Study plan

Name of study plan: Bachelor Specialization Computer Engineering, 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 ur ena pro ro níky, které byly p ijaty ke studiu od

akademického roku 2021/2022 do prezen ní formy studia bakalá ského programu. . Garant: doc. Ing. Hana

Kubátová CSc., email: hana.kubatova@fit.cvut.cz

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 106

The role of the block: PP

Code of the group: BI-PP.21

Name of the group: Compulsory Courses of Bachelor Study Program Informatics, presented in Czech, version

2021

Requirement credits in the group: In this group you have to gain 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, Ond ej 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 Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	14		L,Z	PP
BI-BPR.21	Bachelor project Zden k Muziká Zden k Muziká (Gar.)	Z	1	0P+0C	Z,L	PP
BI-DBS.21	Database Systems Michal Valenta, Jan Blizni enko, Ji í Hunka, Monika Borkovcová, Jan Matoušek, Pavel K íž, Št pán Pechman, Dominik Roudný, Jan Bittner, Ji í Hunka Michal Valenta (Gar.)	Z,ZK	5	2P+2R+1L	L	PP
BI-DML.21	Discrete Mathematics and Logic Ji ina Scholtzová, Daniel Dombek, Jan Sp vák Daniel Dombek Jan Sp vák (Gar.)	Z,ZK	5	2P+1R+1C	Z	PP
BI-KAB.21	Cryptography and Security Ivana Trummová, Tomáš Rabas, Tomáš Zahradnický, Ji í Bu ek, Martin Jure ek, 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 Lud k Kleprlík, Jakub Krásenský, Karel Klouda Lud k Kleprlík Karel Klouda (Gar.)	Z,ZK	5	2P+1R+1C	Z	PP

BI-MA1.21	Mathematical Analysis 1 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 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 Petr Zemánek, Ji í Kašpar, Michal Štepanovský, Jan Trdli ka, Pavel Tvrdík, Ladislav Vagner Pavel Tvrdík Michal Štepanovský (Gar.)	Z,ZK	5	2P+1R+1L	L	PP
BI-PSI.21	Computer Networks Viktor erný, Michal Hažlinský, Vladimír Smotlacha, Yelena Trofimova, Jan Fesl, Josef Koumar, Petr Hoda, Josef Zápotocký, Michal Polák, Jan Fesl Jan Fesl (Gar.)	Z,ZK	5	2P+1R+1C	L	PP
BI-PST.21	Probability and Statistics 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 Radek Hušek, Jan Trávní ek, Miroslav Balík, Josef Vogel, Ladislav Vagner Jan Trávní ek Jan Trávní ek (Gar.)	Z,ZK	7	2P+2R+2C	Z	PP
BI-PA2.21	Programming and Algorithmics 2 Radek Hušek, Jan Trávní ek, Josef Vogel, Ladislav Vagner Jan Trávní ek Jan Trávní ek (Gar.)	Z,ZK	7	2P+1R+2C	L	PP
BI-SAP.21	Computer Structure and Architecture 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 Jan ezní ek, Jaroslav Borecký, Robert Hülle, Martin Kohlík, Vojt ch Miškovský, Martin Novotný, Matúš Olekšák Martin Novotný Martin Novotný (Gar.)	Z,ZK	5	2P+2C	Z	PP
BI-GIT.21	SW Development Technologies Petr Pulc, Robin Ob rka Robin Ob rka Petr Pulc (Gar.)	Z	3	2P	Z	PP
BI-TDP.21	Documentation and Presentation Ond ej Guth, Petra Pavlí ková, Dana Vynikarová, Alena Libánská, Tomáš Nová ek Dana Vynikarová Dana Vynikarová (Gar.)	KZ	3	2P+2C	Z,L	PP
BI-UOS.21	Unix-like Operating Systems Zden k Muziká, Petr Zemánek, Viktor erný, Michal Hažlinský, Jakub Jan i ka, Miroslav Prágl, Michal Šoch, Jan Trdli ka, Yelena Trofimova, Zden k Muziká Zden k Muziká (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.

BI-AAG.21 Automata and Grammars

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

 BI-BAP.21
 Bachelor Thesis
 Z
 14

 BI-BPR.21
 Bachelor project
 Z
 1

and they understand the relationships between formal languages and automata. They are introduced to the Turing machine and complexity classes P and NP.

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

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.

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-MA1.21 Mathematical Analysis 1 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. Mathematical Analysis 2 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 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 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. Probability and Statistics 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. Programming and Algorithmics 1 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 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). Computer Structure and Architecture 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. Technological Fundamentals of Computers 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** 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** ΚZ 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.

Unix-like Operating Systems

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-PI-PS.21

Name of the group: Compulsory Courses for Bachelor Specialization Computer Engineering, 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-APS.21	Architectures of Computer Systems Michal Štepanovský, Pavel Tvrdík Michal Štepanovský Pavel Tvrdík (Gar.)	Z,ZK	5	2P+2C	Z	PS
BI-JPO.21	Computer Units Pavel Kubalík Pavel Kubalík (Gar.)	Z,ZK	5	2P+2C	Z	PS
BI-LA2.21	Linear Algebra 2 Daniel Dombek, Lud k Kleprlík, Karel Klouda, Marta Nollová, Jakub Šístek Lud k Kleprlík Karel Klouda (Gar.)	Z,ZK	5	2P+2C	L	PS
BI-MPP.21	Methods of interfacing peripheral devices Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	Z	PS
BI-PNO.21	Practical Digital Design Martin Novotný Martin Novotný Martin Novotný (Gar.)	KZ	5	2P+2C	Z	PS
BI-SRC.21	Real-time systems Hana Kubátová, Ji í Vysko il Jaroslav Borecký Hana Kubátová (Gar.)	Z,ZK	5	2P+2C	Z	PS
BI-VES.21	Embedded Systems Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	L	PS
BI-ZRS.21	Basics of System Control Kate ina Hyniová Kate ina Hyniová Kate ina Hyniová (Gar.)	Z,ZK	5	2P+2C	Z	PS

Characteristics of the courses of this group of Study Plan: Code=BI-PI-PS.21 Name=Compulsory Courses for Bachelor Specialization Computer Engineering, version 2021

BI-APS.21 Architectures of Computer Systems

Z,ZK

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-JPO.21 Computer Units Z,ZK

Students deepen their basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detail with the internal structure and organization of computer units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using appropriate codes for implementation of multiplication. The organization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, including codes for error detection and correction for parallel and serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of communication of the processor with the environment and the architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational microprogrammed processor simulator and programmable hardware design kits (FPGA).

BI-LA2.21 Linear Algebra 2 Z.ZK

5

Studenti si v tomto p edm tu rozší í znalosti z p edm tu BI-LA1, kde se pracovalo pouze s vektory ve form n-tic ísel. Zde si zavedeme vektorový prostor v abstraktní obecné form Seznámíme se také s pojmem skalární sou in a lineární zobrazení, což nám dovolí ukázat souvislost s lineární algebrou, geometrií a po íta ovou grafikou. Dalším velkým tématem bude numerická lineární algebra, kde si ukážeme potíže s ešením soustav lineárních rovnic na po íta i a možnosti, jak se s tímto problémem vypo ádat s d razem na rozklady matic. Ukážeme si také aplikace lineární algebry v r zných oborech.

Methods of interfacing peripheral devices

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.

Practical Digital Design

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-SRC.21 Real-time systems

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-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-ZRS.21 **Basics of System Control**

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.

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-PI-PV.21

Name of the group: Compulsory elective courses in Computer Engineering, 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-BEK.21	Secure Code Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	2P+2C	L	PV
BI-PJP.21	Programming Languages and Compilers Jan Janoušek, Tomáš Pecka Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	L	PV
BI-ZUM.21	Artificial Intelligence Fundamentals Pavel Survnek Pavel Survnek (Gar.)	Z,ZK	5	2P+2C	L	PV

Characteristics of the courses of this group of Study Plan: Code=BI-PI-PV.21 Name=Compulsory elective courses in Computer Engineering, version 2021

BI-BEK.21 Secure Code 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-PJP.21 **Programming Languages and Compilers** 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-ZUM.21 Artificial Intelligence Fundamentals 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.

Name of the block: Povinná t lesná 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 Ji í 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

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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 angli tiny

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.

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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.

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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 Kate ina Valentová Kate ina Valentová (Gar.)	Z,ZK	2	2D	L	PJ
BIE-EEC	English language external certificate Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	4	2D	L	PJ
BI-ANG	English Language, Internal Certificate Kate ina Valentová Kate ina 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

	0 1 7					
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2			
BIE-EEC	English language external certificate	Z	4			
The BIE-ECC course ca	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 exceed					
the B2 level of the Com	mon 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 Ji í Kašpar, 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 Lud k Ku era Lud k Ku era Lud k Ku era (Gar.)	Z,ZK	4	2P+1C	L	V
BI-A2L	English language, preparation for the B2 level exam Kate ina Valentová Kate ina Valentová (Gar.)	Z	2	2C	L	V
BI-APJ	Aplication Programming in Java Ji í Dan ek	Z,ZK	4	2P+1R+1C	Z	V
NI-AFP	Applied Functional Programming Robert Pergl, Marek Suchánek, Daniel N mec 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 Ba inka Lukáš Ba inka Lukáš Ba inka (Gar.)	Z,ZK	4	2P+2C	L	V

NI-DSP	Database Systems in Practes	Z,ZK	4	2P+1C	L	V
BI-STO	Tomáš Vichta Tomáš Vichta Tomáš Vichta (Gar.) Storage and Filesystems	Z,ZK	4	2P+2C	L,Z	V
NI-PSD	Public Services Design David Pešek, Ond ej Brém David Pešek Ond ej Brém (Gar.)	KZ	4	1P+2C		V
BIE-DIF	Differential equations Antonella Marchesiello, Jan Valdman, Ond ej Bouchala Tomáš Kalvoda Ond ej 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 Martin Ka er Martin Ka er (Gar.)	KZ	4	2P+2C	Z	V
BI-EP2	Efficient Programming 2 Martin Ka er Martin Ka er (Gar.)	KZ	4	2P+2C	L	V
BI-ANGK	English language, contact preparation for the B2 level exam Kate ina Valentová (Gar.)	Z	2	2C	Z,L	V
BI-EJA	Enterprise Java Ji í Dan ek	Z,ZK	4	2P+2C	L	V
BI-EJK	Enterprise Java and Kotlin Ji í Dan ek Ji í Dan ek Ji í Dan ek (Gar.)	Z,ZK	4	2P+2C	L	V
BI-FMU	Financial and Management Accounting David Buchtela	Z,ZK	5	2P+2C	Z	V
BI-HAM	HW accelerated network traffic monitoring Tomáš ejka, Karel Hynek Tomáš ejka Tomáš ejka (Gar.)	KZ	4	2P+1C	L	V
BI-HMI	History of Mathematics and Informatics Alena Solcová Alena Šolcová (Gar.)	Z,ZK	3	2P+1C	L	V
BI-ARD	Interactive applications on Arduino Jan ezní ek, Ji í Cvr ek, Robert Hülle, Vojt ch Miškovský Robert Hülle Robert Hülle (Gar.)	KZ	4	3C	L	V
NI-IAM	Internet and Multimedia Ji í Melnikov	Z,ZK	4	2P+1C	L	V
BIE-CSI	Introduction to Computer Science Christoph Kirsch Christoph Kirsch (Gar.)	Z	2	2C	Z	V
FITE-EHD	Introduction to European Economic History Tomáš Evan	Z,ZK	3	2P+1C	L	V
BIE-IMA2	Introduction to Mathematics 2 Karel Klouda	Z	2	1C	Z	V
BI-CS2	C# language and data access Pavel Št pán Pavel Št pán Pavel Št pán (Gar.)	KZ	4	0P+3C	Z	V
BI-CS3	Language C# - design of web applications Pavel Št pán Pavel Št pán (Gar.)	KZ	4	3C	Z	V
BI-SQL.1	Language SQL, advanced Michal Valenta Michal Valenta (Gar.)	KZ	4	3C	L	V
BI-QAP	Quantum algorithms and programming Tomáš Kalvoda, Ivo Petr Ivo Petr (Gar.)	KZ	5	1P+2C	Z	V
NI-LSM	Statistical Modelling Lab Kamil Dedecius Kamil Dedecius (Gar.)	KZ	5	3C	L	V
BI-HAS	Human Aspects in Cryptography and Security Ivana Trummová Ivana Trummová (Gar.)	Z,ZK	5	2P+1C	Z	V
NI-MPL	Managerial Psychology Jan Fiala Jan Fiala (Gar.)	ZK	2	2P	Z,L	V
NI-MSI	Mathematical Structures in Computer Science Jan Stary	Z,ZK	4	2P+1C	L	V
BI-MPP.21	Methods of interfacing peripheral devices Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-MIT	Mikrotik technologies Jan Fesl Jan Fesl (Gar.)	KZ	3	1P+2C	Z	V
NI-MOP	Modern Object-Oriented Programming in Pharo Jan Blizni enko Robert Pergl Robert Pergl (Gar.)	KZ	4	3C	Z	V
BI-MVT.21	Modern Visualisation Technologies Ji í Chludil, Petr Pauš Petr Pauš (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-MMP	Multimedia team project Zde ka echová Zde ka echová (Gar.)	KZ	4	3C	Z,L	V
BI-ORL	Operations Research and Linear Programming Dušan Knop Dušan Knop Dušan Knop (Gar.)	KZ	5	1P+2C	L	V
NI-OLI	Linux Drivers Miroslav Skrbek, Jaroslav Borecký Jaroslav Borecký Miroslav Skrbek (Gar.)	Z,ZK	4	2P+2C	L	V
BI-ACM	Programming Practices 1 Tomáš Valla Tomáš Valla (Gar.)	KZ	5	4C	L	V
BI-ACM2	Programming Practices 2 Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	KZ	5	4C	Z	V
BI-ACM3	Programming Practices 3 Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	KZ	5	4C	L	V
BI-ACM4	Programming Practices 4 Ond ej Suchý, Tomáš Valla Tomáš Valla Ond ej Suchý (Gar.)	KZ	5	4C	Z	V

BI-AND.21	Programming for the Android Operating System Jan Mottl, Jan Vep ek, Marek Kodr, Petr Šíma Jan Mottl Marek Kodr (Gar.)	KZ	4	3C	L	V
BI-CS1	Programming in C# Pavel Št pán, Helena Wallenfelsová Helena Wallenfelsová Pavel Št pán (Gar.)	KZ	4	3C	L,Z	V
BI-PJV	Programming in Java Miroslav Balík, Jan Blizni enko, Ji í Borský, Jan Zimolka Miroslav Balík Miroslav Balík (Gar.)	Z,ZK	4	2P+2C	Z,L	V
BI-PJS.1	JavaScript Programming Old ich Malec	KZ	4	3C	L	V
BI-KOT	Programing in Kotlin Ji í Dan ek Ji í Dan ek (Gar.)	Z,ZK	4	2P+2C	L	V
NI-PSL	Programming in Scala Ji í Dan ek Ji í Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	V
BI-PMA	Programming in Mathematica	Z,ZK	4	2P+2C	Z,L	V
BI-PHP.1	Zden k Buk Zden k Buk (Gar.) Programing in PHP	KZ	4	3C	Z	V
BI-PS2	Programming in shell 2	Z,ZK	4	2P+2C	L	V
NI-PDD	Lukáš Ba inka Data Preprocessing	Z,ZK	5	2P+1C	 	V
	Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.) Introduction to mathematics	·		21 110		
BI-PKM	Tomáš Kalvoda Tomáš Kalvoda Tomáš Kalvoda (Gar.)	Z	4		Z	V
NI-REV	Reverse Engineering Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	1P+2C	Z	V
BI-SCE1	Computer Engineering Seminar I Hana Kubátová Hana Kubátová (Gar.)	Z	4	2C	L,Z	V
BI-SCE2	Computer Engineering Seminar II Hana Kubátová Hana Kubátová Hana Kubátová (Gar.)	Z	4	2C	L,Z	V
BI-ST1	Network Technology 1 Alexandru Moucha Alexandru Moucha (Gar.)	Z	3	2C	Z	V
BI-ST2	Network Technology 2 Alexandru Moucha Alexandru Moucha (Gar.)	Z	3	3C	L	V
BI-ST3	Network Technology 3 Alexandru Moucha Alexandru Moucha (Gar.)	Z	3	2C	Z	V
BI-ST4	Network Technology 4 Alexandru Moucha Alexandru Moucha (Gar.)	Z	3	2C	L	V
BI-SKJ.21	Scripting Languages Lukáš Ba inka, Jan Ž árek Lukáš Ba inka Jan Ž árek (Gar.)	Z,ZK	4	2+2	L	V
BI-SOJ	Machine Oriented Languages	Z,ZK	4	2P+2C	L	V
FIT-SEP	World Economy and Business	Z,ZK	4	2P+2C	L	V
BI-SEP	World Economy and Business Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	4	2P+2C	L	V
NI-SYP	Parsing and Compilers Jan Janoušek Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	Z	V
BI-GIT	Version control system GIT Petr Pulc	KZ	2	16P	Z,L	V
BIE-SEG	Systems Engineering Christoph Kirsch Christoph Kirsch (Gar.)	Z	0	2C	Z	V
TVK1	Physical Education Luboš Neuman Ji í 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 Dušan Knop, Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	V
BI-TS2	Theoretical Seminar II Dušan Knop, Ond ej Suchý, Tomáš Valla Tomáš Valla Ond ej Suchý (Gar.)	Z	4	2C	L	V
BI-TS3	Theoretical Seminar III Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	Z	V
BI-TS4	Theoretical Seminar IV Ond ej Suchý, Tomáš Valla Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	L	V
				100 10	- .	.,
BI-TDA	Test driven architecture Marek Hakala	KZ	4	2P+1C	Z,L	V

BI-QUA	Quality Assurance Marek Kodr, Martin Pilný, Kate ina Kalášková Kate ina Kalášková Marek Kodr (Gar.)	KZ	4	3C	z	V
FI-TOP	Academic writing Tomáš Nová ek	Z	2	10B	Z	V
BI-CCN	Compiler Construction Christoph Kirsch Christoph Kirsch (Gar.)	Z,ZK	5	2P+1C	L	V
BI-TEX	TeX and Typography Petr Olšák Petr Olšák Petr Olšák (Gar.)	Z,ZK	4	2P+1C	L	V
BI-EHD	Introduction to European Economic History Tomáš Evan Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	3	2P+1C	Z,L	V
BI-KSA	Cultural and Social Anthropology Tomáš Houdek, Alena Libánská, Jakub Šenovský Jakub Šenovský Alena Libánská (Gar.)	ZK	2	2P	Z,L	V
BI-ULI	Introduction to Linux Zden k Muziká, Petr Zemánek, Jan Ž árek Zden k Muziká Zden k Muziká (Gar.)	Z	2	4D	Z	V
BI-OPT	Introduction to Optical Networks Pavel Tvrdík	Z,ZK	4	2P+1C	Z	٧
NI-VCC	Virtualization and Cloud Computing Tomáš Vondra, Jan Fesl Tomáš Vondra Tomáš Vondra (Gar.)	Z,ZK	5	2P+1C	L	V
BI-VHS	Virtual game worlds Radek Richtr	ZK	4	2P+2C	Z	V
BI-VR1	Virtual reality I Petr Pauš, Petr Klán Petr Klán (Gar.)	KZ	4	2P+2C	L,Z	V
BI-VR2	Virtual reality II Petr Klán Petr Klán Petr Klán (Gar.)	KZ	3	1P+2C	L	V
BI-VAK.21	Selected Applications of Combinatorics Michal Opler Michal Opler Michal Opler (Gar.)	Z	3	2R	L	V
BI-VMM	Selected Mathematical Methods Marzieh Forough Tomáš Kalvoda Tomáš Kalvoda (Gar.)	Z,ZK	4	2P+2C	L	V
NI-VYC	Computability Jan Starý Jan Starý Jan Starý (Gar.)	Z,ZK	4	2P+2C	L	V
BI-ZS10	Bachelor internship abroad for 10 credits Zden k Muziká Zden k Muziká (Gar.)	Z	10		Z,L	V
BI-ZS20	Bachelor internship abroad for 20 credits Zden k Muziká Zden k Muziká (Gar.)	Z	20		Z,L	V
BI-ZS30	Bachelor internship abroad for 30 credits Zden k Muziká Zden k Muziká (Gar.)	Z	30		Z,L	V
BI-ZIVS	Intelligent Embedded System Fundamentals Miroslav Skrbek Miroslav Skrbek (Gar.)	KZ	4	1P+3C	Z	V
BI-ZPI	Process engineering Robert Pergl Robert Pergl (Gar.)	KZ	4	1P+2C	L	V
BI-ZNF	PHP Framework Nette - basics Ji í Chludil	KZ	3	2P+1C	L	V
BI-IOS	Fundamentals of iOS Application Development for iPhone and iPad Rostislav Babá ek, Igor Rosocha Martin P Ipitel Martin P Ipitel (Gar.)	KZ	4	2C	Z	V
BI-ZWU	Introduction to Web and User Interfaces Lukáš Ba inka Lukáš Ba inka Jakub Klímek (Gar.)	Z,ZK	4	2P+2C	L	V
BI-3DT.1	3D Printing Miroslav Hron ok, Tomáš Sýkora Tomáš Sýkora Miroslav Hron ok (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

BI-MPP.21 Z,ZK Methods of interfacing peripheral devices 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. TVK1 Physical Education Z TVV Physical education Z 0 TV1 Physical Education Z 0 TVV0 Ζ Physical education 0 TV2 Physical Education Ζ 0 TVKLV Z **Physical Education Course** 0 Z **TVKZV** Physical Education Course 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 Z,ZK Algorithms visually 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

The course complements other algorithm courses at F11. 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 Achieve		
active part in the language instructionMeet the requirements for writing assignments - Summary, Abstract, Argumentation PaperSucceed in both the control of the contr		
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 teacher	rs during the first
class of the term.	7 71/	4
BI-APJ Aplication Programming in Java This course is presented in Czech. Advanced technologies in Java.	Z,ZK	4
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 paradigms.	1	
the rise nowadays and the functional paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, m		
necessary competence of a software engineer: the theory and especially the practice.	g p	g
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		he areas of state
space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary alg	orithms and the neu	ral 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 the		
animation. It offers a complete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graphs and provided in the provided introduction of Blender environment.)		
NI-DSP Database Systems in Practes	Z,ZK	4
This course is presented in Czech.	7.71	
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 load balancing and high availability.	d archiving, as so as	storage scaling,
	KZ	4
NI-PSD Public Services Design The course will introduce students to specifics of UX, Service design and development for public sector. We will look into the design and development	I	
suppliers (devs and designesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaborations.	•	
Course is aimed at students-designers as well as clients.	a	
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 esse		-
of variables. Key theorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered		-
polynomial analysis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world applic	ations. Finally, an in	troduction to
partial differential equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving C	DEs and PDEs, inc	luding 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 practic	-	· ·
implement and have an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background the	at is also valuable ou	itside the domain
	DP compression de	blurring in
of digital image processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, H	=	_
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gradient	y conversion, contex	kt enhancement,
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting	y conversion, contex	kt enhancement,
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gradient	y conversion, contex , adding depth, alph KZ	kt enhancement, a matting.
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining	y conversion, contex , adding depth, alph KZ ands on experience	t enhancement, a matting. 4 with large scale
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain here	y conversion, contex , adding depth, alph KZ ands on experience	t enhancement, a matting. 4 with large scale
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hadata processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementation.	y conversion, contex , adding depth, alph KZ ands on experience	t enhancement, a matting. 4 with large scale
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain he data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementat approaches to parallelize other algorithms. The course is prezented in czech language.	y conversion, contex, adding depth, alph KZ ands on experience ions and will be cap.	t enhancement, a matting. 4 with large scale able to propose
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gradinteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain he data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementate approaches to parallelize other algorithms. The course is prezented in czech language. BI-EP1.24 Effective programming 1	y conversion, contex, adding depth, alph KZ ands on experience ions and will be cap.	t enhancement, a matting. 4 with large scale able to propose
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain he data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementat approaches to parallelize other algorithms. The course is prezented in czech language. BI-EP1.24 Effective programming 1 The course is taught in Czech. BI-EP2 Efficient Programming 2 Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving to the parallelized programming 1.	y conversion, contex, adding depth, alph KZ ands on experience ions and will be cap:	t enhancement, a matting. 4 with large scale able to propose 4
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain he data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementat approaches to parallelize other algorithms. The course is prezented in czech language. BI-EP1.24 Effective programming 1 The course is taught in Czech. BI-EP2 Efficient Programming 2 Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving with the aim to choose the best one and avoid implementation errors.	y conversion, contex, adding depth, alph KZ ands on experience ions and will be capa KZ	t enhancement, a matting. 4 with large scale able to propose 4 4 are discussed,
frequency domain, abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-grainteractive as-rigid-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting NI-DDM Distributed Data Mining Course focuses on state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain he data processing framework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementate approaches to parallelize other algorithms. The course is prezented in czech language. BI-EP1.24 Effective programming 1 The course is taught in Czech. BI-EP2 Efficient Programming 2 Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving with the aim to choose the best one and avoid implementation errors. BI-ANGK English language, contact preparation for the B2 level exam	y conversion, contex, adding depth, alph KZ ands on experience ions and will be capa KZ KZ Individual problems	t enhancement, a matting. 4 with large scale able to propose 4 4 are discussed,
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·	applications on Arduino	KZ	4
	rst grade of bachelor study as introduction to embedded systems. Students will learn how to design simple app nelp of available libraries. The goal of the subject is to show varied software approaches to control embedder		
	ossible control on higher (objective) layer, this platform is frequently used for artist performance and therefor	e is suitable even	for Web and
Software Engineering students.	N Multimadia	7 71/	4
· ·	d Multimedia oles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes a	Z,ZK cquisition of AV sig	-
	vork communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practic		
	bs, students will practically assemble AV transmission chains using HW and SW technologies and verify the ons. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recordin		
for audience.	ons. Students will learn now to build internet inhastructure for end-to-end AV transmissions from the recordin	g the scene up to	ine presentation
BIE-CSI Introduction	to Computer Science	Z	2
	ary Computer Science for broad audiences: bachelor students in computer science, students majoring in other		
-	with a background in basic math and the desire to understand the absolute basics of computer science. The science for students to understand, early on, what computer science is, why things such as high-level progra	-	
· · ·	n a basic yet representative and practically relevant level. After taking the class, students are able to answer		
	nselves such as which courses to take next and which books to follow up with, ideally realizing if they are into	erested in compute	er science more
than expected, or even less than before. FITE-EHD Introduction	n to European Economic History	Z,ZK	3
·	ernes from the European economic history. It gives the student basic knowledge about forming of the global (-
	an countries have been dominant actors in this process it focuses predominantly on their roles in the econom		-
	of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial ins	•	
does not cover detailed economic histor meetings will consist of a mixture of lect	ry of particular European countries but rather the impact of trade and role of particular events, institutions an ture and discussion.	d organizations in	nistory. Class
	to Mathematics 2	Z	2
-	of elementary functions and their properties. Students understand basic mathematical principles and they a	re able to apply th	em in particular
examples. BI-CS2 C# languag	a and data access	V7	4
	e and data access se objective is to introduce students several data access technologies - database, XML, NoSQL - on the Mic	KZ crosoft platform Th	4 le students will
	a - Connection, Command, Data Reader and DataAdapter v ADO.NET. Next, they will learn to use current te	•	
	ata, integrated directly with the .NET platform languages, which enable LINQ use with Objects, XML and SQL	`	-
· · · · · · · · · · · · · · · · · · ·	the Entity Framework - an object-relational mapper that enables .NET developers to work with relational data es Code First, Database First, Model First approaches. The students will also get to know the Conceptual Mo		
(XML description).		ouel, etc.uge meu	or and mapping
, ,	C# - design of web applications	KZ	4
	it technologies in web application development on the .NET platform.They will acquire a comprehensive overvi • WebAPI and to use it by client programs.	ew of the developn	nent possibilities
	SQL, advanced	KZ	4
1 3 3	l in BI-DBS. Students become familiar with advanced relational and non-relational features of SQL language. I	1	•
	rt, object-relational constructions. Part of the course is dedicated to practical database optimization from the po		
	irganized tables, and materialized views. as well as from the point of view query optimization. Execution plan discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Ora		· ·
PostgreSQL.			, , ,
	gorithms and programming	KZ	5
5 5	n experience with quantum computers and their programming. We focus on fundaments of quantum mechanic antages and limitations of quantum computing. During tutorials students work in open-source software devel	•	٠ ا
_	ar algebra at the level of BI-LA1 and BI-LA2 (or BI-LIN) is necessary. Previous completion of BI-MA2 or BI-VI	=	
might be an advantage. No previous kno	owledge of physics is assumed.		
	Modelling Lab	KZ	5
_	multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is sing numpy and scipy. The second half of the semester is focused on the design of methods and algorithms,	=	
	r of own research and may result in the topic of final work (diploma or bachelor thesis).		
	ects in Cryptography and Security	Z,ZK	5
	ot only in technical scope of computer science, but also in making products usable - for users and for develop Islan and analyse their own projects in the context of human-centered security.	pers. Students of the	nis course can
NI-MPL Managerial		ZK	2
	al Structures in Computer Science	Z,ZK	4
	g languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Sco		a calculus.
Introduction to category theory.		1/7	
BI-MIT Mikrotik tec	NNOIOGIES ds in the introduction of the RouterOS operating system and some network Mikrotik technologies which are a	KZ	the small and
	. The students learn how to use and create the architectures of the network solutions which are based on the		
	deploy them. The successful completion of this subject requires the previous knowledge of elementary computer	er networks conce	ots like protocols
	ork and transport layer of the OSI model. ject-Oriented Programming in Pharo	KZ	4
	ly one of the most widespread paradigms of software creation, especially enterprise information systems, wh	1 1	
is used to build complex modern application	tions. 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
	t system Pharo (https://pharo.org). The course focuses on individual approach to students, their developmen		
	ing skills, which are generally applicable in other OO languages, students will also gain the opportunity to wo with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct invol		-
	ualisation Technologies	Z,ZK	5
The goal of the course is to give an over	rview of modern visualization technologies and their principles, namely technologies related to virtual and au	igmented reality, v	
- · · · · -	I video mapping) and their applications in practice. Several lectures deal with the content creation for the ment lata visualization, and 3D model scanning.	ioned technologie	s, namely fractal
ana procedurar violanzarion, soientille u	and recommending and op moder countring.		

BI-MMP Multimedia team project This course is presented in Czech.	KZ	4
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 fun		_
Operational research primarily focuses on the use of engineering methods (with a mathematical background) to solve practical problems (such as m	anagement).	
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		
increase the variability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development course provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical experience		udents. The
BI-ACM Programming Practices 1	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.	I IXE	3
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 This course is presented in Czech.	KZ	4
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 fundamenta		•
operators, arrays, loops, definitions and calls of functions will be discussed. Attention is focused on the object oriented programming in C# - class de		
constructors, methods, properties, static members, Garbage Collector, inheritance and polymorphism, collections, delegates, and generics. Debuggi		
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 developmer 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	-	
of study.	or triis course in tr	icii 4tii 3ciiic3tci
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 adv	anced 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 The source introduces the modern programming lenguage Scale which evaluits chiest functional paradism. Scale comprises advance lenguage fact	Z,ZK	4
The course introduces the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language feat advance standard library. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks		-
Scalaz, etc.	and nordings org.	ray, caccarrara,
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 program	'	ed 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		
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 register for this course in their 3rd semester of study.	IOI BIE-TWA.T. I	ney should
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 ad-		
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 for further processing and analysis.		-
time series, etc., and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characte	ristics from image	s or from web
pages. BI-PKM Introduction to mathematics	Z	4
This course is presented in Czech.		4
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		
is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dec	dicated 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 d		
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 comput the course is on the seminars, where students will solve practically oriented tasks from the real world.	er malware scene	e. The focus of
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.		
are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of		
articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar tead	chers. The topics	are new for each
semester.		
BI-SCE2 Computer Engineering Seminar II The Seminar of Computer Engineering is a (a) elective source for students who want to deal with deeper topics of digital decign, reliability and resistance.	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 are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of		
articles and other professional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers and other professional literature and/or work in K N laboratories.		
semester.	·	

BI-ST1			
	Network Technology 1	Z	3
	to providing the students basic information and practical skills from the area of digital and IP networks. The subject is acredite	ed under the Cisc	o Netacad -
CCNA1 - R&S Intro			
BI-ST2	Network Technology 2	Z	3
This course is presented		7	0
BI-ST3	Network Technology 3	Z	3
	nance their knowledge acquired from previous BI-ST1 and BI-ST2 courses. Principles of routing and switching presented durin The course. Students will be able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, prec	-	
simple topology, security		dictability, exterior	on beyond a
BI-ST4	Network Technology 4	Z	3
	nance their knowledge already acquired from previous BI-ST1, BI-ST2, and BI-ST3 courses. Principles of routing and switchin		
	ner extended in BI-ST3. Students were able to start fine-tune protocols' settings to gain certain advantages like increased effi		- 1
beyond a simple topolog	gy, security, etc. This module teaches students to configure and fine-tune Wide Area Networks and to experience a completely	y other type of ne	twork (Non
Broadcast Multiple Acce	ess) which radically differs from well-known Ethernet (broadcast) type of networks. Students will also manage router and switch	ch firmware, perfo	orm password
recoveries, and emerge	ncy procedures. Also the security aspect is treated; students will learn possible intra- and inter-network attacks and the mitiga	ation ways while i	maintaining the
network running.			
BI-SKJ.21	Scripting Languages	Z,ZK	4
	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In add	dition, they gain a	deeper insight
	er particular scripting languages and will get practical experience with shell script programming.		
BI-SOJ	Machine Oriented Languages	Z,ZK	4
	vill gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal	•	
· · · · · · · · · · · · · · · · · · ·	n of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of view used during reverse engineering, optimization, and evaluation of code security.	w iinkea to nigner	lever languages.
FIT-SEP	World Economy and Business	Z,ZK	4
_	d in Czech. The course introduces students of technical university to the international business. It does that predominantly by		-
•	economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well		
· -	c development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form o		
•	take bachelor level of this course BIE-SEP as a prerequisite.		
BI-SEP	World Economy and Business	Z,ZK	4
_	d in Czech. The course introduces students of technical university to the international business. It does that predominantly by	,	dual 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 eco	onomic freedom,
corruption and economi	c development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form o	f discussions bas	ed 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 knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of	f various variants	and applications
	troduced to special applications of parsers, such as incremental and parallel parsing.		
BI-GIT	Version control system GIT	KZ	2
	ced to basic principles of version control systems. These principles will be then shown on DCVS Git both theoretically and pra		articular system
	n details will be shown. Students will be challenged to use Git as users, project managers, team leaders as well as Git server		
BIE-SEG	Systems Engineering	Z	0
-	lass on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles r and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After takir		
•	ce between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what cor	ng the class, stud	erits are able to
		ncurrency is lasio	nnosed to
	poesses and threads synchronize efficiently to overcome concurrency for communication.	ncurrency is, as o	pposed to
parallelism, and how pro	ocesses and threads synchronize efficiently to overcome concurrency for communication.		
parallelism, and how pro	pocesses and threads synchronize efficiently to overcome concurrency for communication. Physical Education 2	Z	1
parallelism, and how pro TV2K1 BI-TS1	Physical Education 2 Theoretical Seminar I	Z Z	1 4
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in	pocesses and threads synchronize efficiently to overcome concurrency for communication. Physical Education 2	Z Z ssical reading gro	1 4 up. The students
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a	Physical Education 2 Theoretical Seminar I Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class	Z Z ssical reading gro	1 4 up. The students
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a other scholarly literature	Physical Education 2 Theoretical Seminar I Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	Z Z ssical reading gro	1 4 up. The students
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a other scholarly literature BI-TS2	Physical Education 2 Theoretical Seminar I Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a. The capacity is limited by the the potentials of the teachers of the seminar.	Z Z scical reading gro a work with scie	1 4 up. The students ntific papers and
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a other scholarly literature BI-TS2 Theoretical seminar is in are treated individually a	Physical Education 2 Theoretical Seminar I Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is an expectation of the course is an expectation of the potentials of the teachers of the seminar. Theoretical Seminar II Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	Z sical reading gro a work with scie Z sical reading gro	1 4 up. The students ntific papers and 4 up. The students
parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a other scholarly literature BI-TS2 Theoretical seminar is in are treated individually a other scholarly literature	Physical Education 2 Theoretical Seminar I Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is an expectation of the seminar. Theoretical Seminar II Intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a The capacity is limited by the the potentials of the teachers of the seminar.	Z Z scical reading gro a work with scie Z Scical reading gro a work with scie	1 4 up. The students ntific papers and 4 up. The students
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parallelism, and how pro TV2K1 BI-TS1 Theoretical seminar is in are treated individually a other scholarly literature. BI-TS2 Theoretical seminar is in are treated individually a other scholarly literature. BI-TS3 Theoretical seminar is in are treated individually a other scholarly literature. BI-TS4 Theoretical seminar is in are treated individually a other scholarly literature. BI-TS4 Theoretical seminar is in are treated individually a other scholarly literature. BI-TDA The course is focused of world. This course has a NI-TSP Students will gain know the intuitive path sensiti will be able to compute, BI-QUA This course introduces a development and will exited the scholarly literature.	Physical Education 2 Theoretical Seminar I tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is an according to the seminar. Theoretical Seminar II tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is an according to the seminar. Theoretical Seminar III tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is an according to the seminar. Theoretical Seminar III tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a trace to students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a trace themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a trace according to the seminar. Theoretical Seminar IV Tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a trace according to the seminar. Test driven architecture In practical examples of how to develop, test, and deploy so	Z Sisical reading groes a work with scie X Sisical reading groes a work	1 4 up. The students ntific papers and 4 the DevOps roject. 5 with the help of equipment. They 4 of software o perform a test

Publishing is an important an publications can be useful for	cademic writing Indirequired part of research activity. It is not only about obtaining research results but also about applying them in the force or students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the cut parts such an article should have, and how the peer review process works. Students will also try their hand at presenting a	ourse, students w	vill learn how to
	Il be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. I		- 1
BI-CCN Co	ompiler Construction	Z,ZK	5
This is an introductory class	s on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme	=	students to
BI-TEX Te	X and Typography	Z,ZK	4
This course is presented in Crules.	Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of the	ne course focuses	s on typographic
I I	troduction to European Economic History Czech. However, there is an English variant in the program Informatics (B1801 / 4753).	Z,ZK	3
l l	ultural and Social Anthropology	ZK	2
anthropological research fro	ims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diver om our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, he	•	
shown. The course is preser BI-ULI Int		Z	2
Students become familiar wi	troduction to Linux - ith the basics of the Linux operating system using e-learning form. They learn to work with the command line and become te system. Topics can be studied first theoretically and then practically verified in a virtual machine (terminal).		
	troduction to Optical Networks	Z,ZK	4
l l	v of optical networking technology with the emphasis on practical utilization in Internet and in network infrastructures, on po	, ,	
-	gy and on their solutions. The course will include the history of optical communications, an overview of passive component		-
	nd others), and an overview of active components (optical switches and amplifiers, high-speed coherent transmission sys presented at premium research conferences, such as ECOC or OFC. Attention will also be paid to new applications, such		
	er, or sensor networks. The labs will focus on real work with optical components and on measurement of their parameters		
	rtualization and Cloud Computing	Z.ZK	5
· ·	le of architectures of large computer systems that are used in data centers and computer infrastructure of companies and	, ,	-
•	on principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficient the state of the		
•	modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effecti mputer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skill		,
= :	ntinuous integration and development).	is in the use of the	deminiegration
-	rtual game worlds	ZK	4
l l	o create a complex virtual world. The course is a continuation of basic graphical courses (MGA, PGR, BLE,). This current st	ı tudents knowledg	je is furthermore
	y of game design, principles of writing dialogues and characters in order to create a functional and complex virtual world. task of converting scenes and their dynamics into a fully virtual environment suitable for VR devices.	The course can b	pe followed by
I	rtual reality I	KZ	4
	y (VR), virtual reality operating system and virtual reality creation. Another objective is to meet the rules and requirements		
and shared social activities.	ways of teaching using virtual reality technologies and interactive activities in educational virtual 3D worlds. It improves co	mputational think	drig, empatry
	rtual reality II	KZ	3
	/irtual Reality I. The new course focuses on collaborative telepresence, spatial computing and social life of avatars. The ot amification in various social metaverse and desktop engines.	bjective is to deve	elop applications
	elected Applications of Combinatorics	Z	3
	e students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the	ı	-
	neory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some ba		
	of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) in		
•	olved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimi. Ons to the studied problems with a special focus on the effective use of existing tools.	zation and more.	Students will
	elected Mathematical Methods	Z,ZK	4
l l	ntroduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then a		
-	duce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the		
	olem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples.		
· ·	omputability e functions and effective computability.	Z,ZK	4
	achelor internship abroad for 10 credits	Z	10
	in his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or r		
•	FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the profess BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits o		
	nstitution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided	•	
exceeds the academic year's	•	·	
	achelor internship abroad for 20 credits	Z	20
	in his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/or r		
•	FIT, or the vice-dean for study affairs assesses the professional content. The student must provide evidence of the profess s BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits o		
	nstitution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divided	· ·	
exceeds the academic year's	·		

BI-ZS30	Bachelor internship abroad for 30 credits	Z	30
Each student can on	ce within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific and/o	r research institution	on. 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 profe	ssional content an	d extent of the
internship. Auxiliary of	ourses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits	s correspond to 4 v	weeks of full-time
employment with a fo	reign institution. The maximum number of credits a student can earn for one internship is 30 credits. This amount can be divide	ed into two subject	s if the internship
exceeds the academ	ic 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 ain	n of the course is t	o teach students
modern humanoid ro	bot control and development of applications in a graphical development environment. Lectures provide fundamentals of motion	control, sensor rea	ading, application
interfaces, robot navi	gation and development tools. In labs, students program a set of basic task by using the robot simulator and real hardware to	get practical exper	ience with these
technologies.			
BI-ZPI	Process engineering	KZ	4
	Process engineering ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles	1	1
Students will learn fu		s of process mode	lling and they will
Students will learn full learn basics of the us	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles	s of process mode f business process	lling and they will es using modern
Students will learn fullearn basics of the us CASE tools. The role	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles sed notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of	s of process mode f business process	lling and they will es using modern
Students will learn full learn basics of the use CASE tools. The role an enterprise.	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles sed notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of	s of process mode f business process	lling and they will es using modern
Students will learn fullearn basics of the use CASE tools. The role an enterprise. BI-ZNF	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles sed notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in	s of process mode f business process formation and bus	lling and they will es using modern iness strategy of
Students will learn fullearn basics of the use CASE tools. The role an enterprise. BI-ZNF Students will gain the	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles sed notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in PHP Framework Nette - basics	s of process mode f business process formation and bus	lling and they will es using modern iness strategy of
Students will learn fullearn basics of the use CASE tools. The role an enterprise. BI-ZNF Students will gain the	ndamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles sed notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in PHP Framework Nette - basics basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czec rive for the efficient creation of a web backend in PHP language.	s of process mode f business process formation and bus	lling and they will es using modern iness strategy of
Students will learn fullearn basics of the us CASE tools. The role an enterprise. BI-ZNF Students will gain the knowledge should see	Indamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles and notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in PHP Framework Nette - basics Phase basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czec rive for the efficient creation of a web backend in PHP language. Fundamentals of iOS Application Development for iPhone and iPad	s of process mode f business process formation and bus KZ ch popular framew	ling and they will es using modern iness strategy of 3 ork. The resulting
Students will learn fullearn basics of the us CASE tools. The role an enterprise. BI-ZNF Students will gain the knowledge should set BI-IOS	Indamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles and notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in PHP Framework Nette - basics Phase basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czec rive for the efficient creation of a web backend in PHP language. Fundamentals of iOS Application Development for iPhone and iPad	s of process mode f business process formation and bus KZ ch popular framew	ling and they will es using modern iness strategy of 3 ork. The resulting
Students will learn fullearn basics of the use CASE tools. The role an enterprise. BI-ZNF Students will gain the knowledge should see BI-IOS This course is present	Indamentals of process engineering in this subject. Students will get necessary foundations for understanding formal principles and notations (UML, BPMN, BORM). The focus in this subject lies in training of practical skills of formalisation and modelling of of process engineering for information systems development is discussed as well as its importance in the overall context of in PHP Framework Nette - basics The basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of this Czec rive for the efficient creation of a web backend in PHP language. Fundamentals of iOS Application Development for iPhone and iPad anted in Czech. Introduction to Web and User Interfaces	s of process mode f business process formation and bus KZ ch popular framew	ling and they will es using modern iness strategy of 3 ork. The resulting

Code of the group: BI-PI-VO.21

Name of the group: Elective vocational Courses for a Bachelor Specialization BI-PI.21, version 2021

Requirement credits in the group: Requirement courses in the group:

Credits in the group: 0 Note on the group:

Note on the g		1			T	
Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members)	Completion	Credits	Scope	Semester	Role
	Tutors, authors and guarantors (gar.)					
BI-ADU.21	Unix Administration Zden k Muziká, Petr Zemánek, Miroslav Prágl Zden k Muziká Zden k Muziká (Gar.)	Z,ZK	5	2P+2C	L	٧
BI-AWD.21	Web and Database Server Administration Michal Valenta, Lukáš Ba inka Lukáš Ba inka Michal Valenta (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-AG2.21	Algorithms and Graphs 2 Dušan Knop, Michal Opler, Ond ej Suchý, Tomáš Valla, Radek Hušek Ond ej Suchý Ond ej Suchý (Gar.)	Z,ZK	5	2P+2C	L	٧
BI-ASB.21	Applied Network Security Yelena Trofimova, Ji í Dostál, Jakub Tetera, Michal Polák, Martin Šutovský, Martin Mandík Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	Z	٧
BI-BEK.21	Secure Code Josef Kokeš Josef Kokeš (Gar.)	Z,ZK	5	2P+2C	L	V
BI-BIG.21	DB Technologies for Big Data 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 Ji í Dostál, Martin Kolárik, Andrej Šimko Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	L	V
BI-FBI.21	Financial Business Intelligence David Buchtela David Buchtela Petra Pavlí ková (Gar.)	Z,ZK	5	2P+2C	Z,L	V
BI-HWB.21	Hardware Security Jií Bu ek Jií Bu ek Jií Bu ek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-IOT.21	Internet of Things Viktor erný, Lenka Kosková T ísková Lenka Kosková T ísková Lenka Kosková T ísková (Gar.)	Z,ZK	5	2P+2C	Z	٧
BI-KOM.21	Conceptual Modelling Robert Pergl, Marek B Iohoubek Robert Pergl Robert Pergl (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-LOG.21	Mathematical Logic Kate ina Trlifajová Kate ina Trlifajová (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
FIT-ITI	Modern IT infrastructure Ivan Šime ek	Z,ZK	5	2P+1C	Z,L	V
BI-MVT.21	Modern Visualisation Technologies Ji í Chludil, Petr Pauš Petr Pauš (Gar.)	Z,ZK	5	2P+2C	Z	V

BI-MGA.21	Multimedia and Graphics Applications Ji í Chludil, Lukáš Ba inka, Jan Buriánek, Šimon Tan v Lukáš Ba inka Ji í Chludil (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-OOP.21	Object-Oriented Programming Filip K ikava, Petr Máj, Filip íha Filip K ikava Filip K ikava (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 (Gar.)	KZ	5	1P+2C	L	V
BI-PAI.21	Law and Informatics Zden k Ku era, Št pánka Havlíková, Dominik Vítek, Martin Samek, Ji í Maršál, Michal Mat jka Št pánka Havlíková Zden k Ku era (Gar.)	ZK	5	2P+2C	L	V
BI-PJP.21	Programming Languages and Compilers Jan Janoušek, Tomáš Pecka Jan Janoušek (Gar.)	Z,ZK	5	2P+1C	L	V
BI-PPA.21	Programming Paradigms 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 Ji i Chludil, Radek Richtr Radek Richtr Radek Richtr (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-PJS.21	JavaScript Programming Martin Kolárik, Nikita Mironov Monika Borkovcová Monika Borkovcová (Gar.)	KZ	5	3C	L	V
BI-PYT.21	Python Programming Martin Šlapák, Ji í Hanuš, Ond ej Bouchala, Mohamed Bettaz, Jan Šafa ík Martin Šlapák Martin Šlapák (Gar.)	KZ	5	3C	Z,L	V
BI-PRR.21	Project management David Pešek David Pešek Petra Pavlí ková (Gar.)	Z,ZK	5	2P+2C	Z,L	V
BI-SIP.21	Network Programming Jan Fest Jan Fest (Gar.)	Z	5	2P+2C	Z	V
BI-SWI.21	Software Engineering Michal Valenta, Ji í Mlejnek, Zden k Rybola Zden k Rybola Michal Valenta (Gar.)	Z,ZK	5	2P+1C	L	V
BI-SP1.21	Team Software Project 1 Michal Valenta, Ji í Chludil, Ji í Mlejnek, Ji í Hunka, Zden k Rybola, Ji í Borský, Jan Matoušek, Radek Richtr, Marek Suchánek, Zden k Rybola Ji í Mlejnek (Gar.)	KZ	5	2C	L	V
BI-SP2.21	Team Software Project 2 Stanislav Kuznetsov, Michal Valenta, Ji í Chludil, Ji í Mlejnek, Ji í Hunka, Zden k Rybola, Ji í Borský, Jan Matoušek, Radek Richtr, Ji í Mlejnek Ji í Mlejnek (Gar.)	KZ	5	2C	Z	V
BI-SPS.21	Administration of Computer Networks and Services Jan Kubr, Libor Dostálek Pavel Tvrdík Libor Dostálek (Gar.)	Z,ZK	5	2P+2S	Z	V
BI-ML1.21	Machine Learning 1 Karel Klouda, Daniel Vašata Daniel Vašata (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-ML2.21	Machine Learning 2 Daniel Vašata Daniel Vašata (Gar.)	Z,ZK	5	2P+2C	L	V
BI-SVZ.21	Machine vision and image processing Marcel Ji ina, Jakub Novák, David Kramný, Justýna Frommová Jakub Novák Marcel Ji ina (Gar.)	Z,ZK	5	2P+2C	L,Z	V
BI-TAB.21	Applications of Security in Technology Ji í Dostál, Jan B lohoubek, Martin Kolárik, Martin Pozd na Ji í Dostál Ji í Dostál (Gar.)	Z,ZK	5	2P+2C	L	V
BI-TJV.21	Java Technology Stanislav Kuznetsov, Jan Blizni enko, Ji í Dan ek, Raian Samerkhanov Ji í Dan ek	Z,ZK	5	2P+2C	Z	V
BI-TPS.21	Computer Networks Technologies Vladimír Smotlacha, Josef Koumar Vladimír Smotlacha Vladimír Smotlacha (Gar.)	Z,ZK	5	2P+2S	Z	V
TVV	Physical education	Z	0	0+2	Z,L	V
TVV0	Physical education	Z	0	0+2	Z,L	V
TVKLV	Physical Education Course	Z	0	7dní	L	V
TVKZV	Physical Education Course	Z	0	7dní	Z	V
BI-TIS.21	Information Systems Pavel Náplava Pavel Náplava Pavel Náplava (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-TUR.21	User Interface Design Jan Schmidt Jan Schmidt (Gar.)	Z,ZK	5	2P+2C	L	V
BI-TWA.21	Design of Web Applications David Bernhauer David Bernhauer David Bernhauer (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-IDO.21	Introduction to DevOps Michal Valenta, Ji í Mlejnek, Tomáš Vondra, Zden k Rybola Tomáš Vondra Ji í Mlejnek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-UKB.21	Introduction to Cybersecurity Ivana Trummová, Jan B Iohoubek, David Pokorný, Jakub Tetera, František Ková, Martin Mandík, Tomáš Lu ák David Pokorný Jan B Iohoubek (Gar.)	Z,ZK	5	3P+1C	Z	V
BI-VDC.21	Virtualization and Data Centers Ji í Kašpar Ji í Kašpar Ji í Kašpar (Gar.)	Z,ZK	5	2P+2C	L	V
	and a section of the		1	1		1

BI-VIZ.21	Data Visualization Magda Friedjungová Magda Friedjungová (Gar.)	KZ	5	3P	Z	V
BI-VPS.21	Selected Topics in Computer Networking Alexandru Moucha, Mohamed Bettaz Pavel Tvrdík Mohamed Bettaz (Gar.)	Z,ZK	5	2P+2C	L	V
BI-VWM.21	Searching the Web and Multimedia Databases Ji í Novák, Tomáš Skopal Ji í Novák Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	٦	V
BI-FEM.21	Fundamentals of Economics Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-ZSB.21	Basics of System Security Marián Svetlík, Martin Šutovský, Dominik Novák, Ladislav Marko Simona Forn sek Simona Forn sek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-ZUM.21	Artificial Intelligence Fundamentals Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+2C	L	V

Characteristics of the courses of this group of Study Plan: Code=BI-PI-VO.21 Name=Elective vocational Courses for a Bachelor Specialization BI-PI.21, version 2021 BI-BEK.21 Secure Code 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-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-ZUM.21 Artificial Intelligence Fundamentals Z,ZK 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. TVV Physical education n TVV0 Physical education Ζ 0 **TVKLV** Physical Education Course Ζ 0 Ζ TVKZV Physical Education Course 0 Modern Visualisation Technologies Z,ZK BI-MVT.21 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-ADU.21 Unix Administration Z,ZK Students will learn the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They will understand the differences between user and administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights, file systems, disk subsystems, processes, memory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the knowledge from the lectures on specific examples from practice. BI-AWD.21 Web and Database Server Administration Z,ZK 5 Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server. Algorithms and Graphs 2 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 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-BIG.21 DB Technologies for Big Data 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. Z,ZKBI-EPP.21 **Economic Business Processes** 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 Z,ZK **Ethical Hacking** 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 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 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 Z,ZK Internet of Things 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-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-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 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. FIT-ITI Modern IT infrastructure Z,ZK5 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 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. Computer graphics programming 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** 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. Law and Informatics 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. **Programming Paradigms** 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 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 ΚZ 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 K7 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
	amental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level prog		
	to designing communication protocols and their verification. The third part introduces the principles and applications of middless and the second of the sec	_	-
programming language	n models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in co	omputer labs using	g a cnosen
BI-SWI.21	Software Engineering	Z,ZK	5
	d with methods of analysis and design of larger software projects that are typically designed and implemented in teams. The	1 ' 1	_
- :	he analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get han	-	
using the visual languag	ge UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design	gn and testing. Wit	hin the course,
students also gain a the	oretical basis in the field of project management, estimation of costs of software projects, and methods of their development	t.	
BI-SP1.21	Team Software Project 1	KZ	5
_	experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the		
-	aches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The te consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software		
and finished in the BIE-		artelact will be lu	ittlei developed
BI-SP2.21	Team Software Project 2	KZ	5
_	experience with the iterative development process while working on a large-scale software project. The first iteration is the re-	1	_
However, in this follow-u	p, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will we	ork in teams of 4-6	people. The
teacher, in the role of th	e team and project leader, regularly consults with the team (at the seminars) the formal as well as material aspects of their s	solution.	
BI-SPS.21	Administration of Computer Networks and Services	Z,ZK	5
	s to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administration		
	course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained	d by practical hand	s-on experience
with real network infrast		7 71/	5
BI-ML1.21	Machine Learning 1 is to introduce students to the basic methods of machine learning. They get theoretical understanding and practical working is	Z,ZK	_
	the supervised learning scenario and clustering models in the unsupervised scenario. Students will be aware of the relations		
	fundamentals of assessing model quality. Moreover, they learn the basic techniques of data preprocessing and multidimension		
demonstrations, pandas	and scikit libraries in Python will be used.		
BI-ML2.21	Machine Learning 2	Z,ZK	5
_	is to introduce students to the selected advanced methods of machine learning. In the supervised learning scenario, they, in	•	
	the unsupervised learning scenario students learn the principal component analysis and other dimensionality reduction met	hods. Moreover, s	tudents get the
	procedure the learning and natural language processing.	7.71/	
BI-SVZ.21	Machine vision and image processing coming a common part of life by being universally available. Related to this phenomenon is the need to process and evaluate	Z,ZK	5
<u> </u>	ifferent types of camera systems and a variety of methods for image and video processing. The course is focused on practical	_	
	more in type of the more dy created at the course for integer and the options of the course to receive and at the course and the production		
problems of practice that	tt he graduates may encounter.	acc or camera cy	.
			5
BI-TAB.21	t the graduates may encounter. Applications of Security in Technology s to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Stu	Z,ZK	5
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BI-VDC.21 Virtualization and Data Centers The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses. BI-VIZ.21 **Data Visualization** 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-VPS.21 Selected Topics in Computer Networking Z,ZK The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security. BI-VWM.21 Searching the Web and Multimedia Databases Z,ZK 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 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-ZSB.21 Basics of System Security Z.ZK 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.

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	ourse 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 la	anguage instructionMeet the requirements for writing assignments - Summary, Abstract, Argumentation PaperSucceed in both the	ne midterm and the	final term
tests with the succe	ss rate set at 70%80% and over in BOTH tests means ORAL EXAM ONLY (no written part). Requirements will be specified by indi class of the term.	vidual teachers du	ring the firs
BI-AAG.21	Automata and Grammars	Z.ZK	5
-	iced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite	,	_
	irs, context-free grammars, construction and use of pushdown automata, and translation grammars and transducers. They know the		•
	y understand the relationships between formal languages and automata. They are introduced to the Turing machine and complexity	-	33
BI-ACM	Programming Practices 1	KZ	5
'	This is a selective course for preparing talented student for representation in international programming contests.	1	
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.	ı	
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 th	e internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They	will understand the	differences
	dministrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights,	•	•
processes, memor	ry, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the known that the contract of	owledge from the le	ectures on
5 5	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	Algorithms and Graphs 1 sthe basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing cur	rriculum. It links an	d partially
The course covers	Algorithms and Graphs 1 sthe basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the	rriculum. It links an time and space co	d partially
The course covers develops the knowledger	Algorithms and Graphs 1 sthe basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the ithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics.	rriculum. It links an time and space co nptotic notation.	d partially mplexity of
The course covers develops the knowledger algor BI-AG2.21	Algorithms and Graphs 1 s the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the ithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics and Graphs 2	rriculum. It links an time and space conptotic notation.	d partially mplexity of
The course covers develops the knowledger algor BI-AG2.21 This course, present the course of the cou	Algorithms and Graphs 1 s the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the ithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics, in particular, the asymptotic mathematics, in particular, the asymptotic mathematics is particular, the asymptotic mathematics in particular, the asymptotic mathematics is particular, the asymptotic mathematics in particular, the asymptotic mathematics is particular, the asymptotic mathematics is particular, the asymptotic mathematics is particular, the particular is particular to the particular in the particular is particular in the particular in the particular is particular in the particular i	rriculum. It links an time and space conptotic notation. Z,ZK v course BI-AG1.2	d partially mplexity of 5
The course covers develops the knowledger algor BI-AG2.21 This course, present algorithms are supported to the course of the cou	Algorithms and Graphs 1 s the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the ithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics and Graphs 2	rriculum. It links an time and space conptotic notation. Z,ZK v course BI-AG1.2	d partially mplexity of 5 . It further
The course covers develops the knowledger algor BI-AG2.21 This course, present the course of the cou	Algorithms and Graphs 1 s the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curedge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the ithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics is particular.	rriculum. It links an time and space conptotic notation. Z,ZK v course BI-AG1.2	d partially mplexity of 5 . It further

BI-AND.21	Programming for the Android Operating System	KZ	4
	This course is presented in Czech.		
BI-ANG	English Language, Internal Certificate Course information and teaching materials can be found at https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANC	ZK 3	2
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2
BI-ANGK	English language, contact preparation for the B2 level exam	Z	2
- 1	course corresponds to the preparation for the English exam at the B2 level. Requirements for course credit. Academic Achievement -		I .
	anguage instructionMeet the requirements for writing assignments - Summary, Abstract, Argumentation PaperSucceed in both the		
-	ss rate set at 70%80% and over in BOTH tests means ORAL EXAM ONLY (no written part). Requirements will be specified by indiv class of the term.		
BI-APJ	Aplication Programming in Java	Z,ZK	4
DI-AF3	This course is presented in Czech. Advanced technologies in Java.	∠,∠r∖	4
BI-APS.21	Architectures of Computer Systems	Z,ZK	5
	a the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Speci	•	-
	processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the princ		
- ·	processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of	-	-
•	e further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coher		
	systems.		
BI-ARD	Interactive applications on Arduino	KZ	4
, ,	ned for students of first grade of bachelor study as introduction to embedded systems. Students will learn how to design simple application	•	•
	ried peripherals with help of available libraries. The goal of the subject is to show varied software approaches to control embedded sy		
not only on display	y of a PC. Thanks to possible control on higher (objective) layer, this platform is frequently used for artist performance and therefore is Software Engineering students.	s suitable even fo	or Web and
BI-ASB.21	Applied Network Security	Z,ZK	5
I	rse is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gained		
	ons like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing knowledge of security applications in computer networks.		
BI-AVI.21	Algorithms visually	Z.ZK	4
1	,	,	1
•	ments other algorithm courses at FIT. It brings knowledge about particular important algorithms from different fields of the computer sci		-
knowledge presenter	d in BI-AG1 and BI-AG2. A wide scope of covered subject is made possible due to using visualization bz Algovision (www.algovision.org< that make understanding the principles of algorithms easy.	,rittp://www.aigov	ision.orgagi,)
DL AVAD 24		Z,ZK	5
BI-AWD.21	Web and Database Server Administration	∠,∠r\) 5
Ctudonto will got oo	auginted with the administration of database and web convers and convises. They will be able to inetall, configure, apparet, test, and b	adus aamalay	totoboso and
-	quainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and b		
web servi	ce systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an exam	ple of a web serv	/er.
web servio	ce systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an exam Bachelor Thesis	ple of a web serv	/er.
web service BI-BAP.21 BI-BEK.21	ce systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an exam Bachelor Thesis Secure Code	ple of a web serv	/er. 14 5
web servion BI-BAP.21 BI-BEK.21 The students will lea	Compared by the principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an exame Bachelor Thesis Secure Code arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting fair	ple of a web serv Z Z,ZK miliar with the thr	ver. 14 5 reat modeling
web service BI-BAP.21 BI-BEK.21 The students will lead theory, students	Bachelor Thesis Secure Code arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting far gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every	ple of a web serv Z Z,ZK miliar with the thr program needs t	ver. 14 5 eat modeling o run with
web service BI-BAP.21 BI-BEK.21 The students will lead theory, students administrator privile	Bachelor Thesis Secure Code arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting far gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every leges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing of the sec	ple of a web served Z Z,ZK miliar with the thr program needs to data and the rela	yer. 14 5 eat modeling or run with tionships of
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web service BI-BAP.21 BI-BEK.21 The students will lead theory, students administrator privile security and description of the big security	Bachelor Thesis Secure Code arn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting far gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every leges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing of latabase systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the DB Technologies for Big Data	Z Z,ZK milliar with the thr program needs t data and the rela e defense agains KZ	ter. 14 5 eat modeling or un with tionships of them. 5
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BI-CS3 Language C# - design of web applications ΚZ 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. **Database Systems** 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 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 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 Z,ZK Introduction to European Economic History 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. **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 ΚZ Effective programming 1 The course is taught in Czech. BI-FP2 Efficient Programming 2 ΚZ 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 K7 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 SW Development Technologies 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 K7 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 Z,ZK History of Mathematics and Informatics 3 This course is presented in Czech. BI-HWB.21 Hardware Security 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.

	Introduction to DevOps	Z,ZK	5
	with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of syst		
	support software development, testing and compilation. It also focuses on tools for automating infrastructure management and buildi introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainte		
	used in practice.		ı
BI-IOS	Fundamentals of iOS Application Development for iPhone and iPad This course is presented in Czech.	KZ	4
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	view of sensors ar	d actuators,
wireless communic	cation technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architec	tures for different	application
areas. Within the c	omputer labs, students will gain practical experience with developing simple IoT systems using common development environments (software - Arduino, Raspberry Pi OS).	(hardware - ARM,	ESP, STM;
BI-JPO.21	Computer Units	Z,ZK	5
	their basic knowledge of digital computer units acquired in the obligatory course of the program (BIE-SAP), get acquainted in detail w	•	-
organization of com	puter units and processors and their interactions with the environment, including accelerating arithmetic-logic units and using appropr	riate codes for imp	lementation
of multiplication. The	e organization of main memory and other internal memories (addressable, LIFO, FIFO and CAM) will be discussed in detail, including	codes for error d	etection and
· ·	el and serial data transmissions. They will also get acquainted with the methodology of controller design, with the principles of commu	· · · · · · · · · · · · · · · · · · ·	
he environment and	d the architecture of the bus system. The problems will be practically evaluated in the labs and with the help of the educational micropro	grammed process	or simulator
DL KAD 24	and programmable hardware design kits (FPGA).	7 71/	
BI-KAB.21	Cryptography and Security erstand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to	Z,ZK	5
	erstand the mathematical loundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to ems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in appli		-
-	actical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procec		
BI-KOM.21	Conceptual Modelling	Z,ZK	5
-	sed on developing abstract thinking and precise formulation skills using conceptual models. Students learn skills of discerning key ter	,	-
	cify correct relations in complex systems of social reality, mostly enterprises and institutions. Students learn basics of ontological struct		
notation. Next, they	learn how to express business rules and constraints using the OCL language and foundations of OWL/RDF semantic data representations of OWL/RDF semantic data representations.	ation in the Interne	et. They also
earn the foundation	ns of enterprise engineering, being a discipline for conceptual modelling of enterprises and institutes and their processes. The DEMO m	ethod and the BP	MN notation
	be taught. The course is designed with the respect to continuation in software implementations. Recommended optional follow-up co		
BI-KOT	Programing in Kotlin	Z,ZK	4
	, statically-styled object-functional language that exploits the extensive Java language ecosystem while delivering a number of advan		
The language is iu	Ily Java compliant and allows for mixed projects that preserve existing parts written in Java, and continue with the development of a n with minimum of boiler-plate code. Last but not least, Kotlin is suitable for designing of DSLs (Domain-Specific Languages)		iciioriai way
BI-KSA	Cultural and Social Anthropology	ZK	2
	course aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the diversity		l .
	earch from our "exotic" cultures (topics: kinship, religion, social exclusion, migration, globalization, , material culture, language, health		
	shown. The course is presented in Czech.		
BI-LA1.21	Linear Algebra 1	Z,ZK	5
	students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field		
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 elimina	ation method (GEN	Λ) and show
the connection w	ith linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenv	alues and eigenve	ectors of a
	matrix. We will also demonstrate some applications of these concepts in computer science.		
BI-LA2.21	matrix. We will also demonstrate some applications of these concepts in computer science. Linear Algebra 2	Z,ZK	5
BI-LA2.21 Studenti si v tomto	matrix. We will also demonstrate some applications of these concepts in computer science.	Z,ZK tor v abstraktní ob	5 ecné form .
BI-LA2.21 Studenti si v tomto Seznámíme se tak	matrix. We will also demonstrate some applications of these concepts in computer science. Linear Algebra 2 p edm tu rozší í znalosti z p edm tu BI-LA1, kde se pracovalo pouze s vektory ve form n-tic ísel. Zde si zavedeme vektorový prost	Z,ZK tor v abstraktní ob kou. Dalším velký	5 ecné form . m tématem
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BI-MIT Mikrotik technologies ΚZ 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 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 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 ΚZ 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 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. Object-Oriented Programming 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. Z,ZK **BI-OPT** Introduction to Optical Networks 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 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 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 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. Programming and Algorithmics 2 Z.ZK BI-PA2.21 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 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 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 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. Programing in PHP 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 ba	asic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers G	NU and LLVM. The	ey learn to
create a specificat	ion 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. T	he compiler can to	ranslate not
DI D 10 4	only a programming language but any text in a language generated by a given LL input grammar.	1/7	
BI-PJS.1	JavaScript Programming	KZ	4
-	course is an introduction to Javascript programming. Students will learn also best practices and will use tool that eases development tudents of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for the	•	
recommended for 3	of study.		till scillester
BI-PJS.21	JavaScript Programming	KZ	5
	introduction to Javascript programming. Students will also learn best practices and get acquai nted with tools that make code develo	pment in Javascri	ipt 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 This course is presented in Czech.	Z	4
BI-PMA	Programming in Mathematica	Z,ZK	4
	rking with modern technical and scientific software. Students will learn how to use different programming styles (functional programm		-
	etc.), how to create dynamic interactive applications and visualisations, data processing and presentations.		
BI-PNO.21	Practical Digital Design	KZ	5
Students get an ov	verview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the	basics of the VHD	L language
and implementation	on technologies FPGA and ASIC. Students demonstrate practical use of the design techniques in the course project using modern in	dustry-standard C	AD design
	tools.		
BI-PPA.21	Programming Paradigms	Z,ZK	5
	vith basic paradigms of high-level programming languages, including their basic execution models, benefits, and disadvantages of par		
	ligm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. Th s and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstr		
on lambda calculu	such as C++ and Java.	eam programming	g lariguages
BI-PRR.21	Project management	Z.ZK	5
	urse is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, anal	,	_
	cation, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk as	-	
Gantt charts, reso	ource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for st	udents who are in	terested in
deepening their ki	nowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in lar	ge companies. Th	e 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
	e introduced to methods of applied statistics.They will learn how to work with various types of data, perform analyses, and choose moc gression and correlation analysis, analysis of variance and non-parametric methods. Students will learn to use the statistical software	_	
wiii ericompass re	gression and correlation analysis, analysis of variance and non-parametric methods. Students will learn to use the statistical software		
	methods on data from real problems.		
BI-PS2	methods on data from real problems. Programming in shell 2		
BI-PS2 Students gain a ge	methods on data from real problems. Programming in shell 2 eneral overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In additi	Z,ZK	4
	Programming in shell 2	Z,ZK	4
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BI-SCE2 Computer Engineering Seminar II 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 K N 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 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** 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. Machine Oriented Languages 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. Team Software Project 1 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 K7 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 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 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 Z,ZK Real-time systems 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 Ζ 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 Ζ 3 This course is presented in Czech. BI-ST3 7 Network Technology 3 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. Network Technology 4 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 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 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 students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of thei	-	he course,
BI-TAB.21 Applications of Security in Technology The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students	Z,ZK	5 verview of
cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware	e security.	
BI-TDA Test driven architecture The course is focused on practical examples of how to develop, test, and deploy software with tools like GitLab, Docker, Kubernetes, and more that a	KZ are well known in the	4 DevOns
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 occ		
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 these	s. Students
earn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically presentation		
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 1 exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed.	4 days of teaching. V	Vithin the
BI-TEX TeX and Typography 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	Z,ZK	4 vnographic
rules.		, pog. upo
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 is to familiarise students with the information systems topic and information systems implementation principles.	irse, students are int	roduced to
"on the market" existing types of systems and their usage in specific industry segments. Students are familiarised with the CRM, ERP, MRP and othe		
The fundamental part of the course is the introduction to key ideas of an information system selection, evaluation of information system benefits, v		
mplementation and information system implementation based on the project management principles. The emphasis is on the initial customer analysis	,	, ,
lecide whether it is better to implement any existing information system or to develop a new one from scratch. These factors determine the information system At the end of the course information systems security, operation, support, maintenance, legislation impacts, and government information system		
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 ex	1 ' 1	-
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 physic	1 '	rlap to the
ink layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies	logies will be demon	strated and
with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ether	net, modern wireless	s 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 classic transfer and in the latest and in the latest and a second		
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BI-TS2 Theoretical Seminar II	Z	4
Di-102 Theoretical Definition if		
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BI-VAK.21 Selected Applications of Combinatorics he 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 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. **Data Visualization** 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-VMM Selected Mathematical Methods Z.ZK 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. Selected Topics in Computer Networking RI-VPS 21 7.7K 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. Virtual reality I 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 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 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 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 K7 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 ΚZ Process engineering 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 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 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 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 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 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** Ζ Introduction to Computer Science 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-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. **BIE-EEC** 4 English language external certificate 7 The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages. BIE-IMA2 Introduction to Mathematics 2 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 **BIE-SEG** Systems Engineering 7 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. **BIE-ZUM** Artificial Intelligence Fundamentals Z,ZK 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. FI-TOP Academic writing Ζ 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. FIT-ITI Modern IT infrastructure Z,ZK 5 FIT-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. FITE-EHD Introduction to European Economic History 7.7K The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economy through the description of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic history. From large economic area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institutions is deciphered. The course does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and organizations in history. Class meetings will consist of a mixture of lecture and discussion. Applied Functional Programming 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.

NI-DDM	Distributed Data Mining	1/7	1
Course focuses on	Distributed Data Mining state-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands of	KZ	large scale
	amework Apache Spark and with existing distributed DM / ML algorithms. They will learn principles of their parallel implementations a	•	_
	approaches to parallelize other algorithms. The course is prezented in czech language.	•	• •
NI-DSP	Database Systems in Practes	Z,ZK	4
'	This course is presented in Czech.		<u>'</u>
NI-DZO	Digital Image Processing	Z,ZK	4
-	nts a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical alg		-
•	e an interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is also		
	processing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR	-	_
	abstraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conv		
NI-IAM	Internet and Multimedia	Z.ZK	4
	e is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acq	,	1
	signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical u	-	
audiovisual transm	nissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effective of the control of	ect of various com	ponents o
ne quality and late	ncy of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the	e scene up to the	presentation
	for audience.		
NI-LSM	Statistical Modelling Lab	KZ	5
	ented on a single and multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is p		
vallable information	on and its modeling using numpy and scipy. The second half of the semester is focused on the design of methods and algorithms, and	=	r properties
NI MOD	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	s). KZ	4
NI-MOP	Modern Object-Oriented Programming in Pharo gramming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where i		
-	plex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills		
	in modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development ne		
	ing object programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work of		
echnologies in ter	ms of semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvem	ent in the Pharo	Consortium
NI-MPL	Managerial Psychology	ZK	2
NI-MSI	Mathematical Structures in Computer Science	Z,ZK	4
Mathematical se	mantics of programming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott	model of lambda	calculus.
	Introduction to category theory.		
NI-OLI	Linux Drivers	Z,ZK	4
	g system is an important operating system for personal computer and also for embedded systems. Systems on chip and combining po	•	
	ability of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development		dents. The
	urse provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical		
NI-PDD	Data Preprocessing	Z,ZK	5
		•	-
time series, etc., a	repare raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data s and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characterist	ources, such as ir	nages, text
time series, etc., a		ources, such as ir	nages, text
NI-PSD	and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characterist	ources, such as ir	nages, text
NI-PSD	and learn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characterist pages.	ources, such as ir ics from images o	mages, text or from web
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