Study plan

Name of study plan: Bachelor specialization Management Informatics, in Czech, 2021

Faculty/Institute/Others:
Department: Department of Software Engineering
Branch of study guaranteed by the department:
Garantor of the study branch: prof. Ing. Róbert Lórencz, CSc.
Program of study: Informatics
Type of study: Bachelor full-time
Required credits: 148
Elective courses credits: 32
Sum of credits in the plan: 180
Note on the plan: Tato verze studijního plánu je určena pro ročníky, které byly přijaty ke studiu od akademického roku 2021/2022 do prezenční formy studia bakalářského programu. . Garant: Ing. Buchtela, David, Ph.D., email: David.Buchtela@fit.cvut.cz

---

Name of the block: Compulsory courses in the program
Minimal number of credits of the block: 106
The role of the block: PP

Code of the group: BI-PP.21
Name of the group: Compulsory Courses of Bachelor Study Program Informatics, presented in Czech, version 2021
Requirement credits in the group: In this group you have to gain 95 credits
Requirement courses in the group: In this group you have to complete 18 courses
Credits in the group: 95
Note on the group: If you plan to profile the specialization Information Security, Management Informatics, Computer Networks and Internet, Computer Systems and Virtualization, Software Engineering, or Web Engineering, enroll in the course BI-PSI.21 in your 2nd semester of study. If you plan to profile the specialization Computer Graphics, Computer Engineering, Computer Science, or Artificial Intelligence, enroll in the course BI-PSI.21 in your 4th semester of study. If you plan to profile yourself in the Artificial Intelligence specialization, enroll in the course BI-PST.21 in your 3rd semester of study. Otherwise, enroll in the course BI-PSI.21 in your 5th semester of study. If you plan to profile the specialization Artificial Intelligence or Web Engineering, enroll in the course BI-AAG.21 in your 5th semester of study. Otherwise, enroll in the course BI-PSI.21 in your 3rd semester of study.

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
BI-AG1.21	**Algorithms and Graphs 1** *Dušan Knop, Pavel Tvrdík, Jiřina Scholtzová, Ondřej Suchý* ***Pavel Tvrdík*** *Dušan Knop (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BI-AAG.21	**Automata and Grammars** *Jan Holub, Jan Janoušek* ***Jan Janoušek*** *Jan Holub (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BI-BAP.21	**Bachelor Thesis** ***Zdeněk Muzikář***	Z	14		L,Z	PP
BI-BPR.21	**Bachelor project** ***Zdeněk Muzikář***	Z	1		Z,L	PP
BI-DBS.21	**Database Systems** *Jiří Hunka, Michal Valenta* ***Jiří Hunka*** *Michal Valenta (Gar.)*	Z,ZK	5	2P+2R+1L	L	PP
BI-DML.21	**Discrete Mathematics and Logic** *Jan Spěvák, Daniel Dombek* ***Daniel Dombek*** *Jan Spěvák (Gar.)*	Z,ZK	5	2P+1R+1C	Z	PP
BI-KAB.21	**Cryptography and Security** ***Róbert Lórencz***	Z,ZK	5	2P+2C	L	PP
BI-LA1.21	**Linear Algebra 1** *Luděk Kleprlík, Karel Klouda* ***Karel Klouda*** *Karel Klouda (Gar.)*	Z,ZK	5	2P+1R+1C	Z	PP
BI-OSY.21	**Operating Systems** ***Pavel Tvrdík***	Z,ZK	5	2P+1R+1L	L	PP
BI-PSI.21	**Computer Networks** *Jan Fesl, Viktor Černý, Yelena Trofimova, Pavel Kubalík, Vladimír Smotlacha* ***Jan Fesl*** *Jan Fesl (Gar.)*	Z,ZK	5	2P+1R+1C	L	PP
BI-PST.21	**Probability and Statistics**	Z,ZK	5	2P+2C	Z	PP

BI-PA1.21	**Programming and Algorithmics 1** *Josef Vogel, Miroslav Balík, Ladislav Vagner, Jan Trávníček* ***Jan Trávníček*** *Jan Trávníček (Gar.)*	Z,ZK	7	2P+2R+2C	Z	PP
BI-PA2.21	**Programming and Algorithmics 2** *Jan Trávníček* ***Jan Trávníček*** *Jan Trávníček (Gar.)*	Z,ZK	7	2P+1R+2C	L	PP
BI-SAP.21	**Computer Structure and Architecture** *Hana Kubátová, Petr Fišer* ***Hana Kubátová*** *Hana Kubátová (Gar.)*	Z,ZK	5	2P+1R+2C	L	PP
BI-TZP.21	**Technological Fundamentals of Computers** *Martin Kohlík, Jaroslav Borecký, Martin Novotný, Jan Řezníček, Miroslav Skrbek, Robert Hülle* ***Martin Novotný*** *Martin Novotný (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BI-GIT.21	**SW Development Technologies** *Robin Obůrka, Petr Pulc* ***Robin Obůrka*** *Petr Pulc (Gar.)*	Z	3	2P	Z	PP
BI-TDP.21	**Documentation and Presentation** *Dana Vynikarová* ***Dana Vynikarová*** *Dana Vynikarová (Gar.)*	KZ	3	2P+2C	Z,L	PP
BI-UOS.21	**Unix-like Operating Systems** *Viktor Černý, Yelena Trofimova, Jiří Borský, Jiří Kašpar, Jan Trdlička, Zdeněk Muzikář, Jakub Žitný, Tomáš Vondra, Jakub Jančička, ...* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	KZ	5	2P+2C	Z	PP

Characteristics of the courses of this group of Study Plan: Code=BI-PP.21 Name=Compulsory Courses of Bachelor Study Program Informatics, presented in Czech, version 2021

BI-AG1.21	Algorithms and Graphs 1	Z,ZK	5

The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. Students learn techniques of proofs of correctness of algorithms and techniques of asymptotic mathematics for estimation of their complexity in the best, worse, or average case (the course includes basics from probability theory needed for understanding randomized algorithms). Within exercises students learn applications of studied algorithms for solving practical problems.

BI-AAG.21	Automata and Grammars	Z,ZK	5

Students are introduced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite automata, regular expressions, and regular grammars, context-free grammars, construction and use of pushdown automata, and translation grammars and transducers. They know the hierarchy of formal languages and they understand the relationships between formal languages and automata. They are introduced to the Turing machine and complexity classes P and NP.

BI-BAP.21	Bachelor Thesis	Z	14
BI-BPR.21	Bachelor project	Z	1

1. At the beginning of the semester, the student reserves the topic of the bachelor's thesis and connects with the supervisor. He / she will arrange the partial tasks that he / she will perform during the semester to process the assignment. If he completes these tasks, the supervisor will award him a credit from the subject BI-BPR 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 will be handed over by the student to the head of the Department of Defense, who will record the credit in KOS. 3. If the topic of the work that the student has reserved is formulated more generally, the tasks assigned to him by the supervisor for the semester should be aimed primarily at fine-tuning the assignment so that the assignment can be supplemented and approved at the end of the semester.

BI-DBS.21	Database Systems	Z,ZK	5

Students are introduced to the database engine architecture and typical user roles. They are briefly introduced to various database models. They learn to design small databases (including integrity constraints) using a conceptual model and implement them in a relational database engine. They get a hands-on experience with the SQL language, as well as with its theoretical foundation - the relational database model. They learn the principles of normalizing a relational database schema. They understand the fundamental concepts of transaction processing, controlling parallel user access to a single data source, as well as recovering a database engine from a failure. They are briefly introduced to special ways of storing data in relational databases with respect to speed of access to large quantities of data. This introductory-level course does not cover: Administration of database systems, debugging and optimizing database applications, distributed database systems, data stores.

BI-DML.21	Discrete Mathematics and Logic	Z,ZK	5

Students will get acquainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from set theory will be explained. Special attention is paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The course also lays down the basics of combinatorics and number theory, with emphasis on modular arithmetics.

BI-KAB.21	Cryptography and Security	Z,ZK	5

Students will understand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to use cryptographic keys and certificates in systems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in applications. Finally, students get acquainted with the basics of information security. Within labs, students will gain practical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procedures of cryptanalysis.

BI-LA1.21	Linear Algebra 1	Z,ZK	5

We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a matrix. We will also demonstrate some applications of these concepts in computer science.

BI-OSY.21	Operating Systems	Z,ZK	5

In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems, OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows.

BI-PSI.21	Computer Networks	Z,ZK	5

The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS.

BI-PST.21	Probability and Statistics	Z,ZK	5

Students will learn the basics of probabilistic thinking, the ability to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables.

BI-PA1.21	Programming and Algorithmics 1	Z,ZK	7

Students gain the ability to formulate algorithms for solving basic problems and write them in the C language. They understand data types (simple, structured, pointers), expressions, statements, functions, concept of recursion. They learn to analyse simple cases of algorithm complexity. They know fundamental algorithms for searching, sorting, and manipulating with linked lists and trees.

BI-PA2.21	Programming and Algorithmics 2	Z,ZK	7
Students know the instruments of object-oriented programming and are able to use them for specifying and implementing abstract data types (stack, queue, enlargeable array, list, set, table). They learn these skills using the C++ programming language and are introduced to all C++ features needed in object-oriented programming (e.g., template programming, copying/moving of objects, operator overloading, inheritance, polymorphism).			
BI-SAP.21	Computer Structure and Architecture	Z,ZK	5
Students will get acquainted with the basic architecture and units of a digital computer, understand the structure, function, and implementation of arithmetic-logic unit , controllers, memory, I/O communication, methods of data transfers between the units. The logic design and the implementation of a program-controlled simple processor is practically implemented in the labs using programmable circuits (FPGA), a single-chip microcomputer, and modern design (EDA) tools.			
BI-TZP.21	Technological Fundamentals of Computers	Z,ZK	5
Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica.			
BI-GIT.21	SW Development Technologies	Z	3
This course is aimed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to Git, the information manager from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use.			
BI-TDP.21	Documentation and Presentation	KZ	3
The course is focused on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically final university theses. Students learn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically present it in front of classmates and the teacher. The course is intended primarily for those students who have chosen the topic of their bachelor's thesis or will choose it within the first 14 days of teaching. Within the exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed.			
BI-UOS.21	Unix-like Operating Systems	KZ	5
Unix-like operating systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative functions of multiuser operating systems for computers and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properties of this OS family, such as processes and threads, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of advanced users who are not only able to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting interface, called shell.			

Code of the group: BI_ZMA-MA1-MA2.21
Name of the group: Compulsory subject in Module of Bachelor Study Program Informatics Elements of Calculus, in Czech
Requirement credits in the group: In this group you have to gain 11 credits
Requirement courses in the group: In this group you have to complete 2 courses
Credits in the group: 11
Note on the group: Tato skupina je určená pro studijní plány BI-xxx.2021. Skupinu lze splnit dvojicemi předmětů MA1+MA2, nebo ZMA+MA2. Předmět ZMA je zde uveden kvůli opakovačům, kterým byl přiřazený nový studijní plán. Předmět ZMA bude naposledy vyučován v semestru B211.

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**
BI-MA1.21	**Mathematical Analysis 1** *Tomáš Kalvoda* ***Tomáš Kalvoda*** *Tomáš Kalvoda (Gar.)*	Z,ZK	5	2P+1R+1C	L	PP
BI-MA2.21	**Mathematical Analysis 2** ***Tomáš Kalvoda***	Z,ZK	6	3P+2C	Z	PP
BI-ZMA	**Elements of Calculus** *Tomáš Kalvoda, Ivo Petr Tomáš Kalvoda (Gar.)*	Z,ZK	6	3P+2C	Z	PP

Characteristics of the courses of this group of Study Plan: Code=BI_ZMA-MA1-MA2.21 Name=Compulsory subject in Module of Bachelor Study Program Informatics Elements of Calculus, in Czech

BI-MA1.21	Mathematical Analysis 1	Z,ZK	5
We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newton's method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landau's asymptotic notation and methods of mathematical description of complexity of algorithms.			
BI-MA2.21	Mathematical Analysis 2	Z,ZK	6
The course completes the theme of analysis of real functions of a real variable initiated in BI-MA1 by introducing the Riemann integral. Students will learn how to integrate by parts and use the substitution method.The next part of the course is devoted to number series, and Taylor polynomials and series. We apply Taylor's theorem to the computation of elementary functions with a prescribed accuracy. Then we study the linear recurrence equations with constant coefficients, the complexity of recursive algorithms, and its analysis using the Master theorem. Finally, we introduce the student to the theory of multivariate functions. After establishing basic concepts of partial derivative, gradient, and Hessian matrix, we study the analytical method of localization of local extrema of multivariate functions as well as the numerical descent method. We conclude the course with the integration of multivariate functions. This course can be enrolled only after successful completion of the course BI-MA1, which can be replaced by the course BI-ZMA in the case of repetitive students.			
BI-ZMA	Elements of Calculus	Z,ZK	6
Students acquire knowledge and understanding of the fundamentals of classical calculus so that they are able to apply mathematical way of thinking and reasoning and are able to use basic proof techniques. They get skills to practically handle functions of one variable in solving the problems in informatics. They understand the links between the integrals and sums of sequences. They are able to estimate lower or upper bounds of values of real functions and to handle simple asymptotic expressions.			

Name of the block: Povinné předměty specializace
Minimal number of credits of the block: 40
The role of the block: PS

Code of the group: BI-PS-MI.21
Name of the group: Compulsory courses of specialization Management Informatics, version 2021
Requirement credits in the group: In this group you have to gain 40 credits
Requirement courses in the group: In this group you have to complete 8 courses
Credits in the group: 40
Note on the group: Guarantor: Ing. David Buchtela, Ph.D., email: David.Buchtela@fit.cvut.cz

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
BI-EPP.21	**Economic Business Processes** ***David Buchtela***	Z,ZK	5	2P+2C	L	PS
BI-FBI.21	**Financial Business Intelligence** ***David Buchtela***	Z,ZK	5	2P+2C	L	PS
BI-KOM.21	**Conceptual Modelling** ***Robert Pergl***	Z,ZK	5	2P+2C	Z	PS
BI-PAI.21	**Law and Informatics**	ZK	5	2P+2C	L	PS
BI-PRR.21	**Project management** *David Pešek* ***David Pešek*** *David Pešek (Gar.)*	Z,ZK	5	2P+2C	Z	PS
BI-SWI.21	**Software Engineering**	Z,ZK	5	2P+1C	L	PS
BI-SP1.21	**Team Software Project 1**	KZ	5	2C	L	PS
BI-TIS.21	**Information Systems**	Z,ZK	5	2P+2C	Z	PS
BI-FEM.21	**Fundamentals of Economics**	Z,ZK	5	2P+2C	Z	PS

Characteristics of the courses of this group of Study Plan: Code=BI-PS-MI.21 Name=Compulsory courses of specialization Management Informatics, version 2021

BI-EPP.21	Economic Business Processes	Z,ZK	5

The aim of the course is to present typical processes related to the usual life cycle of a company. The course focuses mainly on the basic economic and financial aspects of business in the market environment of the Czech Republic and the basics of management. In the course, students are acquainted with the typical phases of the company's life cycle, from the establishment of the company, through the management of property and capital structure, financing of the company, determining the cost function of the company and labor costs, to evaluating the financial health of the company and its eventual rehabilitation or termination.

BI-FBI.21	Financial Business Intelligence	Z,ZK	5

The aim of the course is to acquaint students primarily with financial accounting as a tool for recording business operations and documents for business analysis, determining its value and other indicators for comparison with other companies and management decision process at the tactical and strategic level. The second view is management accounting as a tool for financial management and prediction of business development. Management accounting allows monitoring of the financial status and performance of business activities over several accounting periods, enables a multidimensional view of business data, enables to control effectively factors affecting the return on invested capital and to use value information to assess options related to future business decisions. The principles of management accounting, described in this course, are the basis of Business Intelligence modules in business information systems, decision support systems, and other knowledge-oriented systems.

BI-KOM.21	Conceptual Modelling	Z,ZK	5

The course is focused on developing abstract thinking and precise formulation skills using conceptual models. Students learn skills of discerning key terms in a domain, the ability to categorize and specify correct relations in complex systems of social reality, mostly enterprises and institutions. Students learn basics of ontological structural modeling in the OntoUML notation. Next, they learn how to express business rules and constraints using the OCL language and foundations of OWL/RDF semantic data representation in the Internet. They also learn the foundations of enterprise engineering, being a discipline for conceptual modelling of enterprises and institutes and their processes. The DEMO method and the BPMN notation will be taught. The course is designed with the respect to continuation in software implementations. Recommended optional follow-up course: BI-ZPI.

BI-PAI.21	Law and Informatics	ZK	5

The aim of the course is to introduce students into the basic legal instruments that they will encounter in their practice. Students will gain knowledge of doing business in the Czech Republic and will be alerted to the pitfalls that await them in business from the point of view of law. They will understand the process of concluding contracts in real and Internet environment, will know their responsibilities in working with the Internet, will be familiar with the institutes of intellectual property law, and will be able to use commercial license types and open-source licenses. Emphasis will also be put on the legal protection of data on the Internet, the registration of Internet domains and protection against their misuse. Students will also be alerted to such behaviour in the field of IT that can be classified as criminal under the Czech law. The course will also include analyses of real cases from practice.

BI-PRR.21	Project management	Z,ZK	5

The aim of the course is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, analysis, crisis management in a project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk assessment and management, Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for students who are interested in deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in large companies. The course is also suitable for all those who will develop software or hardware in the form of team projects.

BI-SWI.21	Software Engineering	Z,ZK	5

Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development.

BI-SP1.21	Team Software Project 1	KZ	5

Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course.

BI-TIS.21	Information Systems	Z,ZK	5
The goal of this course is to familiarise students with the information systems topic and information systems implementation principles. During the course, students are introduced to "on the market" existing types of systems and their usage in specific industry segments. Students are familiarised with the CRM, ERP, MRP and other types of information systems. The fundamental part of the course is the introduction to key ideas of an information system selection, evaluation of information system benefits, ways of information systems implementation and information system implementation based on the project management principles. The emphasis is on the initial customer analysis, customer insight and ability to decide whether it is better to implement any existing information system or to develop a new one from scratch. These factors determine the information system implementation success. At the end of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems topics are discussed.			
BI-FEM.21	Fundamentals of Economics	Z,ZK	5
The course allows the students to discover basics of economic theory, which will then be used in subsequent courses of economics and management. It contains a general overview of fundamental microeconomic and macroeconomic topics.			

Name of the block: Povinná zkouška z angličtiny
Minimal number of credits of the block: 2
The role of the block: PJ

Code of the group: BI-ZKA.21
Name of the group: English Language Exam
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 4)
Requirement courses in the group: In this group you have to complete 1 course
Credits in the group: 2
Note on the group: BI-ANG, ending with an exam for two credits, is enrolled by students who have completed preparator English courses and have a credit from the BI-A2L course.
 --
 BI-ANG1, ending with an exam for two credits, is enrolled by students who prepared for the exam independently and do not have credit from BI-A2L. These students must complete a credit paper before their own exam. After passing the exam, the student will also be recognized for the course BI-ANGS (Independent preparation for the English exam) for 2 credits.
 --
 The BIE-ECC course can be recognized for any active semester after the submission of a external certificate at the level of at least B2 according to the Common European Framework of Reference.

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
BIE-EEC	**English external certificate** *Zdeněk Muzikář **Miroslav Balík** Zdeněk Muzikář (Gar.)*	Z	4		L	PJ
BI-ANG1	**English Language Examination without Preparatory Courses** *Kateřina Valentová **Kateřina Valentová** Kateřina Valentová (Gar.)*	Z,ZK	2		L	PJ
BI-ANG	**English Language, Internal Certificate** *Kateřina Valentová **Kateřina Valentová** Kateřina Valentová (Gar.)*	ZK	2		Z,L	PJ

Characteristics of the courses of this group of Study Plan: Code=BI-ZKA.21 Name=English Language Exam

BIE-EEC	English external certificate	Z	4
The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages.			
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2
BI-ANG	English Language, Internal Certificate	ZK	2
Course information and teaching materials can be found at https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG			

Name of the block: Povinná tělesná výchova, sportovní kurzy
Minimal number of credits of the block: 0
The role of the block: PT

Code of the group: BI-PT.21
Name of the group: Compulsory Physical Education, version 2021
Requirement credits in the group:
Requirement courses in the group: In this group you have to complete at least 2 courses (at most 6)
Credits in the group: 0
Note on the group: Guarantor: prof. Ing. Róbert Lórencz, CSc., email: robert.lorencz@fit.cvut.cz

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
TV1	**Physical Education**	Z	0	0+2	Z	PT
TVV	**Physical education**	Z	0	0+2	Z,L	PT
TVV0	**Physical education**	Z	0	0+2	Z,L	PT

TV2	**Physical Education**	Z	0	0+2	L	PT
TVKLV	**Physical Education Course**	Z	0	7dní	L	PT
TVKZV	**Physical Education Course**	Z	0	7dní	Z	PT

Characteristics of the courses of this group of Study Plan: Code=BI-PT.21 Name=Compulsory Physical Education, version 2021

TV1	Physical Education	Z	0
TVV	Physical education	Z	0
TVV0	Physical education	Z	0
TV2	Physical Education	Z	0
TVKLV	Physical Education Course	Z	0
TVKZV	Physical Education Course	Z	0

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

Code of the group: BI-MI-VO.21
Name of the group: Elective Vocational Courses for a Bachelor Specialization BI-MI.21, version 2021
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group: Guarantor: Ing. David Buchtela, Ph.D., email: David.Buchtela@fit.cvut.cz

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
BI-ADU.21	**Unix Administration** ***Zdeněk Muzikář***	Z,ZK	5	2P+2C	L	V
BI-AWD.21	**Web and Database Server Administration** ***Michal Valenta***	Z,ZK	5	2P+2C	Z	V
BI-AG2.21	**Algorithms and Graphs 2** ***Ondřej Suchý***	Z,ZK	5	2P+2C	L	V
BI-ASB.21	**Applied Network Security** ***Jiří Dostál***	Z,ZK	5	2P+2C	Z	V
BI-APS.21	**Architectures of Computer Systems**	Z,ZK	5	2P+2C	Z	V
BI-BEK.21	**Secure Code** ***Róbert Lórencz***	Z,ZK	5	2P+2C	L	V
BI-BIG.21	**DB Technologies for Big Data**	KZ	5	2P+2C	L	V
BI-EHA.21	**Ethical Hacking** ***Jiří Dostál***	Z,ZK	5	2P+2C	L	V
BI-HWB.21	**Hardware Security**	Z,ZK	5	2P+2C	Z	V
BI-IOT.21	**Internet of Things**	Z,ZK	5	2P+2C	Z	V
BI-JPO.21	**Computer Units** ***Pavel Kubalík***	Z,ZK	5	2P+2C	Z	V
BI-LA2.21	**Linear Algebra 2** *Karel Klouda* ***Karel Klouda*** *Karel Klouda (Gar.)*	Z,ZK	5	2P+2C	L	V
BI-LOG.21	**Mathematical Logic** ***Kateřina Trlifajová***	Z,ZK	5	2P+2C	Z	V
BI-MPP.21	**Methods of interfacing peripheral devices** ***Miroslav Skrbek***	Z,ZK	5	2P+2C	Z	V
BI-MDF.21	**Modern Data Formats** *Jakub Klímek* ***Jakub Klímek*** *Jakub Klímek (Gar.)*	KZ	3	1P+1C	Z	V
BI-MVT.21	**Modern Visualisation Technologies** *Petr Pauš, Jiří Chludil* ***Petr Pauš*** *Petr Pauš (Gar.)*	Z,ZK	5	2P+2C	Z	V
BI-MGA.21	**Multimedia and Graphics Applications**	Z,ZK	5	2P+2C	Z	V
BI-OOP.21	**Object-Oriented Programming**	Z,ZK	5	2P+2C	Z	V
BI-PGR.21	**Computer graphics programming** *Petr Felkel, Jaroslav Sloup* ***Jaroslav Sloup*** *Petr Felkel (Gar.)*	Z,ZK	5	2P+2C	L	V
BI-PRS.21	**Practical Statistics**	KZ	5	1P+2C	L	V
BI-PNO.21	**Practical Digital Design** ***Martin Novotný***	KZ	5	2P+2C	Z	V
BI-PJP.21	**Programming Languages and Compilers** ***Jan Janoušek***	Z,ZK	5	2P+1C	L	V
BI-PPA.21	**Programming Paradigms** ***Jan Janoušek***	Z,ZK	5	2P+2C	Z	V

BI-PGA.21	**Programming of Graphic Applications** ***Radek Richtr***	Z,ZK	5	2P+2C	Z	v
BI-PJS.21	**JavaScript Programming**	KZ	5	2P+2C	L	v
BI-PYT.21	**Python Programming** *Jiří Hanuš, Valeriia Iegorova, Jan Lukány, Vojtěch Vančura* ***Martin Šlapák*** *Vojtěch Vančura (Gar.)*	KZ	5	3C	Z	v
BI-SIP.21	**Network Programming** ***Jan Fesl***	Z	5	2P+2C	Z	v
BI-SP2.21	**Team Software Project 2**	KZ	5	2C	Z	v
BI-SPS.21	**Administration of Computer Networks and Services** ***Dana Čermáková***	Z,ZK	5	2P+2S	Z	v
BI-ML1.21	**Machine Learning 1** ***Daniel Vašata***	Z,ZK	5	2P+2C	Z	v
BI-ML2.21	**Machine Learning 2** ***Daniel Vašata***	Z,ZK	5	2P+2C	L	v
BI-SVZ.21	**Machine vision and image processing** ***Marcel Jiřina***	Z,ZK	5	2P+2C	L,Z	v
BI-SRC.21	**Real-time systems** ***Jaroslav Borecký***	Z,ZK	5	2P+2C	Z	v
BI-TAB.21	**Applications of Security in Technology** ***Jiří Dostál***	Z,ZK	5	2P+2C	L	v
BI-TJV.21	**Java Technology**	Z,ZK	5	2P+2C	Z	v
BI-TPS.21	**Computer Networks Technologies** ***Vladimír Smotlacha***	Z,ZK	5	2P+2S	Z	v
BI-TUR.21	**User Interface Design**	Z,ZK	5	2P+2C	L	v
BI-TWA.21	**Design of Web Applications** ***David Bernhauer***	Z,ZK	5	2P+2C	Z	v
BI-IDO.21	**Introduction to DevOps** ***Tomáš Vondra***	Z,ZK	5	2P+2C	Z	v
BI-UKB.21	**Introduction to Cybersecurity**	Z,ZK	5	3P+1C	Z	v
BI-VES.21	**Embedded Systems** ***Miroslav Skrbek***	Z,ZK	5	2P+2C	L	v
BI-VDC.21	**Virtualization and Data Centers** ***Jiří Kašpar***	Z,ZK	5	2P+2C	L	v
BI-VIZ.21	**Data Visualization** ***Magda Friedjungová***	KZ	5	2P+2C	Z	v
BI-VPS.21	**Selected Topics in Computer Networking** ***Pavel Tvrdík***	Z,ZK	5	2P+2C	L	v
BI-VWM.21	**Searching the Web and Multimedia Databases** *Tomáš Skopal, Jiří Novák* ***Jiří Novák*** *Tomáš Skopal (Gar.)*	Z,ZK	5	2P+1C	L	v
BI-ZRS.21	**Basics of System Control** ***Kateřina Hyniová***	Z,ZK	5	2P+2C	Z	v
BI-ZSB.21	**Basics of System Security**	Z,ZK	5	2P+2C	Z	v
BI-ZUM.21	**Artificial Intelligence Fundamentals** ***Pavel Surynek***	Z,ZK	5	2P+2C	L	v

Characteristics of the courses of this group of Study Plan: Code=BI-MI-VO.21 Name=Elective Vocational Courses for a Bachelor Specialization BI-MI.21, version 2021

BI-ADU.21	Unix Administration	Z,ZK	5

Students will learn the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They will understand the differences between user and administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights, file systems, disk subsystems, processes, memory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the knowledge from the lectures on specific examples from practice.

BI-AWD.21	Web and Database Server Administration	Z,ZK	5

Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server.

BI-AG2.21	Algorithms and Graphs 2	Z,ZK	5

This course, presented in Czech, introduces basic algorithms and concepts of graph theory as a follow=up on the introduction given in the compulsory course BI-AG1.21. It further delves into advances data structures and amortized complexity analysis. It also includes a very light introduction to approximation algorithms. For English version of the course see BIE-AG2.21.

BI-ASB.21	Applied Network Security	Z,ZK	5

The aim of the course is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gained in course BI-PSI with actual security applications like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing the course student will get knowledge of security applications in computer networks.

BI-APS.21	Architectures of Computer Systems	Z,ZK	5

Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction processing not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such systems.

BI-BEK.21	Secure Code	Z,ZK	5
The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them.			
BI-BIG.21	DB Technologies for Big Data	KZ	5
Students will be introduced into the field of Big Data processing where nonrelational (NoSQL) database engines are typically used today. The course is focused practically so that after finishing the course students were able to choose suitable tools (mostly open source) and techniques,design and implement a simplest reproducible method of data processing (data collection, transformation/aggregation, presentation). Students get acquainted with various architectures for processing and storing big data. A theoretical foundation and presentation of individual technologies will be supplemented with specific case studies.			
BI-EHA.21	Ethical Hacking	Z,ZK	5
The goal of the course is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnerabilities, and their possible exploitation in computer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is on hands-on experience with vulnerabilities testing and the following process of penetration test documentation.			
BI-HWB.21	Hardware Security	Z,ZK	5
The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers.			
BI-IOT.21	Internet of Things	Z,ZK	5
The course focuses on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS).			
BI-JPO.21	Computer Units	Z,ZK	5
Students deepen their basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detail with the internal structure and organization of computer units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using appropriate codes for implementation of multiplication. The organization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, including codes for error detection and correction for parallel and serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of communication of the processor with the environment and the architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational microprogrammed processor simulator and programmable hardware design kits (FPGA).			
BI-LA2.21	Linear Algebra 2	Z,ZK	5
1. Vektorové prostory. 2. Skalární součin, norma vektoru, ortogonalita. 3. Snalytická geometrie. 4. Lineární zobrazení 5. Matice lineárního zobrazení. 6. [2] Afinní transformace, homogenní souřadnice, projekce a operace v 3D prostoru jako lineární zobrazení. 8. Řešení soustav lineárních rovnic. 9. [2] Maticové rozklady (metody LU, SVD, QR) a jejich výpočet. 11. Metoda nejmenších čtverců. 12. Lineární programování. 13. Rekurentní rovnice.			
BI-LOG.21	Mathematical Logic	Z,ZK	5
The course focuses on the basics of propositional and predicate logic. It starts from the semantic point of view. Based on the notion of truth, satisfiability, logical equivalence, and the logical consequence of formulas are defined. Methods for determining the satisfiability of formulas, some of which are used for automated proving, are explained. This relates to the P vs. NP problem and Boolean functions in propositional logic. In predicate logic, the course further deals with formal theories, such as arithmetics, and their models. The syntactic approach to mathematical logic is demonstrated on the axiomatic system of propositional logic and its properties. Gödel's incompleteness theorems is explained.			
BI-MPP.21	Methods of interfacing peripheral devices	Z,ZK	5
The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices.			
BI-MDF.21	Modern Data Formats	KZ	3
The goal of the course is to give an overview of commonly used data formats for typical types of data. There will be a description of each data type and the data formats used for that data type along with tools available to work with such data. After finishing the course, the students should know how to work with common data, e.g. on the Web.			
BI-MVT.21	Modern Visualisation Technologies	Z,ZK	5
The goal of the course is to give an overview of modern visualization technologies and their principles, namely technologies related to virtual and augmented reality, visualization on high resolution displays (e.g., SAGE and video mapping) and their applications in practice. Several lectures deal with the content creation for the mentioned technologies, namely fractal and procedural visualization, scientific data visualization, and 3D model scanning.			
BI-MGA.21	Multimedia and Graphics Applications	Z,ZK	5
Students get acquainted with multimedia technologies and applications for 2D/3D bitmap and vector graphics. During the course, current tools for working with images, videos, 3D graphics and animation will be introduced. Students learn several basic techniques of creation and editing content in computer graphics, introduction to graphic formats, and compression technologies. They learn to use multimedia transmission and representation systems, including real-time multimedia processing. They understand the principle of operation and use of graphics processing cards. They gain a number of practical skills, such as vectorizing raster images, retouching photos, or creating 3D models.			
BI-OOP.21	Object-Oriented Programming	Z,ZK	5
Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handing, refactoring, and application of design pattern.			
BI-PGR.21	Computer graphics programming	Z,ZK	5
After attending this curse, students can program a simple interactive 3D graphical application like a computer game or scientific visualization, design the scene, add textures imitating geometric details and materials (like wall surface, wood, sky), and set up the lighting. At the same time, they understand the fundamental principles and terms used in computer graphics, such as graphical pipeline, geometric transformations, or lighting model. They gain knowledge allowing orientation in computer graphics and representing solid fundamentals for your professional development, e.g., GPU programming and animations. They get used to techniques utilized in geometric modeling, modeling curves and surfaces, and scientific visualization.			
BI-PRS.21	Practical Statistics	KZ	5
The students will be introduced to methods of applied statistics. They will learn how to work with various types of data, perform analyses, and choose models fitting the data. The course will encompass regression and correlation analysis, analysis of variance and non-parametric methods. Students will learn to use the statistical software R and will apply the studied methods on data from real problems.			
BI-PNO.21	Practical Digital Design	KZ	5
Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the basics of the VHDL language and implementation technologies FPGA and ASIC. Students demonstrate practical use of the design techniques in the course project using modern industry-standard CAD design tools.			

BI-PJP.21	Programming Languages and Compilers	Z,ZK	5
Students learn basic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers GNU and LLVM. They learn to create a specification of a translation of a text that conforms a given syntax, to a target code and also to create a compiler based on the specification. The compiler can translate not only a programming language but any text in a language generated by a given LL input grammar.			
BI-PPA.21	Programming Paradigms	Z,ZK	5
The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and disadvantages of particular approaches. Functional programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. The principles are demonstrated on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstream programming languages such as C++ and Java.			
BI-PGA.21	Programming of Graphic Applications	Z,ZK	5
The course will present the possibilities of current professional open-source tools for image editing, video editing, 3D animation (GIMP, Blender) and their use for visualization of specific data (3D scenes, mathematical data). Emphasis will be placed on the possibilities of further enhancement of the presented software tools, both using built-in scripting languages and by implementation of plugins.			
BI-PJS.21	JavaScript Programming	KZ	5
The course is an introduction to Javascript programming. Students will also learn best practices and get acquai nted with tools that make code development in Javascript easier.			
BI-PYT.21	Python Programming	KZ	5
The aim of the course is to get acquainted with basic efficient control and data structures of the Python programming language for text and binary data processing. The differences between philosophy of programming in Python and in other programming languages will be explained. Each topic is prepared for students in the format of a Jupyter notebook, which enables greater accent to individual student work. Before each lab, students pass a short test on the last week topic. Four homeworks plus a semester work will be assigned during the semester.			
BI-SIP.21	Network Programming	Z	5
The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment.			
BI-SP2.21	Team Software Project 2	KZ	5
Students gain hands-on experience with the iterative development process while working on a large-scale software project. The first iteration is the result of the BIE-SP1 course project. However, in this follow-up, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will work in teams of 4-6 people. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) the formal as well as material aspects of their solution.			
BI-SPS.21	Administration of Computer Networks and Services	Z,ZK	5
The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure.			
BI-ML1.21	Machine Learning 1	Z,ZK	5
The goal of this course is to introduce students to the basic methods of machine learning. They get theoretical understanding and practical working knowledge of regression and classification models in the supervised learning scenario and clustering models in the unsupervised scenario. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Moreover, they learn the basic techniques of data preprocessing and multidimensional data visualization. In practical demonstrations, pandas and scikit libraries in Python will be used.			
BI-ML2.21	Machine Learning 2	Z,ZK	5
The goal of this course is to introduce students to the selected advanced methods of machine learning. In the supervised learning scenario, they, in particular, learn kernel methods and neural networks. In the unsupervised learning scenario students learn the principal component analysis and other dimensionality reduction methods. Moreover, students get the basic principles of reinforcement learning and natural language processing.			
BI-SVZ.21	Machine vision and image processing	Z,ZK	5
Camera systems are becoming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluate image information. The course introduces students to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical use of camera systems for solving problems of practice that the graduates may encounter.			
BI-SRC.21	Real-time systems	Z,ZK	5
Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues. Theoretical knowledge from lectures will be experimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are the same as in the BIE-VES course.			
BI-TAB.21	Applications of Security in Technology	Z,ZK	5
The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students get a broader overview of cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security.			
BI-TJV.21	Java Technology	Z,ZK	5
The goal is to provide knowledge and skills for developing information systems and applications through concepts used in software development and experience with libraries and tools from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.			
BI-TPS.21	Computer Networks Technologies	Z,ZK	5
The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks.			
BI-TUR.21	User Interface Design	Z,ZK	5
Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them.			
BI-TWA.21	Design of Web Applications	Z,ZK	5
The basic course of web application development. Initially, the students become familiar with HTTP and its possibilities and partly with some properties of language describing the structure (HTML) and presentation of document on the Web (CSS). These skills provide the necessary basis for the development of Web applications, which will be demonstrated in modern libraries facilitate the development of Web pages applications. Server side will be demonstrated on PHP technology using frameworks Symfony 2, Doctrine 2. Developments on the client side will be demonstrated using a JavaScript language with library jQuery and possibly MV* framework AngularJS.			

BI-IDO.21	Introduction to DevOps	Z,ZK	5
The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice.			
BI-UKB.21	Introduction to Cybersecurity	Z,ZK	5
The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations.			
BI-VES.21	Embedded Systems	Z,ZK	5
Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.			
BI-VDC.21	Virtualization and Data Centers	Z,ZK	5
The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses.			
BI-VIZ.21	Data Visualization	KZ	5
The goal of the course is to introduce students to the area of data visualization, its basic principles and methods. The course offers an overview of the types and characteristics of data as well as suitable visualization methods. This will aid the students in understanding data, their content and their application in areas such as data mining, machine learning, and business intelligence. Within the course, students will be introduced to exploratory data analysis, preprocessing, dimensionality reduction, and ways of visualizing different kinds of data such as text or geospatial. A part of the course is also dedicated to the area of business intelligence and different visualization tools, which students often encounter in the commercial sphere. During labs, students will get hands-on experience in applications of selected methods to real-world examples.			
BI-VPS.21	Selected Topics in Computer Networking	Z,ZK	5
The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security.			
BI-VWM.21	Searching the Web and Multimedia Databases	Z,ZK	5
Students get basic overview about search techniques in the web environment that is interpreted as a very large distributed and heterogeneous storage of documents. In particular, students acquire information about search techniques in text and hypertext documents (the web pages themselves) and about feature extraction from web pages. They get detailed knowledge of similarity search in multimedia databases (generally in collections of unstructured data). They also learn techniques for programming web search engines for the mentioned data types (documents).			
BI-ZRS.21	Basics of System Control	Z,ZK	5
The course gives an introduction to the field of automatic control. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems, description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD, and fuzzy controllers. Students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementation of continuous and digital controllers and PLC control.			
BI-ZSB.21	Basics of System Security	Z,ZK	5
The goal of the course is to provide introduction to basic concepts in security of computer systems. Further, the course introduces the basics of forensic analysis and related topics such as malware analysis or incident response. After finishing the course student will get both theoretical and practical knowledge in the area of modern operating systems security, as well as skills needed for independent work in the area of operating system security incident analysis.			
BI-ZUM.21	Artificial Intelligence Fundamentals	Z,ZK	5
Basic course on introduction to artificial intelligence with emphasis on symbolic techniques. The design of an intelligent agent and the techniques needed to create it will be discussed, especially at the decision-making level. The intelligent agent in the context of the course can be represented for example by a physical robot, but also by a non-physical entity, such as a virtual assistant or a character in a computer game. We will not only introduce the basics, but also show the current state-of-the-art during the course.			

Code of the group: BI-V.21
Name of the group: Purely Elective Courses of Bachelor Programme BI, Version 2021
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group: Guarantor: prof. Ing. Róbert Lórencz, CSc., email: robert.lorencz@fit.cvut.cz

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
BI-ALO	**Algebra and Logic** *Jan Starý* ***Jan Starý*** *Jan Starý (Gar.)*	Z,ZK	4	2P+1C	L	v
BI-AVI.21	**Algorithms visually** *Luděk Kučera* ***Luděk Kučera*** *Luděk Kučera (Gar.)*	Z,ZK	4	2P+1C	*	v
BI-A2L	**English language, preparation for the B2 level exam** *Kateřina Valentová* ***Kateřina Valentová*** *Kateřina Valentová (Gar.)*	Z	2	2C	L	v
BI-APJ	**Aplication Programming in Java** ***Michal Valenta***	Z,ZK	4	2P+1R+1C	Z	v
MI-AFP	**Applied Functional Programming** ***Robert Pergl***	KZ	5	2P+1C	L	v
BIE-ZUM	**Artificial Intelligence Fundamentals** *Pavel Surynek Pavel Surynek (Gar.)*	Z,ZK	4	2P+2C	L	v
BI-BLE	**Blender** *Lukáš Bařinka* ***Lukáš Bařinka*** *Lukáš Bařinka (Gar.)*	Z,ZK	4	2P+2C	L	v

NI-DSP	**Database Systems in Practes** ***Michal Valenta***	Z,ZK	4	2P+1C	L	v
BI-STO	**Storage and Filesystems** *Jiří Kašpar Jiří Kašpar (Gar.)*	Z,ZK	4	2P+2C	L,Z	v
MI-DZO	**Digital Image Processing** ***Daniel Sýkora***	Z,ZK	4	2P+1C	L	v
NI-DZO	**Digital Image Processing** *Daniel Sýkora* ***Daniel Sýkora*** *Daniel Sýkora (Gar.)*	Z,ZK	4	2P+1C	L	v
MI-DDM	**Distributed Data Mining**	KZ	4	3C	L	v
NI-DDM	**Distributed Data Mining**	KZ	4	3C	L	v
BI-EP1	**Effective programming 1** *Martin Kačer* ***Martin Kačer*** *Martin Kačer (Gar.)*	Z	4	2P+2C	Z	v
BI-EP2	**Efficient Programming 2** *Martin Kačer* ***Martin Kačer*** *Martin Kačer (Gar.)*	KZ	4	2P+2C	L	v
BI-EJA	**Enterprise Java** *Jiří Daněček Jiří Daněček (Gar.)*	Z,ZK	4	2P+2C	L	v
BI-EHA.21	**Ethical Hacking** ***Jiří Dostál***	Z,ZK	5	2P+2C	L	v
BI-FMU	**Financial and Management Accounting** *David Buchtela* ***David Buchtela*** *David Buchtela (Gar.)*	Z,ZK	5	2P+2C	Z	v
BI-HAM	**HW accelerated network traffic monitoring** *Tomáš Čejka* ***Tomáš Čejka*** *Tomáš Čejka (Gar.)*	KZ	4	2P+1C	L	v
BI-HMI	**History of Mathematics and Informatics** *Alena Šolcová* ***Alena Šolcová*** *Alena Šolcová (Gar.)*	Z,ZK	3	2P+1C	L	v
BI-ARD	**Interactive applications on Arduino** *Robert Hülle* ***Robert Hülle*** *Robert Hülle (Gar.)*	KZ	4	3C	L	v
NI-IAM	**Internet and Multimedia** *Sven Ubik, Jiří Melnikov* ***Jiří Melnikov*** *Sven Ubik (Gar.)*	Z,ZK	4	2P+1C	L	v
BIE-IMA2	**Introduction to Mathematics 2** ***Karel Klouda***	Z	2	1C	Z	v
BI-CS2	**C# language and data access** *Pavel Štěpán* ***Pavel Štěpán*** *Pavel Štěpán (Gar.)*	KZ	4	0P+3C	Z	v
BI-CS3	**Language C# - design of web applications** *Pavel Štěpán* ***Pavel Štěpán*** *Pavel Štěpán (Gar.)*	KZ	4	3C	Z	v
BI-SQL.1	**Language SQL, advanced** *Michal Valenta* ***Michal Valenta*** *Michal Valenta (Gar.)*	KZ	4	3C	L	v
BI-QAP	**Quantum algorithms and programming** *Tomáš Kalvoda, Ivo Petr* ***Ivo Petr*** *Ivo Petr (Gar.)*	KZ	5	1P+2C	Z	v
NI-LSM	**Statistical Modelling Lab** ***Karel Klouda***	KZ	5	3C	L	v
NI-MPL	**Managerial Psychology** *Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)*	ZK	2	2P	Z,L	v
MI-MSI	**Mathematical Structures in Computer Science** ***Jan Starý***	Z,ZK	4	2P+1C	L	v
BI-MPP	**Methods of interfacing peripheral devices** *Miroslav Skrbek* ***Miroslav Skrbek*** *Miroslav Skrbek (Gar.)*	Z,ZK	4	2P+2C	Z	v
BI-MIT	**Mikrotik technologies** *Jan Fesl* ***Jan Fesl*** *Jan Fesl (Gar.)*	KZ	3	1P+2C	Z	v
NI-MOP	**Modern Object-Oriented Programming in Pharo** *Marek Skotnica, Jan Blizničenko* ***Robert Pergl*** *Robert Pergl (Gar.)*	KZ	4	3C	Z	v
BI-MMP	**Multimedia team project** *Zdeňka Čechová* ***Michal Valenta*** *Zdeňka Čechová (Gar.)*	KZ	4	3C	L	v
NI-OLI	**Computer Engineering Seminar Master II** *Jaroslav Borecký, Miroslav Skrbek* ***Jaroslav Borecký*** *Miroslav Skrbek (Gar.)*	Z,ZK	4	2P+2C	L	v
MI-OLI	**Linux Drivers** ***Martin Daňhel***	Z,ZK	4	2P+2C	L	v
BI-ACM	**Programming Practices 1** ***Ivan Šimeček*** *Ondřej Suchý (Gar.)*	KZ	5	4C	L	v
BI-ACM2	**Programming Practices 2** *Jan Matyáš Křišťan, Ondřej Suchý, Václav Blažej, Tomáš Valla* ***Ivan Šimeček*** *Tomáš Valla (Gar.)*	KZ	5	4C	Z	v
BI-ACM3	**Programming Practices 3** *Jan Matyáš Křišťan, Ondřej Suchý, Václav Blažej, Tomáš Valla* ***Ivan Šimeček*** *Tomáš Valla (Gar.)*	KZ	5	4C	L	v
BI-ACM4	**Programming Practices 4** *Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Ondřej Suchý (Gar.)*	KZ	5	4C	Z	v
BI-AND.21	**Programming for the Android Operating System** ***Martin Půlpitel*** *Martin Půlpitel (Gar.)*	KZ	4	3C	L	v
BI-CS1	**Programming in C#** *Pavel Štěpán, Helena Wallenfelsová* ***Helena Wallenfelsová*** *Pavel Štěpán (Gar.)*	KZ	4	3C	L,Z	v
BI-PJV	**Programming in Java** *Miroslav Balík, Jan Blizničenko, Vojtěch Knaisl* ***Miroslav Balík*** *Miroslav Balík (Gar.)*	Z,ZK	4	2P+2C	Z	v
BI-PJS.1	**JavaScript Programming** *Oldřich Malec, Nikita Mironov Nikita Mironov (Gar.)*	KZ	4	3C	L	v

BI-KOT	**Programing in Kotlin** *Jiří Daněček* ***Jiří Daněček*** *Jiří Daněček (Gar.)*	Z,ZK	4	2P+2C	L	v
MI-PSL	**Programming in Scala** ***Michal Valenta***	Z,ZK	4	2P+1C	L	v
BI-PMA	**Programming in Mathematica** *Zdeněk Buk Zdeněk Buk (Gar.)*	Z,ZK	4	2P+2C	Z	v
BI-PHP.1	**Programing in PHP** *Oldřich Malec, Marek Erben Oldřich Malec (Gar.)*	KZ	4	3C	Z	v
MI-PDD.16	**Data Preprocessing** ***Daniel Vašata***	Z,ZK	5	2P+1C	Z	v
NI-PDD	**Data Preprocessing** *Marcel Jiřina* ***Daniel Vašata*** *Marcel Jiřina (Gar.)*	Z,ZK	5	2P+1C	Z	v
BI-PKM	**Introduction to mathematics** ***Karel Klouda*** *Karel Klouda (Gar.)*	Z	4		Z	v
NI-REV	**Reverse Engineering** *Josef Kokeš, Róbert Lórencz, Jiří Dostál* ***Jiří Dostál*** *Jiří Dostál (Gar.)*	Z,ZK	5	1P+2C	Z	v
MI-REV.16	**Reverse Engineering**	Z,ZK	5	1P+2C	Z	v
BI-SCE1	**Computer Engineering Seminar I** *Hana Kubátová, Martin Novotný* ***Miroslav Skrbek*** *Hana Kubátová (Gar.)*	Z	4	2C	L,Z	v
BI-SCE2	**Computer Engineering Seminar II** *Hana Kubátová, Miroslav Skrbek* ***Miroslav Skrbek*** *Hana Kubátová (Gar.)*	Z	4	2C	L,Z	v
BI-ST1	**Network Technology 1** ***Alexandru Moucha*** *Alexandru Moucha (Gar.)*	Z	3	2C	Z	v
BI-ST2	**Network Technology 2** ***Alexandru Moucha*** *Alexandru Moucha (Gar.)*	Z	3	3C	L	v
BI-ST3	**Network Technology 3** ***Alexandru Moucha*** *Alexandru Moucha (Gar.)*	Z	3	2C	Z	v
BI-ST4	**Network Technology 4** ***Alexandru Moucha*** *Alexandru Moucha (Gar.)*	Z	3	2C	L	v
BI-SOJ	**Machine Oriented Languages**	Z,ZK	4	2P+2C	L	v
BI-SVZ.21	**Machine vision and image processing** ***Marcel Jiřina***	Z,ZK	5	2P+2C	L,Z	v
MI-SYP.16	**Parsing and Compilers** ***Jan Janoušek***	Z,ZK	5	2P+1C	Z	v
NI-SYP	**Parsing and Compilers** *Jan Janoušek* ***Jan Janoušek*** *Jan Janoušek (Gar.)*	Z,ZK	5	2P+1C	Z	v
BI-GIT	**Version control system GIT** *Robin Obůrka, Petr Pulc* ***Petr Pulc*** *Petr Pulc (Gar.)*	KZ	2	16P	Z,L	v
BI-TS1	**Theoretical Seminar I** *Ondřej Suchý, Tomáš Valla* ***Jan Janoušek*** *Tomáš Valla (Gar.)*	Z	4	2C	Z	v
BI-TS2	**Theoretical Seminar II** *Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)*	Z	4	2C	L	v
BI-TS3	**Theoretical Seminar III** ***Tomáš Valla*** *Tomáš Valla (Gar.)*	Z	4	2C	Z	v
BI-TS4	**Theoretical Seminar IV** *Ondřej Suchý, Tomáš Valla* ***Jan Janoušek*** *Tomáš Valla (Gar.)*	Z	4	2C	L	v
BI-TDA	**Test driven architecture**	KZ	4	2P+1C	Z,L	v
NI-TSP	**Testing and Reliability** *Petr Fišer* ***Martin Daňhel*** *Petr Fišer (Gar.)*	Z,ZK	5	2P+2C	Z	v
MI-TSP.16	**Testing and Reliability** ***Petr Fišer***	Z,ZK	5	2P+2C	Z	v
BI-TEX	**TeX and Typography** *Petr Olšák* ***Petr Olšák*** *Petr Olšák (Gar.)*	Z,ZK	4	2P+1C	L	v
BI-ULI	**Introduction to Linux** *Zdeněk Muzikář, Dana Čermáková, Jan Žďárek* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	Z	2	4D	Z	v
BI-OPT	**Introduction to Optical Networks**	Z,ZK	4	2P+1C	Z	v
NI-VCC	**Virtualization and Cloud Computing** *Jan Fesl, Tomáš Vondra* ***Tomáš Vondra*** *Tomáš Vondra (Gar.)*	Z,ZK	5	2P+1C	L	v
BI-VHS	**Virtual game worlds** *Radek Richtr* ***Radek Richtr*** *Radek Richtr (Gar.)*	ZK	4	2P+2C	Z	v
BI-VR1	**Virtual reality I** *Petr Pauš, Petr Klán* ***Petr Klán*** *Petr Klán (Gar.)*	KZ	4	2P+2C	L,Z	v
BI-VR2	**Virtual reality II** *Petr Klán* ***Petr Klán*** *Petr Klán (Gar.)*	KZ	3	1P+2C	L	v
BI-VAK.21	**Selected Applications of Combinatorics** *Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)*	Z	3	2R	L	v
BI-VMM	**Selected Mathematical Methods** *Tomáš Kalvoda Tomáš Kalvoda (Gar.)*	Z,ZK	4	2P+2C	L	v
MI-VYC	**Computability** ***Jan Starý***	Z,ZK	4	2P+2C	L	v
NI-VYC	**Computability** *Jan Starý* ***Jan Starý*** *Jan Starý (Gar.)*	Z,ZK	4	2P+2C	L	v

BI-ZS10	**Bachelor internship abroad for 10 credits** ***Miroslav Balík*** *Zdeněk Muzikář (Gar.)*	Z	10		Z,L	v
BI-ZS20	**Bachelor internship abroad for 20 credits** ***Miroslav Balík*** *Zdeněk Muzikář (Gar.)*	Z	20		Z,L	v
BI-ZS30	**Bachelor internship abroad for 30 credits** ***Miroslav Balík*** *Zdeněk Muzikář (Gar.)*	Z	30		Z,L	v
BI-ZIVS	**Intelligent Embedded System Fundamentals** *Miroslav Skrbek* ***Miroslav Skrbek*** *Miroslav Skrbek (Gar.)*	KZ	4	1P+3C	Z	v
BI-ZPI	**Process engineering** *Robert Pergl* ***Robert Pergl*** *Robert Pergl (Gar.)*	KZ	4	1P+2C	L	v
BI-ZNF	**PHP Framework Nette - basics** ***Jiří Chludil***	KZ	3	2P+1C	L	v
BI-ZRS	**Basics of System Control** *Kateřina Hyniová* ***Kateřina Hyniová*** *Kateřina Hyniová (Gar.)*	Z,ZK	4	2P+2C	Z	v
BI-IOS	**Fundamentals of iOS Application Development for iPhone and iPad** *Martin Půlpitel, Dominik Veselý Martin Půlpitel (Gar.)*	KZ	4	2C	Z	v
BI-ZWU	**Introduction to Web and User Interfaces** *Lukáš Bařinka Jakub Klímek (Gar.)*	Z,ZK	4	2P+2C	L	v
BI-ZNS.21	**Knowledge-based Systems** ***Marcel Jiřina***	Z,ZK	5	2P+2C	Z	v
BI-3DT.1	**3D Printing** *Miroslav Hrončok Miroslav Hrončok (Gar.)*	KZ	4	3C	L	v

Characteristics of the courses of this group of Study Plan: Code=BI-V.21 Name=Purely Elective Courses of Bachelor Programme BI, Version 2021

BI-EHA.21	Ethical Hacking	Z,ZK	5

The goal of the course is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnerabilities, and their possible exploitation in computer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is on hands-on experience with vulnerabilities testing and the following process of penetration test documentation.

BI-SVZ.21	Machine vision and image processing	Z,ZK	5

Camera systems are becoming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluate image information. The course introduces students to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical use of camera systems for solving problems of practice that the graduates may encounter.

BI-ALO	Algebra and Logic	Z,ZK	4

The course extends and deepens the study of topics touched upon in the basic course in logic.

BI-AVI.21	Algorithms visually	Z,ZK	4

The course complements other algorithm courses at FIT. It brings knowledge about particular important algorithms from different fields of the computer science that extend substantially knowledge presented in BI-AG1 and BI-AG2. A wide scope of covered subject is made possible due to using visualization bz Algovision (www.algovision.org<http://www.algovision.org>) that make understanding the principles of algorithms easy.

BI-A2L	English language, preparation for the B2 level exam	Z	2

The content of the course corresponds to the preparation for the English exam at the B2 level. Requirements for course credit. Academic Achievement - students are due to: -Take an active part in the language instruction. -Meet the requirements for writing assignments - Summary, Abstract, Argumentation Paper. -Succeed in both the midterm and the final term tests with the success rate set at 70%. -80% and over in BOTH tests means ORAL EXAM ONLY (no written part). Requirements will be specified by individual teachers during the first class of the term.

BI-APJ	Aplication Programming in Java	Z,ZK	4

This course is presented in Czech. Advanced technologies in Java.

MI-AFP	Applied Functional Programming	KZ	5

This course is prezented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional programming languages are on the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, mastering this paradigm becomes a necessary competence of a software engineer: the theory and especially the practice.

BIE-ZUM	Artificial Intelligence Fundamentals	Z,ZK	4

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.

BI-BLE	Blender	Z,ZK	4

The course extends knowledge of opensource program Blender from BI-MGA (Multimedia and Graphics Applications) course. It is intended for those interested in 3D graphics and animation. It offers a complete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graphics applications) course.

NI-DSP	Database Systems in Practes	Z,ZK	4

This course is presented in Czech.

BI-STO	Storage and Filesystems	Z,ZK	4

The student will learn principles and current solutions of storage systems architecture. The module explains principles of data store, protection, and archiving, as so as storage scaling, load balancing and high availability.

MI-DZO	Digital Image Processing	Z,ZK	4

This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both easy to implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the domain of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurring in frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhancement, interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matting.

NI-DZO	Digital Image Processing	Z,ZK	4
This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both easy to implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the domain of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurring in frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhancement, interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matting.			
MI-DDM	Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands on experience with large scale data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations and will be capable to propose approaches to parallelize other algorithms. The course is prezented in czech language.			
NI-DDM	Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands on experience with large scale data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations and will be capable to propose approaches to parallelize other algorithms. The course is prezented in czech language.			
BI-EP1	Effective programming 1	Z	4
The course is taught in Czech.			
BI-EP2	Efficient Programming 2	KZ	4
Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving individual problems are discussed, with the aim to choose the best one and avoid implementation errors.			
BI-EJA	Enterprise Java	Z,ZK	4
The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information systems which are connected to a database and are accessed through the web interface.			
BI-FMU	Financial and Management Accounting	Z,ZK	5
The aim of the course is explanation of basic terms in the theory of accounting, the principles of balancing the property amounts and liabilities in the particular accounting operations, operations in accounts and accounting statements including opening and closing of bookkeeping. The course provides students with a legal modification of bookkeeping, description of economic operations based on current methods of double-entry bookkeeping for enterprising subjects in the Czech Republic. Principles of management accounting are base of Business Inteligence moduls in Business information systems.			
BI-HAM	HW accelerated network traffic monitoring	KZ	4
This course introduces students to modern and widely used technologies and principles in the area of network infrastructure and traffic monitoring. The monitoring and analysis of network traffic are mandatory skills to network operators (planning and development of resources and infrastructure) and security analysts alike (as a source of information and data for analysis). The goals of the course are to acquaint students with the modern trends and cornerstone principles in the area of monitoring network traffic on a hardware and software level and to develop their practical abilities in this field.			
BI-HMI	History of Mathematics and Informatics	Z,ZK	3
This course is presented in Czech.			
BI-ARD	Interactive applications on Arduino	KZ	4
The subject is designed for students of first grade of bachelor study as introduction to embedded systems. Students will learn how to design simple applications for modern programmable kits and control varied peripherals with help of available libraries. The goal of the subject is to show varied software approaches to control embedded systems, i.e. to see the results not only on display of a PC. Thanks to possible control on higher (objective) layer, this platform is frequently used for artist performance and therefore is suitable even for Web and Software Engineering students.			
NI-IAM	Internet and Multimedia	Z,ZK	4
The NI-IAM course is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acquisition of AV signals (input), presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical use case scenarios of real-time audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effect of various components on the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the scene up to the presentation for audience.			
BIE-IMA2	Introduction to Mathematics 2	Z	2
Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular examples.			
BI-CS2	C# language and data access	KZ	4
The C# language and data access course objective is to introduce students several data access technologies - database, XML, NoSQL - on the Microsoft platform. The students will get to know objects used to retrieve data - Connection, Command, Data Reader and DataAdapter v ADO.NET. Next, they will learn to use current technologies such as LINQ - a set of features for querying and updating data, integrated directly with the .NET platform languages, which enable LINQ use with Objects, XML and SQL (LINQ to Objects, LINQ to XML and LINQ to SQL). Another objective is the Entity Framework - an object-relational mapper that enables .NET developers to work with relational data using domain-specific objects (ORM). This part of the course introduces Code First, Database First, Model First approaches. The students will also get to know the Conceptual Model, Storage Model and Mapping (XML description).			
BI-CS3	Language C# - design of web applications	KZ	4
The students will be introduced to current technologies in web application development on the .NET platform. They will acquire a comprehensive overview of the development possibilities on thisplatform. They will learn to create WebAPI and to use it by client programs.			
BI-SQL.1	Language SQL, advanced	KZ	4
Module is based on knowledge obtained in BI-DBS. Students become familiar with advanced relational and non-relational features of SQL language. In particular stored program unites, triggers, recursive queries, OLAP support, object-relational constructions. Part of the course is dedicated to practical database optimization from the point of view of specialized database structures like indexes, clusters, index-organized tables, and materialized views. as well as from the point of view query optimization. Execution plan and possibilities of its. changes will be discussed. Lectures will usually discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Oracle DBMS and partially on PostgreSQL.			
BI-QAP	Quantum algorithms and programming	KZ	5
Course aims at giving students hands-on experience with quantum computers and their programming. We focus on fundaments of quantum mechanics, on which quantum technologies are based, and algorithms showing advantages and limitations of quantum computing. During tutorials students work in open-source software development kit Qiskit, which is based on Python language. Knowledge of linear algebra at the level of BI-LA1 and BI-LA2 (or BI-LIN) is necessary. Previous completion of BI-MA2 or BI-VMM and experience with Python might be an advantage. No previous knowledge of physics is assumed.			

NI-LSM	Statistical Modelling Lab	KZ	5
The subject is oriented on a low-level approach to Bayesian statistical and information-theoretical modelling, where the student both learns the existing methods (regression models, Kalman filtering, models fusion, etc.) and tries to implement them. That is, instead of the (standard) intensive use of high-level libraries like pandas, scikit-learn or statsmodels, the stress is put on the use of numpy and scipy, as well as the low-level algebra and calculus. The second half of the semester is focused on the design of methods and algorithms, and analyses of their properties. At this point, the subject is on the border of own research and may result in the topic of final work (diploma or bachelor thesis).			
NI-MPL	Managerial Psychology	ZK	2
Students will get acquainted with the basic psychological basis for managerial practice and personnel management. They will understand the basics of cognitive and behavioral approach, the importance of the manager's personality, his internal attitudes, behavior, interaction and communication. They will get acquainted with theories of personality, intelligence, motivation, cognitive and affective processes. Selected techniques will be practiced during practical exercises. The knowledge acquired in the course can be applied in future employment and in everyday life.			
MI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages.			
BI-MPP	Methods of interfacing peripheral devices	Z,ZK	4
The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices.			
BI-MIT	Mikrotik technologies	KZ	3
The main motivation of the subject stands in the introduction of the RouterOS operating system and some network Mikrotik technologies which are commonly used by the small and middle internet service providers (ISPs). The students learn how to use and create the architectures of the network solutions which are based on the metallic, optical or wireless links and how to administrate and practically deploy them. The successful completion of this subject requires the previous knowledge of elementary computer networks concepts like protocols and technologies of the data-link, network and transport layer of the OSI model.			
NI-MOP	Modern Object-Oriented Programming in Pharo	KZ	4
Object-oriented programming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where its ability to natural abstraction is used to build complex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills of design and implementation of object systems in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development needs and areas of interest. In addition to deepening object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work on interesting projects and OO technologies in terms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvement in the Pharo Consortium.			
BI-MMP	Multimedia team project	KZ	4
This course is presented in Czech.			
NI-OLI	Computer Engineering Seminar Master II	Z,ZK	4
The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerful processors and FPGAs increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for master's students. The course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience.			
MI-OLI	Linux Drivers	Z,ZK	4
The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerful processors and FPGAs increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for master's students. The course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience.			
BI-ACM	Programming Practices 1	KZ	5
This course is presented in Czech.			
BI-ACM2	Programming Practices 2	KZ	5
This course is presented in Czech.			
BI-ACM3	Programming Practices 3	KZ	5
This course is presented in Czech.			
BI-ACM4	Programming Practices 4	KZ	5
This course is presented in Czech.			
BI-AND.21	Programming for the Android Operating System	KZ	4
This course is presented in Czech.			
BI-CS1	Programming in C#	KZ	4
The goal of the course is to introduce .NET Framework as a multi-language development platform. Then, programming language C#, its fundamental construction, types of variables, operators, arrays, loops, definitions and calls of functions will be discussed. Attention is focused on the object oriented programming in C# - class definition and class instancing, constructors, methods, properties, static members, Garbage Collector, inheritance and polymorphism, collections, delegates, and generics. Debugging and exception processing, as well as work with files are emphasized.			
BI-PJV	Programming in Java	Z,ZK	4
The course is taught in Czech.			
BI-PJS.1	JavaScript Programming	KZ	4
Main goal of the course is an introduction to Javascript programming. Students will learn also best practices and will use tool that eases development in Javascript. The course is recommended for students of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for this course in their 4th semester of study.			
BI-KOT	Programing in Kotlin	Z,ZK	4
Kotlin is a modern, statically-styled object-functional language that exploits the extensive Java language ecosystem while delivering a number of advanced language constructions. The language is fully Java compliant and allows for mixed projects that preserve existing parts written in Java, and continue with the development of a modern, object-functional way with minimum of boiler-plate code. Last but not least, Kotlin is suitable for designing of DSLs (Domain-Specific Languages).			
MI-PSL	Programming in Scala	Z,ZK	4
The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language features - e.g.pattern matching and advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and libraries e.g. Play, Cassandra, Scalaz, etc.			
BI-PMA	Programming in Mathematica	Z,ZK	4
Students will be working with modern technical and scientific software. Students will learn how to use different programming styles (functional programming, rule-based programming, etc.), how to create dynamic interactive applications and visualisations, data processing and presentations.			
BI-PHP.1	Programing in PHP	KZ	4
The course is taught in Czech.. Main goal of the course is an introduction to PHP - language and technology. Students will learn also best practices and will use tool that eases development in PHP. The course is recommended for students of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for this course in their 3rd semester of study.			

MI-PDD.16	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
NI-PDD	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteristics from images or from web pages.			
BI-PKM	Introduction to mathematics	Z	4
This course is presented in Czech.			
NI-REV	Reverse Engineering	Z,ZK	5
Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world.			
MI-REV.16	Reverse Engineering	Z,ZK	5
Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world.			
BI-SCE1	Computer Engineering Seminar 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.			
BI-SCE2	Computer Engineering Seminar 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.			
BI-ST1	Network Technology 1	Z	3
The subject is oriented to providing the students basic information and practical skills from the area of digital and IP networks. The subject is acredited under the Cisco Netacad - CCNA1 - R&S Introduction to Networks.			
BI-ST2	Network Technology 2	Z	3
This course is presented in Czech.			
BI-ST3	Network Technology 3	Z	3
Students will further enhance their knowledge acquired from previous BI-ST1 and BI-ST2 courses. Principles of routing and switching presented during BI-ST1 and BI-ST2 courses will get further extended in the course. Students will be able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, predictability, extension beyond a simple topology, security, etc.			
BI-ST4	Network Technology 4	Z	3
Students will further enhance their knowledge already acquired from previous BI-ST1, BI-ST2, and BI-ST3 courses. Principles of routing and switching presented during BI-ST1 and BI-ST2 courses got further extended in BI-ST3. Students were able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, predictability, extension beyond a simple topology, security, etc. This module teaches students to configure and fine-tune Wide Area Networks and to experience a completely other type of network (Non Broadcast Multiple Access) which radically differs from well-known Ethernet (broadcast) type of networks. Students will also manage router and switch firmware, perform password recoveries, and emergency procedures. Also the security aspect is treated; students will learn possible intra- and inter-network attacks and the mitigation ways while maintaining the network running.			
BI-SOJ	Machine Oriented Languages	Z,ZK	4
Students of the course will gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal use of microprocessor's features and efficient cooperation of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of view linked to higher level languages. This knowledge will be used during reverse engineering, optimization, and evaluation of code security.			
MI-SYP.16	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.			
NI-SYP	Parsing and Compilers	Z,ZK	5
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.			
BI-GIT	Version control system GIT	KZ	2
Students will be introduced to basic principles of version control systems. These principles will be then shown on DCVS Git both theoretically and practically. In this particular system even the implementation details will be shown. Students will be challenged to use Git as users, project managers, team leaders as well as Git server administrators.			
BI-TS1	Theoretical Seminar I	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TS2	Theoretical Seminar II	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TS3	Theoretical Seminar III	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			

BI-TS4	Theoretical Seminar IV	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TDA	Test driven architecture	KZ	4
The course is focused on practical examples of how to develop, test, and deploy software with tools like GitLab, Docker, Kubernetes, and more that are well known in the DevOps world. This course has a strong connection on courses like BI(E)-SI1 and BI(E)-SI2. The main goal of this course is to learn by examples that occur in the semester project.			
NI-TSP	Testing and Reliability	Z,ZK	5
Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with built-in-self-test equipment. They will be able to compute, analyze, and control the reliability and availability of the designed circuits.			
MI-TSP.16	Testing and Reliability	Z,ZK	5
Students gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
BI-TEX	TeX and Typography	Z,ZK	4
This course is presented in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of the course focuses on typographic rules.			
BI-ULI	Introduction to Linux	Z	2
Students become familiar with the basics of the Linux operating system using e-learning form. They learn to work with the command line and become familiar with basic commands and techniques of a Unix-like system. Topics can be studied first theoretically and then practically verified in a virtual machine (terminal).			
BI-OPT	Introduction to Optical Networks	Z,ZK	4
Students get basic overview of optical networking technology with the emphasis on practical utilization in Internet and in network infrastructures, on possible problems with deployment of optical network technology and on their solutions. The course will include the history of optical communications, an overview of passive components (optical fibres, multiplexors, dispersion compensators, and others), and an overview of active components (optical switches and amplifiers, high-speed coherent transmission systems). The course will also cover the most up-to-date topics presented at premium research conferences, such as ECOC or OFC. Attention will also be paid to new applications, such as the accurate time on Internet, ultrastable frequency transfer, or sensor networks. The labs will focus on real work with optical components and on measurement of their parameters. Students will solve real tasks from practice.			
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
Students will gain knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and organizations. They will get acquainted with virtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficiently operate and optimize the performance parameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effective technology today for the management of complex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills in the use of modern integration and development tools (Continuous integration and development).			
BI-VHS	Virtual game worlds	ZK	4
The course leads students to create a complex virtual world. The course is a continuation of basic graphical courses (MGA, PGR, BLE,…). This current students knowledge is furthermore complemented by the theory of game design, principles of writing dialogues and characters in order to create a functional and complex virtual world. The course can be followed by the course MI-PVR with the task of converting scenes and their dynamics into a fully virtual environment suitable for VR devices.			
BI-VR1	Virtual reality I	KZ	4
Introduction to Virtual Reality (VR), virtual reality operating system and virtual reality creation. Another objective is to meet the rules and requirements of virtual worlds communication. The course focuses on the ways of teaching using virtual reality technologies and interactive activities in educational virtual 3D worlds and improves computational thinking and shared social activities.			
BI-VR2	Virtual reality II	KZ	3
Continuation of the course Virtual Reality I. The new course focuses on collaborative telepresence, spatial computing and social life of avatars. The objective is to develop applications for computer science and gamification in various social metaverse and desktop engines.			
BI-VAK.21	Selected Applications of Combinatorics	Z	3
The course aims to introduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the basic courses, we approach the issue from applications to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some basic data structures. Furthermore, with the active participation of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) informatics. Areas from which we will select problems to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimization and more. Students will also try to implement solutions to the studied problems with a special focus on the effective use of existing tools.			
BI-VMM	Selected Mathematical Methods	Z,ZK	4
We start reviewing geometric properties of linear spaces with inner product. Next, we introduce and analyze the discrete Fourier transform (DFT) and its fast implementation (FFT). Further we deal with differential calculus of functions involving multiple variables. We present methods for the localization of extreme values of functions. For this purposes, we study normed linear spaces and quadratic forms. In addition, we introduce the least square method. The last part of the course is devoted to optimization and duality. The linear programming and the Simplex method is analyzed in more detail.			
MI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability.			
NI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability.			
BI-ZS10	Bachelor internship abroad for 10 credits	Z	10
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			
BI-ZS20	Bachelor internship abroad for 20 credits	Z	20
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			

BI-ZS30	Bachelor internship abroad for 30 credits	Z	30
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			
BI-ZIVS	Intelligent Embedded System Fundamentals	KZ	4
Intelligent embedded system fundamentals course is focused on high-level technology embedded systems integrating artificial intelligence. The aim of the course is to teach students modern humanoid robot control and development of applications in a graphical development environment. Lectures provide fundamentals of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students program a set of basic task by using the robot simulator and real hardware to get practical experience with these technologies.			
BI-ZPI	Process engineering	KZ	4
Students will learn fundamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles of process modelling and they will learn basics of the used notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of business processes using modern CASE tools. The role of process engineering for information systems development is discussed as well as its importance in the overall context of information and business strategy of an enterprise.			
BI-ZNF	PHP Framework Nette - basics	KZ	3
Students will gain the basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czech popular framework. The resulting knowledge should serve for the efficient creation of a web backend in PHP language.			
BI-ZRS	Basics of System Control	Z,ZK	4
The course gives an introduction to the field of automatic control. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems, description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD, and fuzzy controllers. Students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementation of continuous and digital controllers and PLC control.			
BI-IOS	Fundamentals of iOS Application Development for iPhone and iPad	KZ	4
This course is presented in Czech.			
BI-ZWU	Introduction to Web and User Interfaces	Z,ZK	4
This course is presented in Czech.			
BI-ZNS.21	Knowledge-based Systems	Z,ZK	5
Students will become familiar with the systems based on knowledge (knowledge-based systems), which are systems that usetechniques of artificial intelligence to solve problems that require human judgment, learning and reasoning from findingsand actions. The course introduces students to the philosophy and architecture of knowledge-based systems to support decision-makingand planning. The course assumes knowledge of set theory, probability theory, artificial neural networks, and evolutionary algorithms.			
BI-3DT.1	3D Printing	KZ	4

List of courses of this pass:

Code	Name of the course	Completion	Credits
BI-3DT.1	3D Printing	KZ	4
BI-A2L	English language, preparation for the B2 level exam	Z	2
The content of the course corresponds to the preparation for the English exam at the B2 level. Requirements for course credit. Academic Achievement - students are due to: -Take an active part in the language instruction. -Meet the requirements for writing assignments - Summary, Abstract, Argumentation Paper. -Succeed in both the midterm and the final term tests with the success rate set at 70%. -80% and over in BOTH tests means ORAL EXAM ONLY (no written part). Requirements will be specified by individual teachers during the first class of the term.			
BI-AAG.21	Automata and Grammars	Z,ZK	5
Students are introduced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite automata, regular expressions, and regular grammars, context-free grammars, construction and use of pushdown automata, and translation grammars and transducers. They know the hierarchy of formal languages and they understand the relationships between formal languages and automata. They are introduced to the Turing machine and complexity classes P and NP.			
BI-ACM	Programming Practices 1	KZ	5
This course is presented in Czech.			
BI-ACM2	Programming Practices 2	KZ	5
This course is presented in Czech.			
BI-ACM3	Programming Practices 3	KZ	5
This course is presented in Czech.			
BI-ACM4	Programming Practices 4	KZ	5
This course is presented in Czech.			
BI-ADU.21	Unix Administration	Z,ZK	5
Students will learn the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They will understand the differences between user and administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights, file systems, disk subsystems, processes, memory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the knowledge from the lectures on specific examples from practice.			
BI-AG1.21	Algorithms and Graphs 1	Z,ZK	5
The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. Students learn techniques of proofs of correctness of algorithms and techniques of asymptotic mathematics for estimation of their complexity in the best, worse, or average case (the course includes basics from probability theory needed for understanding randomized algorithms). Within exercises students learn applications of studied algorithms for solving practical problems.			

BI-AG2.21	Algorithms and Graphs 2	Z,ZK	5
This course, presented in Czech, introduces basic algorithms and concepts of graph theory as a follow=up on the introduction given in the compulsory course BI-AG1.21. It further delves into advances data structures and amortized complexity analysis. It also includes a very light introduction to approximation algorithms. For English version of the course see BIE-AG2.21.			
BI-ALO	Algebra and Logic	Z,ZK	4
The course extends and deepens the study of topics touched upon in the basic course in logic.			
BI-AND.21	Programming for the Android Operating System	KZ	4
This course is presented in Czech.			
BI-ANG	English Language, Internal Certificate	ZK	2
Course information and teaching materials can be found at https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG			
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2
BI-APJ	Aplication Programming in Java	Z,ZK	4
This course is presented in Czech. Advanced technologies in Java.			
BI-APS.21	Architectures of Computer Systems	Z,ZK	5
Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction processing not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such systems.			
BI-ARD	Interactive applications on Arduino	KZ	4
The subject is designed for students of first grade of bachelor study as introduction to embedded systems. Students will learn how to design simple applications for modern programmable kits and control varied peripherals with help of available libraries. The goal of the subject is to show varied software approaches to control embedded systems, i.e. to see the results not only on display of a PC. Thanks to possible control on higher (objective) layer, this platform is frequently used for artist performance and therefore is suitable even for Web and Software Engineering students.			
BI-ASB.21	Applied Network Security	Z,ZK	5
The aim of the course is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gained in course BI-PSI with actual security applications like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing the course student will get knowledge of security applications in computer networks.			
BI-AVI.21	Algorithms visually	Z,ZK	4
The course complements other algorithm courses at FIT. It brings knowledge about particular important algorithms from different fields of the computer science that extend substantially knowledge presented in BI-AG1 and BI-AG2. A wide scope of covered subject is made possible due to using visualization bz Algovision (www.algovision.org<http://www.algovision.org>) that make understanding the principles of algorithms easy.			
BI-AWD.21	Web and Database Server Administration	Z,ZK	5
Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server.			
BI-BAP.21	Bachelor Thesis	Z	14
BI-BEK.21	Secure Code	Z,ZK	5
The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them.			
BI-BIG.21	DB Technologies for Big Data	KZ	5
Students will be introduced into the field of Big Data processing where nonrelational (NoSQL) database engines are typically used today. The course is focused practically so that after finishing the course students were able to choose suitable tools (mostly open source) and techniques,design and implement a simplest reproducible method of data processing (data collection, transformation/aggregation, presentation). Students get acquainted with various architectures for processing and storing big data. A theoretical foundation and presentation of individual technologies will be supplemented with specific case studies.			
BI-BLE	Blender	Z,ZK	4
The course extends knowledge of opensource program Blender from BI-MGA (Multimedia and Graphics Applications) course. It is intended for those interested in 3D graphics and animation. It offers a complete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graphics applications) course.			
BI-BPR.21	Bachelor project	Z	1
1. At the beginning of the semester, the student reserves the topic of the bachelor's thesis and connects with the supervisor. He / she will arrange the partial tasks that he / she will perform during the semester to process the assignment. If he completes these tasks, the supervisor will award him a credit from the subject BI-BPR 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 will be handed over by the student to the head of the Department of Defense, who will record the credit in KOS. 3. If the topic of the work that the student has reserved is formulated more generally, the tasks assigned to him by the supervisor for the semester should be aimed primarily at fine-tuning the assignment so that the assignment can be supplemented and approved at the end of the semester.			
BI-CS1	Programming in C#	KZ	4
The goal of the course is to introduce .NET Framework as a multi-language development platform. Then, programming language C#, its fundamental construction, types of variables, operators, arrays, loops, definitions and calls of functions will be discussed. Attention is focused on the object oriented programming in C# - class definition and class instancing, constructors, methods, properties, static members, Garbage Collector, inheritance and polymorphism, collections, delegates, and generics. Debugging and exception processing, as well as work with files are emphasized.			
BI-CS2	C# language and data access	KZ	4
The C# language and data access course objective is to introduce students several data access technologies - database, XML, NoSQL - on the Microsoft platform. The students will get to know objects used to retrieve data - Connection, Command, Data Reader and DataAdapter v ADO.NET. Next, they will learn to use current technologies such as LINQ - a set of features for querying and updating data, integrated directly with the .NET platform languages, which enable LINQ use with Objects, XML and SQL (LINQ to Objects, LINQ to XML and LINQ to SQL). Another objective is the Entity Framework - an object-relational mapper that enables .NET developers to work with relational data using domain-specific objects (ORM). This part of the course introduces Code First, Database First, Model First approaches. The students will also get to know the Conceptual Model, Storage Model and Mapping (XML description).			
BI-CS3	Language C# - design of web applications	KZ	4
The students will be introduced to current technologies in web application development on the .NET platform. They will acquire a comprehensive overview of the development possibilities on thisplatform. They will learn to create WebAPI and to use it by client programs.			

BI-DBS.21	Database Systems	Z,ZK	5
Students are introduced to the database engine architecture and typical user roles. They are briefly introduced to various database models. They learn to design small databases (including integrity constraints) using a conceptual model and implement them in a relational database engine. They get a hands-on experience with the SQL language, as well as with its theoretical foundation - the relational database model. They learn the principles of normalizing a relational database schema. They understand the fundamental concepts of transaction processing, controlling parallel user access to a single data source, as well as recovering a database engine from a failure. They are briefly introduced to special ways of storing data in relational databases with respect to speed of access to large quantities of data. This introductory-level course does not cover: Administration of database systems, debugging and optimizing database applications, distributed database systems, data stores.			
BI-DML.21	Discrete Mathematics and Logic	Z,ZK	5
Students will get acquainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from set theory will be explained. Special attention is paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The course also lays down the basics of combinatorics and number theory, with emphasis on modular arithmetics.			
BI-EHA.21	Ethical Hacking	Z,ZK	5
The goal of the course is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnerabilities, and their possible exploitation in computer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is on hands-on experience with vulnerabilities testing and the following process of penetration test documentation.			
BI-EJA	Enterprise Java	Z,ZK	4
The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information systems which are connected to a database and are accessed through the web interface.			
BI-EP1	Effective programming 1	Z	4
The course is taught in Czech.			
BI-EP2	Efficient Programming 2	KZ	4
Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving individual problems are discussed, with the aim to choose the best one and avoid implementation errors.			
BI-EPP.21	Economic Business Processes	Z,ZK	5
The aim of the course is to present typical processes related to the usual life cycle of a company. The course focuses mainly on the basic economic and financial aspects of business in the market environment of the Czech Republic and the basics of management. In the course, students are acquainted with the typical phases of the company's life cycle, from the establishment of the company, through the management of property and capital structure, financing of the company, determining the cost function of the company and labor costs, to evaluating the financial health of the company and its eventual rehabilitation or termination.			
BI-FBI.21	Financial Business Intelligence	Z,ZK	5
The aim of the course is to acquaint students primarily with financial accounting as a tool for recording business operations and documents for business analysis, determining its value and other indicators for comparison with other companies and management decision process at the tactical and strategic level. The second view is management accounting as a tool for financial management and prediction of business development. Management accounting allows monitoring of the financial status and performance of business activities over several accounting periods, enables a multidimensional view of business data, enables to control effectively factors affecting the return on invested capital and to use value information to assess options related to future business decisions. The principles of management accounting, described in this course, are the basis of Business Intelligence modules in business information systems, decision support systems, and other knowledge-oriented systems.			
BI-FEM.21	Fundamentals of Economics	Z,ZK	5
The course allows the students to discover basics of economic theory, which will then be used in subsequent courses of economics and management. It contains a general overview of fundamental microeconomic and macroeconomic topics.			
BI-FMU	Financial and Management Accounting	Z,ZK	5
The aim of the course is explanation of basic terms in the theory of accounting, the principles of balancing the property amounts and liabilities in the particular accounting operations, operations in accounts and accounting statements including opening and closing of bookkeeping. The course provides students with a legal modification of bookkeeping, description of economic operations based on current methods of double-entry bookkeeping for enterprising subjects in the Czech Republic. Principles of management accounting are base of Business Inteligence moduls in Business information systems.			
BI-GIT	Version control system GIT	KZ	2
Students will be introduced to basic principles of version control systems. These principles will be then shown on DCVS Git both theoretically and practically. In this particular system even the implementation details will be shown. Students will be challenged to use Git as users, project managers, team leaders as well as Git server administrators.			
BI-GIT.21	SW Development Technologies	Z	3
This course is aimed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to Git, the information manager from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use.			
BI-HAM	HW accelerated network traffic monitoring	KZ	4
This course introduces students to modern and widely used technologies and principles in the area of network infrastructure and traffic monitoring. The monitoring and analysis of network traffic are mandatory skills to network operators (planning and development of resources and infrastructure) and security analysts alike (as a source of information and data for analysis). The goals of the course are to acquaint students with the modern trends and cornerstone principles in the area of monitoring network traffic on a hardware and software level and to develop their practical abilities in this field.			
BI-HMI	History of Mathematics and Informatics	Z,ZK	3
This course is presented in Czech.			
BI-HWB.21	Hardware Security	Z,ZK	5
The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers.			
BI-IDO.21	Introduction to DevOps	Z,ZK	5
The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice.			
BI-IOS	Fundamentals of iOS Application Development for iPhone and iPad	KZ	4
This course is presented in Czech.			
BI-IOT.21	Internet of Things	Z,ZK	5
The course focuses on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application			

	areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS).		
BI-JPO.21	Computer Units	Z,ZK	5
	Students deepen their basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detail with the internal structure and organization of computer units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using appropriate codes for implementation of multiplication. The organization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, including codes for error detection and correction for parallel and serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of communication of the processor with the environment and the architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational microprogrammed processor simulator and programmable hardware design kits (FPGA).		
BI-KAB.21	Cryptography and Security	Z,ZK	5
	Students will understand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to use cryptographic keys and certificates in systems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in applications. Finally, students get acquainted with the basics of information security. Within labs, students will gain practical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procedures of cryptanalysis.		
BI-KOM.21	Conceptual Modelling	Z,ZK	5
	The course is focused on developing abstract thinking and precise formulation skills using conceptual models. Students learn skills of discerning key terms in a domain, the ability to categorize and specify correct relations in complex systems of social reality, mostly enterprises and institutions. Students learn basics of ontological structural modeling in the OntoUML notation. Next, they learn how to express business rules and constraints using the OCL language and foundations of OWL/RDF semantic data representation in the Internet. They also learn the foundations of enterprise engineering, being a discipline for conceptual modelling of enterprises and institutes and their processes. The DEMO method and the BPMN notation will be taught. The course is designed with the respect to continuation in software implementations. Recommended optional follow-up course: BI-ZPI.		
BI-KOT	Programing in Kotlin	Z,ZK	4
	Kotlin is a modern, statically-styled object-functional language that exploits the extensive Java language ecosystem while delivering a number of advanced language constructions. The language is fully Java compliant and allows for mixed projects that preserve existing parts written in Java, and continue with the development of a modern, object-functional way with minimum of boiler-plate code. Last but not least, Kotlin is suitable for designing of DSLs (Domain-Specific Languages).		
BI-LA1.21	Linear Algebra 1	Z,ZK	5
	We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a matrix. We will also demonstrate some applications of these concepts in computer science.		
BI-LA2.21	Linear Algebra 2	Z,ZK	5
	1. Vektorové prostory. 2. Skalární součin, norma vektoru, ortogonalita. 3. Snalytická geometrie. 4. Lineární zobrazení 5. Matice lineárního zobrazení. 6. [2] Afinní transformace, homogenní souřadnice, projekce a operace v 3D prostoru jako lineární zobrazení. 8. Řešení soustav lineárních rovnic. 9. [2] Maticové rozklady (metody LU, SVD, QR) a jejich výpočet. 11. Metoda nejmenších čtverců. 12. Lineární programování. 13. Rekurentní rovnice.		
BI-LOG.21	Mathematical Logic	Z,ZK	5
	The course focuses on the basics of propositional and predicate logic. It starts from the semantic point of view. Based on the notion of truth, satisfiability, logical equivalence, and the logical consequence of formulas are defined. Methods for determining the satisfiability of formulas, some of which are used for automated proving, are explained. This relates to the P vs. NP problem and Boolean functions in propositional logic. In predicate logic, the course further deals with formal theories, such as arithmetics, and their models. The syntactic approach to mathematical logic is demonstrated on the axiomatic system of propositional logic and its properties. Gödel's incompleteness theorems is explained.		
BI-MA1.21	Mathematical Analysis 1	Z,ZK	5
	We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newton's method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landau's asymptotic notation and methods of mathematical description of complexity of algorithms.		
BI-MA2.21	Mathematical Analysis 2	Z,ZK	6
	The course completes the theme of analysis of real functions of a real variable initiated in BI-MA1 by introducing the Riemann integral. Students will learn how to integrate by parts and use the substitution method.The next part of the course is devoted to number series, and Taylor polynomials and series. We apply Taylor's theorem to the computation of elementary functions with a prescribed accuracy. Then we study the linear recurrence equations with constant coefficients, the complexity of recursive algorithms, and its analysis using the Master theorem. Finally, we introduce the student to the theory of multivariate functions. After establishing basic concepts of partial derivative, gradient, and Hessian matrix, we study the analytical method of localization of local extrema of multivariate functions as well as the numerical descent method. We conclude the course with the integration of multivariate functions. This course can be enrolled only after successful completion of the course BI-MA1, which can be replaced by the course BI-ZMA in the case of repetitive students.		
BI-MDF.21	Modern Data Formats	KZ	3
	The goal of the course is to give an overview of commonly used data formats for typical types of data. There will be a description of each data type and the data formats used for that data type along with tools available to work with such data. After finishing the course, the students should know how to work with common data, e.g. on the Web.		
BI-MGA.21	Multimedia and Graphics Applications	Z,ZK	5
	Students get acquainted with multimedia technologies and applications for 2D/3D bitmap and vector graphics. During the course, current tools for working with images, videos, 3D graphics and animation will be introduced. Students learn several basic techniques of creation and editing content in computer graphics, introduction to graphic formats, and compression technologies. They learn to use multimedia transmission and representation systems, including real-time multimedia processing. They understand the principle of operation and use of graphics processing cards. They gain a number of practical skills, such as vectorizing raster images, retouching photos, or creating 3D models.		
BI-MIT	Mikrotik technologies	KZ	3
	The main motivation of the subject stands in the introduction of the RouterOS operating system and some network Mikrotik technologies which are commonly used by the small and middle internet service providers (ISPs). The students learn how to use and create the architectures of the network solutions which are based on the metallic, optical or wireless links and how to administrate and practically deploy them. The successful completion of this subject requires the previous knowledge of elementary computer networks concepts like protocols and technologies of the data-link, network and transport layer of the OSI model.		
BI-ML1.21	Machine Learning 1	Z,ZK	5
	The goal of this course is to introduce students to the basic methods of machine learning. They get theoretical understanding and practical working knowledge of regression and classification models in the supervised learning scenario and clustering models in the unsupervised scenario. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Moreover, they learn the basic techniques of data preprocessing and multidimensional data visualization. In practical demonstrations, pandas and scikit libraries in Python will be used.		
BI-ML2.21	Machine Learning 2	Z,ZK	5
	The goal of this course is to introduce students to the selected advanced methods of machine learning. In the supervised learning scenario, they, in particular, learn kernel methods and neural networks. In the unsupervised learning scenario students learn the principal component analysis and other dimensionality reduction methods. Moreover, students get the basic principles of reinforcement learning and natural language processing.		

BI-MMP	Multimedia team project	KZ	4
	This course is presented in Czech.		
BI-MPP	Methods of interfacing peripheral devices	Z,ZK	4
	The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices.		
BI-MPP.21	Methods of interfacing peripheral devices	Z,ZK	5
	The course is focused on methods for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Universal serial bus (USB). The course includes both PC side and peripheral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of USB devices, Linux and Windows drivers, simple application development, and APIs of selected devices.		
BI-MVT.21	Modern Visualisation Technologies	Z,ZK	5
	The goal of the course is to give an overview of modern visualization technologies and their principles, namely technologies related to virtual and augmented reality, visualization on high resolution displays (e.g., SAGE and video mapping) and their applications in practice. Several lectures deal with the content creation for the mentioned technologies, namely fractal and procedural visualization, scientific data visualization, and 3D model scanning.		
BI-OOP.21	Object-Oriented Programming	Z,ZK	5
	Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handing, refactoring, and application of design pattern.		
BI-OPT	Introduction to Optical Networks	Z,ZK	4
	Students get basic overview of optical networking technology with the emphasis on practical utilization in Internet and in network infrastructures, on possible problems with deployment of optical network technology and on their solutions. The course will include the history of optical communications, an overview of passive components (optical fibres, multiplexors, dispersion compensators, and others), and an overview of active components (optical switches and amplifiers, high-speed coherent transmission systems). The course will also cover the most up-to-date topics presented at premium research conferences, such as ECOC or OFC. Attention will also be paid to new applications, such as the accurate time on Internet, ultrastable frequency transfer, or sensor networks. The labs will focus on real work with optical components and on measurement of their parameters. Students will solve real tasks from practice.		
BI-OSY.21	Operating Systems	Z,ZK	5
	In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems, OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows.		
BI-PA1.21	Programming and Algorithmics 1	Z,ZK	7
	Students gain the ability to formulate algorithms for solving basic problems and write them in the C language. They understand data types (simple, structured, pointers), expressions, statements, functions, concept of recursion. They learn to analyse simple cases of algorithm complexity. They know fundamental algorithms for searching, sorting, and manipulating with linked lists and trees.		
BI-PA2.21	Programming and Algorithmics 2	Z,ZK	7
	Students know the instruments of object-oriented programming and are able to use them for specifying and implementing abstract data types (stack, queue, enlargeable array, list, set, table). They learn these skills using the C++ programming language and are introduced to all C++ features needed in object-oriented programming (e.g., template programming, copying/moving of objects, operator overloading, inheritance, polymorphism).		
BI-PAI.21	Law and Informatics	ZK	5
	The aim of the course is to introduce students into the basic legal instruments that they will encounter in their practice. Students will gain knowledge of doing business in the Czech Republic and will be alerted to the pitfalls that await them in business from the point of view of law. They will understand the process of concluding contracts in real and Internet environment, will know their responsibilities in working with the Internet, will be familiar with the institutes of intellectual property law, and will be able to use commercial license types and open-source licenses. Emphasis will also be put on the legal protection of data on the Internet, the registration of Internet domains and protection against their misuse. Students will also be alerted to such behaviour in the field of IT that can be classified as criminal under the Czech law. The course will also include analyses of real cases from practice.		
BI-PGA.21	Programming of Graphic Applications	Z,ZK	5
	The course will present the possibilities of current professional open-source tools for image editing, video editing, 3D animation (GIMP, Blender) and their use for visualization of specific data (3D scenes, mathematical data). Emphasis will be placed on the possibilities of further enhancement of the presented software tools, both using built-in scripting languages and by implementation of plugins.		
BI-PGR.21	Computer graphics programming	Z,ZK	5
	After attending this curse, students can program a simple interactive 3D graphical application like a computer game or scientific visualization, design the scene, add textures imitating geometric details and materials (like wall surface, wood, sky), and set up the lighting. At the same time, they understand the fundamental principles and terms used in computer graphics, such as graphical pipeline, geometric transformations, or lighting model. They gain knowledge allowing orientation in computer graphics and representing solid fundamentals for your professional development, e.g., GPU programming and animations. They get used to techniques utilized in geometric modeling, modeling curves and surfaces, and scientific visualization.		
BI-PHP.1	Programing in PHP	KZ	4
	The course is taught in Czech.. Main goal of the course is an introduction to PHP - language and technology. Students will learn also best practices and will use tool that eases development in PHP. The course is recommended for students of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for this course in their 3rd semester of study.		
BI-PJP.21	Programming Languages and Compilers	Z,ZK	5
	Students learn basic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers GNU and LLVM. They learn to create a specification of a translation of a text that conforms a given syntax, to a target code and also to create a compiler based on the specification. The compiler can translate not only a programming language but any text in a language generated by a given LL input grammar.		
BI-PJS.1	JavaScript Programming	KZ	4
	Main goal of the course is an introduction to Javascript programming. Students will learn also best practices and will use tool that eases development in Javascript. The course is recommended for students of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for this course in their 4th semester of study.		
BI-PJS.21	JavaScript Programming	KZ	5
	The course is an introduction to Javascript programming. Students will also learn best practices and get acquai nted with tools that make code development in Javascript easier.		
BI-PJV	Programming in Java	Z,ZK	4
	The course is taught in Czech.		
BI-PKM	Introduction to mathematics	Z	4
	This course is presented in Czech.		

BI-PMA	Programming in Mathematica	Z,ZK	4
Students will be working with modern technical and scientific software. Students will learn how to use different programming styles (functional programming, rule-based programming, etc.), how to create dynamic interactive applications and visualisations, data processing and presentations.			
BI-PNO.21	Practical Digital Design	KZ	5
Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the basics of the VHDL language and implementation technologies FPGA and ASIC. Students demonstrate practical use of the design techniques in the course project using modern industry-standard CAD design tools.			
BI-PPA.21	Programming Paradigms	Z,ZK	5
The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and disadvantages of particular approaches. Functional programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. The principles are demonstrated on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstream programming languages such as C++ and Java.			
BI-PRR.21	Project management	Z,ZK	5
The aim of the course is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, analysis, crisis management in a project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk assessment and management, Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for students who are interested in deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in large companies. The course is also suitable for all those who will develop software or hardware in the form of team projects.			
BI-PRS.21	Practical Statistics	KZ	5
The students will be introduced to methods of applied statistics. They will learn how to work with various types of data, perform analyses, and choose models fitting the data. The course will encompass regression and correlation analysis, analysis of variance and non-parametric methods. Students will learn to use the statistical software R and will apply the studied methods on data from real problems.			
BI-PSI.21	Computer Networks	Z,ZK	5
The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS.			
BI-PST.21	Probability and Statistics	Z,ZK	5
Students will learn the basics of probabilistic thinking, the ability to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables.			
BI-PYT.21	Python Programming	KZ	5
The aim of the course is to get acquainted with basic efficient control and data structures of the Python programming language for text and binary data processing. The differences between philosophy of programming in Python and in other programming languages will be explained. Each topic is prepared for students in the format of a Jupyter notebook, which enables greater accent to individual student work. Before each lab, students pass a short test on the last week topic. Four homeworks plus a semester work will be assigned during the semester.			
BI-QAP	Quantum algorithms and programming	KZ	5
Course aims at giving students hands-on experience with quantum computers and their programming. We focus on fundaments of quantum mechanics, on which quantum technologies are based, and algorithms showing advantages and limitations of quantum computing. During tutorials students work in open-source software development kit Qiskit, which is based on Python language. Knowledge of linear algebra at the level of BI-LA1 and BI-LA2 (or BI-LIN) is necessary. Previous completion of BI-MA2 or BI-VMM and experience with Python might be an advantage. No previous knowledge of physics is assumed.			
BI-SAP.21	Computer Structure and Architecture	Z,ZK	5
Students will get acquainted with the basic architecture and units of a digital computer, understand the structure, function, and implementation of arithmetic-logic unit , controllers, memory, I/O communication, methods of data transfers between the units. The logic design and the implementation of a program-controlled simple processor is practically implemented in the labs using programmable circuits (FPGA), a single-chip microcomputer, and modern design (EDA) tools.			
BI-SCE1	Computer Engineering Seminar 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.			
BI-SCE2	Computer Engineering Seminar 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.			
BI-SIP.21	Network Programming	Z	5
The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment.			
BI-SOJ	Machine Oriented Languages	Z,ZK	4
Students of the course will gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal use of microprocessor's features and efficient cooperation of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of view linked to higher level languages. This knowledge will be used during reverse engineering, optimization, and evaluation of code security.			
BI-SP1.21	Team Software Project 1	KZ	5
Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course.			

BI-SP2.21	Team Software Project 2	KZ	5
Students gain hands-on experience with the iterative development process while working on a large-scale software project. The first iteration is the result of the BIE-SP1 course project. However, in this follow-up, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will work in teams of 4-6 people. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) the formal as well as material aspects of their solution.			
BI-SPS.21	Administration of Computer Networks and Services	Z,ZK	5
The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure.			
BI-SQL.1	Language SQL, advanced	KZ	4
Module is based on knowledge obtained in BI-DBS. Students become familiar with advanced relational and non-relational features of SQL language. In particular stored program unites, triggers, recursive queries, OLAP support, object-relational constructions. Part of the course is dedicated to practical database optimization from the point of view of specialized database structures like indexes, clusters, index-organized tables, and materialized views. as well as from the point of view query optimization. Execution plan and possibilities of its. changes will be discussed. Lectures will usually discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Oracle DBMS and partially on PostgreSQL.			
BI-SRC.21	Real-time systems	Z,ZK	5
Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues. Theoretical knowledge from lectures will be experimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are the same as in the BIE-VES course.			
BI-ST1	Network Technology 1	Z	3
The subject is oriented to providing the students basic information and practical skills from the area of digital and IP networks. The subject is acredited under the Cisco Netacad - CCNA1 - R&S Introduction to Networks.			
BI-ST2	Network Technology 2	Z	3
This course is presented in Czech.			
BI-ST3	Network Technology 3	Z	3
Students will further enhance their knowledge acquired from previous BI-ST1 and BI-ST2 courses. Principles of routing and switching presented during BI-ST1 and BI-ST2 courses will get further extended in the course. Students will be able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, predictability, extension beyond a simple topology, security, etc.			
BI-ST4	Network Technology 4	Z	3
Students will further enhance their knowledge already acquired from previous BI-ST1, BI-ST2, and BI-ST3 courses. Principles of routing and switching presented during BI-ST1 and BI-ST2 courses got further extended in BI-ST3. Students were able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, predictability, extension beyond a simple topology, security, etc. This module teaches students to configure and fine-tune Wide Area Networks and to experience a completely other type of network (Non Broadcast Multiple Access) which radically differs from well-known Ethernet (broadcast) type of networks. Students will also manage router and switch firmware, perform password recoveries, and emergency procedures. Also the security aspect is treated; students will learn possible intra- and inter-network attacks and the mitigation ways while maintaining the network running.			
BI-STO	Storage and Filesystems	Z,ZK	4
The student will learn principles and current solutions of storage systems architecture. The module explains principles of data store, protection, and archiving, as so as storage scaling, load balancing and high availability.			
BI-SVZ.21	Machine vision and image processing	Z,ZK	5
Camera systems are becoming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluate image information. The course introduces students to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical use of camera systems for solving problems of practice that the graduates may encounter.			
BI-SWI.21	Software Engineering	Z,ZK	5
Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development.			
BI-TAB.21	Applications of Security in Technology	Z,ZK	5
The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students get a broader overview of cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security.			
BI-TDA	Test driven architecture	KZ	4
The course is focused on practical examples of how to develop, test, and deploy software with tools like GitLab, Docker, Kubernetes, and more that are well known in the DevOps world. This course has a strong connection on courses like BI(E)-SI1 and BI(E)-SI2. The main goal of this course is to learn by examples that occur in the semester project.			
BI-TDP.21	Documentation and Presentation	KZ	3
The course is focused on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically final university theses. Students learn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically present it in front of classmates and the teacher. The course is intended primarily for those students who have chosen the topic of their bachelor's thesis or will choose it within the first 14 days of teaching. Within the exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed.			
BI-TEX	TeX and Typography	Z,ZK	4
This course is presented in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of the course focuses on typographic rules.			
BI-TIS.21	Information Systems	Z,ZK	5
The goal of this course is to familiarise students with the information systems topic and information systems implementation principles. During the course, students are introduced to "on the market" existing types of systems and their usage in specific industry segments. Students are familiarised with the CRM, ERP, MRP and other types of information systems. The fundamental part of the course is the introduction to key ideas of an information system selection, evaluation of information system benefits, ways of information systems implementation and information system implementation based on the project management principles. The emphasis is on the initial customer analysis, customer insight and ability to decide whether it is better to implement any existing information system or to develop a new one from scratch. These factors determine the information system implementation success. At the end of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems topics are discussed.			
BI-TJV.21	Java Technology	Z,ZK	5
The goal is to provide knowledge and skills for developing information systems and applications through concepts used in software development and experience with libraries and tools from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.			

BI-TPS.21	Computer Networks Technologies	Z,ZK	5
The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks.			
BI-TS1	Theoretical Seminar I	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TS2	Theoretical Seminar II	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TS3	Theoretical Seminar III	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TS4	Theoretical Seminar IV	Z	4
Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.			
BI-TUR.21	User Interface Design	Z,ZK	5
Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them.			
BI-TWA.21	Design of Web Applications	Z,ZK	5
The basic course of web application development. Initially, the students become familiar with HTTP and its possibilities and partly with some properties of language describing the structure (HTML) and presentation of document on the Web (CSS). These skills provide the necessary basis for the development of Web applications, which will be demonstrated in modern libraries facilitate the development of Web pages applications. Server side will be demonstrated on PHP technology using frameworks Symfony 2, Doctrine 2. Developments on the client side will be demonstrated using a JavaScript language with library jQuery and possibly MV* framework AngularJS.			
BI-TZP.21	Technological Fundamentals of Computers	Z,ZK	5
Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica.			
BI-UKB.21	Introduction to Cybersecurity	Z,ZK	5
The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations.			
BI-ULI	Introduction to Linux	Z	2
Students become familiar with the basics of the Linux operating system using e-learning form. They learn to work with the command line and become familiar with basic commands and techniques of a Unix-like system. Topics can be studied first theoretically and then practically verified in a virtual machine (terminal).			
BI-UOS.21	Unix-like Operating Systems	KZ	5
Unix-like operating systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative functions of multiuser operating systems for computers and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properties of this OS family, such as processes and threads, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of advanced users who are not only able to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting interface, called shell.			
BI-VAK.21	Selected Applications of Combinatorics	Z	3
The course aims to introduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the basic courses, we approach the issue from applications to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some basic data structures. Furthermore, with the active participation of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) informatics. Areas from which we will select problems to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimization and more. Students will also try to implement solutions to the studied problems with a special focus on the effective use of existing tools.			
BI-VDC.21	Virtualization and Data Centers	Z,ZK	5
The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses.			
BI-VES.21	Embedded Systems	Z,ZK	5
Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.			
BI-VHS	Virtual game worlds	ZK	4
The course leads students to create a complex virtual world. The course is a continuation of basic graphical courses (MGA, PGR, BLE,…). This current students knowledge is furthermore complemented by the theory of game design, principles of writing dialogues and characters in order to create a functional and complex virtual world. The course can be followed by the course MI-PVR with the task of converting scenes and their dynamics into a fully virtual environment suitable for VR devices.			
BI-VIZ.21	Data Visualization	KZ	5
The goal of the course is to introduce students to the area of data visualization, its basic principles and methods. The course offers an overview of the types and characteristics of data as well as suitable visualization methods. This will aid the students in understanding data, their content and their application in areas such as data mining, machine learning, and business intelligence. Within the course, students will be introduced to exploratory data analysis, preprocessing, dimensionality reduction, and ways of visualizing different kinds of data such as text or geospatial. A part of the course is also dedicated to the area of business intelligence and different visualization tools, which students often encounter in the commercial sphere. During labs, students will get hands-on experience in applications of selected methods to real-world examples.			

BI-VMM	Selected Mathematical Methods	Z,ZK	4
We start reviewing geometric properties of linear spaces with inner product. Next, we introduce and analyze the discrete Fourier transform (DFT) and its fast implementation (FFT). Further we deal with differential calculus of functions involving multiple variables. We present methods for the localization of extreme values of functions. For this purposes, we study normed linear spaces and quadratic forms. In addition, we introduce the least square method. The last part of the course is devoted to optimization and duality. The linear programming and the Simplex method is analyzed in more detail.			
BI-VPS.21	Selected Topics in Computer Networking	Z,ZK	5
The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security.			
BI-VR1	Virtual reality I	KZ	4
Introduction to Virtual Reality (VR), virtual reality operating system and virtual reality creation. Another objective is to meet the rules and requirements of virtual worlds communication. The course focuses on the ways of teaching using virtual reality technologies and interactive activities in educational virtual 3D worlds and improves computational thinking and shared social activities.			
BI-VR2	Virtual reality II	KZ	3
Continuation of the course Virtual Reality I. The new course focuses on collaborative telepresence, spatial computing and social life of avatars. The objective is to develop applications for computer science and gamification in various social metaverse and desktop engines.			
BI-VWM.21	Searching the Web and Multimedia Databases	Z,ZK	5
Students get basic overview about search techniques in the web environment that is interpreted as a very large distributed and heterogeneous storage of documents. In particular, students acquire information about search techniques in text and hypertext documents (the web pages themselves) and about feature extraction from web pages. They get detailed knowledge of similarity search in multimedia databases (generally in collections of unstructured data). They also learn techniques for programming web search engines for the mentioned data types (documents).			
BI-ZIVS	Intelligent Embedded System Fundamentals	KZ	4
Intelligent embedded system fundamentals course is focused on high-level technology embedded systems integrating artificial intelligence. The aim of the course is to teach students modern humanoid robot control and development of applications in a graphical development environment. Lectures provide fundamentals of motion control, sensor reading, application interfaces, robot navigation and development tools. In labs, students program a set of basic task by using the robot simulator and real hardware to get practical experience with these technologies.			
BI-ZMA	Elements of Calculus	Z,ZK	6
Students acquire knowledge and understanding of the fundamentals of classical calculus so that they are able to apply mathematical way of thinking and reasoning and are able to use basic proof techniques. They get skills to practically handle functions of one variable in solving the problems in informatics. They understand the links between the integrals and sums of sequences. They are able to estimate lower or upper bounds of values of real functions and to handle simple asymptotic expressions.			
BI-ZNF	PHP Framework Nette - basics	KZ	3
Students will gain the basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czech popular framework. The resulting knowledge should serve for the efficient creation of a web backend in PHP language.			
BI-ZNS.21	Knowledge-based Systems	Z,ZK	5
Students will become familiar with the systems based on knowledge (knowledge-based systems), which are systems that usetechniques of artificial intelligence to solve problems that require human judgment, learning and reasoning from findingsand actions. The course introduces students to the philosophy and architecture of knowledge-based systems to support decision-makingand planning. The course assumes knowledge of set theory, probability theory, artificial neural networks, and evolutionary algorithms.			
BI-ZPI	Process engineering	KZ	4
Students will learn fundamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles of process modelling and they will learn basics of the used notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of business processes using modern CASE tools. The role of process engineering for information systems development is discussed as well as its importance in the overall context of information and business strategy of an enterprise.			
BI-ZRS	Basics of System Control	Z,ZK	4
The course gives an introduction to the field of automatic control. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems, description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD, and fuzzy controllers. Students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementation of continuous and digital controllers and PLC control.			
BI-ZRS.21	Basics of System Control	Z,ZK	5
The course gives an introduction to the field of automatic control. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems, description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD, and fuzzy controllers. Students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementation of continuous and digital controllers and PLC control.			
BI-ZS10	Bachelor internship abroad for 10 credits	Z	10
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			
BI-ZS20	Bachelor internship abroad for 20 credits	Z	20
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			
BI-ZS30	Bachelor internship abroad for 30 credits	Z	30
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or research institution. Before the internship the Dean of the FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the professional content and extent of the internship. Auxiliary courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits correspond to 4 weeks of full-time			

employment with a foreign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided into two subjects if the internship exceeds the academic year's dead-line.			
BI-ZSB.21	Basics of System Security	Z,ZK	5
The goal of the course is to provide introduction to basic concepts in security of computer systems. Further, the course introduces the basics of forensic analysis and related topics such as malware analysis or incident response. After finishing the course student will get both theoretical and practical knowledge in the area of modern operating systems security, as well as skills needed for independent work in the area of operating system security incident analysis.			
BI-ZUM.21	Artificial Intelligence Fundamentals	Z,ZK	5
Basic course on introduction to artificial intelligence with emphasis on symbolic techniques. The design of an intelligent agent and the techniques needed to create it will be discussed, especially at the decision-making level. The intelligent agent in the context of the course can be represented for example by a physical robot, but also by a non-physical entity, such as a virtual assistant or a character in a computer game. We will not only introduce the basics, but also show the current state-of-the-art during the course.			
BI-ZWU	Introduction to Web and User Interfaces	Z,ZK	4
This course is presented in Czech.			
BIE-EEC	English external certificate	Z	4
The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages.			
BIE-IMA2	Introduction to Mathematics 2	Z	2
Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular examples.			
BIE-ZUM	Artificial Intelligence Fundamentals	Z,ZK	4
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.			
MI-AFP	Applied Functional Programming	KZ	5
This course is prezented in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional programming languages are on the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, mastering this paradigm becomes a necessary competence of a software engineer: the theory and especially the practice.			
MI-DDM	Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands on experience with large scale data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations and will be capable to propose approaches to parallelize other algorithms. The course is prezented in czech language.			
MI-DZO	Digital Image Processing	Z,ZK	4
This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both easy to implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the domain of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurring in frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhancement, interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matting.			
MI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical semantics of programming languages.			
MI-OLI	Linux Drivers	Z,ZK	4
The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerful processors and FPGAs increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for master's students. The course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience.			
MI-PDD.16	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract parameters from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve a specific problem in individual projects - e.g., parameter extraction from image data or from Internet.			
MI-PSL	Programming in Scala	Z,ZK	4
The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language features - e.g.pattern matching and advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and libraries e.g. Play, Cassandra, Scalaz, etc.			
MI-REV.16	Reverse Engineering	Z,ZK	5
Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world.			
MI-SYP.16	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.			
MI-TSP.16	Testing and Reliability	Z,ZK	5
Students gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits.			
MI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability.			
NI-DDM	Distributed Data Mining	KZ	4
Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands on experience with large scale data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations and will be capable to propose approaches to parallelize other algorithms. The course is prezented in czech language.			
NI-DSP	Database Systems in Practes	Z,ZK	4
This course is presented in Czech.			

NI-DZO	Digital Image Processing	Z,ZK	4
This course presents a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algorithms that are both easy to implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also valuable outside the domain of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR compression, de-blurring in frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conversion, context enhancement, interactive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, adding depth, alpha matting.			
NI-IAM	Internet and Multimedia	Z,ZK	4
The NI-IAM course is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acquisition of AV signals (input), presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical use case scenarios of real-time audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effect of various components on the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the scene up to the presentation for audience.			
NI-LSM	Statistical Modelling Lab	KZ	5
The subject is oriented on a low-level approach to Bayesian statistical and information-theoretical modelling, where the student both learns the existing methods (regression models, Kalman filtering, models fusion, etc.) and tries to implement them. That is, instead of the (standard) intensive use of high-level libraries like pandas, scikit-learn or statsmodels, the stress is put on the use of numpy and scipy, as well as the low-level algebra and calculus. The second half of the semester is focused on the design of methods and algorithms, and analyses of their properties. At this point, the subject is on the border of own research and may result in the topic of final work (diploma or bachelor thesis).			
NI-MOP	Modern Object-Oriented Programming in Pharo	KZ	4
Object-oriented programming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where its ability to natural abstraction is used to build complex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills of design and implementation of object systems in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development needs and areas of interest. In addition to deepening object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work on interesting projects and OO technologies in terms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvement in the Pharo Consortium.			
NI-MPL	Managerial Psychology	ZK	2
Students will get acquainted with the basic psychological basis for managerial practice and personnel management. They will understand the basics of cognitive and behavioral approach, the importance of the manager's personality, his internal attitudes, behavior, interaction and communication. They will get acquainted with theories of personality, intelligence, motivation, cognitive and affective processes. Selected techniques will be practiced during practical exercises. The knowledge acquired in the course can be applied in future employment and in everyday life.			
NI-OLI	Computer Engineering Seminar Master II	Z,ZK	4
The Linux operating system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerful processors and FPGAs increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for master's students. The course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience.			
NI-PDD	Data Preprocessing	Z,ZK	5
Students learn to prepare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data sources, such as images, texts, time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteristics from images or from web pages.			
NI-REV	Reverse Engineering	Z,ZK	5
Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world.			
NI-SYP	Parsing and Compilers	Z,ZK	5
The module builds upon the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various variants and applications of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.			
NI-TSP	Testing and Reliability	Z,ZK	5
Students will gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with built-in-self-test equipment. They will be able to compute, analyze, and control the reliability and availability of the designed circuits.			
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
Students will gain knowledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and organizations. They will get acquainted with virtualization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficiently operate and optimize the performance parameters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effective technology today for the management of complex computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills in the use of modern integration and development tools (Continuous integration and development).			
NI-VYC	Computability	Z,ZK	4
Classical theory of recursive functions and effective computability.			
TV1	Physical Education	Z	0
TV2	Physical Education	Z	0
TVKLV	Physical Education Course	Z	0
TVKZV	Physical Education Course	Z	0
TVV	Physical education	Z	0
TVV0	Physical education	Z	0

For updated information see http://bilakniha.cvut.cz/en/FF.html
Generated: day 03. 12. 2021, time 04:18.