

Field of Study: Computer science

Offered courses for the academic year 2021/2022, winter semester, with descriptions

Semester 1

Basics of Programming

The main aim of the course is to familiarize students with the basic concepts of programming in C and to acquire practical skills to create software in C and C++.

The course presents information for people learning C and C++ as first programming language. Course will give a full introduction to all of the core concepts in the C and C++ programming language.

Topics:

- C and C++ Introduction
 - Variables & Constants, Data Types, Input/Output, Operators
- Flow Control
- Functions
 - Programming Functions, User-defined Functions, Recursion
- Programming Arrays
 - Arrays, Multi-dimensional Arrays, Arrays & Function
- Programming Pointers
 - Pointers, Pointers & Arrays, Pointers & Functions,
- Programming Strings
- Structure And Union
- Programming Files

Operating Systems

In this course, you'll learn the basics of the command line interface of a Linux server: the terminal and shell (GNU Bash). This course includes an introduction to files and directories in the Linux filesystem.



Topics:

- Terminal user interface.
- Interacting with a Linux server using shell commands.
- Working with files and directories.
- Archiving and compression
- User management
- System devices management
- Linux network management
- Shell scripts

Semester 3

Algorithms and Data Structures

The main aim of the course is to familiarize students with the basic concepts of using data structures and algorithms in programming. It provides guidance on how to implement basic data structures from scratch: arrays, linked lists, graph, trees and then use the structures to implement algorithms such as sorting, searching, etc. using C++ or Java language.

Topics:

Arrays, Linked Lists, Trees, Hashtables, Stacks, Queues, Heaps, Sort algorithms: Bubble Sort, Selection Sort, Heap Sort Quick Sort, Merge Sort, Insertion Sort, Search algorithms: linear and binary search. Recursion.

Introduction to Numerical Methods

The course aims to present numerical analysis topics and the basic numerical methods, implemented in standard programs. In each case there will be discussed the applicability of the methods, conditions of convergence (for iterative methods), approaches to estimate the error of computations and effective algorithms of correcting the accuracy.

Topics:

- Linearization of nonlinear systems of equations
- Direct methods of solving the linear systems of equations
- Iterative methods of solving the linear systems of equations
- Iterative methods of solving the nonlinear equations
- Orthogonalization of vectors
- Polynomial interpolation
- Numerical integration
- Random number generators and their applications

- Monte Carlo Methods

Basics of Artificial Intelligence

The aim of the course is to outline the basic methods and techniques of artificial intelligence and to put them in an algorithmic context. The course also equips students with the skills to use artificial intelligence tools in forecasting, classification, approximation, estimation, and logical inference.

Topics:

- Programming in Matlab. Interface. Variables. Vectors (single row or single column matrices). Two-dimensional matrices. Array and array operations.
- Basic functions and constants. Relational Operators. Logical operators and functions.
- If statement. Switch instruction. The for and while loops.
- Creating m-files. Scripts.
- Features. Sub-functions.
- Graphics in Matlab. 2D graphics
- 3D Graphics. Graphs of functions.
- Simulink - modeling of dynamic systems. Mathematical model. Simulink
- Simulink - examples of models of dynamic systems
- Selected numerical capabilities of the Matlab package
- Working with Toolboxes: Neural Network, Genetic Algorithm.
- Modeling KAG systems in Matlab.
- Classification of raster objects and space points using SSN.
- Application of SSN in approximation tasks.
- Modeling SSN systems in Matlab.

Cryptography

The aim of the course is to acquaint students with the basics of modern cryptographic algorithms and steganographic techniques. Objectives pursued during the course:

- Implementation and analysis of one of the base ciphers,
- Implementation and analysis of one of the representation ciphers,
- learning mathematical basis of modern cryptography
- implementation of tools that are components of modern cryptographic tools,
- implementation of the indicated asymmetric algorithm,
- Implementation and analysis of the indicated hash function,
- analysis of steganographic tools protecting image files.

Visual Object-oriented Programming

The aim of the course is to gain knowledge about working in RAD environment (rapid application development using visual tools). Rapid Application Development is a methodology of designing information systems, focused on rapid creation of a system prototype, susceptible to further development in an iterative design cycle. RAD is a response to structured design and programming methodologies. During the classes Windows Forms library of Visual Studio environment for C# and Visual Basic language are used.

Topics:

- Overview of Visual Studio environment, principles of creating projects, working with debugger.
- A console application that displays the annual calendar, use of packages, string operations String class.
- Digital clock, using ProgressBar controls to represent the passage of time. Using Timer component, sample application in Visual Basic or C# language.
- Handling events generated by user interface elements, working with basic controls, common properties.
- Complex class implementation for basic operations on complex numbers, Mandelbrot set drawing application
- Multithreaded implementation of sorting algorithms. Mergesort, Insertionsort
- Multithreading in GUI applications, delegation, synchronization.

Advanced Computer Networks

During this class students will learn network routing algorithms and protocols, DHCP, NAT IPv4, access control lists, VLANs. They will acquire the ability to discover, configure, manage and maintain network devices.

Topics:

- Initialization of routers, configuration of interfaces
- Configuration of static routing and default routes
- Configuring dynamic routing protocol and troubleshooting
- Switch configuration
- VLAN configuration, routing between VLANs and troubleshooting
- Configure, verify and troubleshoot access control lists for IPv4 and Pv6 in switches and routers.
- DHCP configuration
- Configuring and Troubleshooting IPv4 NAT
- Configuration, management of network devices

Semester 5

Technologies of Internet Application Manufacturing

The aim of the course is to familiarize students with technologies and methodologies of web application development by discussing their advantages and disadvantages. In addition, the specialist lab will cover the basic problems of designing Internet applications, in which students will use Python, Javascript and the Django framework.

Topics:

- Introduction to HTML and CSS
- Introduction to the Python language
- Introduction to the Django tool, project configuration
- Views and templates
- Creation of databases and models
- Dynamic resources and user files
- Session and authentication mechanism
- Introduction to Javascript
- Create pages that don't need refreshing
- Unit test implementation in Django
- Creating a Rest compliant application programming interface
- Dynamic PDF and image generation
- Publication of applications on the web

Advanced Software Engineering

The course aims to develop the broad understanding of the discipline of software engineering by considering the wider systems engineering context. It aims to examine the concepts and techniques associated with a number of advanced and industrially relevant topics, relating to both the product and processes of software engineering. Presented topics refer to the associated practical and professional issues in software engineering.

Topics:

- Tools of code versioning
- Design patterns
- Code inspections in the software development process
- Automation of testing
- Design and implementation of self-tests
- Extreme programming
- Software quality, software quality metrics
- Evaluation of the software development process – Joel's test

Security of Computer Networks

The course aims to develop Network security issues: activity designed to protect the usability and integrity of network and data. It includes both hardware and software technologies. Network security combines multiple layers of defenses at the edge of the network. Each network security layer implements policies and controls. Authorized users gain access to network resources, but malicious actors are blocked from carrying out exploits and threats.

Topics:

- Threats in modern computer networks.
- Securing network devices.
- Security audit tools and attack methods.
- Setting router security for administrative access
- AAA mechanisms (Authentication, Authorization, Accounting)
- Using RADIUS and AAA for administrative access security
- CBAC configuration and area-based firewall
- Configuration of intrusion protection system (IPS)
- Security on Layer 2 switches
- Examination of encryption methods
- Configuring Virtual Private Network (Site-to-Site VPN)
- Configuration of remote VPN access (client, server)
- Implementation and enforcement of security policy

Multimedia

The course aims to present information about basic algorithms of coding and processing multimedia and their use to create multimedia applications. The laboratory covers the scope of creating multimedia applications containing audio, images and video presenting and processing methods using C# or Java language.

Topics:

- Audio recording and processing. An application to play the sound.
- Audio coding and compression methods. Audio signal transcoding.
- Compressed audio formats. Visualization of the sound spectrum using the Fourier transform.
- Image viewer.
- Image file editor
- Image processing algorithms.
- Video playback and processing. Software implementation of selected issues in the field of digital video processing.
- Transmission of multimedia content over the Internet.

Team project I

During the classes students develop a project of an information system solution to a given problem with particular emphasis on data exchange between an application and a database.

The resulting system must consist of:

- databases on the server (MySQL/Postgress/MsSQL)

and at least one of the following three subsystems:

- desktop application (Windows/Linux/iOS),
- web (internet) application (PHP/ASP.NET),
- mobile application (Android/iOS/Tizen/Windows Mobile/Android Wear).

Teamwork is an important part of the class. Students must demonstrate the ability to work in a group, delegate tasks, exchange information and mobilize each other to work.

As part of the project activities, the student will gain skills by completing the following:

- development of project assumptions, description of the created system and its functionality,
- definition and division of tasks in the team
- development of a Gantt chart
- analysis of literature and existing solutions in the field of the created project
- selection, installation and configuration of IT tools necessary to implement the project.
- development of protocols for information exchange between subsystems.
- development of a database structure.
- user interface development
- development of algorithms for application operation
- implementation of an IT solution
- development of project documentation
- presentation of the final result

Methods and techniques of artificial intelligence

Subject offered on the specialization: software systems. This course is a continuation of the Basics of Artificial Intelligence topics. The course is conducted using the Matlab software package.

Topics:

- Programming in Matlab. Selection methods based on adaptation function - random selection method with repetition/ roulette wheel.
- Practical implementation of genetic algorithms. Linear scaling.
- Advanced techniques and operations. Scaling by the σ -cutoff method.
- Advanced techniques and operations. Logarithmic scaling.



- Practical implementation of genetic algorithms. Types of crossovers in genetic algorithms.
- Basic genetic operators: one-point and two-point crossing. Mutation.
- Advanced techniques and operations. Evolutionary strategy (1+1).
- Project 1 Study of parameters Population Size, Generations on the result of optimization using GA function.
- Project 2. Study of Fitness scaling, Selection parameters on the result of optimization using GA function.
- Project 3. Goal function optimization with genetic algorithm (GA).
- Project 4. Goal function optimization by genetic algorithm (GA) with hybrid function.
- Project 5. Goal function optimization with pattern search (PS) algorithm.
- Application of AG to solve specific problems as part of the student's own work (project completion and credit).
- Demonstration of the operation of genetic algorithms (AG) for solving optimization problems