Recomended pass through the study plan

Name of the pass: Master Specialization Digital Business Engineering, 2023

Faculty/Institute/Others:
Department:
Pass through the study plan: Master Specialization Digital Business Engineering, 2023
Branch of study guranteed by the department: Welcome page
Guarantor of the study branch:
Program of study: Informatics
Type of study: Follow-up master full-time
Note on the pass: The remaining credits to the obligation to get a minimum of 120 credits can be obtained for any course of this study plan

Coding of roles of courses and groups of courses:
P - compulsory courses of the program, PO - compulsory courses of the branch, Z - compulsory courses, S - compulsory elective courses, PV - compulsory elective courses, F - elective specialized courses, V - elective courses, T - physical training courses

Coding of ways of completion of courses (KZ/Z/ZK) and coding of semesters (Z/L):
KZ - graded assesment, Z - assesment, ZK - examination, L - summer semester, Z - winter semester

Number of semester: 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
NIE-KOP	**Combinatorial Optimization** *Petr Fišer, Jan Schmidt **Petr Fišer** Petr Fišer (Gar.)*	Z,ZK	6	3P+1C	Z	PP
NIE-MPI	**Mathematics for Informatics** *Francesco Dolce **Štěpán Starosta** Štěpán Starosta (Gar.)*	Z,ZK	7	3P+2C	Z	PP
DA-DMI	**Data Mining** ***Michal Valenta***	Z,ZK	6	30KP+30KC	Z,L	PS
NIE-DBE-PV1.23	**Compulsory Elective Courses for Master Specialization DBE - Modern Technology** *NIE-PDB,DD-ZUM,..... (see the list of groups below)*	Min. cours. 1 Max. cours. 5	Min/Max 5/25			PV
NIE-V.21	**Purely elective master's courses** *NIE-BLO,NIE-CPX,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 31	Min/Max 0/136			V

Number of semester: 2

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
NIE-PDP	**Parallel and Distributed Programming** *Pavel Tvrdík **Pavel Tvrdík** Pavel Tvrdík (Gar.)*	Z,ZK	6	2P+2C	L	PP
NIE-VSM	**Selected statistical Methods** *Petr Novák **Pavel Hrabák** Pavel Hrabák (Gar.)*	Z,ZK	7	4P+2C	L	PP
DA-DRS	**Digital Risk And Security (DA-DRS)** ***Michal Valenta***	Z,ZK	6	30KP+30KC	Z	PS
NIE-DBE-PVA.23	**Compulsory Elective Courses for Master DBE Specialization A - Normalized Systems Theory** *NIE-NSS,DA-SEA-CZ,..... (see the list of groups below)*	Min. cours. 1 Max. cours. 2	Min/Max 5/9			PV
NIE-V.21	**Purely elective master's courses** *NIE-BLO,NIE-CPX,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 31	Min/Max 0/136			V

Number of semester: 3

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
DD-DIN	**Digital innovation** ***Michal Valenta***	ZK	6		Z	PS
DD-DSG	**Digital strategy and governance** ***Michal Valenta***	ZK	6	2P+2C	Z	PS
DD-SMN	**Strategic management** ***Michal Valenta***	ZK	6	4P+0C	Z	PS
NIE-DBE-PVB.23	**Compulsory Elective Courses for Master Double degree Specialization DBE B - Engineering and Ethics** *DD-DSE,DA-ESB*	Min. cours. 1 Max. cours. 2	Min/Max 3/6			PV
NIE-DBE-PVC.23	**Compulsory Elective Courses for Master Specialization DBE C - Master Project** *DA-IPR,NIE-MPR*	Min. cours. 1 Max. cours. 2	Min/Max 7/16			PV
NIE-V.21	**Purely elective master's courses** *NIE-BLO,NIE-CPX,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 31	Min/Max 0/136			V

Number of semester: 4

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
NIE-DIP	**Diploma Thesis** *Zdeněk Muzikář* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	Z	30	270ZP	L,Z	PP

List of groups of courses of this pass with the complete content of members of individual groups

Kód	Name of the group of courses and codes of members of this group (for specification see here or below the list of courses)	Completion	Credits	Scope	Semester	Role
NIE-DBE-PV1.23	**Compulsory Elective Courses for Master Specialization DBE - Modern Technology**	**Min. cours. 1 Max. cours. 5**	**Min/Max** 5/25			**PV**

NIE-PDB	Advanced Database Systems	DD-ZUM	Artificial Intelligence Fundamen ...	NIE-BLO	Blockchain
NIE-AM1	Middleware Architectures 1	NIE-SWE	Semantic Web and Knowledge Graph ...		

		Completion	Credits	Scope	Semester	Role
NIE-DBE-PVA.23	**Compulsory Elective Courses for Master DBE Specialization A - Normalized Systems Theory**	**Min. cours. 1 Max. cours. 2**	**Min/Max** 5/9			**PV**

NIE-NSS	Normalized Software Systems	DA-SEA-CZ	Software Engineeering and Archit ...	DA-SEA	Software Engineering And Archite ...

		Completion	Credits	Scope	Semester	Role
NIE-DBE-PVB.23	**Compulsory Elective Courses for Master Double degree Specialization DBE B - Engineering and Ethics**	**Min. cours. 1 Max. cours. 2**	**Min/Max** 3/6			**PV**

DD-DSE	Data science and ethics	DA-ESB	Ethical And Sustainable Business

		Completion	Credits	Scope	Semester	Role
NIE-DBE-PVC.23	**Compulsory Elective Courses for Master Specialization DBE C - Master Project**	**Min. cours. 1 Max. cours. 2**	**Min/Max** 7/16			**PV**

DA-IPR	Integration project digital busi ...	NIE-MPR	Master Project

NIE-V.21	Purely elective master's courses	Min. cours. 0 Max. cours. 31	Min/Max 0/136			v

NIE-BLO	Blockchain	NIE-CPX	Complexity Theory	NIE-VYC	Computability
NIE-MVI	Computational Intelligence Metho ...	NIE-ARI	Computer arithmetic	NIE-SCE1	Computer Engineering Seminar Mas ...
NIE-SCE2	Computer Engineering Seminar Mas ...	NI-DSW	Design Sprint	NI-DID	Digital drawing
NIE-EVY	Efficient Text Pattern Matching	NI-GLR	Games and reinforcement learning	NI-GRI	Grid Computing
NIE-HMI	History of Mathematics and Infor ...	NIE-DVG	Introduction to Discrete and Com ...	FITE-EHD	Introduction to European Economi ...
MIE-MZI	Mathematics for data science	NIE-AM2	Middleware Architectures 2	NIE-OSY	Operating Systems and Systems Pr ...
NIE-PAM	Parameterized Algorithms	NIE-SYP	Parsing and Compilers	NIE-ROZ	Pattern Recognition
NIE-PML	Personalized Machine Learning	NI-AML	Advanced machine learning	NIE-PDL	Practical Deep Learning
FIT-ACM1	Programming Practices 1	FIT-ACM2	Programming Practices 2	FIT-ACM3	Programming Practices 3
FIT-ACM4	Programming Practices 4	FIT-ACM5	Programming Practices 5	FIT-ACM6	Programming Practices 6
NIE-VPR	Research Project	NIE-SWE	Semantic Web and Knowledge Graph ...	MI-SCE1	Computer Engineering Seminar Mas ...
NIE-HSC	Side-Channel Analysis in Hardwar ...	NIE-DDW	Web Data Mining	NIE-BPS	Wireless Computer Networks
NIE-SEP	World Economy and Business	FITE-SEP	World Economy and Business		

List of courses of this pass:

Code	Name of the course	Completion	Credits
DA-DMI	Data Mining	Z,ZK	6
In the past decade, weve witnessed a huge increase in the amount of data being captured and stored. In these large datasets very useful knowledge is present, though often concealed in the vastness of the data. With data mining techniques patterns are automatically revealed from such large datasets. First, data mining techniques and applications are discussed. Next, we will go into popular predictive and descriptive data mining techniques, with applications in marketing and risk management. Also, analyses such as social network analysis, text mining, process mining, and Big Data will be looked at. Basic programming skills in Python will be learnt. The learned concepts, techniques and programming language will be applied and evaluated with a real-life case. Teaching takes place at University of Antwerpen. See the web page https://www.uantwerpen.be/en/study/programmes/all-programmes/digital-business-engineering/about-the-programme/study-programme/			
DA-DRS	Digital Risk And Security (DA-DRS)	Z,ZK	6
Information technology has become crucial in the growth, sustainability and support of enterprises. However, the pervasive use of technologies also incurs many business risks, anging from abuse, cybercrime, fraud, errors and ommissions. The objective of this course is to understand and analyse IT related business risks and and how these risks can be translated into an appropiate information risk management and security strategy and action plan. In the course, will first discuss the basics of IT Risk, Information Security, and some of the general and specific standards and frameworks to address them. Next, we will elaborate on the IT risk management and IT security functions in an organisation. Specific attention will be given to risk assessment methods, both qualitative and quantitative. The theoretical knowledge will be applied in a group project, where students will conduct a risk assessment in a real organisation, and present the results to the responsible managers. Guarantor and teacher: MSc. Steven De Haes, Ph.D.			
DA-ESB	Ethical And Sustainable Business	ZK	3
This course covers corporate responsibility, morality and sustainability. It has three main parts: Part 1: Ethics and morality in business History of ethics in business Origins, stakeholder theory, basic philosophy Utilitarianism vs Kantian approaches Behavioural economic. Part 2: Corporate responsibility and sustainability in theory Shared value creation, social profit, social entrepreneurship Sustainable HR Circular Economy Green Deal and CSRD New business models for sustainability. Part 3: Corporate responsibility and sustainability in practice Implementing sustainability in the value chain of a company: products, operations, organisation and HR How to apply a management approach to sustainability. Teaching takes place at University Antwerpen. See the web page https://www.uantwerpen.be/en/study/programmes/all-programmes/digital-business-engineering/about-the-programme			
DA-IPR	Integration project digital business engineering	Z	9
This is typically a study followed by a thesis. Teaching takes place at University Antwerpen. Contact Information: Jan Verelst jan.verelst@uantwerpen.be Dieter Van Nuffel dieter.vannuffel@uantwerpen.be See the web page https://www.uantwerpen.be/en/study/programmes/all-programmes/digital-business-engineering/about-the-programme/study-programme/			
DA-SEA	Software Engineering And Architecture	Z,ZK	9
Basic software engineering structures, practices, and patterns are explained in a realistic software engineering environment using the Java progarmming language. Practical assignments complement these lectures. Basic software architecture structures, practices, and patterns are explained and discussed, including various aspects of evolvability. Video lectures and a practical assignment deepen this. Teaching takes place at University of Antwerpen. See the web page https://www.uantwerpen.be/en/study/programmes/all-programmes/digital-business-engineering/about-the-programme/study-programme/			
DA-SEA-CZ	Software Engineeering and Architecture - project	Z	4
NSS project. Only for Czech students of NIE-DBE. At CTU credits are recognized as optionals. At UA credits are recognized together with NIE-NSS instead of DA-SEA in order to fulfill UA study plan.			
DD-DIN	Digital innovation	ZK	6
This course focuses on innovation in the context of the digital, software-intensive economy. Starting from a broader perspective on innovation, both mainstream theories and thinking on innovation, as well as alternative views from challengers, are discussed. This includes omnipresent innovation models in which IT-related innovations are adopted by startups and scaleups (eg. blockchains or drones) and making them available in certain business domains, which requires agility and speed of development at the software level. Also, disruptive innovation, where existing value chains are challenged, is discussed with its requirement for new levels of productivity in software development. Leading theories are discussed and illustrated with local and international cases using guest lectures. Students of a master double degree specialisation Digital Business Engineering will attend this course during their stay at the partner university Antwerp.			
DD-DSE	Data science and ethics	ZK	3
Ethics tell us about right and wrong. The course will provide an overview of key: (1) concepts, related to privacy, discrimination, transparency, and explainability, (2) techniques to assess and improve on these aspects, and (3) cautionary tales that motivate the importance thereof. The consideration of data science ethics is crucial for any data-driven company, as will be motivated by ample cautionary tales. With a wide range of cases, the large implications of new data science technologies on ethics will be discussed. These include online tracking, medical records, Facebook data, Internet censorship, big data, privacy engineering, and Artificial Intelligence. Data scientists and business managers are not inherently			

	unethical, but at the same time not trained to think this through neither. This course aims to address this important gap. Students of a master double degree specialisation Digital Business Engineering will attend this course during their stay at the partner university Antwerp		
DD-DSG	Digital strategy and governance	ZK	6
	The course provides a complete and comprehensive overview of what digital governance entails and how it can be applied in practice. The course is organized around the following three main themes: concepts and practices of digital governance, the impact of digital governance on business/IT strategic and operational alignment, and the notion of digital value and risk. The course is based on the teacher's knowledge obtained in applied research projects on the relationship between digital governance practices and digital value. To support the student in understanding and absorbing the material provided, the course uses short assignments and case studies. Students of a master double degree specialisation Digital Business Engineering will attend this course during their stay at the partner university Antwerp		
DD-SMN	Strategic management	ZK	6
	In the first part of the course, the different concepts and perspectives of strategic management are analyzed. The basic characteristics of strategic thinking are being analyzed. Then the importance of mission/vision, as the starting point in strategic thinking, is being discussed. This is being linked to the broader concept of sustainability / corporate social responsibility. The remaining parts focus on the three basic dimensions of strategy: (1) the strategy content: business level strategy, corporate level strategy, and network level strategy (2) the strategy process: strategic formation, strategic change, and strategic innovation, (3) the strategy context: the industry context, the organizational context, and the international context. In each of the different chapters, the fundamental strategic management paradoxes are situated and evaluated in the strategic management theory. Attention is also given to some strategic management tools which can be used to manage the strategy process. Students of a master double degree specialisation Digital Business Engineering will attend this course during their stay at the partner university Antwerp		
DD-ZUM	Artificial Intelligence Fundamentals	Z,ZK	5
	Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classical tasks from the areas of state space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms and the neural networks, will be presented as well. This course is only for students of the double degree program with the University of Antwerp. Other students are not allowed to enrol this course, enrol the BIE-ZUM course instead.		
FIT-ACM1	Programming Practices 1	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FIT-ACM2	Programming Practices 2	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FIT-ACM3	Programming Practices 3	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FIT-ACM4	Programming Practices 4	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FIT-ACM5	Programming Practices 5	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FIT-ACM6	Programming Practices 6	KZ	5
	This is a selective course for preparing talented student for representation in international programming contests.		
FITE-EHD	Introduction to European Economic History	Z,ZK	3
	The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economy through the description of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic history. From large economic area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institutions is deciphered. The course does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and organizations in history. Class meetings will consist of a mixture of lecture and discussion.		
FITE-SEP	World Economy and Business	Z,ZK	4
	The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.		
MI-SCE1	Computer Engineering Seminar Master I	Z	4
	The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.		
MIE-MZI	Mathematics for data science	Z,ZK	4
	In this course, the students are introduced to the domains of mathematics necessary for understanding the standard methods and algorithms used in data science. The studied topics include mainly: linear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality principle, gradient methods) and selected notions from probability theory and statistics.		
NI-AML	Advanced machine learning	Z,ZK	5
	The course introduces students to selected advanced topics of machine learning and artificial intelligence. The topics present techniques in the field of recommendation systems, image processing, control and interconnection of physical laws with the field of machine learning. The aim of the exercise is to familiarize students with the methods discussed.		
NI-DID	Digital drawing	Z	2
	The course will introduce students to the basic principals of digital drawing and graphical design. Students will gain understanding of composition, perspective and color theory, which they will practically apply in their own design works. Students will also gain experience in drawing and painting with digital and analog tools. The course is fit for anyone who wants to practice or learn drawing and painting. The course is organized as a thematic practices covering parts of theory and practical exercise to practice gained knowledge.		
NI-DSW	Design Sprint	Z	2
	Students will work on projects using the Design Sprint method, developed by Google. THanks to this method the teams are able to go from idea to validated prototype in 5 days. During the course the students will get familiar with the method as participants. Through practical challenges they will try the whole 5 day process starting with research and finishing with testing the prototypes (plus final presentation).		
NI-GLR	Games and reinforcement learning	Z,ZK	4
	The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligence. This course is intended to give you both theoretical and practical background so you can participate in related research activities. Presented in English.		
NI-GRI	Grid Computing	Z,ZK	5
	Grid computing and gain knowledge about the world-wide network and computing infrastructure.		

NIE-AM1	Middleware Architectures 1	Z,ZK	5
Students will study new trends, concepts, and technologies in the area of service-oriented architectures. The will gain an overview of information system architecture, web service architecture and aplication servers. The will also study principles and technologies for middleware focused on application integrations, asynchronous communications and high availability of applications. This course replaces the course MIE-MDW.			
NIE-AM2	Middleware Architectures 2	Z,ZK	5
Students will learn new trends and technologies on the Web including theoretical foundations. They will gain an overview of Web application architectures, concepts and technologies for microservices, distrubuted cache and databases, smart contracts, realtime communication and web security.			
NIE-ARI	Computer arithmetic	Z,ZK	4
Students will learn various data representations used in digital devices and will be able to design arithmetic operations implementation units.			
NIE-BLO	Blockchain	Z,ZK	5
Students will understand the foundations of blockchain technology, smart contract programming, and gain an overview of most notable blockchain platforms. They will be able to design, code and deploy a secure decentralized application, and assess whether integration of a blockchain is suitable for a given problem. The course places an increased emphasis on the relationship between blockchains and information security. It is concluded with a defense of a research or applied semester project, which prepares the students for implementing or supervising implementation of blockchain-based solutions in both academia and business.			
NIE-BPS	Wireless Computer Networks	Z,ZK	4
Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad-hoc networks, multicast and broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowledge of security mechanisms for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools.			
NIE-CPX	Complexity Theory	Z,ZK	5
Students will learn about the fundamental classes of problems in the complexity theory and different models of algoritms and about implications of the theory concerning practical (in)tractability of difficult problems.			
NIE-DDW	Web Data Mining	Z,ZK	5
Students will learn latest methods and technologies for web data acquisition, analysis and utilization of the discovered knowledge. Students will gain an overview of Web mining techniques for Web crawling, Web structure analysis, Web usage analysis, Web content mining and information extraction. Students will also gain an overview of most recent developments in the field of social web and recommendation systems.			
NIE-DIP	Diploma Thesis	Z	30
NIE-DVG	Introduction to Discrete and Computational Geometry	Z,ZK	5
The course intends to introduce the students to the discipline of Discrete and Computational Geometry. The main goal of the course is to get familiar with the most fundamental notions of this discipline, and to be able to solve simple algorithmic problems with a geometric component.			
NIE-EVY	Efficient Text Pattern Matching	Z,ZK	5
Students get knowledge of efficient algorithms for text pattern matching. They learn to use so called succinct data structures that are efficient in both access time and memory complexity. They will be able to use the knowledge in design of applications that utilize pattern matching.			
NIE-HMI	History of Mathematics and Informatics	Z,ZK	3
The course focuses on selected topics from calculus, general algebra, number theory, numerical mathematics and logic - useful for today computer science The topics are selected for finding some relations between computer science and mathematical methods. Some examples of applications of mathematics to computer sciences will be showed.			
NIE-HSC	Side-Channel Analysis in Hardware	Z,ZK	4
This course is dedicated to so-called side-channel information leakage in hardware devices. It focuses on both theoretical analysis and practical attacks. Students get familiar with various kinds of side channels and they get deeper insight in power attacks. Students learn to implement various profiled and non-profiled attacks and get familiar with higher-order attacks. They also get practice in both designing the SCA countermeasures and analyzing the amount and characteristics of the side-channel information leakage.			
NIE-KOP	Combinatorial Optimization	Z,ZK	6
The students will gain knowledge and understanding necessary deployment of combinatorial heuristics at a professional level. They will be able not only to select and implement but also to apply and evaluate heuristics for practical problems.			
NIE-MPI	Mathematics for Informatics	Z,ZK	7
The course focuses on selected topics from general algebra with emphasis on finite structures used in computer science. It includes topics from multi-variate analysis, smooth optimization, and multi-variate integration. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last topic includes selected numerical algorithm and their stability analysis. The topics are completed with the demonstration of applications in computer science. The course focuses on clear presentation and argumentation.			
NIE-MPR	Master Project	Z	7
1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. The external supervisor enters the information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvut.cz/student/studijni/formulare). The completed and signed form must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester.			
NIE-MVI	Computational Intelligence Methods	Z,ZK	5
Students will understand the basic methods and techniques of computational intelligence, which are based on traditional artificial intelligence, are parallel in nature and are applicable to solving a wide range of problems. The subject is also devoted to modern neural networks and the ways in which they learn and neuroevolution. Students will learn how these methods work and how to apply them to problems related to data extraction, management, intelligence in games and optimisation, etc.			
NIE-NSS	Normalized Software Systems	ZK	5
Students will learn the foundations of normalized systems theory that studies the evolvability of modular structures based on concepts from engineering, such as stability from system theory and entropy from thermodynamics. Students will understand a set of principles that indicate where violations of stability and entropy-related issues occur in any given software architecture. In the second part of the course, students learn how to construct software architectures using a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors, and triggers, while handling violations of the stability and entropy-related principles. This knowledge allows students to realize new levels of evolvability in software architectures.			
NIE-OSY	Operating Systems and Systems Programming	Z,ZK	5
This course is focused on the design and implementation of the basic components that make up modern operating systems. This includes threads, processes, switching context, virtual memory, system calls, interrupts and interactions of SW and HW using drivers. Students will learn the theory of the concept of operating system architecture with emphasis on the kernel architecture. Within the course, they will gain practical experience with the development of a small but fully functional operating system.			
NIE-PAM	Parameterized Algorithms	Z,ZK	4
There are many optimization problems for which no polynomial time algorithms are known (e.g. NP-complete problems). Despite that it is often necessary to solve these problems exactly in practice. We will demonstrate that many problems can be solved much more effectively than by naively trying all possible solutions. Often one can find a common property (parameter) of the inputs from practice-e.g., all solutions are relatively small. Parameterized algorithms exploit that by limiting the time complexity exponentially in this (small) parameter			

	and polynomially in the input size (which can be huge). Parameterized algorithms also represent a way to formalize the notion of effective polynomial time preprocessing of the input, which is not possible in the classical complexity. Such a polynomial time preprocessing is then a suitable first step, whatever is the subsequent solution method. We will present a plethora of parameterized algorithm design methods and we will also show how to prove that for some problem (and parameter) such an algorithm (presumably) does not exist. We will also not miss out the relations to other approaches to hard problems such as moderately exponential algorithms or approximation schemes.		
NIE-PDB	Advanced Database Systems	Z,ZK	5
	Students orient themselves in problems of evaluation and optimization of SQL queries. The next part of the course deals with new concepts of database machines (so called NoSQL databases), with the related new data models (XML, graph databases, column databases) and languages for working with them (XQuery, XPath, CYPHER, Gremlin). The last part of the course deals with performance evaluation of database machines. This course is equivalent to the course MIE-PDB.		
NIE-PDL	Practical Deep Learning	KZ	5
	This course is designed to provide students with a comprehensive understanding of Deep Learning using PyTorch, a popular open-source machine learning framework. Throughout the course, students will develop practical skills in building and training deep neural networks, using PyTorch to solve real-world problems in fields such as computer vision and natural language processing.		
NIE-PDP	Parallel and Distributed Programming	Z,ZK	6
	21st century in computer architectures is primarily influenced by the shift of the Moore's law into parallelization of CPUs at the level of computing cores. Parallel computing systems are becoming a ubiquitous commodity and parallel programming becomes the basic paradigm of development of efficient applications for these platforms. Students get acquainted with architectures of parallel and distributed computing systems, their models, theory of interconnection networks and collective communication operations, and languages and environments for parallel programming of shared and distributed memory computers. They get acquianted with fundamental parallel algorithms and on selected problems, they will learn the techniques of design of efficient and scalable parallel algorithms and methods of performance evaluation of their implementations. The course includes a semester project of practical programming in OpenMP and MPI for solving a particular nontrivial problem.		
NIE-PML	Personalized Machine Learning	Z,ZK	5
	Personalized machine learning (PML) is a sub-field of machine learning that aims to create models and predictions based on the unique characteristics and behaviors of individual entities. While PML is commonly used in applications such as recommender systems, which recommend items to users based on their personal interests, its principles can be applied to a wide range of other fields, including education, medicine, and chemical engineering. In this course, we will explore the latest PML methods from theoretical, algorithmic, and practical perspectives. Specifically, we will focus on cutting-edge models that are of interest to both the research and commercial communities.		
NIE-ROZ	Pattern Recognition	Z,ZK	5
	The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the statistical approach to pattern recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, and their numerical aspects.		
NIE-SCE1	Computer Engineering Seminar Master I	Z	4
	The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.		
NIE-SCE2	Computer Engineering Seminar Master II	Z	4
	The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.		
NIE-SEP	World Economy and Business	Z,ZK	4
	The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.		
NIE-SWE	Semantic Web and Knowledge Graphs	Z,ZK	5
	The students will learn the most recent concepts and technologies of the Semantic Web. The course will provide an overview of the Semantic Web technologies, methods and best practices for modelling, integration, publishing, querying and consumption of semantic data. The students will also gain skills in creation of knowledge graphs and their systematic quality assurance.		
NIE-SYP	Parsing and Compilers	Z,ZK	5
	The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.		
NIE-VPR	Research Project	Z	5
	1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester.		
NIE-VSM	Selected statistical Methods	Z,ZK	7
	Summary of probability theory; Multivariate normal distribution; Entropy and its application to coding; Statistical tests: T-tests, goodness of fit tests, independence test; Random processes - stacionarity; Markov chains and limiting properties; Queuing theory		
NIE-VYC	Computability	Z,ZK	4
	Classical theory of recursive functions and effective computability.		

For updated information see http://bilakniha.cvut.cz/en/FF.html
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