## Study plan

## Name of study plan: Bachelor Specialization Artificial Intelligence, 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 stud. plánu je ur ena pro ro níky, které byly p ijaty ke studiu od ak. roku 2021/2022 do prezen ní formy studia bakalá ského programu. Garant specializace: Ing. Magda Friendjungová,

Ph.D.&email: magda.friedjungova@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. 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 <b>Dušan</b> 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 <b>Hana Kubátová</b> 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 <b>Martin Novotný</b> 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: 30

The role of the block: PS

Code of the group: BI-PS-UI.21

Name of the group: Compulsory courses of specialization Artificial Intelligence, version 2021

Requirement credits in the group: In this group you have to gain 30 credits

Requirement courses in the group: In this group you have to complete 6 courses

Credits in the group: 30 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-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-PRS.21	Practical Statistics Kamil Dedecius, Petr Novák Petr Novák (Gar.)	KZ	5	1P+2C	L	PS
BI-ML1.21	Machine Learning 1 Karel Klouda, Daniel Vašata Daniel Vašata (Gar.)	Z,ZK	5	2P+2C	Z	PS
BI-ML2.21	Machine Learning 2 Daniel Vašata Daniel Vašata (Gar.)	Z,ZK	5	2P+2C	L	PS
BI-VIZ.21	Data Visualization Magda Friedjungová Magda Friedjungová (Gar.)	KZ	5	3P	Z	PS
BI-ZUM.21	Artificial Intelligence Fundamentals Pavel Surynek Pavel Surynek Pavel Surynek (Gar.)	Z,ZK	5	2P+2C	L	PS

Characteristics of the courses of this group of Study Plan: Code=BI-PS-UI.21 Name=Compulsory courses of specialization Artificial Intelligence, version 2021

BI-LA2.21 Linear Algebra 2

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.

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.

BI-ML1.21 Machine Learning 1 Z.ZK

The goal of this course is to introduce students to the basic methods of machine learning. They get theoretical understanding and practical working knowledge of regression and classification models in the supervised learning scenario and clustering models in the unsupervised scenario. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Moreover, they learn the basic techniques of data preprocessing and multidimensional data visualization. In practical demonstrations, pandas and scikit libraries in Python will be used.

BI-ML2.21 Machine Learning 2 Z,ZK

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-VIZ.21 **Data Visualization**  ΚZ

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.

Artificial Intelligence Fundamentals BI-ZUM.21

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.

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 15

The role of the block: PV

Code of the group: BI-PV-UI1.21

Name of the group: Compulsory elective courses for the specialization Artificial Intelligence - Group 1, version 2021

Requirement credits in the group: In this group you have to gain at least 5 credits (at most 10)

Requirement courses in the group: In this group you have to complete at least 1 course (at most 2)

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-JUL.21	Programming in Julia Tomáš Kalvoda <b>Tomáš Kalvoda</b> Tomáš Kalvoda (Gar.)	KZ	5	3C	Z	PV
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	PV

Characteristics of the courses of this group of Study Plan: Code=BI-PV-UI1.21 Name=Compulsory elective courses for the specialization Artificial Intelligence - Group 1, version 2021

BI-JUL.21 Programming in Julia

ΚZ

5

The goal of the course is to introduce the students to Julia, a modern programming language and scientific programming environment. In the first part, the students will learn the basic concepts and features of Julia. The second part is focused on thematically diverse applications of tools available in Julia. Students will learn how to work effectively in the Julia environment and get an overview of its capabilities for solving problems in various fields, which they can encounter during their studies.

BI-PYT.21 Python Programming

ΚZ

5

The aim of the course is to get acquainted with basic efficient control and data structures of the Python programming language for text and binary data processing. The differences between philosophy of programming in Python and in other programming languages will be explained. Each topic is prepared for students in the format of a Jupyter notebook, which enables greater accent to individual student work. Before each lab, students pass a short test on the last week topic. Four homeworks plus a semester work will be assigned during the semester.

Code of the group: BI-PV-UI2.21

Name of the group: Compulsory elective courses for the specialization Artificial Intelligence - Group 2, version 2021

Requirement credits in the group: In this group you have to gain at least 10 credits (at most 20)

Requirement courses in the group: In this group you have to complete at least 2 courses (at most 4)

Credits in the group: 10

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
BI-BIG.21	DB Technologies for Big Data Monika Borkovcová Monika Borkovcová (Gar.)	KZ	5	2P+2C	Z,L	PV
BI-SVZ.21	Machine vision and image processing Marcel Ji ina, Jakub Novák, David Kramný, Justýna Frommová <b>Jakub Novák</b> Marcel Ji ina (Gar.)	Z,ZK	5	2P+2C	L,Z	PV
BI-VWM.21	Searching the Web and Multimedia Databases Ji í Novák, Tomáš Skopal <b>Ji í Novák</b> Tomáš Skopal (Gar.)	Z,ZK	5	2P+1C	L	PV
BI-ZNS.21	Knowledge-based Systems Marcel Ji ina Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+2C	Z	PV

# Characteristics of the courses of this group of Study Plan: Code=BI-PV-UI2.21 Name=Compulsory elective courses for the specialization Artificial Intelligence - Group 2, version 2021

BI-BIG.21 DB Technologies for Big Data

ΚZ

5

Students will be introduced into the field of Big Data processing where nonrelational (NoSQL) database engines are typically used today. The course is focused practically so that after finishing the course students were able to choose suitable tools (mostly open source) and techniques, design and implement a simplest reproducible method of data processing (data collection, transformation/aggregation, presentation). Students get acquainted with various architectures for processing and storing big data. A theoretical foundation and presentation of individual technologies will be supplemented with specific examples from practice.

BI-SVZ.21 Machine vision and image processing

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-VWM.21 Searching the Web and Multimedia Databases

Z,ZK

5

Students get basic overview about search techniques in the web environment that is interpreted as a very large distributed and heterogeneous storage of documents. In particular, students acquire information about search techniques in text and hypertext documents (the web pages themselves) and about feature extraction from web pages. They get detailed knowledge of similarity search in multimedia databases (generally in collections of unstructured data). They also learn techniques for programming web search engines for the mentioned data types (documents).

BI-ZNS.21

Knowledge-based Systems

Z.ZK

5

Students will become familiar with the systems based on knowledge (knowledge-based systems), which are systems that usetechniques of artificial intelligence to solve problems that require human judgment, learning and reasoning from findingsand actions. The course introduces students to the philosophy and architecture of knowledge-based systems to support decision-makingand planning. The course assumes knowledge of set theory, probability theory, artificial neural networks, and evolutionary algorithms.

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

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. <br/>
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br> --<br/>
BI-ANG1, ending with an exam for two credits, is enrolled by students who prepared for the exam independently and do not have credit from BI-A2L. These students must complete a credit paper before their own exam. After passing the exam, the student will also be recognized for the course BI-ANGS (Independent preparation for the English exam) for 2 credits. <br/>
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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 <b>Zden k Muziká</b> 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

BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2			
BIE-EEC	English language external certificate	Z	4			
The BIE-ECC course ca	he 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 Com	mon European Framework of Reference for Languages.					
BI-ANG	English Language, Internal Certificate	ZK	2			
Course information and	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	Z,ZK	4	2P+1C	Z	V
BI-ALO	Ji í Kašpar, Miroslav Prágl Miroslav Prágl (Gar.)  Algebra and Logic	Z,ZK	4	2P+1C	L	V
BI-AVI.21	Jan Starý Jan Starý Jan Starý (Gar.)  Algorithms visually 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	Z	2	2C	L	V
BI-APJ	Kate ina Valentová Kate ina Valentová Kate ina Valentová (Gar.)  Aplication Programming in Java	Z,ZK	4	2P+1R+1C	; z	V
NI-AFP	Ji í Dan ek  Applied Functional Programming Robert Pergl, Marek Suchánek, Daniel N mec Robert Pergl Robert Pergl	KZ	5	2P+1C	L	V
BIE-ZUM	(Gar.)  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 Tomáš Vichta Tomáš Vichta Tomáš Vichta (Gar.)	Z,ZK	4	2P+1C	L	V
BI-STO	Storage and Filesystems	Z,ZK	4	2P+2C	L,Z	V
NI-PSD	Public Services Design 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 Martin Ka er (Gar.)	KZ	4	2P+2C	Z	V
BI-EP2	Efficient Programming 2  Martin Ka er 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 Šolcová 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 i 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 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 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 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 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 Jií Dan ek <b>Jií Dan ek</b> Jií Dan ek (Gar.)	Z,ZK	4	2P+2C	L	V
NI-PSL	Programming in Scala Ji í Dan ek <b>Ji í Dan ek</b> Ji í Dan ek (Gar.)	Z,ZK	4	2P+1C	Z	V
BI-PMA	Programming in Mathematica  Zden k Buk Zden k Buk Zden k Buk (Gar.)	Z,ZK	4	2P+2C	Z,L	V
BI-PHP.1	Programing in PHP	KZ	4	3C	Z	V
BI-PS2	Programming in shell 2 <i>Lukáš Ba inka</i>	Z,ZK	4	2P+2C	L	V
NI-PDD	Data Preprocessing  Marcel Ji ina Marcel Ji ina (Gar.)	Z,ZK	5	2P+1C	Z	V
BI-PKM	Introduction to mathematics 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 <b>Hana Kubátová</b> Hana Kubátová (Gar.)	Z	4	2C	L,Z	٧
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 Tomáš Evan	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 <b>Jan Janoušek</b> 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 Tomáš Valla (Gar.)	Z	4	2C	Z	V
BI-TS4	Theoretical Seminar IV Ond ej Suchý, Tomáš Valla Tomáš Valla (Gar.)	Z	4	2C	L	V
BI-TDA	Test driven architecture  Marek Hakala	KZ	4	2P+1C	Z,L	V
NI-TSP	Testing and Reliability Petr Fišer Martin Da hel Petr Fišer (Gar.)	Z,ZK	5	2P+2C	Z	٧
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 (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 <b>Zden k Muziká</b> Zden k Muziká (Gar.)	Z	2	4D	Z	V
BI-OPT	Introduction to Optical Networks Pavel Tvrdík	Z,ZK	4	2P+1C	Z	V
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 <b>Petr Klán</b> 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 (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	KZ	4	2C	Z	V
DI-103	and iPad Rostislav Babá ek, Igor Rosocha Martin P Ipitel Martin P Ipitel (Gar.)	NΔ	4	20	_	V
BI-ZWU	Introduction to Web and User Interfaces	Z,ZK	4	2P+2C	L	V
BI-3DT.1	Lukáš Ba inka Lukáš Ba inka Jakub Klímek (Gar.)  3D Printing	KZ	4	3C	L	V
	Miroslav Hron ok, Tomáš Sýkora Tomáš Sýkora Miroslav Hron ok (Gar.)					
	s of the courses of this group of Study Plan: Code=BI-V.2021 Name=P rsion from 2021/22 till 2024/25	urely Electiv	e Cours	es of Bac	helor Pr	ogramme
TVK1	Physical Education				Z	1
TVV	Physical education				Z	0
ΓV1	Physical Education				Z	0
TVV0	Physical education				Z	0
TV2	Physical Education				Z	0
TVKLV	Physical Education Course				Z	0
TVKZV	Physical Education Course				Z	0
BI-ADW.1	Windows Administration			Z	,ZK	4
	ented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).			<u> </u>	·	
BI-ALO	Algebra and Logic			Z	,ZK	4
	s and deepens the study of topics touched upon in the basic course in logic.				717	
3I-AVI.21	Algorithms visually		l£41	1	ZK	4
	ments other algorithm courses at FIT. It brings knowledge about particular important algorithms fi ed in BI-AG1 and BI-AG2. A wide scope of covered subject is made possible due to using visualizatio					
	nding the principles of algorithms easy.	52 / ligovisioi (1	w w.aiguvis	nomorgan,mu	, vv vv vv.alg	orision.orgagi
BI-A2L	English language, preparation for the B2 level exam				Z	2
	course corresponds to the preparation for the English exam at the B2 level. Requirements for co	urse credit. Acad	demic Achie	1	_	_
active part in the lar	nguage instructionMeet the requirements for writing assignments - Summary, Abstract, Argum	entation Paper.	-Succeed ir	both the mid	term and t	he final term
	ess rate set at 70%80% and over in BOTH tests means ORAL EXAM ONLY (no written part). F	Requirements wil	l be specifie	ed by individua	al teachers	during the fire
lass of the term.					<b>-</b>	
BI-APJ	Aplication Programming in Java			2	,ZK	4
	ented in Czech. Advanced technologies in Java.				ΚZ	5
NI-AFP	Applied Functional Programming ented in Czech. Functional programming represents one of the traditional programming paradigi	me Traditional a	nd noval fur	1 -		•
	and the functional paradigm becomes an important construct of traditionally imperative language				_	
=	ence of a software engineer: the theory and especially the practice.	23 (011, 0#, 0av	a). 713 3doi1	, mastering tri	is paradigi	ii becomes a
BIE-ZUM	Artificial Intelligence Fundamentals			7	ZK	4
	uced to the fundamental problems in the Artificial Intelligence, and the basic methods for their so	ving. It focuses r	nainly on th	1		e areas of stat
space search, multi	-agent systems, game theory, planning, and machine learning. Modern soft-computing methods	, including the ev	olutionary	algorithms an	d the neur	al networks, w
pe presented as we						
BI-BLE	Blender				ZK	. 4
	s knowledge of opensource program Blender from BI-MGA (Multimedia and Graphics Applicatio a complete and practically oriented introduction to Blender environment. Students may continue	,				
NI-DSP	Database Systems in Practes	to Bi-FGA (FIO	granning g		ZK	4
This course is prese	· · · · · · · · · · · · · · · · · · ·				,21	7
BI-STO				7	ZK	4
	Storage and Filesystems	es of data store	protection,			-
oad balancing and	Storage and Filesystems rn principles and current solutions of storage systems architecture. The module explains principle	00 01 0010 01010,				storage scalling
NI-PSD	rn principles and current solutions of storage systems architecture. The module explains principle	oo or data otoro,				storage scaling
	rn principles and current solutions of storage systems architecture. The module explains principle			I	ζZ	4
	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will loo	k into the design		pment proces	ss from the	4 perspective of
suppliers (devs and	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will lood designesr) as well as clients. In small teams students will work on projects from partner organizations.	k into the design		pment proces	ss from the	4 perspective of
suppliers (devs and Course is aimed at	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will loo designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.	k into the design		opment proces	ss from the	4 perspective cesentatives.
suppliers (devs and Course is aimed at BIE-DIF	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design duce students to specifics of UX, Service design and development for public sector. We will look designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.  Differential equations	k into the desigr zations and will t	ry out collal	opment proces	ss from the	4 perspective constitutions.
suppliers (devs and Course is aimed at BIE-DIF This course provide	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will look designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.  Differential equations s a foundational overview of differential equations, starting with basic motivation and examples of	k into the desigr zations and will t	ry out collai	ppment proces poration with o	ss from the client representations of the client representation of the cli	4 e perspective cesentatives.  5 s like separatio
suppliers (devs and Course is aimed at BIE-DIF This course provide of variables. Key the	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design duce students to specifics of UX, Service design and development for public sector. We will look designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.  Differential equations	k into the desigr zations and will t ODEs and progr ystem-based OE	ry out collal essing to es DEs are cov	ppment proces poration with a  Z sential solution ered with met	SS from the client representation of the clie	4 e perspective desentatives.  5 s like separatio
suppliers (devs and Course is aimed at BIE-DIF This course provide of variables. Key the polynomial analysis	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will look designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.  Differential equations as a foundational overview of differential equations, starting with basic motivation and examples of experse on existence and uniqueness establish when solutions can be guaranteed. Linear and seconds.	k into the design zations and will t ODEs and progr ystem-based OD to showcase re	essing to es DEs are coval-	ppment processoration with of the control of the co	SS from the client representation of the clie	4 e perspective desentatives.  5 s like separation characteristic oduction to
suppliers (devs and Course is aimed at BIE-DIF This course provide of variables. Key the colynomial analysis partial differential erand explicit Euler mand explicit E	rn principles and current solutions of storage systems architecture. The module explains principle high availability.  Public Services Design oduce students to specifics of UX, Service design and development for public sector. We will look designesr) as well as clients. In small teams students will work on projects from partner organizatudents-designers as well as clients.  Differential equations as a foundational overview of differential equations, starting with basic motivation and examples of eorems on existence and uniqueness establish when solutions can be guaranteed. Linear and so, followed by examples of non-linear models such as predator-prey and epidemiological models.	k into the design zations and will t ODEs and progr ystem-based OD to showcase re	essing to es DEs are coval-	popment procesoration with or Zesential solution ered with met polications. Finding ODEs and F	ZK promethods like of ally, an intr	4 e perspective desentatives.  5 s like separation characteristic oduction to
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KZ

BI-EP1.24

The course is taught in Czech.

Effective programming 1

BI-EP2 Efficient Programming 2	KZ	4
Continuation of Efficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving indi with the aim to choose the best one and avoid implementation errors.	ividual problems a	are discussed,
BI-ANGK English language, contact preparation for the B2 level exam	Z	2
The content of the course corresponds to the preparation for the English exam at the B2 level. Requirements for course credit. Academic Achieveme		
active part in the language instructionMeet the requirements for writing assignments - Summary, Abstract, Argumentation PaperSucceed in both		
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 i	individual teacher	s during the first
class of the term.  BI-EJA Enterprise Java	Z,ZK	4
The course is on advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information is		-
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 that can be deployed to the cloud	mation systems w	vith microservice
architecture, that can be deployed to the cloud.  BI-FMU Financial and Management Accounting	Z,ZK	5
The aim of the course is explanation of basic terms in the theory of accounting, the principles of balancing the property amounts and liabilities in the		-
operations in accounts and accounting statements including opening and closing of bookkeeping. The course provides students with a legal modifica	•	- '
of economic operations based on current methods of double-entry bookkeeping for enterprising subjects in the Czech Republic. Principles of manag	ement accounting	g are base of
Business Inteligence moduls in Business information systems.  BI-HAM HW accelerated network traffic monitoring	KZ	4
BI-HAM   HW accelerated network traffic monitoring   This course introduces students to modern and widely used technologies and principles in the area of network infrastructure and traffic monitoring. T		
network traffic are mandatory skills to network operators (planning and development of resources and infrastructure) and security analysts alike (as a	=	-
for analysis). The goals of the course are to acquaint students with the modern trends and cornerstone principles in the area of monitoring network tr	raffic on a hardwa	are and software
level and to develop their practical abilities in this field.	7 71	
BI-HMI History of Mathematics and Informatics  This course is presented in Czech.	Z,ZK	3
BI-ARD Interactive applications on Arduino	KZ	4
The subject is designed for students of first grade of bachelor study as introduction to embedded systems. Students will learn how to design simple appli		•
kits and control varied peripherals with help of available libraries. The goal of the subject is to show varied software approaches to control embedded		
not only on display of a PC. Thanks to possible control on higher (objective) layer, this platform is frequently used for artist performance and therefore	e is suitable even	for Web and
Software Engineering students.	7 71/	4
NI-IAM Internet and Multimedia Internet and multimedia Internet and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes ac	Z,ZK	4 gnals (input).
presentation of AV signals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practic	•	
audiovisual transmissions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the		
the quality and latency of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording	the scene up to	the presentation
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for audience.		
for audience.  BIE-CSI Introduction to Computer Science	Z	2
for audience.	Z er fields but interes	2 sted in computer
for audience.  BIE-CSI Introduction to Computer Science  This is an introductory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in othe science, high-school students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. The and relate basic principles of computer science for students to understand, early on, what computer science is, why things such as high-level program.	Z or fields but intered goal of the class mming languages	2 sted in computer is to introduce s and tools are
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	al Modelling Lab	KZ	5
,	and multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is	•	
	ing using numpy and scipy. The second half of the semester is focused on the design of methods and algorithms, operator of own research and may result in the topic of final work (diploma or bachelor thesis).	and analyses of t	neir properties.
	Aspects in Cryptography and Security	Z,ZK	5
	ed not only in technical scope of computer science, but also in making products usable - for users and for develope		-
use their gained knowledge to desi	gn, plan and analyse their own projects in the context of human-centered security.		
	erial Psychology	ZK	2
	natical Structures in Computer Science	Z,ZK	4
	nming languages. Data types as continous lattices, Scott topology. Procedures as continuous mappings. The Scott	t model of lambda	a calculus.
Introduction to category theory.  BI-MPP.21 Method	s of interfacing peripheral devices	Z,ZK	5
	for interfacing of peripheral devices. Interfacing of real peripheral devices is focused on techniques based on Unive		-
includes both PC side and periphe	ral devices side. Labs are practically oriented. Students gain experience with implementation of relevant parts of U	SB devices, Linu	x and Windows
	ment, and APIs of selected devices.		
!	technologies	KZ	3
· ·	stands in the introduction of the RouterOS operating system and some network Mikrotik technologies which are c SPs). The students learn how to use and create the architectures of the network solutions which are based on the		
• •	ally deploy them. The successful completion of this subject requires the previous knowledge of elementary computer		
and technologies of the data-link, r	network and transport layer of the OSI model.		
	Object-Oriented Programming in Pharo	KZ	4
	rrently one of the most widespread paradigms of software creation, especially enterprise information systems, whe	-	
1	plications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the sl object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development		
1	amming skills, which are generally applicable in other OO languages, students will also gain the opportunity to wor		
technologies in terms of semestral	work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involved	ement in the Pha	ro Consortium.
	Visualisation Technologies	Z,ZK	5
, ,	n overview of modern visualization technologies and their principles, namely technologies related to virtual and aug		
	E and video mapping) and their applications in practice. Several lectures deal with the content creation for the menti- tific data visualization, and 3D model scanning.	onea technologie	s, namely fractal
	dia team project	KZ	4
This course is presented in Czech.			·
	ons Research and Linear Programming	KZ	5
I	ents to the issues of operational research and primarily to the practical application of linear programming as a fund	· ·	ation technique.
	uses on the use of engineering methods (with a mathematical background) to solve practical problems (such as ma		
NI-OLI Linux D	rivers	Z,ZK	4 sors and FPGAs
NI-OLI Linux D The Linux operating system is an ir		Z,ZK powerful process	sors and FPGAs
NI-OLI Linux D The Linux operating system is an ir increase the variability of periphera	rivers  nportant operating system for personal computer and also for embedded systems. Systems on chip and combining	Z,ZK powerful process nt for master's st	sors and FPGAs udents. The
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BI-PHP.1			
	Programing in PHP	KZ	4
_	Czech Main goal of the course is an introduction to PHP - language and technology. Students will learn also best practices		
· · · · · · · · · · · · · · · · · · ·	e 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. Th	ney should
	n their 3rd semester of study.	7.71/	4
BI-PS2	Programming in shell 2 overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In ad-	Z,ZK	dooper insight
	er particular scripting languages and will get practical experience with shell script programming.	ullon, they gain a	deeper insigni
NI-PDD	Data Preprocessing	Z,ZK	5
	e raw data for further processing and analysis. They learn what algorithms can be used to extract information from various da	1 1	-
	arn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of character		• •
pages.			
BI-PKM	Introduction to mathematics	Z	4
This course is presented	J in Czech.		
NI-REV	Reverse Engineering	Z,ZK	5
	nted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens		
	nderstand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dec		
	++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be d ng work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the comput	_	-
	ning work and which methods can be ascalte detect it. One of the lectures will be decleated to the latest defias on the compati- ninars, where students will solve practically oriented tasks from the real world.	ici maiware seeme	The locus of
BI-SCE1	Computer Engineering Seminar I	Z	4
	er Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance	. – .	ttacks. Students
are approached individu	ally within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of t	the subject is worl	k with scientific
articles and other profes	sional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teach	chers. The topics a	are new for each
semester.			
BI-SCE2	Computer Engineering Seminar II	Z	4
•	er Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance		
	ally within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of t	· ·	
semester.	sional literature and/or work in K N laboratories. The capacity of the subject is limited by the possibilities of the seminar teach	chers. The topics a	are new for each
BI-ST1	Network Technology 1	Z	3
_	o providing the students basic information and practical skills from the area of digital and IP networks. The subject is acredite	. – .	-
CCNA1 - R&S Intro		od diraci tilo Cico.	011010000
BI-ST2	Network Technology 2	Z	3
This course is presented		- 1	Ŭ
BI-ST3	Network Technology 3	Z	3
	ance their knowledge acquired from previous BI-ST1 and BI-ST2 courses. Principles of routing and switching presented during	າ ng BI-ST1 and BI-	ST2 courses will
get further extended in	he course. Students will be able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, pre-	dictability, extension	on beyond a
simple topology, securit	ı, etc.		
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 switching		-
•	ner extended in BI-ST3. Students were able to start fine-tune protocols' settings to gain certain advantages like increased eff		•
	gy, security, etc. This module teaches students to configure and fine-tune Wide Area Networks and to experience a completel ess) which radically differs from well-known Ethernet (broadcast) type of networks. Students will also manage router and swit		
•	ncy procedures. Also the security aspect is treated; students will learn possible intra- and inter-network attacks and the mitig		
network running.		•	9
BI-SKJ.21	Scripting Languages		
Students gain a general	Scripting Languages	Z,ZK	4
	Scripting Languages overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In add	1 1	
into shell and some other		1 1	
BI-SOJ	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In ader particular scripting languages and will get practical experience with shell script programming.  Machine Oriented Languages	dition, they gain a	deeper insight
BI-SOJ Students of the course v	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In ader particular scripting languages and will get practical experience with shell script programming.  Machine Oriented Languages  vill gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal	dition, they gain a	deeper insight  4 sessor's features
BI-SOJ Students of the course v and efficient cooperation	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In ader particular scripting languages and will get practical experience with shell script programming.  Machine Oriented Languages  vill gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of view	dition, they gain a	deeper insight  4 sessor's features
BI-SOJ Students of the course v and efficient cooperation This knowledge will be to	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In adder particular scripting languages and will get practical experience with shell script programming.  Machine Oriented Languages  vill gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of views during reverse engineering, optimization, and evaluation of code security.	dition, they gain a  Z,ZK  al use of microproces linked to higher	deeper insight  4 eessor's features level languages.
BI-SOJ Students of the course vand efficient cooperation This knowledge will be value.	overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In ader particular scripting languages and will get practical experience with shell script programming.  Machine Oriented Languages  vill gain an ability to create their own programs in the assembly language of the most common PC platform focusing on optimal of software with hardware. Next, there will be discussed x86 specifics of the majority of OSes from the application point of views during reverse engineering, optimization, and evaluation of code security.  World Economy and Business	Z,ZK al use of microproces winked to higher	deeper insight  4 eessor's features level languages.
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BI-TS1	Theoretical Seminar I	Z	4
	ntended 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		•
_ ·	e. The capacity is limited by the the potentials of the teachers of the seminar.	o a work with oolo	nuno paporo ana
BI-TS2	Theoretical Seminar II	Z	4
Theoretical seminar is in	ntended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a class	ssical reading gro	up. The students
· ·	and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	s a work with scie	ntific papers and
-	e. The capacity is limited by the the potentials of the teachers of the seminar.	7	4
BI-TS3 Theoretical seminar is in	Theoretical Seminar III tended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a clas	Z ssical reading gro	4 un The students
	and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is	0.0	•
other scholarly literature	e. The capacity is limited by the the potentials of the teachers of the seminar.		
BI-TS4	Theoretical Seminar IV	Z	4
	ntended 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 b. The capacity is limited by the the potentials of the teachers of the seminar.	s a work with scie	ntific papers and
BI-TDA	Test driven architecture	KZ	4
	on practical examples of how to develop, test, and deploy software with tools like GitLab, Docker, Kubernetes, and more that		<u>-</u>
	a strong connection on courses like BI(E)-SI1 and BI(E)-SI2. The main goal of this course is to learn by examples that occur i		•
NI-TSP	Testing and Reliability	Z,ZK	5
_	ledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to		-
•	zation and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with analyze, and control the reliability and availability of the designed circuits.	i built-in-self-test e	equipment. They
BI-QUA	Quality Assurance	KZ	4
	students to the fundamentals of testing and quality management. Students will learn what the role of a tester is in the context		· ·
	sperience hands-on application testing using both manual and automated testing. At the end of the semester, the student sho		
analysis, design a set o	f test scenarios, prepare test data, automate an appropriate portion of the scenarios, and prepare a report on the bugs found	in the product ur	nder test.
FI-TOP	Academic writing	Z	2
	ant and required part of research activity. It is not only about obtaining research results but also about applying them in the for		_
•	ful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the c what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting		
	e will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester.		-
on the availability of enr	olled students.		
BI-CCN	Compiler Construction	Z,ZK	5
-	class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles	-	students to
understand the design a			
	and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme		4
BI-TEX	TeX and Typography	Z,ZK	4 s on typographic
BI-TEX		Z,ZK	
BI-TEX This course is presented	TeX and Typography	Z,ZK	
BI-TEX This course is presented rules. BI-EHD	TeX and Typography d in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of t	Z,ZK the course focuse	s on typographic
BI-TEX This course is presented rules. BI-EHD This course is presented BI-KSA	TeX and Typography d in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of to Introduction to European Economic History d in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).  Cultural and Social Anthropology	Z,ZK the course focuse: Z,ZK ZK	s on typographic  3
BI-TEX This course is presented rules. BI-EHD This course is presented BI-KSA The one-semester course.	TeX and Typography d in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of to Introduction to European Economic History d in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).  Cultural and Social Anthropology se aims to acquaint students with the basics of social and cultural anthropology as a scientific discipline dealing with the dive	Z,ZK the course focuse: Z,ZK  ZK trity of the world	s on typographic  3  2 - examples from
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BI-VAK.21 Selected Applications of Combinatorics	Z	3
The course aims to introduce students in an accessible form to various branches of theoretical computer science and combinatorics. In cont	rast to the basic courses, \	we approach the
ssue from applications to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce	some basic data structure	es. Furthermore,
with the active participation of students, we will focus on solving popular and easily formulated problems from various areas of (not only the	oretical) informatics. Areas	from which we
will select problems to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithn	ns, optimization and more.	Students will
also try to implement solutions to the studied problems with a special focus on the effective use of existing tools.		
BI-VMM Selected Mathematical Methods	Z,ZK	4
The lecture begins with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. I	Ne then address Fourier se	eries and their
properties. Further, we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discrete		n. We examine
the linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples are considered as a solution of the simplex algorithm.	mples.	
NI-VYC Computability	Z,ZK	4
Classical theory of recursive functions and effective computability.		
BI-ZS10 Bachelor internship abroad for 10 credits	Z	10
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific	c and/or research institutio	n. 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 th	e professional content and	l 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 w	eeks 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 b	e divided into two subjects	if the internship
exceeds the academic year's dead-line.		
BI-ZS20 Bachelor internship abroad for 20 credits	Z	20
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific	c and/or research institutio	n. 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 th	e professional content and	l 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 w	eeks 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	e divided into two subjects	if the internship
exceeds the academic year's dead-line.		
BI-ZS30 Bachelor internship abroad for 30 credits	Z	30
Each student can once within his / her bachelor's study programme have a foreign internship at a foreign university or other foreign scientific	c and/or research institutio	n. 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 th	e professional content and	l 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 w	eeks 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 b	e divided into two subjects	if the internship
exceeds the academic year's dead-line.		
BI-ZIVS Intelligent Embedded System Fundamentals	KZ	4
Intelligent embedded system fundamentals course is focused on high-level technology embedded systems integrating artificial intelligence.	The aim of the course is to	teach students
modern humanoid robot control and development of applications in a graphical development environment. Lectures provide fundamentals of	motion control, sensor read	ding, application
interfaces, robot navigation and development tools. In labs, students program a set of basic task by using the robot simulator and real hardw	vare to get practical experi-	ence with these
technologies.		
BI-ZPI Process engineering	KZ	4
Students will learn fundamentals of process engineering in this subject. Students will get necessary foundations for understanding formal pr	inciples of process modell	ing 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 mode	elling of business processe	es using modern
CASE tools. The role of process engineering for information systems development is discussed as well as its importance in the overall conte	ext of information and busing	ness strategy of
an enterprise.		
BI-ZNF PHP Framework Nette - basics	KZ	3
Students will gain the basics of PHP framework Nette. They will learn how to practically work with MVP architecture and various libraries of the	nis Czech popular framewo	ork. The resulting
knowledge should serve for the efficient creation of a web backend in PHP language.	• •	Ū
BI-IOS Fundamentals of iOS Application Development for iPhone and iPad	KZ	4
This course is presented in Czech.	.=	•
BI-ZWU Introduction to Web and User Interfaces	Z,ZK	4
DI-ZWO I INTOQUED IO Crock	۷,۷۱۸	-

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

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

ΚZ

Requirement credits in the group:

Requirement courses in the group:

3D Printing

Credits in the group: 0

This course is presented in Czech.

BI-3DT.1

Note on the group:

Note on the gro	ιuρ.					
Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
BI-ADU.21	Unix Administration Zden k Muziká , Petr Zemánek, Miroslav Prágl <b>Zden k Muziká</b> 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 <b>Ond ej Suchý</b> Ond ej Suchý (Gar.)	Z,ZK	5	2P+2C	L	V
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	V

BI-APS.21	Architectures of Computer Systems  Michal Štepanovský, Pavel Tvrdík Michal Štepanovský Pavel Tvrdík (Gar.)	Z,ZK	5	2P+2C	Z	V
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 <b>Ji í Dostál</b> 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 Ji í Bu ek Ji í Bu ek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-IOT.21	Internet of Things Viktor erný, Lenka Kosková Tísková Lenka Kosková Tísková Lenka Kosková Tísková (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-JPO.21	Computer Units Pavel Kubalik Pavel Kubalik (Gar.)	Z,ZK	5	2P+2C	Z	V
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-MPP.21	Methods of interfacing peripheral devices Miroslav Skrbek Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-MDF.21	Modern Data Formats Petr Pauš Petr Pauš Petr Pauš (Gar.)	KZ	3	1P+1C	Z	V
FIT-ITI	Modern IT infrastructure Ivan Sime 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 fina 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-PNO.21	Practical Digital Design Martin Novotný Martin Novotný (Gar.)	KZ	5	2P+2C	Z	V
BI-PAI.21	Law and Informatics Zden k Ku era, Št pánka Havlíková, Dominik Vítek, Martin Samek, Ji í Maršál, Michal Mat jka <b>Št pánka Havlíková</b> 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	٧
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 í 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 <b>Martin Šlapák</b> 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 Fesl Jan Fesl (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-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-SRC.21	Real-time systems Hana Kubátová, Ji í Vysko il <b>Jaroslav Borecký</b> Hana Kubátová (Gar.)	Z,ZK	5	2P+2C	Z	V

BI-TAB.21	Applications of Security in Technology Ji í Dostál, Jan B lohoubek, Martin Kolárik, Martin Pozd na <b>Ji í Dostál</b> 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 <b>Ji í</b> 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
BI-TIS.21	Information Systems 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 (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 <b>David Pokorný</b> Jan B Iohoubek (Gar.)	Z,ZK	5	3P+1C	Z	V
BI-VES.21	Embedded Systems Miroslav Skrbek Miroslav Skrbek (Gar.)	Z,ZK	5	2P+2C	L	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
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	L	V
BI-FEM.21	Fundamentals of Economics Tomáš Evan Tomáš Evan (Gar.)	Z,ZK	5	2P+2C	Z	V
BI-ZRS.21	Basics of System Control Kate ina Hyniová Kate ina Hyniová (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

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

BI-PYT.21 Python Programming ΚZ 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-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

ΚZ

finishing the course students were able to choose suitable tools (mostly open source) and techniques, design and implement a simplest reproducible method of data processing (data collection, transformation/aggregation, presentation). Students get acquainted with various architectures for processing and storing big data. A theoretical foundation and presentation of individual technologies will be supplemented with specific examples from practice.

#### BI-SVZ.21 Machine vision and image processing

Z,ZK

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-VWM.21 Searching the Web and Multimedia Databases

Z,ZK

5

Students get basic overview about search techniques in the web environment that is interpreted as a very large distributed and heterogeneous storage of documents. In particular, students acquire information about search techniques in text and hypertext documents (the web pages themselves) and about feature extraction from web pages. They get detailed knowledge of similarity search in multimedia databases (generally in collections of unstructured data). They also learn techniques for programming web search engines for the mentioned data types (documents).

#### BI-MPP.21 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.

#### BI-MVT.21 Modern Visualisation Technologies

Z,ZK

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

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

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

BI-AG2.21 Algorithms and Graphs 2 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. **Architectures of Computer Systems** Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction processing not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such systems BI-BEK.21 Secure Code Z.ZK 5 The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them. BI-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 **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. 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 Z,ZK 5 The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers. BI-IOT.21 Z,ZK Internet of Things 5 The course focuses on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS). Computer Units 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). Conceptual Modelling 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 Mathematical Logic 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. 3 BI-MDF.21 Modern Data Formats 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. Modern IT infrastructure 5 Multimedia and Graphics Applications BI-MGA.21 7.7K Students get acquainted with multimedia technologies and applications for 2D/3D bitmap and vector graphics. During the course, current tools for working with images, videos, 3D graphics and animation will be introduced. Students learn several basic techniques of creation and editing content in computer graphics, introduction to graphic formats, and compression technologies. They learn to use multimedia transmission and representation systems, including real-time multimedia processing. They understand the principle of operation and use of graphics processing cards. They gain a number of practical skills, such as vectorizing raster images, retouching photos, or creating 3D models

BI-OOP.21 Object-Oriented Programming	Z,ZK	5
Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate togeth		-
course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The e for developing software, which includes testing, error handing, refactoring, and application of design pattern.	mphasis is on prac	tical techniques
BI-PGR.21 Computer graphics programming	Z,ZK	5
After attending this curse, students can program a simple interactive 3D graphical application like a computer game or scientific visualization, design	1	-
geometric details and materials (like wall surface, wood, sky), and set up the lighting. At the same time, they understand the fundamental principles and		٠ ا
such as graphical pipeline, geometric transformations, or lighting model. They gain knowledge allowing orientation in computer graphics and representations	enting solid fundan	nentals for your
professional development, e.g., GPU programming and animations. They get used to techniques utilized in geometric modeling, modeling curves and s	urfaces, and scienti	ific visualization.
BI-PNO.21 Practical Digital Design	KZ	5
Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand		
and implementation technologies FPGA and ASIC. Students demonstrate practical use of the design techniques in the course project using modern tools.	industry-standard	CAD design
BI-PAI.21 Law and Informatics	ZK	5
The aim of the course is to introduce students into the basic legal instruments that they will encounter in their practice. Students will gain knowledge	1	-
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 of	=	
environment, will know their responsibilities in working with the Internet, will be familiar with the institutes of intellectual property law, and will be able		
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	on against their mi	suse. 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 p	practice.
BI-PJP.21 Programming Languages and Compilers	Z,ZK	5
Students learn basic compiling methods of programming languages. They are introduced to intermediate representations used in current compilers		·
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	n. The compiler car	n translate not
only a programming language but any text in a language generated by a given LL input grammar.	7.71/	
BI-PPA.21   Programming Paradigms  The source deals with basis paradigms of high level programming languages, including their basis execution models, hand disadvantages as	Z,ZK	5
The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and disadvantages of programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming		
on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern main		
such as C++ and Java.		
BI-PGA.21 Programming of Graphic Applications	Z,ZK	5
The course will present the possibilities of current professional open-source tools for image editing, video editing, 3D animation (GIMP, Blender) and to		-
data (3D scenes, mathematical data). Emphasis will be placed on the possibilities of further enhancement of the presented software tools, both using	ng built-in scripting	languages and
by implementation of plugins.		
BI-PJS.21 JavaScript Programming	KZ	5
The course is an introduction to Javascript programming. Students will also learn best practices and get acquai nted with tools that make code deve	lopment in Javascr	ript easier.
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, a	-	-
project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk		_
Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in		
also suitable for all those who will develop software or hardware in the form of team projects.	large companies. I	The course is
BI-SIP.21 Network Programming	7	5
The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming network applications.		-
second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of midd		
introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in c	omputer labs usinç	g a chosen
programming language environment.		
BI-SWI.21 Software Engineering	Z,ZK	5
Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. The		
their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get har	•	
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 their development.		nin the course,
	KZ	5
BI-SP1.21   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	1	
concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The te		
project leader, regularly 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-SP2 course.		
BI-SP2.21 Team Software Project 2	KZ	5
Students gain hands-on experience with the iterative development process while working on a large-scale software project. The first iteration is the re	sult of the BIE-SP1	I course project.
However, in this follow-up, the functionality, testing, and documentation of the software system being developed will be emphasized. Students will we		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 seminars.		_
BI-SPS.21 Administration of Computer Networks and Services	Z,ZK	5
The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administ	-	
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 with real network infrastructure.	a by practical fialls:	3 on expendice
BI-SRC.21 Real-time systems	Z,ZK	5
Students obtain the basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issu	1	
lectures will be experimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab		
course.		
BI-TAB.21 Applications of Security in Technology	Z,ZK	5
The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Str	idents get a broad	er overview of
cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security.		
BI-TJV.21 Java Technology	Z,ZK	5
The goal is to provide knowledge and skills for developing information systems and applications through concepts used in software development and	experience with lib	oraries and tools
from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.		

BI-TPS.21 Computer Networks Technologies The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks. Information Systems BI-TIS.21 Z,ZK The goal of this course is to familiarise students with the information systems topic and information systems implementation principles. During the course, students are introduced to "on the market" existing types of systems and their usage in specific industry segments. Students are familiarised with the CRM, ERP, MRP and other types of information systems. The fundamental part of the course is the introduction to key ideas of an information system selection, evaluation of information system benefits, ways of information systems implementation and information system implementation based on the project management principles. The emphasis is on the initial customer analysis, customer insight and ability to decide whether it is better to implement any existing information system or to develop a new one from scratch. These factors determine the information system implementation success At the end of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems topics are discussed. BI-TUR.21 User Interface Design Z.ZK 5 Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them. BI-TWA.21 **Design of Web Applications** Z.ZK 5 The basic course of web application development. Initially, the students become familiar with HTTP and its possibilities and partly with some properties of language describing the structure (HTML) and presentation of document on the Web (CSS). These skills provide the necessary basis for the development of Web applications, which will be demonstrated in modern libraries facilitate the development of Web pages applications. Server side will be demonstrated on PHP technology using frameworks Symfony 2, Doctrine 2. Developments on the client side will be demonstrated using a JavaScript language with library jQuery and possibly MV\* framework React. BI-IDO.21 Introduction to DevOps Z.ZK 5 The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice. BI-UKB.21 Introduction to Cybersecurity The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations. BI-VES.21 **Embedded Systems** Z,ZK 5 Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools. 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-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-FEM.21 Fundamentals of Economics 7 7K 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-7RS.21 **Basics of System Control** Z.ZK 5 The course gives an introduction to the field of automatic control. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems, description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD, and fuzzy controllers. Students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD, and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters, and certain aspects of the industrial implementation of continuous and digital controllers and PLC control.

BI-ZSB.21 Basics of System Security

7.7K 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 course corresponds to the preparation for the English exam at the B2 level. Requirements for course credit. Academic Achievement - students are due to: -Take an active part in the language instruction. -Meet the requirements for writing assignments - Summary, Abstract, Argumentation Paper, -Succeed in both the midterm and the final term tests with the success rate set at 70%. -80% and over in BOTH tests means ORAL EXAM ONLY (no written part). Requirements will be specified by individual teachers during the first class of the term.

BI-AAG.21	Automata and Grammars	Z,ZK	5
	uced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite a	_	-
	ars, context-free grammars, construction and use of pushdown automata, and translation grammars and transducers. They know the	=	al languages
	ey understand the relationships between formal languages and automata. They are introduced to the Turing machine and complexity		
BI-ACM	Programming Practices 1  This is a selective course for preparing talented student for representation in international programming contests.	KZ	5
BI-ACM2	Programming Practices 2 This is a selective course for preparing talented student for representation in international programming contests.	KZ	5
BI-ACM3	Programming Practices 3  This is a selective course for preparing talented student for representation in international programming contests.	KZ	5
BI-ACM4	Programming Practices 4  This is a selective course for preparing talented student for representation in international programming contests.	KZ	5
BI-ADU.21	Unix Administration	Z,ZK	5
	he internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They		_
	administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights,		
processes, memo	ory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the known specific examples from practice.	owledge from the le	ectures on
BI-ADW.1	Windows Administration This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).	Z,ZK	4
BI-AG1.21	Algorithms and Graphs 1	Z,ZK	5
	rs the basics of efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing cui		_
develops the know	rledge from the course BI-DML.21, in which students acquire the knowledge and skills in combinatorics necessary for evaluating the	time and space co	mplexity of
algo	rithms. The course also follows up knowledge from BI-MA1.21, the practical usage of asymptotic mathematics, in particular, the asymptotic mathematics in the particular mathem	ptotic notation.	
BI-AG2.21	Algorithms and Graphs 2	Z,ZK	5
	ented in Czech, introduces basic algorithms and concepts of graph theory as a follow=up on the introduction given in the compulsory		
delves into advan	ces data structures and amortized complexity analysis. It also includes a very light introduction to approximation algorithms. For Engl BIE-AG2.21.	ish version of the o	course see
BI-ALO	Algebra and Logic	Z,ZK	4
BI-ALO	The course extends and deepens the study of topics touched upon in the basic course in logic.	Z,ZN	4
BI-AND.21	Programming for the Android Operating System  This course is presented in Czech.	KZ	4
BI-ANG	English Language, Internal Certificate	ZK	2
DI-ANG	Course information and teaching materials can be found at https://moodle-vyuka.cvut.cz/course/search.php?search=BI-AN		
DI ANIO4			
BI-ANG-T		/ / N	
BI-ANG1	English Language Examination without Preparatory Courses  English Language Contact preparation for the R2 level exam	Z,ZK	2
BI-ANGK	English language, contact preparation for the B2 level exam	Z	2
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BI-BIG.21	DB Technologies for Big Data	KZ	5
	troduced into the field of Big Data processing where nonrelational (NoSQL) database engines are typically used today. The course is for e students were able to choose suitable tools (mostly open source) and techniques, design and implement a simplest reproducible mo		
-	mation/aggregation, presentation). Students get acquainted with various architectures for processing and storing big data. A theoretic		
	of individual technologies will be supplemented with specific examples from practice.		
BI-BLE	Blender  ds knowledge of opensource program Blender from Bl-MGA (Multimedia and Graphics Applications) course. It is intended for those in	Z,ZK	4
	offers a complete and practically oriented introduction to Blender environment. Students may continue to BI-PGA (Programming graph	<del>-</del>	
BI-BPR.21	Bachelor project	Z	1
_	ng of the semester, the student reserves the topic of the bachelor's thesis and connects with the supervisor. He / she will arrange 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 enters the information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" (http://fit.cvul		
•	d 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 top	•	′
has reserved is for	mulated more generally, the tasks assigned to him by the supervisor for the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed primarily at fine-tuning the semester should be aimed primarily at fine-tuning the assignment of the semester should be aimed by the semester should be also should be al	nment so that the	assignment
BI-CCN	can be supplemented and approved at the end of the semester.  Compiler Construction	Z,ZK	5
	uctory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles		_
understa	and the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching	theme of the class	S.
BI-CS1	Programming in C#	KZ	4
	urse is to introduce .NET Framework as a multi-language development platform. Then, programming language C#, its fundamental cc s, loops, definitions and calls of functions will be discussed. Attention is focused on the object oriented programming in C# - class def		
	nods, properties, static members, Garbage Collector, inheritance and polymorphism, collections, delegates, and generics. Debugging		
	well as work with files are emphasized.		
BI-CS2	C# language and data access and data access course objective is to introduce students several data access technologies - database, XML, NoSQL - on the Micros	KZ KZ	4 tudents will
0 0	ts used to retrieve data - Connection, Command, Data Reader and DataAdapter v ADO.NET. Next, they will learn to use current technical technical services and the services of the services and the services are services as	•	
	erying and updating data, integrated directly with the .NET platform languages, which enable LINQ use with Objects, XML and SQL (L		
	.). Another objective is the Entity Framework - an object-relational mapper that enables .NET developers to work with relational data u of the course introduces Code First, Database First, Model First approaches.The students will also get to know the Conceptual Model		
(Oran). The part of	(XML description).	, ctorage moder ar	ia mapping
BI-CS3	Language C# - design of web applications	KZ	4
The students will be	e introduced to current technologies in web application development on the .NET platform. They will acquire a comprehensive overview on thisplatform. They will learn to create WebAPI and to use it by client programs.	of the development	possibilities
BI-DBS.21	Database Systems	Z,ZK	5
	roduced to the database engine architecture and typical user roles. They are briefly introduced to various database models. They lear	' '	
	constraints) using a conceptual model and implement them in a relational database engine. They get a hands-on experience with the		
	dation - the relational database model. They learn the principles of normalizing a relational database schema. They understand the funda olling parallel user access to a single data source, as well as recovering a database engine from a failure. They are briefly introduced t	•	
-	ases with respect to speed of access to large quantities of data. This introductory-level course does not cover: Administration of data		-
DI DIMI 04	optimizing database applications, distributed database systems, data stores.	7.71	
BI-DML.21 Students will get a	Discrete Mathematics and Logic cquainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from	Z,ZK	5 e explained
<del>-</del>	s paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The cours		
	combinatorics and number theory, with emphasis on modular arithmetics.		
BI-EHA.21	Ethical Hacking ourse is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vuln	Z,ZK	5 ir possible
_	nputer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is		
	vulnerabilities testing and the following process of penetration test documentation.		
BI-EHD	Introduction to European Economic History	Z,ZK	3
BI-EJA	This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).  Enterprise Java	Z,ZK	4
	advanced technologies in the Java programming language. The focus is on technologies for development of enterprise information sys		
	a database and are accessed through the web interface.		
BI-EJK	Enterprise Java and Kotlin	Z,ZK	4
ine course is on a	dvanced technologies in the Java and Kotlin programming languages. The focus is on technologies for developing enterprise informat architecture, that can be deployed to the cloud.	ion systems with m	nicroservice
BI-EP1.24	Effective programming 1	KZ	4
	The course is taught in Czech.		
BI-EP2	Efficient Programming 2	KZ	4
Continuation of El	fficient Programming 1. Students will practice implementation of algorithms by solving typical problems. Various ways of solving indivi- with the aim to choose the best one and avoid implementation errors.	auai probiems are o	discussed,
BI-EPP.21	Economic Business Processes	Z,ZK	5
	urse is to present typical processes related to the usual life cycle of a company. The course focuses mainly on the basic economic and		
	ronment of the Czech Republic and the basics of management. In the course, students are acquainted with the typical phases of the ne company, through the management of property and capital structure, financing of the company, determining the cost function of the		
	evaluating the financial health of the company and its eventual rehabilitation or termination.		
BI-FBI.21	Financial Business Intelligence	Z,ZK	5
	rse is to acquaint students primarily with financial accounting as a tool for recording business operations and documents for business rs for comparison with other companies and management decision process at the tactical and strategic level. The second view is man		-
	pement and prediction of business development. Management accounting allows monitoring of the financial status and performance of the second view is manual transfer.	_	-
accounting perio	ds, enables a multidimensional view of business data, enables to control effectively factors affecting the return on invested capital and	d to use value infor	mation to

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 Intelligence moduls in Business information systems.  BI-GIT Version control system GIT KZ 2  Students will be introduced to basic principles of version control systems. These principles will be then shown on DCVS Git both theoretically and practically. In this particular system even the implementation details will be shown. Students will be challenged to use Git as users, project managers, team leaders as well as Git server administrators.  BI-GIT.21 SW Development Technologies Z 3			
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 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 operation 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 based on Business Intelligence moduls in Business information systems.  BI-GIT Version control system GIT Students will be introduced to basic principles of version control systems. These principles will be then shown on DCVS Git both theoretically and practically. In this particular system even the implementation details will be shown. Students will be challenged to use Git as users, project managers, team leaders as well as Git server administrators.  BI-GIT.21 SW Development Technologies Z 3			
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This course is almed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to Git, the information mana-			
from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use.			
BI-HAM HW accelerated network traffic monitoring KZ 4			
This course introduces students to modern and widely used technologies and principles in the area of network infrastructure and traffic monitoring. The monitoring and analysis of the monitoring analysis of the monitoring and analysis of the monitoring analysis of the monitoring			
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 and			
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 or			
use their gained knowledge to design, plan and analyse their own projects in the context of human-centered security.			
BI-HMI History of Mathematics and Informatics Z,ZK 3			
This course is presented in Czech.			
BI-HWB.21 Hardware Security Z,ZK 5			
The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptograp			
modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-chan			
attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topic			
for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers.  BI-IDO.21 Introduction to DevOps Z,ZK 5			
The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course			
covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software			
the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies			
used in practice.			
BI-IOS Fundamentals of iOS Application Development for iPhone and iPad KZ 4			
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BI-LA1.21 Linear Algebra 1 Z,ZK 5 We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a matrix. We will also demonstrate some applications of these concepts in computer science. BI-LA2.21 Linear Algebra 2 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. BI-LOG.21 Mathematical Logic The course focuses on the basics of propositional and predicate logic. It starts from the semantic point of view. Based on the notion of truth, satisfiability, logical equivalence, and the logical consequence of formulas are defined. Methods for determining the satisfiability of formulas, some of which are used for automated proving, are explained. This relates to the P vs. NP problem and Boolean functions in propositional logic. In predicate logic, the course further deals with formal theories, such as arithmetics, and their models. The syntactic approach to mathematical logic is demonstrated on the axiomatic system of propositional logic and its properties. Gödel's incompleteness theorems is explained. BI-MA1.21 Mathematical Analysis 1 Z,ZK 5 We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newtons method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landaus asymptotic notation and methods of mathematical description of complexity of algorithms. 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-MDF.21 Modern Data Formats The goal of the course is to give an overview of commonly used data formats for typical types of data. There will be a description of each data type and the data formats used for that data type along with tools available to work with such data. After finishing the course, the students should know how to work with common data, e.g. on the Web. BI-MGA.21 Multimedia and Graphics Applications Students get acquainted with multimedia technologies and applications for 2D/3D bitmap and vector graphics. During the course, current tools for working with images, videos, 3D graphics and animation will be introduced. Students learn several basic techniques of creation and editing content in computer graphics, introduction to graphic formats, and compression technologies. They learn to use multimedia transmission and representation systems, including real-time multimedia processing. They understand the principle of operation and use of graphics processing cards. They gain a number of practical skills, such as vectorizing raster images, retouching photos, or creating 3D models. **BI-MIT** Mikrotik technologies 3 The main motivation of the subject stands in the introduction of the RouterOS operating system and some network Mikrotik technologies which are commonly used by the small and middle internet service providers (ISPs). The students learn how to use and create the architectures of the network solutions which are based on the metallic, optical or wireless links and how to administrate and practically deploy them. The successful completion of this subject requires the previous knowledge of elementary computer networks concepts like protocols and technologies of the data-link, network and transport layer of the OSI model. BI-ML1.21 Machine Learning 1 7.7K 5 The goal of this course is to introduce students to the basic methods of machine learning. They get theoretical understanding and practical working knowledge of regression and classification models in the supervised learning scenario and clustering models in the unsupervised scenario. Students will be aware of the relationships between model bias and variance, and know the fundamentals of assessing model quality. Moreover, they learn the basic techniques of data preprocessing and multidimensional data visualization. In practical demonstrations, pandas and scikit libraries in Python will be used. BI-ML2.21 Machine Learning 2 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 This course is presented in Czech. 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. 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. BI-OOP.21 Object-Oriented Programming Z,ZK Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handing, refactoring, and application of design pattern. **BI-OPT** Introduction to Optical Networks 7.7K 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 Z,ZK 5 In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems. OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows BI-PA1.21 Programming and Algorithmics 1 Students gain the ability to formulate algorithms for solving basic problems and write them in the C language. They understand data types (simple, structured, pointers), expressions, statements, functions, concept of recursion. They learn to analyse simple cases of algorithm complexity. They know fundamental algorithms for searching, sorting, and manipulating with linked lists and trees. BI-PA2.21 Programming and Algorithmics 2 Z,ZK 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. **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. 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. RI-PHP1 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. Programming Languages and Compilers BI-PJP.21 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. JavaScript Programming BI-PJS.1 Main goal of the course is an introduction to Javascript programming. Students will learn also best practices and will use tool that eases development in Javascript. The course is recommended for students of BIE-WSI-WI.2015 branch of study and do not have required knowledge to register for BIE-TWA.1. They should register for this course in their 4th semester of study. JavaScript Programming BI-PJS.21 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-PJV** Programming in Java Z,ZK This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753). **BI-PKM** Introduction to mathematics Ζ 4 This course is presented in Czech. **BI-PMA** Programming in Mathematica Z,ZK 4 Students will be working with modern technical and scientific software. Students will learn how to use different programming styles (functional programming, rule-based programming etc.), how to create dynamic interactive applications and visualisations, data processing and presentations. BI-PNO.21 Practical Digital Design K7 Students get an overview of the contemporary digital design flow and learn practical skills to use synchronous design techniques. They understand the basics of the VHDL language and implementation technologies FPGA and ASIC. Students demonstrate practical use of the design techniques in the course project using modern industry-standard CAD design tools BI-PPA.21 **Programming Paradigms** The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and disadvantages of particular approaches. Functional programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. The principles are demonstrated on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstream programming languages such as C++ and Java. BI-PRR.21 7.7K Project management The aim of the course is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, analysis, crisis management in a project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk assessment and management, Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for students who are interested in deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in large companies. The course is also suitable for all those who will develop software or hardware in the form of team projects. BI-PRS.21 **Practical Statistics** K7 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. Programming in shell 2 BI-PS2 Students gain a general overview of available scripting languages, their syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into shell and some other particular scripting languages and will get practical experience with shell script programming.

BI-PSI.21 Computer Networks Z,ZK 5 The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS. BI-PST.21 Probability and Statistics Students will learn the basics of probabilistic thinking, the ability to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables. BI-PYT.21 Python Programming The aim of the course is to get acquainted with basic efficient control and data structures of the Python programming language for text and binary data processing. The differences between philosophy of programming in Python and in other programming languages will be explained. Each topic is prepared for students in the format of a Jupyter notebook, which enables greater accent to individual student work. Before each lab, students pass a short test on the last week topic. Four homeworks plus a semester work will be assigned during the semester. BI-QAP Quantum algorithms and programming Course aims at giving students hands-on experience with quantum computers and their programming. We focus on fundaments of quantum mechanics, on which quantum technologies are based, and algorithms showing advantages and limitations of quantum computing. During tutorials students work in open-source software development kit Qiskit, which is based on Python language. Knowledge of linear algebra at the level of BI-LA1 and BI-LA2 (or BI-LIN) is necessary. Previous completion of BI-MA2 or BI-VMM and experience with Python might be an advantage. No previous knowledge of physics is assumed. **BI-QUA** Quality Assurance ΚZ 4 This course introduces students to the fundamentals of testing and quality management. Students will learn what the role of a tester is in the context of different types of software development and will experience hands-on application testing using both manual and automated testing. At the end of the semester, the student should be prepared to perform a test analysis, design a set of test scenarios, prepare test data, automate an appropriate portion of the scenarios, and prepare a report on the bugs found in the product under test. BI-SAP.21 Computer Structure and Architecture Students will get acquainted with the basic architecture and units of a digital computer, understand the structure, function, and implementation of arithmetic-logic unit, controllers, memory, I/O communication, methods of data transfers between the units. The logic design and the implementation of a program-controlled simple processor is practically implemented in the labs using programmable circuits (FPGA), a single-chip microcomputer, and modern design (EDA) tools. BI-SCF1 Computer Engineering Seminar I 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-SCE2 Computer Engineering Seminar II 4 The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in 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. BI-SP1.21 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 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. 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. 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 gueries. 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 discusse	d. Lectures will usually discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Ora PostgreSQL.	cle DBMS and par	tially on
BI-SRC.21	Real-time systems	Z,ZK	5
	ne basic knowledge in the real-time (RT) system theory and in the design methods for RT systems including the dependability issues.		_
	perimentally verified in computer labs. The course is mainly focused on embedded RT systems, therefore the design kits in the lab are course.		
BI-ST1	Network Technology 1	Z	3
	iented to providing the students basic information and practical skills from the area of digital and IP networks. The subject is acredited CCNA1 - R&S Introduction to Networks.	I under the Cisco	
BI-ST2	Network Technology 2 This course is presented in Czech.	Z	3
BI-ST3	Network Technology 3	Z	3
Students will furthe	r enhance their knowledge acquired from previous BI-ST1 and BI-ST2 courses. Principles of routing and switching presented during B	I-ST1 and BI-ST2	courses will
get further extend	ded in the course. Students will be able to start fine-tune protocols' settings to gain certain advantages like increased efficiency, predisimple topology, security, etc.	ctability, extension	beyond a
BI-ST4	Network Technology 4	Z	3
	er enhance their knowledge already acquired from previous BI-ST1, BI-ST2, and BI-ST3 courses. Principles of routing and switching	-	
_	ot further extended in BI-ST3. Students were able to start fine-tune protocols' settings to gain certain advantages like increased effici		
	topology, security, etc. This module teaches students to configure and fine-tune Wide Area Networks and to experience a completely		•
· ·	e Access) which radically differs from well-known Ethernet (broadcast) type of networks. Students will also manage router and switch nergency procedures. Also the security aspect is treated; students will learn possible intra- and inter-network attacks and the mitigatic		-
recoveries, and er	network running.	m ways wille mail	tairiing trie
BI-STO	Storage and Filesystems	Z,ZK	4
	rn principles and current solutions of storage systems architecture. The module explains principles of data store, protection, and archi		-
	load balancing and high availability.	g, 22 30 0.010	J
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 in	nage information.	he course
introduces students	s to different types of camera systems and a variety of methods for image and video processing. The course is focused on practical use	of camera systems	for solving
	problems of practice that the graduates may encounter.		
BI-SWI.21	Software Engineering	Z,ZK	5
	ainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They co	· · · · · · · · · · · · · · · · · · ·	-
_	ring the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-c	· ·	
_	nguage UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design a	-	ne course,
	Idents also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their		
BI-TAB.21	Applications of Security in Technology urse is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Stude	Z,ZK	5 vorviou of
The goal of the co	cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware	_	verview or
BI-TDA	Test driven architecture	KZ	4
	sused on practical examples of how to develop, test, and deploy software with tools like GitLab, Docker, Kubernetes, and more that ar		
world. This co	urse has a strong connection on courses like BI(E)-SI1 and BI(E)-SI2. The main goal of this course is to learn by examples that occur	in the semester p	roject.
BI-TDP.21	Documentation and Presentation	KZ	3
	sed on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically fin	-	
	of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically prese		
	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 exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed.		
BI-TEX	TeX and Typography	Z,ZK	4
This course is pres	ented in Czech. This course gives basics of programming in TeX (plain TeX, ConTeXt, LaTeX, OpTeX, LuaTeX). Te second part of the crules.	course focuses on	ypographic
BI-TIS.21	Information Systems	Z,ZK	5
_	urse is to familiarise students with the information systems topic and information systems implementation principles. During the course		
	cisting types of systems and their usage in specific industry segments. Students are familiarised with the CRM, ERP, MRP and other to tal part of the course is the introduction to key ideas of an information system selection, evaluation of information system benefits, wa		•
	d information system implementation based on the project management principles. The emphasis is on the initial customer analysis,	=	-
			-
	better to implement any existing information system or to develop a new one from scratch. These factors determine the information sy	stem implementation	JII SUCCESS.
	better to implement any existing information system or to develop a new one from scratch. These factors determine the information sy of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems	•	
	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems	•	
At the end of BI-TJV.21		z,ZK	sed.
At the end of BI-TJV.21 The goal is to provi	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology	z,ZK	sed.
At the end of BI-TJV.21	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and exp	z,ZK	sed.
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and expression from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  uces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical	Z,ZK erience with librarie  Z,ZK  I layer with the ove	5 es and tools 5 rlap to the
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lecture	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  uces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical responsible foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies	Z,ZK erience with librarie  Z,ZK I layer with the ovegies will be demon	5 es and tools  5 rlap to the strated and
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important to the second sec	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  uces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitation to the students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethern always with focus on high-speed networks.	z,ZK erience with librarie  Z,ZK  I layer with the ovegies will be demonet, modern wireles	5 se and tools 5 rlap to the strated and s networks,
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important BI-TS1	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  uces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalized symptomic and supplies the course of the properties of the course of t	s topics are discus  Z,ZK erience with librarie  Z,ZK  I layer with the ove gies will be demon et, modern wireles	5 se and tools 5 rlap to the strated and s networks,
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important billing	of the course information systems security, operation, support, maintenance, legislation impacts, and government information systems  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  uces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalways with focus on high-speed networks.  Theoretical Seminar I  r is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classic	s topics are discus  Z,ZK erience with librarie  Z,ZK I layer with the ove gies will be demon et, modern wireles  Z al reading group. T	5 sand tools 5 rlap to the strated and s networks, 4 ne students
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important the most important are treated individual.	In the course information systems security, operation, support, maintenance, legislation impacts, and government information systems.  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  Loss students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalways with focus on high-speed networks.  Theoretical Seminar I  T is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a vother scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.	s topics are discus  Z,ZK erience with librarie  Z,ZK  I layer with the ove gies will be demon et, modern wireles  Z  al reading group. Tivork with scientific	5 s and tools 5 rlap to the strated and s networks, 4 ne students papers and
At the end of BI-TJV.21 The goal is to provious BI-TPS.21 The course introd link layer. The lectur with the most impossible BI-TS1 Theoretical seminal are treated individual.	Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  Lices students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalways with focus on high-speed networks.  Theoretical Seminar I  T is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a vother scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.  Theoretical Seminar II	s topics are discus  Z,ZK erience with librarie  Z,ZK I layer with the ove gies will be demon et, modern wireles  Z al reading group. Tivork with scientific	5 s and tools 5 rlap to the strated and s networks, 4 ne students papers and
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important the most important are treated individual BI-TS2 Theoretical seminal are treated individual theoretical seminal are treated individual theoretical seminal theoretical theoretical seminal theoretical theoretical seminal theoretical theoretical theoretical theoretical seminal theoretical theoreti	In the course information systems security, operation, support, maintenance, legislation impacts, and government information systems.  Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  Lices students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical resprovide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalways with focus on high-speed networks.  Theoretical Seminar I  Tris intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a vector of the seminar.  Theoretical Seminar II  Tris intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical contemporary theoretical computer science.	s topics are discus  Z,ZK erience with librarie  Z,ZK I layer with the ove gies will be demon et, modern wireles  Z al reading group. Tivork with scientific  Z al reading group. T	5 s and tools 5 rlap to the strated and s networks, 4 ne students papers and 4 ne students
At the end of BI-TJV.21 The goal is to provi BI-TPS.21 The course introd link layer. The lectu with the most important the most important are treated individual BI-TS2 Theoretical seminal are treated individual theoretical seminal are treated individual theoretical seminal theoretical theoretical seminal theoretical theoretical seminal theoretical theoretical theoretical theoretical seminal theoretical theoreti	Java Technology  de knowledge and skills for developing information systems and applications through concepts used in software development and experience from Java language ecosystem. At the course end, the students are able to develop software systems in Java platform.  Computer Networks Technologies  Lices students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical respective theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologitant ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernalways with focus on high-speed networks.  Theoretical Seminar I  T is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classically and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a vother scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar.  Theoretical Seminar II	s topics are discus  Z,ZK erience with librarie  Z,ZK I layer with the ove gies will be demon et, modern wireles  Z al reading group. Tivork with scientific  Z al reading group. T	5 s and tools 5 rlap to the strated and s networks, 4 ne students papers and 4 ne students

BI-TS3 Theoretical Seminar III Ζ Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. BI-TS4 Theoretical Seminar IV 7 Theoretical seminar is intended for students which want to come in deeper contact with contemporary theoretical computer science. It is mostly a classical reading group. The students are treated individually and concern themselves with interesting topics from the latest research in the area. Therefore, an integral part of the course is a work with scientific papers and other scholarly literature. The capacity is limited by the the potentials of the teachers of the seminar. BI-TUR.21 User Interface Design Z,ZK Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them. Design of Web Applications BI-TWA.21 The basic course of web application development. Initially, the students become familiar with HTTP and its possibilities and partly with some properties of language describing the structure (HTML) and presentation of document on the Web (CSS). These skills provide the necessary basis for the development of Web applications, which will be demonstrated in modern libraries facilitate the development of Web pages applications. Server side will be demonstrated on PHP technology using frameworks Symfony 2, Doctrine 2. Developments on the client side will be demonstrated using a JavaScript language with library jQuery and possibly MV\* framework React. BI-TZP.21 Technological Fundamentals of Computers Z,ZK 5 Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica. BI-UKB.21 Introduction to Cybersecurity The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations BI-ULI Introduction to Linux 2 Students become familiar with the basics of the Linux operating system using e-learning form. They learn to work with the command line and become familiar with basic commands and techniques of a Unix-like system. Topics can be studied first theoretically and then practically verified in a virtual machine (terminal) BI-UOS.21 Unix-like Operating Systems 5 Unix-like operating systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative functions of multiuser operating systems for computers and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properties of this OS family, such as processes and threads, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of advanced users who are not only able to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting interface, called shell. BI-VAK.21 Selected Applications of Combinatorics The course aims to introduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the basic courses, we approach the issue from applications to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some basic data structures. Furthermore, with the active participation of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) informatics. Areas from which we will select problems to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimization and more. Students will also try to implement solutions to the studied problems with a special focus on the effective use of existing tools. BI-VDC.21 Virtualization and Data Centers 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** Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools. **BI-VHS** Virtual game worlds ZK The course leads students to create a complex virtual world. The course is a continuation of basic graphical courses (MGA, PGR, BLE,). This current students knowledge is furthermore complemented by the theory of game design, principles of writing dialogues and characters in order to create a functional and complex virtual world. The course can be followed by the course MI-PVR with the task of converting scenes and their dynamics into a fully virtual environment suitable for VR devices BI-VIZ.21 Data Visualization 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 The lecture begins with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then address Fourier series and their properties. Further, we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the wavelet transform. We examine the linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples. BI-VPS.21 Selected Topics in Computer Networking The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security. BI-VR1 Virtual reality I 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 ΚZ 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	Z,ZK	5
_	ic overview about search techniques in the web environment that is interpreted as a very large distributed and heterogeneous storage information about search techniques in text and hypertext documents (the web pages themselves) and about feature extraction from v		
· · · · · · · · · · · · · · · · · · ·	arity search in multimedia databases (generally in collections of unstructured data). They also learn techniques for programming web search		
-	data types (documents).		
BI-ZIVS	•	KZ	4
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	technologies.		
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Students will gain t		pular framework. I	he resulting
BI-ZNS.21		Z.ZK	5
	· · · · · · · · · · · · · · · · · · ·	'	roblems that
		-	s to support
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CASE tools. The ro		ation and business	s strategy of
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	and digital controllers and PLC control.		
BI-ZS10	Bachelor internship abroad for 10 credits	Z	10
	·	-	
	exceeds the academic year's dead-line.	_	
	· ·		
internship. Auxiliar	y courses BI-ZS10, BI-ZS20, BI-ZS30 are used used for the evidence and evaluation of the internship in IS KOS. Every 10 credits corr	respond to 4 week	s of full-time
employment with a		o two subjects if th	e internship
BI-7S30	·	7	30
	!	_	
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	·	-	
employment with a	exceeds the academic year's dead-line.	o two subjects ii tii	ie internanip
BI-ZSB.21	Basics of System Security	Z,ZK	5
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such as maiware		n operating syster	ns security,
BI-ZUM.21		Z.ZK	5
	· · · · · · · · · · · · · · · · · · ·		
			entity, such
			1
BI-ZWO	This course is presented in Czech.	2,210	, T
BIE-CSI	Introduction to Computer Science	Z	2
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questions but also		sted in computer so	cience more
DIE DIE	than expected, or even less than before.	7 71/	
	Intelligent Embedded System Fundamentals course is a boused on high-vene technology embedded systems in ingrating articular intelligence. The aim of the course is to beach students in humanical foots control and development of applications in a graphical development embedded systems in registral provided from the control and development tools. In bits, subdest program as of it hosts closely by using the whole simulation and rain humanical to get many the students and rain humanical to get many the students and rain humanical to get many the students and rain humanical and rain humanical to get many the students and rain humanical to get process engineering in this subject. Students will get necessary foundations for understanding from principles of process modeling and they will be a subject to the first and principles and process		
· · · · · · · · · · · · · · · · · · ·	BLZVIS   Intelligent Embedded System Fundamentals course in testade on the journal intelligence and season of the journal intelligence and season of the journal intelligence and the season of the journal intelligence and the season of the journal intelligence and the season of the journal intelligence on the season of the journal intelligence on the season of the journal intelligence on the season of the journal intelligence and season of the journal intelligence and season of the journal intelligence and season of the journal intelligence as the season of the journal intelligence as		
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partial differential		and PDES, includ	ing implicit
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BIE-EEC	English language external certificate	Z	4
he BIE-ECC course	can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in Englis the B2 level of the Common European Framework of Reference for Languages.	sh comparable to	or exceeding
BIE-IMA2   Students refresh and	Introduction to Mathematics 2 extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are a examples.	Z able to apply them	2 n in particula
BIE-SEG	Systems Engineering	Z	0
	y class on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles of c		
•	sor and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After taking t		
	ference between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what con parallelism, and how processes and threads synchronize efficiently to overcome concurrency for communication.	icurrency is, as o	pposed to
BIE-ZUM	Artificial Intelligence Fundamentals	Z,ZK	4
	ed to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classica gent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms be presented as well.		
FI-TOP	Academic writing	Z	2
	rtant and required part of research activity. It is not only about obtaining research results but also about applying them in the form of	-	-
	seful for students not only in their own publishing activities but also in the preparation of a bachelor's or master's thesis. In the cour	,	
	e, what parts such an article should have, and how the peer review process works. Students will also try their hand at presenting an a		•
eise's article. The co	urse will be taught in blocks, with one lecture at the beginning of the semester and one practicum in the middle of the semester. Da on the availability of enrolled students.	ites will be determ	ninea based
FIT-ITI	Modern IT infrastructure	Z,ZK	5
FIT-SEP	World Economy and Business	Z,ZK	4
	nted in Czech. The course introduces students of technical university to the international business. It does that predominantly by co		
· · · · · · · · · · · · · · · · · · ·	rld economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as		
orruption and econo	mic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of dis	scussions based	on individua
	readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.		
FITE-EHD	Introduction to European Economic History	Z,ZK	3
	es a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economic history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic		-
	re to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institution	-	
	lled economic history of particular European countries but rather the impact of trade and role of particular events, institutions and o	•	
	meetings will consist of a mixture of lecture and discussion.	3	•
NI-AFP	Applied Functional Programming	KZ	5
•	ted in Czech. Functional programming represents one of the traditional programming paradigms. Traditional and novel functional productional programming paradigm becomes an important construct of traditionally imperative languages (C++, C#, Java). As such, masterial traditionally imperative languages (C++, C#, Java).		ū
NI-DDM	necessary competence of a software engineer: the theory and especially the practice.	KZ	1 4
	Distributed Data Mining   late-of-the-art approaches for distributed data mining and parallelization of machine learning algorithms. Students will gain hands o		4 h large scale
	nework 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 This course is presented in Czech.	Z,ZK	4
NI-DZO	Digital Image Processing	Z,ZK	4
	s a comprehensive overview of modern methods for interactive editing of digital images and video. It mainly deals with practical algor In interesting theoretical basis. Visually attractive applications provide better understanding of basic theoretical background that is als		-
	ocessing. This course will introduce algorithms solving the following practical applications: edge-aware editing, tone mapping, HDR	-	_
	estraction, hybrid images, gradient domain editing, seamless image stitching and cloning, digital photo-montage, color-to-gray conv		
NI-IAM	I-as-possible image deformation, free-form image registration, texture synthesis, interactive segmentation, colorization, painting, ac Internet and Multimedia	Z,ZK	4
I .	is focused on principles and modern technologies for network transmissions of audiovisual (AV) signals. The syllabus includes acqu		1
	inals (output), network communication protocols, device interfaces, codecs, data formats and stereoscopy. We will look at practical u	_	
	sions. Within the labs, students will practically assemble AV transmission chains using HW and SW technologies and verify the effect of AV transmissions. Students will learn how to build Internet infrastructure for end-to-end AV transmissions from the recording the for audience.		-
NI-LSM	Statistical Modelling Lab	KZ	5
	ted on a single and multi-target tracking. The student both learns the existing methods and tries to implement them. The stress is p		
The subject is orien	and its modeling using numpy and scipy. The second half of the semester is focused on the design of methods and algorithms, and		
=	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).	
vailable information	M 1 011 (01 (1D	KZ	4
NI-MOP	Modern Object-Oriented Programming in Pharo	,	al abetraction
NI-MOP  Object-oriented progress used to build complete.	amming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where is ex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills	s of design and im	plementatio
NI-MOP Dipiect-oriented progres used to build complor object systems in	amming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where is ex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development not	s of design and im eeds and areas o	plementation of interest. Ir
NI-MOP Object-oriented progres used to build complor object systems in iddition to deepening	amming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where is ex modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills	s of design and im eeds and areas o on interesting proj	plementation of interest. In sects and O
NI-MOP Dbject-oriented progr s used to build compl of object systems in addition to deepening	amming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where in the extension of the most widespread paradigms of software creation, especially enterprise information systems, where in the extension of the course of	s of design and im eeds and areas o on interesting proj	plementation of interest. In sects and OC
NI-MOP Dipiect-oriented progriss used to build complion of object systems in addition to deepening technologies in terms	amming is currently one of the most widespread paradigms of software creation, especially enterprise information systems, where it is a modern applications. In this course, we build on the knowledge acquired in the course BI-OOP and aim to further deepen the skills modern pure object system Pharo (https://pharo.org). The course focuses on individual approach to students, their development not provide programming skills, which are generally applicable in other OO languages, students will also gain the opportunity to work of sof semestral work with the possibility of cooperation with practice and related bachelor, diploma, postgraduate our direct involvem.	s of design and im eeds and areas o on interesting proj nent in the Pharo	plementation of interest. In ects and Of Consortium

NI-OLI	Linux Drivers	Z,ZK	4
The Linux operating sys	tem is an important operating system for personal computer and also for embedded systems. Systems on chip and combining powerfu	l processors	and FPGAs
increase the variabili	y of peripheral subsystems requiring specific software drivers. This course is an advanced course in the Linux driver development for r	master's stud	ents. The
course	provides knowledge of Linux operating system architecture, principles of development of various types drivers, including practical expensions of the provided provided by the provided	erience.	
NI-PDD	Data Preprocessing	Z,ZK	5
Students learn to prepa	re raw data for further processing and analysis. They learn what algorithms can be used to extract information from various data source		ages, texts
time series, etc., and l	earn the skills to apply these theoretical concepts to solve specific problems in individual projects - e.g., extraction of characteristics fro	om images o	r from web
	pages.		
NI-PSD	Public Services Design	KZ	4
	es students to specifics of UX, Service design and development for public sector. We will look into the design and development process		
	esignesr) as well as clients. In small teams students will work on projects from partner organizations and will try out collaboration with		•
	Course is aimed at students-designers as well as clients.		
NI-PSL	Programming in Scala	Z,ZK	4
- 1	the modern programming language Scala which exploits object-functional paradigm. Scala comprises advance language features - e.	, , , , , , , , , , , , , , , , , , ,	•
	y. Scala enables to use of applications functional patterns e.g. H-List, Monads, etc. Scala is used by many powerful frameworks and librar	· .	•
avance standard librar	Scalaz, etc.	ioo o.g.r iay,	Caocanarc
NI-REV	Reverse Engineering	Z.ZK	5
I	inted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before an	_,	-
• .	understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to		
	n C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicate		
• •	ging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malw.		
debuggers and debug	the course is on the seminars, where students will solve practically oriented tasks from the real world.	are scene. II	ie locus oi
NII OVD		7 71/	
NI-SYP	Parsing and Compilers	Z,ZK	. 5
i ne module bullas upor	the knowledge of fundamentals of automata theory, formal language and formal translation theories. Students gain knowledge of various	variants and	application
====	of LR parsing and are introduced to special applications of parsers, such as incremental and parallel parsing.		
NI-TSP	Testing and Reliability	Z,ZK	5
	ledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a		
he intuitive path sensit	zation and to use an ATPG for automatic test generation. They will be able to design easily testable circuits and systems with built-in-s	elf-test equip	ment. The
	will be able to compute, analyze, and control the reliability and availability of the designed circuits.		
NI-VCC	Virtualization and Cloud Computing	Z,ZK	5
Students will gain kn	owledge of architectures of large computer systems that are used in data centers and computer infrastructure of companies and orgar	nizations. The	y will get
•	ization principles, tools and technologies that serve to facilitate and automate configuration, testing and monitoring, and to efficiently o	•	
performance param	eters of modern computer systems. Theoretically and practically, they will get acquainted with containerization as the most effective tec	hnology toda	ay for the
•	x computer systems and with specific technologies of cloud systems. Finally, they will learn the principles and gain practical skills in the u	ise of moderr	n integratio
nanagement of comple			
	and development tools (Continuous integration and development).		
NI-VYC	and development tools (Continuous integration and development).  Computability	Z,ZK	4
		Z,ZK	4
	Computability	Z,ZK	4
NI-VYC TV1	Computability Classical theory of recursive functions and effective computability.  Physical Education	Z	0
NI-VYC TV1 TV2	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education	Z Z	0
NI-VYC  TV1  TV2  TV2K1	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education Physical Education 2	Z Z Z	0 0 1
NI-VYC  TV1  TV2  TV2K1  TVK1	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education Physical Education 2 Physical Education	Z Z Z Z Z	0 0 1 1
NI-VYC  TV1  TV2  TV2K1  TVK1  TVKLV	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education Physical Education 2 Physical Education Physical Education Physical Education	Z Z Z Z Z Z Z	0 0 1 1 0
NI-VYC  TV1  TV2  TV2K1  TVK1  TVKLV  TVKZV	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education Physical Education 2 Physical Education Physical Education Physical Education Physical Education Physical Education Course Physical Education Course	Z Z Z Z Z	0 0 1 1 0
NI-VYC  TV1  TV2  TV2K1  TVK1  TVKLV	Computability Classical theory of recursive functions and effective computability.  Physical Education Physical Education Physical Education 2 Physical Education Physical Education Physical Education	Z Z Z Z Z Z Z	0 0 1 1 0

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