# Study plan

## Name of study plan: Bachelor Specialization Computer Systems and Virtualization, in Czech, 2021

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Informatika
Type of study: Bachelor full-time
Required credits: 153
Elective courses credits: 27
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: prof. Ing. Pavel Tvrdík, CSc., email:pavel.tvrdik@fit.cvut.cz

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

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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 106 credits
Requirement courses in the group: In this group you have to complete 20 courses
Credits in the group: 106
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, Michal Opler, Ondřej Suchý, Tomáš Valla, Radek Hušek* ***Dušan Knop*** *Dušan Knop (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PP |
| BI-AAG.21 | **Automata and Grammars** *Jan Holub, Jan Janoušek* ***Jan Holub*** *Jan Holub (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PP |
| BI-BAP.21 | **Bachelor Thesis** *Zdeněk Muzikář* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 14 | | L,Z | PP |
| BI-BPR.21 | **Bachelor project** ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 1 | 0P+0C | Z,L | PP |
| BI-DBS.21 | **Database Systems** *Michal Valenta, Jan Bliznìčenko, Jiří Hunka, Monika Borkovcová, Jan Matoušek, Pavel Kříž, Štěpán Pechman, Dominik Roudný, Jan Bittner, .....* ***Jiří Hunka*** *Michal Valenta (Gar.)* | Z,ZK | 5 | 2P+2R+1L | L | PP |
| BI-DML.21 | **Discrete Mathematics and Logic** *Jiřina Scholtzová, Daniel Dombek, Jan Spěvák* ***Daniel Dombek*** *Jan Spěvák (Gar.)* | Z,ZK | 5 | 2P+1R+1C | Z | PP |
| BI-KAB.21 | **Cryptography and Security** *Ivana Trummová, Tomáš Rabas, Tomáš Zahradnický, Jiří Buček, Martin Jureček, Josef Kokeš, Róbert Lórencz, Julia Plotnikova, David Pokorný, .....* ***Róbert Lórencz*** *Róbert Lórencz (Gar.)* | Z,ZK | 5 | 2P+2C | L | PP |
| BI-LA1.21 | **Linear Algebra 1** *Luděk Kleprlík, Jakub Krásenský, Karel Klouda* ***Luděk Kleprlík*** *Karel Klouda (Gar.)* | Z,ZK | 5 | 2P+1R+1C | Z | PP |

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|---|---|---|---|---|---|---|
| BI-MA1.21 | **Mathematical Analysis 1**<br>*Pavel Hrabák, Tomáš Kalvoda, Ivo Petr, Petr Olšák, Pavel Paták* ***Tomáš Kalvoda*** *Tomáš Kalvoda (Gar.)* | Z,ZK | 5 | 2P+1R+1C | L | PP |
| BI-MA2.21 | **Mathematical Analysis 2**<br>*Pavel Hrabák, Tomáš Kalvoda, Ivo Petr, Petr Olšák, Pavel Paták* ***Tomáš Kalvoda*** *Tomáš Kalvoda (Gar.)* | Z,ZK | 6 | 3P+2C | Z | PP |
| BI-OSY.21 | **Operating Systems**<br>*Petr Zemánek, Jiří Kašpar, Michal Štepanovský, Jan Trdlička, Pavel Tvrdík, Ladislav Vagner* ***Pavel Tvrdík*** *Michal Štepanovský (Gar.)* | Z,ZK | 5 | 2P+1R+1L | L | PP |
| BI-PSI.21 | **Computer Networks**<br>*Viktor Černý, Michal Hažlinský, Vladimír Smotlacha, Yelena Trofimova, Jan Fesl, Josef Koumar, Petr Hodač, Josef Zápotocký, Michal Polák, .....* ***Jan Fesl*** *Jan Fesl (Gar.)* | Z,ZK | 5 | 2P+1R+1C | L | PP |
| BI-PST.21 | **Probability and Statistics**<br>*Kamil Dedecius, Pavel Hrabák, Jitka Hrabáková, Petr Novák, Jana Vacková* ***Pavel Hrabák*** *Pavel Hrabák (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PP |
| BI-PA1.21 | **Programming and Algorithmics 1**<br>*Radek Hušek, Jan Trávníček, Miroslav Balík, Josef Vogel, Ladislav Vagner* ***Jan Trávníček*** *Jan Trávníček (Gar.)* | Z,ZK | 7 | 2P+2R+2C | Z | PP |
| BI-PA2.21 | **Programming and Algorithmics 2**<br>*Radek Hušek, Jan Trávníček, Josef Vogel, Ladislav Vagner* ***Jan Trávníček*** *Jan Trávníček (Gar.)* | Z,ZK | 7 | 2P+1R+2C | L | PP |
| BI-SAP.21 | **Computer Structure and Architecture**<br>*Hana Kubátová, Jaroslav Borecký, Petr Fišer, Martin Kohlík* ***Hana Kubátová*** *Hana Kubátová (Gar.)* | Z,ZK | 5 | 2P+1R+2C | L | PP |
| BI-TZP.21 | **Technological Fundamentals of Computers**<br>*Jan Řezníček, Jaroslav Borecký, Robert Hülle, Martin Kohlík, Vojtěch Mišković, Martin Novotný, Matúš Olekšák* ***Martin Novotný*** *Martin Novotný (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PP |
| BI-GIT.21 | **SW Development Technologies**<br>*Petr Pulc, Robin Obůrka* ***Robin Obůrka*** *Petr Pulc (Gar.)* | Z | 3 | 2P | Z | PP |
| BI-TDP.21 | **Documentation and Presentation**<br>*Ondřej Guth, Petra Pavlíčková, Dana Vynikarová, Alena Libánská, Tomáš Nováček* ***Dana Vynikarová*** *Dana Vynikarová (Gar.)* | KZ | 3 | 2P+2C | Z,L | PP |
| BI-UOS.21 | **Unix-like Operating Systems**<br>*Zdeněk Muzikář, Petr Zemánek, Viktor Černý, Michal Hažlinský, Jakub Jančička, Miroslav Prágl, Michal Šoch, Jan Trdlička, Yelena Trofimova, .....* ***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 of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. It links and partially develops the knowledge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the time and space complexity of algorithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic notation.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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 must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 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. 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.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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 Newtons 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 Landaus 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 Taylors 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. | | | |
| 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. | | | |

Name of the block: Compulsory courses in the specialization
Minimal number of credits of the block: 40
The role of the block: PS

Code of the group: BI-PS-PV.21
Name of the group: Compulsory Courses of Specialization Computer Systems and Virtualization, 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:

| 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, Petr Zemánek, Miroslav Prágl* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z,ZK | 5 | 2P+2C | L | PS |
| BI-AWD.21 | **Web and Database Server Administration** *Michal Valenta, Lukáš Bařinka* ***Lukáš Bařinka*** *Michal Valenta (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PS |
| BI-APS.21 | **Architectures of Computer Systems** *Michal Štepanovský, Pavel Tvrdík* ***Michal Štepanovský*** *Pavel Tvrdík (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PS |
| BI-SPS.21 | **Administration of Computer Networks and Services** *Jan Kubr, Libor Dostálek* ***Pavel Tvrdík*** *Libor Dostálek (Gar.)* | Z,ZK | 5 | 2P+2S | Z | PS |
| BI-IDO.21 | **Introduction to DevOps** *Michal Valenta, Jiří Mlejnek, Tomáš Vondra, Zdeněk Rybola* ***Tomáš Vondra*** *Jiří Mlejnek (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PS |
| BI-VDC.21 | **Virtualization and Data Centers** *Jiří Kašpar* ***Jiří Kašpar*** *Jiří Kašpar (Gar.)* | Z,ZK | 5 | 2P+2C | L | PS |
| BI-VPS.21 | **Selected Topics in Computer Networking** *Alexandru Moucha, Mohamed Bettaz* ***Pavel Tvrdík*** *Mohamed Bettaz (Gar.)* | Z,ZK | 5 | 2P+2C | L | PS |
| BI-ZSB.21 | **Basics of System Security** *Marián Svetlík, Dominik Novák, Ladislav Marko, Martin Šutovský* ***Simona Fornůsek*** *Simona Fornůsek (Gar.)* | Z,ZK | 5 | 2P+2C | Z | PS |

**Characteristics of the courses of this group of Study Plan: Code=BI-PS-PV.21 Name=Compulsory Courses of Specialization Computer Systems and Virtualization, 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.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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-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.

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|---|---|---|---|
| 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.

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|---|---|---|---|
| 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.

Name of the block: Compulsory elective courses
Minimal number of credits of the block: 5
The role of the block: PV

Code of the group: BI-PV-PV.21
Name of the group: Compulsory elective Courses of Specialization Computer Systems and Virtualization, version 2021
Requirement credits in the group: In this group you have to gain at least 5 credits (at most 15)

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 3)
Credits in the group: 5
Note on the group:

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| BI-BIG.21 | **DB Technologies for Big Data** *Monika Borkovcová **Monika Borkovcová** Monika Borkovcová (Gar.)* | KZ | 5 | 2P+2C | Z,L | PV |
| BI-TAB.21 | **Applications of Security in Technology** *Jiří Dostál, Jan Bělohoubek, Martin Kolárik, Martin Pozděna **Jiří Dostál** Jiří Dostál (Gar.)* | Z,ZK | 5 | 2P+2C | L | PV |
| BI-VES.21 | **Embedded Systems** *Miroslav Skrbek **Miroslav Skrbek** Miroslav Skrbek (Gar.)* | Z,ZK | 5 | 2P+2C | L | PV |

**Characteristics of the courses of this group of Study Plan: Code=BI-PV-PV.21 Name=Compulsory elective Courses of Specialization Computer Systems and Virtualization, version 2021**

| | | | |
|---|---|---|---|
| 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 examples from practice. | | | |
| 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-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. | | | |

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 7)
Credits in the group: 0
Note on the group: The student is obliged to successfully complete two courses of this group.

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| TVK1 | **Physical Education** ***Luboš Neuman*** *Jiří Drnek (Gar.)* | Z | 1 | | L,Z | PT |
| TVV | **Physical education** | Z | 0 | 0+2 | Z,L | PT |
| TV1 | **Physical Education** | Z | 0 | 0+2 | Z | 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**

| | | | |
|---|---|---|---|
| TVK1 | Physical Education | Z | 1 |
| TVV | Physical education | Z | 0 |
| TV1 | 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: 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. <br> --<br> 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. <br> --<br> 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 |
|---|---|---|---|---|---|---|
| BI-ANG1 | **English Language Examination without Preparatory Courses** *Kateřina Valentová **Kateřina Valentová** Kateřina Valentová (Gar.)* | Z,ZK | 2 | 2D | L | PJ |
| BIE-EEC | **English language external certificate** *Zdeněk Muzikář **Zdeněk Muzikář** Zdeněk Muzikář (Gar.)* | Z | 4 | 2D | L | PJ |
| BI-ANG | **English Language, Internal Certificate** *Kateřina Valentová **Kateřina Valentová** Kateřina Valentová (Gar.)* | ZK | 2 | 2D | Z,L | PJ |

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

| | | | |
|---|---|---|---|
| BI-ANG1 | English Language Examination without Preparatory Courses | Z,ZK | 2 |
| BIE-EEC | English language 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-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: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

Code of the group: BI-V.2021
Name of the group: Purely Elective Courses of Bachelor Programme Informatics, version from 2021/22 till 2024/25
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| BI-ADW.1 | **Windows Administration** *Jiří Kašpar, Miroslav Prágl **Miroslav Prágl** Miroslav Prágl (Gar.)* | Z,ZK | 4 | 2P+1C | Z | V |
| 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 | L | 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** ***Jiří Daněček*** | Z,ZK | 4 | 2P+1R+1C | Z | V |
| NI-AFP | **Applied Functional Programming** *Robert Pergl, Marek Suchánek, Daniel Němec **Robert Pergl** Robert Pergl (Gar.)* | KZ | 5 | 2P+1C | L | V |
| BIE-ZUM | **Artificial Intelligence Fundamentals** ***Pavel Surynek*** | 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** *Tomáš Vichta **Tomáš Vichta** Tomáš Vichta (Gar.)* | Z,ZK | 4 | 2P+1C | L | V |

| | | | | | | |
|---|---|---|---|---|---|---|
| BI-STO | **Storage and Filesystems** | Z,ZK | 4 | 2P+2C | L,Z | v |
| NI-PSD | **Public Services Design**<br>*David Pešek, Ondřej Brém* ***David Pešek*** *Ondřej Brém (Gar.)* | KZ | 4 | 1P+2C | | v |
| BIE-DIF | **Differential equations**<br>*Antonella Marchesiello, Jan Valdman, Ondřej Bouchala* ***Tomáš Kalvoda*** *Ondřej Bouchala (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| NI-DZO | **Digital Image Processing** | Z,ZK | 4 | 2P+1C | L | v |
| NI-DDM | **Distributed Data Mining** | KZ | 4 | 3C | L | v |
| BI-EP1.24 | **Effective programming 1**<br>*Martin Kačer* ***Martin Kačer*** *Martin Kačer (Gar.)* | KZ | 4 | 2P+2C | Z | v |
| BI-EP2 | **Efficient Programming 2**<br>*Martin Kačer* ***Martin Kačer*** *Martin Kačer (Gar.)* | KZ | 4 | 2P+2C | L | v |
| BI-ANGK | **English language, contact preparation for the B2 level exam**<br>***Kateřina Valentová*** *Kateřina Valentová (Gar.)* | Z | 2 | 2C | Z,L | v |
| BI-EJA | **Enterprise Java**<br>***Jiří Daněček*** | Z,ZK | 4 | 2P+2C | L | v |
| BI-EJK | **Enterprise Java and Kotlin**<br>*Jiří Daněček* ***Jiří Daněček*** *Jiří Daněček (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| BI-FMU | **Financial and Management Accounting**<br>***David Buchtela*** | Z,ZK | 5 | 2P+2C | Z | v |
| BI-HAM | **HW accelerated network traffic monitoring**<br>*Tomáš Čejka, Karel Hynek* ***Tomáš Čejka*** *Tomáš Čejka (Gar.)* | KZ | 4 | 2P+1C | L | v |
| BI-HMI | **History of Mathematics and Informatics**<br>*Alena Šolcová* ***Alena Šolcová*** *Alena Šolcová (Gar.)* | Z,ZK | 3 | 2P+1C | L | v |
| BI-ARD | **Interactive applications on Arduino**<br>*Jan Řezníček, Jiří Cvrček, Robert Hülle, Vojtěch Miškovský* ***Robert Hülle*** *Robert Hülle (Gar.)* | KZ | 4 | 3C | L | v |
| NI-IAM | **Internet and Multimedia**<br>***Jiří Melnikov*** | Z,ZK | 4 | 2P+1C | L | v |
| BIE-CSI | **Introduction to Computer Science**<br>*Christoph Kirsch* ***Christoph Kirsch*** *Christoph Kirsch (Gar.)* | Z | 2 | 2C | Z | v |
| BIE-IMA2 | **Introduction to Mathematics 2**<br>***Karel Klouda*** | Z | 2 | 1C | Z | v |
| BI-CS2 | **C# language and data access**<br>*Pavel Štěpán* ***Pavel Štěpán*** *Pavel Štěpán (Gar.)* | KZ | 4 | 0P+3C | Z | v |
| BI-CS3 | **Language C# - design of web applications**<br>*Pavel Štěpán* ***Pavel Štěpán*** *Pavel Štěpán (Gar.)* | KZ | 4 | 3C | Z | v |
| BI-SQL.1 | **Language SQL, advanced**<br>*Michal Valenta* ***Michal Valenta*** *Michal Valenta (Gar.)* | KZ | 4 | 3C | L | v |
| BI-QAP | **Quantum algorithms and programming**<br>*Tomáš Kalvoda, Ivo Petr* ***Ivo Petr*** *Ivo Petr (Gar.)* | KZ | 5 | 1P+2C | Z | v |
| NI-LSM | **Statistical Modelling Lab**<br>*Kamil Dedecius* ***Kamil Dedecius*** *Kamil Dedecius (Gar.)* | KZ | 5 | 3C | L | v |
| BI-HAS | **Human Aspects in Cryptography and Security**<br>*Ivana Trummová* ***Ivana Trummová*** *Ivana Trummová (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| NI-MPL | **Managerial Psychology**<br>*Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)* | ZK | 2 | 2P | Z,L | v |
| NI-MSI | **Mathematical Structures in Computer Science**<br>***Jan Starý*** | Z,ZK | 4 | 2P+1C | L | v |
| BI-MPP.21 | **Methods of interfacing peripheral devices**<br>*Miroslav Skrbek* ***Miroslav Skrbek*** *Miroslav Skrbek (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-MIT | **Mikrotik technologies**<br>*Jan Fesl* ***Jan Fesl*** *Jan Fesl (Gar.)* | KZ | 3 | 1P+2C | Z | v |
| NI-MOP | **Modern Object-Oriented Programming in Pharo**<br>*Jan Bliznìčenko* ***Robert Pergl*** *Robert Pergl (Gar.)* | KZ | 4 | 3C | Z | v |
| BI-MVT.21 | **Modern Visualisation Technologies**<br>*Jiří Chludil, Petr Pauš* ***Petr Pauš*** *Petr Pauš (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-MMP | **Multimedia team project**<br>*Zdeňka Čechová* ***Zdeňka Čechová*** *Zdeňka Čechová (Gar.)* | KZ | 4 | 3C | Z,L | v |
| BI-ORL | **Operations Research and Linear Programming**<br>*Dušan Knop* ***Dušan Knop*** *Dušan Knop (Gar.)* | KZ | 5 | 1P+2C | L | v |
| NI-OLI | **Linux Drivers**<br>*Miroslav Skrbek, Jaroslav Borecký* ***Jaroslav Borecký*** *Miroslav Skrbek (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| BI-ACM | **Programming Practices 1**<br>*Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | KZ | 5 | 4C | L | v |
| BI-ACM2 | **Programming Practices 2**<br>*Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | KZ | 5 | 4C | Z | v |
| BI-ACM3 | **Programming Practices 3**<br>*Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | KZ | 5 | 4C | L | v |
| BI-ACM4 | **Programming Practices 4**<br>*Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Ondřej Suchý (Gar.)* | KZ | 5 | 4C | Z | v |
| BI-AND.21 | **Programming for the Android Operating System**<br>*Jan Mottl, Jan Vepřek, Marek Kodr, Petr Šíma* ***Jan Mottl*** *Marek Kodr (Gar.)* | KZ | 4 | 3C | L | v |

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|---|---|---|---|---|---|---|
| BI-CS1 | **Programming in C#**<br>*Pavel Štěpán, Helena Wallenfelsová* ***Helena Wallenfelsová*** *Pavel Štěpán (Gar.)* | KZ | 4 | 3C | L,Z | v |
| BI-PJV | **Programming in Java**<br>*Miroslav Balík, Jan Blizničenko, Jiří Borský, Jan Zimolka* ***Miroslav Balík*** *Miroslav Balík (Gar.)* | Z,ZK | 4 | 2P+2C | Z,L | v |
| BI-PJS.1 | **JavaScript Programming**<br>***Oldřich Malec*** | KZ | 4 | 3C | L | v |
| BI-KOT | **Programing in Kotlin**<br>*Jiří Daněček* ***Jiří Daněček*** *Jiří Daněček (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| NI-PSL | **Programming in Scala**<br>*Jiří Daněček* ***Jiří Daněček*** *Jiří Daněček (Gar.)* | Z,ZK | 4 | 2P+1C | Z | v |
| BI-PMA | **Programming in Mathematica**<br>*Zdeněk Buk* ***Zdeněk Buk*** *Zdeněk Buk (Gar.)* | Z,ZK | 4 | 2P+2C | Z,L | v |
| BI-PHP.1 | **Programing in PHP** | KZ | 4 | 3C | Z | v |
| BI-PS2 | **Programming in shell 2**<br>***Lukáš Bařinka*** | Z,ZK | 4 | 2P+2C | L | v |
| NI-PDD | **Data Preprocessing**<br>*Marcel Jiřina* ***Marcel Jiřina*** *Marcel Jiřina (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| BI-PKM | **Introduction to mathematics**<br>*Tomáš Kalvoda* ***Tomáš Kalvoda*** *Tomáš Kalvoda (Gar.)* | Z | 4 | | Z | v |
| NI-REV | **Reverse Engineering**<br>*Josef Kokeš* ***Josef Kokeš*** *Josef Kokeš (Gar.)* | Z,ZK | 5 | 1P+2C | Z | v |
| BI-SCE1 | **Computer Engineering Seminar I**<br>*Hana Kubátová* ***Hana Kubátová*** *Hana Kubátová (Gar.)* | Z | 4 | 2C | L,Z | v |
| BI-SCE2 | **Computer Engineering Seminar II**<br>*Hana Kubátová* ***Hana Kubátová*** *Hana Kubátová (Gar.)* | Z | 4 | 2C | L,Z | v |
| BI-ST1 | **Network Technology 1**<br>***Alexandru Moucha*** *Alexandru Moucha (Gar.)* | Z | 3 | 2C | Z | v |
| BI-ST2 | **Network Technology 2**<br>***Alexandru Moucha*** *Alexandru Moucha (Gar.)* | Z | 3 | 3C | L | v |
| BI-ST3 | **Network Technology 3**<br>***Alexandru Moucha*** *Alexandru Moucha (Gar.)* | Z | 3 | 2C | Z | v |
| BI-ST4 | **Network Technology 4**<br>***Alexandru Moucha*** *Alexandru Moucha (Gar.)* | Z | 3 | 2C | L | v |
| BI-SKJ.21 | **Scripting Languages**<br>*Lukáš Bařinka, Jan Žďárek* ***Lukáš Bařinka*** *Jan Žďárek (Gar.)* | Z,ZK | 4 | 2+2 | L | v |
| BI-SOJ | **Machine Oriented Languages** | Z,ZK | 4 | 2P+2C | L | v |
| BI-SEP | **World Economy and Business**<br>*Tomáš Evan* ***Tomáš Evan*** *Tomáš Evan (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| NI-SYP | **Parsing and Compilers**<br>*Jan Janoušek* ***Jan Janoušek*** *Jan Janoušek (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| BI-GIT | **Version control system GIT**<br>***Petr Pulc*** | KZ | 2 | 16P | Z,L | v |
| BIE-SEG | **Systems Engineering**<br>*Christoph Kirsch* ***Christoph Kirsch*** *Christoph Kirsch (Gar.)* | Z | 0 | 2C | Z | v |
| TVK1 | **Physical Education**<br>***Luboš Neuman*** *Jiří Drnek (Gar.)* | Z | 1 | | L,Z | v |
| TVV | **Physical education** | Z | 0 | 0+2 | Z,L | v |
| TV1 | **Physical Education** | Z | 0 | 0+2 | Z | v |
| TVV0 | **Physical education** | Z | 0 | 0+2 | Z,L | v |
| TV2 | **Physical Education** | Z | 0 | 0+2 | L | v |
| TV2K1 | **Physical Education 2** | Z | 1 | | L,Z | v |
| TVKLV | **Physical Education Course** | Z | 0 | 7dní | L | v |
| TVKZV | **Physical Education Course** | Z | 0 | 7dní | Z | v |
| BI-TS1 | **Theoretical Seminar I**<br>*Dušan Knop, Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | Z | 4 | 2C | Z | v |
| BI-TS2 | **Theoretical Seminar II**<br>*Dušan Knop, Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Ondřej Suchý (Gar.)* | Z | 4 | 2C | L | v |
| BI-TS3 | **Theoretical Seminar III**<br>*Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | Z | 4 | 2C | Z | v |
| BI-TS4 | **Theoretical Seminar IV**<br>*Ondřej Suchý, Tomáš Valla* ***Tomáš Valla*** *Tomáš Valla (Gar.)* | Z | 4 | 2C | L | v |
| BI-TDA | **Test driven architecture**<br>***Marek Hakala*** | KZ | 4 | 2P+1C | Z,L | v |
| NI-TSP | **Testing and Reliability**<br>*Petr Fišer* ***Martin Daňhel*** *Petr Fišer (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-QUA | **Quality Assurance**<br>*Marek Kodr, Martin Pilný, Kateřina Kalášková* ***Kateřina Kalášková*** *Marek Kodr (Gar.)* | KZ | 4 | 3C | Z | v |
| FI-TOP | **Academic writing**<br>***Tomáš Nováček*** | Z | 2 | 10B | Z | v |

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|---|---|---|---|---|---|---|
| BI-CCN | **Compiler Construction**<br>*Christoph Kirsch* ***Christoph Kirsch*** *Christoph Kirsch (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| BI-TEX | **TeX and Typography**<br>*Petr Olšák* ***Petr Olšák*** *Petr Olšák (Gar.)* | Z,ZK | 4 | 2P+1C | L | v |
| BI-EHD | **Introduction to European Economic History**<br>*Tomáš Evan* ***Tomáš Evan*** *Tomáš Evan (Gar.)* | Z,ZK | 3 | 2P+1C | Z,L | v |
| BI-KSA | **Cultural and Social Anthropology**<br>*Tomáš Houdek, Alena Libánská, Jakub Šenovský* ***Jakub Šenovský*** *Alena Libánská (Gar.)* | ZK | 2 | 2P | Z,L | v |
| BI-ULI | **Introduction to Linux**<br>*Zdeněk Muzikář, Petr Zemánek, Jan Žďárek* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 2 | 4D | Z | v |
| BI-OPT | **Introduction to Optical Networks**<br>***Pavel Tvrdík*** | Z,ZK | 4 | 2P+1C | Z | v |
| NI-VCC | **Virtualization and Cloud Computing**<br>*Tomáš Vondra, Jan Fesl* ***Tomáš Vondra*** *Tomáš Vondra (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| BI-VHS | **Virtual game worlds**<br>***Radek Richtr*** | ZK | 4 | 2P+2C | Z | v |
| BI-VR1 | **Virtual reality I**<br>*Petr Pauš, Petr Klán* ***Petr Klán*** *Petr Klán (Gar.)* | KZ | 4 | 2P+2C | L,Z | v |
| BI-VR2 | **Virtual reality II**<br>*Petr Klán* ***Petr Klán*** *Petr Klán (Gar.)* | KZ | 3 | 1P+2C | L | v |
| BI-VAK.21 | **Selected Applications of Combinatorics**<br>*Michal Opler* ***Michal Opler*** *Michal Opler (Gar.)* | Z | 3 | 2R | L | v |
| BI-VMM | **Selected Mathematical Methods**<br>*Marzieh Forough* ***Tomáš Kalvoda*** *Tomáš Kalvoda (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| NI-VYC | **Computability**<br>*Jan Starý* ***Jan Starý*** *Jan Starý (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| BI-ZS10 | **Bachelor internship abroad for 10 credits**<br>***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 10 | | Z,L | v |
| BI-ZS20 | **Bachelor internship abroad for 20 credits**<br>***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 20 | | Z,L | v |
| BI-ZS30 | **Bachelor internship abroad for 30 credits**<br>***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)* | Z | 30 | | Z,L | v |
| BI-ZIVS | **Intelligent Embedded System Fundamentals**<br>*Miroslav Skrbek* ***Miroslav Skrbek*** *Miroslav Skrbek (Gar.)* | KZ | 4 | 1P+3C | Z | v |
| BI-ZPI | **Process engineering**<br>*Robert Pergl* ***Robert Pergl*** *Robert Pergl (Gar.)* | KZ | 4 | 1P+2C | L | v |
| BI-ZNF | **PHP Framework Nette - basics**<br>***Jiří Chludil*** | KZ | 3 | 2P+1C | L | v |
| BI-IOS | **Fundamentals of iOS Application Development for iPhone and iPad**<br>*Rostislav Babáček, Igor Rosocha* ***Martin Půlpitel*** *Martin Půlpitel (Gar.)* | KZ | 4 | 2C | Z | v |
| BI-ZWU | **Introduction to Web and User Interfaces**<br>*Lukáš Bařinka* ***Lukáš Bařinka*** *Jakub Klímek (Gar.)* | Z,ZK | 4 | 2P+2C | L | v |
| BI-3DT.1 | **3D Printing**<br>*Miroslav Hrončok, Tomáš Sýkora* ***Tomáš Sýkora*** *Miroslav Hrončok (Gar.)* | KZ | 4 | 3C | L | v |

**Characteristics of the courses of this group of Study Plan: Code=BI-V.2021 Name=Purely Elective Courses of Bachelor Programme Informatics, version from 2021/22 till 2024/25**

| | | | |
|---|---|---|---|
| TVK1 | Physical Education | Z | 1 |
| TVV | Physical education | Z | 0 |
| TV1 | 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 |
| BI-ADW.1 | Windows Administration | Z,ZK | 4 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| 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. | | | |

| | | | |
|---|---|---|---|
| NI-AFP | Applied Functional Programming | KZ | 5 |
| This course is presented 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. | | | |
| NI-PSD | Public Services Design | KZ | 4 |
| The course will introduce students to specifics of UX, Service design and development for public sector. We will look into the design and development process from the perspective of suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration with client representatives. Course is aimed at students-designers as well as clients. | | | |
| BIE-DIF | Differential equations | Z,ZK | 5 |
| This course provides a foundational overview of differential equations, starting with basic motivation and examples of ODEs and progressing to essential solution methods like separation of variables. Key theorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered with methods like characteristic polynomial analysis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world applications. Finally, an introduction to partial differential equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving ODEs and PDEs, including implicit and explicit Euler methods, Runge-Kutta methods, and finite element methods for both ODEs and PDEs. | | | |
| 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-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-EP1.24 | Effective programming 1 | KZ | 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-ANGK | English language, contact 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-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-EJK | Enterprise Java and Kotlin | Z,ZK | 4 |
| The course is on advanced technologies in the Java and Kotlin programming languages. The focus is on technologies for developing enterprise information systems with microservice architecture, that can be deployed to the cloud. | | | |
| 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. | | | |

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| 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-CSI | Introduction to Computer Science | Z | 2 |
| This is an introductory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in other fields but interested in computer science, high-school students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. The goal of the class is to introduce and relate basic principles of computer science for students to understand, early on, what computer science is, why things such as high-level programming languages and tools are done the way they are, and even how, on a basic yet representative and practically relevant level. After taking the class, students are able to answer not just basic computer science questions but also questions about themselves such as which courses to take next and which books to follow up with, ideally realizing if they are interested in computer science more than expected, or even less than before. | | | |
| 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 single and multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is put on the effective use of the available information and its modeling using numpy and scipy. 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). | | | |
| BI-HAS | Human Aspects in Cryptography and Security | Z,ZK | 5 |
| This course is for students interested not only in technical scope of computer science, but also in making products usable - for users and for developers. Students of this course can use their gained knowledge to design, plan and analyse their own projects in the context of human-centered security. | | | |
| NI-MPL | Managerial Psychology | ZK | 2 |
| NI-MSI | Mathematical Structures in Computer Science | Z,ZK | 4 |
| Mathematical semantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott model of lambda calculus. Introduction to category theory. | | | |
| 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-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-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-MMP | Multimedia team project | KZ | 4 |
| This course is presented in Czech. | | | |
| BI-ORL | Operations Research and Linear Programming | KZ | 5 |
| The subject aims to introduce students to the issues of operational research and primarily to the practical application of linear programming as a fundamental optimization technique. Operational research primarily focuses on the use of engineering methods (with a mathematical background) to solve practical problems (such as management). | | | |

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| NI-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 is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM2 | Programming Practices 2 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM3 | Programming Practices 3 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM4 | Programming Practices 4 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| 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 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| 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). | | | |
| NI-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. | | | |
| BI-PS2 | Programming in shell 2 | Z,ZK | 4 |
| Students gain a general overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into shell and some other particular scripting languages and will get practical experience with shell script programming. | | | |
| 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. | | | |
| 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. | | | |

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| 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-SKJ.21 | Scripting Languages | Z,ZK | 4 |
| Students gain a general overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into shell and some other particular scripting languages and will get practical experience with shell script programming. | | | |
| 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-SEP | World Economy and Business | Z,ZK | 4 |
| This course is presented in Czech. The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite. | | | |
| 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. | | | |
| BIE-SEG | Systems Engineering | Z | 0 |
| This is an introductory class on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles of operating systems for students to understand processor and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After taking the class, students are able to understand the difference between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what concurrency is, as opposed to parallelism, and how processes and threads synchronize efficiently to overcome concurrency for communication. | | | |
| TV2K1 | Physical Education 2 | Z | 1 |
| 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. | | | |
| BI-QUA | Quality Assurance | KZ | 4 |
| This course introduces students to the fundamentals of testing and quality management. Students will learn what the role of a tester is in the context of different types of software development and will experience hands-on application testing using both manual and automated testing. At the end of the semester, the student should be prepared to perform a test analysis, design a set of test scenarios, prepare test data, automate an appropriate portion of the scenarios, and prepare a report on the bugs found in the product under test. | | | |
| FI-TOP | Academic writing | Z | 2 |
| Publishing is an important and required part of research activity. It is not only about obtaining research results but also about applying them in the form of publication. Writing scientific publications can be useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the course, students will learn how to write a scientific article, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an article and reviewing someone else's article. The course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Dates will be determined based on the availability of enrolled students. | | | |
| BI-CCN | Compiler Construction | Z,ZK | 5 |
| This is an introductory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles of compilers for students to understand the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme of the class. | | | |

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| 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-EHD | Introduction to European Economic History | Z,ZK | 3 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| BI-KSA | Cultural and Social Anthropology | ZK | 2 |
| The one-semester course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversity of the world - examples from anthropological research from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, health, history, death, etc ...) will be shown. The course is presented in Czech. | | | |
| 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. It improves computational thinking, empathy 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 |
| The lecture begins with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then address Fourier series and their properties. Further, we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the wavelet transform. We examine the linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples. | | | |
| 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. | | | |

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| 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-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-3DT.1 | 3D Printing | KZ | 4 |

Code of the group: BI-PV-VO.21
Name of the group: Elective vocational Courses for a Bachelor Specialization BI-PV.21, version 2021
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

| Code | Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| BI-AG2.21 | **Algorithms and Graphs 2** *Dušan Knop, Michal Opler, Ondřej Suchý, Tomáš Valla, Radek Hušek **Ondřej Suchý** Ondřej Suchý (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-ASB.21 | **Applied Network Security** *Yelena Trofimova, Jiří Dostál, Jakub Tetera, Michal Polák, Martin Šutovský, Martin Mandík **Jiří Dostál** Jiří Dostál (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-BEK.21 | **Secure Code** *Josef Kokeš **Josef Kokeš** Josef Kokeš (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-BIG.21 | **DB Technologies for Big Data** *Monika Borkovcová **Monika Borkovcová** Monika Borkovcová (Gar.)* | KZ | 5 | 2P+2C | Z,L | v |
| BI-EPP.21 | **Economic Business Processes** *David Buchtela **David Buchtela** Tomáš Evan (Gar.)* | Z,ZK | 5 | 2P+2C | L,Z | v |
| BI-EHA.21 | **Ethical Hacking** *Jiří Dostál, Martin Kolárik, Andrej Šimko **Jiří Dostál** Jiří Dostál (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-FBI.21 | **Financial Business Intelligence** *David Buchtela **David Buchtela** Petra Pavlíčková (Gar.)* | Z,ZK | 5 | 2P+2C | Z,L | v |
| BI-HWB.21 | **Hardware Security** *Jiří Buček **Jiří Buček** Jiří Buček (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-IOT.21 | **Internet of Things** *Viktor Černý, Lenka Kosková Třísková **Lenka Kosková Třísková** Lenka Kosková Třísková (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-JPO.21 | **Computer Units** *Pavel Kubalík **Pavel Kubalík** Pavel Kubalík (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-KOM.21 | **Conceptual Modelling** *Robert Pergl, Marek Bělohoubek **Robert Pergl** Robert Pergl (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-LA2.21 | **Linear Algebra 2** *Daniel Dombek, Luděk Kleprlík, Karel Klouda, Marta Nollová, Jakub Šístek **Luděk Kleprlík** Karel Klouda (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-LOG.21 | **Mathematical Logic** *Kateřina Trlifajová **Kateřina Trlifajová** Kateřina Trlifajová (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-MPP.21 | **Methods of interfacing peripheral devices** *Miroslav Skrbek **Miroslav Skrbek** Miroslav Skrbek (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-MDF.21 | **Modern Data Formats** *Petr Pauš **Petr Pauš** Petr Pauš (Gar.)* | KZ | 3 | 1P+1C | Z | v |
| BI-MVT.21 | **Modern Visualisation Technologies** *Jiří Chludil, Petr Pauš **Petr Pauš** Petr Pauš (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-MGA.21 | **Multimedia and Graphics Applications** *Jiří Chludil, Lukáš Bařinka, Jan Buriánek, Šimon Taněv **Lukáš Bařinka** Jiří Chludil (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-OOP.21 | **Object-Oriented Programming** *Filip Křikava, Petr Máj, Filip Říha **Filip Křikava** Filip Křikava (Gar.)* | 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** *Kamil Dedecius, Petr Novák **Petr Novák** Petr Novák (Gar.)* | KZ | 5 | 1P+2C | L | v |
| BI-PNO.21 | **Practical Digital Design** *Martin Novotný **Martin Novotný** Martin Novotný (Gar.)* | KZ | 5 | 2P+2C | Z | v |

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|---|---|---|---|---|---|---|
| BI-PAI.21 | **Law and Informatics**<br>*Zdeněk Kučera, Štěpánka Havlíková, Dominik Vítek, Martin Samek, Jiří Maršál, Michal Matějka* ***Štěpánka Havlíková*** *Zdeněk Kučera (Gar.)* | ZK | 5 | 2P+2C | L | v |
| BI-PJP.21 | **Programming Languages and Compilers**<br>*Jan Janoušek, Tomáš Pecka* ***Jan Janoušek*** *(Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| BI-PPA.21 | **Programming Paradigms**<br>*Jan Janoušek, Tomáš Pecka, Petr Máj, Tomáš Jakl* ***Jan Janoušek*** *Jan Janoušek (Gar.)* | Z,ZK | 5 | 2P+2R | Z | v |
| BI-PGA.21 | **Programming of Graphic Applications**<br>*Jiří Chludil, Radek Richtr* ***Radek Richtr*** *Radek Richtr (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-PJS.21 | **JavaScript Programming**<br>*Martin Kolárik, Nikita Mironov* ***Monika Borkovcová*** *Monika Borkovcová (Gar.)* | KZ | 5 | 3C | L | v |
| BI-PYT.21 | **Python Programming**<br>*Martin Šlapák, Jiří Hanuš, Ondřej Bouchala, Mohamed Bettaz, Jan Šafařík* ***Martin Šlapák*** *Martin Šlapák (Gar.)* | KZ | 5 | 3C | Z,L | v |
| BI-PRR.21 | **Project management**<br>*David Pešek* ***David Pešek*** *Petra Pavlíčková (Gar.)* | Z,ZK | 5 | 2P+2C | Z,L | v |
| BI-SIP.21 | **Network Programming**<br>*Jan Fesl* ***Jan Fesl*** *Jan Fesl (Gar.)* | Z | 5 | 2P+2C | Z | v |
| BI-SWI.21 | **Software Engineering**<br>*Michal Valenta, Jiří Mlejnek, Zdeněk Rybola* ***Zdeněk Rybola*** *Michal Valenta (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| BI-SP1.21 | **Team Software Project 1**<br>*Michal Valenta, Jiří Chludil, Jiří Mlejnek, Jiří Hunka, Zdeněk Rybola, Jiří Borský, Jan Matoušek, Radek Richtr, Marek Suchánek, .....* ***Zdeněk Rybola*** *Jiří Mlejnek (Gar.)* | KZ | 5 | 2C | L | v |
| BI-SP2.21 | **Team Software Project 2**<br>*Stanislav Kuznetsov, Michal Valenta, Jiří Chludil, Jiří Mlejnek, Jiří Hunka, Zdeněk Rybola, Jiří Borský, Jan Matoušek, Radek Richtr, .....* ***Jiří Mlejnek*** *Jiří Mlejnek (Gar.)* | KZ | 5 | 2C | Z | v |
| BI-ML1.21 | **Machine Learning 1**<br>*Karel Klouda, Daniel Vašata* ***Daniel Vašata*** *Daniel Vašata (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-ML2.21 | **Machine Learning 2**<br>*Daniel Vašata* ***Daniel Vašata*** *Daniel Vašata (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-SVZ.21 | **Machine vision and image processing**<br>*Marcel Jiřina, Jakub Novák, David Kramný, Justýna Frommová* ***Jakub Novák*** *Marcel Jiřina (Gar.)* | Z,ZK | 5 | 2P+2C | L,Z | v |
| BI-SRC.21 | **Real-time systems**<br>*Hana Kubátová, Jiří Vyskočil* ***Jaroslav Borecký*** *Hana Kubátová (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-TAB.21 | **Applications of Security in Technology**<br>*Jiří Dostál, Jan Bělohoubek, Martin Kolárik, Martin Pozděna* ***Jiří Dostál*** *Jiří Dostál (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-TJV.21 | **Java Technology**<br>*Stanislav Kuznetsov, Jan Blizničenko, Jiří Daněček, Raian Samerkhanov* ***Jiří Daněček*** | Z,ZK | 5 | 2P+2C | Z | v |
| BI-TPS.21 | **Computer Networks Technologies**<br>*Vladimír Smotlacha, Josef Koumar* ***Vladimír Smotlacha*** *Vladimír Smotlacha (Gar.)* | Z,ZK | 5 | 2P+2S | Z | v |
| BI-TIS.21 | **Information Systems**<br>*Pavel Náplava* ***Pavel Náplava*** *Pavel Náplava (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-TUR.21 | **User Interface Design**<br>*Jan Schmidt* ***Jan Schmidt*** *Jan Schmidt (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-TWA.21 | **Design of Web Applications**<br>*David Bernhauer* ***David Bernhauer*** *David Bernhauer (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-UKB.21 | **Introduction to Cybersecurity**<br>*Ivana Trummová, Jan Bělohoubek, David Pokorný, Jakub Tetera, František Kovář, Martin Mandík, Tomáš Luňák* ***David Pokorný*** *Jan Bělohoubek (Gar.)* | Z,ZK | 5 | 3P+1C | Z | v |
| BI-VES.21 | **Embedded Systems**<br>*Miroslav Skrbek* ***Miroslav Skrbek*** *Miroslav Skrbek (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| BI-VIZ.21 | **Data Visualization**<br>*Magda Friedjungová* ***Magda Friedjungová*** *Magda Friedjungová (Gar.)* | KZ | 5 | 3P | Z | v |
| BI-VWM.21 | **Searching the Web and Multimedia Databases**<br>*Jiří Novák, Tomáš Skopal* ***Jiří Novák*** *Tomáš Skopal (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| BI-FEM.21 | **Fundamentals of Economics**<br>*Tomáš Evan* ***Tomáš Evan*** *Tomáš Evan (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-ZRS.21 | **Basics of System Control**<br>*Kateřina Hyniová* ***Kateřina Hyniová*** *Kateřina Hyniová (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| BI-ZUM.21 | **Artificial Intelligence Fundamentals**<br>*Pavel Surynek* ***Pavel Surynek*** *Pavel Surynek (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |

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

| | | | |
|---|---|---|---|
| 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 examples from practice.

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| 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-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-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-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-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-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-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-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-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-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-LA2.21 | Linear Algebra 2 | Z,ZK | 5 |
| Studenti si v tomto předmětu rozšíří znalosti z předmětu BI-LA1, kde se pracovalo pouze s vektory ve formě n-tic čísel. Zde si zavedeme vektorový prostor v abstraktní obecné formě. Seznámíme se také s pojmem skalární součin a lineární zobrazení, což nám dovolí ukázat souvislost s lineární algebrou, geometrií a počítačovou grafikou. Dalším velkým tématem bude numerická lineární algebra, kde si ukážeme potíže s řešením soustav lineárních rovnic na počítači a možnosti, jak se s tímto problémem vypořádat s důrazem na rozklady matic. Ukážeme si také aplikace lineární algebry v různých oborech. | | | |

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| 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-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-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-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-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-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-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-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. | | | |

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| 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-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-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-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-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 React. | | | |
| 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-VIZ.21 | Data Visualization | KZ | 5 |
| 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 and machine learning. Within the course, students will be introduced to exploratory data analysis, preprocessing, and ways of visualizing different kinds of data such as text, social networks, time series or basic image data processing. Students will get hands-on experience in applications of selected methods to real-world examples in the Python programming language. | | | |
| 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-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-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. | | | |

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| 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.

## 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 is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM2 | Programming Practices 2 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM3 | Programming Practices 3 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| BI-ACM4 | Programming Practices 4 | KZ | 5 |
| This is a selective course for preparing talented student for representation in international programming contests. | | | |
| 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-ADW.1 | Windows Administration | Z,ZK | 4 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| BI-AG1.21 | Algorithms and Graphs 1 | Z,ZK | 5 |
| The course covers the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. It links and partially develops the knowledge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the time and space complexity of algorithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic notation. | | | |
| 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-ANGK | English language, contact 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. | | | |
| 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. | | | |

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| 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 examples from practice. | | | |
| 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 must be delivered in person or by email to the SZZ coordinator, who will arrange for the credit to be granted. 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-CCN | Compiler Construction | Z,ZK | 5 |
| This is an introductory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles of compilers for students to understand the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme of the class. | | | |
| 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-EHD | Introduction to European Economic History | Z,ZK | 3 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| 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. | | | |

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| BI-EJK | Enterprise Java and Kotlin | Z,ZK | 4 |
| The course is on advanced technologies in the Java and Kotlin programming languages. The focus is on technologies for developing enterprise information systems with microservice architecture, that can be deployed to the cloud. | | | |
| BI-EP1.24 | Effective programming 1 | KZ | 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-HAS | Human Aspects in Cryptography and Security | Z,ZK | 5 |
| This course is for students interested not only in technical scope of computer science, but also in making products usable - for users and for developers. Students of this course can use their gained knowledge to design, plan and analyse their own projects in the context of human-centered security. | | | |
| 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. 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. | | | |

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| 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-KSA | Cultural and Social Anthropology | ZK | 2 |
| The one-semester course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversity of the world - examples from anthropological research from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, health, history, death, etc ...) will be shown. The course is presented in Czech. | | | |
| 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 |
| Studenti si v tomto předmětu rozšíří znalosti z předmětu BI-LA1, kde se pracovalo pouze s vektory ve formě n-tic čísel. Zde si zavedeme vektorový prostor v abstraktní obecné formě. Seznámíme se také s pojmem skalární součin a lineární zobrazení, což nám dovolí ukázat souvislost s lineární algebrou, geometrií a počítačovou grafikou. Dalším velkým tématem bude numerická lineární algebra, kde si ukážeme potíže s řešením soustav lineárních rovnic na počítači a možnosti, jak se s tímto problémem vypořádat s důrazem na rozklady matic. Ukážeme si také aplikace lineární algebry v různých oborech. | | | |
| 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 Newtons 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 Landaus 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 Taylors 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. | | | |
| 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.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. | | | |

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| 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-ORL | Operations Research and Linear Programming | KZ | 5 |
| The subject aims to introduce students to the issues of operational research and primarily to the practical application of linear programming as a fundamental optimization technique. Operational research primarily focuses on the use of engineering methods (with a mathematical background) to solve practical problems (such as management). | | | |
| 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 |
| This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). | | | |
| 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. | | | |

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| 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-PS2 | Programming in shell 2 | Z,ZK | 4 |
| Students gain a general overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into shell and some other particular scripting languages and will get practical experience with shell script programming. | | | |
| 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-QUA | Quality Assurance | KZ | 4 |
| This course introduces students to the fundamentals of testing and quality management. Students will learn what the role of a tester is in the context of different types of software development and will experience hands-on application testing using both manual and automated testing. At the end of the semester, the student should be prepared to perform a test analysis, design a set of test scenarios, prepare test data, automate an appropriate portion of the scenarios, and prepare a report on the bugs found in the product under test. | | | |
| 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-SEP | World Economy and Business | Z,ZK | 4 |
| This course is presented in Czech. The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite. | | | |
| 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-SKJ.21 | Scripting Languages | Z,ZK | 4 |
| Students gain a general overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into shell and some other particular scripting languages and will get practical experience with shell script programming. | | | |
| 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. | | | |

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| 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. | | | |

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| 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 React. | | | |
| 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 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 and machine learning. Within the course, students will be introduced to exploratory data analysis, preprocessing, and ways of visualizing different kinds of data such as text, social networks, time series or basic image data processing. Students will get hands-on experience in applications of selected methods to real-world examples in the Python programming language. | | | |

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| BI-VMM | Selected Mathematical Methods | Z,ZK | 4 |
| The lecture begins with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then address Fourier series and their properties. Further, we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the wavelet transform. We examine the linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting 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-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. It improves computational thinking, empathy 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-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-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.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-CSI | Introduction to Computer Science | Z | 2 |
| This is an introductory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in other fields but interested in computer science, high-school students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. The goal of the class is to introduce and relate basic principles of computer science for students to understand, early on, what computer science is, why things such as high-level programming languages and tools are | | | |

done the way they are, and even how, on a basic yet representative and practically relevant level. After taking the class, students are able to answer not just basic computer science questions but also questions about themselves such as which courses to take next and which books to follow up with, ideally realizing if they are interested in computer science more than expected, or even less than before.

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| BIE-DIF | Differential equations | Z,ZK | 5 |

This course provides a foundational overview of differential equations, starting with basic motivation and examples of ODEs and progressing to essential solution methods like separation of variables. Key theorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered with methods like characteristic polynomial analysis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world applications. Finally, an introduction to partial differential equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving ODEs and PDEs, including implicit and explicit Euler methods, Runge-Kutta methods, and finite element methods for both ODEs and PDEs.

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| BIE-EEC | English language 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.

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| 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.

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| BIE-SEG | Systems Engineering | Z | 0 |

This is an introductory class on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles of operating systems for students to understand processor and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After taking the class, students are able to understand the difference between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what concurrency is, as opposed to parallelism, and how processes and threads synchronize efficiently to overcome concurrency for communication.

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| 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.

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| FI-TOP | Academic writing | Z | 2 |

Publishing is an important and required part of research activity. It is not only about obtaining research results but also about applying them in the form of publication. Writing scientific publications can be useful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the course, students will learn how to write a scientific article, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an article and reviewing someone else's article. The course will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Dates will be determined based on the availability of enrolled students.

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| NI-AFP | Applied Functional Programming | KZ | 5 |

This course is presented 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.

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| 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.

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| NI-DSP | Database Systems in Practes | Z,ZK | 4 |

This course is presented in Czech.

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| 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.

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| 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.

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| NI-LSM | Statistical Modelling Lab | KZ | 5 |

The subject is oriented on a single and multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is put on the effective use of the available information and its modeling using numpy and scipy. 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).

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| 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.

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| NI-MPL | Managerial Psychology | ZK | 2 |
| NI-MSI | Mathematical Structures in Computer Science | Z,ZK | 4 |

Mathematical semantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott model of lambda calculus. Introduction to category theory.

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| NI-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.

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| 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-PSD | Public Services Design | KZ | 4 |
| The course will introduce students to specifics of UX, Service design and development for public sector. We will look into the design and development process from the perspective of suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration with client representatives. Course is aimed at students-designers as well as clients. | | | |
| NI-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. | | | |
| 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 |
| TV2K1 | Physical Education 2 | Z | 1 |
| TVK1 | Physical Education | Z | 1 |
| 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
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