Study plan

Name of study plan: Master specialization Knowledge Engineering, 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: 98 Elective courses credits: 22 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: doc. RNDr. Ing. Marcel Ji ina, Ph.D., email: marcel.jirina@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 (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 g	in 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 e	aluate heuristics for practical problems.		
NI-DIP	Diploma Project	Z	30
NI-MPR	Master Project	Z	7
supervisor enters t completed and sign is rather general, th approvable at the e		cz/student/studijn opic that the stud	i/formulare). The ent has reserved
NI-MPI	Mathematics for Informatics	Z,ZK	7
The course compri	es 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
			nization and
multi-variate integra	tion. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last		

NI-PDP Parallel and Distributed Programming

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

6

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: 35 The role of the block: PS

Code of the group: NI-PS-ZI.20

Name of the group: Compulsory Courses of Master Specialization Knowledge Engineering, v. 2020, in Czech Requirement credits in the group: In this group you have to gain 35 credits

Requirement courses in the group:

Credits in the group: 35

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-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	PS
NI-BML	Bayesian Methods for Machine Learning Ond ej Tichý, Kamil Dedecius Ond ej Tichý Kamil Dedecius (Gar.)	KZ	5	2P+1C	L	PS
NI-MVI	Computational Intelligence Methods Pavel Kordík Pavel Kordík Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	z	PS
NI-PDD	Data Preprocessing Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-SCR	Statistical Analysis of Time Series Kamil Dedecius Kamil Dedecius Kamil Dedecius (Gar.)	Z,ZK	5	2P+1C	Z	PS
NI-UMI	Artificial intelligence Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+1C	Z	PS
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	PS

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

NI-ADM	Data Mining Algorithms	Z,ZK	5			
The course focuses on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the students should know machine learning						
basics. The emphasis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation systems) and models (e.g., kernel						
methods).						
NI-BML	Bayesian Methods for Machine Learning	KZ	5			
The subject is focused of	on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studi	ies the construction	on of appropriate			
models providing descr	iption of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidde	n variables (true	object position			
from noisy observations	s etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose	e, a number of rea	I world examples			
	presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging	g. The students w	vill try to solve			
some of them.						
NI-MVI	Computational Intelligence Methods	Z,ZK	5			
	d methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to	many problems.	They will learn			
	rk and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.					
NI-PDD	Data Preprocessing	Z,ZK	5			
Students learn to prepa	re raw data for further processing and analysis. They learn what algorithms can be used to extract information from various da	ta sources, such	as images, texts,			
time series, etc., and le	arn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of character	ristics from image	es or from web			
pages.						
NI-SCR	Statistical Analysis of Time Series	Z,ZK	5			
The course deals with t	he practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange pric	es, employment)	and industrial			
problems (modelling of	signals and processes) to computer networks (network components load, attacks detection). The students learn to select a co	nvenient process	model, estimate			
its parameters, analyze	its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the	main principles b	ased on practical			
	oth the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward tra	nsfer of students	knowledge from			
the academic to the rea	ıl world.					
NI-UMI	Artificial intelligence	Z,ZK	5			
	ch and inference algorithms in major formal paradigms used in artificial intelligence such as logic theories, constraint program	mming and autom	nated planning.			
The main principles and	d practical applications of discussed techniques will be illustrated.					

NI-PON

Selected Topics in Optimization and Numerical mathematics

The course focuses on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge of continuous optimization obtained in the course Mathematics for informatics. The methods are explained and described along with the details on how they are implemented on computers. Hence, the relevant concepts of numerical matematics, mainly numerical linear algebra, are explained too.

Z.ZK

5

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 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.

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Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members)	Completion	Credits	Scope	Semester	Role
	Tutors, authors and guarantors (gar.)					
NI-AOA	Completing a professional event Zden k Muziká	Z	1			V
NI-ATH	AlgorithmicTheories of Games Dušan Knop, Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+2C	L	V
NI-AFP	Applied Functional Programming Robert Pergl, Marek Suchánek, Daniel N mec Robert Pergl Robert Pergl (Gar.)	КZ	5	2P+1C	L	V
NI-APH	Architecture of computer games Adam Vesecký Adam Vesecký 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.)	κz	4	3C	Z	V
NI-DPH	Game Design Adam Vesecký	Z,ZK	5	2P+1C	L	V
NI-DSW	Design Sprint Ond ej Brém, Michal Manda Michal Manda David Pešek (Gar.)	Z	2	30B	Z	V
NI-PSD	Public Services Design Ond ej Brém, David Pešek David Pešek Ond ej Brém (Gar.)	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	КZ	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 Pavel Tvrdík André Sopczak (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-HCM	Mind Hacking Marcel Ji ina, Josef Holý Marcel Ji ina Marcel Ji ina (Gar.)	ZK	5	2P+1C	Z	V
NI-HSC	Side-Channel Analysis in Hardware Vojt ch Miškovský, Petr Socha Petr Socha Vojt ch Miškovský (Gar.)	Z,ZK	4	2P+2C	Z	V
NI-HMI2	History of Mathematics and Informatics Alena Šolcová Alena Šolcová (Gar.)	ZK	3	2P+1C	Z	V
NI-IBE	Information Security Igor ermák	ZK	2	2P	Z	V

NI-IVS	Intelligent embedded systems Miroslav Skrbek Miroslav Skrbek (Gar.)	KZ	4	1P+3C	L	V
NI-IKM	Internet and Classification Methods Martin Hole a Martin Hole a Martin Hole a (Gar.)	Z,ZK	4	1P+1C	L	V
NI-IAM	Internet and Multimedia	Z,ZK	4	2P+1C	L	V
NI-IOT	Internet of Things Jan Jane ek	Z,ZK	4	2P+1C	L	V
FITE-EHD	Introduction to European Economic History Tomáš Evan	Z,ZK	3	2P+1C	L	V
NI-KTH	Combinatorial Theories of Games Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z,ZK	4	2P+1C	L	V
NI-FMT	Finite model theory Tomáš Jakl Tomáš Jakl Tomáš Jakl (Gar.)	Z,ZK	4	2P+1C	L	V
NI-CCC	Creative Coding and Computational Art Radek Richtr, Josef Kortán Radek Richtr Radek Richtr (Gar.)	KZ	4	1P+2C	Z,L	V
NI-KYB	Cybernality	ZK	5	2P	Z	V
NI-LSM2	Statistical Modelling Lab Kamil Dedecius Kamil Dedecius (Gar.)	KZ	5	3C	Z,L	V
NI-LOM	Linear Optimization and Methods Dušan Knop Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MPL	Managerial Psychology Jan Fiala Jan Fiala Jan Fiala (Gar.)	ZK	2	2P	Z,L	V
NI-MSI	Mathematical Structures in Computer Science Jan Starý	Z,ZK	4	2P+1C	L	V
NI-MZI	Mathematics for data science Št pán Starosta	Z,ZK	4	2P+1C	L	V
FIT-ITI	Modern IT infrastructure Ivan Šime ek	Z,ZK	5	2P+1C	Z,L	V
NI-MOP	Modern Object-Oriented Programming in Pharo Jan Blizni enko Robert Pergl Robert Pergl (Gar.)	KZ	4	3C	Z	V
NI-NLM	Neural Language Models	Z	5	2P+1C	L	V
NI-NMS	Neural Networks, Machine Learning and Randomness 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 (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.)	KZ	4	2P+2C	L	V
NI-APT	Advanced Program Testing Pierre Donat-Bouillud Pierre Donat-Bouillud Pierre Donat-Bouillud (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-PVS	Advanced embedded systems Miroslav Skrbek	Z,ZK	4	2P+2C	Z	V
NI-DNP	Advanced .NET 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 Ji í Dan ek Ji í Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	V
NI-RUB	Programming in Ruby Cyril erný Cyril erný Cyril erný (Gar.)	KZ	4	3C	Z	V
NI-ROZ	Pattern Recognition	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 (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 in 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 (Gar.)	Z,ZK	3	1P+1C	L,Z	v
NI-TS1	Theoretical Seminar Master I Dušan Knop, Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	v
NI-TS2	Theoretical Seminar Master II Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	L	v
NI-TS3	Theoretical Seminar Master III Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	v
NI-TS4	Theoretical Seminar Master IV Ond ej Suchý, Tomáš Valla Tomáš Valla Ond ej Suchý (Gar.)	Z	4	2C	L	v
NI-TKA	Category Theory Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+1C	L	v
NI-TNN	Theory of Neural Networks Martin Hole a Martin Hole a Martin Hole a (Gar.)	Z,ZK	5	2P+1C	L	v
NI-CPX	Complexity Theory Dušan Knop, Ond ej Suchý Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	5	3P+1C	Z	v
FI-TOP	Academic writing Tomáš Nová ek	Z	2	10B	Z	V
NI-DVG	Introduction to Discrete and Computational Geometry Maria Saumell Mendiola Maria Saumell Mendiola Maria Saumell Mendiola (Gar.)	Z,ZK	5	2P+1C	L	V
NI-VOL	Elections Dušan Knop Dušan Knop Dušan Knop (Gar.)	Z,ZK	5	2P+1C	L	v
NI-VYC	Computability Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+2C	L	V
NI-VPR	Research Project Št pán Starosta Št pán Starosta (Gar.)	Z	5		Z,L	V
NI-ZS10	Master internship abroad for 10 credits Zden k Muziká Zden k Muziká (Gar.)	Z	10		Z,L	V
NI-ZS20	Master internship abroad for 20 credits Zden k Muziká Zden k Muziká (Gar.)	Z	20		Z,L	V
NI-ZS30	Master internship abroad for 30 credits Zden k Muziká Zden k Muziká (Gar.)	Z	30		Z,L	v

Characteristics of the courses of this group of Study Plan: Code=NI-V.2021 Name=Purely Elective Master Courses

NI-AOA	Completing a professional event	Z	1			
The subject is participation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, concluded with a workshop, a test, drafting a report, etc. Such an event						
must be approved in advance by the vice-dean for pedagogical activities or the vice-dean for science and research and is presented within the FIT through a website, infomail, etc.						
NI-ATH	AlgorithmicTheories of Games	Z,ZK	4			
Traditional game theory	is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory str	udies the behavio	ur of agents			
(players) of a certain co	mpetitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game	e theory is to find	the equilibria,			
which are the states of t	he game where no player wants to deviate from his strategy. Due to the recent development of computers, internet, social netw	orks, online aucti	ons, advertising,			
multiagent systems and	l other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of	f efficient computa	ation of various			
solution concepts. In thi	s course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods of their c	computation.				
NI-AFP	Applied Functional Programming	KZ	5			
This course is presented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional programming languages are on						
the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, mastering this paradigm becomes a						
necessary competence	of a software engineer: the theory and especially the practice.					

NI-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		-
perspective. They will get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base	-	
part of most games. They will also understand the basics of pathfinding, networking and scripting and apply them in practical exercises (labs). An im	portant part of the	e course is an
implementation of a simple game, with a strong focus on nontrivial game mechanics.		
NI-VGA Video Games Architecture	Z,ZK	5
The course covers a wide range of topics, procedures and methodologies related to the development of computer games - from a technical point of	view, but also fror	n a design and
philosophical point of view. In the lectures, students will be guided through the history of development, the structure of game engines, component ar	nd functional archi	tecture typical of
game development, physics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected technological topics in greater details	ail, including ways	of implementing
some game mechanics, in the form of practical demonstrations.		
NI-BPS Wireless Computer Networks	Z,ZK	4
Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in	ad-hoc networks,	multicast and
broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get know	wledge of security	/ mechanisms
for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools.		
NIE-BLO Blockchain	Z,ZK	5
Students will understand the foundations of blockchain technology, smart contract programming, and gain an overview of most notable blockchain pla		-
code and deploy a secure decentralized application, and assess whether integration of a blockchain is suitable for a given problem. The course place		-
relationship between blockchains and information security. It is concluded with a defense of a research or applied semester project, which prepares	the students for ir	nplementing or
supervising implementation of blockchain-based solutions in both academia and business.		
NI-CTF Capture The Flag	KZ	4
The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber security.		
NI-DPH Game Design	Z,ZK	5
The course complements the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on gar	•	
interested in deeper knowledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanic		
development cycle. The students will get an overview of game development from the designer's perspective, from theoretical concepts to practical im	plementation app	lied to semestral
projects.		
NI-DSW Design Sprint	Z	2
Students will work on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to va		, ,
the course the students will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting v	vith research and	finishing with
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 developme		
suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration of the students of a students of a students will be allocated as a student of the students of the s	ion with client repi	esentatives.
Course is aimed at students-designers as well as clients.	7	0
NI-DID Digital drawing	<u>Z</u>	2
The course will introduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, p	-	-
they will practically apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice ga	-	e who wants to
		4
NI-DZO Digital Image Processing This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical	Z,ZK	-
implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that i	-	-
of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDF		
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray of	-	-
interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, a		
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	1	-
data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementation	-	-
approaches to parallelize other algorithms. The course is prezented in czech language.		
NI-PAM Efficient Preprocessing and Parameterized Algorithms	Z,ZK	4
There are many optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often nece		-
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 polynomia		
which is not possible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solut	ion method. We w	ill present a
plethora of parameterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (presumably) does	s not exist. We
will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes.		
NI-ESC Experimental Project Course	KZ	8
"The Design Project course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the 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	projects, collabor	ate with industry
experts, and learn to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their sk	ills in user-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
The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intellig	gence. This course	e is intended to
give you both theoretical and practical background so you can participate in related research activities. Presented in English.		
NI-GNN Graph Neural Networks	Z,ZK	4
The course introduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural r	networks for creat	ng vector
representations of nodes, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last		
	part of the course	e also covers
graph generation and interpretability of graph neural networks. In the exercises, students will try out selected techniques and problems. NI-GRI Grid Computing	z part of the course	e also covers

Grid computing and gain knowledge about the world-wide network and computing infrastructure.

NI-HCM	Mind Hacking	ZK	5
	emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks,		
	e security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive sec on warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Inter	, , ,	·
	tion of social cohesion, threats to democracy or war.		
NI-HSC	Side-Channel Analysis in Hardware	Z,ZK	4
	d to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical atta	-	
	nannels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks are	-	h higher-order
NI-HMI2	practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel inform History of Mathematics and Informatics	ZK	3
	d in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithr	1	-
	s, etc.) note on possibilities of applications of some mathematical methods in informatics and its development.	,	
NI-IBE	Information Security	ZK	2
	tion and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and internat		this area. They
	r management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., pen		
NI-IVS	Intelligent embedded systems ystems course for master's degree is focused on high-level technology embedded systems integrating artificial intelligence. The	KZ	4
-	Ided system fundamentals course for the bachelor degree. The aim of the course is to teach students humanoid robot progra		
e e	provide basis of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, studer	•	
	of various courses like nature inspired algorithms, data mining algorithms, image recognition and web technologies		
NI-IKM	Internet and Classification Methods	Z,ZK	4
	ents get acquainted with classification methods used in four important internet, or generally network applications: in spam filte ystems and in intrusion detection systems. However, they will learn more than only how classification is performed when solvi	-	-
	hese applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycl	-	
-	xercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult the		
NI-IAM	Internet and Multimedia	Z,ZK	4
	ocused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes a	-	
	als (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practice		
	ons. 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		
for audience.		5	
NI-IOT	Internet of Things	Z,ZK	4
	on the area of hardware and software technologies for the strongly growing computer support of various devices. Its goal is fa	amiliarization with	available
	(Raspberry Pi, Arduino Due) and with the language for efficient application development and modification (GNU Forth).		
FITE-EHD	Introduction to European Economic History	Z,ZK	3
	a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global e story. 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	d organizations in	history. Class
-	a mixture of lecture and discussion.	7 71/	
NI-KTH	Combinatorial Theories of Games y is a branch of mathematics, which has broad applications in economy, biology, politics and computer science. This theory st	Z,ZK	4
	propertitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game		-
	the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-pl	-	-
	y, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea	•	
-	games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The t		-
	blished the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force oduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theo	-	-
	eoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course	•	•
	yse, 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 s to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiabilit		4
	ption in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as	, , , ,	
	Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.	decemptive comp	liosaly alcoly, alc
NI-CCC	Creative Coding and Computational Art	KZ	4
	ical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows		
.,	tudents to suitable visualization methods for traditional as well as for open data. It combines well-known visualization techniques as the subscript of the state of the subscript of the state of the subscript o		s.
(Institute of Intermedia	The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture ar FEL)	id Metropolitan Pl	ianning) and ilivi
NI-KYB	Cybernality	ZK	5
	d with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand t		1
-	stems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker a	activities and beha	avior. The course
	operation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams).		_
NI-LSM2	Statistical Modelling Lab	KZ	5
-	dvanced multiple target tracking (MTT). This domain covers simultaneous tracking of multiple targets using radar under the pre the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli) filters.	sence of clutter, o	DI VIDEO TRACKING.
NI-LOM	Linear Optimization and Methods	Z,ZK	5
	lications of optimization methods in computer science, economics, and industry. They are aware of practical importance of line		1
	ptimization software and are familiar with languages used in programming of that software. They get skills in formalization of c		-
	duling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, trav	• •	
in linear programming.	, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems.	mey get orientation	on in algorithms
NI-MPL	Managerial Psychology	ZK	2

	Mathematical Structures in Computer Science	Z,ZK	4
NI-MSI Mathematical compation	s of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Sco		
			a calculus.
Introduction to category			
NI-MZI	Mathematics for data science	Z,ZK	4
In this course, students	are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used i	n data science. Th	ne studied topics
	Igebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality prir	nciple, gradient me	ethods) and
selected notions from p	robability theory and statistics.		
FIT-ITI	Modern IT infrastructure	Z,ZK	5
NI-MOP	Modern Object-Oriented Programming in Pharo	KZ	4
	nming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, wh		tural abstraction
	modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the s		
	odern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their developmen	-	-
	bject programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to wo		
	f semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involve		-
NI-NLM	Neural Language Models	Z	5
	will learn the technical foundations of the Transformer architecture as well as the practical aspects of using language models	. The goal of the c	ourse is to teach
	nguage models to solve problems, make informed risk assessments, and work critically with the scientific literature.		
NI-NMS	Neural Networks, Machine Learning and Randomness	Z,ZK	4
Stochastic methods, i.e	. methods based on randomness, are extremely important for the construction and training of neural networks as well as a network of the second s	umber of other ma	achine learning
models. The course "N	eural networks, machine learning and randomness" will discuss in sufficient depth a number of specific types of neural netwo	rks that rely subst	antially on
randomness, as well as	a number of specific stochastic methods for neural networks and machine learning. In the final two topics, it explains the gene	eral stochastic app	proach to training
neural networks and sh	ows that, in addition to the use of randomness in neural networks and machine learning, machine learning models, including	neural networks,	are used in one
of the most important a	pplications of randomness stochastic optimization methods, which include e.g. popular evolutionary algorithms.		
NI-NMU	New media in art and design	ZK	3
The course introduces	students to the issue of using new media in artistic and design work. Key topics are moving image, internet, computer game	and sound. The m	ain goal is to
	with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especia		-
art projects.		,	
NI-OLI	Linux Drivers	Z,ZK	4
	stem is an important operating system for personal computer and also for embedded systems. Systems on chip and combining		
	of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver developmine		
-			uueniis. me
	edge of Linux operating system architecture, principles of development of various types drivers, including practical experience		-
NIE-PML	Personalized Machine Learning	Z,ZK	5
	earning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteris		
	ommonly 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	eoretical, algorithn	nic, and practical
perspectives. Specifica	lly, we will focus on cutting-edge models that are of interest to both the research and commercial communities.		
perspectives. Specifica	lly, we will focus on cutting-edge models that are of interest to both the research and commercial communities.	Z,ZK	4
NI-ARI		Z,ZK	-
NI-ARI Students will learn vari	Computer arithmetic bus data representations used in digital devices and will be able to design arithmetic operations implementation units.		-
NI-ARI Students will learn vari NI-PG1	Computer arithmetic bous data representations used in digital devices and will be able to design arithmetic operations implementation units.	ZK	4
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NI-ARI Students will learn vari NI-PG1 The course builds on g interested in advanced articles and their subse NI-PIV The Computer Vision c	Computer arithmetic bus data representations used in digital devices and will be able to design arithmetic operations implementation units. Computer Grafics 1 aphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of t quent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas an Computer Vision burse focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing	ZK e. The course is de the course is the s d topics of compu Z,ZK g.Students will get	4 esigned for those study of scientific ter graphics. 5 acquainted with
NI-ARI Students will learn vari NI-PG1 The course builds on g interested in advanced articles and their subse NI-PIV The Computer Vision c the basic principles of d	Computer arithmetic bus data representations used in digital devices and will be able to design arithmetic operations implementation units. Computer Grafics 1 aphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of the requent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas an Computer Vision burse focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoretical	ZK e. The course is de the course is the s d topics of compu Z,ZK g.Students will get tical knowledge as	4 esigned for those study of scientific ter graphics. 5 acquainted with s well as on
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NI-ARI Students will learn vari NI-PG1 The course builds on g interested in advanced articles and their subse NI-PIV The Computer Vision c the basic principles of o practical applications a and recognition and se	Computer arithmetic bus data representations used in digital devices and will be able to design arithmetic operations implementation units. Computer Grafics 1 aphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of t quent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas an Computer Vision burse focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoret and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, colo gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (include gme	ZK e. The course is de the course is the s d topics of compu Z,ZK g.Students will get tical knowledge as r representations,	4 esigned for those study of scientific ter graphics. 5 acquainted with s well as on object detection
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NI-ARI Students will learn vari NI-PG1 The course builds on guinterested in advanced articles and their subset NI-PIV The Computer Vision c the basic principles of of practical applications a and recognition and see motion detection, visua NI-EDW The Enterprise Data W not only in designing w visualization. NI-PVR The course introduces stu in available 3D engines in virtual reality, or dire NI-AML The course introduces processing, control and NI-IOS Students will learn the BI-IOS. NI-APT Testing a program is estimation	Computer arithmetic bus data representations used in digital devices and will be able to design arithmetic operations implementation units. Computer Grafics 1 aphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of t quent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas an Computer Vision Durse focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoret modern through classical and recent approaches based on deep learning, deep neural networks for computer vision (incl expressiveness (saliency). Enterprise Data Warehouse Systems arehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods arehouses and various architectures, but also their deployment and maintenance. This course also includes an introduction to Advanced Virtual Reality advanced parts of the virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will (mainly Unity3D). The course is freely connected with the subject VHS (virtual game worlds), students will be able to apply th tty create a complex game for VR. Advanced machine learning students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with the fodvanced Program Testing sential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The	ZK a. The course is the s d topics of compu- Z,ZK g. Students will get tical knowledge as r representations, uding CNN, RCNI Z,ZK and will gain prac- to the area of repor- KZ odels in Blender, a also deal with crea- e knowledge gained Z,ZK f recommendation methods discussed KZ he basics from the Z,ZK	4 signed for those tudy of scientific ter graphics. 5 acquainted with s well as on object detection N, YOLO, ViT), 5 tical knowledge rting and data 4 and among other ting applications ed in this subject 5 systems, image ed. 4 beginners class
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NI-ARI Students will learn vari NI-PG1 The course builds on guinterested in advanced articles and their subset NI-PIV The Computer Vision c the basic principles of of practical applications a and recognition and se motion detection, visua NI-EDW The Enterprise Data W not only in designing w visualization. NI-PVR The course introduces stu in available 3D engines in virtual reality, or dire NI-AML The course introduces processing, control and NI-IOS Students will learn the BI-IOS. NI-APT Testing a program is es advanced program test NI-PVS The course is focused	Computer arithmetic Computer arithmetic Computer arithmetic Computer Grafics 1 Computer Vision Com	ZK a. The course is the s d topics of compu- Z,ZK g.Students will get tical knowledge as r representations, uding CNN, RCN Z,ZK and will gain prac- to the area of repor- KZ odels in Blender, a also deal with creat e knowledge gained Z,ZK f recommendation methods discussed KZ ne basics from the Z,ZK goal of the coursed Z,ZK and of the coursed Z,ZK solution the coursed Z,ZK and topics like set and to	4 asigned for those study of scientific ter graphics. 5 acquainted with s well as on object detection N, YOLO, ViT), 5 tical knowledge rting and data 4 and among other ting applications ed in this subject 5 systems, image ed. 4 beginners class 5 is to present 4 acquirity support,

NI-DNP	Advanced .NET	Z.ZK	4
	overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET MAUI	, ,	zor and also will
get notions of Azure De	vOps and GIT. Students will get practical experience in semestral work where they will create a client-server application utilized	zing technologies	ASP.NET Core,
	and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT.		
NI-PYT	Advanced Python	KZ 🛛	4
, v	is to learn various advanced techniques and methods in Python. The course indirectly continues where Programming in Pyth	. ,	
teachers from Red Hat.	s 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
NIE-PDL		KZ	5
	Practical Deep Learning I to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine	1 1	-
-	I 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 modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language fea		matching and
advance standard librar	y. 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. F	Play, Cassandra,
Scalaz, etc.		,	
NI-RUB	Programming in Ruby	KZ	4
This course is presente			
NI-ROZ	Pattern Recognition	Z,ZK	5
	is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the s ill learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, a		
NI-PLS1		Z	2
-	Programming Language Seminar juage Seminar aims to introduce students to research in programming languages. It has the format of a reading group in whi	1 – 1	
	guages and related fields. Participating students are expected to present a paper of their interest and actively participate in the		
	n FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		
NI-PLS3	Programming Language Seminar	Z	2
The Programming Lang	juage 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 lan	guages and related fields. Participating students are expected to present a paper of their interest and actively participate in the	he discussions. Th	e reading group
is a joint venue betweer	n FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		
NI-PLS2	Programming Language Seminar	Z	2
	uage Seminar aims to introduce students to research in programming languages. It has the format of a reading group in whi		
	guages and related fields. Participating students are expected to present a paper of their interest and actively participate in the second MEE CLINE this area to all attributes and second here interested in programming longuages.	he discussions. Th	e reading group
NI-PLS4	n FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.	7	2
-	Programming Language Seminar juage Seminar aims to introduce students to research in programming languages. It has the format of a reading group in whi	Ch we discuss said	_
	guages and related fields. Participating students are expected to present a paper of their interest and actively participate in the		
	n FIT and MFF CUNI. It is open to all students and researchers interested in programming languages.		lo rouding group
NI-SCE1	Computer Engineering Seminar Master I	Z	4
	ter Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance	1 1	ttacks. Students
are approached individu	ually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of	the subject is worl	k with scientific
articles and other profes	ssional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar tea	chers. The topics a	are new for each
semester.			
NI-SCE2	Computer Engineering Seminar Master II	Z	4
	ter Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance with the selected expression of the selected expression.		
	Jally within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of ssional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar tea	-	
semester.		chers. The topics a	are new ior each
NI-SZ1	Knowledge Engineering Seminar Master I	Z	4
	I present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top rese	1 1	
-	rn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma		
and summer schools, a	s well as FIT's own Summer Research Program (VyLet).		
NI-SZ2	Knowledge Engineering Seminar Master II	Z	4
On this seminar you wil	I present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top rese	arch labs around t	he world.
	rn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top ma	achine learning and	d AI conferences
	s well as FIT's own Summer Research Program (VyLet).		
PI-SCN	Seminars on Digital Design	ZK	4
-	problems of realization and implementation of digital circuits - both combinational and sequential. Basic means of description	-	-
	ion algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial		-
NI-MLP	Machine Learning in Practice ing methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client to	Z,ZK	5 implementation
	ents through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practic	-	
-	arn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear and un	-	
FIT-SEP	World Economy and Business	Z,ZK	4
-	d in Czech. The course introduces students of technical university to the international business. It does that predominantly by	1 ' 1	dual countries
and key regions of world	economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as we	Il as indexes of eco	onomic freedom,
	ic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form	of discussions bas	ed on individual
	b take bachelor level of this course BIE-SEP as a prerequisite.		
NI-SEP	World Economy and Business	Z,ZK	4
	d in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students in the description of the second results and the second rescend results and the second rescend results and		-
	It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about a single so indexes of economic freedom, corruption and economic development, which are needed	-	
	siness in diverse societies as well as indexes of economic freedom, corruption and economic development, which are neede ve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this cours	-	
		c_ . uo u pi	

NI-TVR	Virtual Reality Technology	Z,ZK	3
	iced to the basic concepts of virtual reality. Techniques for displaying virtual worlds (CAVE, HMD,) and the possibilities of c		
	eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways o	of using virtual and	d augmented
reality will be presented		-	4
NI-TS1	Theoretical Seminar Master I		4
	ntended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clas and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is		-
-	e. The capacity is limited by the the potentials of the teachers of the seminar.		
NI-TS2	Theoretical Seminar Master II	Z	4
-	ntended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a cla	-	-
	and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is		
other scholarly literatur	e. The capacity is limited by the the potentials of the teachers of the seminar.		
NI-TS3	Theoretical Seminar Master III	Z	4
Theoretical seminar is i	ntended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classifier of the students which want to come in deeper contact with contemporary theoretical computer science.	ssical reading gro	up. The students
-	and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	s a work with scie	ntific papers and
	e. The capacity is limited by the the potentials of the teachers of the seminar.	_	
NI-TS4	Theoretical Seminar Master IV		4
	ntended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classified and an active the second bin the second		
-	and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is e. The capacity is limited by the the potentials of the teachers of the seminar.	s a work with scie	nunc papers and
NI-TKA	Category Theory	Z,ZK	4
	Theory of Neural Networks	Z,ZK Z,ZK	4 5
NI-TNN	reural networks from the point of view of the theory of function approximation and from the point of view of probability theory	· ·	÷
	eural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmissi		
	work training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transfor		
	somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with tra		
	and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most		
employed for neural ne	work training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within	the topic approxi	mation approach
to neural networks, we	first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Ko	olmogorov theorer	n, Vituškin
theorem). Afterwards, v	ve will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mapp	ings computed by	neural networks
	nt Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect		
	us derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on exp		-
	th probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see h	-	-
	ctancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak la logy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the cen	-	-
	ral networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can b		• •
topology of the network			
		7 7K	5
NI-CPX	Complexity Theory	Z,ZK	5 ing practical
NI-CPX	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the		
NI-CPX Students will learn abo	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the		
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th t problems.	he theory concern	ing practical
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th t problems. Academic writing	he theory concern	ing practical 2 Writing scientific
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import publications can be use	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the t problems. Academic writing ant and required part of research activity. It is not only about obtaining research results but also about applying them in the fo	he theory concern Z rm of publication. course, students v	ing practical 2 Writing scientific vill learn how to
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import publications can be use write a scientific article, else's article. The course	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th t problems. Academic writing ant and required part of research activity. It is not only about obtaining research results but also about applying them in the fo efful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the e what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting se will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester.	The theory concern Z rm of publication. course, students v an article and rev	2 Writing scientific vill learn how to iewing someone
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import publications can be use write a scientific article, else's article. The cours on the availability of en	Complexity Theory Ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the t problems. Academic writing ant and required part of research activity. It is not only about obtaining research results but also about applying them in the for efful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting se will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. rolled students.	The theory concern Z rm of publication. course, students v an article and rev Dates will be deter	Ing practical 2 Writing scientific vill learn how to iewing someone ermined based
NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import publications can be use write a scientific article, else's article. The cours on the availability of en NI-DVG	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of th t problems. Academic writing ant and required part of research activity. It is not only about obtaining research results but also about applying them in the fo efful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the o what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting se will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. rolled students. Introduction to Discrete and Computational Geometry	The theory concern Z rm of publication. course, students v an article and rev Dates will be deter Z,ZK	2 Writing scientific vill learn how to iewing someone ermined based
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NI-CPX Students will learn abo (in)tractability of difficul FI-TOP Publishing is an import publications can be use write a scientific article, else's article. The cours on the availability of en NI-DVG The course intends to i of this discipline, and to NI-VOL We will cover the basic NI-VPC Classical theory of rect NI-VPR Student obtains the cre NI-ZS10 Each student can once Dean of the FIT, or the courses MI-ZS10, MI-Z a foreign institution. The academic year's dead- NI-ZS20 Each student can once Dean of the FIT, or the courses MI-ZS10, MI-Z a foreign institution. The academic year's dead- NI-ZS30 The course is prezente research institution. Bei content and extent of th to 4 weeks of full-time of	Complexity Theory ut the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the tip problems. Academic writing ant and required part of research activity. It is not only about obtaining research results but also about applying them in the for ful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the e what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Introduction to Discrete and Computational Geometry Introduct be simple algorithmic problems with a geometric component. Elections s of committee) elections and, in general, opinion aggregation. Computability resive functions and effective computability. Research Project dits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. Master internship abroad for 10 credits within his / her master's degree have a foreign internship at a foreign university or other foreign scientific and/or research ins //ce-dean for study affairs assesses the professional content. The student must provide evidence of the professional content an \$20, MI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 we a maximum number of credits a student can earn for one internship is 30 credits. This	Z rm of publication. course, students wan article and rew Dates will be determined Z,ZK Z,ZK Z,ZK Z,ZK Z,ZK Z titution. Before the dextent of the intereship Z Kitution. Before the dextent of the intereship Z Kitution. Before the dextent of the intereship Z Y or other foreign structure of the intereship Y or other foreign structure of KOS. Every 10 cr	2 Writing scientific vill learn how to iewing someone ermined based 5 lamental notions 5 4 5 4 5 10 e internship the ernship. Auxiliary mployment with exceeds the 20 e internship the ernship. Auxiliary mployment with exceeds the 30 scientific and/or the professional edits correspond

Code of the group: NI-ZI-VS.20 Name of the group: Elective Vocational Courses for Master Specialization Knowledge Engineering Requirement credits in the group: Requirement courses in the group:

Credits in the group: 0

Note on the group:

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

Note on the gr				cpuon o		anzation
Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
NI-ADM	Data Mining Algorithms Pavel Kordík, Daniel Vašata, Rodrigo Augusto Da Silva Alves Daniel Vašata Pavel Kordík (Gar.)	Z,ZK	5	2P+1C	L	V
NI-AIB	Algorithms of Information Security Martin Jure ek, Róbert Lórencz, Olha Jure ková Martin Jure ek Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-ADP	Architecture and Design patterns Filip K ikava, Jan Kurš, Jan Zimolka, Tomáš Chvosta, Ji í Borský Jan Kurš Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-AM1	Middleware Architectures 1 Jaroslav Kucha, Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-AM2	Middleware Architectures 2 Jaroslav Kucha, Tomáš Vitvar Jaroslav Kucha Tomáš Vitvar (Gar.)	Z,ZK	5	2P+1C	L	V
NI-BVS	Embedded Security Martin Novotný Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	L	V
NI-BKO	Error Control Codes Pavel Kubalík Pavel Kubalík Pavel Kubalík (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 (Gar.)	Z,ZK	5	2P+1C	L	V
NI-GEN	Code Generators Petr Máj, Jan Janoušek Petr Máj 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 Ji í Bu ek Ji í Bu ek (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 Kordik Pavel Kordik (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MEP	Modelling of Enterprise Processes Robert Pergl, Marek Suchánek Robert Pergl Robert Pergl (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 (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-NON	Nonlinear Continuous Optimization and Numerical Methods 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	Operating Systems and Systems Programming Petr Zemánek, Tomáš Martinec Petr Zemánek Petr Zemánek (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-BUI	Business Informatics Petra Pavlí ková Petra Pavlí ková Petra Pavlí ková (Gar.)	Z,ZK	5	2P+2C	L	V
NI-PIS	Enterprise Information Systems Vlastimil Jinoch, Martin Závrbský, Martin Mach, Martin Hasaj David Buchtela David Buchtela (Gar.)	Z,ZK	5	2P+1C	L	V
NI-KRY	Advanced Cryptology Ji í Bu ek, Róbert Lórencz Ji í Bu ek Róbert Lórencz (Gar.)	Z,ZK	5	2P+2C	Z	V

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	V
Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta (Gar.)	Z,ZK	5	2P+1C	Z	V
GPU Architectures and Programming Ivan Šime ek Ivan Šime ek Ivan Šime ek (Gar.)	Z,ZK	5	2P+1C	L	V
Reverse Engineering Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	1P+2C	Z	V
Runtime Systems Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	L	V
Semantic Web and Knowledge Graphs Milan Doj inovski, Jakub Klímek Milan Doj inovski Milan Doj inovski (Gar.)	Z,ZK	5	2P+1C	Z	V
Digital Circuit Simulation and Verification Martin Kohlík Martin Kohlík Martin Kohlík (Gar.)	Z,ZK	5	2P+1C	L	V
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
Parsing and Compilers Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	V
System Security and Forensics Simona Forn sek, Marián Svetlík Simona Forn sek Róbert Lórencz (Gar.)	Z,ZK	5	2P+1C	Z	V
Decision Support Systems Petra Pavlí ková, Robert Pergl, David Buchtela David Buchtela Robert Pergl (Gar.)	Z,ZK	5	2P+1C	Z	V
Systems Theory Ji í Vysko il, Stefan Ratschan Stefan Ratschan (Gar.)	Z,ZK	5	2P+1C	Z	V
Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.)	Z,ZK	5	2P+2C	Z	V
Software Product Development Petra Pavlí ková Ond ej Pluha Petra Pavlí ková (Gar.)	KZ	4	1P+2C	Z	V
Embedded Hardware Jan Schmidt Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	5	2P+1C	Z	V
Embedded Software Hana Kubátová, Miroslav Skrbek Miroslav Skrbek Hana Kubátová (Gar.)	Z,ZK	5	2P+1C	Z	V
Virtualization and Cloud Computing Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.)	Z,ZK	5	2P+1C	L	V
Selected Methods for Program Analysis Filip K ikava Filip K ikava (Gar.)	Z,ZK	5	2P+1C	Z	V
Retrieval from Multimedia Ji í Novák, Tomáš Skopal Jaroslav Kucha Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	Z	V
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Decision Support Systems Petra Pavlí ková, Robert Pergl, David Buchtela David Buchtela Robert Pergl (Gar.) System Stefan Ratschan Stefan Ratschan Stefan Ratschan (Gar.) Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.) Software Product Development Petra Pavlí ková Ond ej Pluha Petra Pavlí ková (Gar.) Embedded Hardware Jan Schmidt Jan Schmidt Jan Schmidt (Gar.) Embedded Software Hana Kubátová, Miroslav Skrbek Miroslav Skrbek Hana Kubátová (Gar.) Virtualization and Cloud Computing Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.) Selected Methods for Program Analysis Filip K ikava Filip K ikava Filip K ikava (Gar.) Retrieval from Multimedia Ji I Novák, Tomáš Skopal Jaroslav Kucha Tomáš Skopal (Gar.) Multicore CPU Computing	David Buchtela, Št pánka Havlíková, Dominik Vitek, Ji í Maršál, Jana Z,ZK Soukupová, Zden k Ku era David Buchtela Zden k Ku era (Gar.) Advanced Database Systems Yelena Trofimova, Michal Valenta Michal Valenta Michal Valenta (Gar.) 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Characteristics of the courses of this group of Study Plan: Code=NI-ZI-VS.20 Name=Elective Vocational Courses for Master Specialization Knowledge Engineering

NI-ADM	Data Mining Algorithms	Z,ZK	5
The course focuses on	algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the studer	nts should know n	nachine learning
basics. The emphasis is	s put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation s	systems) and mo	dels (e.g., kernel
methods).			
NI-MVI	Computational Intelligence Methods	Z,ZK	5
Students will understan	d methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to	many problems.	They will learn
how these methods wo	rk and how to apply them to problems related to data mining, control, intelligen games, optimizations, etc.		
NI-AIB	Algorithms of Information Security	Z,ZK	5
Students will get acquai	nted with the algorithms of secure key generation and cryptographic error (not only biometric) data processing. Furthermore, st	udents will learn t	he mathematical
principles of cryptograp	hic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware dete	ction and the use	of machine
learning in detection sy	stems. 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 co	urse is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis	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 knowledg	e 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 problem	ns. In the second j	part the students
	principles of software architecture design and analysis. This includes the classical architectural styles, component based syste	ms, and some ad	vanced software
architectures used in la	rge-scale distributed systems.		
NI-AM1	Middleware Architectures 1	Z,ZK	5
Students will study new	trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information sys	tem architecture,	web service
architecture and aplicati	on servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous co	mmunications and	d high availability
of applications.			
NI-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 architect	tures, concepts a	nd technologies
for microservices, distru	ubuted cache and databases, smart contracts, realtime communication and web security.		
NI-BVS	Embedded Security	Z,ZK	5
Students gain basic kno	wledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of cry	ptographic primit	ives in hardware
and software (in embed	ded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resour	ces for securing i	nternal functions
of computer systems.			
NI-BKO	Error Control Codes	Z,ZK	5
The goal of the course	is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted vi	a channels.	

NI-DSV Distributed Systems and Computing Z,ZK 5
Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communicat
channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of be
data and services, and safety in case of failures. NI-DDW Web Data Mining Z,ZK
NI-DDW Web Data Mining Z,ZK 5 Students will learn latest methods and technologies for web data acquisition, analysis and utilization of the discovered knowledge. Students will gain an overview of Web mining
techniques for Web crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overview of most recent developme
in the field of social web and recommendation systems.
NI-EPC Effective C++ programming Z,ZK 5
Students learn how to use the modern features of contemporary versions of the C++ programming language for software development. The course focuses on programming effective
and efficiency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor time requirements.
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 complex
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 pro
basic properties of software.
NI-GEN Code Generators Z,ZK 5
Advanced techniques of translating programs written in high-level programming languages are essential for understanding the field of systems programming. This primarily involves
understanding the algorithms and techniques used to translate more complex programming constructs of modern languages employed in systems programming. Students will become familiar with both the theoretical 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 algorithms. The emphasis will be not or
on undestanding the basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected topics from graph and hypergra
coloring, Ramsey theory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory will be also applied in the field
of combinatorics on words, formal languages and bioinformatics.
NI-HWB Hardware Security Z,ZK 5
The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards against abuse of the syste using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge about
the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer.
NI-KOD Data Compression Z,ZK 5
Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being
used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals
lossy data compression methods used in image, audio, and video compression.
NI-MKY Mathematics for Cryptology Z,ZK 5 Students will gain deeper knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphers. In particular, the course focuse
on the problem of solving a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of discrete logarithm. The problem of
factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems based on lattices.
NI-MEP Modelling of Enterprise Processes Z,ZK 5
The subject is focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approach for (re)engineering and
implementation of processes, organisation structures and information support in big enterprises and institutions.
NI-MPJ Modelling of Programming Languages Z,ZK 5
The analysis, transformation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserve the semantics of the language This course explores the semantics of programming languages. The students will learn the language models with emphasis on functional languages, students are expected to understa
the basics of the lambda calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with semantic modeling and execution too
NI-MTI Modern Internet Technologies Z,ZK 5
SYNOPSIS The subject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration - A single network, oriented or
TCP/IP is able to carry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video and data to achieve seamle
integrated services. 2. Design of Extremely Scalable Networks - This provides the insights of network architectures which can accommodate hundreds of millions of users and billic of devices. Thus, there is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching and Traffic Prioritisation - These
technologies allow service providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, delay, jitter, type of protocol). 4.
Acceleration Technologies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in case of failures.
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, formal user models, the fundament
notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs.
NI-NON Nonlinear Continuous Optimization and Numerical Methods Z,ZK 5
Students will be introduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such methods to real-world problems. The will also learn the finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They will learn to solve systems
linear algebraic equations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement these algorithms sequential
as well as in parallel.
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 engineering, such as stability from systems
theory and entropy from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related issues occur in any given software architecture. In the second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements. These elements provide the co
functionality of information systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stability and entropy-related principal
This knowledge allows students to realize new levels of evolvability in software architectures.
NI-OSY Operating Systems and Systems Programming Z,ZK 5
The course covers system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kernel data structures. Key topics ar
process management, memory management, file operations and architecture of modern file systems, device drivers and network programming. The course also addresses kernel
development process, upgrades of existing kernels, kernel booting, debugging using dynamic instrumentation, and techniques to guarantee portability. Specifics of kernel architectu in embedded and real-time operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within labs, students will work on proje
focused on development of LINUX kernel modules.

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 are		-
ICT services and architectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT mana	•	•
of ICT services and resource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Gove		
business and the context of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT managemanagement, IT investment evaluation and human resources management in IT (roles CIO, CEO, CFO).	iment, revenue and i	nvestment
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		
in BI (Business Intelligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunic		•
real examples. Furthermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on a Students will be acquainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and op		
company / organization.		
NI-KRY Advanced Cryptology	Z,ZK	5
Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will k	1 1	al principles of
random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which the	ney can apply to the	integration of
their own systems or to the creation of their own software solutions.		
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 ru	n their own business	or business
management, especially in law, administration (necessary steps and documents), business economics, foreign trade and related aspects. NI-PDB Advanced Database Systems	Z,ZK	5
NI-PDB Advanced Database Systems Students orient themselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of da		
databases), with the related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath,		
the course deals with performance evaluation of database machines.	- , ,	
NI-GPU GPU Architectures and Programming	Z,ZK	5
Students will gain knowledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in t	1 1	ing environment,
which is already a widespread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchie	al computational stru	uctures, students
will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.		
NI-REV Reverse Engineering	Z,ZK	5
Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happe		
is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be		
debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the com		
the course is on the seminars, where students will solve practically oriented tasks from the real world.		
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	perience in design and	dimplementation
of a compiler and a VM from scratch, including Abstract Syntax Tree (AST) interpretation Byte code (BC) design and interpretation AST to BC co		-
Just-in-time compilation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implem	entations of real-wor	ld VMs, including
Dynamic optimizations, speculations, and deoptimizations Language implementation frameworks Read-world VMs NI-SWE Semantic Web and Knowledge Graphs	7 71/	F
NI-SWE Semantic Web and Knowledge Graphs The students will learn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web	b technologies met	5 ods and best
practices for modelling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowle	-	
quality assurance.	0 0 1	,
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-SYP Parsing and Compilers	Z,ZK	5
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of fundamentals of automata theory, formal language and formal translation theories.	ge of various variants	and applications
of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.	7 71/	
NI-SBF System Security and Forensics	Z,ZK	5
	1 1	urthormore
Students will get familiar with aspects of system security (principles of end station security, principles of security policies, security models, auther	tication concepts). F	
	tication concepts). F	
Students will get familiar with aspects of system security (principles of end station security, principles of security policies, security models, auther students will get familiar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and importance of operating system/operating system artifacts or file system for attack analysis and detection).	tication concepts). F forensic analysis tec	
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NI-ESW	Embedded Software	Z.ZK	5		
-	I consecuted contriver course covers the areas from the areas from the course covers the covers the areas from the covers the areas from the covers the covers the covers the areas from the covers the areas from the covers the cover	1 ' 1	-		
	e optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing,				
combined with artificial		up to sophisticate	su techniques		
		7 71	5		
NI-VCC	Virtualization and Cloud Computing	Z,ZK	-		
-	ledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies an	-			
	zation principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to eff		•		
1.	s of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effect				
	x computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical ski	lls in the use of mo	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 dy	namic analysis. Ir	1 Static Analysis,		
we will look at the art of	f reasoning about computer programs without running them. We will look at the analyses for program understanding, optimize	ations, error detec	tion. In Dynamic		
Analysis, we will look at	t the analyses considering individual program runs using a concrete environment and inputs.				
NI-VMM	Retrieval from Multimedia	Z,ZK	5		
The student obtains ger	, reral knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of	feature extraction	from multimedia		
objects, indexing, and s	tructure of distributed search engines.				
NI-MCC	Multicore CPU Computing	Z,ZK	5		
Students will get acqua	inted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations or	multicore proces	sors with shared		
and virtually shared me	mories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain knowle	edge of architectu	rally specific		
optimization techniques	s used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs	and memory inter	face throughput.		
On specific non-trivial n	On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications.				

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 publication. Writi	ng scientific
	a useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the cou	-	-
write a scientific art	icle, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an	article and reviewir	ng someone
else's article. The	course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Da	tes will be determi	ned based
	on the availability of enrolled students.		
FIT-ITI	Modern IT infrastructure	Z,ZK	5
FIT-SEP	World Economy and Business	Z,ZK	4
This course is pre	sented in Czech. The course introduces students of technical university to the international business. It does that predominantly by c	omparing individua	l countries
and key regions of	world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as	indexes of econom	nic freedom,
corruption and eco	nomic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of di	scussions based o	n individual
	readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.		
FITE-EHD	Introduction to European Economic History	Z,ZK	3
The course introdu	ces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global eco	nomy through the	description
of the key periods	in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic	history. From large	economic
area of Roman Em	pire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial instituti	ons is deciphered.	The course
does not cover de	tailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and c	rganizations in his	tory. Class
	meetings will consist of a mixture of lecture and discussion.		
NI-ADM	Data Mining Algorithms	Z,ZK	5
The course focuses	s on algorithms used in the fields of machine learning and data mining. However, this is not an introductory course, and the students	should know mach	ine learning
basics. The empha	sis is put on advanced algorithms (e.g., gradient boosting) and non-basic kinds of machine learning tasks (e.g., recommendation syst	ems) and models	(e.g., kernel
	methods).		
NI-ADP	Architecture and Design patterns	Z,ZK	5
The objective of thi	s course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as	well as with under	standing of
	ies, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge o		•
and get familiar with	n the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. I	n the second part t	he students
will be introduced to	o the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems	, and some advanc	ed software
	architectures used in large-scale distributed systems.		
NI-AFP	Applied Functional Programming	KZ	5
	ented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional p		
the rise nowadays	and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, master	ing this paradigm b	becomes a
	necessary competence of a software engineer: the theory and especially the practice.		
NI-AIB	Algorithms of Information Security	Z,ZK	5
	quainted with the algorithms of secure key generation and cryptographic error (not only biometric) data processing. Furthermore, stude		
principles of cryp	tographic protocols (identification, authentication, and signature schemes). Another part of the course is dedicated to malware detec		machine
	learning in detection systems. The last topic includes practical steganographic methods and attacks on steganographic syste		
NI-AM1	Middleware Architectures 1	Z,ZK	5
	ly new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information syste		
architecture and ap	lication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous comm	unications and hig	n availability
	of applications.		

NI-AM2	Middleware Architectures 2	Z,ZK	5
Students will learn	new trends and technologies on the Web including theoretical foundations. They will gain an overview of Web application architecture	es, concepts and te	echnologies
	for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.		
NI-AML	Advanced machine learning	Z,ZK	5
The course introdu	ces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of rec	commendation syst	tems, image
processing,	control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with	the methods discus	ssed.
NI-AOA	Completing a professional event	Z	1
The subject is part	icipation in a one-off professional event, usually a lecture by a foreign guest of the FIT CTU, concluded with a workshop, a test, drafti	ng a report, etc.Su	ch an event
must be approve	d in advance by the vice-dean for pedagogical activities or the vice-dean for science and research and is presented within the FIT thr	ough a website, infe	omail, etc.
NI-APH	Architecture of computer games	Z.ZK	4
	a basic understanding of the various issues in the field of computer games development, especially from a technical point of view, but also		-
	will get a grasp of component-oriented and functional-oriented architecture, game mechanics, decision-making processes and base co		
	es. They will also understand the basics of pathfinding, networking and scripting and apply them in practical exercises (labs). An importance of the second		•
	implementation of a simple game, with a strong focus on nontrivial game mechanics.		
		774	F
NI-APR	Selected Methods for Program Analysis	Z,ZK	5
	uces you to program analysis, i.e., the automated reasoning about the behavior of a computer program. We will cover static and dynar		
we will look at the	art of reasoning about computer programs without running them. We will look at the analyses for program understanding, optimization	is, error detection.	In Dynamic
	Analysis, we will look at the analyses considering individual program runs using a concrete environment and inputs.		
NI-APT	Advanced Program Testing	Z,ZK	5
Testing a program	n is essential to ensure that a program respects its specification, that changes do not introduce regressions or security issues. The go	al of the course is	to present
	advanced program testing techniques, beyond writing unit tests, especially fuzzing and symbolic execution.		
NI-ARI	Computer arithmetic	Z,ZK	4
	Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementa	tion units.	I
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 stu	I ' I	-
-	tain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game t		-
	is of the game where no player wants to deviate from his strategy. Due to the recent development of computers, internet, social network		-
	is and other concepts the algorithmic point of view is gaining attention. In addition to existential questions we study the problems of el		-
		-	
	concepts. In this course we introduce the basics of game theory of many players, solution concept (usually equilibria) and methods of		
NI-BKO	Error Control Codes	Z,ZK	5
	al of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transr	nitted via channels	5.
NI-BML	Bayesian Methods for Machine Learning	KZ	5
The subject is focu	sed on practical use of basic Bayesian modeling methods in the dynamically evolving machine learning theory. In particular, it studies	the construction of	appropriate
models providing	description of real phenomena, as well as their subsequent use, e.g., for forecasting of future evolution or learning about the hidden	variables (true obje	ect position
from noisy observa	ations etc.). The emphasis is put on understanding of explained principles and methods and their practical adoption. For this purpose, a	number of real worl	ld examples
and applications	will be presented to students, for instance, 2D/3D object tracking, radiation source term estimation, or separation in medical imaging.	The students will tr	ry to solve
	some of them.		
NI-BPS	Wireless Computer Networks	Z,ZK	4
Students will lear	n about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad		lticast and
broadcast mecha	nisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowle	edge of security me	echanisms
	for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitat	ole tools.	
NI-BUI	Business Informatics	Z,ZK	5
	rse is to focus on operational, tactical and strategic management of business informatics. Students will gain knowledge in the areas of b		
	architectures in enterprise informatics. They will also learn about the principles, models and standards (ITIL, COBIT) in IT management		
	ind resource management (sourcing). Students will learn the process of creating and implementing information strategy, IT Governan		•
	the context of information strategy with global business strategy. They will also gain knowledge in the areas of economic IT manageme		
	management, IT investment evaluation and human resources management in IT (roles CIO, CEO, CFO).		oounoni
NI-BVS		774	F
	Embedded Security	Z,ZK	5
-	c knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of crypto		
and software (in en	nbedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources	s for securing intern	nal functions
	of computer systems.		
NI-CCC	Creative Coding and Computational Art	KZ	4
Students work on	practical tasks, get acquainted with creative and yet proven methods of visualizing various types of data. The course freely follows the	basic graphics cou	irses (MGA,
BLE,) and introd	uces students to suitable visualization methods for traditional as well as for open data. It combines well-known visualization technique	s with artistic meth	nods using
modern technolog	ies. The aim is to create an interesting visualization project. It is planned to work closely with IPR CAMP (Center of Architecture and N	Aetropolitan Planni	ing) and IIM
	(Institute of Intermedia FEL).		
NI-CPX	Complexity Theory	Z,ZK	5
Students will lea	rn about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the	theory concerning	g practical
	(in)tractability of difficult problems.		
NI-CTF	Capture The Flag	KZ	4
_	The course is designed to introduce students to CTF competitions and let them gain practical experience in the field of cyber set		I
NI-DDM	Distributed Data Mining	KZ	4
	n state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands of	I I	1
	amework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations a	-	-
	anework Apache Spark and with existing distributed DM7 ML algorithms. They will learn principles of their parallel implementations a approaches to parallelize other algorithms. The course is prezented in czech language.		h. ohose
		771	~
NI-DDW	Web Data Mining		5
	arn latest methods and technologies for web data acquisition, analysis and utilization of the discovered knowledge. Students will gain		-
lechniques for Web	crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overvie	w or most recent de	evelopments
	in the field of social web and recommendation systems.		

NI-DID	Digital drawing	Z	2		
The course will intr	oduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, persp	pective and color th	eory, which		
they will practically	apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course	is fit for anyone wh	no wants to		
practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice gained knowledge.					
NI-DIP	Diploma Project	Z	30		
NI-DNP	Advanced .NET	Z,ZK	4		
Students will acqui	re an overview of platform .NET and will gain knowledge about technologies ASP.NET Core, Entity Framework Core, .NET MAUI (WI	PF, UWP), Blazor a	nd also will		
get notions of Azu	re DevOps and GIT. Students will get practical experience in semestral work where they will create a client-server application utilizing	technologies ASP.	NET Core,		
	Entity Framework Core and (Blazor, .NET MAUI or WPF) and also Azure DevOps and GIT.				
NI-DPH	Game Design	Z,ZK	5		
	ments the NI-APH (Architecture of Computer Games) and BI-VHS (Virtual gaming worlds) course, while focusing primarily on game of	-			
	er knowledge of the principles used for games design, such as: level design, gameplay design, character design, game mechanics d		-		
development cycle.	The students will get an overview of game development from the designer's perspective, from theoretical concepts to practical imple	mentation applied to	o semestral		
	projects.				
NI-DSS	Decision Support Systems	Z,ZK	5		
	rse is to provide students with knowledge and skills in decision support systems, their classification (Powerova), selected principles of				
-	ented decision support systems. Students will also gain knowledge of multicriterial decision-making methods and game theory. They wil conceptually and ontologically oriented decision support systems and the basics of distribution, optimization and evolution methods a		e principies		
		-			
NI-DSV	Distributed Systems and Computing uced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing	Z,ZK	5		
	rn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that s				
channels. They lear	data and services, and safety in case of failures.	support night availat			
		7	2		
NI-DSW	Design Sprint on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to valida				
	John projects using the Design Sprint method, developed by Google. Thanks to this method the teams are able to go norm dea to validate John so and the second				
	testing the prototypes (plus final presentation).	In research and line	sing with		
		Z,ZK	5		
NI-DVG	Introduction to Discrete and Computational Geometry to introduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar with	1 1	-		
The course interios	of this discipline, and to be able to solve simple algorithmic problems with a geometric component.		niai nolions		
		774	4		
NI-DZO	Digital Image Processing	Z,ZK	4		
	nts a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical alc e an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is al	-	-		
-	processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR				
	abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conv	-	-		
	gid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, a				
NI-EDW	Enterprise Data Warehouse Systems	Z,ZK	5		
	ta Warehouses course focuses on the area of business intelligence. Students will be introduced to business intelligence methods and	1 ' 1	-		
	ing warehouses and various architectures, but also their deployment and maintenance. This course also includes an introduction to the		-		
	visualization.				
NI-EHW	Embedded Hardware	Z.ZK	5		
The course brings	basic laws that govern digital design and basic techniques to use them. It deals with both large and small scale systems. This is the	base of advanced	embedded		
systems, that profit	from their specialized structure for effective computation and acceleration. Design of fast custom computing machines is discussed,	including standard	ized means		
	of internal communication, parallelism extraction and utilization in special structures and system architectures.				
NI-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 focu	ses on programmin	g effectivity		
and eff	iciency in the form of writing maintainable and portable source code and creating correct programs with low memory and processor t	time requirements.			
NI-ESC	Experimental Project Course	KZ	8		
"The Design Proje	ct course offers a holistic exploration of the design process, providing students with a well-rounded understanding of the principles, n	nethodologies, and	tools used		
	logy-driven solutions that are user-centric and industry-relevant. Throughout the semester, students will work on real-world design pro	-	-		
experts, and learr	to integrate theory with practical application. Through a hands-on, project-based learning approach, students will develop their skills	in user-centered d	lesign 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		
	e course acquainted students with the specifics of software development for embedded systems. The course covers the areas from the ba				
in C language and	d code optimizations, through typical areas as the reliable software development, embedded operating systems, signal processing, u	p to sophisticated to	echniques		
	combined with artificial intelligence.				
NI-EVY	Efficient Text Pattern Matching	Z,ZK	5		
Students get knowl	edge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both acces	s time and memory	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	o describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some so	ftware tools that all	ow to prove		
	basic properties of software.	771/	A		
NI-FMT	Finite model theory	Z,ZK	4		
	se is to introduce students to the basics of finite model theory. The original motivation is the questions expressibility and verifiability of nception in the 1970s, the course has evolved rapidly and touched on many other areas of theoretical computer science, such as de:				
	Constraint Satisfaction Problem (CSP), the theory of algorithmic meta-theorems and combinatorics.	sonpuve complexity			
NI-GAK	Graph theory and combinatorics	Z,ZK	5		
	ss is to introduce the most important topics in graph theory, combinatorics, combinatorial structures, discrete models and algorithms.	1			
-	e basic principles but also on applications in problem solving and algorithm design. The topics include: generating functions, selected top	-	-		
-	heory, introduction to probabilistic method, properties of various special classes of graphs and combinatorial structures. The theory v				
<u>,</u>	of combinatorics on words, formal languages and bioinformatics.	11			
L					

NI-GEN	Code Generators	Z,ZK	5
Advanced technic	ues of translating programs written in high-level programming languages are essential for understanding the field of systems program	nming. This primar	ily involves
understanding the	algorithms and techniques used to translate more complex programming constructs of modern languages employed in systems progra	amming. Students	will become
	familiar with both the theoretical and practical aspects of implementing the back-end of optimizing compilers for programming lang	guages.	
NI-GLR	Games and reinforcement learning	Z,ZK	4
The field of reinfo	reement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligen		intended to
	give you both theoretical and practical background so you can participate in related research activities. Presented in English		
NI-GNN	Graph Neural Networks	Z,ZK	4
	oduces students to advanced artificial intelligence techniques for working with graphs. Lectures will focus on the latest graph neural n		
representations	f nodes, edges and entire graphs. The techniques discussed cover various types of graphs, including time-varying graphs. The last pa graph generation and interpretability of graph neural networks. In the exercises, students will try out selected techniques and pro		ISO COVEIS
			F
NI-GOL	Programming of distributed systems in GO	KZ	5
NI-GPU	GPU Architectures and Programming	Z,ZK	5
-	cnowledge of the internal architecture of modern massively parallel GPU processors. They will learn to program them mainly in the CUI videspread programming technology of GPU processors. As an integral part of the effective computational use of these hierarchical com		
which is alleady a	will also learn optimization programming techniques and methods of programming multiprocessor GPU systems.		65, 510061115
NI-GRI	Grid Computing	Z,ZK	5
	Grid computing and gain knowledge about the world-wide network and computing infrastructure.	2,213	5
NI-HCM	Mind Hacking	ZK	5
	is an emerging discipline that is closely related to cyber security. While the domain of cyber security is the protection of networks, info	I	-
• •	nitive security is the protection of the human mind from intentional and unintentional digital manipulation. The topic of cognitive securi		
the context of infor	nation warfare, increasing digital dependence and the development of artificial intelligence, where these phenomena from the Internet	environment have	real societal
	impacts such as disruption of social cohesion, threats to democracy or war.		
NI-HMI2	History of Mathematics and Informatics	ZK	3
This course is p	esented in Czech. Selected topics {Infinitesimal calculus, probability, number theory, general algebra, different examples of algorithms	s, transformations,	recursive
	functions, eliptic curves, etc.) note on possibilities of applications of some mathematical methods in informatics and its develop	ment.	
NI-HSC	Side-Channel Analysis in Hardware	Z,ZK	4
	dicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical attack	-	
	ide channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and	-	-
	hey also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel		-
NI-HWB	Hardware Security	Z,ZK	5
	es the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards eans. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Studer	-	-
-	potographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions	-	suge about
NI-IAM	Internet and Multimedia	Z.ZK	4
	se is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acq	1 '	1
	signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical u		
audiovisual transr	nissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effe	ect of various com	ponents on
the quality and late	ncy of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the	e scene up to the p	presentation
	for audience.		
NI-IBE	Information Security	ZK	2
	prmation and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and international		
	d methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g.		
NI-IKM	Internet and Classification Methods	Z,ZK	4
	students get acquainted with classification methods used in four important internet, or generally network applications: in spam filtering		
	ion systems and in intrusion detection systems. However, they will learn more than only how classification is performed when solving d of these applications, they get an overview of the fundamentals of classification methods. The course is taught in a 2-weeks cycle w		-
, s	During the exercises, the students on the one hand implement simple examples to topics from the lectures, on the other hand consult		
			sks
NI-105		t their semester ta	1
NI-IOS Students will learn	Advanced techniques in iOS applications	t their semester tas KZ	4
		t their semester tas KZ	4
	Advanced techniques in iOS applications the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the ba BI-IOS.	t their semester tas KZ asics from the beg	4
Students will learn	Advanced techniques in iOS applications the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the ba	t their semester tas KZ asics from the beg Z,ZK	4 inners class
Students will learn	Advanced techniques in iOS applications the latest trends in mobile development technologies for iOS platform. Class covers advanced topics, students need to know all the ba BI-IOS. Internet of Things	t their semester tag KZ asics from the beg Z,ZK amiliarization with a	4 inners class
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NI-KTH	Combinatorial Theories 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		•			
	(players) of a certain competitive process by designinng a mathematical model and investigating the strategies. The traditional task of classical game theory is to find the equilibria,					
	which are the states of the game where no player wants to deviate from his strategy. Historically, the second big development in game theory of two-player full-information combinatorial games, was by Conway, Berlekamp and Guy. They developed a theory, originally used for solving end-games in Go, into a full fledged field. The idea is to evaluate games such that					
	batilities games can be added, that is, played simultaneously. This led to the algrebraic approach to study combinatorial games. The thin	-				
	established the theory of positional games (like tic-tac-toe and hex). In analysis of these game, one cannot escape the brute-force tra					
	k introduced the "false probabilistic method", which aims to tackhle this problem. In this course we build the foundation of the theory c	0				
games. We focus o	n theoretical analysis of games and building the theory, not on the programming aspects of game solving algorithms. The course requ	uires independent v	work, ability			
to mathematically	analyse, think and proof. The course is also suitable for bachelors student in the third year, who attended introduction to graph theory	/, as well as for Phi	D students			
	looking for research topics.					
NI-KYB	Cybernality	ZK	5			
• •	uainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the					
	f systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker activ		The course			
	vill also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CE	,				
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 optim					
	scheduling of tasks to processors, analysis of network flows), distribution and allocation of resources (transportation problems, travelli mics, and modelling of conflicts via the game theory. They get an overview of computational complexity of optimization problems. The	-	-			
	in linear programming.	y get onentation in	aiguninns			
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 presen	I	-			
	We aim at the state-of-the-art filters, in particular the PHD (Probability Hypothesis Density) and PMBM (Poisson Multi-Bernoulli)		oo traoiting.			
NI-MCC	Multicore CPU Computing	Z,ZK	5			
	cquainted in detail with hardware support and programming technologies for the creation of parallel multithreaded computations on mu					
-	red memories, which are today the most common computing nodes of powerful (super)computer systems. Students will gain knowled	-				
	ques used to reduce the performance drop due to the widening gap between the computational requirements of multi-core CPUs and	-				
	On specific non-trivial multithreaded programs, students will also learn the basics of the art of creating these applications.					
NI-MEP	Modelling of Enterprise Processes	Z,ZK	5			
The subject is	focused on introduction to the discipline of Enterprise Engineering. Students learn the importance of a proper methodological approa	ch for (re)engineer	ing and			
	implementation of processes, organisation structures and information support in big enterprises and institutions.					
NI-MKY	Mathematics for Cryptology	Z,ZK	5			
Students will gain	deeper knowledge of algebraic procedures solving the most important mathematical problems concerning the security of ciphers. In	particular, the cour	se focuses			
on the problem of	of solving a system of polynomial equations over a finite field, the problem of factorization of large numbers and the problem of discret		roblem of			
	factorization will also be solved on elliptic curves. Students will further become familiar with modern encryption systems based on	lattices.				
NI-MLP	Machine Learning in Practice	Z,ZK	5			
	earning methods to real projects in practice involves many other necessary tasks - from understanding the intentions of the client to, ide					
-	students through all phases of a project according to the standard CRISP-DM methodology, not only theoretically but also practically	-				
	sing and learn how to describe the whole process from exploration to evaluation of the model performance in the form of a clear and					
NI-MOP	Modern Object-Oriented Programming in Pharo	KZ	4			
	ogramming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where i nplex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills	-				
	in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development no					
	ing object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work of					
	ms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvem					
NI-MPI	Mathematics for Informatics	Z,ZK	7			
	prises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate 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					
NI-MPJ	Modelling of Programming Languages	Z,ZK	5			
	formation, and code generation processes depend on the semantics of the language; in particular, they are correct if they preserve the		e language.			
This course explore	es the semantics of programming languages. The students will learn the language models with emphasis on functional languages, studer	nts are expected to	understand			
the basics of the la	mbda calculus and here get acquainted with the advanced lambda calculus. The students also get hands-on-experience with semantic	modeling and exec	cution tools.			
NI-MPL	Managerial Psychology	ZK	2			
NI-MPR	Master Project	Z	7			
1. At the beginning	g of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial ta	sks that should be	carried out			
during the semeste	r. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end o	f the semester. 2. T	he external			
-	he information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.cz/s	-				
	ned form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT topic					
is rather general,	the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the	ne FTT will be com	plete and			
	approvable at the end of the semester.					
NI-MSI	Mathematical Structures in Computer Science	Z,ZK	4			
iviathematical se	emantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott Introduction to category theory	model of lambda of	calculus.			
	Introduction to category theory.	7 7/	E			
NI-MTI	Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration -	Z,ZK	5 riented on			
	ubject "Modern Internet Technologies" is designed on four major pillars of networking: 1. Unified Communication and Collaboration - , arry whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video	-				
	any whatever types of protocols for whatever purposes. This architecture is able to be protocol independent and carries voice, video is able to be protocol independent and carries voice, video is a composition of extremely scalable Networks - This provides the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can accommodate hundreds of the insights of network architectures which can be accommodate hundred architectures which are accommodate hundred architectures which are accommodate hundred architectures a					
-	, there is a paradigm switch from LANs (Local Area Networks) to SPs (Service Providers). 3. Traffic Segregation, Traffic Matching and					
	ow service providers to create private channels of communication between customers, with guaranteed parameters (bandwidth, dela					
-	eration Technologies - They allow traffic to be carried at the optimal speed and allow for graceful degradation of service parameters in					

NI-MVI	Computational Intelligence Methods	Z,ZK	5	
Students will und	erstand methods and techniques of computational intelligence that are mostly nature-inspired, parallel by nature, and applicable to m		/ will learn	
	how these methods work and how to apply them to problems related to data mining, control, intelligen games, optimizations,			
NI-MZI	Mathematics for data science dents are introduced to those fields of mathematics that are necessary for understanding standard methods and algorithms used in da	Z,ZK	4 Idied topics	
	inear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality princ		-	
	selected notions from probability theory and statistics.		,	
NI-NLM	Neural Language Models	Z	5	
In this course, stuc	lents will learn the technical foundations of the Transformer architecture as well as the practical aspects of using language models. The	-	e is to teach	
	students how to use language models to solve problems, make informed risk assessments, and work critically with the scientific li		4	
NI-NMS	Neural Networks, Machine Learning and Randomness ds, i.e. methods based on randomness, are extremely important for the construction and training of neural networks as well as a num	Z,ZK	4	
	urse "Neural networks, machine learning and randomness" will discuss in sufficient depth a number of specific types of neural networks		-	
	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 ar	nd shows that, in addition to the use of randomness in neural networks and machine learning, machine learning models, including ne	ural networks, are ι	used in one	
	of the most important applications of randomness stochastic optimization methods, which include e.g. popular evolutionary algo	1		
NI-NMU	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 ar dent with the largest possible range of creative approaches in new media. The subject emphasizes dialogue with students, especially		-	
	art projects.		to speeme	
NI-NON	Nonlinear Continuous Optimization and Numerical Methods	Z,ZK	5	
	roduced to nonlinear continuous optimization, principles of the most popular methods of optimization and applications of such method			
	finite element method and the finite difference method used for solving ordinary and partial differential equations in engineering. They		-	
linear algebraic e	quations that arise from discretization of the continuous problems by direct and iterative algorithms. They will also learn to implement as well as in parallel.	these algorithms se	equentially	
NI-NSS	Normalized Software Systems	ZK	5	
	the foundations of normalized systems theory that studies the evolvability of modular structures based on concepts from engineering	1 1	-	
theory and entropy	/ from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related issu	es occur in any give	en software	
	second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements. The	-		
functionality of info	rmation systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stability	and entropy-related	d principles.	
NI-NUR	This knowledge allows students to realize new levels of evolvability in software architectures. 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	1 / 1	-	
	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	
The Linux operatin	g system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining po	werful processors	and FPGAs	
	iability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development		ents. The	
	burse provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practic	·		
NI-OSY	Operating Systems and Systems Programming system programming in UNIX environment. Emphasis is given on kernel development with focus on kernel architecture and kernel d	Z,ZK	5 topics are:	
	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.			
in embedded and r	real-time operating systems are also discussed. Theoretical and general principles are demonstrated on the LINUX kernel. Within labs	, students will work	on projects	
	focused on development of LINUX kernel modules.	т <u> </u>		
NI-PAM	Efficient Preprocessing and Parameterized Algorithms	Z,ZK	4	
	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 expone		,	
	n the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial tir			
which is not pos	sible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solution	on method. We will p	present a	
plethora of param	neterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (prove that for some problem (and parameter) such an algorithm (and parameter) such an algor	• •	t exist. We	
	will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation		4	
NI-PAS	Advanced Aspects of Business ourse is to provide students with advanced (compared to the bachelor's degree) knowledge and skills needed to establish and run the	Z,ZK	4 business	
	management, especially in law, administration (necessary steps and documents), business economics, foreign trade and related		50311033	
NI-PDB	Advanced Database Systems	Z,ZK	5	
	emselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of databas			
databases), with the	he related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CYPF the course deals with performance evaluation of database machines.	IER, Gremlin). The	last part of	
NI-PDD	Data Preprocessing	Z,ZK	5	
	prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data s	1 1		
time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteristics from images or from web				
	pages.			
NI-PDP	Parallel and Distributed Programming	Z,ZK	6 a systems	
	omputer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platfor			
with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication operations, and languages and				
environments for parallel programming of shared and distributed memory computers. They get acquianted with fundamental parallel algorithms and on selected problems, they will				
learn the technique	es of design of efficient and scalable parallel algorithms and methods of performance evaluation of their implementations. The course	includes a semeste	er project of	
1	practical programming in OpenMP and MPI for solving a particular nontrivial problem.			

NI-PG1	Computer Grafics 1	ZK	4
	on graphic courses (mainly BI-PGA and BI-PGR) and the knowledge from these courses is deepened by state-of-the-art knowledge. The	0	
	nced computer graphics. Students will gain practical knowledge with realistic texturing and raytracing methods. An integral part of the	-	
	subsequent implementation. The course will be followed by a course PG2 supplementing the knowledge of PG1 on other areas and		
NI-PIS	Enterprise Information Systems	Z,ZK	5
	sed on the current IT requirements of large companies in the Czech Republic (Top 100). The basis is Data management, storage of bi telligence). The principles of solving the overall architecture of information systems in the banking, insurance and telecommunication.		
	thermore, students will get acquainted with the life cycle of information systems in the company / organization and its impact on the bus		
	equainted with technologies that have proven themselves in the elimination of basic risks in the planning, implementation and operation		
	company / organization.		
NI-PIV	Computer Vision	Z,ZK	5
	on course focuses on the theoretical and practical mastery of modern methods and algorithms in the field of image data processing. St		ainted with
	oles of computer vision, gradually move to advanced computer vision techniques using deep learning. Emphasis is placed on theoretic		
practical application	ns and implementation of learned methods during exercises. Topics covered include morphological operations, image filtering, color re	presentations, objec	ct detection
and recognition a	nd segmentation through classical and recent approaches based on deep learning, deep neural networks for computer vision (includ	ing CNN, RCNN, YC	OLO, ViT),
	motion detection, visual expressiveness (saliency).		
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		
about programmin	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		ang 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		
1 0	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		00 1
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	we discuss scientif	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	es.	
NI-PLS4	Programming Language Seminar	Z	2
-	g Language Seminar aims to introduce students to research in programming languages. It has the format of a reading group in which		
about programmin	g languages and related fields. Participating students are expected to present a paper of their interest and actively participate in the c		ading group
	is a joint venue between FIT and MFF CUNI. It is open to all students and researchers interested in programming language		-
NI-PON	Selected Topics in Optimization and Numerical mathematics	Z,ZK	5 op obtained
	s on optimization problems that appear in the field of machine learning and artificial intelligence. Students broaden their knowledge of co rematics for informatics. The methods are explained and described along with the details on how they are implemented on computers	-	
	is males for mornales. The methods are explained and described along with the details of now they are implemented on computers	. riched, the releval	
	of numerical matematics, mainly numerical linear algebra, are explained too.		it concepts
NI-PSD	of numerical matematics, mainly numerical linear algebra, are explained too. Public Services Design	KZ	
NI-PSD The course will int	of numerical matematics, mainly numerical linear algebra, are explained too. Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p	KZ rocess from the per	4
The course will int	Public Services Design	rocess from the per	4 spective of
The course will int	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p	rocess from the per n with client represe	4 spective of
The course will int suppliers (devs a NI-PSL	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration Course is aimed at students-designers as well as clients. Programming in Scala	rocess from the per n with client represe Z,ZK	4 rspective of entatives. 4
The course will int suppliers (devs a NI-PSL The course introc	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboratio Course is aimed at students-designers as well as clients. Programming in Scala luces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feature	rocess from the per n with client represe Z,ZK es - e.g.pattern mat	4 entatives. 4 tching and
The course will int suppliers (devs a NI-PSL The course introc	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration Course is aimed at students-designers as well as clients. Programming in Scala luces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feature library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and	rocess from the per n with client represe Z,ZK es - e.g.pattern mat	4 entatives. 4 tching and
The course will int suppliers (devs a NI-PSL The course introc advance standard	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration Course is aimed at students-designers as well as clients. Programming in Scala luces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feature 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.	rocess from the per n with client represe Z,ZK es - e.g.pattern mat d libraries e.g. Play, (4 rspective of entatives. 4 tching and Cassandra,
The course will int suppliers (devs a NI-PSL The course introc advance standard NI-PVR	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration Course is aimed at students-designers as well as clients. Programming in Scala luces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feature 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. Advanced Virtual Reality	rocess from the per n with client represe Z,ZK es - e.g.pattern mat d libraries e.g. Play, (KZ	4 rspective of entatives. 4 tching and Cassandra, 4
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The course will int suppliers (devs a NI-PSL The course introc advance standard NI-PVR The course introdu things, it introduces	Public Services Design roduce students to specifics of UX, Service design and development for public sector. We will look into the design and development p and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration Course is aimed at students-designers as well as clients. Programming in Scala luces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language featur 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. Advanced Virtual Reality uces advanced parts of the virtual reality. It is a continuation of the already running graphic objects, especially the creation of 3D mode is students to their application in virtual reality. Lectures will focus on virtual reality technology, its use in various applications and will also	rocess from the per n with client representation Z,ZK es - e.g.pattern mate d libraries e.g. Play, G KZ Is in Blender, and and and deal with creating a	4 rspective of entatives. 4 tching and Cassandra, 4 mong other applications
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Just-in-time compilation and some optimization techniques Through a series of guest lectures, introduce you to various advanced topics and implementations of real-world VMs, including Dynamic optimizations, speculations, and deoptimizations Language implementation frameworks Read-world VMs NI-SRF 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, authentication concepts). Furthermore, students will get familiar with forensic analysis as a tool for investigating security incidents (techniques used by malicious software/attackers and forensic analysis techniques and the importance of operating system/operating system artifacts or file system for attack analysis and detection). NI-SCE1 Computer Engineering Seminar Master I 7 4 The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. NI-SCE2 Computer Engineering Seminar Master II Ζ 4 The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester. NI-SCR Statistical Analysis of Time Series 7.7K 5 The course deals with the practical use of the basic time series modelling theory in engineering tasks, ranging from economics (stock exchange prices, employment) and industrial problems (modelling of signals and processes) to computer networks (network components load, attacks detection). The students learn to select a convenient process model, estimate its parameters, analyze its properties and use it for forecasting of future or intermediate values. The stress is put on understanding and adoption of the main principles based on practical real-world examples. Both the lab classes and the lectures exploit freely available software packages in order to provide easy and straightforward transfer of students' knowledge from the academic to the real world. NI-SEP World Economy and Business Δ 7 7K This course is presented in Czech. However, there is an English variant in the program Informatics (N1801 / 4793). The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite. NI-SIB Network Security Z.ZK 5 NI-SIM **Digital Circuit Simulation and Verification** Z,ZK 5 The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level Modeling) levels and with the properties of proper tools. The course covers recent verification methods, too. NI-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 technologies, methods and best practices for modelling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge graphs and their systematic quality assurance. Parsing and Compilers NI-SYP 7.7K 5 The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing. NI-SZ1 Knowledge Engineering Seminar Master I Ζ 4 On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research labs around the world. Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machine learning and AI conferences and summer schools, as well as FIT's own Summer Research Program (VyLet). NI-SZ2 Knowledge Engineering Seminar Master II Ζ 4 On this seminar you will present a research paper from a top institute / research group to your peers. You will learn what is being cooked in top research labs around the world. Additionally, you will learn how to properly present and read scientific papers. The work in the seminar will prepare you to attend (and profit from) top machine learning and AI conferences and summer schools, as well as FIT's own Summer Research Program (VyLet). NI-TES Systems Theory Z,ZK 5 Today, humankind has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However, the costs of managing this complexity and of ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of models that describe only those aspects of the systems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and algorithms that form the basis for the modeling and analysis of complex systems. NI-TKA Z,ZK Category Theory 4 NI-TNN Theory of Neural Networks 7 7K 5 In this course, we study neural networks from the point of view of the theory of function approximation and from the point of view of probability theory. At first, we recall basic concepts pertaining to artificial neural Networks, such as neurons and connections between them, types of neurons from the point of view of signal transmission, network topology, somatic and synaptic mappings, network training, and the role of time in neural networks. In connection with network topology, we get acquainted with its transformation into a canonical topology, and in connection with somatic and synaptic mappings, with their composition into mappings computed by the Network, Finally in connection with training, we pay attention to the problem of overtraining and to the fact that training is actually a specific optimization task, recalling the most typical objective functions and the most important optimization methods employed for neural network training. We will see the meaninig of all these concepts in the context of common kinds of forward neural networks. Within the topic approximation approach to neural networks, we first notice the connection of neural networks to expressing functions of many variables using functions of fewer variables (Kolmogorov theorem, Vituškin theorem). Afterwards, we will see how the universal approximation capacity of neural networks can be mathematically formalized as the sets of mappings computed by neural networks being dense in important Banach spaces of functions, in particular in the spaces of continuous functions, spaces of functions integrable with respect to a finite measure, spaces of functions with continuous derivatives, and Sobolev spaces. Within the topic probabilistic approach, we first get acquainted with training based on expectation and training based on a random sample, and with probabilistic assumptions about training data with which those two kinds of neural networks can be employed. We will see how it is possible to get an estimate of the conditional expectancy of network outputs conditioned by its inputs using the expectancy based learning. We recall the strong and the weak law of large numbers and get acquainted with an analogy of the strong law of large numbers for neural networks and with the assumptions for its validity. Finally, we recall the central limit theorem, get acquinted with its analogy for neural networks, with the assumptions for its validity and with the hypothesis tests based on it. We will see how those tests can be employed to search for the topology of the network. NI-TS1 Theoretical Seminar Master I 7 4 Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.

	Theoretical Seminar Master II	Z	4
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic		
are treated individu	ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a v	work with scientific	papers and
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	Z	4
NI-TS3	Theoretical Seminar Master III Ir is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	-	
	ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a v	00 1	
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.		
NI-TS4	Theoretical Seminar Master IV	Z	4
	r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic		
are treated individu	ally and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a v	work with scientific	papers and
	other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	7 71/	
NI-TSP	Testing and Reliability knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to pre	Z,ZK	5
-	ensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with but		
	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 contr	-	
tracking, hand tra	cking, eye tracking) will be discussed. Furthermore, the concepts of mixed and augmented reality will be introduced. Finally, ways of reality will be presented.	using virtual and a	lugmented
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.	3	5
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
-	n knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and	-	
	rtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficie		-
	rameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effection of allowed systems. Theoretically and practically the will be a similar to a similar system of allowed systems.		
management of cor	mplex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills ir and development tools (Continuous integration and development).	the use of moder	n integration
NI-VGA	Video Games Architecture	Z,ZK	5
-	a wide range of topics, procedures and methodologies related to the development of computer games - from a technical point of vie	, ,	-
	of view. In the lectures, students will be guided through the history of development, the structure of game engines, component and fu		
	t, physics, graphics, artificial intelligence and multiplayer. The exercises will then cover selected technological topics in greater detail, ir		
	some game mechanics, in the form of practical demonstrations.		
NI-VMM	Retrieval from Multimedia	Z,ZK	5
The student obtains	s general knowledge regarding interfaces of portals providing multimedia content, the principles of similarity search, the methods of feat objects, indexing, and structure of distributed search engines.	ture extraction from	n multimedia
NI-VOL			
	Floationa	7 71/	E
INI-VOL	Elections We will cover the basics of (committee) elections and in general opinion aggregation	Z,ZK	5
	We will cover the basics of (committee) elections and, in general, opinion aggregation.		ı
NI-VOL		Z,ZK Z	5 5
	We will cover the basics of (committee) elections and, in general, opinion aggregation. Research Project		ı
NI-VPR NI-VSM	We will cover the basics of (committee) elections and, in general, opinion aggregation. Research Project Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en.	Z Z,ZK	5
NI-VPR NI-VSM The course leads	We will cover the basics of (committee) elections and, in general, opinion aggregation. Research Project Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. Selected statistical Methods the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with moreopy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with random	Z Z,ZK ultivariate normal c	5 7 distribution,
NI-VPR NI-VSM The course leads application of ent	We will cover the basics of (committee) elections and, in general, opinion aggregation. Research Project Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. Selected statistical Methods the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with more provide the output in the course of the course of the course deals with rance Markov chains. The high point of the course is the Queuing theory and its application in networks.	Z Z,ZK ultivariate normal c dom processes wit	5 7 Jistribution, h focus on
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NI-VPR NI-VSM The course leads application of ent NI-VYC	We will cover the basics of (committee) elections and, in general, opinion aggregation. Research Project Student obtains the credits for published scientific outputs. The details are at https://courses.fit.cvut.cz/NI-VPR/en. Selected statistical Methods the student through advanced probabilistic and statistical methods used in information technology praxis. Particularly it deals with mu ropy in coding theory, hypothesis testing (T-tests, goodness of fit tests, independence test). Second part of the course deals with rance Markov chains. The high point of the course is the Queuing theory and its application in networks. Computability Classical theory of recursive functions and effective computability.	Z Z,ZK ultivariate normal c dom processes wit Z,ZK	5 7 distribution, h focus on 4
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NIE-PDL	Practical Deep Learning	KZ	5	
This course is designed to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine learning framework. Throughout				
the course, students will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields such as computer vision and natural				
language processing.				
NIE-PML	Personalized Machine Learning	Z,ZK	5	
Personalized machine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristics and behaviors of individual				
entities. While PML is commonly used in applications such as recommender systems, which recommend items to users based on their personal interests, its principles can be applied				
to a wide range of other fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theoretical, algorithmic, and practical				
perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial communities.				
PI-SCN	Seminars on Digital Design	ZK	4	
This subject deals with problems of realization and implementation of digital circuits - both combinational and sequential. Basic means of description of digital circuits and basic logic				
synthesis and optimization algorithms are described. Basics of EDA (Electronic Design Automation) systems are given, together with combinatorial problems emerging in EDA.				

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2025-07-04, time 02:26.