Study plan

Name of study plan: Matematická informatika

Faculty/Institute/Others: Department: Branch of study guaranteed by the department: Welcome page Garantor of the study branch: Program of study: Mathematical Informatics 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: NMSPMINF1 Name of the group: MDP P_MINFN 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 Code Completion Credits Scope Semester members) Tutors, authors and guarantors (gar.) **Digital Image Processing** 01DIZO 7K 4 2P+2C Barbara Zitová Barbara Zitová Barbara Zitová (Gar.) Languages, Automata and Computability 01JAU Z,ZK 4 3P+1C Petr Ambrož Petr Ambrož Petr Ambrož (Gar.) **Mathematical Logic** 01MAL Z,ZK 4 2+1 Petr Cintula Petr Cintula Petr Cintula (Gar.) **Neural Networks and their Applications 1** 01NEUR1 ΖK 2 2+0 Martin Hole a, František Hakl František Hakl František Hakl (Gar.) **Object Oriented Programming** 1800P Ζ 2 2C Miroslav Virius Miroslav Virius Miroslav Virius (Gar.) **Parallel Algorithms and Architectures** 01PAA 4 2P+1C ΚZ Tomáš Oberhuber Tomáš Oberhuber Tomáš Oberhuber (Gar.) **Number Theory** 01TEC 5 4P+0C ΖK Zuzana Masáková, Edita Pelantová Zuzana Masáková Zuzana Masáková (Gar.) **Graph Theory** 01TG ΖK 5 4P+0C Petr Ambrož, Jan Volec Petr Ambrož Petr Ambrož (Gar.) Information Theory Tomáš Hobza Tomáš Hobza (Gar.) 01TIN ΖK 2 2+0 Matrix Theory

01TEMA	Edita Pelantová Edita Pelantová Edita Pelantová (Gar.)	Ζ	3	2+0	L	P
01TSLO	Complexity Theory Petr Ambrož Petr Ambrož Petr Ambrož (Gar.)	ZK	3	3+0	Z	Р
01VUSI1	Research Project 1 Edita Pelantová, estmír Burdík estmír Burdík Edita Pelantová (Gar.)	Z	6	0+6	Z	Р
01VUSI2	Research Project 2 Edita Pelantová, estmír Burdík estmír Burdík Edita Pelantová (Gar.)	KZ	8	0P+8C	L	Р

Characteristics of the courses of this group of Study Plan: Code=NMSPMINF1 Name=MDP P_MINFN 1st year 01DIZO

Digital Image Processing

4

7K

Role

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image sampling and quantization, Shannon theorem, aliasing basic image operations, histogram, contrast stretching, noise removal, image sharpening linear filtering in the spatial and frequency domains, convolution, Fourier transform edge detection, corner detection feature detection image degradations and their modelling, inverse and Wiener filtering, restoration of motion-blurred and out-of-focus blurred images image segmentation mathematical morphology image registration and matching

01JAU	Languages, Automata and Computability	Z,ZK	4
1. Finite automata, regu	lar languages and operations, star lemmas. (3 lectures) 2. Kleene theorem (2 lectures) 3. Determinisation a minimisation (2	lectures) 4. Confex	t-free grammas
and their reductions (2 I	lectures) 5. Pushdown automata and context-free languages (2 lectures) 6. Star lemma for CFL, closure properties of CFL (2	2 lectures) 7. Turing	machine,
recursive and recursive	ly enumerable languages, methods of design of turing machines (2 lectures) 8. Undecidability (1 lecture) 9. Rice theorem, Po	ost correspondence	e problem,
undecidable properties	of CFL (2 lectures)		
01MAL	Mathematical Logic	Z,ZK	4
Logic is in the same tim	e an object studied by mathematics and the language used to formalize and study mathematics. The goal of the course is to	introduce basic no	otion of results
of classical mathematic	al logic. 1. Propositions, evaluation, tautologies, axioms, theorems, soundness, completeness, and decidability of Hilbert and (Gentzen style prop	ositional calculi.
2.Language of predicate	e calculus, terms, formulas, relational structures, satisfiability, truth, tautologies, axioms, theorems, soundness, model constr	uctions. 3.Gödel co	ompleteness
theorem, Skolem and H	lerbrand theorems. 4. The first and the second Gödel theorems on incompleteness of Peano arithmetics and undecidability o	f predicate calculus	δ.
01NEUR1	Neural Networks and their Applications 1	ZK	2
Keywords: Neural netwo	rks, data separation, functional approximation, supervised learning	,	
1800P	Object Oriented Programming	Z	2
This course consists of	the contributions of students concerning given topics concerned on technologies uded in program development.		
01PAA	Parallel Algorithms and Architectures	KZ	4
This course deals with t	the parallel data processing. It is important in situations when one processing unit (CPU) is not powerful enough to finish give	en task in reasonal	ole time. When
designing parallel algori	ithms, good knowledge of the parallel architectures is important. Therefore these architectures are studied as a part of this c	ourse too.	
01TEC	Number Theory	ZK	5
1. Algebraic and transce	endental numbers 2. Algebraic number fields, field isomorphisms 3. Rational approximations, continued fractions 4. Diophant	tic equations, Pell's	equation 5.
Rings of integers in alge	ebraic number fields and divisibility 6. Number representation in non-integer bases, finite and periodic expansions		
01TG	Graph Theory	ZK	5
1. Basic notion of graph	theory. 2. Edge and vertex connectivity (Menger Theorem). 3. Bipartite graphs. 4. Trees and forests. 5. Spanning trees (Matr	ix-Tree Theorem).	Euler tours
and Hamilton cycles. 7.	Maximal and perfect matching. 8. Edge coloring. 9. Flows in networks. 10. Vertex coloring. 11. Plannar graphs (Kuratowski th	eorem), vertex col	oring of planar
graphs. 12. Spectrum of	f the adjacency matrix. 13. Extremal graph theory.		
01TIN	Information Theory	ZK	2
Information theory explo	ores the fundamental limits of the representation and transmission of information. We will focus on the definition and implicat	ions of (information	n) entropy, the
source coding theorem,	, and the channel coding theorem. These concepts provide a vital background for researchers in the areas of data compress	ion, signal process	ing, controls,
and pattern recognition.			
01TEMA	Matrix Theory	Z	3
The subject deals main	ly with: 1) similarity of matrices and canonical forms of matrices 2) Perron-Frobenius theory and its applications 3) tensor pro-	oduct 4) Hermitian	and positive
semidefinite matrices	-		
01TSLO	Complexity Theory	ZK	3
The course is devoted t	o incorporation of complexity questions during algorithm development, introduction to NP completeness and generally to cor	nplexity classes of	deterministic or
nondeterministic Turing	machines bounded by time or space. Emphasis is placed on mutual relations among these classes. Aside from nondeterminis	stic classes we exa	mine probability
classes. Class of interac	tive protocols is presented at the end of lecture course.		
01VUSI1	Research Project 1	Z	6
Research project on the	e selected topic under the supervision. Supervision and regular checking of the research project under preparation.		
01VUSI2	Research Project 2	KZ	8
Research project on the	e selected topic under the supervision. Supervision and regular checking of the research project under preparation.		
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Name of the group: MDP P_MINFN 2nd year

Requirement credits in the group:

Requirement courses in the group: In this group you have to complete at least 6 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
01DPSI1	Master Thesis 1 estmír Burdík estmír Burdík estmír Burdík (Gar.)	Z	10	0+10	Z	Ρ
01DPSI2	Master Thesis 2 estmír Burdík estmír Burdík estmír Burdík (Gar.)	Z	20	0+20	L	Ρ
01KOAL	Commutative Algebra Severin Pošta Severin Pošta (Gar.)	ZK	3	1P+1C		Ρ
01DISE	Diploma Seminar estmír Burdík estmír Burdík estmír Burdík (Gar.)	Z	1	0P+2S		Ρ
01SU1	Machine Learning 1 Jan Flusser Jan Flusser (Gar.)	ZK	3	2P+1C		Ρ
01NEUR2	Theoretical Fundamentals of Neural Networks Martin Hole a Martin Hole a Martin Hole a (Gar.)	ZK	3	2+0		Ρ

Characteristics of the courses of this group of Study Plan: Code=NMSPMINF2 Name=MDP P_MINFN 2nd year

01DPSI1	Master Thesis 1	Z	10
Master's thesis prepara	tion.		
01DPSI2	Master Thesis 2	Z	20
Master's thesis prepara	tion.		

01KOAL Co. 1. Rings, ideals, homomorph factorization of polynomials. group and correspondence	mmutative Algebra isms, prime and maximal ideals. 2. Rings of polynomials, symmetric polynomials, irrea 5. Hilbert's Nullstellensatz, ideals and manifolds, Krull dimension. 6. Fields, extensions	ducibility. 3. Gröbn s, finite fields. 7. In	er bases. 4. troduction to	Polynomial o Galois the	ZK s with rational cory, Galois ex	3 coefficients, tensions,
01DISE Dip In the first part of the semina at the faculty. The second part achieved during the work on	Ioma Seminar r, students familiarize themselves with the general principles of publishing and presen rt is designed as a practical training for the defence of the diploma project. The studen their projects. Each presentation is followed by a discussion on scientific matters as w	ting scientific worl ts give oral preserved	c and the for ntations of the	mal require	Z ments for dipl tate of the res	1 oma projects earch results formance
01SU1 Ma [1] features for description an and nonsupervised classifica	chine Learning 1 d recognition of 2-D shapes [2] invariant features, Fourier descriptors, moment invarian tion, NN- classifier, linear classifier, Bayessian classifier [4] clustering in a feature spa	ts, differential inva ace, iterative and h	riants [3] sta	atistical patte methods [5]	ZK dimensionalit	3 n, supervised by reduction
of a feature space	eoretical Fundamentals of Neural Networks				ZK	3
Keywords: Functional approx	imation, supervised learning, Vapnik-Chervonenkis-dimension			I	I	
Name of the block Minimal number of The role of the blo	k: Elective courses of credits of the block: 0 ock: V					
Code of the group Name of the group Requirement creat Requirement councredits in the group Note on the group	b: NMSPMINFV p: MDP P_MINFN Optional courses dits in the group: rses in the group: up: 0 b:	1			1	
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
01ALTI	Algebraic structures in theoretical informatics Edita Pelantová, Severin Pošta, Milena Svobodová Severin Pošta Severin Pošta (Gar.)	ZK	3	1+1		v
18DDS	Database System Decomposition Dana Majerová, Jaromír Kukal Dana Majerová, Jaromír Kukal (Gar.)	ZK	4	2P+2C	L	V
01FIMA	Financial and Insurance Mathematics Joel Horowitz Joel Horowitz Joel Horowitz (Gar.)	ZK	2	2P+0C	Z	V
01KOS	Compressed Sensing Jan Vybíral Jan Vybíral Jan Vybíral (Gar.)	ZK	2	2+0	Z	v
01MMNS	Mathematical Modelling of Non-linear Systems Michal Beneš Michal Beneš Michal Beneš (Gar.)	ZK	3	1P+1C	Z	V
18MEMC	Monte Carlo Method Miroslav Virius, Jaromír Kukal Miroslav Virius Miroslav Virius (Gar.)	Z,ZK	4	2P+2C	Z	V
01MRMMI	Methods for Sparse Matrices Ji í Mikyška Ji í Mikyška Ji í Mikyška (Gar.)	KZ	2	2P+0C		v
01SMF	Modern Trends in Corporate Information Technologies Tomáš Oberhuber Tomáš Oberhuber Tomáš Oberhuber (Gar.)	Z	2	2	L	v
01NELO	Nonlinear Optimization Radek Fu ík Radek Fu ík (Gar.)	ZK	4	3P+0C		V
01PALG	Advanced Algorithmization Tomáš Oberhuber Tomáš Oberhuber (Gar.)	KZ	2	1P+1C		V
01PNL	Advanced Methods of Numerical Linear Algebra Ji í Mikyška Ji í Mikyška Ji í Mikyška (Gar.)	ZK	2	2P+0C		V
01PMU	Probabilistic Learning Models František Hakl František Hakl František Hakl (Gar.)	ZK	2	2+0	Z	v
01PSM1	Problem Seminar in Mathematical Analysis Mat j Tušek Mat j Tušek (Gar.)	Z	2	0P+2S	Z	V
01PSM2	Problem Seminar in Mathematical Analysis 2 Mat j Tušek Mat j Tušek (Gar.)	Z	2	2S		V
01PAMF	Mainframe Programming in Assembler Tomáš Oberhuber Tomáš Oberhuber (Gar.)	Z	2	2	L	v
01SFTO	Special Functions and Transformations in Image Analysis Jan Flusser Jan Flusser Jan Flusser (Gar.)	ZK	2	2+0	L	V
01SUP	Start-up Project Pemysl Rubeš Pemysl Rubeš (Gar.)	KZ	2	2P+0C		V
01SMS1	Student's seminar in mathematics 1 Václav Klika Václav Klika (Gar.)	Z	2	0P+2C		V
01SMS2	Student's seminar in mathematics 2 Václav Klika Václav Klika (Gar.)	Z	2	0P+2C	L	V
01TEH	Game Theory Jan Volec Jan Volec (Gar.)	ZK	2	2+0	L	V

01UMF	Introduction to Mainframe Tomáš Oberhuber Tomáš Oberhuber Tomáš Oberhuber (Gar.)	Z	2	1P+1C	Z	V
01UTS	Introduction to the Theory of Semigroups Václav Klika Václav Klika Václav Klika (Gar.)	ZK	3	2P+0C		V
01ZPB2	Introduction to Computer Security 2 Petr Voká Petr Voká Petr Voká (Gar.)	Z	2	1+1		V
Characteristics of	the courses of this group of Study Plan: Code=NMSPMINFV Name	e=MDP P_MI	NFN Opti	onal cou	urses	
01ALTI	Algebraic structures in theoretical informatics				ZK	3
The course is devoted to	to the applications of some special algebraic structures. The first part of the course is devote	ed to the Gröbner	bases of ide	eals of poly	nomial rings	and their use
of various representation	r algebraic equations and other applications. The second part of the course is devoted to the	e ring of integers	of algebraic	number fie	ids, used to	constructions
	Database System Decomposition	or elementary full	0110113.		7K	1
The lectures are oriented	d to basic terms, database objects, their properties and relationships together with the accent	t to loaics of decor	nposition ar	l Id applicatio	ns of databa	ase operations.
01FIMA	Einancial and Insurance Mathematics				7K	2
This course is an introdu	uction to the problems of life and non-life insurance and financial mathematics.			I	211	2
01KOS	Compressed Sensing				ZK	2
The lecture will introduce	e basic concepts of the theory of compressed sensing an area founded in 2006 in the work	s of D. Donoho, E	. Candes, a	nd T. Tao. Tl	his theory st	udies the
search for sparse solution	ons of underdetermined systems of linear equations. Due to the applications of sparse repres	sentations in elect	ric engenee	ring and sig	inal process	ing, this theory
was quickly used in mar	ny different fields. After the first survey lecture, we will study the mathematical foundations of	of the theory. We p	prove genera	al NP-comp	leteness of t	he search for
sparse solutions of syste	ems of linear equations. We introduce conditions which ensure also existence of more effect	tive solvers and s	show, that th	ese are sat	isfied for exa	ample for
Gaussian random matric	ces. As an effective solution method, we will analyze I1-minimization and Orthogonal Matchin	ng Pursuit. We will	also study s	tability and	robustness	of the obtained
results with respect to th	e corruption of measurements and the optimality of the results.			1	714	
	Mathematical Modelling of Non-linear Systems				ZK	3
The course consists of the	basic terms and results of the theory of finite- and infinitedimensional dynamical systems ge Second part is devoted to the evolution of basic results of the fractal geometry dealing w	enerated by evolu	tionary diffe	rential equa	itions, and d	escription of
	Monto Corlo Method		uch dynamic			4
	WONTE CATIO METHOD			2	.,∠n	4
	Methode for Sporeo Metricos				V 7	
	IVIELITOUS TOT Sparse matrices in direct methods for solution of large systems of linear algebra	aic equations. The	a course wil	cover the (NZ	∠ on theory for
symmetric and positive	definite matrices. Theoretic results will be further applied for solution of more general systems	ms Main features	of the meth	ods and co	mmon imple	ementation
issues will be covered.						
01SMF	Modern Trends in Corporate Information Technologies				7	2
The course is devoted to	p mainframe administration basics. After introduction to mainframe hardware the following le	ectures covers se	curity, trans	action syste	ms, virtualiz	ation and
non-relational databases	s in the mainframe environment.					
01NELO	Nonlinear Optimization				ZK	4
Nonlinear optimization p	roblems find their application in may areas of applied mathematics. The lecture covers the ba	asics of mathemat	tical program	nming theor	y with emph	asis on convex
optimization and basic n	nethods for unconstrained and constrained optimization. The lecture is supplemented by illu	ustrative example	S.			
01PALG	Advanced Algorithmization				KZ	2
Keywords: String algorit	hms, graph algorithms, dynamic programming, suffix tress, graph cuts, numerical methods	for solution of par	tial different	ial equation	IS.	
01PNL	Advanced Methods of Numerical Linear Algebra				ZK	2
Representation of real n	umbers in computers, behaviour of rounding errors during numerical computations, sensitiv	vity of a problem,	numerical st	ability of an	algorithm. V	Ve will analyse
second part of the cours	aues of a given main and sensitivity of foots of systems of infeat algebraic equations. The	n, the backward a odern Krylov subs	marysis or tr	iese problei ids for the s	olution of sv	stems of linear
algebraic equations and	the Lanczos method for approximation of the eigenvalues of a symmetric square matrix.				olution of Sy	
	Probabilistic Learning Models				7K	2
Introduction into the the	ory PAC learning model, VC-dimension of finite sets, Sauer, Cover and Radon's lemma, VC	-dimension of co	mposed ma	l opings, app	lication of V	C-dimension
for lower bound of neces	ssary patterns, analysis of properties of delta rule based learning processes, PAC learning	model extensions	and PAO le	arning, Fou	urier coefficie	ents search for
Boolean functions.						
01PSM1	Problem Seminar in Mathematical Analysis				Z	2
This course is a seminal	r in advanced mathematical analysis and its applications. Seminar talks will be delivered by	students, departr	nent staff, a	nd invited q	uests. There	e are no exams
but students will be assi	gned by some homework and they will give at least one talk per semester. The seminar is h	eld in English an	d attendanc	e is mandat	ory.	_
01PSM2	Problem Seminar in Mathematical Analysis 2				Z	2
This course is a seminal	r in advanced mathematical analysis and its applications. Seminar talks will be delivered by	students, departr	nent staff, a	nd invited q	uests. There	e are no exams
	gned by some nomework and mey will give at least one tak per semester. The seminar is r	ieid in English an	u allendanc	e is mandai		
	Mainframe Programming in Assembler	untional magrae lu	O opportion	a DLL libra		Z nd como othor
topics are discussed				S, DEL IIDIA	i y loauli iy a	
	Special Functions and Transformations in Image Analysis				7K	2
The course broadens to	pics of the courses ROZ1 and ROZ2. Main attention will be paid to several special functions	s and transformat	ions (espec	l iallv momer	t functions a	and wavelet
transform) and their use	in selected tasks of image processing - edge detection, noise removal, recognition of defo	rmed objects, ima	ige registrat	ion, image (compressior	n, etc. Both the
theory and practical app	lications will be discussed.					
01SUP	Start-up Project				KZ	2
01SMS1	Student's seminar in mathematics 1				Z	2
01SMS2	Student's seminar in mathematics 2				Z	2
01TEH	Game Theory			1	ZK	2
1. Combinatorial games	, normal games - impartial and partizan games. 2. Multidimensional tic-tac-toe, Hales Jewe	tt theorem. 3. Ga	me tree, Zer	melo's Theo	orem, Strate	gy stealing. 4.
Arithmetic on normal ga	mes, equivalence on games, MEX principle, Sprague-Grundy theorem. 5. Strategic games,	, pure and mixed	strategies, d	ominated s	trategies. 6.	Zero-sum
games, MAX-min princip	ole, von Neumann theorem. 7. Nash equilibrium, Nash theorem. 8. Cooperation of two playe	ers, Nash arbitrati	on. 9. Coalit	ional games	s, Shapley v	alue.
01UMF	Introduction to Mainframe				Ζ 🗌	2
In this course we teach t	the mainframe architecture. We explain how to operate the system z/OS, how to start a job	using the JCL and	d we explain	some diffe	rences wher	n programming
in C/C++ for z/OS:						

01UTS	Introduction to the Theory of Semigroups	ZK	3			
It is known that a system of linear ordinary differential equations can be solved by virtue of the matrix exponential. However, the extension to partial differential equations is not						
straightforward. For exa	mple in the case of heat equation the matrix is replaced by Laplace operator which is not bounded and the series for the expor	ential will not con-	verge. Moreover,			
solutions of the heat ec	uation exist in general only for positive times and hence the solution operator can be at best a semigroup. The aim of the cou	rse is to provide a	a mathematical			
foundation for these typ	es of problems and extend the concept of stability from ordinary differential equations, which is again in relation to spectrum	of a linear operate	or.			
01ZPB2	Introduction to Computer Security 2	Z	2			

List of courses of this pass:

Code	Name of the course	Completion	Credits
01ALTI	Algebraic structures in theoretical informatics	ZK	3
The course is devo	ted to the applications of some special algebraic structures. The first part of the course is devoted to the Gröbner bases of ideals of	oolynomial rings a	nd their use
for solving of syste	ms of algebraic equations and other applications. The second part of the course is devoted to the ring of integers of algebraic number of various representations of numbers utilized in fast effective algorithms for arithmetic operations and evaluations of elementary fi	er fields, used to co unctions.	onstructions
01DISE	Diploma Seminar	Z	1
In the first part of th	e seminar, students familiarize themselves with the general principles of publishing and presenting scientific work and the formal required	uirements for diplo	ma projects
at the faculty. The s	econd part is designed as a practical training for the defence of the diploma project. The students give oral presentations of the curre	nt state of the rese	arch results
	The work on their projects. Each presentation is followed by a discussion on scientific matters as well as on the possibilities of improvin		normance.
	DIGITAL IMAGE Processing	L ZN	4 spatial and
frequency domains	. convolution. Fourier transform edge detection, corner detection feature detection image degradations and their modelling. inverse a	nd Wiener filtering	, restoration
	of motion-blurred and out-of-focus blurred images image segmentation mathematical morphology image registration and mate	ching	,
01DPSI1	Master Thesis 1	Z	10
	Master's thesis preparation.		
01DPSI2	Master Thesis 2	Z	20
	Master's thesis preparation.		
01FIMA	Financial and Insurance Mathematics	ZK	2
	This course is an introduction to the problems of life and non-life insurance and financial mathematics.		
01JAU	Languages, Automata and Computability		4
1. Finite automata,	regular languages and operations, star lemmas. (3 lectures) 2. Kielene theorem (2 lectures) 3. Determinisation a minimisation (2 lectures) 6. Star lemma for CEL clocure properties of CEL (2	ures) 4. Context-tre	e grammas
recursive and re	cursively enumerable languages, methods of design of turing machines (2 lectures) 6. Star lenting for CL, closure properties of CL (2	st correspondence	problem
	undecidable properties of CFL (2 lectures)		problem,
01KOAL	Commutative Algebra	ZK	3
1. Rings, ideals, ho	momorphisms, prime and maximal ideals. 2. Rings of polynomials, symmetric polynomials, irreducibility. 3. Gröbner bases. 4. Polynon	nials with rational	coefficients,
factorization of po	olynomials. 5. Hilbert's Nullstellensatz, ideals and manifolds, Krull dimension. 6. Fields, extensions, finite fields. 7. Introduction to Galc	is theory, Galois e	xtensions,
	group and correspondence.		
01KOS	Compressed Sensing	ZK	2
I he lecture will i	ntroduce basic concepts of the theory of compressed sensing an area founded in 2006 in the works of D. Donono, E. Candes, and I.	1ao. This theory st	udies the
was quickly used in	n many different fields. After the first survey lecture, we will study the mathematical foundations of the theory. We prove general NP-c	ompleteness of the	e search for
sparse solutions	of systems of linear equations. We introduce conditions which ensure also existence of more effective solvers and show, that these	are satisfied for ex	ample for
Gaussian random r	natrices. As an effective solution method, we will analyze 11-minimization and Orthogonal Matching Pursuit. We will also study stability	and robustness of	he obtained
	results with respect to the corruption of measurements and the optimality of the results.		
01MAL	Mathematical Logic	Z,ZK	4
Logic is in the sam	e time an object studied by mathematics and the language used to formalize and study mathematics. The goal of the course is to interest language used to formalize and study mathematics. The goal of the course is to interest language used to formalize and study mathematics.	roduce basic notio	n of results
2 anguage of pr	latical logic. 1. Propositions, evaluation, tautologies, axioms, theorems, soundness, completeness, and decidability of Hilbert and Gen	tions 3 Gödel com	onal calcull.
theorem, Sk	olem and Herbrand theorems. 4.The first and the second Gödel theorems on incompleteness of Peano arithmetics and undecidabilit	y of predicate calc	ulus.
01MMNS	Mathematical Modelling of Non-linear Systems	ZK	3
The course consis	ts of basic terms and results of the theory of finite- and infinitedimensional dynamical systems generated by evolutionary differential	equations, and de	scription of
bifurca	ations and chaos. Second part is devoted to the explanation of basic results of the fractal geometry dealing with attractors of such dy	namical systems.	
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	positive definite matrices. Theoretic results will be further applied for solution of more general systems. Main features of the methods a	ind common imple	mentation
	Nonlineer Optimization	71/	4
Nonlinear ontimizat	INULINITIE OPUTITIZATION ion problems find their application in may areas of applied mathematics. The lecture covers the basics of mathematical programming th	∠ ∩ Peory with emphas	
	optimization and basic methods for unconstrained and constrained optimization. The lecture is supplemented by illustrative examined and constrained optimization.	nples.	o on convex
01NEUR1	Neural Networks and their Applications 1	ZK	2
	Keywords: Neural networks, data separation, functional approximation, supervised learning		. –
01NEUR2	Theoretical Fundamentals of Neural Networks	ZK	3
	Keywords: Functional approximation, supervised learning, Vapnik-Chervonenkis-dimension	-	
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 given t	ask in reasonable	time. When
design	rig parallel algorithms, good knowledge of the parallel architectures is important. I herefore these architectures are studied as a part	oi this course too.	

01PALG	Advanced Algorithmization	KZ	2
Keywo	rds: String algorithms, graph algorithms, dynamic programming, suffix tress, graph cuts, numerical methods for solution of partial diffe	erential equations.	
01PAMF	Mainframe Programming in Assembler	Z	2
In this course the b	asics of programming in z/OS are explained namely the programming in assembler. Basic instructions, macros, I/O operations, DLL I	library loading and	some other
	topics are discussed.	1	
01PMU	Probabilistic Learning Models	ZK	2
Introduction into the	he theory PAC learning model, VC-dimension of finite sets, Sauer, Cover and Radon's lemma, VC-dimension of composed mappings	, application of VC	-dimension
for lower bound of	necessary patterns, analysis of properties of delta rule based learning processes, PAC learning model extensions and PAO learning, Boolean functions.	Fourier coefficient	s search for
01PNL	Advanced Methods of Numerical Linear Algebra	ZK	2
Representation of	real numbers in computers, behaviour of rounding errors during numerical computations, sensitivity of a problem, numerical stability o	f an algorithm. We	will analyse
sensitivity of the ei	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 perf	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	he solution of syste	ms of linear
04 DOM4	algebraic equations and the Lanczos method for approximation of the eigenvalues of a symmetric square matrix.	7	0
	PTODIETTI SETTITIAL ITI MALTETTIALICAI ATTAIYSIS	∠ ad quests There a	
but stud	dents will be assigned by some homework and they will give at least one talk per semester. The seminar is held in English and attend	ance is mandatory	
01PSM2	Problem Seminar in Mathematical Analysis 2	Z	2
This course is a se	minar in advanced mathematical analysis and its applications. Seminar talks will be delivered by students, department staff, and invite	ed quests. There a	e no exams
but stud	dents will be assigned by some homework and they will give at least one talk per semester. The seminar is held in English and attend	ance is mandatory	-
01SFTO	Special Functions and Transformations in Image Analysis	ZK	2
The course broad	lens topics of the courses ROZ1 and ROZ2. Main attention will be paid to several special functions and transformations (especially m	oment functions a	nd wavelet
transform) and the	ir use in selected tasks of image processing - edge detection, noise removal, recognition of deformed objects, image registration, image	age compression, e	etc. Both the
	theory and practical applications will be discussed.	_	
_01SMF	Modern Trends in Corporate Information Technologies	Z	2
The course is de	voted to mainframe administration basics. After introduction to mainframe hardware the following lectures covers security, transaction	n systems, virtualiz	ation and
0401404	non-relational databases in the maintrame environment.	7	0
015MS1	Student's seminar in mathematics 1	Ζ	2
01SMS2	Student's seminar in mathematics 2	Ζ	2
01SU1	Machine Learning 1	K	3
[1] features for desc	cription and recognition of 2-D snapes [2] invariant features, Fourier descriptors, moment invariants, differential invariants [3] statistical p	pattern recognition	supervised
and nonsupervise	of a feature space, iterative and metarchical method	is [5] dimensionalit	yreduction
01SUP	Start-up Project	K7	2
01750	Number Theory	7K	5
1. Algebraic and	transcendental numbers 2. Algebraic number fields, field isomorphisms 3. Rational approximations, continued fractions 4. Diophantic	equations. Pell's e	quation 5.
	Rings of integers in algebraic number fields and divisibility 6. Number representation in non-integer bases, finite and periodic exp	ansions	1
01TEH	Game Theory	ZK	2
1. Combinatorial g	ames, normal games - impartial and partizan games. 2. Multidimensional tic-tac-toe, Hales Jewett theorem. 3. Game tree, Zermelo's	, Theorem, Strategy	stealing. 4.
Arithmetic on no	rmal games, equivalence on games, MEX principle, Sprague-Grundy theorem. 5. Strategic games, pure and mixed strategies, domin	ated strategies. 6.	Zero-sum
games, MAX-	min principle, von Neumann theorem. 7. Nash equilibrium, Nash theorem. 8. Cooperation of two players, Nash arbitration. 9. Coalition	al games, Shapley	value.
01TEMA	Matrix Theory	Z	3
The subject deals	s mainly with: 1) similarity of matrices and canonical forms of matrices 2) Perron-Frobenius theory and its applications 3) tensor produ	uct 4) Hermitian ar	id positive
01TC		71/	F
1 Basic notion of	GIAPIT THEORY aranh theory 2 Edge and vertex connectivity (Menger Theorem) 3 Binartite graphs 4 Trees and forests 5 Spanning trees (Matrix-	<u> </u>	C Euler tours
and Hamilton cvcl	es. 7. Maximal and perfect matching. 8. Edge coloring. 9. Flows in networks. 10. Vertex coloring. 11. Plannar graphs (Kuratowski theor	rem), vertex colorir	a of planar
	graphs. 12. Spectrum of the adjacency matrix. 13. Extremal graph theory.	,,	5 1
01TIN	Information Theory	ZK	2
Information theory	vexplores the fundamental limits of the representation and transmission of information. We will focus on the definition and implication	s of (information) e	entropy, the
source coding the	eorem, and the channel coding theorem. These concepts provide a vital background for researchers in the areas of data compression	n, signal processing	g, controls,
	and pattern recognition.		
01TSLO	Complexity Theory	ZK	3
The course is devo	ted to incorporation of complexity questions during algorithm development, introduction to NP completeness and generally to comple	xity classes of det	erministic or
nondeterministic It	Iring machines bounded by time or space. Emphasis is placed on mutual relations among these classes. Aside from hondeterministic of classes. Class of interactive protocols is presented at the and of lecture course.	classes we examine	e probability
		7	2
In this course we te	ach the mainframe architecture. We explain how to operate the system z/OS, how to start a job using the JCL and we explain some of	<u> </u>	
	in C/C++ for z/OS:		logrammig
01UTS	Introduction to the Theory of Semigroups	ZK	3
It is known that	a system of linear ordinary differential equations can be solved by virtue of the matrix exponential. However, the extension to partial	differential equatio	ns is not
straightforward. For	r example in the case of heat equation the matrix is replaced by Laplace operator which is not bounded and the series for the exponent	ial will not converge	e. Moreover,
solutions of the he	eat equation exist in general only for positive times and hence the solution operator can be at best a semigroup. The aim of the course	e is to provide a ma	athematical
foundation f	or these types of problems and extend the concept of stability from ordinary differential equations, which is again in relation to spectr	um of a linear oper	rator.
01VUSI1	Research Project 1	Z	6
000000	Research project on the selected topic under the supervision. Supervision and regular checking of the research project under pre	paration.	^
01VUSI2	Research Project 2	K∠	8
047000	Research project on the selected topic under the supervision. Supervision and regular checking of the research project under prej	paralion.	0
	Detabase Oustern Decemposition		۷
SUUS		<u>∠</u> K	4

18MEMC	Monte Carlo Method	Z,ZK	4		
	This courseis devoted to the numerical method Monte Carlo and to its selected applications.		•		
1800P	Object Oriented Programming	Z	2		
This course consists of the contributions of students concerning given topics concerned on technologies uded in program development.					

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u> Generated: day 2025-06-07, time 02:42.