Study plan

Name of study plan: Aplikace informatiky v přírodních vědách

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:

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
01ASM	**Application of Statistical Methods** *Tomáš Hobza* ***Tomáš Hobza*** *Tomáš Hobza (Gar.)*	KZ	2	2+0		P
18AS	**Applications of Statistics and Data Processing**	Z,ZK	2	1P+1C	Z	P
18AEK	**Applied Econometrics and Time Series Theory** *Radek Hřebík, Quang Van Tran* ***Quang Van Tran*** *Quang Van Tran (Gar.)*	Z,ZK	4	2P+2C	Z	P
18DDS	**Database System Decomposition** *Dana Majerová, Jaromír Kukal* ***Dana Majerová*** *Jaromír Kukal (Gar.)*	ZK	4	2P+2C	L	P
18IMI	**Engeneering Methods in Informatics** *Vladimír Jarý, Vojtěch Merunka* ***Vladimír Jarý*** *Vladimír Jarý (Gar.)*	KZ	4	2P+2C	Z	P
18OOP	**Object Oriented Programming** *Miroslav Virius* ***Miroslav Virius*** *Miroslav Virius (Gar.)*	Z	2	2C	Z	P
12PF1	**Computational Physics 1** *Ondřej Klimo* ***Ondřej Klimo*** *Ondřej Klimo (Gar.)*	ZK	2	2+0	Z	P
12PF2	**Computational Physics 2** *Milan Kuchařík* ***Milan Kuchařík*** *Milan Kuchařík (Gar.)*	Z,ZK	2	1+1	L	P
12POEX	**Computer Control of Experiments** *Miroslav Čech* ***Miroslav Čech*** *Miroslav Čech (Gar.)*	Z	2	2+0	L	P
18SC	**Soft Computing** *Quang Van Tran, Jaromír Kukal* ***Quang Van Tran*** *Jaromír Kukal (Gar.)*	ZK	4	2P+2C	L	P
01TG	**Graph Theory** *Jan Volec, Petr Ambrož* ***Petr Ambrož*** *Petr Ambrož (Gar.)*	ZK	5	4P+0C		P
01UMF	**Introduction to Mainframe** *Tomáš Oberhuber* ***Tomáš Oberhuber*** *Tomáš Oberhuber (Gar.)*	Z	2	1P+1C	Z	P
18VUSE1	**Research Project 1** *Dana Majerová, Milan Kuchařík, Jakub Klinkovský, Radek Fučík* ***Milan Kuchařík*** *Milan Kuchařík (Gar.)*	Z	6	0+6	Z	P
18VUSE2	**Research Project 2** *Dana Majerová, Milan Kuchařík, Jakub Klinkovský, Radek Fučík* ***Milan Kuchařík*** *Milan Kuchařík (Gar.)*	KZ	8	0+8	L	P

Characteristics of the courses of this group of Study Plan: Code=NMSPAIPV1 Name=MDP P_AIPVN 1st year

01ASM	Application of Statistical Methods	KZ	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 and warrant of inevitability 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 and vector autoregressive models in economic diagnostics, analysis and forecasting and optimization of economic policy. Case studies and illustrative examples are solved during the 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 database 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 development process is explained as an integration of system development, software quality assurance, and software project management using miscellaneous techniques. Moreover, programming language Smalltalk is used as a demonstration tool for explained tools and techniques.			
18OOP	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 simulation methods - molecular dynamics, Monte Carlo method and other methodsof solving the particle transport in self-consistent fields (e.g. Particle in Cell method in 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 moments. 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 detection. Code parallelization, memory hierarchy, supercomputers. Euler equations on moving computational mesh. Eulerian, Lagrangian, and ALE methods, staggered discretization. Methods for mesh smoothing, methods for conservative interpolations of functions between meshes. Applications in simulations of laser/target interactions. Generalization for elastic materials. Methods 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, sensors, drivers, etc.) Software: operating systems for control of experiments (real time OS, multitasking, multiuser). Basic theory of control systems. Programming languages for control (assembler, C, etc.) Introduction to TCP/IP protocols. Control of experiments via Internet.			
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 limited output. Both theories and application conventions are included.			
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 (Matrix-Tree Theorem). 6. Euler tours and Hamilton cycles. 7. Maximal and perfect matching. 8. Edge coloring. 9. Flows in networks. 10. Vertex coloring. 11. Plannar graphs (Kuratowski theorem), vertex coloring of planar graphs. 12. Spectrum of the adjacency matrix. 13. Extremal graph theory.			
01UMF	Introduction to Mainframe	Z	2
In this course we teach the mainframe architecture. We explain how to operate the system z/OS, how to start a job using the JCL and we explain some differences when programming in C/C++ for z/OS:			
18VUSE1	Research Project 1	Z	6
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.			
18VUSE2	Research Project 2	KZ	8
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.			

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	P
18AEK	**Applied Econometrics and Time Series Theory** *Radek Hřebík, Quang Van Tran* ***Quang Van Tran*** *Quang Van Tran (Gar.)*	Z,ZK	4	2P+2C	Z	P
18DPSE1	**Master Thesis 1** *Dana Majerová, Milan Kuchařík, Radek Fučík* ***Milan Kuchařík*** *Milan Kuchařík (Gar.)*	Z	10	0+10	Z	P
18DPSE2	**Master Thesis 2** *Dana Majerová, Milan Kuchařík, Radek Fučík* ***Milan Kuchařík*** *Milan Kuchařík (Gar.)*	Z	20	0+20	L	P
18HA	**Heuristic Algorithms** *Jaromír Kukal* ***Jaromír Kukal*** *Jaromír Kukal (Gar.)*	ZK	4	2P+2C	L	P
18MEMC	**Monte Carlo Method** *Jaromír Kukal, Miroslav Virius* ***Miroslav Virius*** *Miroslav Virius (Gar.)*	Z,ZK	4	2P+2C	Z	P

18MPSE	**Modeling of Production Systems in Economy** *Adam Borovička **Adam Borovička** Quang Van Tran (Gar.)*	Z,ZK	4	2P+2C	Z	P
01PAA	**Parallel Algorithms and Architectures** *Tomáš Oberhuber **Tomáš Oberhuber** Tomáš Oberhuber (Gar.)*	KZ	4	2P+1C	L	P
18SDIP	**Diploma Seminar** *Quang Van Tran, Dana Majerová, Jaromír Kukal, Milan Kuchařík **Milan Kuchařík** Milan Kuchařík (Gar.)*	Z	2	2S	L	P
18SMRR	**Statistical Pattern Recognition and Decision Making Methods** *Jaromír Kukal **Jaromír Kukal** Jaromír Kukal (Gar.)*	ZK	2	2P+0C	Z	P

Characteristics of the courses of this group of Study Plan: Code=NMSPAIPV2 Name=MDP P_AIPVN 2nd year

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 and vector autoregressive models in economic diagnostics, analysis and forecasting and optimization of economic policy. Case studies and illustrative examples are solved during the practice lessons.			
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 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			
18DPSE2	Master Thesis 2	Z	20
The diploma 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.			
18HA	Heuristic Algorithms	ZK	4
Heuristic algorithms of optimization operates on discrete or continuous domains. Brutal force, stochastic, greedy, physically, biologically and sociologically motivated heuristic are included, used for optimum finding and compared.			
18MEMC	Monte Carlo Method	Z,ZK	4
This courseis 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 teaching course is to introduce students to basic models and methods for analysis and optimization of production systems. Models are oriented on design, operation, measurement and improvement phases of production systems. Models and analyses of supply chains are considered also. Model formulations are based on integer programming a graph theory. Optimization 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 given task in reasonable time. When designing parallel algorithms, good knowledge of the parallel architectures is important. Therefore these architectures are studied as a part of this course too.			
18SDIP	Diploma Seminar	Z	2
Preparation of the thesis defense.			
18SMRR	Statistical Pattern Recognition and Decision Making Methods	ZK	2
Collection of recognition 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:

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** 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 **Jaromír Kukal***	KZ	2	1P+1C	Z	V
01DAS	**Data science** *Jiří Franc **Jiří Franc** Jiří Franc (Gar.)*	KZ	3	1P+2C		V
01MRMMI	**Methods for Sparse Matrices** *Jiří Mikyška **Jiří Mikyška** Jiří Mikyška (Gar.)*	KZ	2	2P+0C		V

18MUML	**Modeling in UML** *Vojtěch Merunka* ***Vojtěch 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** *Jiří Mikyška* ***Jiří Mikyška*** *Jiří Mikyška (Gar.)*	ZK	2	2P+0C		v
18PCP	**Advanced C++** *Miroslav Virius* ***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*** *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** *Přemysl Rubeš* ***Přemysl Rubeš*** *Přemysl Rubeš (Gar.)*	KZ	2	2P+0C		v
01SU2	**Machine Learning 2** *Filip Šroubek* ***Filip Šroubek*** *Filip Šroubek (Gar.)*	Z,ZK	4	2P+2C		v
01SVK	**Student's Scientific Conference** ***Jiří Mikyška*** *Jiří Mikyška (Gar.)*	Z	1	5 dní		v
18TFT	**Financial Markets Theory** *Quang Van Tran, Nichita Vatamaniuc* ***Quang Van Tran*** *Quang Van Tran (Gar.)*	KZ	4	2P+2C	Z	v
01TIN	**Information Theory** *Tomáš Hobza* ***Tomáš Hobza*** *Tomáš Hobza (Gar.)*	ZK	2	2+0	Z	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

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 systems an fractal set generation. Analysis of trajectories, attractors and fractal sets including estimation of their properties.

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 and subsequently, methods for large problems and training of deep artificial neural networks are explained. Finaly, advanced methods for regret minimization or sparsity inducing 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 Data, 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 understand the basic tools and procedures used in modern Big Data repositories Lakehouses. The student will have a basic understanding of integration with other systems (data consumption and data provisioning), understand the architecture of modern analytics platforms with respect to the business data model, data governance, orchestration and freshness of data. The course will also introduce the Spark distributed computing framework, machine learning model management tools (MLOps) and data visualization.

18BI	Business Intelligence	KZ	2

The aim of the subject is to explain to the students different characteristics of production and analytical databases and a set of processes, know-how and tools (not only) 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 implementation of custom algorithms derived from other theories and subjects into the BI environment.

01DAS	Data science	KZ	3

Practical application of mathematical modeling methods, statistics and machine learning needs wide range of tasks from data preparation and collection to design of an appropriate 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 collaboration, 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 aimed 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 positive definite matrices. Theoretic results will be further applied for solution of more general systems. Main features of the methods and common implementation issues will be covered.

18MUML	Modeling in UML	Z,ZK	4

Unified modelling language (UML) is explained from the perspective of the theoretical background of the object-oriented programing and modelling using lambda-calculus. In semestral projects and practical examples, instance-level modeling approach is stressed. This course also brings an introduction into the technology of object-oriented databases and object-oriented data structure querying as the essential tool of modeled system verification and validation.

01SMF	Modern Trends in Corporate Information Technologies	Z	2

The course is devoted to mainframe administration basics. After introduction to mainframe hardware the following lectures covers security, transaction systems, virtualization and non-relational databases in the mainframe environment.

18UIA2	Advanced Algorithms 2	Z	2

The lecture covers selected algorithms of the artificial inteligence and construction of autonomous robot.

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 of an algorithm. We will analyse sensitivity of the eigenvalues of a given matrix and sensitivity of roots of systems of linear algebraic equations. Then, the backward analysis of these problems will be performed. 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 solution of 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 data type processing in compile time and for the advanced diagnostic of the templates, concepts, coroutines, modules, ranges, views and other tools introduced in C++ 20, application of the multithreading (execution parallelization).			
01PAMF	Mainframe Programming in Assembler	Z	2
In this course the basics of programming in z/OS are explained namely the programming in assembler. Basic instructions, macros, I/O operations, DLL library loading and some other topics are discussed.			
18CIS	Programming in C#	Z,ZK	4
This lecture provides an introduction to the programming language C# and teaches students how to create common types of applications (graphical user interface, databases, multithreading) for most platforms.			
18PVS	Industrial Software Development	Z	2
General lecture about applied code writing in commercial sphere. All essential programmer skills assosiated with development of software for industrial purposes will be covered during the lecture. This includes versioning, testing, release handling and also code quality measurement. The simple real world use scenarios introduced in lectures will be deeply examined in examples. The examples will be constructed with emphasis on understanding and reuse of already done third person code.			
01SUP	Start-up Project	KZ	2
01SU2	Machine Learning 2	Z,ZK	4
1.Fundamental topics from the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of dimensionality, overfitting, maximum likelihood and maximum a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal partitioning and pruning, ensemble learning - bagging, boosting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical methods for optimization (steepest descent, conjugate gradient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear activation functions, output units, loss functional, stochastic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adaptive learning rates) 7.Convolutional neural networks 8.Recurrent neural networks 9.Advanced network architectures (autoencoders, Generative Adversarial networks) 10.Applications of deep learning (classification, segmentation, image reconstruction)			
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 course guarantor.			
18TFT	Financial Markets Theory	KZ	4
Since financial instrument prices are unknown in advance to financial market participants, financial derivatives are currently being used as common instruments to eliminate risks arising from price instability of financial assets. The theory of financial markets uses the knowledge of mathematical analysis and statistics to manage the portfolio of risk assets and the valuation of sophisticated financial instruments in the form of derivatives such as swaps, forwards, futures and options.			
01TIN	Information Theory	ZK	2
Information theory explores the fundamental limits of the representation and transmission of information. We will focus on the definition and implications of (information) entropy, the source coding theorem, 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.			
18UIA1	Introduction to Advanced Algorithms	Z	2
The lecture covers selected algorithms of the artificial inteligence and their application in the real world.			
18ZDFT	Financial Markets Data Processing	KZ	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.			

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 and subsequently, methods for large problems and training of deep artificial neural networks are explained. Finaly, advanced methods for regret minimization or sparsity inducing methods are explained. All methods are demonstrated on real problems.			
01ASM	Application of Statistical Methods	KZ	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.			
01DAS	Data science	KZ	3
Practical application of mathematical modeling methods, statistics and machine learning needs wide range of tasks from data preparation and collection to design of an appropriate 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 collaboration, 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 aimed 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 positive definite matrices. Theoretic results will be further applied for solution of more general systems. Main features of the methods and common implementation issues will be covered.			
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 task in reasonable time. When designing 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 basics of programming in z/OS are explained namely the programming in assembler. Basic instructions, macros, I/O operations, DLL library loading and some other topics are discussed.			

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 of an algorithm. We will analyse sensitivity of the eigenvalues of a given matrix and sensitivity of roots of systems of linear algebraic equations. Then, the backward analysis of these problems will be performed. 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 solution of systems 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	Z	2
The course is devoted to mainframe administration basics. After introduction to mainframe hardware the following lectures covers security, transaction systems, virtualization and non-relational databases in the mainframe environment.			
01SU2	Machine Learning 2	Z,ZK	4
1.Fundamental topics from the probability theory and machine learning (classical distributions, Bayes theorem, Kullback-Leibler divergence, curse of dimensionality, overfitting, maximum likelihood and maximum a posteriori estimators, Principle Component Analysis) 2.Decision trees: general schema, recursive partitioning, optimal partitioning and pruning, ensemble learning - bagging, boosting, random forests. 3.Examples of decision trees: Adaptive boosting AdaBoost, Gradient boosting, Xgboost. 4.Numerical methods for optimization (steepest descent, conjugate gradient, Newton and quasi-Newton, constrained extrema, Lagrangian). 5.Deep feedforward networks (hidden units, nonlinear activation functions, output units, loss functional, stochastic gradient descent, back-propagation algorithm) 6.Optimization for training deep models (regularization, algorithms with adaptive learning rates) 7.Convolutional neural networks 8.Recurrent neural networks 9.Advanced network architectures (autoencoders, Generative Adversarial networks) 10.Applications of deep learning (classification, 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 course guarantor.			
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 (Matrix-Tree Theorem). 6. Euler tours and Hamilton cycles. 7. Maximal and perfect matching. 8. Edge coloring. 9. Flows in networks. 10. Vertex coloring. 11. Plannar graphs (Kuratowski theorem), vertex coloring of planar graphs. 12. Spectrum of the adjacency matrix. 13. Extremal graph theory.			
01TIN	Information Theory	ZK	2
Information theory explores the fundamental limits of the representation and transmission of information. We will focus on the definition and implications of (information) entropy, the source coding theorem, 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.			
01UMF	Introduction to Mainframe	Z	2
In this course we teach the mainframe architecture. We explain how to operate the system z/OS, how to start a job using the JCL and we explain some differences when programming in C/C++ for z/OS:			
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 simulation methods - molecular dynamics, Monte Carlo method and other methodsof solving the particle transport in self-consistent fields (e.g. Particle in Cell method in 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 moments. 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 detection. Code parallelization, memory hierarchy, supercomputers. Euler equations on moving computational mesh. Eulerian, Lagrangian, and ALE methods, staggered discretization. Methods for mesh smoothing, methods for conservative interpolations of functions between meshes. Applications in simulations of laser/target interactions. Generalization for elastic materials. Methods 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, sensors, drivers, etc.) Software: operating systems for control of experiments (real time OS, multitasking, multiuser). Basic theory of control systems. Programming languages for control (assembler, C, etc.) Introduction to TCP/IP protocols. Control of experiments via Internet.			
18AAD	Applied Data Analysis	Z	3
A practically focused subject that guides you through the topics of Big Data, neural networks, parallel computing, graph analysis, cloud technologies, deployment, and development of software or IoT solutions.			
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 and vector autoregressive models in economic diagnostics, analysis and forecasting and optimization of economic policy. Case studies and illustrative examples are solved during the practice lessons.			
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 systems an fractal set generation. Analysis of trajectories, attractors and fractal sets including estimation of their properties.			
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 inevitability of this relationship			
18BI	Business Intelligence	KZ	2
The aim of the subject is to explain to the students different characteristics of production and analytical databases and a set of processes, know-how and tools (not only) 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 implementation of custom algorithms derived from other theories and subjects into the BI environment.			
18BIG	Big Data tools and architecture	Z	3
Practically oriented course, after completing which the student will understand the basic tools and procedures used in modern Big Data repositories Lakehouses. The student will have a basic understanding of integration with other systems (data consumption and data provisioning), understand the architecture of modern analytics platforms with respect to the business data model, data governance, orchestration and freshness of data. The course will also introduce the Spark distributed computing framework, machine learning model management tools (MLOps) and data visualization.			
18CIS	Programming in C#	Z,ZK	4
This lecture provides an introduction to the programming language C# and teaches students how to create common types of applications (graphical user interface, databases, multithreading) for most platforms.			
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 database operations.			

18DPSE1	Master Thesis 1	Z	10
The diploma 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			
18DPSE2	Master Thesis 2	Z	20
The diploma 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.			
18HA	Heuristic Algorithms	ZK	4
Heuristic algorithms of optimization operates on discrete or continuous domains. Brutal force, stochastic, greedy, physically, biologically and sociologically motivated heuristic are included, used for optimum finding and compared.			
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 development process is explained as an integration of system development, software quality assurance, and software project management using miscellaneous techniques. Moreover, programming language Smalltalk is used as a demonstration tool for explained tools and techniques.			
18MEMC	Monte Carlo Method	Z,ZK	4
This courseis 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 teaching course is to introduce students to basic models and methods for analysis and optimization of production systems. Models are oriented on design, operation, measurement and improvement phases of production systems. Models and analyses of supply chains are considered also. Model formulations are based on integer programming a graph theory. Optimization and heuristic approaches are used for solutions.			
18MUML	Modeling in UML	Z,ZK	4
Unified modelling language (UML) is explained from the perspective of the theoretical background of the object-oriented programing and modelling using lambda-calculus. In semestral projects and practical examples, instance-level modeling approach is stressed. This course also brings an introduction into the technology of object-oriented databases and object-oriented data structure querying as the essential tool of modeled system verification and validation.			
18OOP	Object Oriented Programming	Z	2
This course consists of the contributions of students concerning given topics concerned on technologies uded in program development.			
18PCP	Advanced C++	Z,ZK	4
This lecture covers the virtual inheritance,variadic templetes, template metaprogramming, template libraries design and implementation, tools for data type processing in compile time and for the advanced diagnostic of the templates, concepts, coroutines, modules, ranges, views and other tools introduced in C++ 20, application of the multithreading (execution parallelization).			
18PVS	Industrial Software Development	Z	2
General lecture about applied code writing in commercial sphere. All essential programmer skills assosiated with development of software for industrial purposes will be covered during the lecture. This includes versioning, testing, release handling and also code quality measurement. The simple real world use scenarios introduced in lectures will be deeply examined in examples. The examples will be constructed with emphasis on understanding and reuse of already done third person code.			
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 limited output. Both theories 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
Collection of recognition and classification methods with accent to mathematical and statistical principles of their design and functionality.			
18SQL	SQL Applications	Z	2
Practical realization of database system according to general principles of database analysis.			
18TFT	Financial Markets Theory	KZ	4
Since financial instrument prices are unknown in advance to financial market participants, financial derivatives are currently being used as common instruments to eliminate risks arising from price instability of financial assets. The theory of financial markets uses the knowledge of mathematical analysis and statistics to manage the portfolio of risk assets 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 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.			
18VUSE2	Research Project 2	KZ	8
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.			
18ZDFT	Financial Markets Data Processing	KZ	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 http://bilakniha.cvut.cz/en/FF.html
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