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

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

NI-KOP	Combinatorial Optimization	Z,ZK	6
The students will gain	knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not	, only to select and	implement but
also to apply and eva	uate heuristics for practical problems.		
NI-DIP	Diploma Project	Z	30
NI-MPR	Master Project	Z	7
1. At the beginning of	the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partia	I tasks that should	I be carried out
during the semester. I	the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the e	nd of the semeste	r. 2. The external
supervisor enters the	information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.	cz/student/studijn	i/formulare). The
completed and signed	I form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT t	opic that the stude	ent has reserved
is rather general, the	mmediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so tha	t the FTT will be o	omplete 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 optir	nization and
multi-variate integration	m. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The las	t topic includes se	lected numerical
algorithm and their st	ability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear	presentation and	argumentation.
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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: Compulsory courses in the specialization 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 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 Vlastimil Jinoch, Martin Závrbský, Martin Mach, Martin Hasaj David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+1C	L	PS
NI-PAS	Advanced Aspects of Business David Buchtela, Št pánka Havlíková, Dominik Vítek, Ji í Maršál, Jana Soukupová, Zden k Ku era David Buchtela Zden k Ku era (Gar.)	Z,ZK	4	2P+1C	Z	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 syst	tem architecture,	web service
architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous con	mmunications and	d high availability
of applications.		
NI-MEP Modelling of Enterprise Processes	Z,ZK	5
The subject is focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approac	h for (re)enginee	ring and
implementation of processes, organisation structures and information support in big enterprises and institutions.		
NI-BUI Business Informatics	Z,ZK	5
The aim of the course is to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas of	f business proce	ss management,
ICT services and architectures 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 resource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governal	nce, the importar	nce of ICT for
business and the context 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 investment evaluation and human resources management in IT (roles CIO, CEO, CFO).		
NI-PIS Enterprise Information Systems	Z,ZK	5
The course is focused on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage o		
in BI (Business Intelligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication		
real examples. Furthermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the company / organization and its impact on the life cycle of information systems in the life cycle of information systems in the cycle of information systems in the life cycle of information systems in the cycle of inform	ousiness strategy	of the company.
Students will be acquainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and opera	tion 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	eir 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 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	tures, concepts a	nd 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 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	ssues occur in an	y given software
architecture. In the seco	nd 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 (so	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
	of the courses of this group of Study Plan: Code=NI-PV-KMK.20 Nam Communication and management competencies	ne=Compuls	sory Elec	ctive Cours	ses for N	laster
NI-CAP	Cultural and Social Anthropology				ZK	2
The one-semester of	ourse aims to acquaint students with the basics of social and cultural anthropology as a scientif	fic discipline dea	aling with th	e diversity of t	the world - e	examples from
anthropological rese	arch from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization	n, , material cult	ure, langua	ge, health, his	story, death,	etc) will be
shown. The course is	s presented in Czech.					
NI-HPZ	Master humanities from a study abroad				Z	2
Master course "Hum	nanities that has been studied abroad" is covered by the Humanities from a study abroad in Con	npulsory Humai	nities Modu	le that is requi	ired in the c	urriculum. Th
substitution is approv	ved by the Vice-Dean for study affairs on behalf of the Dean at the request of the student.					
					Z	4
NI-EMZ	Master Management economics course from a study abroad	tudv plan the na	ture of the	1	- 1	4 ts acquired b
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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 group: NI-V.2021 Name of the group: Purely Elective Master Courses Requirement credits in the group: Requirement courses in the group: Credits in the group: 0 Note on the group: In addition to the courses listed her

e on the group: In addition to the courses listed here, you can enroll as an elective any course that is offered within your study program and form of study that you did not enroll as a compulsory subject in the program/branch/specialization or a compulsory elective course.Courses of this group that a student has completed in the bachelor study at CTU cannot be re-completed.

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-AOA	Completing a professional event Zden k Muziká	Z	1			V
NI-ATH	AlgorithmicTheories of Games Dušan Knop, Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+2C	L	V

NI-AFP	Applied Functional Programming Robert Pergl, Marek Suchánek, Daniel N mec Robert Pergl Robert Pergl (Gar.)	KZ	5	2P+1C	L	V
NI-APH	Architecture of computer games Adam Vesecký Adam Vesecký (Gar.)	Z,ZK	4	2P+1C	Z	V
NI-VGA	Video Games Architecture Jan Matoušek	Z,ZK	5	2P+1C	Z	V
NI-BPS	Wireless Computer Networks Ji í Kašpar, Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	4	2P+1C	L	V
NIE-BLO	Blockchain Róbert Lórencz, Jakub R ži ka, Josef Gattermayer, Marek Bielik Josef Gattermayer Róbert Lórencz (Gar.)	Z,ZK	5	1P+2C	Z	V
NI-CTF	Capture The Flag Ji í Dostál, Martin Šutovský, Ivana Trummová, Ladislav Marko, František Ková Ji í Dostál Ji í Dostál (Gar.)	KZ	4	3C	Z	V
NI-DPH	Game Design Adam Vesecký	Z,ZK	5	2P+1C	L	V
NI-DSW	Design Sprint Ond ej Brém, Michal Manda Michal Manda David Pešek (Gar.)	Z	2	30B	Z	V
NI-PSD	Public Services Design Ond ej Brém, David Pešek David Pešek Ond ej Brém (Gar.)	KZ	4	1P+2C		V
NI-DID	Digital drawing Denisa Nová ková, Eliška Novotná Denisa Nová ková Denisa Nová ková (Gar.)	Z	2	4C	Z,L	v
NI-DZO	Digital Image Processing	Z,ZK	4	2P+1C	L	V
NI-DDM	Distributed Data Mining Tomáš Borovi ka	KZ	4	3C	L	V
NI-PAM	Efficient Preprocessing and Parameterized Algorithms Ond ej Suchý Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	4	2P+1C	L	V
NI-ESC	Experimental Project Course Jan Matoušek, Ond ej Brém Ond ej Brém Ond ej Brém (Gar.)	KZ	8	0P#3R#52C	L	V
NI-GLR	Games and reinforcement learning Juan Pablo Maldonado Lopez	Z,ZK	4	2P+2C	L	V
NI-GNN	Graph Neural Networks Miroslav epek Miroslav epek (Gar.)	Z,ZK	4	1P+1C	L	V
NI-GRI	Grid Computing André Sopczak, Petr Fiedler <b>Pavel Tvrdík</b> 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 (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 Miroslav Skrbek (Gar.)	KZ	4	1P+3C	L	V
NI-IKM	Internet and Classification Methods Martin Hole a Martin Hole a Martin Hole a (Gar.)	Z,ZK	4	1P+1C	L	V
NI-IAM	Internet and Multimedia	Z,ZK	4	2P+1C	L	V
NI-IOT	Internet of Things Jan Jane ek	Z,ZK	4	2P+1C	L	V
FITE-EHD	Introduction to European Economic History	Z,ZK	3	2P+1C	L	V
NI-KTH	Combinatorial Theories of Games Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+1C	L	V
NI-FMT	Finite model theory           Tomáš Jakl         Tomáš Jakl         Tomáš Jakl         Gar.)	Z,ZK	4	2P+1C	L	V
NI-CCC	Creative Coding and Computational Art Radek Richtr, Josef Kortán Radek Richtr Radek Richtr (Gar.)	KZ	4	1P+2C	Z,L	V
NI-KYB	Cybernality	ZK	5	2P	Z	V
NI-LSM2	Statistical Modelling Lab Kamil Dedecius Kamil Dedecius (Gar.)	KZ	5	3C	Z,L	V
NI-LOM	Kamil Dedecius Kamil Dedecius Kamil Dedecius (Gar.)         Linear Optimization and Methods         Dušan Knop Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MPL	Jusan Knop Dusan Knop Dusan Knop (Gar.) Managerial Psychology Jan Fiala Jan Fiala Jan Fiala (Gar.)	ZK	2	2P	Z,L	V
NI-MSI	Mathematical Structures in Computer Science Jan Starý	Z,ZK	4	2P+1C	L	V
NI-MZI	Mathematics for data science	Z,ZK	4	2P+1C	L	V
	Št pán Starosta			ļ		
FIT-ITI	Modern IT infrastructure Ivan Šime ek	Z,ZK	5	2P+1C	Z,L	V

NI-NLM	Neural Language Models	Z	5	2P+1C	L	V
NI-NMS	Neural Networks, Machine Learning and Randomness Martin Hole a	Z,ZK	4	1P+1C	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 Alois Pluhá ek (Gar.)	Z,ZK	4	2P+1C	Z,L	V
NI-PG1	Computer Grafics 1 Radek Richtr Radek Richtr Radek Richtr (Gar.)	ZK	4	2P+1C	L	V
NI-PIV	Computer Vision Radek Richtr	Z,ZK	5	2P+2C	Z	v
NI-EDW	Enterprise Data Warehouse Systems Jakub Krej í, Robert Kotlá Jakub Krej í Magda Friedjungová (Gar.)	Z,ZK	5	1P+1C	L	V
NI-PVR	Advanced Virtual Reality Petr Pauš Petr Pauš Petr Pauš (Gar.)	KZ	4	2P+1C	Z	v
NI-AML	Advanced machine learning Zden k Buk, Miroslav epek, Rodrígo 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.)	ΚZ	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 David Šenký, Nikolas Jíša David Šenký Nikolas Jíša (Gar.)	Z,ZK	4	2P+1C	Z	v
NI-PYT	Advanced Python Miroslav Hron ok	KZ	4	3C	Z	V
NIE-PDL	Practical Deep Learning Martin Barus, Yauhen Babakhin Karel Klouda Karel Klouda (Gar.)	KZ	5	2P+1C	Z	v
NI-GOL	Programming of distributed systems in GO	KZ	5	0P+3C	Z	V
NI-PSL	Programming in Scala Ji í Dan ek <b>Ji í Dan ek</b> Ji í Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	V
NI-RUB	Programming in Ruby Cyril erný Cyril erný Cyril erný (Gar.)	KZ	4	3C	Z	V
NI-ROZ	Pattern Recognition Radek Richtr, Michal Haindl Michal Haindl (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-PLS1	Programming Language Seminar Pierre Donat-Bouillud	Z	2	0P+1C	Z	V
NI-PLS3	Programming Language Seminar Pierre Donat-Bouillud	Z	2	0P+1C	Z	V
NI-PLS2	Programming Language Seminar Pierre Donat-Bouillud	Z	2	0P+1C	L	v
NI-PLS4	Programming Language Seminar Pierre Donat-Bouillud, Filip K ikava Pierre Donat-Bouillud Pierre Donat-Bouillud (Gar.)	Z	2	0P+1C	L	v
NI-SCE1	Computer Engineering Seminar Master I 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 Petr Fišer Petr Fišer (Gar.)	ZK	4	2P+1C	Z,L	v
NI-MLP	Machine Learning in Practice Jan Hu ín Daniel Vašata Daniel Vašata (Gar.)	Z,ZK	5	2P+1C	Z	v
FIT-SEP	World Economy and Business Tomáš Evan	Z,ZK	4	2P+2C	L	v
NI-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+1C	Z,L	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 Tomáš Valla (Gar.)	Z	4	2C	L	v

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NI-TS3	Theoretical Seminar Master III Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	V
NI-TS4	<b>Theoretical Seminar Master IV</b> Ond ej Suchý, Tomáš Valla <b>Tomáš Valla</b> 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 (Gar.)	Z,ZK	5	3P+1C	Z	v
FI-TOP	Academic writing Tomáš Nová ek	Z	2	10B	Z	v
NI-DVG	Introduction to Discrete and Computational Geometry Maria Saumell Mendiola Maria Saumell Mendiola Maria Saumell Mendiola (Gar.)	Z,ZK	5	2P+1C	L	V
NI-VOL	Elections Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	L	v
NI-VYC	Computability Jan Starý Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+2C	L	v
NI-VPR	Research Project           Št pán Starosta Št pán Starosta Št pán Starosta (Gar.)	Z	5		Z,L	v
NI-ZS10	Master internship abroad for 10 credits	Z	10		Z,L	v
NI-ZS20	Zden k Muziká         Zden k Muziká (Gar.)           Master internship abroad for 20 credits	Z	20		Z,L	v
NI-ZS30	Zden k Muziká         Zden k Muziká (Gar.)           Master internship abroad for 30 credits	Z	30		Z,L	v
	Zden k Muziká Zden k Muziká (Gar.)					
	f the courses of this group of Study Plan: Code=NI-V.2021 Name=P	urely Electiv	e Maste			
NI-MPL	Managerial Psychology				ZK	2
NI-SEP	World Economy and Business			Z	',ZK	4
This course is presente	ed in Czech. However, there is an English variant in the program Informatics (N1801 / 4793).	The course intro	duces stude	ents of techn	ical universi	ty to the
international business.	It does that predominantly by comparing individual countries and key regions of world econo	omv. Students ae	t to know al	out different	religions ar	d cultures.
	siness in diverse societies as well as indexes of economic freedom, corruption and economi	, ,			•	
, ,					0	
Seminars help to impro	ove on the knowledge in the form of discussions based on individual readings. It is advised to	) take bachelor le		OUISE DIE-S	EP as a pre	requisite.
NI-AOA	Completing a professional event				Z	1
The subject is participa	ation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, con	cluded with a wo	rkshop a te	st drafting a	report etc.	Such an event
			-	-	-	
	dvance by the vice-dean for pedagogical activities or the vice-dean for science and research	and is presented				-
NI-ATH	AlgorithmicTheories of Games			Z	,ZK	4
Traditional game theory	y is a branch of mathematics, which has broad applications in economy, biology, politics and	computer scienc	e. This thec	rv studies th	e behaviour	of agents
	ompetitive process by designing a mathematical model and investigating the strategies. The					
. ,				• •		•
	the game where no player wants to deviate from his strategy. Due to the recent development	• •				
multiagent systems and	d other concepts the algorithmic point of view is gaining attention. In addition to existential qu	Jestions we study	y the proble	ms of efficie	nt computati	on of various
solution concepts. In th	is course we introduce the basics of game theory of many players, solution concept (usually	equilibria) and n	nethods of t	heir computa	ation.	
NI-AFP				1	KZ	5
	Applied Functional Programming					-
This course is presente	ed in Czech. Functional programming represents one of the traditional programming paradig	ms. Traditional an	id novel fun	ctional progr	amming lan	guages are on
the rise nowadays and	the functional paradigm becomes an important construct of traditionally imperative language	əs (C++, C#, Java	a). As such,	mastering th	his paradign	l becomes a
necessary competence	e of a software engineer: the theory and especially the practice.					
NI-APH	Architecture of computer games			7	,ZK	4
	ic understanding of the various issues in the field of computer games development, especially	from a tashnical	noint of viou			-
-			-		-	
, ,	et a grasp of component-oriented and functional-oriented architecture, game mechanics, dec					0
	ey will also understand the basics of pathfinding, networking and scripting and apply them in	n practical exercis	ses (labs). A	n important	part of the o	ourse is an
implementation of a sir	nple game, with a strong focus on nontrivial game mechanics.					
NI-VGA	Video Games Architecture			Z	,ZK	5
	ide range of topics, procedures and methodologies related to the development of computer	games - from a te	echnical poi		,	-
	iew. In the lectures, students will be guided through the history of development, the structure	-	-			-
	ysics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected to		-			
	s, in the form of practical demonstrations.		greater	actail, molu	ang ways 0	pionicituity
<u> </u>						
NI-BPS	Wireless Computer Networks			2	,ZK	4
Students will learn abo	ut the modern technologies, protocols, and standards for wireless networks. They will under	stand the routing	mechanism	is in ad-hoc	networks, m	ulticast and
broadcast mechanisms	s, and data flow control mechanisms. They will also learn about principles of communication	in sensor networ	ks. They ge	t knowledge	of security r	nechanisms
for wireless networks a	nd get skills of configuration of wireless network elements and simulation of wireless networ	ks using suitable	tools.			
NIE-BLO	Blockchain			7	.ZK	5
-	I blockchain Ind the foundations of blockchain technology, smart contract programming, and gain an overvie	ew of most notabl	la blackaba:	1	· ·	
				-	-	-
	ure decentralized application, and assess whether integration of a blockchain is suitable for a	<b>e</b> 1		•		
-	lockchains and information security. It is concluded with a defense of a research or applied s	ernester project,	which prepa	ares the stud	aents for imp	ementing or
supervising implement	ation of blockchain-based solutions in both academia and business.					
NI-CTF	Capture The Flag				KZ	4
	d to introduce students to CTF competitions and let them gain practical experience in the fiel	d of cyber securi	tv.	I	I	-
-			· y *			~
NI-DPH	Game Design				,ZK	5
The course complement	nts the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) cours	e, while focusing	primarily or	n game desig	gn. It is inten	ded for people
interested in deeper kn	owledge of the principles used for games design, such as: level design, gameplay design, c	haracter design,	game mech	anics desigr	n, storytelling	g, and game
	e students will get an overview of game development from the designer's perspective, from the		•	•		
		22. 20. 20. 20 P				
projects						
projects.						

NI-DSW Design Sprint	Z	2
Students will work on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to va	alidated prototype	in 5 days. During
the course the students will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting the students will get familiar with the method as participants.	with research and	finishing with
testing the prototypes (plus final presentation).		
NI-PSD Public Services Design	KZ	4
The course will introduce students to specifics of UX, Service design and development for public sector. We will look into the design and development for public sector. We will look into the design and development for public sector.		
suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaborat	ion with client repi	resentatives.
Course is aimed at students-designers as well as clients.	Z	2
NI-DID   Digital drawing The course will introduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, p	-	1
they will practically apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The cou	-	-
practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice gr		
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	1 '	-
implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that	-	-
of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HD	R compression, de	e-blurring in
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray	conversion, contex	kt enhancement,
interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, a	adding depth, alph	a matting.
NI-DDM Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain han		-
data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementatio	ns and will be cap	able to propose
approaches to parallelize other algorithms. The course is prezented in czech language.	7 71/	4
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 need exactly in practice. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often	-	-
(parameter) of the inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exp		
and polynomially in the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial		<i>,</i> ,
which is not possible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solu		
plethora of parameterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm	(presumably) does	s not exist. We
will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes.		
NI-ESC Experimental Project Course	KZ	8
"The Design Project course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principle	s, methodologies,	and tools used
in designing technology-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design		-
experts, and learn to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their sl	kills in user-center	ed design and
user experience evaluation, as well as gain experience working in a team to design and prototype a functional solution."		-
NI-GLR Games and reinforcement learning	Z,ZK	4
NI-GLR Games and reinforcement learning The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelli	1 1	
NI-GLR Games and reinforcement learning The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelli give you both theoretical and practical background so you can participate in related research activities. Presented in English.	gence. This course	e is intended to
NI-GLR         Games and reinforcement learning           The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligive you both theoretical and practical background so you can participate in related research activities. Presented in English.           NI-GNN         Graph Neural Networks	gence. This course	e is intended to
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NI-IAM	Internet and Multimedia	Z,ZK	4
The NI-IAM course is for	cused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes ac	equisition of AV sig	gnals (input),
	als (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practic		
	ns. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the		-
	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.		7 71/	4
NI-IOT	Internet of Things	Z,ZK	4 available
-	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).		available
FITE-EHD		Z,ZK	3
	Introduction to European Economic History a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global e	· ·	
	tory. As European countries have been dominant actors in this process it focuses predominantly on their roles in the econom		-
	to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial inst	-	-
	economic history of particular European countries but rather the impact of trade and role of particular events, institutions and		
	a mixture of lecture and discussion.	0	
NI-KTH	Combinatorial Theories of Games	Z,ZK	4
Traditional game theory	is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stu	· ·	ur of agents
	mpetitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game		-
which are the states of t	he game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player	ayer full-information	on combinatorial
games, was by Conway	Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea	is to evaluate gar	mes such that
otherwise incompatible	games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The the	nird most importa	nt step is the
work of Beck, who esta	blished the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force	e traversal of the g	ame tree, which
is no efficient. Beck intr	oduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory	ry of combinatoria	I and positional
-	poretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course is	-	-
	se, think and proof. The course is also suitable for bachelors student in the third year, who attended introduction to graph the	ory, as well as for	PhD students
looking for research top			
NI-FMT	Finite model theory	Z,ZK	4
	to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiability		
	tion in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as	descriptive comp	lexity theory, the
	Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.		
NI-CCC	Creative Coding and Computational Art	KZ	4
	cal tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows t		
	udents to suitable visualization methods for traditional as well as for open data. It combines well-known visualization techniqu		-
-	he aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture an	nd Metropolitan Pl	anning) and IIM
(Institute of Intermedia			
NI-KYB	Cybernality	ZK	5
	d with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the		
	tems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker a	activities and beha	avior. The course
	peration of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams).		
NI-LSM2	Statistical Modelling Lab	KZ	5
	vanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the pre	sence of clutter, c	or video tracking.
	he-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli) filters.		
NI-LOM	Linear Optimization and Methods	Z,ZK	5
	cations of optimization methods in computer science, economics, and industry. They are aware of practical importance of lines		
	timization software and are familiar with languages used in programming of that software. They get skills in formalization of o		
	uling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, trav		
	and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems. T	ney get orientatio	on in algorithms
in linear programming.		7 71/	4
NI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
	s of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scot	t model of lambda	a calculus.
Introduction to category			
NI-MZI	-		4
I in this course students	Mathematics for data science	Z,ZK	4
	Mathematics for data science are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in	n data science. Th	ne studied topics
include mainly: linear al	Mathematics for data science are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin	n data science. Th	ne studied topics
include mainly: linear al selected notions from p	Mathematics for data science are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used ir gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin robability theory and statistics.	n data science. Th ciple, gradient me	e studied topics ethods) and
include mainly: linear al selected notions from p	Mathematics for data science are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin robability theory and statistics. Modern IT infrastructure	n data science. Tr ciple, gradient me Z,ZK	e studied topics ethods) and 5
include mainly: linear al selected notions from p FIT-ITI NI-MOP	Mathematics for data science         are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in         gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin         robability theory and statistics.         Modern IT infrastructure         Modern Object-Oriented Programming in Pharo	n data science. Tr ciple, gradient me Z,ZK KZ	ethods) and 5
include mainly: linear al selected notions from p FIT-ITI NI-MOP Object-oriented program	Mathematics for data science         are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in         gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin         robability theory and statistics.         Modern IT infrastructure         Modern Object-Oriented Programming in Pharo         nming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, when	n data science. Tr ciple, gradient me Z,ZK KZ ere its ability to na	e studied topics ethods) and 5 4 tural abstraction
include mainly: linear al selected notions from p FIT-ITI NI-MOP Object-oriented program is used to build complex	Mathematics for data science         are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin robability theory and statistics.         Modern IT infrastructure         Modern Object-Oriented Programming in Pharo         nming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the s	n data science. Tr ciple, gradient me Z,ZK KZ ere its ability to na kills of design and	e studied topics ethods) and 5 4 tural abstraction l implementation
include mainly: linear al selected notions from p FIT-ITI NI-MOP Object-oriented program is used to build complex of object systems in mo	Mathematics for data science         are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in gebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prin robability theory and statistics.         Modern IT infrastructure         Modern Object-Oriented Programming in Pharo         nming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, whe modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the s dern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development	n data science. Tr ciple, gradient me Z,ZK KZ ere its ability to na kills of design and reeds and areas	e studied topics ethods) and 5 4 tural abstraction l implementation o finterest. In
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NI-NMU New media in art and design	ZK	3
The course introduces students to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game	and sound. The m	ain goal is to
familiarize the student with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especial	ally in lectures dev	oted to specific
art projects.	7 71/	4
NI-OLI Linux Drivers The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combinin		4
increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver developm		
course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience		
NIE-PML Personalized Machine Learning	Z,ZK	5
Personalized machine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteris		
entities. While PML is commonly used in applications such as recommender systems, which recommend items to users based on their personal inte		
to a wide range of other fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from the perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial communities.	eoretical, algorithn	nic, and practical
NI-ARI Computer arithmetic	Z,ZK	4
Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementation units.	2,213	-
NI-PG1 Computer Grafics 1	ZK	4
The course builds on graphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge	e. The course is de	esigned for those
interested in advanced computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of		-
articles and their subsequent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas an		
NI-PIV Computer Vision	Z,ZK	5
The Computer Vision course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing the basic principles of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theore		
practical applications and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, colo	-	
and recognition and segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (incl		
motion detection, visual expressiveness (saliency).		
NI-EDW Enterprise Data Warehouse Systems	Z,ZK	5
The Enterprise Data Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods		-
not only in designing warehouses and various architectures, but also their deployment and maintenance. This course also includes an introduction to	o the area of repo	rting and data
Visualization.       NI-PVR     Advanced Virtual Reality	KZ	4
NI-PVR Advanced Virtual Reality The course introduces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D m	1	•
things, it introduces students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will		-
in available 3D engines (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply th		
in virtual reality, or directly create a complex game for VR.		
NI-AML Advanced machine learning	Z,ZK	5
The course introduces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field o		
processing, control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with the		
NI-IOS Advanced techniques in iOS applications Students will learn the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the	KZ	4 beginners class
BI-IOS.		beginners class
NI-APT Advanced Program Testing	Z,ZK	5
Testing a program is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The	goal of the course	e is to present
advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution.		
NI-PVS Advanced embedded systems	Z,ZK	4
The course is focused on ARM processors and microcontrollers and their usage in wide range of applications. The course includes a series of adva		
working with mass storage devices, motor control, system control and industrial communication. The students obtain both theoretical and also pract systems.	ical experiences w	htn embedded
NI-DNP Advanced .NET	Z,ZK	4
Students will acquire an overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET MAUI		
get notions of Azure DevOps and GIT. Students will get practical experience in semestral work where they will create a client-server application utilized		
Entity Framework Core and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT.		
NI-PYT Advanced Python	KZ	4
The goal of this course is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Python.		
very hands-on and it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursew	vork. The course is	lead by external
teachers from Red Hat.           NIE-PDL         Practical Deep Learning	KZ	5
NIE-PDL Practical Deep Learning This course is designed to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine	1	-
the course, students will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields su	-	-
language processing.		
NI-GOL Programming of distributed systems in GO	KZ	5
NI-PSL Programming in Scala	Z,ZK	4
The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language 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. l	-lay, Cassandra,
Scalaz, etc.	V7	4
NI-RUB Programming in Ruby This course is presented in Czech.	KZ	4
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		
NI-PLS1 Programming Language Seminar	Z	2
The Programming Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in whi	ch we discuss scie	entific papers
about programming languages and related fields. Participating students are expected to present a paper of their interest and actively participate in t	he discussions. Th	e reading group
is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		

NI-PLS3 Programmi			
	ng Language Seminar	Z	2
	aims to introduce students to research in programming languages. It has the format of a reading group in which	ch we discuss scie	entific papers
about programming languages and rela	ated fields. Participating students are expected to present a paper of their interest and actively participate in the	ne discussions. Th	e reading group
is a joint venue between FIT and MFF	CUNI. It is open to all students and researchers interested in programming languages.		
NI-PLS2 Programmi	ng Language Seminar	Z	2
	aims to introduce students to research in programming languages. It has the format of a reading group in which		
	ated fields. Participating students are expected to present a paper of their interest and actively participate in the		
	CUNI. It is open to all students and researchers interested in programming languages.		lo rouding group
		Z	2
	ng Language Seminar	_	
	aims to introduce students to research in programming languages. It has the format of a reading group in which		
	ated fields. Participating students are expected to present a paper of their interest and actively participate in the	ne discussions. I h	ie reading group
	CUNI. It is open to all students and researchers interested in programming languages.		
	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 resistand	ce to failures and a	attacks. Students
are approached individually within the s	subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of t	the subject is wor	k with scientific
articles and other professional literature	e and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar tead	chers. The topics a	are new for each
semester.			
NI-SCE2 Computer I	Engineering Seminar Master II	Z	4
	is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance		-
	subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of t		
		-	
	e and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar tead	chers. The topics a	are new ior each
semester.			
-	Engineering Seminar Master I	Z	4
	arch paper from a top institute / research group to your peers. You will learn what is being cooked in top resea		
Additionally, you will learn how to proper	ly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma	chine learning and	d AI conferences
and summer schools, as well as FIT's of	own Summer Research Program (VyLet).		
NI-SZ2 Knowledge	Engineering Seminar Master II	Z	4
-	arch paper from a top institute / research group to your peers. You will learn what is being cooked in top resea	arch labs around t	he world.
	ly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma		
	own Summer Research Program (VyLet).	ioninio locarining ant	
		71/	4
	n Digital Design	ZK	4
	lization and implementation of digital circuits - both combinational and sequential. Basic means of description	-	-
	are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial p	oroblems emerain	a in EDA.
			-
NI-MLP Machine Le	earning in Practice	Z,ZK	5
	earning in Practice real projects in practice involves many other necessary tasks - from understanding the intentions of the client to	Z,ZK	5
Applying machine learning methods to r	•	Z,ZK , ideally, technical	5 implementation.
Applying machine learning methods to r The course guides students through all	eal projects in practice involves many other necessary tasks - from understanding the intentions of the client to	Z,ZK , ideally, technical cally. The aim is to	5 implementation. experience real
Applying machine learning methods to r The course guides students through all data processing and learn how to desc	real projects in practice involves many other necessary tasks - from understanding the intentions of the client to phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practic ribe the whole process from exploration to evaluation of the model performance in the form of a clear and unc	Z,ZK , ideally, technical cally. The aim is to derstandable repo	5 implementation. experience real rt.
Applying machine learning methods to r The course guides students through all data processing and learn how to desc FIT-SEP World Ecor	real projects in practice involves many other necessary tasks - from understanding the intentions of the client to phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practic ribe the whole process from exploration to evaluation of the model performance in the form of a clear and unc nomy and Business	Z,ZK , ideally, technical cally. The aim is to derstandable repo Z,ZK	5 implementation. experience real rt. 4
Applying machine learning methods to r The course guides students through all data processing and learn how to desc FIT-SEP World Econ This course is presented in Czech. The	real projects in practice involves many other necessary tasks - from understanding the intentions of the client to phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practic ribe the whole process from exploration to evaluation of the model performance in the form of a clear and unc nomy and Business course introduces students of technical university to the international business. It does that predominantly by	Z,ZK , ideally, technical cally. The aim is to derstandable repo Z,ZK v comparing indivi	5 implementation. experience real rt. 4 dual countries
Applying machine learning methods to r         The course guides students through all         data processing and learn how to desc         FIT-SEP       World Ecor         This course is presented in Czech. The         and key regions of world economy. Students	real projects in practice involves many other necessary tasks - from understanding the intentions of the client to phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practice ribe the whole process from exploration to evaluation of the model performance in the form of a clear and uncon nomy and Business course introduces students of technical university to the international business. It does that predominantly by ents get to know about different religions and cultures, necessary for doing business in diverse societies as well	Z,ZK , ideally, technical cally. The aim is to derstandable repo Z,ZK v comparing indivi Il as indexes of eco	5 implementation. experience real rt. 4 dual countries onomic freedom,
Applying machine learning methods to r The course guides students through all data processing and learn how to desc FIT-SEP World Ecor This course is presented in Czech. The and key regions of world economy. Stud corruption and economic development,	real projects in practice involves many other necessary tasks - from understanding the intentions of the client to phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practice ribe the whole process from exploration to evaluation of the model performance in the form of a clear and uncomposed normal Business course introduces students of technical university to the international business. It does that predominantly by lents get to know about different religions and cultures, necessary for doing business in diverse societies as well which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of the form of the form	Z,ZK , ideally, technical cally. The aim is to derstandable repo Z,ZK v comparing indivi Il as indexes of eco	5 implementation. experience real rt. 4 dual countries onomic freedom,
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	ory of Neural Networks			1	,ZK	5
-	al networks from the point of view of the theory of function approximation and from the p	-	-	-		
	letworks, such as neurons and connections between them, types of neurons from the po-		•			
	raining, and the role of time in neural networks. In connection with network topology, we					
	ic and synaptic mappings, with their composition into mappings computed by the Netwo o the fact that training is actually a specific optimization task, recalling the most typical o	-		-		
-	raining. We will see the meaninig of all these concepts in the context of common kinds of	-		-	-	
	tice the connection of neural networks to expressing functions of many variables using			-		
	see how the universal approximation capacity of neural networks can be mathematically					
· · · · ·	ach spaces of functions, in particular in the spaces of continuous functions, spaces of fu					
functions with continuous der	ivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquai	inted with traini	ng based on	expectatio	n and training	based on a
random sample, and with pro	pabilistic assumptions about training data with which those two kinds of neural networks	can be employe	ed. We will se	e how it is	possible to ge	t an estimate
of the conditional expectancy	of network outputs conditioned by its inputs using the expectancy based learning. We re	ecall the strong	and the wea	ak law of lai	rge numbers a	ind get
	f the strong law of large numbers for neural networks and with the assumptions for its va				-	-
	works, with the assumptions for its validity and with the hypothesis tests based on it. We	e will see how th	nose tests ca	an be emplo	oyed to search	for the
topology of the network.						
	nplexity Theory				,ZK	5
	fundamental classes of problems in the complexity theory and different models of algori	itms and about i	implications	of the theo	ry concerning	practical
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'	idemic writing				Ζ	2
	d required part of research activity. It is not only about obtaining research results but also		-	-		-
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	parts such an article should have, and how the peer review process works. Students will a	-	-	-		-
on the availability of enrolled	be taught in blocks, with one lecture at the beginning of the semester and one practicum	n in the middle (	or the series	ster. Dates	will be determ	neu baseu
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	oduction to Discrete and Computational Geometry ce the students to the discipline of Discrete and Computational Geometry. The main goal	l of the course i	s to got famil		Z,ZK	-
	le to solve simple algorithmic problems with a geometric component.		s to get lattil		most fundam	
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	ctions ommittee) elections and, in general, opinion aggregation.			2	Z,ZK	5
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	functions and effective computability.			2	.,∠r\	4
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	search Project				Ζ	5
	r published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en.				7	10
	ster internship abroad for 10 credits	an aniontifia and	l/or rococrob	institution	- 1	10 ornahin tha
	his / her master's degree have a foreign internship at a foreign university or other foreig an for study affairs assesses the professional content. The student must provide evidenc	-				-
Deali of the FTI, of the vice-ut		ce of the profess	ional conten	i anu exien		nip. Auxilial y
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NI-ADP	Architecture and Design patterns Filip K ikava, Jan Kurš, Jan Zimolka, Tomáš Chvosta, Ji í Borský <b>Jan Kurš</b> 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 Ond ej Tichý, Kamil Dedecius Ond ej Tichý Kamil Dedecius (Gar.)	KZ	5	2P+1C	L	v
NI-BVS	Embedded Security Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	L	v
NI-BKO	Error Control Codes Pavel Kubalik Pavel Kubalik Pavel Kubalik (Gar.)	Z,ZK	5	2P+1C	L	v
NI-DSV	Distributed Systems and Computing Pavel Tvrdik Jan Fesl Pavel Tvrdik (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 Daniel Langr Daniel Langr (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-EVY	Efficient Text Pattern Matching Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-FME	Formal Methods and Specifications Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	L	v
NI-GEN	Code Generators Petr Máj, Jan Janoušek <b>Petr Máj</b> Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-GAK	Graph theory and combinatorics Michal Opler Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	5	2P+2C	L	v
NI-HWB	Hardware Security Ji í Bu ek <b>Ji í Bu ek</b> (Gar.)	Z,ZK	5	2P+2C	L	v
NI-KOD	Data Compression Jan Holub Jan Holub Jan Holub (Gar.)	Z,ZK	5	2P+1C	L	V
NI-MKY	Mathematics for Cryptology Martin Jure ek, Róbert Lórencz Róbert Lórencz (Gar.)	Z,ZK	5	3P+1C	L	v
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MPJ	Modelling of Programming Languages	Z,ZK	5	2P+1C	Z	V
NI-MTI	Modern Internet Technologies Viktor erný, Alexandru Moucha Alexandru Moucha Alexandru Moucha (Gar.)	Z,ZK	5	2P+1C	z	V
NI-NUR	User Interface Design Josef Pavlí ek Josef Pavlí ek Josef Pavlí ek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-NON	Nonlinear Continuous Optimization and Numerical Methods Jaroslav Kruis Jaroslav Kruis Jaroslav Kruis (Gar.)	Z,ZK	5	2P+1C	Z,L	V
NI-NSS	Normalized Software Systems Robert Pergl, Marek Suchánek, Jan Verelst Robert Pergl Robert Pergl (Gar.)	ZK	5	2P	L	V
NI-OSY	<b>Operating Systems and Systems Programming</b> Petr Zemánek, Tomáš Martinec <b>Petr Zemánek</b> Petr Zemánek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-KRY	Advanced Cryptology Ji í Bu ek, Róbert Lórencz <b>Ji í Bu ek</b> Róbert Lórencz (Gar.)	Z,ZK	5	2P+2C	Z	V
NI-PDB	Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-GPU	GPU Architectures and Programming Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	L	V
NI-PDD	Data Preprocessing Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-REV	Reverse Engineering Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	1P+2C	Z	v
NI-RUN	Runtime Systems Filip K ikava Fili <b>p K ikava</b> Filip K ikava (Gar.)	Z,ZK	5	2P+1C	L	v
NI-SWE	Semantic Web and Knowledge Graphs Milan Doj inovski, Jakub Klímek Milan Doj inovski Milan Doj inovski (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-SIM	Digital Circuit Simulation and Verification Martin Kohlik Martin Kohlik Martin Kohlik (Gar.)	Z,ZK	5	2P+1C	L	v
NI-SIB	Network Security Ji í Dostál, Simona Forn sek, Martin Šutovský, Martin Holec Simona Forn sek Ji í Dostál (Gar.)	Z,ZK	5	2P+1C	L	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 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 Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	v
NI-TES	<b>Systems Theory</b> Ji í Vysko il, Stefan Ratschan <b>Stefan Ratschan</b> 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 <b>Tomáš Vondra</b> Tomáš Vondra (Gar.)	Z,ZK	5	2P+1C	L	V
NI-APR	Selected Methods for Program Analysis Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-PON	Selected Topics in Optimization and Numerical mathematics Karel Klouda, Št pán Starosta, Daniel Vašata Daniel Vašata Št pán Starosta (Gar.)	Z,ZK	5	2P+1C	L	V
NI-VMM	<b>Retrieval from Multimedia</b> Ji í Novák, Tomáš Skopal <b>Jaroslav Kucha</b> Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MCC	Multicore CPU Computing Daniel Langr, Ivan Šime ek 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 archite	ctures, 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	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	e to design advanc	ed UIs.
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	ering, 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		-
architecture. In the second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements		
functionality of information systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stal	bility and entropy-re	elated principles.
This knowledge allows students to realize new levels of evolvability in software architectures.		
NI-PDB Advanced Database Systems	Z,ZK	5
Students orient themselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of datal		
databases), with the related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, C' the course deals with performance evaluation of database machines.	TPHER, Gremin).	The last part of
	Z.ZK	5
NI-ADM Data Mining Algorithms The course focuses on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the stude	1 ' 1	-
basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation		-
methods).	by clothic, and mos	
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, s	1	
principles of cryptographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware dete		
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 analysi	is as well as with u	inderstanding of
the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowled	ge of object-orient	ed programming
and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design proble		
	ms. 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 syst		
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syst architectures used in large-scale distributed systems.	ems, and some ad	vanced software
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syst architectures used in large-scale distributed systems.         NI-BML       Bayesian Methods for Machine Learning	ems, and some ad	vanced software
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syst architectures used in large-scale distributed systems.         NI-BML       Bayesian Methods for Machine Learning         The subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it stude	ems, and some ad	vanced software 5 on of appropriate
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syst architectures used in large-scale distributed systems.         NI-BML       Bayesian Methods for Machine Learning         The subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it stude models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidde	ems, and some ad	vanced software 5 on of appropriate object position
will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based syst architectures used in large-scale distributed systems.         NI-BML       Bayesian Methods for Machine Learning         The subject is focused on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it stude models providing description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidder from noisy observations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose	ems, and some ad KZ dies the construction en variables (true of e, a number of real	vanced software 5 on of appropriate object position world examples
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	Efficient Text Pattern Matching	Z,ZK	5
Students get knowledge	e of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both ac		nory 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
Students are able to de	scribe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some	e software tools th	at allow to prove
basic properties of soft	Nare.		
NI-GEN	Code Generators	Z,ZK	5
Advanced techniques of	f translating programs written in high-level programming languages are essential for understanding the field of systems progr	ramming. This prin	narily involves
understanding the algo	rithms and techniques used to translate more complex programming constructs of modern languages employed in systems pr	rogramming. Stude	ents will become
familiar with both the th	eoretical and practical aspects of implementing the back-end of optimizing compilers for programming languages.		
NI-GAK	Graph theory and combinatorics	Z,ZK	5
The goal of the class is	to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorithm	ms. The emphasis	will be not only
on undestanding the ba	sic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected	topics from graph	and hypergraph
coloring, Ramsey theor	y, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory	ry will be also app	lied in the fields
	rds, formal languages and bioinformatics.		
NI-HWB	Hardware Security	Z,ZK	5
The course provides th	e knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safegua	ards against abus	e of the system
using hardware means	They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Stud	dents will gain kno	wledge about
the cryptographic acce	erators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the co	omputer.	
NI-KOD	Data Compression	Z,ZK	5
Students are introduce	d to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of da	ata compression m	ethods being
used in practice. The or	verview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, st	tudents learn the	undamentals of
lossy data compression	n methods used in image, audio, and video compression.		
NI-MKY	Mathematics for Cryptology	Z,ZK	5
Students will gain deep	er knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphers.	In particular, the o	ourse focuses
on the problem of solvi	ng a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of discr	ete logarithm. The	problem of
factorization will also be	e solved on elliptic curves. Students will further become familiar with modern encryption systems based on lattices.		
NI-MVI	Computational Intelligence Methods	Z,ZK	5
Students will understar	d methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to	many problems. T	hey will learn
how these methods wo	rk and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.		-
NI-MPJ	Modelling of Programming Languages	Z,ZK	5
	ation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserv		of the language.
	e semantics of programming languages. The students will learn the language models with emphasis on functional languages, stu		
the basics of the lambd	a calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with sema	intic modeling and	execution tools.
NI-MTI	Modern Internet Technologies	Z.ZK	5
SYNOPSIS The subject	t "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration	i - A single networ	k, oriented on
TCP/IP is able to carry	whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, vid	leo and data to ac	hieve seamless
integrated services. 2. I	Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundre	de of millione of u	
of devices. Thus, there			sers and billions
	is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching and		
	is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Iraffic Segregation, Iraffic rice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela	d Traffic Prioritisat	ion - These
technologies allow serv		d Traffic Prioritisat ay, jitter, type of pr	ion - These
technologies allow serv	rice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela	d Traffic Prioritisat ay, jitter, type of pr	ion - These
technologies allow serv Acceleration Technolog	ice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela ies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of f	d Traffic Prioritisat ay, jitter, type of pr failures.	ion - These otocol). 4. 5
technologies allow serv Acceleration Technolog NI-NON Students will be introdu	rice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela ies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of f Nonlinear Continuous Optimization and Numerical Methods	d Traffic Prioritisat ay, jitter, type of pr failures. Z,ZK thods to real-world	ion - These otocol). 4. 5 I problems. They
technologies allow serv Acceleration Technolog NI-NON Students will be introdu will also learn the finite	rice providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela ies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of f Nonlinear Continuous Optimization and Numerical Methods ced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such met	d Traffic Prioritisat ay, jitter, type of pr failures. Z,ZK thods to real-world hey will learn to so	ion - These otocol). 4. 5 I problems. They olve systems of
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the course is on the seminars, where students will solve practically oriented tasks from the real world.

		1
NI-RUN Runtime Systems	Z,ZK	5
This course is an introduction to the world of virtual machines (VM) for high-level programming languages. There are two goals: Give you hands-on exp	-	
of a compiler and a VM from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC con Just-in-time compilation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implement		-
Dynamic optimizations, speculations, and deoptimizations Language implementation frameworks Read-world VMs		ia vivis, including
NI-SWE Semantic Web and Knowledge Graphs	Z,ZK	5
The students will learn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web		
practices for modelling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowle	-	
quality assurance.		-
NI-SIM Digital Circuit Simulation and Verification	Z,ZK	5
The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction	Level Modeling) lev	els and with the
properties of proper tools. 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 course deals with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange p		
problems (modelling of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a		
its parameters, analyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the real-world examples. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward		-
the academic to the real world.		knowledge nom
NI-SLA Sublinear algorithms	Z,ZK	5
We will introduce three methods to tackle algorithms working in sublinear space.		5
NI-SYP Parsing and Compilers	Z,ZK	5
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledg		-
of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.		
NI-SBF System Security and Forensics	Z,ZK	5
Students will get familiar with aspects of system security (principles of end station security, principles of security policies, security models, authent		
students will get familiar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and for	orensic analysis tec	hniques and the
importance of operating 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 (e.g., trains, microprocessors, airplanes, nuclear power plants). How		
complexity and of ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage		-
aspects of the systems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory ar the modeling and analysis of complex systems.	id algorithms that it	orm the basis lor
NI-TSP Testing and Reliability	Z,ZK	5
Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able t	1 1	-
the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems w		
will be able to compute, analyze, and control the reliability and availability of the designed circuits.		
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 prog	ramming and autom	nated planning.
The main principles and practical applications of discussed techniques will be illustrated.		
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		
systems, that profit from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discu	ssed, including star	idardized means
of internal communication, parallelism extraction and utilization in special structures and system architectures.	7 71/	
NI-ESW Embedded Software Embedded software course acquainted students with the specifics of software development for embedded systems. The course covers the areas from	Z,ZK	5
in C language and code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processir	-	
combined with artificial intelligence.	.g, up to copinioned	ou toorninquoo
NI-VCC Virtualization and Cloud Computing	Z,ZK	5
Students will gain knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies a	1 7	1
acquainted with virtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to	efficiently operate a	nd optimize the
performance parameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effective of the systems.		-
management of complex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical s	skills in the use of m	odern integration
and development tools (Continuous integration and development).		
NI-APR Selected Methods for Program Analysis	Z,ZK	5
This course introduces you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and we will look at the art of reasoning about computer programs without running them. We will look at the analyses for program understanding, optim		-
Analysis, we will look at the analyses considering individual program runs using a concrete environment and inputs.		
Nil-PON         Selected Topics in Optimization and Numerical mathematics	Z,ZK	5
The course focuses on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge		1
in the course Mathematics for informatics. The methods are explained and described along with the details on how they are implemented on comp	-	
of numerical matematics, mainly numerical linear algebra, are explained too.		
NI-VMM Retrieval from Multimedia	Z,ZK	5
The student obtains general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods	of feature extraction	from multimedia
objects, indexing, and structure of distributed search engines.		
NI-MCC Multicore CPU Computing	Z,ZK	5
Students will get acquainted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations	-	
and virtually shared memories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain know optimization techniques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPL		
On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications.	s and memory lifte	

### List of courses of this pass:

Code	Name of the course	Completion	Credits
FI-TOP	Academic writing	Z	2
	portant and required part of research activity. It is not only about obtaining research results but also about applying them in the form of	-	-
	e useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the council cle, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an a		
	course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Da		-
	on the availability of enrolled students.		
FIT-ITI	Modern IT infrastructure	Z,ZK	5
FIT-SEP	World Economy and Business	Z,ZK	4
	sented in Czech. The course introduces students of technical university to the international business. It does that predominantly by co	1 0	
	vorld economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as nomic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of di		
corruption and eco	readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.	scussions based c	ni inuiviuuai
FITE-EHD	Introduction to European Economic History	Z,ZK	3
	ices a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global eco	•	
	in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic		
	bire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institution and a standard standard standard standards for a standard standards.		
does not cover de	tailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and o meetings will consist of a mixture of lecture and discussion.	rganizations in his	tory. Class
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	,	-
	sis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation syst		-
	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. I	, ,	0 0
e e	the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems,	•	
	architectures used in large-scale distributed systems.		
NI-AFP	Applied Functional Programming	KZ	5
This course is pres	ented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional pi	rogramming langu	ages are on
the rise nowadays	and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, master	ing this paradigm I	pecomes a
NI-AIB	necessary competence of a software engineer: the theory and especially the practice.	Z.ZK	5
	Algorithms of Information Security quainted with the algorithms of secure key generation and cryptographic error (not only biometric) data processing. Furthermore, stude	,	
-	tographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware detect		
	learning in detection systems. The last topic includes practical steganographic methods and attacks on steganographic system	ms.	
NI-AM1	Middleware Architectures 1	Z,ZK	5
	y new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information syste		
architecture and ap	ication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous comm of applications.	unications and hig	h availability
NI-AM2	Middleware Architectures 2	Z,ZK	5
	new trends and technologies on the Web including theoretical foundations. They will gain an overview of Web application architecture		
	for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.		
NI-AML	Advanced machine learning	Z,ZK	5
	es students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of rec	-	-
NI-AOA	control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with t	_	
	Completing a professional event cipation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, concluded with a workshop, a test, draftir	Z ng a report etc Su	1 ch an event
	in advance by the vice-dean for pedagogical activities or the vice-dean for science and research and is presented within the FIT through		
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 p	hilosophical
	ill get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base con	-	-
part of most game	An imposite the second seco	rtant part of the co	ourse is an
NI-APR	Selected Methods for Program Analysis	Z,ZK	5
	ces you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and dynam		
	int of reasoning about computer programs without running them. We will look at the analyses for program understanding, optimization	-	-
	Analysis, we will look at the analyses considering individual program runs using a concrete environment and inputs.		
NI-APT	Advanced Program Testing	Z,ZK	5
Testing a program	is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The go	al of the course is	to present
	advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution.	7 71/	A
NI-ARI	Computer arithmetic Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementat	Z,ZK	4
L			

NI-ATH	AlgorithmicTheories of Games	Z,ZK	4
-	theory is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory stud		-
	ain 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. Due to the recent development of computers, internet, social network	-	-
	s and other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of ef		-
	concepts. In this course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods o		
NI-BKO	Error Control Codes	Z,ZK	5
The goa	I of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transm	nitted via channels	5.
NI-BML	Bayesian Methods for Machine Learning	KZ	5
-	sed on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studies t		
	description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden v tions etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose, a i		-
•	vill be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging.		
	some of them.		,
NI-BPS	Wireless Computer Networks	Z,ZK	4
	about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad		
broadcast mechar	isms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowle		echanisms
	for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitab		F
NI-BUI	Business Informatics se is to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas of b	Z,ZK	5 anagement
	rchitectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT manageme	•	
	nd resource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governance	-	-
business and the	e context of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme	nt, revenue and in	vestment
	management, IT investment evaluation and human resources management in IT (roles CIO, CEO, CFO).		
NI-BVS	Embedded Security	Z,ZK	5
-	: knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of crypto bedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources	- · ·	
	of computer systems.	for securing interi	
NI-CAP	Cultural and Social Anthropology	ZK	2
The one-semester	course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversit	y of the world - exa	amples from
anthropological res	earch from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, health	n, history, death, e	tc) will be
	shown. The course is presented in Czech.		
NI-CCC	Creative Coding and Computational Art	KZ	4
-	ractical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows the ces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization technique		
.,	es. The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture and N		•
Ū.		•	0,
	(Institute of Intermedia FEL).		
NI-CPX	Complexity Theory	Z,ZK	5
-	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the		-
Students will lear	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems.	theory concerning	g practical
-	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems. Capture The Flag	theory concerning	-
Students will lear	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems. Capture The Flag The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber se	theory concerning KZ curity.	g practical
Students will lear NI-CTF NI-DDM	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems. Capture The Flag The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber se Distributed Data Mining	KZ KZ	g practical 4 4
Students will lear NI-CTF NI-DDM Course focuses on	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems. Capture The Flag The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber se	KZ curity. KZ n experience with	g practical 4 4 large scale
Students will lear NI-CTF NI-DDM Course focuses on	Complexity Theory n about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the (in)tractability of difficult problems. Capture The Flag The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber se Distributed Data Mining state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands of amework Apache Spark and with existing distributed DM / ML algorithms. The ywill learn principles of their parallel implementations a approaches to parallelize other algorithms. The course is prezented in czech language.	KZ curity. KZ on experience with nd will be capable	g practical 4 4 large scale to propose
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NI-DSW Design Sprint Z Students will work on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to validated prototype in 5 days. the course the students will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting with research and finishing	2
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	-
testing the prototypes (plus final presentation).	
NI-DVG Introduction to Discrete and Computational Geometry Z,ZK	5
The course intends to introduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar with the most fundamental	notions
of this discipline, and to be able to solve simple algorithmic problems with a geometric component.	
NI-DZO Digital Image Processing Z,ZK	4
This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both e	easy to
implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the	domain
of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurri	ng in
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhance	ement,
interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matt	ting.
NI-EDW Enterprise Data Warehouse Systems Z,ZK	5
The Enterprise Data Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods and will gain practical know	-
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	d 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 emb	
systems, that profit from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discussed, including standardized	means
of internal communication, parallelism extraction and utilization in special structures and system architectures.	
NI-EMZ         Master Management economics course from a study abroad         Z	4
The master's management-economic course "Management economics course from a study abroad" covers in the study plan the nature of the economics elective subjects acquine active subjects acquine active subject acquine active subject acquine active subject acquine active active subject acquine active active subject active subject acquine active a	
students as part of their trip abroad. Completion by compensation is therefore assumed. Recognition is decided by the vice-dean for study and pedagogical activities on behal	f of the
dean and on the basis of the student's request.	
NI-EPC Effective C++ programming Z,ZK	5
Students learn how to use the modern features of contemporary versions of the C++ programming language for software development. The course focuses on programming eff	fectivity
and efficiency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor time requirements.	
NI-ESC Experimental Project Course KZ	8
"The Design Project course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principles, methodologies, and tool	
in designing technology-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design projects, collaborate with in	
experts, and learn to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their skills in user-centered desig	jn and
user experience evaluation, as well as gain experience working in a team to design and prototype a functional solution."	
NI-ESW Embedded Software Z,ZK	5
Embedded software course acquainted students with the specifics of software development for embedded systems. The course covers the areas from the basic techniques of progra	•
in C language and code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing, up to sophisticated techn	nques
combined with artificial intelligence.	
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 access time and memory com	ipiexity.
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
Students are able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to	
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Cognitive security is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, information systems and ass	5
	ets,
the domain of cognitive security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive security is growing in importance	e in
the context of information warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Internet environment have real soc	ietal
impacts such as disruption of social cohesion, threats to democracy or war.	
NI-HMI2 History of Mathematics and Informatics ZK 3	3
This course is presented in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithms, transformations, recursi	ve
functions, eliptic curves, etc.) note on possibilities of applications of some mathematical methods in informatics and its development.	
NI-HPZ Master humanities from a study abroad Z 2	)
Master course "Humanities that has been studied abroad" is covered by the Humanities from a study abroad in Compulsory Humanities Module that is required in the curriculum.	The
substitution is approved by the Vice-Dean for study affairs on behalf of the Dean at the request of the student.	
NI-HSC Side-Channel Analysis in Hardware Z,ZK	ŀ
This course is dedicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical attacks. Students get familiar w	ith
various kinds of side channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and get familiar with higher-or	der
attacks. They also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel information leakage.	
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 safeguards against abuse of the systems	stem
using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge ab	out
the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer.	
NI-IAM Internet and Multimedia Z,ZK 4	ł
The NI-IAM course is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acquisition of AV signals (input	ut),
presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical use case scenarios of real-	·time
audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effect of various components	s on
the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the scene up to the present	ation
for audience.	
NI-IBE Information Security ZK 2	2
Students learn information and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and international standards in this area. T	hey
understand methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., penetration testing).	
NI-IKM Internet and Classification Methods Z,ZK 4	ł
In this course, the students get acquainted with classification methods used in four important internet, or generally network applications: in spam filtering, in recommendation syst	ems,
in malware detection systems and in intrusion detection systems. However, they will learn more than only how classification is performed when solving these four kinds of proble	ms.
On the background of these applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycle with 2-hour lectures and 2-	hour
exercises. During the exercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult their semester tasks.	
NI-IOS Advanced techniques in iOS applications KZ 4	•
Students will learn the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the basics from the beginners of	class
BI-IOS.	
NI-IOT Internet of Things Z,ZK 4	ł
The subject is focused on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is familiarization with available	
	9
development elements (Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth).	
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development elements (Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth).         NI-IVS       Intelligent embedded systems       KZ       A         Intelligent embedded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The course is an advance verse of the Intelligent embedded system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot programming and advance applicat development. Lectures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students develop advanced applicat combining knowledge of various courses like nature inspired algorithms, data mining algorithms, image recognition and web technologies       Z,ZK       E         NI-KOD       Data Compression       Z,ZK       E         Students are introduced to the basic principles of data compression methods used in image, audio, and video compression. Lossy data compression methods used in image, audio, and video compression.       Z,ZK       E         NI-KOP       Combinatorial Optimization       Z,ZK       E         NI-KOP       Combinatorial Optimization       Z,ZK       E         NI-KOP       Combinatorial Optimization       Z,ZK       E         Students will gain knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not only to select and implement also to apply and evaluate heuristics for practical problems.       Z,	Lision tion tions bring als of b b but
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Intelligent         Intelligent         Intelligent         Intelligent         KZ         AZ           NI-IVS         Intelligent embedded systems         KZ         A           Intelligent embedded systems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The course is an advance applicat development. Lectures provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students develop advanced applicat combining knowledge of various courses like nature inspired algorithms, data mining algorithms, data mining algorithms, data compression methods be used in practice. The overview of data compression methods used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentar lossy data compression methods used in image, audio, and video compression.         Z,ZK         Z           NI-KOP         Combinatorial Optimization         Z,ZK         Z         Z           NI-KOP         Combinatorial Optimization         Z,ZK         Z	Letter to the second se
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Intervent         Intelligent         Intelligent <thintelligent< th=""> <thintelligent< th="">         &lt;</thintelligent<></thintelligent<>	Lesion tions being als of being to but bill that the vhich onal billity ents band

NI-LNG	Introduction to Linguistics for IT Students	ZK	2
	course should provide a gentle introduction to linguistics and language research for students majoring in IT and programming. Stude	<b>a</b> 1	
concepts used in la	inguage descriptions as well as major theories influencing the current mainstream in linguistics. Specific attention will be paid to empi	irical and quantitati	ve methods
	in linguistics, including the use of language corpora, and to specific issues of Czech.		
NI-LOM	Linear Optimization and Methods	Z,ZK	5
	applications of optimization methods in computer science, economics, and industry. They are aware of practical importance of linear a		• •
	th optimization software and are familiar with languages used in programming of that software. They get skills in formalization of optir scheduling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, travell	-	-
	mics, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems. They		-
	in linear programming.	y get onemation in	aigonanno
NI-LSM2	Statistical Modelling Lab	KZ	5
	is advanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the preser	1 1	
	We aim at the state-of-the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli)		
NI-MCC	Multicore CPU Computing	Z,ZK	5
Students will get ac	equainted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations on mu		with shared
and virtually shar	red memories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain knowled	lge of architectural	y specific
optimization technic	ques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs and	-	throughput.
	On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications.		
NI-MEP	Modelling of Enterprise Processes	Z,ZK	5
The subject is f	focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approa	ch for (re)engineer	ing and
	implementation of processes, organisation structures and information support in big enterprises and institutions.		
NI-MKY	Mathematics for Cryptology	Z,ZK	5
-	deeper knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphers. In	-	
on the problem o	if solving a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of discre		roblem of
	factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems based on Machine Learning in Practice		F
	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
-	pgramming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where	1	-
	plex 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	• •	
addition to deepeni	ing object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work of	on interesting proje	cts and OO
technologies in ter	ms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involven	nent in the Pharo C	onsortium.
technologies in ter NI-MPI	ms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involver Mathematics for Informatics	nent in the Pharo C Z,ZK	consortium. 7
NI-MPI The course comp	Mathematics for Informatics prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis	Z,ZK sis, smooth optimiz	7 ation and
NI-MPI The course comp multi-variate integra	Mathematics for Informatics prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analys ation. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last top	Z,ZK sis, smooth optimiz pic includes selecte	7 ation and d numerical
NI-MPI The course comp multi-variate integra algorithm and their	Mathematics for Informatics prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analys 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-	Z,ZK sis, smooth optimiz pic includes selecte esentation and argu	7 ation and d numerical umentation.
NI-MPI The course comp multi-variate integra algorithm and their NI-MPJ	Mathematics for Informatics prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analys 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 Modelling of Programming Languages	Z,ZK sis, smooth optimiz pic includes selecte esentation and argu Z,ZK	7 ation and d numerical umentation. 5
NI-MPI The course comp multi-variate integra algorithm and their NI-MPJ The analysis, trans	Mathematics for Informatics           prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis ation. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last topic stability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear presentation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the language; in particular, they are correct if they preserve to the semantics of the semantics of the language; in particular, they are correct if they preserve to the semantics of the semantics to the semantics of the semantics of the semantics of	Z,ZK sis, smooth optimiz bic includes selecte esentation and argu Z,ZK he semantics of the	7 ation and d numerical umentation. 5 e language.
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	Mathematics for data science	Z,ZK	4
	dents are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in da		
Include mainly:	inear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality princ selected notions from probability theory and statistics.	cipie, gradient metr	hods) and
NI-NLM	Neural Language Models	Z	5
	Jents will learn the technical foundations of the Transformer architecture as well as the practical aspects of using language models. The	-	-
	students how to use language models to solve problems, make informed risk assessments, and work critically with the scientific li	-	0 13 10 10001
NI-NMS	Neural Networks, Machine Learning and Randomness	Z,ZK	4
	ds, i.e. methods based on randomness, are extremely important for the construction and training of neural networks as well as a num		ne learning
models. The co	urse "Neural networks, machine learning and randomness" will discuss in sufficient depth a number of specific types of neural networ	ks that rely substa	ntially on
	ell as a number of specific stochastic methods for neural networks and machine learning. In the final two topics, it explains the general		-
neural networks a	nd shows that, in addition to the use of randomness in neural networks and machine learning, machine learning models, including ne	,	used in one
NI-NMU	of the most important applications of randomness stochastic optimization methods, which include e.g. popular evolutionary algo New media in art and design	ZK	3
_	duces students to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game an		1
	dent with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especially		-
	art projects.		
NI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5
	troduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such method		
	finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They		
linear algebraic e	quations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement	these algorithms s	sequentially
NI-NSS	as well as in parallel. Normalized Software Systems	ZK	5
	the foundations of normalized systems theory that studies the evolvability of modular structures based on concepts from engineering	1	-
	y from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related issue	-	-
architecture. In the	second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements. The	ese elements prov	vide the core
functionality of info	rmation 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.		_
NI-NUR	User Interface Design	Z,ZK	5
	rstand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, forma rocesures. 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
-	g system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining po	· · ·	1 -
	iability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development		
	purse provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practice	al experience.	
NI-OSY	Operating Systems and Systems Programming	Z,ZK	5
			-
	s system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kernel d		topics are:
process manage	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c	ourse also addres	/ topics are: ses kernel
process manage development proce	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c ess, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability.	ourse also address Specifics of kernel	/ topics are: ses kernel architecture
process manage development proce	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c	ourse also address Specifics of kernel	/ topics are: ses kernel architecture
process manage development proce	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c ess, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. real-time operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within labs	ourse also address Specifics of kernel	/ topics are: ses kernel architecture
process manage development proce in embedded and NI-PAM There are many	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c ess, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. 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. Efficient Preprocessing and Parameterized Algorithms optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necess	ourse also address Specifics of kernel , students will work Z,ZK sary to solve these	topics are: ses kernel architecture on projects 4 problems
process manage development proce in embedded and NI-PAM There are many exactly in practice	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The class, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. Streat-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.  Efficient Preprocessing and Parameterized Algorithms optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necess. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one	ourse also address Specifics of kernel , students will work Z,ZK sary to solve these e can find a commo	y topics are: ses kernel architecture on projects 4 problems on property
process manage development proce in embedded and in NI-PAM There are many exactly in practice (parameter) of the	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The class, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. Streat-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. Efficient Preprocessing and Parameterized Algorithms optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necess We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exponential optimization problems that the complexity exponential parameterized algorithms exploit that by limiting the time complexity exponential problems for which no polynomial time algorithms are known (e.g. NP-complete problems).	ourse also address Specifics of kernel , students will work Z,ZK sary to solve these e can find a common ntially in this (smal	y topics are: ses kernel architecture k on projects 4 problems on property I) parameter
process manage development proce in embedded and in NI-PAM There are many exactly in practice (parameter) of the and polynomially in	ement, memory management, file operations and architecture of modern file systems, device drivers and network programming. The c ease, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. S 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. Efficient Preprocessing and Parameterized Algorithms optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necess w. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity expone n the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial time	ourse also address Specifics of kernel , students will work Z,ZK sary to solve these e can find a common ntially in this (small me preprocessing	y topics are: ses kernel architecture on projects 4 problems on property 1) parameter of the input,
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NI-PIS	Enterprise Information Systems	Z,ZK	5
	sed on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage of b	1 1	nd their use
in BI (Business In	telligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication	s sectors will be ex	plained on
real examples. Fur	thermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the bus	siness strategy of th	ie company.
Students will be ac	equainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and operatio	n of information sys	stems in the
	company / organization.		
NI-PIV	Computer Vision	Z,ZK	5
	on course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing. St		
	oles of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoreti		
	ns and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, color re		
and recognition a	nd segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (includ	ING CNN, RCNN, Y	OLO, VIT),
	motion detection, visual expressiveness (saliency).	<b>7</b>	0
NI-PLS1	Programming Language Seminar	Z	2
-	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the c		
about programmin	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		aung group
NI-PLS2	Programming Language Seminar	Z	2
-	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which		
	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the c		
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		
NI-PLS3	Programming Language Seminar	Z	2
	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which		
-	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the c		
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language	s.	
NI-PLS4	Programming Language Seminar	Z	2
The Programmin	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which	we discuss scienti	fic papers
about programmin	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the c	liscussions. The rea	ading group
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language	÷S.	
NI-PON	Selected Topics in Optimization and Numerical mathematics	Z,ZK	5
The course focuses	s on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge of co	ntinuous optimizati	on obtained
in the course Math	ematics for informatics. The methods are explained and described along with the details on how they are implemented on computers	. Hence, the releva	nt concepts
	of numerical matematics, mainly numerical linear algebra, are explained too.		
NI-PSD	Public Services Design	KZ	4
	roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p	-	-
suppliers (devs a	and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboratio	n with client repres	entatives.
	Course is aimed at students-designers as well as clients.		
NI-PSL	Programming in Scala	Z,ZK	4
	uces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language featur		-
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 Scalaz, etc.	i libraries e.g. Play,	Cassanura,
NI-PVR	Advanced Virtual Reality	КZ	4
	ces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D mode		
	s students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will also		•
	jines (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply the kr		
	in virtual reality, or directly create a complex game for VR.		· · · · · · · · · · · · · · · · · · ·
NI-PVS	Advanced embedded systems	Z,ZK	4
	used on ARM processors and microcontrollers and their usage in wide range of applications. The course includes a series of advance	1 1	
working with mas	s storage devices, motor control, system control and industrial communication. The students obtain both theoretical and also practica	l experiences with	embedded
	systems.		
NI-PYT	Advanced Python	KZ	4
The goal of this co	burse is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Python	(BI-PYT) left of. Th	e course is
very hands-on and	it has only tutorials, everything is demonstrated on examples. Classification is based on work in class as well as semestral coursework	. The course is lead	by external
	teachers from Red Hat.		
NI-REV	Reverse Engineering	Z,ZK	5
Students will get a	equainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens bef	ore and after the m	ain function
	s will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedic	-	-
	tten in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be d	00	
debuggers and de	ebugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer	maiware scene. Ir	ne focus of
	the course is on the seminars, where students will solve practically oriented tasks from the real world.	774	F
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 udents will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, a		-
-			4
NI-RUB	Programming in Ruby This course is presented in Czech.	KZ	4
NI-RUN	Runtime Systems	Z,ZK	5
	roduction to the world of virtual machines (VM) for high-level programming languages. There are two goals: Give you hands-on experience		-
	d a VM from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC compil		
	ation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implementation		-
	Dynamic optimizations, speculations, and depotimizations Language implementation frameworks Read-world VMs		

NI-SBF	System Security and Forensics	Z,ZK	5
		I ' I	-
-	t familiar with aspects of system security (principles of end station security, principles of security policies, security models, authenticat		
students will get ta	miliar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and forensi	c analysis techniqu	ues and the
	importance of operating system/operating system artifacts or file system for attack analysis and detection).	r	Г
NI-SCE1	Computer Engineering Seminar Master I	Z	4
The Seminar of Co	mputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to	o failures and attack	ks. Students
are approached ir	ndividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the	subject is work with	th scientific
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 teacher	rs. The topics are n	ew for each
	semester.	·	
NI-SCE2	Computer Engineering Seminar Master II	Z	4
		I – I	-
	mputer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to		
	ndividually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the		
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 teacher	s. The topics are n	ew for each
	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		
problems (modellin	ng of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a conve	nient process mod	lel, estimate
its parameters, and	alyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the mai	n principles based	on practical
real-world example	es. 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.		
NI-SEP	World Economy and Business	Z,ZK	4
	presented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students o		
	iness. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about dif		
	g business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for	•	
-	-	-	
	o improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course		
NI-SIB	Network Security	Z,ZK	5
NI-SIM	Digital Circuit Simulation and Verification	Z,ZK	5
The aim of the cou	arse is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level	Modeling) levels a	and with the
	properties of proper tools. The course covers recent verification methods, too.		
NI-SLA	Sublinear algorithms	Z,ZK	5
	We will introduce three methods to tackle algorithms working in sublinear space.	_,,,	Ū
NI-SWE	Semantic Web and Knowledge Graphs	Z,ZK	5
	learn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web teck		-
	delling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge	-	
	quality assurance.	graphs and their s	ystematic
NI-SYP	Parsing and Compilers	774	r
		Z,ZK	5
The module builds	upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of va	11005 Variarits ariu	applications
	of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.	· - · ·	
NI-SZ1	Knowledge Engineering Seminar Master I	Z	4
	r you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research		
Additionally, you wi	ill learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machin	he learning and AI o	conferences
	and summer schools, as well as FIT's own Summer Research Program (VyLet).		
NI-SZ2	Knowledge Engineering Seminar Master II	Z	4
On this semina	r you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top resea	arch labs around th	e world.
Additionally, you wi	Ill learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machir	ne learning and AI o	conferences
	and summer schools, as well as FIT's own Summer Research Program (VyLet).		
NI-TES	Systems Theory	Z,ZK	5
Today, humankir	d has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However	r, the costs of man	aging this
complexity and of	ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of m	odels that describe	e only those
	tems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and alg		-
,	the modeling and analysis of complex systems.		
NI-TKA	Category Theory	Z,ZK	4
	÷ · · ·		
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. At		
	ial neural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission, i	1 07	
	s, network training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transforma		
and in connectio	n with somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with train	ning, we pay attent	tion to the
	aining and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most im		
employed for neura	al network training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within the	topic approximatic	on approach
to neural netwo	rks, we first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Kol	imogorov theorem,	, Vituškin
theorem). Afterwar	ds, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappings	computed by neur	ral networks
being dense in in	nportant Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect to	o a finite measure,	spaces of
functions with con	tinuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on expect	tation and training	based on a
random sample, ar	nd with probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see how i	t is possible to get	an estimate
	al expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak law	-	-
	an analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the central	-	-
with its analogy	for neural networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can be	employed to sear	ch for the
	topology of the network.		
NI-TS1	Theoretical Seminar Master I	Z	4
Theoretical semina	ar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	al reading group. T	he students
are treated individu	ually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a v	work with scientific	papers and
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.		

NI-TS2	Theoretical Seminar Master II	Z	4
Theoretical semina	ar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	al reading group. T	he students
are treated individ	ually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a	work with scientific	papers and
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.		
NI-TS3	Theoretical Seminar Master III	Z	4
	ar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	001	
are treated individ	ually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a start of	NORK WITH SCIENTIFIC	papers and
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	7	4
NI-TS4	Theoretical Seminar Master IV ar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic		4
	ually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a v		
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	NOTE WITH SCIENTING	papers and
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		-
	ensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with bu		
	will be able to compute, analyze, and control the reliability and availability of the designed circuits.		
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		-
	acking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of	•	
	reality will be presented.	0	0
NI-UMI	Artificial intelligence	Z,ZK	5
	s search and inference algorithms in major formal paradigms used in artificial intelligence such as logic theories, constraint programm		
	The main principles and practical applications of discussed techniques will be illustrated.	0	
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
	in knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and	I ' I	
-	irtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficie	-	
	arameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effection		-
management of co	mplex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills ir	the use of modern	n integration
	and development tools (Continuous integration and development).		
NI-VEM	Scientific thinking	KZ	2
The objective of	the course is to get acquainted with scientific methods and discovery of order and laws of the universe, including the aspects of huma	an life. The subject	combines
scientific method	s in natural sciences, mathematics, computer science and humanities. Another aim is to introduce rules and requirements of scientific	communication via	a research
	papers and posters.		
NI-VGA	Video Games Architecture	Z,ZK	5
The course cover	s a wide range of topics, procedures and methodologies related to the development of computer games - from a technical point of vie	w, but also from a	design and
	t of view. In the lectures, students will be guided through the history of development, the structure of game engines, component and fu		
game developmen	t, physics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected technological topics in greater detail, in	ncluding ways of im	plementing
	some game mechanics, in the form of practical demonstrations.		
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 feat	ure extraction from	multimedia
	objects, indexing, and structure of distributed search engines.		
NI-VOL	Elections	Z,ZK	5
	We will cover the basics of (committee) elections and, in general, opinion aggregation.		
NI-VPR	Research Project	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 me		
application of en	tropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with rand	dom processes with	n focus on
	Markov chains. The high point of the course is the Queuing theory and its application in networks.		
NI-VYC	Computability	Z,ZK	4
	Classical theory of recursive functions and effective computability.		
NI-ZS10	Master internship abroad for 10 credits	Z	10
	once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institu		
	the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and ex		
	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 instituti	on. 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 exi	ceeds the
	academic year's dead-line.	7	
NI-ZS20	Master internship abroad for 20 credits	Z	20
	once within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research institu the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and ex		
	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		
	on. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects	-	-
	academic year's dead-line.		
NI-ZS30	Master internship abroad for 30 credits	Z	30
	zented in chzech language. Each student can once within his / her master's degree have a foreign internship at a foreign university or	I I	
	h. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide	-	
	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		
	time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This ar	-	-
	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 platforn	ms. 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	arning 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
the course, student			
the course, student	language processing.		
NIE-PML		Z,ZK	5
NIE-PML	language processing.	· ·	-
NIE-PML Personalized mac	language processing. Personalized Machine Learning	s and behaviors of	individual
NIE-PML Personalized mac entities. While PML	Ianguage processing.           Personalized Machine Learning           chine 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 s, its principles car	individual be applied
NIE-PML Personalized mac entities. While PML	Ianguage processing.           Personalized Machine Learning           chine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristic is commonly used in applications such as recommender systems, which recommend items to users based on their personal interest	s and behaviors of s, its principles car etical, algorithmic, a	individual be applied
NIE-PML Personalized mac entities. While PML	Ianguage processing. Personalized Machine Learning chine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristic is commonly used in applications such as recommender systems, which recommend items to users based on their personal interest ther fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theore	s and behaviors of s, its principles car etical, algorithmic, a	individual be applied
NIE-PML Personalized mac entities. While PML to a wide range of o PI-SCN	Ianguage processing. Personalized Machine Learning chine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristic is commonly used in applications such as recommender systems, which recommend items to users based on their personal interest other fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theore perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial commu-	s and behaviors of rs, its principles car etical, algorithmic, a unities. ZK	individual to be applied and practical 4

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2025-06-07, time 18:46.