## Study plan

# Name of study plan: Aplikace informatiky v p írodních v dách

Faculty/Institute/Others: Department: Branch of study guaranteed by the department: Welcome page Garantor of the study branch: Program of study: Applications of Informatics in Natural Sciences Type of study: Follow-up master full-time Required credits: 0 Elective courses credits: 120 Sum of credits in the plan: 120 Note on the plan:

Name of the block: Compulsory courses in the program Minimal number of credits of the block: 0 The role of the block: P

Code of the group: NMSPAIPV1 Name of the group: MDP P\_AIPVN 1st year Requirement credits in the group: Requirement courses in the group: In this group you have to complete at least 13 courses Credits in the group: 0

Note on the group: Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their Completion Credits Code Scope Semester Role members) Tutors, authors and guarantors (gar.) Application of Statistical Methods 01ASM K7 2 2+0Р Tomáš Hobza Tomáš Hobza Tomáš Hobza (Gar.) Z,ZK 18AS 2 1P+1C Ζ Р Applications of Statistics and Data Processing Applied Econometrics and Time Series Theory Ζ 18AEK Z,ZK 4 2P+2C Р Radek H ebík, Quang Van Tran Quang Van Tran Quang Van Tran (Gar.) **Database System Decomposition** 18DDS ΖK 4 2P+2C L Ρ Dana Majerová, Jaromír Kukal Dana Majerová Jaromír Kukal (Gar.) **Engeneering Methods in Informatics** 18IMI ΚZ 4 2P+2C Ζ Р Vladimír Jarý, Vojt ch Merunka Vladimír Jarý Vladimír Jarý (Gar.) **Object Oriented Programming** 1800P Ζ 2 2C Ζ Р Miroslav Virius Miroslav Virius Miroslav Virius (Gar.) **Computational Physics 1** 12PF1 ΖK 2 2+0 Ζ Р Ond ej Klimo Ond ej Klimo Ond ej Klimo (Gar.) Computational Physics 2 Milan Kucha ik Milan Kucha ik Milan Kucha ik (Gar.) 12PF2 Z.ZK 2 1+1 L Р **Computer Control of Experiments** 12POEX 7 2 L 2+0Ρ Miroslav ech Miroslav ech Miroslav ech (Gar.) Soft Computing 18SC ΖK 4 2P+2C L Ρ Quang Van Tran, Jaromír Kukal Quang Van Tran Jaromír Kukal (Gar.) **Graph Theory** 01TG ΖK 5 4P+0C Р Jan Volec, Petr Ambrož Petr Ambrož Petr Ambrož (Gar.) Introduction to Mainframe 01UMF Ζ 2 Ζ 1P+1C Р Tomáš Oberhuber Tomáš Oberhuber Tomáš Oberhuber (Gar.) **Research Project 1** 18VUSE1 Ζ 6 0+6Ζ Dana Majerová, Milan Kucha ík, Jakub Klinkovský, Radek Fu ík Milan Р Kucha ik Milan Kucha ik (Gar.) **Research Project 2** 18VUSE2 K7 8 L Dana Majerová, Milan Kucha ík, Jakub Klinkovský, Radek Fu ík Milan 0+8Р Kucha ik Milan Kucha ik (Gar.)

#### Characteristics of the courses of this group of Study Plan: Code=NMSPAIPV1 Name=MDP P\_AIPVN 1st year

Application of Statistical Methods 01ASM ΚZ 2 The course focuses on applications of selected methods of statistical data analysis to concrete problems including their solutions using statistical software. Namely we will deal with: hypotheses tests about parameters of normal distribution, nonparametric methods, contingency tables, linear regression and correlation, analysis of variance.

18AS Applications of Statistics and Data Processing	Z,ZK	2
The lecture links to previous analogue courses with significant emphasis of relationship between mathematical models and practical application a	nd warrant of inevita	ability of this
relationship		
18AEK Applied Econometrics and Time Series Theory	Z,ZK	4
The lectures consist of comments on econometric methods with emphasis on sets of simultaneous linear equations econometric models, time series	es and vector autore	gressive models
in economic diagnostics, analysis and forecasting and optimization of economic policy. Case studies and illustrative examples are solved during the	e practice lessons.	
18DDS Database System Decomposition	ZK	4
The lectures are oriented to basic terms, database objects, their properties and relationships together with the accent to logics of decomposition and	applications of data	base operations.
18IMI Engeneering Methods in Informatics	KZ	4
The course explains essential design methods and development of the complex software system building using objectoriented programming. The	software developm	ent process is
explained as an integration of system development, software quality assurance, and software project management using miscellaneous technique	s. Moreover, progra	imming language
Smalltalk is used as a demonstration tool for explained tools and techniques.		
1800P Object Oriented Programming	Z	2
This course consists of the contributions of students concerning given topics concerned on technologies uded in program development.		
12PF1 Computational Physics 1	ZK	2
The course is giving an overview of some of the well-known computational physics methods in various fields of physics. The first part concentrates	on particle simula	tion methods -
molecular dynamics, Monte Carlo method and other methodsof solving the particle transport in self-consistent fields (e.g. Particle in Cell method in	n plasma physics).	The second part
concentrates on methods of solving Maxwell equations and in particular on the finite difference, finite elements methods and the method of momentary	nts. An introduction	to application of
computational physics methods in quantum physics (Hartree-Fock method, density functional theory) is also given.		
12PF2 Computational Physics 2	Z,ZK	2
Structure of hydrodynamic code, representation of structured and unstructured computational meshes. Tools for code debugging and profiling, error	or detection. Code	parallelization,
memory hierarchy, supercomputers. Euler equations on moving computational mesh. Eulerian, Lagrangian, and ALE methods, staggered discretize	ation. Methods for i	mesh smoothing,
methods for conservative interpolations of functions between meshes. Applications in simulations of laser/target interactions. Generalization for ela	astic materials. Met	hods of artificial
intelligence in computational physics.		-
12POEX Computer Control of Experiments	Z	2
Introduction. Basic design of computers, microcomputers. Hardware: computer-experiment interconnection (interfaces RS232C,IEE488, A/D and	D/A converters, ser	nsors, drivers,
etc.) Software: operating systems for control of experiments (real time OS, multitasking, multituser). Basic theory of control systems. Programming	languages for cont	trol (assembler,
C, etc.) Introduction to TCP/IP protocols. Control of experiments via Internet.	714	
18SC   Soft Computing		4
Fuzzy systems and selected artificial neural networks are discused as special cases of Lipschitz continuous functions with constrained sensitivity a	and limited output. E	Both theories and
	71/	
UTIG   Graph Theory		5
1. Basic notion of graph theory. 2. Edge and vertex connectivity (Menger Theorem). 3. Bipartite graphs. 4. Irees and torests. 5. Spanning trees (Ma	trix-Iree Theorem).	6. Euler tours
and harmiton cycles. 7. waximal and peried matching, o. Edge coloning, 9. Flows in networks. 10. vertex coloning, 11. Plannar graphs (Kuratowski arobe 12. Spectrum of the editoronal matrix 12. Spectrum of the editoronal matrix 12. Strettme	ineorem), vertex co	boning of planar
	7	0
UTUMP Introduction to Mainframe		
In this course we teach the maintaine architecture, we explain now to operate the system 2/05, now to start a job using the JCL and we explain s	ome differences wr	ien programming
	7	e
I OVUGE I Research project in based on a topic approved by the administrators of the programme, department and by the deap. The student is guided by the		
receive research project is based on a topic approved by the authinistrators of the programme, department and by the dean. The student is guided by the regular meetings and discussions	e project superviso	a during common
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recular meetings and discussions	e project superviso	adding common

### Code of the group: NMSPAIPV2 Name of the group: MDP P\_AIPVN 2nd year Requirement credits in the group: Requirement courses in the group: In this group you have to complete at least 10 courses Credits in the group: 0

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
18SQL	SQL Applications Dana Majerová, Jaromír Kukal Dana Majerová Jaromír Kukal (Gar.)	Z	2	0+2	Z	Р
18DPSE1	Master Thesis 1 Dana Majerová, Milan Kucha ík, Radek Fu ík Vladimír Jarý Milan Kucha ík (Gar.)	Z	10	0+10	Z	Р
18DPSE2	Master Thesis 2 Dana Majerová, Milan Kucha ík, Radek Fu ík Vladimír Jarý Milan Kucha ík (Gar.)	Z	20	0+20	L	Р
18HA	Heuristic Algorithms Jaromír Kukal Matej Mojzeš Jaromír Kukal (Gar.)	ZK	4	2P+2C	L	Р
18MEMC	Monte Carlo Method Jaromír Kukal, Miroslav Virius Miroslav Virius (Gar.)	Z,ZK	4	2P+2C	Z	Р
18MPSE	Modeling of Production Systems in Economy Adam Borovi ka Adam Borovi ka Quang Van Tran (Gar.)	Z,ZK	4	2P+2C	Z	Р

01PAA	Parallel Algorithms and Architectures Tomáš Oberhuber Tomáš Oberhuber (Gar.)	KZ	4	2P+1C	L	Р
18SDIP	<b>Diploma Seminar</b> Quang Van Tran, Dana Majerová, Jaromír Kukal, Milan Kucha ík <b>Milan</b> <b>Kucha ík</b> Milan Kucha ík (Gar.)	Z	2	2S	L	Р
18SMRR	Statistical Pattern Recognition and Decision Making Methods Jaromír Kukal Jaromír Kukal Jaromír Kukal (Gar.)	ZK	2	2P+0C	Z	Ρ
Characteristics of the	courses of this group of Study Plan: Code-NMSPAIPV2 Name		VN 2nd	voar		

Characteristics of	the courses of this group of Study Plan: Code=NMSPAIPV2 Name=MDP P_AIPVN 2nd yea	r	
18SQL	SQL Applications	Z	2
Practical realization of	database system according to general principles of database analysis.		
18DPSE1	Master Thesis 1	Z	10
The diploma project is t	based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the	project superviso	during common
regular meetings and d	iscussions		
18DPSE2	Master Thesis 2	Z	20
The diploma project is t	ased on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the	project superviso	during common
regular meetings and d	iscussions.		
18HA	Heuristic Algorithms	ZK	4
Heuristic algorithms of	optimization operates on discrete or continuous domains. Brutal force, stochastic, greedy, physically, biologically and sociolog	ically motivated h	neuristic are
included, used for optin	num finding and compared.		
18MEMC	Monte Carlo Method	Z,ZK	4
This courseis devoted t	o the numerical method Monte Carlo and to its selected applications.		
18MPSE	Modeling of Production Systems in Economy	Z,ZK	4
The aim of the teaching	course is to introduce students to basic models and methods for analysis and optimization of production systems. Models and	e oriented on des	sign, operation,
measurement and impr	ovement phases of production systems. Models and analyses of supply chains are considered also. Model formulations are b	ased on integer p	programming a
graph theory. Optimizat	ion and heuristic approaches are used for solutions.		
01PAA	Parallel Algorithms and Architectures	KZ	4
This course deals with	the parallel data processing. It is important in situations when one processing unit (CPU) is not powerful enough to finish give	n task in reasona	ble time. When
designing parallel algor	ithms, good knowledge of the parallel architectures is important. Therefore these architectures are studied as a part of this co	ourse too.	
18SDIP	Diploma Seminar	Z	2
Preparation of the thesi	s defense.		
18SMRR	Statistical Pattern Recognition and Decision Making Methods	ZK	2
Collection of recognition	n and classification methods with accent to mathematical and statistical principles of their design and functionality.		

### Name of the block: Elective courses Minimal number of credits of the block: 0 The role of the block: V

Code of the group: NMSPAIPVV Name of the group: MDP P\_AIPVN Optional courses Requirement credits in the group: Requirement courses in the group: Credits in the group: 0 Note on the group: Name of the course / Name of the group of c

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
18AMTL	Matlab Applications Jaromír Kukal	KZ	4	2P+2C	L	V
01AOM	Applications of Optimization Methods Tomáš Oberhuber Tomáš Oberhuber (Gar.)	ZK	2	1P+1C		V
18AAD	Applied Data Analysis Jaromír Kukal, Tomáš Hubínek, Karel Šimánek Jaromír Kukal Jaromír Kukal (Gar.)	Z	3	1P+1C	L	V
18BIG	Big Data tools and architecture Petr Pokorný Petr Pokorný (Gar.)	Z	3	1P+1C	Z	V
18BI	Business Intelligence Jaromír Kukal, Matej Mojzeš <b>Jaromír Kukal</b>	KZ	2	1P+1C	Z	V
01DAS	Data science Ji í Franc Ji í Franc Ji í Franc (Gar.)	KZ	3	1P+2C		V
04MGA1	English for Academic Purposes Speaking Practice - intermediate Darren Copeland Darren Copeland (Gar.)	Z	2	0+2	L,Z	V
04MGA2	Academic English Writing and Presentation Course - intermadiate Darren Copeland (Gar.)	Z	2	0+2	L,Z	V
01MRMMI	Methods for Sparse Matrices Ji í Mikyška <b>Ji í Mikyška</b> Ji í Mikyška (Gar.)	KZ	2	2P+0C		V

18MUML	Modeling in UML Vojt ch Merunka Vojt ch Merunka	Z,ZK	4	2+2	L	V
01SMF	Modern Trends in Corporate Information Technologies Tomáš Oberhuber Tomáš Oberhuber Tomáš Oberhuber (Gar.)	Z	2	2	L	V
18UIA2	Advanced Algorithms 2 Vladimír Jarý Vladimír Jarý	Z	2	1P+1C	L	V
01PNL	Advanced Methods of Numerical Linear Algebra Ji í Mikyška Ji í Mikyška Ji í Mikyška (Gar.)	ZK	2	2P+0C		V
18PCP	Advanced C++ Miroslav Virius Miroslav Virius (Gar.)	Z,ZK	4	2P+2C	L	V
01PAMF	Mainframe Programming in Assembler Tomáš Oberhuber Tomáš Oberhuber (Gar.)	Z	2	2	L	V
18CIS	Programming in C# Miroslav Virius Miroslav Virius (Gar.)	Z,ZK	4	2P+1C	Z	V
18PVS	Industrial Software Development Jan Doubek Jan Doubek	Z	2	1+1	Z	V
01SUP	Start-up Project P emysl Rubeš P emysl Rubeš (Gar.)	KZ	2	2P+0C		V
01SU2	<b>Machine Learning 2</b> Filip Šroubek <b>Filip Šroubek</b> (Gar.)	Z,ZK	4	2P+2C		V
01SVK	Student's Scientific Conference Kate ina Horaisová <b>Ji í Mikyška</b> Ji í Mikyška (Gar.)	Z	1	5 dní		V
18TFT	<b>Financial Markets Theory</b> Quang Van Tran, Nichita Vatamaniuc <b>Quang Van Tran</b> Quang Van Tran (Gar.)	KZ	4	2P+2C	Z	V
01TINF	Information Theory Tomáš Hobza	ZK	3	2P+0C		V
18UIA1	Introduction to Advanced Algorithms Vladimír Jarý Vladimír Jarý	Z	2	1P+1C	Z	V
18ZDFT	Financial Markets Data Processing Quang Van Tran Quang Van Tran Quang Van Tran (Gar.)	KZ	4	2P+2C	L	V

#### Characteristics of the courses of this group of Study Plan: Code=NMSPAIPVV Name=MDP P\_AIPVN Optional courses

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18AMTL Matlab Applications		KZ	4
Systematic application of Matlab optimization toolbox for the solution of	linear, quadratic, binary, integer an nonlinear programming tasks. Simulation	of chaotic systen	ns an fractal set
generation. Analysis of trajectories, attractors and fractal sets including	estimation of their properties.		
01AOM Applications of Optimization Method	S	ZK	2
Aim of this course is to enhance the knowledge of the optimization meth	ods and show their practical applications. Number of methods are applied or	the support-vect	or machines and
subsequently, methods for large problems and training of deep artificial	neural networks are explained. Finaly, advanced methods for regret minimiza	ation or sparsity in	ducing methods
are explained. All methods are demonstrated on real problems.			
18AAD Applied Data Analysis		Z	3
A practically focused subject that guides you through the topics of Big D	ata, neural networks, parallel computing, graph analysis, cloud technologies	, deployment, and	development of
software or IoT solutions.			
18BIG Big Data tools and architecture		Z	3
Practically oriented course, after completing which the student will unde	rstand the basic tools and procedures used in modern Big Data repositories I	Lakehouses. The	student will have
a basic understanding of integration with other systems (data consumption	n and data provisioning), understand the architecture of modern analytics plat	tforms with respec	t to the business
data model, data governance, orchestration and freshness of data. The	course will also introduce the Spark distributed computing framework, machine	ine learning mode	I management
tools (MLOps) and data visualization.			
18BI Business Intelligence		KZ	2
The aim of the subject is to explain to the students different characterist	ics of production and analytical databases and a set of processes, know-hov	v and tools (not or	nly) to support
decision-making activities within the organization. In addition to the basic	concept of BI, listeners will get acquainted with the general methodology of im	plementation of cu	stom algorithms
derived from other theories and subjects into the BI environment.			
01DAS Data science		KZ	3
Practical application of mathematical modeling methods, statistics and i	nachine learning needs wide range of tasks from data preparation and colled	ction to design of	an appropriate
method and its division into units for development and implementation in	to the production. Last, but not least, the cooperation in group and manager	ment of a modern	data project is
crucial. The actual standard of required tools will be presented on lectur	es. Further, these procedures will be applied during exercises with an empha	asis on team colla	boration, project
planning. At the end of the course, students will present their results to	other teams.		
04MGA1 English for Academic Purposes Spe	aking Practice - intermediate	Z	2
Optional course offers Master's Degree students at intermediate level of	f English a chance to improve, develop, and strengthen their vocabulary and	speaking skills. C	ourse syllabus
will respond to specific professional interests and situations of students	and choice of topics will be agreed on with tutor. Course is a non-graded ass	sessment course.	
04MGA2 Academic English Writing and Prese	entation Course - intermadiate	Z	2
Optional course, a possible free sequel to course 04MGA1, offers Master	er's degree students at intermediate level of English a chance to develop, in	prove, and streng	then their writing
and presentation skills. Syllabus will respond to specific professional ne	eds of participants, but will include also writing and preparing a presentation	on own research	topic, a search,
instruction on writing Master thesis in English and presenting chosen fa	cts. Course will thus prepare students for presentations at conferences. Cour	rse is a non-grade	d assessment
course.			
01MRMMI Methods for Sparse Matrices		KZ	2
The course is aimed at utilization of sparse matrices in direct methods f	or solution of large systems of linear algebraic equations. The course will cov	ver the decomposition	tion theory for
symmetric and positive definite matrices. Theoretic results will be furthe	r applied for solution of more general systems. Main features of the methods	and common imp	lementation
issues will be covered.			
18MUML Modeling in UML		Z,ZK	4
Unified modelling language (UML) is explained from the perspective of t	ne theoretical background of the object-oriented programing and modelling us	sing lambda-calcu	lus. In semestral
projects and practical examples, instance-level modeling approach is stre	ssed. This course also brings an introduction into the technology of object-orier	nted databases an	d object-oriented
data structure guerying as the essential tool of modeled system verifica	tion and validation.		

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01SMF	Modern Trends in Corporate Information Technologies	Z	2
The course is devoted t	o mainframe administration basics. After introduction to mainframe hardware the following lectures covers security, transaction	on systems, virtua	lization and
non-relational database	s in the mainframe environment.		
18UIA2	Advanced Algorithms 2	Z	2
The lecture covers sele	cted algorithms of the artificial inteligence and construction of autonomous robot.		
01PNL	Advanced Methods of Numerical Linear Algebra	ZK	2
Representation of real r	umbers in computers, behaviour of rounding errors during numerical computations, sensitivity of a problem, numerical stabil	ity of an algorithm	. We will analyse
sensitivity of the eigenv	alues of a given matrix and sensitivity of roots of systems of linear algebraic equations. Then, the backward analysis of these	e problems will be	performed. The
second part of the cours	e is devoted to the methods of QR-decomposition, least squares problem, and to several modern Krylov subspace methods	for the solution of s	systems of linear
algebraic equations and	the Lanczos method for approximation of the eigenvalues of a symmetric square matrix.		
18PCP	Advanced C++	Z,ZK	4
This lecture covers the	virtual inheritance,variadic templetes, template metaprogramming, template libraries design and implementation, tools for da	ta type processing	g in compile time
and for the advanced di	agnostic of the templates, concepts, coroutines, modules, ranges, views and other tools introduced in C++ 20, application of	f the multithreading	g (execution
parallelization).			
01PAMF	Mainframe Programming in Assembler	Z	2
In this course the basics	s of programming in z/OS are explained namely the programming in assembler. Basic instructions, macros, I/O operations, E	LL library loading	and some other
topics are discussed.		5	
18CIS	Programming in C#	7 7K	4
This lecture provides ar	$r$ regramming in $\sigma_m$	user interface da	itabases
multithreading) for most	platforms.		
18P\/S	Industrial Software Development	7	2
General lecture about a	in reducting converting between the second programmer skills associated with development of software for industr	ial nurnoses will h	e covered during
the lecture This include	service of the servic	n lectures will be a	eenly examined
in examples. The examples	les will be constructed with emphasis on understanding and reuse of already done third person code.		
	Start-un Project	K7	2
01001	Start-up Troject	1\2	<u> </u>
1 / 1 / 1 / 1 / 1 / 1	Machina Learning 2	7 71/	4
01SU2	Machine Learning 2	Z,ZK	4
01SU2 1.Fundamental topics fro	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d	Z,ZK	4 fitting, maximum
1.Fundamental topics fr likelihood and maximum	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal parti- ting, random ference 3. Examples of decision trees: Adaptive bacting, AdaPaget Cardiant bacting, Xabaset 4. Numerical	Z,ZK imensionality, over intitioning and prur	4 fitting, maximum hing, ensemble
01SU2 1.Fundamental topics fruit likelihood and maximum learning - bagging, boos descent, conjugate grad	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r	Z,ZK imensionality, over irtitioning and prur nethods for optimi	4 fitting, maximum ning, ensemble zation (steepest
01SU2 1.Fundamental topics fr likelihood and maximum learning - bagging, boos descent, conjugate grad	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r lient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear a in arradiant december theory back propositions of the partition for training for an adaptive partition of the partition	Z,ZK imensionality, over irtitioning and prur nethods for optimi ctivation functions	4 fitting, maximum ning, ensemble zation (steepest , output units,
01SU2 1.Fundamental topics fr likelihood and maximum learning - bagging, boo descent, conjugate grad loss functional, stochast	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d in a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa- sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r lient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear a ic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adap rest neuron antworks 0.Advanced exturers, architectures, Conserting Advanced active 10. Applications.	Z,ZK imensionality, over rrtitioning and prur nethods for optimi ctivation functions tive learning rates)	4 fitting, maximum ning, ensemble zation (steepest , output units, ) 7.Convolutional levaitiontion
01SU2 1.Fundamental topics fr likelihood and maximum learning - bagging, boo descent, conjugate grad loss functional, stochast neural networks 8.Recu	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r lient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear a ic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adap rrent neural networks 9.Advanced network architectures (autoencoders, Generative Adversarial networks) 10.Applications of construction)	Z,ZK imensionality, over rrtitioning and prur nethods for optimi ctivation functions tive learning rates; of deep learning (c	4 fitting, maximum ning, ensemble zation (steepest , output units, ) 7.Convolutional lassification,
01SU2 1.Fundamental topics fr likelihood and maximum learning - bagging, boos descent, conjugate grad loss functional, stochast neural networks 8.Recu segmentation, image re	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r lient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear a ic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adap rrent neural networks 9.Advanced network architectures (autoencoders, Generative Adversarial networks) 10.Applications of construction)	Z,ZK imensionality, over rrtitioning and prur nethods for optimi ctivation functions tive learning rates) of deep learning (c	4 fitting, maximum ning, ensemble zation (steepest , output units, ) 7.Convolutional lassification,
01SU2 1.Fundamental topics fr likelihood and maximum learning - bagging, boo descent, conjugate grad loss functional, stochast neural networks 8.Recu segmentation, image re 01SVK	Machine Learning 2 om the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of d o a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal pa sting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical r lient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear a ic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adap rrent neural networks 9.Advanced network architectures (autoencoders, Generative Adversarial networks) 10.Applications of construction) Student's Scientific Conference	Z,ZK imensionality, over irtitioning and prur nethods for optimi ctivation functions tive learning rates) of deep learning (c	4 fitting, maximum ning, ensemble zation (steepest , output units, ) 7.Convolutional lassification, 1
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## List of courses of this pass:

Code	Name of the course	Completion	Credits		
01AOM	Applications of Optimization Methods	ZK	2		
Aim of this course is to enhance the knowledge of the optimization methods and show their practical applications. Number of methods are applied on the support-vector machines an					
subsequently, methods for large problems and training of deep artificial neural networks are explained. Finaly, advanced methods for regret minimization or sparsity inducing method					
	are explained. All methods are demonstrated on real problems.				
01ASM	Application of Statistical Methods	KZ	2		
The course focuse	s on applications of selected methods of statistical data analysis to concrete problems including their solutions using statistical softw	are. Namely we wi	I deal with:		
hypoth	eses tests about parameters of normal distribution, nonparametric methods, contingency tables, linear regression and correlation, an	alysis of variance.			
01DAS	Data science	KZ	3		
Practical application	on of mathematical modeling methods, statistics and machine learning needs wide range of tasks from data preparation and collection	on to design of an a	appropriate		
method and its div	method and its division into units for development and implementation into the production. Last, but not least, the cooperation in group and management of a modern data project is				
crucial. The actual	standard of required tools will be presented on lectures. Further, these procedures will be applied during exercises with an emphasis	on team collabora	tion, project		
	planning. At the end of the course, students will present their results to other teams.				

01MRMMI	Methods for Sparse Matrices	KZ	2
The course is aim	ed at utilization of sparse matrices in direct methods for solution of large systems of linear algebraic equations. The course will cover	the decomposition	theory for
symmetric and p	ositive definite matrices. Theoretic results will be further applied for solution of more general systems. Main features of the methods a issues will be covered	and common impler	nentation
01PAA	Parallel Algorithms and Architectures	K7	4
This course deals	with the parallel data processing. It is important in situations when one processing unit (CPU) is not powerful enough to finish given t	ask in reasonable t	time. When
desigr	ing parallel algorithms, good knowledge of the parallel architectures is important. Therefore these architectures are studied as a part	of this course too.	
01PAMF	Mainframe Programming in Assembler	Z	2
In this course the b	basics of programming in z/OS are explained namely the programming in assembler. Basic instructions, macros, I/O operations, DLL I	ibrary loading and	some other
	topics are discussed.	71/	
UTPINL Representation of	Advanced Internous of Inumerical Linear Algebra real numbers in computers, behaviour of rounding errors during numerical computations, sensitivity of a problem, numerical stability of	j <b>∠n</b> ∣ f an algorithm We	۲ will analyse
sensitivity of the e	igenvalues of a given matrix and sensitivity of roots of systems of linear algebraic equations. Then, the backward analysis of these pro-	oblems will be perfe	ormed. The
second part of the	course is devoted to the methods of QR-decomposition, least squares problem, and to several modern Krylov subspace methods for the	ne solution of syste	ms of linear
	algebraic equations and the Lanczos method for approximation of the eigenvalues of a symmetric square matrix.	· · · · · · · · · · · · · · · · · · ·	
01SMF	Modern Trends in Corporate Information Technologies		2
The course is de	wored to mainframe administration basics. After introduction to mainframe nardware the following lectures covers security, transaction	i systems, virtualiza	ation and
015U2	Machine Learning 2	7 7K	4
1.Fundamental top	ics from the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of dimer	isionality, overfitting	g, maximum
likelihood and ma	ximum a posteriori estimators, Principle Component Analysis) 2. Decision trees: general schema, recursive partitioning, optimal partiti	oning and pruning,	ensemble
learning - bagging	boosting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical meth	ods for optimizatio	n (steepest
descent, conjuga	te gradient, newton and quasi-newton, constrained extrema, Lagrangian). 5.Deep teedforward networks (hidden units, nonlinear activ	/ation functions, ou	
neural networks	8. Recurrent neural networks 9. Advanced network architectures (autoencoders, Generative Adversarial networks) 10. Applications of c	deep learning (clas	sification.
	segmentation, image reconstruction)		,
01SUP	Start-up Project	KZ	2
01SVK	Student's Scientific Conference	Z	1
This	is the active participation of the student in one of the approved student conferences. The list of such conferences is defined by the co	ourse guarantor.	
01TG	Graph Theory	ZK	5
and Hamilton cvcl	graph theory. 2. Edge and vertex connectivity (Menger Theorem). 3. Bipartite graphs. 4. Trees and forests. 5. Spanning trees (Matrix- es. 7. Maximal and perfect matching. 8. Edge coloring. 9. Flows in networks. 10. Vertex coloring. 11. Plannar graphs. (Kuratowski theor	ree Theorem). 6. E	a of planar
and harmiton eye	graphs. 12. Spectrum of the adjacency matrix. 13. Extremal graph theory.		g of planar
01TINF	Information Theory	ZK	3
Information theory	v explores the fundamental limits of the representation and transmission of information. We will focus on the definition and implication	s of (information) e	ntropy, the
source coding the	eorem, and the channel coding theorem. These concepts provide a vital background for researchers in the areas of data compression	, signal processing	, controls,
	and pattern recognition.	7	
In this course we te	each the mainframe architecture. We explain how to operate the system z/OS, how to start a job using the JCL and we explain some c	∣	∠ oqramming
	in C/C++ for z/OS:		- J J
04MGA1	English for Academic Purposes Speaking Practice - intermediate	Z	2
Optional course o	ffers Master's Degree students at intermediate level of English a chance to improve, develop, and strengthen their vocabulary and sp	eaking skills. Cours	se syllabus
will respor	In to specific professional interests and situations of students and choice of topics will be agreed on with tutor. Course is a non-grade	assessment cour	se.
	ACademic English whiling and Presentation Course - Intermadiate possible free sequel to course 04MGA1 offers Master's degree students at intermediate level of English a chance to develop improv	⊢ ∠   /e_and strengthen	∠ their writing
and presentation s	skills. Syllabus will respond to specific professional needs of participants, but will include also writing and preparing a presentation on	own research topic	c, a search,
instruction on writ	ing Master thesis in English and presenting chosen facts. Course will thus prepare students for presentations at conferences. Course	is a non-graded as	ssessment
	course.	· · · · · · · · · · · · · · · · · · ·	
12PF1	Computational Physics 1	ZK	2
I ne course is giv	ing an overview of some of the well-known computational physics methods in various fields of physics. The first part concentrates on so Monte Carlo method and other methods of solving the particle transport in self-consistent fields (e.g. Particle in Cell method in place	particle simulation	methods -
concentrates on m	ethods of solving Maxwell equations and in particular on the finite difference, finite elements methods and the method of moments. A	in introduction to ap	oplication of
	computational physics methods in quantum physics (Hartree-Fock method, density functional theory) is also given.		
12PF2	Computational Physics 2	Z,ZK	2
Structure of hydro	odynamic code, representation of structured and unstructured computational meshes. Tools for code debugging and profiling, error de	tection. Code para	llelization,
memory nierarchy, methods for conse	supercomputers. Euler equations on moving computational mesn. Eulerian, Lagrangian, and ALE methods, staggered discretization.	methods for mesh	of artificial
	intelligence in computational physics.		or artinolar
12POEX	Computer Control of Experiments	Z	2
Introduction. Bas	ic design of computers, microcomputers. Hardware: computer-experiment interconnection (interfaces RS232C, IEE488, A/D and D/A	converters, sensor	s, drivers,
etc.) Software: op	erating systems for control of experiments ( real time OS, multitasking, multiuser). Basic theory of control systems. Programming lang	uages for control (a	assembler,
18440	C, etc.) introduction to FCF/F protocols. Control of experiments via Internet. Δnnligh Data Δnalveis	7	
A practically focus	ן ed subject that guides you through the topics of Big Data, neural networks, parallel computing. graph analysis. cloud technologies. de	ployment, and dev	elopment of
, , , , , , , , , , , , , , , , , , , ,	software or IoT solutions.		
18AEK	Applied Econometrics and Time Series Theory	Z,ZK	4
The lectures consis	st of comments on econometric methods with emphasis on sets of simultaneous linear equations econometric models, time series and	vector autoregres	sive models
in econom	ic diagnostics, analysis and forecasting and optimization of economic policy. Case studies and illustrative examples are solved during	the practice lesso	ns.
18AMIL Systematic applic	Matiab Applications	haotic systems or	4 fractal set
Systematic applica	generation. Analysis of trajectories, attractors and fractal sets including estimation of their properties.	chaolic systems al	i naciai Sel

18AS	Applications of Statistics and Data Processing	Z.ZK	2
The lecture links	to previous analogue courses with significant emphasis of relationship between mathematical models and practical application and	warrant of inevitabi	lity of this
	relationship		
18BI	Business Intelligence	KZ	2
The aim of the su	bject is to explain to the students different characteristics of production and analytical databases and a set of processes, know-how a	and tools (not only)	to support
decision-making ac	tivities within the organization. In addition to the basic concept of BI, listeners will get acquainted with the general methodology of imple	nentation of custon	n algorithms
10010	Big Data table and erabitacture	7	2
18BIG	BIG Data tools and architecture	Z	3 opt will boyo
a basic understand	ing of integration with other systems (data consumption and data provisioning), understand the architecture of modern analytics platfor	ms with respect to t	he business
data model, data	governance, orchestration and freshness of data. The course will also introduce the Spark distributed computing framework, machine	learning model m	anagement
	tools (MLOps) and data visualization.		
18CIS	Programming in C#	Z,ZK	4
This lecture pro	ovides an introduction to the programming language C# and teaches students how to create common types of applications (graphica	user interface, dat	tabases,
	multithreading) for most platforms.		
18DDS	Database System Decomposition	ZK	4
The lectures are or	iented to basic terms, database objects, their properties and relationships together with the accent to logics of decomposition and applie	cations of database	operations.
18DPSE1	Master Thesis 1		10
I he diploma projec	t is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the pro-	ect supervisor duri	ing common
1000000	Master Thesis 2	7	20
TODESE2	IVIDSICE THESIS Z	iect supervisor duri	
	regular meetings and discussions.		ing common
18HA	Heuristic Algorithms	ZK	4
Heuristic algorith	nms of optimization operates on discrete or continuous domains. Brutal force, stochastic, greedy, physically, biologically and sociologi	ically motivated her	uristic are
	included, used for optimum finding and compared.		
18IMI	Engeneering Methods in Informatics	KZ	4
The course expla	ins essential design methods and development of the complex software system building using objectoriented programming. The soft	ware development	process is
explained as an int	egration of system development, software quality assurance, and software project management using miscellaneous techniques. Mo	reover, programmir	ng language
	Smalltalk is used as a demonstration tool for explained tools and techniques.	1	
18MEMC	Monte Carlo Method	Z,ZK	4
	This course is devoted to the numerical method Monte Carlo and to its selected applications.		
18MPSE	Modeling of Production Systems in Economy	Z,ZK	4
The aim of the tea	ching course is to introduce students to basic models and methods for analysis and optimization of production systems. Models are to analysis and optimization of production systems. Models are based analysis and patients are based and analysis and optimization of production systems.	oriented on design,	, operation,
measurement and	a improvement phases of production systems. Models and analyses of supply chains are considered also, model formulations are bas graph theory. Optimization and heuristic approaches are used for solutions	sed on integer prog	jianning a
18MUM	Modeling in LIMI	7 7K	4
Unified modelling la	anguage (UML) is explained from the perspective of the theoretical background of the object-oriented programing and modelling usinc	lambda-calculus.	In semestral
projects and practic	al examples, instance-level modeling approach is stressed. This course also brings an introduction into the technology of object-oriented	databases and obj	ect-oriented
	data structure querying as the essential tool of modeled system verification and validation.		
1800P	Object Oriented Programming	Z	2
	This course consists of the contributions of students concerning given topics concerned on technologies uded in program develo	pment.	
18PCP	Advanced C++	Z,ZK	4
This lecture covers	the virtual inheritance, variadic templetes, template metaprogramming, template libraries design and implementation, tools for data ty	/pe processing in c	compile time
and for the advar	nced diagnostic of the templates, concepts, coroutines, modules, ranges, views and other tools introduced in C++ 20, application of t	ne multithreading (	execution
180\/S	Industrial Software Development	7	2
General lecture ab	put applied code writing in commercial sphere. All essential programmer skills assosiated with development of software for industrial c	<u> </u>	/ered during
the lecture. This inc	cludes versioning, testing, release handling and also code quality measurement. The simple real world use scenarios introduced in le	ctures will be deep	ly examined
	in examples. The examples will be constructed with emphasis on understanding and reuse of already done third person con		
18SC	Soft Computing	ZK	4
Fuzzy systems and	selected artificial neural networks are discused as special cases of Lipschitz continuous functions with constrained sensitivity and lir	nited output. Both t	heories and
	application conventions are included.		
18SDIP	Diploma Seminar	Z	2
	Preparation of the thesis defense.		
18SMRR	Statistical Pattern Recognition and Decision Making Methods	ZK	2
1000	Collection or recognition and classification methods with accent to mathematical and statistical principles of their design and func		
ISSQL	SUL APPIICATIONS		
	Financial Markata Theory	<b>K</b> 2	1
Since financial inst	FILIALIUIALIVIALINEUS TILEULY rument prices are unknown in advance to financial market participants, financial derivatives are currently being used as common instru-	ments to eliminate	risks arising
from price instat	participation of the second seco	ortfolio of risk asset	is and the
	valuation of sophisticated financial instruments in the form of derivatives such as swaps, forwards, futures and options.		
18UIA1	Introduction to Advanced Algorithms	Z	2
	The lecture covers selected algorithms of the artificial inteligence and their application in the real world.	· · ·	
18UIA2	Advanced Algorithms 2	Z	2
	The lecture covers selected algorithms of the artificial inteligence and construction of autonomous robot.		
18VUSE1	Research Project 1	Z	6
The research proje	ct is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the pro	ject supervisor duri	ing common
	regular meetings and discussions.		

#### **Research Project 2**

The research project is based on a topic approved by the administrators of the programme, department and by the dean. The student is guided by the project supervisor during common regular meetings and discussions.

ΚZ

8

#### 18ZDFT

Financial Markets Data Processing ΚZ 4 The course enables students to combine knowledge of numerical methods, Matlab programming and financial mathematics to solve practical problems in finance such as portfolio optimization, risk management and valuation of financial derivatives, especially options of different types. Upon completion of the course the student will be able to formulate and numerically solve concrete problems in the given field and subsequently implement their solutions in practice.

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2025-08-08, time 16:31.