system for attack analysis and detection).		
NI-TES	Systems Theory	Z,ZK	5
Today humankind has	the ability to develop systems of incredible complexity (a.g., trains, microprocessors, simplenes, publicar power plants). However		
	the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However		
complexity and of ensu	ring 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
complexity and of ensu aspects of the systems	ring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and	of models that des	scribe only those
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#### Multicore CPU Computing

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 knowledge of architecturally specific optimization techniques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs and memory interface throughput. On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications.

Z,ZK

5

## List of courses of this pass:

Code	Name of the course	Completion	Credits
BI-AG2.21	Algorithms and Graphs 2	Z,ZK	5
	ented in Czech, introduces basic algorithms and concepts of graph theory as a follow=up on the introduction given in the compulsory		
delves into advand	ces data structures and amortized complexity analysis. It also includes a very light introduction to approximation algorithms. For Engl BIE-AG2.21.	ish version of the o	course see
BI-APS.21	Architectures of Computer Systems	Z,ZK	5
	n the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Spec		
	n processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the prince processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the prince processing and on the memory hierarchy.		-
-	processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of e further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory cohe	-	
	systems.		
BI-BEK.21	Secure Code	Z,ZK	5
The students will lea	arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting fa	amiliar with the thre	at modeling
theory, students	gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every	program needs to	run with
	leges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing		
	database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and th	-	
BI-BLE	Blender	Z,ZK	. 4
	ds knowledge of opensource program Blender from BI-MGA (Multimedia and Graphics Applications) course. It is intended for those in ffers a complete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graph	-	
BI-CCN	Compiler Construction	· · · · · ·	
	Ictory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles	of compilers for st	5 udents to
	nd the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching	-	
BI-EHA.21	Ethical Hacking	Z,ZK	5
	purse is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vuln	I ' I	_
	puter networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is		
	vulnerabilities testing and the following process of penetration test documentation.		
BI-FMU	Financial and Management Accounting	Z,ZK	5
	rse is explanation of basic terms in the theory of accounting, the principles of balancing the property amounts and liabilities in the pa	-	-
· ·	unts and accounting statements including opening and closing of bookkeeping. The course provides students with a legal modification		
of economic oper	ations based on current methods of double-entry bookkeeping for enterprising subjects in the Czech Republic. Principles of manage Business Inteligence moduls in Business information systems.	ment accounting a	re base of
BI-FTR.1	Financial Markets	Z,ZK	5
	This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).	2,210	Ũ
BI-JPO.21	Computer Units	Z,ZK	5
Students deepen	their basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detail v	vith the internal str	ucture and
	puter units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using approp		
	e organization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, including	-	
	el and serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of commind the architecture of the bulk overlap and with the balk of the advertised microarce	-	
the environment an	d the architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micropro and programmable hardware design kits (FPGA).	grammed process	or simulator
BI-MPP.21	Methods of interfacing peripheral devices	Z,ZK	5
	ed on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universa	· · ·	
	ide and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USE		
	drivers, simple application development, and APIs of selected devices.		
BI-PJP.21	Programming Languages and Compilers	Z,ZK	5
	asic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers G		-
create a specificat	ion of a translation of a text that conforms a given syntax, to a target code and also to create a compiler based on the specification. T	he compiler can tr	anslate not
	only a programming language but any text in a language generated by a given LL input grammar.	7 71/	4
BI-PMA	Programming in Mathematica rking with modern technical and scientific software. Students will learn how to use different programming styles (functional programm	Z,ZK	4
Students will be wo	etc.), how to create dynamic interactive applications and visualisations, data processing and presentations.	ing, rule-based pr	ogrammig,
BI-SOJ	Machine Oriented Languages	Z,ZK	4
	rse will gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal us		
	ration of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of view lin	-	
	This knowledge will be used during reverse engineering, optimization, and evaluation of code security.		
BI-SRC.21	Real-time systems	Z,ZK	5
	he basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues		-
lectures will be exp	perimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are	e the same as in th	e BIE-VES
	COUISE.		

BI-SVZ.21	Machine vision and image processing	Z,ZK	5
-	are becoming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluate in	-	
ntroduces students	to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical use	of camera systen	ns for solvin
	problems of practice that the graduates may encounter.		
BI-VHS.21	Virtual game worlds	Z,ZK	5
the course studer	nts learn methods to create a complex virtual world. It is a follow-up course of basic courses of the PG specialization (BIE-MGA, BIE-PC	GR). Students gai	n knowledg
f the theory of gam	e design, of principles of writing dialogues and characters in order to create a functional virtual world. Within the labs they get practical s	kills within team	developme
	work on the semester project.		
BI-VMM	Selected Mathematical Methods	Z,ZK	4
	g geometric properties of linear spaces with inner product. Next, we introduce and analyze the discrete Fourier transform (DFT) and it:		
Further we deal wi	th differential calculus of functions involving multiple variables. We present methods for the localization of extreme values of functions	. For this purpose	es, we stud
ormed linear space	es and quadratic forms. In addition, we introduce the least square method. The last part of the course is devoted to optimization and du	uality. The linear p	programmir
	and the Simplex method is analyzed in more detail.		
NI-ADM	Data Mining Algorithms	Z,ZK	5
	s on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the students s		
asics. The emphas	sis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation syste	ems) and models	(e.g., kern
	methods).		
NI-ADP	Architecture and Design patterns	Z,ZK	5
	s course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as		-
-	ies, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge of		-
-	the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. Ir		
ill be introduced to	the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems,	and some advan	ced softwa
	architectures used in large-scale distributed systems.		
NI-AFP	Applied Functional Programming	KZ	5
his course is prese	ented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional pro-	ogramming langu	lages are o
the rise nowadays	and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, masterii	ng this paradigm	becomes a
	necessary competence of a software engineer: the theory and especially the practice.		
NI-AIB	Algorithms of Information Security	Z,ZK	5
Students will get ac	quainted with the algorithms of secure key generation and cryptographic error (not only biometric) data processing. Furthermore, studer	nts will learn the r	nathematic
principles of cryp	tographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware detect	ion and the use o	of machine
	learning in detection systems. The last topic includes practical steganographic methods and attacks on steganographic system	ns.	
NI-AM1	Middleware Architectures 1	Z,ZK	5
Students will stud	ly new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information system		eb service
	ly new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information system lication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous commu	m architecture, w	
		m architecture, w	
	ication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous commu	m architecture, w	
NI-AM2	ication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous commu of applications.	m architecture, w unications and hig Z,ZK	gh availabili 5
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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		
broadcast mecha	nisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowl for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitab		ecnanisms
NI-BUI	Business Informatics	Z,ZK	5
	rse is to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas of b		
	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 ne context of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme		
business and th	management, IT investment evaluation and human resources management in IT (roles CIO, CEO, CFO).	int, revenue and in	vesiment
NI-BVS	Embedded Security	Z,ZK	5
Students gain basi	c knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of crypto	ographic primitives	in hardware
and software (in en	nbedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources	s for securing interr	nal functions
NI-CAP	of computer systems.	ZK	2
	Cultural and Social Anthropology course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversit		
	search from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, healt	-	
	shown. The course is presented in Czech.		
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		
	duces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization techniqu ies. The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture and N		
inedern teenneleg	(Institute of Intermedia FEL).		ing) and inv
NI-CPX	Complexity Theory	Z,ZK	5
Students will lear	rn about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the	theory concerning	g practical
	(in)tractability of difficult problems.	1/7	4
NI-CTF	Capture The Flag The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber set	KZ KZ	4
NI-DDM	Distributed Data Mining	KZ	4
	n state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands of	1	
data processing fr	amework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations a	and will be capable	to propose
	approaches to parallelize other algorithms. The course is prezented in czech language.	7 71/	
NI-DDW	Web Data Mining and technologies for web data acquisition, analysis and utilization of the discovered knowledge. Students will gain	Z,ZK	5 b mining
	o crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overvie		- 1
	in the field of social web and recommendation systems.		
	in the field of social web and recommendation systems.		
NI-DID	Digital drawing	Z	2
The course will intr	Digital drawing roduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, persp	pective and color th	neory, which
The course will intr they will practically	Digital drawing roduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, persp y apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course	bective and color the is fit for anyone wi	neory, which ho wants to
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The course will intr they will practically practice o NI-DIP NI-DNP Students will ac DevOps and GT NI-DPH The course complet interested in deep development cycle NI-DSS The aim of the cou and knowledge-orition of the course NI-DSV Students are introd channels. They lea NI-DSW Students will work the course the st NI-DVG The course intends NI-DZO This course prese implement and hav of digital image frequency domain,	Digital drawing roduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, persy y apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course i learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practi Diploma Project Advanced .NET quire an overview of platform .NET and will gain knowledge about technologies ASPNET, Entity Framework, WPF, .NET MAUI and a T. Students will get practical experience in semestral work where they will create a client-server application utilizing technologies ASP (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT. Game Design ments the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on game of r knowledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanics of the students will get an overview of game development from the designer's perspective, from theoretical concepts to practical implet projects. The students will get an overview of same development from the design systems, their classification (Powerova), selected principles of ented decision support systems. Students will also gain knowledge of multicriterial decision-making methods and game theory. They will conceptually and ontologically oriented decision support systems and the basics of distribution, optimization and evolution methods a data and services, and safety in case of failures. Distributed Systems and services, and safety in case of failures. Design Sprint on projects using the Design Sprint method, developed by Google. Thanks to this method the teams are able to go from idea to valida udents will get familiar with the method as participants. Through practical adlenges they will try the whole 5 day process starting wit testing the prototypes (plus final presentation). Disgr	Z         Z,ZK         Iso will get notions         ISO will get notions         INET, Entity Frame         Z,ZK         design. It is intende         lesign, storytelling,         mentation applied to         Z,ZK         data-oriented, model         laso learn about the         ind algorithms.         Z,ZK         processes and corsupport high availate         Z         ted prototype in 5 ch         h research and finite         Z,ZK         gorithms that are boas         so valuable outside         compression, de-ty         version, context entities	eeory, which ho wants to ge. 30 4 of Azure work and 5 d for people and game to semestral 5 del-oriented he principles 5 nmunication bility of both 2 days. During shing with 5 ental notions 4 oth easy to the domain olurring in hancement,

NI-EDW	Enterprise Data Warehouse Systems	Z,ZK	5	
The Enterprise Da	ta Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods and		knowledge	
not only in designing warehouses and various architectures, but also their deployment and maintenance. This course also includes an introduction to the area of reporting and data				
	visualization.			
NI-EHW	Embedded Hardware	Z,ZK	5	
The course brings	, basic laws that govern digital design and basic techniques to use them. It deals with both large and small scale systems. This is the	base of advanced	embedded	
systems, that profit	from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discussed,	including standard	ized means	
	of internal communication, parallelism extraction and utilization in special structures and system architectures.			
NI-EMZ	Master Management economics course from a study abroad	Z	4	
The master's mana	gement-economic course "Management economics course from a study abroad" covers in the study plan the nature of the economic	s elective subjects	acquired by	
students as part of	their trip abroad. Completion by compensation is therefore assumed. Recognition is decided by the vice-dean for study and pedago	gical activities on b	ehalf of the	
	dean and on the basis of the student's request.	1		
NI-EPC	Effective C++ programming	Z,ZK	5	
	to use the modern features of contemporary versions of the C++ programming language for software development. The course focu		g effectivity	
	iciency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor t			
NI-ESC	Experimental Project Course	KZ	8	
	ct course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principles, n	-		
	logy-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design pro	-		
experts, and learn	n to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their skills user experience evaluation, as well as gain experience working in a team to design and prototype a functional solution."	s in user-centered c	lesign and	
		7 71/		
NI-ESW	Embedded Software	Z,ZK	5	
	e course acquainted students with the specifics of software development for embedded systems. The course covers the areas from the ba			
In C language and	d code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing, u combined with artificial intelligence.	p to sophisticated t	echniques	
	-	771/	-	
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	s line and memory	complexity.	
	They will be able to use the knowledge in design of applications that utilize pattern matching.	7 71/	-	
NI-FME	Formal Methods and Specifications	Z,ZK	5	
Students are able to	o describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some so	itware tools that all	ow to prove	
	basic properties of software.	771	4	
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			
systems. Since its i	nception in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as des Constraint Satisfaction Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.	scriptive complexity	r theory, the	
NI-GAK		Z.ZK	5	
-	Graph theory and combinatorics ss is to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorithms.	I ' I	-	
-	e basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected top			
-	heory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory v			
coloring, rainooy t	of combinatorics on words, formal languages and bioinformatics.			
NI-GEN	Code Generators	Z,ZK	5	
NI-GLR	Games and reinforcement learning	Z,ZK	4	
	cement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelliger			
	give you both theoretical and practical background so you can participate in related research activities. Presented in Englis			
NI-GNN	Graph Neural Networks	Z,ZK	4	
	joduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural r			
	oddes sidden's to advanced anificial intelligence techniques for working with graphs, becomes with ocds on the latest graph neural in f 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		00 001010	
NI-GPU	GPU Architectures and Programming	Z,ZK	5	
	nowledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in the CU			
-	videspread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchical com			
which is alloady a l	will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.		50, 010001110	
NI-GRI	Grid Computing	Z,ZK	5	
	Grid computing and gain knowledge about the world-wide network and computing infrastructure.	2,21	5	
NI-HCM	Mind Hacking	ZK	5	
	is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, infi			
	is an energing discipline that is closely related to cyber security. While the domain of cyber security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive security	-		
-	nation warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Internet			
	impacts such as disruption of social cohesion, threats to democracy or war.		- 3. 00010101	
NI-HMI2	History of Mathematics and Informatics	ZK	3	
	esented in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithm	I I		
	functions, eliptic curves, etc.) note on possibilities of applications of some mathematical methods in informatics and its develop			
NI-HPZ	Master humanities from a study abroad	Z	2	
	manities that has been studied abroad" is covered by the Humanities from a study abroad in Compulsory Humanities Module that is	I I		
	substitution is approved by the Vice-Dean for study affairs on behalf of the Dean at the request of the student.			
NI-HSC	Side-Channel Analysis in Hardware	Z,ZK	4	
	dicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical attac			
	ide channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and	-		
	hey also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel	-	- 1	
		-		

NI-HWB	Hardware Security	Z,ZK	5
	es the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguard	•	
-	eans. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Studer yptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions	-	edge about
NI-IAM	Internet and Multimedia	Z,ZK	4
	se is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acq	,	
	signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical u	e e	
	nissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effe		
the quality and late	ncy of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording th	e scene up to the p	resentation
	for audience.		
NI-IBE	Information Security	ZK	2
	ormation and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and internation		
NI-IKM	d methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g. Internet and Classification Methods		<u>9).</u> 4
	students get acquainted with classification methods used in four important internet, or generally network applications: in spam filtering	Z,ZK	
	ion systems and in intrusion detection systems. However, they will learn more than only how classification is performed when solving		-
On the backgroun	d of these applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycle w	ith 2-hour lectures	and 2-hour
exercises.	During the exercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consul	t their semester tas	sks.
NI-IOS	Advanced techniques in iOS applications	KZ	4
Students will learn	the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the b	asics from the begi	nners class
	BI-IOS.		
NI-IOT	Internet of Things ocused on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is fa	Z,ZK	4
	development elements (Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (G		Ivaliable
NI-IVS	Intelligent embedded systems	KZ	4
	ded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The	I I	-
-	mbedded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot program		
development. Lect	ures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students	develop advanced a	applications
	combining knowledge of various courses like nature inspired algorithms, data mining algorithms, image recognition and web tech	nologies	
NI-KOD	Data Compression	Z,ZK	5
	duced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data		
used in practice. I	he overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, stude lossy data compression methods used in image, audio, and video compression.	ents learn the funda	amentals of
NI-KOP	Combinatorial Optimization	Z,ZK	6
	gain knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not onl		-
		,	
	also to apply and evaluate heuristics for practical problems.		
NI-KRY	also to apply and evaluate heuristics for practical problems. Advanced Cryptology	Z,ZK	5
		· · ·	-
Students will lear	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c	he mathematical pr	inciples of
Students will lear random number	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions.	ne mathematical pr an apply to the inte	inciples of gration of
Students will lear random number NI-KTH	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games	ne mathematical pr an apply to the inte Z,ZK	egration of
Students will lear random number NI-KTH Traditional game	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studied	he mathematical pr an apply to the inte Z,ZK dies the behaviour	egration of 4 of agents
Students will lear random number NI-KTH Traditional game (players) of a cer	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studiation competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t	ne mathematical pr an apply to the inte Z,ZK dies the behaviour heory is to find the	egration of 4 of agents equilibria,
Students will lear random number NI-KTH Traditional game (players) of a cer which are the state	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studied	ne mathematical pr an apply to the inte Z,ZK dies the behaviour heory is to find the r full-information co	egration of 4 of agents equilibria, ombinatorial
Students will lear random number NI-KTH Traditional game (players) of a cer which are the state games, was by C	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory studiation competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t s of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player	ne mathematical pr an apply to the inte Z,ZK dies the behaviour heory is to find the r full-information co to evaluate games	agration of 4 of agents equilibria, ombinatorial s such that
Students will lear random number NI-KTH Traditional game (players) of a cer which are the state games, was by C otherwise incom work of Beck, who	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stud tain competitive process by designing a mathematical model and investigating the strategies. The traditional task of classical game t s of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-playe onway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea is patible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The thi established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force tra	ne mathematical pr an apply to the inte Z,ZK dies the behaviour heory is to find the r full-information co to evaluate games rd most important s versal of the game	A of agents equilibria, ornbinatorial s such that step is the tree, which
Students will lear random number NI-KTH Traditional game (players) of a cer which are the state games, was by C otherwise incom work of Beck, who is no efficient. Bec	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stuttain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t s of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-playe onway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea is batible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The thi established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force tra k introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory of	ne mathematical pr an apply to the inter Z,ZK dies the behaviour heory is to find the r full-information co to evaluate games rd most important s versal of the game of combinatorial and	A of agents equilibria, ombinatorial s such that step is the tree, which d positional
Students will lear random number NI-KTH Traditional game (players) of a cer which are the state games, was by C otherwise incom work of Beck, who is no efficient. Bec games. We focus of	Advanced Cryptology In the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know th generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they c their own systems or to the creation of their own software solutions. Combinatorial Theories of Games theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stuttain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t s of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-playe onway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea is batible games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The thi established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force tra k introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory of n theoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course req	ne mathematical pr an apply to the inter Z,ZK dies the behaviour heory is to find the r full-information co to evaluate games rd most important s versal of the game of combinatorial and uires independent of	A of agents equilibria, ombinatorial s such that step is the tree, which d positional work, ability
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optimization techni	ques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs and On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications	-	throughput.
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 approa	ch for (re)engineer	ring and
	implementation of processes, organisation structures and information support in big enterprises and institutions.	7 71/	
NI-MKY	Mathematics for Cryptology deeper knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphers. In	Z,ZK	5
•	of solving a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of discre		
	factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems based on		
NI-MLP	Machine Learning in Practice	Z,ZK	5
	earning methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client to, ide		
-	students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practically sing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear and	-	
NI-MOP	Modern Object-Oriented Programming in Pharo	KZ	4
-	gramming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where	1	l abstraction
	nplex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills		
	in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development n		
	ing object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work or rms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvent		
NI-MPI	Mathematics for Informatics	Z,ZK	7
	prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analy-	· ·	
	ation. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last top		
-	r stability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear pre-	esentation and arg	
NI-MPJ	Modelling of Programming Languages	Z,ZK	5
-	sformation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserve t		
	es the semantics of programming languages. The students will learn the language models with emphasis on functional languages, stude mbda calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with semantic	-	
NI-MPL	Managerial Psychology	ZK	2
NI-MPR	Master Project	Z	7
	g of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial ta	isks that should be	carried out
-	er. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the er		
	) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the		
	s, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the a the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head		
	MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the	•	•
	aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester.		
NI-MPX	Management practice	Z	4
The Student can or	Management practice nce, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the or	operational, tactical	l or strategic
The Student can or level of managen	Management practice nce, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the o nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a	pperational, tactical assessed well in ad	l or strategic vance the
The Student can or level of managen	Management practice nce, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the or nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation	pperational, tactical assessed well in ad	l or strategic vance the
The Student can or level of managen	Management practice nce, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the or nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation member of the top management).	pperational, tactical assessed well in ad tives of the studen	l or strategic vance the
The Student can or level of managen course guarantor. NI-MSI	Management practice nce, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the or nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation	z,ZK	l or strategic lvance the t (e.g. as a
The Student can or level of managen course guarantor. NI-MSI	Management practice ince, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the or nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation member of the top management). Mathematical Structures in Computer Science	z,ZK	l or strategic lvance the t (e.g. as a
The Student can or level of managen course guarantor. NI-MSI Mathematical se NI-MTI	Management practice           nee, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the of nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation member of the top management).           Mathematical Structures in Computer Science           emantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott Introduction to category theory.           Modern Internet Technologies	z,ZK	l or strategic vance the t (e.g. as a 4 calculus.
The Student can or level of managen course guarantor. NI-MSI Mathematical se NI-MTI SYNOPSIS The s	Management practice           nee, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the of nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a	Typerational, tactical assessed well in ad titves of the studen Z,ZK t model of lambda Z,ZK A single network, o	or strategic ivance the t (e.g. as a 4 calculus. 5 oriented on
The Student can or level of managen course guarantor. NI-MSI Mathematical se NI-MTI SYNOPSIS The s TCP/IP is able to c	Management practice           nee, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the of nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation member of the top management).           Mathematical Structures in Computer Science           emantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott Introduction to category theory.           Modern Internet Technologies" ubject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration - arry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video	In persisting and the studen of the studen o	or strategic ivance the t (e.g. as a 4 calculus. 5 oriented on re seamless
The Student can or level of managen course guarantor. NI-MSI Mathematical se NI-MTI SYNOPSIS The s TCP/IP is able to c integrated services	Management practice           nee, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the of nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a	In persisting the studen of th	or strategic ivance the t (e.g. as a 4 calculus. 5 oriented on re seamless and billions
The Student can or level of managen course guarantor. NI-MSI Mathematical se NI-MTI SYNOPSIS The s TCP/IP is able to c integrated services of devices. Thus,	Management practice           nee, within its master's degree graduate (to apply) management practices in the selected subject of practice (business subject) on the of nent (typically at the position of project manager, middle or top manager). The selected subject of practice and professional filling is a In the selected subject of practice may not have a substantial ownership interest or substantial decision-making influence of the relation member of the top management).           Mathematical Structures in Computer Science           emantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott Introduction to category theory.           Modern Internet Technologies           ubject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration - arry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video s. 2. Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundreds of the selected subjects of protocols for whatever purposes. This provides the insights of network architectures which can accommodate hundreds of the selected selected subject of protocols for whatever purposes. This provides the insights of network architectures which can accommodate hundreds of the selected s	I peperational, tactical assessed well in ad titves of the studen Z,ZK t model of lambda Z,ZK A single network, of and data to achiev of millions of users I Traffic Prioritisatio	or strategic ivance the t (e.g. as a 4 calculus. 5 oriented on re seamless and billions n - These
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functionality of information systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stability	and entropy-relate	d principles.
This knowledge allows students to realize new levels of evolvability in software architectures.	7 71/	
NI-NUR User Interface Design Students will understand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal	Z,ZK	5 fundamental
notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able		
NI-OLI Linux Drivers	Z,ZK	4
The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining po	· · ·	1
increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development	nt for master's stud	lents. The
course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practice	-	
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		•
process management, memory management, file operations and architecture of modern file systems, device drivers and network programming. The control development process, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability.		
in embedded and real-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.		
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 necess		
exactly in practice. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one		
(parameter) of the inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exponent and polynomially in the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial tir		
which is not possible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solution		
plethora of parameterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (pre		-
will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation	n schemes.	
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 the		rbusiness
management, especially in law, administration (necessary steps and documents), business economics, foreign trade and related a		-
NI-PDB Advanced Database Systems Students orient themselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of database	Z,ZK	
databases), with the related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CYPH		
the course deals with performance evaluation of database machines.		abi puri or
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 data s		lages, texts,
time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteris	tics from images o	r from web
pages.		
NI-PDP Parallel and Distributed Programming 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	Z,ZK	6
2 Is century in computer architectures is primarily influenced by the shift of the Moore's law into parallelization of CFOS at the level of computing cores	S. Falallel Computer	IU SVSIEIIIS
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are becoming a ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platfor with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication oper	ms. Students get a	acquainted
	ms. Students get a rations, and langua	acquainted ages and
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NI-PYT	Advanced Python	KZ	4
e e	urse is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Python	. ,	
very hands-on and	it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursework teachers from Red Hat.	. The course is lead	by external
NI-REV	Reverse Engineering	Z,ZK	5
Students will get ac	cquainted 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 d		
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	he focus of
	the course is on the seminars, where students will solve practically oriented tasks from the real world.	7 71/	<b>-</b>
NI-ROZ	Pattern Recognition	Z,ZK	5
	nodule is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the st idents will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, a		
NI-RUB			
NI-RUD	Programming in Ruby This course is presented in Czech.	KZ	4
NI-RUN		Z,ZK	5
	Runtime Systems evel of programming languages steadily rises, modern programs require greater and greater support during their runtime. This course		-
	me support, such as runtime-effective program description, memory management support and garbage collection, just-in-time compi		
	other languages and systems.		
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		
-	miliar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and forens		
otadonio nin got la	importance of operating system/operating system artifacts or file system for attack analysis and detection).		
NI-SCE1	Computer Engineering Seminar Master I	Z	4
	mputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to	I	-
	dividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the		
	professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teacher	-	
	semester.		
NI-SCE2	Computer Engineering Seminar Master II	Z	4
	mputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to	I –	-
	dividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the		
	professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teacher	-	
	semester.		
NI-SCR	Statistical Analysis of Time Series	Z,ZK	5
	with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange prices		d industrial
problems (modellin	g of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a conve	enient process mod	lel, estimate
its parameters, ana	lyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the ma	in principles based	on practical
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	wledge from
	the academic to the real world.		wledge from
NI-SEP		er of students' knov	wledge from
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NI-TNN	Theory of Neural Networks	Z,ZK	5
	study neural networks from the point of view of the theory of function approximation and from the point of view of probability theory. A		
-	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 transformation of the second seco		
	n with somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with trai		
•	ining and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most in		
	I network training. We will see the meaning of all these concepts in the context of common kinds of forward neural networks. Within the		
	ks, we first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Ko	-	
,	ds, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappings oportant Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect t		
-	inuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on expect		-
	d with probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see how	•	
	al expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak la		
	n analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the centra	-	-
	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	-	-
	topology of the network.		
NI-TS1	Theoretical Seminar Master I	Z	4
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	-	1 -
	ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a		
	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
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	1	
	ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a		
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	work with Scientine	papers and
NI-TS3	Theoretical Seminar Master III	Z	4
		-	1 -
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a		
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	WORK WITH SCIENTING	papers and
		7	4
NI-TS4	Theoretical Seminar Master IV	Z	4
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic		
are treated individu	ally 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.	7 71/	<b>_</b>
NI-TSP	Testing and Reliability	Z,ZK	5
-	knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to pre	-	
the intuitive path se	ensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with bu	liit-in-seir-test equip	pment. They
	will be able to compute, analyze, and control the reliability and availability of the designed circuits.	1/7	
NI-TSW	Software Product Development	KZ	4
	The course is presented in Czech.		
NI-TVR	Virtual Reality Technology	Z,ZK	3
	troduced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD,) and the possibilities of cont	-	
tracking, hand tra	cking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of	using virtual and a	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 programmer and the second	ning and automate	d planning.
	The main principles and practical applications of discussed techniques will be illustrated.	<del></del>	
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
	n knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and		
	rtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficient		-
	rameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effect		-
management of co	mplex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills i	n the use of moder	n integration
	and development tools (Continuous integration and development).	<del>,                                    </del>	1
NI-VEM	Scientific thinking	KZ	2
-	he course is to get acquainted with scientific methods and discovery of order and laws of the universe, including the aspects of hum-	-	
scientific methods	in natural sciences, mathematics, computer science and humanities. Another aim is to introduce rules and requirements of scientific	communication vi	ia research
	papers and posters.		1
NI-VMM	Retrieval from Multimedia	Z,ZK	5
The student obtain:	s general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of fea	ture extraction from	n 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	Z	5
	Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en.	•	•
NI-VSM	Selected statistical Methods	Z,ZK	7
	the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with m	1	1
	ropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with ran-		
	Markov chains. The high point of the course is the Queuing theory and its application in networks.		
NI-VYC	Computability	Z,ZK	4
	Classical theory of recursive functions and effective computability.		
NI-ZS10	Master internship abroad for 10 credits	Z	10
	once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institu	1	1
	the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and e		-
	MI-ZS20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 week		
			-

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.		1
NI-ZS20	Master internship abroad for 20 credits	Z	20
Each student can	once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institu	tion. Before the int	ernship the
Dean of the FIT, or t	the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and ex	tent of the internsh	nip. 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	s of full-time emplo	oyment with
a foreign institutio	on. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects i	if the internship ex	ceeds the
	academic year's 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 provic	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	led 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 platforr	ns. They will be ab	le 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.	Throughout
the course, student	ts 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	í 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	and practical
	perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial commu	nities.	
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 o	ntimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial of	vroblems emerging	in EDA

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2024-05-19, time 05:21.