ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Software Engineering Institute			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Programming paradigms and data structures *	NSXPA1EMNF	5	full-time	3	0	2
Responsible person for the subject: Prof. Dr. SZÉNÁSI Sándor			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to introduce the basic data structures, their implementation and basic use cases. In addition, students will be introduced to the basic strategies and programming paradigms used in general problem solving and optimization.
Course description:	The course introduces the basic operations of data structures (list, queue, stack, set, dictionary) and their use cases. It then discusses the commonly used possible implementations (arrays, ordered arrays, linked lists, binary search trees, hash tables). It then introduces special-purpose data structures (graphs, B-trees, heaps) and additional graph algorithms (shortest path search, spanning tree search, topological ordering). Students will be introduced to the basic strategies that can be used to solve general and optimization problems (brute force method, divide and conquer, memoization method, dynamic programming, greedy algorithms, backtracking, branch and bound). Finally, they gain insights into the world of functional and logic programming.

Lecture schedule	
Education week	Topic
1.	Generic types. List, queue, stack, set, dictionary operations. Implementation using array and ordered array.
2.	Linked list structure and operations. Implementation of queue, stack.
3.	Binary search tree structure and operations. Set implementation.
4.	Construction and operations of heap. Priority queue implementation. Heap-sort.
5.	B-tree structure and operations.
6.	Hash functions. Structure and operations of hash table. Dictionary implementation.
7.	Graph structure and basic operations (Breadth-First Search, Depth-First Search, topological ordering).
8.	Operations with weighted graphs (finding shortest paths, finding minimum spanning tree).
9.	Brute force method. Divide and conquer strategy. Memoization method. Dynamic programming.
10.	Design and use of greedy algorithms.
11.	Backtracking. Branch and bound method.
12.	Basics of functional programming.
13.	Fundamentals of logic programming.
14.	Consultation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	In the labs, students will be given tasks to independently solve, the solutions of which must be uploaded to Moodle by the given deadline. Failure to do so/uploading unacceptable solutions will be considered as absence from class.

	During the semester, students will write two examinations outside of class (expected in weeks 7 and 13). These examinations are compulsory. A signature will be given to students who have passed both final exams with at least satisfactory level.

Assessment schedule	
Education week	Topic
7.	Implementation of basic data structures.
13.	Using problem solving methods in practice.
14.	Replacement of an exam.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	If the student has not written or has not reached the satisfactory level in one of the examinations, he/she may write a replacement exam from the given topic in the last week. The result of this test replaces the result of the missing/original test. If the student has failed to write both exams or has not achieved a satisfactory level in either, he/she may only obtain a signature on the signature replacement exam announced during the examination period. The minimum level required to obtain a signature in the signature replacement exam is satisfactory.

Type of the exam (to be filled out only for subjects with exams)
The exam consists of two parts: in the first, written part, the student must achieve at least satisfactory level, if this is not met, he/she will receive a fail mark. The second oral examination is open to students who have achieved at least a pass mark in the written examination of the day.

Calculation of the exam mark (to be filled only for subjects with exams)
A student who has obtained at least a satisfactory result in both the written and oral examinations may obtain a mark other than failed. The mid-year performance (average of the two tests) is weighted 25%, the writen exam result 25% and the oral exam result 50% in the calculation of the final exam mark.
Final grade calculation methods:
0%-49%: failed 50%-61%: satisfactory 62%-73%: average 74%-85%: good 86%-100%: excellent

References	
Obligatory:	Lecture slides available in the Moodle system.
Recommended:	T.H. Cormen, C.E. Leiserson, R. L. Rivest, C. Stein: Introduction to Algorithms, MIT Press, 2022
Other references:	

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Network technologies	NKXNT1EMNF	4	full-time	2	0	2
Responsible person for the subject: Balázsné Dr. KAIL Eszter			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to introduce the students to the network technologies, to familiarize them with the basic characteristics and uses of network devices and transmission media that form the basis of IT systems. Configuration, testing and troubleshooting of networks built from real devices will help students to master the course material.
Course description:	The course introduces modern local and wide area network (LAN, WAN) technologies, their signaling media, physical and logical topologies of networks. Based on the OSI system model, it describes the internal architecture and services of communication systems, the related protocols from the TCP/IP model, the purpose and function of the protocols and interfaces involved, the theoretical possibilities of their implementation and typical practices. It provides a more in-depth knowledge of the basic operational (switching, traffic management) and network security solutions (administrative protection of devices, traffic filtering, address translation) for enterprise networks, and also covers the Quality of Service (QoS) functions and implementation models.

Lecture schedule	
Education week	Topic
1.	Layered models, network models
2.	Physical components and properties of networks, physical layer
3.	Switching processes and their principles of operation in local area networks
4.	Addressing systems and their interconnections
5.	Routing principles for internal and external networks
6.	Transport layer protocols
7.	Structure and operation of the Internet and its services
8.	Address translation
9.	Emerging trends in networking (IPv6, IoT devices)
10.	Emergence and evolution of network security
11.	Administrative protection of devices, traffic filtering
12.	Implementing quality of service
13.	Lab exam
14.	Lab exam (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The students are required to attend at least 70% of the classes, and pass the laboratory exam with at least a satisfactory result.

Assessment schedule	
Education week	Topic
13.	Lab exam
14.	Lab exam (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	During the first week of the exam period the laboratory exam can be replaced
Type of the exam (to be filled out only for subjects with exams)	
Oral exam based on predefined topics.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The final grade is the average of the laboratory and the theoretical exam.	
Final grade calculation methods:	
References	
Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	Wendell Odom: CCNA Routing and Switching 200-125 Official Cert Guide Library, Pearson Education, 2016, ISBN: 1587205815 Andrew Tanenbaum, Nick Feamster, David Wetherall: Computer Networks, Sixth Edition, Pearson Education Limited, 2022, ISBN: 978-1292374062 Larry L. Peterson, Bruce S. Davie: Computer Networks, Elsevier Science & Technology, 2021, ISBN: 0128182008
Other references:	

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Databases and Big Data technologies	NKXDB1EMNF	5	full-time	2	0	2
Responsible person for the subject: Dr. FLEINER Rita			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	In the course, students learn the principles and implementation of relational database management, the process of database design and modern data management methods. During the course, students will gain insights into the world of non-relational database management and Big Data, and will become familiar with the concepts, procedures and tools of NoSQL and Big Data data storage.
Course description:	Relational data model, relational algebra, RDBMS architecture, logical and physical data model, database design, normal forms. Database management in Oracle environment database instances, memory structures, transactions. Execution planning, optimization, SQL tuning. Index structures, join methods. NoSQL database types and their operation, their relation to Big Data systems. Understanding the use of MongoDB and Cassandra database management systems: basics, architecture, queries. Big data basics and the Hadoop framework. Apache Spark.

Lecture schedule	
Education week	Topic
1.	T: Introduction. Knowledge assessment. Relational database systems. L:Basic SQL exercises.
2.	T: Data modelling, single-relationship data model. L: Multi-table queries.
3.	T: Normal forms, dependencies, decomposition of relations. L: DDL, constraints.
4.	T: Relational algebra, relational data model. L: DML, views.
5.	T: Data storage, file organisation, indexes. L: Grouping functions (GROUP BY, HAVING statement parts).
6.	T: Query processing, query optimization. L: Transaction handling.
7.	T: Database tuning. Execution plan, access paths, indexes, join types, CBO statistics, selectivity, cost, materialization, pipelining. L: Execution plan analysis.
8.	T: Database tuning. Execution plan, access paths, indexes, join types, CBO statistics, selectivity, cost, materialization, pipelining. L: Execution plan analysis.
9.	T: NoSQL databases. Cassandra: concepts, architecture, queries. L: Cassandra in practice.
10.	T: NoSQL databases. MongoDB: concepts, architecture, queries. L: MongoDB in practice.
11.	T: Basics of Big data. Hadoop framework. L: Spark in practise.
12.	T: Basics of Big data. Apache Spark. L: Spark in practise.
13.	T: Test (theory + practise)
14.	T: Test replacement

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students have to pass at least 51% in both tests (theory and practise).

Assessment schedule	
Education week	Topic
13.	Theory test, Lab test
14.	Theory test replacement, Lab test replacement

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The mid-term grade is determined by the sum of the points obtained in the tests.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Both tests can be replaced in the 14th week and at the beginning of the exam period.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:
0% - 51%: failed (1) 52% - 65%: satisfactory (2) 66% - 75%: average (3) 76% - 87%: good (4) 88% - 100%: excellent (5)

References	
Obligatory:	Jeffrey D. Ullman; Jennifer Widom: Adatbázisrendszerek – Alapvetés (2. kiadás), Panem, 2009. Budapest, ISBN: 9635454815 Elmasri, R., Navathe, S. B.:Fundamentals of Database Systems 7th Edition, ISBN: 978-0133970777
Recommended:	Alex Holmes: Hadoop In Practice, 2nd Edition, September 2014, ISBN 978-1-617-29222-4 Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk PhD, Bruce Brown, Rafael Coss: Hadoop for Dummies, 2014 John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN 978-1-118-65220-6
Other references:	

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Institute of Applied Mathematics			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Applied Mathematics	NMXAM1EMNF	4	full-time	3	1	0
Responsible person for the subject: Dr. SZŐKE Magdolna			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
System and control theory	NBXSC1EMNF	5	full-time	2	0	2
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s): Czakó Bence Géza						
Prerequisites:	-					
Way of the assessment:	exam					

Course description	
Goal:	The aim of the lecture is to introduce basic concepts in the domain of system theory.
Course description:	Throughout the semester, the course will cover the basic concepts of systems and control theory, with an emphasis on the implementation of theoretical methods on the computer. Students will learn about difference equations, which will help them to master the basic properties of differential equations. Students will be introduced to both modern and classical descriptions of systems, which will be used to learn about various control strategies.

Lecture schedule	
Education week	Topic
1.	Introductory lecture, basic mathematical concepts
2.	Difference equations and simple models
3.	Simulation of differential equations
4.	Equilibrium points, stability
5.	Linearization of nonlinear systems
6.	Linear control strategies
7.	State feedback, observability, controllability
8.	State observers and LQR control
9.	Fourier- and Laplace transforms, transfer functions
10.	Design of PID controllers I.
11.	Design of PID controllers II.
12.	Model Predictive Control I.
13.	Model Predictive Control II.
14.	Summary and Consultation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. One homework assignment will be given during the semester, which must be solved independently by the given deadline and the solution must be documented. The homework will be given to the students in week 8 and they will have two weeks to solve the assigned assignment. Signature requirement: submission of the homework before the deadline and a grade of at least satisfactory

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	According to the Neptun system.

Type of the exam (to be filled out only for subjects with exams)

1. Theoretical exam
   - Only those who have signed all the application form may sit the theoretical examination
2. Practical examination
   - only those who have passed the theoretical examination may sit the practical examination
   - If you fail the practical test, you only have to make up the practical part, you do not have to retake the theory test
   - is done on computer

Calculation of the exam mark (to be filled only for subjects with exams)

Final garden = 0.5 * theoretical test + 0,5 * practice exam. A minimum of 50% must be achieved in each part.

Final grade calculation methods:

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	Lecture notes (download form https://elearning.uni-obuda.hu/)
Recommended:	- Karl J. Åström and Richard M. Murray: Feedback Systems: An Introduction for Scientists and Engineers -
Other references:	

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			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical education I.		1	full-time	0	1	0
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical education II.		1	full-time	0	1	0
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Project management and business development	NBXPM1EMNF	5	full-time	2	2	0
Responsible person for the subject: Dr. ALMÁSI Anikó			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to introduce students to the complex system of business development and project management. By completing the course, participants will acquire basic knowledge of economics and business, as well as micro and macro-economic, financial, innovation and management skills, primarily from a corporate perspective. In particular, external and internal crisis situations, the strategic hierarchy of objectives and how a company can maintain and increase its competitive advantage in the long term in the face of different market and organisational challenges will be addressed.
Course description:	The course takes a practical approach to business development and project management, covering topics relevant to business. The assessment of the external and internal environment, business plan, resource planning are essential tasks for students both as business leaders and project managers. Competence assessment and planning, competitive advantage and innovation In addition to budget planning, efficiency evaluation and other hard factors, soft factors (organisational capabilities, management skills) are also discussed. As a company grows, it is inevitable to develop the organisation, which requires specific managerial skills.

Lecture schedule	
Education week	Topic
1.	Starting a business - legal issues
2.	Assessing the economic environment: competitors, industry
3.	Organisational factors, assessment of competencies, hierarchy of objectives
4.	Crisis, redesign, revised business plan
5.	Project management: time, resources, capacity, budget planning
6.	Consultation for the group exercise: business plan preparation
7.	Mid-term exam, group task (presentation of business plan)
8.	Value creation, customer focus, market research, product and service development
9.	Growth opportunities: exit, venture capital investments, pitch
10.	Competitive advantage, innovation, organisational characteristics
11.	Risk analysis, project life cycle, milestone
12.	Consultation for group exercise: pitch
13.	Mid-term exam, group assignment (pitch)
14.	Live case

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic
7	Mid-term exam
13	Mid-term exam
14	Live case
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Method of assesment: mid-term performance assesment, individual + group performance assesment with test and project tasks. End of the semester grade calculated from the sum of continuous performance: 100%	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The group assignment can be substituted only with individual permission and by special agreement. It is obligatory to indicate this at the beginning of the semester and to agree on the substitution! Supplementary assignments: in week 14 or once during the examination period.
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
0% - 59%: fail (1) 60% - 69%: pass (2) 70% - 79%: satisfactory (3) 80% - 89%: good (4) 90% - 100%: excellent (5)	
References	
Obligatory:	Jarjabka Ákos és tsai: Projektmenedzsment ismeretek. 2020. PTE Chikán Attila: Vállalatgazdaságtan. 2021. Akadémiai Kiadó Moodle
Recommended:	Szerb László – Konlósi Éva – Páger Balázs: Új technológiai cégek az Ipar4.0 küszöbén. 2020. Vezetéstudomány, LI. évf. 6. szám 81-96. old.
Other references:	

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			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Business economics		5	full-time	2	2	0
Responsible person for the subject: Dr. Takácsné Prof. Dr. GYÖRGY Katalin			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Modern Operational systems	NKXMO1EMNF	5	full-time	2	0	3
Responsible person for the subject: Dr. habil LOVAS Róbert			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The course aims to familiarize students with operating systems' theory, development, and tasks, contemporary modern operating systems, and related technologies. In addition, the lab part aims to gain experience in managing client and server operating systems in the case of command-line and graphical interface systems in parallel with the review of theoretical operation and to learn and practice engineering processes in this topic by designing, implementing, testing and documenting a self-installed system.
Course description:	During the lectures, students will get acquainted with the main tasks of operating systems, the development of components that implement specific tasks, and the solutions used in currently widespread operating systems (Windows, Unix versions, Linux). Topics: History of Operating Systems, Architecture of major OSs. Main functions of OSs (purpose, design space, with real-world examples): processes and threads, scheduling, memory management, I/O management – including especially file management and file systems, and Virtualization from an Operating System perspective. During the exercises, students will review the user and administrative use of client and server operating systems, automation of system tasks, and management of server services. In addition, during the semester, they will gain experience installing, configuring, and testing systems and services by compiling their virtualized server-client architecture.

Lecture schedule	
Education week	Topic
1.	P: Introduction: purpose, concept, historical overview, development, and classification of operating systems Lab: Requirements Explained, Operating System Basics - Windows
2.	P: Overview of major operating systems (desktop, server, mobile and embedded operating systems) Lab: Operating System Basics - Linux
3.	P: Processes and threads - process and thread management Lab: File systems and permissions
4.	P: Process and thread scheduling Lab: Linux script - basics
5.	P: Memory management, the importance of the virtual memory management Lab: Linux script - control structures
6.	P: I/O management, disc management (both traditional HDDs and SSDs) Lab: Linux script - text and file processing, homework consultation
7.	P: File management, file systems Lab: Server Architecture Design
8.	P: Virtualization for operating systems

	Lab: Server Basics and Network Services (DNS, DHCP)
9.	P: Operating systems of mobile devices, HMP support Lab: Web Service
10.	P: Most important aspects of embedded operating systems Lab: File sharing and centralized user management, directories
11.	P: Security measures of operating systems Lab: Version control systems and development services
12.	P: Windows and Linux Lab: Monitoring, homework presentation
13.	P: Android and iOS Lab: Midterm thesis
14.	P: An overview of the distributed operating systems Lab: Supplementary Midterm Thesis

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	To obtain the signature, it is necessary to achieve at least 50% results on the midterm test and with homework.

Assessment schedule	
Education week	Topic
13.	Midterm thesis – from the practical curriculum of the entire semester
14.	Supplementary midterm thesis – from the practical curriculum of the whole semester
During Exam period	Signature replacement thesis – from the practical curriculum of the entire semester

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	If the midterm thesis does not reach the 50% result or has not been written, it is possible to write a supplementary midterm thesis in week 14. If neither the midterm nor the supplementary midterm thesis reaches 50%, it is possible to write a signature replacement thesis during the exam period. It is possible to replace the semester-long task: o In the time of supplementary midterm test (week 14) with a deduction of 25 % points. o In the time of s signature replacement thesis at 50 % with a deduction of points.

Type of the exam (to be filled out only for subjects with exams)

Written

Calculation of the exam mark (to be filled only for subjects with exams)

To complete the course, it is necessary to achieve at least 50% results on the midterm test, with homework, and the exam separately. The sum of the points gained will form the final grade.
The maximum points:
Midterm thesis: 10
Homework: 30
Exam: 70

Final grade calculation methods:

Achieved points / Grade
91 – 110 / excellent (5)
81 – 90 / good (4)

71 – 80 / average (3) 50 – 70 / satisfactory (2) Below 50 / failed (1)	
References	
Obligatory:	WILLIAM STALLINGS: Operating Systems: Internals and Design Principles, 9th ed, ISBN: 9352866711
Recommended:	P. Yosifovich, M. Russinovich, A. Ionescu, D. Solomon: Windows Internals: System architecture, processes, threads, memory management, and more, 7th ed, ISBN: 9780735684188 Kaiwan N Billimoria: Linux Kernel Programming: A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization, ISBN: 178995343X
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Safety Technology of Information Systems	NBXST1EMNF	5	full-time	2	0	2
Responsible person for the subject: Dr. PÓSER Valéria			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	Students will learn about the vulnaribilites of the elements of information systems, their security issues, protection methods, tools and their practical application.
Course description:	Major topics that are covered: The elements of informatics systems, it's sensibility. Fundamental concepts of encryption. Symmetric and asymmetric encryption methods. Hash functions. Block cipher modes of operation. Authentication of message. Security services of operating systems. Encryption, authentication, practical realization of digital signatures. Safe correspondence and data storage (PGP), key management, the authentication of keys, encryption of letters, digital signature, disassembling. Certification problems, password-based partner authentication. Users' identification, authentication, authorization, access control. User management. Secure remote operations. Public key infrastructure, its elements and function. Firewalls, penetration detecting, protection against viruses, data loss prevention, rescue and archiving.

Lecture schedule	
Education week	Topic
1.	Elements of IT systems, their vulnerabilities. Basic concepts of encryption. Historical examples.
2.	Symmetric encryption methods. DES, TripleDES algorithms. AES (Rijndael) algorithm.
3.	Asymmetric encryption methods, advantages disadvantages. RSA algorithm. Prime number search, prime tests.
4.	Fission functions. Birthday paradox. Discrete logarithm. Goodness of splitting functions. Description and critical analysis of MD4 MD5 SHA1 hash functions.
5.	Block cipher methods ECB, CBC, CFB, OFB and CTR modes. Process encryptors.
6.	Security features of operating systems.
7.	Encryption, authentication, digital signature in practice. Secure mail and data storage on disk (PGP).
8.	User identification and authentication. Password problems. Working in the domain.
9.	User management.
10.	Secure communication and file transfer.
11.	Public key infrastructure, its elements and operation. Certificate management.
12.	Data backup, data protection.
13.	Practical final paper.
14.	Preliminary exam. Extra Final practical paper

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The conditional of signature are the successful (at least satisfactory) completion of a final paper containing practical exercises. Attendance at lectures and laboratories is subject to the rules of the Study and Examination Regulations. Attendance will be checked at all times.

Assessment schedule	
Education week	Topic
13.	Final practical paper
14.	Preliminary exam. Extra Final practical paper

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Extra final paper at week 14. Substitution of the signature: once during one of the first 10 working days of the examination period.

Calculation of the exam mark (to be filled only for subjects with exams)
The grade for the exam is determined on the basis of the student's oral performance and the practical final paper. The result of the oral examination must also reach the minimum satisfactory level.

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:
0% - 49%: fail (1) 50% - 61%: pass (2) 62% - 73%: satisfactory (3) 74% - 85%: good (4) 86% - 100%: excellent (5)

References	
Obligatory:	Class materials published in Moodle.
Recommended:	• Gregg Kreizman: An Introduction to Information Security Architecture, Gartner The Future of IT Conference, 2011 • Heys, Howard M.: "A tutorial on linear and differential cryptanalysis." Cryptologia 26.3, 189-221. 2002 • John McCabe with the Windows Server team: Introducing Windows Server 2016, Microsoft Press, 2016
Other references:	

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Cloud-based IoT and Big Data Platforms	NKXCB1EMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. habil. LOVAS Róbert			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course introduces distributed/parallel architectures, operating mechanisms, technologies and cloud services for different IT platforms with the main objective of serving Big Data and IoT (Internet of Things) application areas. The course will cover the evolution and characteristics of Big Data solutions, the theoretical and practical background of management and orchestration solutions (Ambari/CloudBreak) for the cloud-based Big Data application domains, IoT and related frameworks.
Course description:	The course will discuss the evolution and characteristics of Big Data solutions, including Hadoop, SPARK, Hana and noSQL databases (including some related Platform-as-a-Service), which are widely used in different research and industrial domains. Also cover the theoretical and practical background of management and orchestration solutions (Ambari/CloudBreak) in the field of cloud-based Big Data applications. Later the course, the focus will shift to IoT and related frameworks, with different use cases for data collection, including medical and agricultural domains. The theoretical background will be extended with Lambda, Kappa and other approaches and further practical solutions for Azure. By the end of the subject, students will have developed their problem solving and modelling/design skills in the area of large-scale parallel and distributed computing platforms, using engineering approaches for pervasive Big Data/IoT platforms, using the most advanced Big Data/IoT platforms (tools from Microsoft, Amazon, Hortonworks, etc.), and various solutions specific to medical and other application domains.

Lecture schedule	
Education week	Topic
1.	Introduction to Big Data
2.	Hadoop Basics
3.	Database scaling and noSQL basics
4.	Document databases
5.	Graph databases
6.	Column-oriented databases
7.	In-memory databases
8.	Hadoop reference architecture for cloud computing
9.	Cloud-based IoT application in healthcare
10.	IoT and Big Data processing on Azure platform
11.	Cloud-based IoT backend
12.	Cloud-based IoT data collector
13.	Midterm test
14.	Midterm test retake
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Passing at least 51% of the midterm test Completion of the project work

Assessment schedule

Education week	Topic
13	Midterm test
14	Replacement occasion of the midterm test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The final grade is determined by the midterm test

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	In week 14, the midterm test can be replaced. A minimum of 51% must be achieved to pass the subject.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

0% - 50%: fail (1)
51% - 62%: pass (2)
63% - 75%: satisfactory (3)
76% - 88%: good (4)
89% - 100%: excellent (5)

References

Obligatory:	Materials published in Moodle Guy Harrison: Next Generation Databases - NoSQL, NewSQL, and Big Data, Apress, 2015, ISBN 978-1-4842-330-8
Recommended:	Zoiner Tejada: Mastering Azure Analytics, O'Reilly, 2017, ISBN 978-1491956656 R. Estrada, I. Ruiz: Big Data SMACK - A Guide to Apache Spark, Mesos, Akka, Cassandra, and Kafka. Apress, 2016 (electronic notes), ISBN: 9781484221747 C. Bhatt, N. Dey, A. S. Ashour (Eds.): Internet of Things and Big Data Technologies for Next Generation Healthcare. Springer, 2017, ISBN: 9783319497358
Other references:	The slides and material used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Software Engineering Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Image processing and computer graphics	NSXIP1EMNF	5	full-time	2	0	2
Responsible person for the subject: Dr. VÁMOSSY Zoltán			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	Homogeneous coordinates and 3D transformations. Modeling objects.
2.	Camera models, orthographic and perspective projection. Objects in 3D projections.
3.	The imaging basics. Gray scale and color images features: resolution, histogram, etc.
4.	Typical image noises, distortions. Image enhancements, image filtering. Histogram and modification in compensation.
5.	Methods of edge detection, edge enhancement, smoothing. Line and curve detection, Hough transform.
6.	Morphological operations
7.	Frequency domain methods, FFT, DFT, filtering.
8.	Image segmentation. Edge and region-based methods
9.	Detecting corner points (Harris, KLT), analyzing image regions. Invariant features, edges, texture.
10.	Camera calibration. Motion detection, object tracking. Optical flow models and calculations.
11.	SSD algorithms. Stereo methods, epipolar geometry.
12.	Model-based image processing: active contour methods, splines, ASM, AAM.
13.	Outlook for parallelization opportunities. Midterm test.
14.	Retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Passing at least 51% of the midterm test Completion of the project work

Assessment schedule	
Education week	Topic
13	Mideterm test
14	Replacement occasion of the midterm test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
0% - 50%: fail (1) 51% - 62%: pass (2) 63% - 75%: satisfactory (3) 76% - 88%: good (4) 89% - 100%: excellent (5)	
References	
Obligatory:	**R. Szeliski: Computer Vision Algorithms and Applications, Springer, 2011** **Gonzales, Woods: Digital Image Processing, 3rd edition. Prentice Hall, 2008**
Recommended:	
Other references:	

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Software Engineering Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Parallel programming	NSXPP1EMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. VÁMOSSY Zoltán			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the lecture is to deepen the knowledge of the students, regarding the design methods and questions for parallel computational systems, and the required programming skills.
Course description:	Students will learn, and obtain practical techniques used in parallel programming, such as thread handling, communication between threads, and synchronization. The lecture will give an additional overview on different programming variants of distributed systems.

Lecture schedule	
Education week	Topic
1.	Fundamentals of Parallel Programming. Efficiency.
2.	Parallel design. Granularity. Load balance. Processes in operating systems.
3.	Designing parallel algorithms. Multithreading, thread parallelism. Race condition.
4.	Decomposition methods by data and function, agglomeration, mappings. Synchronization. Dekker's algorithm and Peterson's algorithm. Critical Section. Mutual Exclusion.
5.	Parallel sum and parallel prefix scan. Dense matrix algorithm. MPI #1
6.	Sorting and search algorithms. MPI #2
7.	Lamport's "bakery" algorithm. Atomic operations. Semaphore. Deadlock.
8.	Classical problems I: dining philosophers, readers-writers
9.	Classical problems II: cigarette smokers, barbershop. Monitor.
10.	Producer-consumer problem. Concurrent data structures.
11.	ABA problem.
12.	Master-worker pattern. Concurrent bag of jobs.
13.	Theoretical exam.
14.	Retake of the theoretical exam.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	For the signature the midterm exam must be successfully completed (50%). A signature can only be obtained if the student has not been blocked due to the absence defined above. If a signature is refused, a signature can only be obtained in a signature replacement exam. The condition for applying for the final exam is the presence of a signature. If the grade calculated from the midterm exam is at least good (4), then this grade will be offered.

Assessment schedule	
Education week	Topic
13	Theoretical test
14	Retake

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
The midterm grade is calculated from the result of the theoretical test held on week nr. 13.	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In case of a missed theoretical exam, a retake test is available on the 14th week. If the necessary 50% is not reached, the exam can be retaken as part of the signature exam.
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Addison Wesley, 2003 Mattson, Sanders, Massingill: Patterns for Parallel Programming, Pearson, 2005 Clay Breshears: The Art of Concurrency, O'Reilly, 2009
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Sensormodalities	NBXSZ1EMNF	4	full-time	2	0	1
Responsible person for the subject: Prof. Dr. KOZLOVSZKY Miklós			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Diagnostic medical imaging	NBXCO1EMNF	4	full-time	2	0	2
Responsible person for the subject: Prof. Dr. KOZLOVSZKY Miklós			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Security of health IT systems	NBXSH1EMNF	4	full-time	2	0	1
Responsible person for the subject: Vörösné Dr. BÁNÁTI-BAUMANN Anna			Classification: associate professor			
Subject lecturer(s): Vörösné Dr. BÁNÁTI-BAUMANN Anna, Bringye Zsolt, Emődi Márk						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to highlight the problems and shortcomings of cyber security in health IT systems and medical devices. Using the knowledge acquired in the subject "Security Engineering of Information Systems", to search for protection solutions and examine their applicability.
Course description:	Tasks of health informatics, specific data. Cybersecurity of medical devices, cybersecurity trends, threats, basic cybersecurity concepts (incident, vulnerability, safety/security,..). Health IT systems. Specific protection requirements in the healthcare sector, regulations, standards, recommendations. Risk analysis, risk management. Security issues of medical devices. Data management, data backup and storage, data leakage. Health informatics standards (HL7, ISO, IHE). Security of health databases, repositories. Access control, data transfer, integration. Mobility, remote access, interoperability between GP and hospital IT systems. Network security techniques in healthcare. PKI, certificate management. Relevant medical cyber security standards. (AAMI TIR57, IEC TR 60601-4-5, IEC 8001-5-1, MDCG 2019-16).

Lecture schedule	
Education week	Topic
1.	Introduction - Why is IT security important in healthcare?
2.	Healthcare IT systems. Standards, laws, recommendations Lab: introduction, operating systems and network setup
3.	IT security, network security
4.	Network security– VPN

	Lab: Firewalls, VPNs
5.	Risk analysis/management. Security, firewall, security, VPN, security management, security risk management. Risk management methods and steps. Practical implementation.
6.	Data security, Data backup. Lab: Risk management
7.	Private Key Infrastructure - components and operation
8.	Cybersecurity issues in medical devices. IT/Cyber security in the development lifecycle, medical devices, verification and validation process, post-manufacturing phase. IT security - Developer environment - Considerations. Documentation requirements (international). Laboratory: security audit
9.	Cybersecurity issues in medical devices. IT/Cyber security in the development lifecycle, medical devices, verification and validation process, post-manufacturing phase. IT security - Developer environment - Considerations. Documentation requirements (international). Laboratory: security audit – cont.
10.	Relevant medical device cyber security standards (AAMI TIR57, IEC TR 60601-4-5). Case study Lab: user management, data backup, data encryption
11.	Relevant medical cybersecurity standards (IEC 8001-5-1, MDCG 2019-16). Case study. Case study
12.	Healthcare IT standards (HL7, ISO, IHE) Laboratory: anonymisation
13.	project presentation
14.	project presentation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Midterm requirements is to document and present a safety audit and risk assessment of a healthcare facility/device in a 10-12 minute presentation.

Assessment schedule	
Education week	Topic
13.	project presentation

14.	project presentation

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The mid-year grade will be based on the documentation and presentatio
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	During the first 10 day of the exam period, the midterm grade can be obtained by submitting the assignment documentation and giving the presentation, upon payment of the surcharge.

Type of the exam (to be filled out only for subjects with exams)
-
Calculation of the exam mark (to be filled only for subjects with exams)
-
Final grade calculation methods:
References

Obligatory:	Lecture notes (download form https://elearning.uni-obuda.hu/)
Recommended:	Guide to Privacy and Security of Electronic Health Information, 2015 (elektronikus jegyzet)
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Basics of evidence based medicine	NBXEI1EMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. habil. FERENCI Tamás			Classification: associate professor			
Subject lecturer(s): Dr. habil. FERENCI Tamás						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	To familiarize students with the basics of evidence based medicine.
Course description:	Evidence based medicine (EBM) is an increasingly applied concept of modern medicine. The essence of EBM is to base clinical decision making – both in diagnosis and therapy – on the best available so-called evidences (in best case: on the results of well-designed, large-sample clinical trials). This includes the summarization of the results of such clinical trials and studies (using statistical methods), the quantifying of expected risks and benefits based on this, which will in turn make the making of best clinical decision possible or easier. The aim of the course is to give an introduction to evidence based medicine, and into those disciplines which are necessarily needed in EBM. Out of these, the course places special emphasis on epidemiology, clinical epidemiology, introducing their core concepts, and also covering the basics of designing and analysing experimental and observational studies.

Lecture schedule	
Education week	Topic
1.	Introduction to medical knowledge acquisition process. Some historical remarks.
2.	The concept of causality. Nature of empirical investigations in medicine.
3.	The problem of confounding. Illustrations from the clinical practice.
4.	Experimental and observational studies.
5.	Removing confounding from observational data, stratification and adjustment (standardization).
6.	The problem of randomness in biomedicine.
7.	Questions of endpoints: metrics, hierarchy, surrogate endpoints, merging endpoints.
8.	Midterm exam
9.	Observational studies.
10.	Experimental studies.
11.	Systematic review and meta-analysis I.
12.	Systematic review and meta-analysis II.
13.	Further problems in the statistical evaluation of biomedical researches.
14.	Conclusion, summary, further topics and problems in evidence-based medicine.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Written mid-term exam and homework.

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Possibility to retake the midterm exam at the end of the semester.

Type of the exam (to be filled out only for subjects with exams)

Written

Calculation of the exam mark (to be filled only for subjects with exams)

Achieved result	Grade
89%-100%	excellent (5)
76%-88%	good (4)
63%-75%	average (3)
51%-62%	satisfactory (2)
0%-50%	failed (1)

Final grade calculation methods:

Garden is calculated based on the weighted average of the mind-term exam (25%), homework (25%), and exam (50%)

References

Obligatory:	Straus, S. E., Richardson, W. S., Glasziou, P., Haynes, R. B. (2005). Evidence-based medicine: how to practice and teach EBM.
Recommended:	Jekel, J. F., Katz, D. L., Elmore, J. G., Wild, D. (2007). Epidemiology, biostatistics and preventive medicine. Elsevier Health Sciences.
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Application of biostatistical methods	NBXAB1EMNF	4	full-time	2	0	2
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s): Dr. habil. FERENCI Tamás, SZIGETI Mátyás						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	To familiarize the students with the basic concepts of biostatistics, as it is applied in the design and analysis of contemporary medical investigations.
Course description:	The course will cover all fundamental areas of (bio)statistics: descriptive statistics, inferential statistics and the basics of statistical models. It will also give an introduction to the R statistical program package which will be used throughout the course to cover the practical material.

Lecture schedule	
Education week	Topic
1.	Introduction to biostatistics: aims and role of biostatistics.
2.	Introduction to the R statistical program package I.
3.	Introduction to the R statistical program package II.
4.	Descriptive statistics I.
5.	Descriptive statistics II.
6.	Descriptive statistics III.
7.	Dynamic documents and the RMarkdown.
8.	Mid-term exam.
9.	Inferential statistics I.
10.	Inferential statistics II.
11.	Inferential statistics III.
12.	Statistical models I.
13.	Statistical models II.
14.	Conclusion, summary.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic
8	Mid-term exam

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The mid-term exam can be replaced, the homework cannot.
Type of the exam (to be filled out only for subjects with exams)	
Written exam in the exam period.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The final graded is a weighted average: 30% exam, 20% mid-term exam, 50% homework.	
Final grade calculation methods:	

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References	
Obligatory:	Mandatory: Armitage P, Berry G, Matthews JNS: Statistical Methods in Medical Research. 2001, Wiley-Blackwell.
Recommended:	Rosner B: Fundamentals of Biostatistics. 2010, Duxbury.
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Robotics and data science in medicine	NBXRD1EMNF	4	full-time	3	0	0
Responsible person for the subject: Dr. HAIDEGGER Tamás			Classification: associate professor			
Subject lecturer(s): Dr. HAIDEGGER Tamás, Nagyné ELEK Renáta						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the subject is to learn about the main directions of computer-integrated surgery, modern medicine and service robots.
Course description:	The course presents the most important technological trends in computer-integrated surgery, e.g.: robot-assisted surgery, surgical skills assessment, image-guided surgery, neural network-based medical image processing, medical imaging. The course introduces service robots, their use and standardization.

Lecture schedule	
Education week	Topic
1.	Introduction of service robots and computer-integrated surgery
2.	Laboratory demonstration at the Antal Bejczy Center for Intelligent Robotics
3.	Basics of robotics
4.	Da Vinci Surgical System
5.	Medical imaging
6.	Surgical autonomy
7.	Image-guided surgery
8.	Project practice lab
9.	Surgical skills assessment
10.	AR/VR
11.	Neural networks
12.	Da Vinci competitors
13.	Business considerations in modern medicine
14.	Midterm, project presentation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Midterm and project work (satisfactory results for both)**

Assessment schedule	
Education week	Topic
14	Midterm 1-13. week lectures, Project presentation

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Retake midterm and project work
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
A minimum of 50% must be achieved in each part.	
Final grade calculation methods:	

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References	
Obligatory:	Lectures
Recommended:	D'Ettorre, Claudia, et al. "Accelerating Surgical Robotics Research: Reviewing 10 Years of Research with the dVRK." arXiv preprint arXiv:2104.09869 (2021).
Other references:	

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Institute of Applied Mathematics			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Machine intelligence	NMXMI1EMNF	4	full-time	3	0	0
Responsible person for the subject: Prof. Dr. TAKÁCS Márta			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is for the students to get to know the most important machine intelligence models among the artificial intelligence procedures. Within the description of the learning algorithms of machine intelligence methods, the main characteristics and representatives of supervised and unsupervised learning algorithms are introduced. Within this, they learn about fuzzy-based systems, basic types of neural networks, hybrid Anfis systems, basic concepts of deep learning procedures, and data set analysis methods. They become familiar with the algorithms of clustering and classification procedures and the editing of cognitive maps. With the help of the Matlab program and related packages of other software platforms, they acquire basic knowledge of machine intelligence methods and problem solving with the described software, including control problems, risk management and decision-making problems.
Course description:	

Lecture schedule	
Education week	Topic
1.	From artificial intelligence to the development of machine intelligence models.
2.	Learning algorithms of machine intelligence methods. Supervised and unsupervised learning algorithms.
3.	Fuzzy based systems I.
4.	Fuzzy based systems II.
5.	Artificial neural networks, hybrid systems, Anfis

6.	1st midterm exam
7.	Basic concepts of deep learning procedures
8.	Data set analysis methods. Algorithms of clustering and classification procedures I
9.	Data set analysis methods. Algorithms of clustering and classification procedures II
10.	Cognitive maps
11.	Novel application topics
12.	2nd midterm exam
13.	Individual project presentation
14.	Replacement of the midterm exams and late project presentation

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	The student can only get the signature if- During the semester, the student needs to write the midterm exams (maximum possible score 20 points/midterm exam), minimum performance 30%. It is possible to replace the midterm exams at a pre-arranged time, in the 14th week of the semester.- Work on one of the related topics in a 4-6 page homework/individual project, submit it in writing form of an essay (together with the completed software solutions of the project), and defend it in an online presentation in weeks 13 or 14, as a ppt or other presentation platform accompanied by 8-10 slides (maximum possible score 25). It is possible to replace the submission at a pre-arranged time, in the 14th week of the semester- During the year, the student prepares/develops homework from class to class related to the actual presented topics, which can count towards the end-of-year grade (up to 35 points).In order to complete the signature, the student must have a score of at least 30% in each of the prerequisites.

Assessment schedule

Education week	Topic
every week	Consultation time, arranged in advance by email, and on Monday, between 18.00-19.00 on the consultation platform of the Ms Teams system, and in person on Wednesday, 18.30-19.30. during the semester class period.
6th and 12th week	midterm exams
14th week	replacements

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In the 14th week, there will be an opportunity to replace the midterm exams and to submit missed homework and project. In the absence of the unsuccessful midterm exams and unsuccessful prepared projects, it will be possible to replace them for the signature once within the first 10 days of the exam period, at a predetermined time. The person entitled to a signature replacement is the person who has written his midterm exams or their replacements, has homework and a project, but did not achieved the 30% requirement. Those who did not present at the midterm exams or their regular replacements, did not submit homework and projects, and were absent from more than half of the classes without proof, are not entitled to the signature replacement.

Type of the exam (to be filled out only for subjects with exams)

Written and/or oral and project preparation. In details:

To complete the signature, the student must have a score of at least 30% in each of the prerequisites (midterm exams, project and homework).

Based on the points received for fulfilling the requirements, if the student obtains a total of at least 51 points, he/she defends his/her homework in an oral discussion (online, if the current regulations provide for it) at one of the previously announced exam dates, and can have a recommended grade (see the table under the exam heading). If the student does not accept this grade, or if he/she has less than 50 points from the mid-semester points, he/she can take an oral/written exam from the course material during the exam period (up to 50 points can be obtained at the exam).In the absence of the unwritten midterm exams and project, it will be possible to replace requirements for the signature once within the first 10 days of the exam period, at a predetermined time. The person entitled to a signature replacement is one who has written midterm exams or/and there replacements, submitted a project assignment, but did not achieved the 30% requirement. Those who did not present at the midterm exams or their regular replacements, did not submit homework and projects, and were absent from more than half of the classes without proof, are not entitled to the signature replacement.

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade = 0.5*theoretical test + 0.5*practice exam

A minimum of 50% must be achieved in each part.

Final grade calculation methods:

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	notes and presentations prepared by the lecturer, uploaded to the actual Moodle page
Recommended:	Stuart Russell, Peter Norvig, Artificial Intelligence A Modern Approach,*Third Edition*, Pearson Education (2010), ISBN 9 78-0-13-604259-4 Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning,Cambridge University Press (2020), ISBN: 978-1108455145 Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons, Ltd.(2010) ISBN: 978-0-470-74376-8
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Programming of robot systems	NBXPR1EMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. GALAMBOS Péter			Classification: associate professor			
Subject lecturer(s): Dr. GALAMBOS Péter, TARSOLY Sándor						
Prerequisites:	-					
Way of the assessment:	exam					

Course description	
Goal:	The aim of the subject is to introduce the programming principles and practices of industrial robots and complex robot systems, with particular attention to system-level architecture design.
Course description:	The concept, purpose, and the runtime environment of the robot program. Features of industrial robot programming languages. Abstract spaces and coordinate systems used in robot programming. Robot movement, interpolation methods. Types of robot peripherals and their connection to the robot controller. Offline and online programming approaches. Modular robot software environments and their services. Cloud robotics. Programming of Universal Robots (UR) type robots, URSim environment. Programming FANUC robots in FANUC TP language and the RoboGuide offline programming environment. Manufacturer-independent offline robot programming environment: RoboDK. Creating software modules in a Robot Operating System (ROS) environment.

Lecture schedule	
Education week	Topic
1.	Introductory presentation, operating environment of industrial robots, the purpose of robot programming.
2.	The birth of the robot program: technological requirements, cell design, programming.
3.	The main characteristics and possibilities of robot programming languages and runtime environments.
4.	The robot's connection with the outside world: the interfacing of sensors, actuators, safety devices, and control devices. Finalizing semester assignments.
5.	Comparison of online (shopfloor) and offline (virtual) robot programming.
6.	Basic paradigms of component-based, distributed robot software systems.
7.	Universal Robot URSim robot simulation environment
8.	Universal Robot URSim, FANUC Roboguide robot simulation environments
9.	FANUC Roboguide and RoboDK robot simulation environments
10.	RoboDK robot simulation environment
11.	Robot Operating System Part 1
12.	Robot Operating System Part 2
13.	Test
14.	Retake Test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required.

	The classroom test and the project assignment must be performed with at least 40% result

Assessment schedule

Education week	Topic
13	Test from the topics of 1-12 week
14	Presentation of the project assignments

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	- The test can be retaken on the 14th week. - The project can be presented (project retake) by the end of the first week of the exam period.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

For those who fulfill the requirements, a mark will be offered. The basis of the offered mark calculation is the weighted sum of the test and the project results: 0.6 * TEST + 0.4 * PROJECT. Those who do not accept the offered mark can take an exam that consists of a test part and a practical part.
A minimum of 50% must be achieved in each part.

Final grade calculation methods:

Achieved result	**Grade**
86%-100%	excellent (5)
71%-85<%	good (4)
56%-<70%	average (3)
41%-55<%	satisfactory (2)
0%-40<%	failed (1)

References

Obligatory:	
Recommended:	[1] Andreas Bihlmaier, Robotics for Programmers, 1. Edition, New York, NY: Manning, 2022. (ISBN 978-1-63343-963-4) [2] J. W. Gruenke, Programming FANUC robots for industry applications. Orland Park, IL: American Technical Publishers, 2021. (ISBN 978-0-8269-3412-3) [3] A. Koubâa, Edited., Robot operating system (ROS): the complete reference. (Volume 3). Cham, Switzerland: Springer, 2019. (ISBN 978-3-319-91590-6) [4] K. CAPEK, R.U.R. (ROSSUM'S UNIVERSAL ROBOTS). AGOG! Press, 2015. (ISBN 978-1-4794-4573-8
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Kinematics and Dynamics of Industrial Robots	NBXKD1EMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. GALAMBOS Péter			Classification: associate professor			
Subject lecturer(s): KUTI József						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The subject aims to provide well-established knowledge about modelling and controlling methods for manipulators with serial kinematics.
Course description:	The subject details the computation methods related to 3D positions and orientations and their derivatives that are necessary to describe trajectories and compose robot commands. Furthermore, the modelling methods can express the relationship between the concepts of the Cartesian space and the low-level control commands of robot joints. These methods will be discussed on three levels: kinematic, differential kinematic, and dynamical. Based on them, the practical relevance of concepts of mobility and singularity, the opportunities in the redundant structure, and the corresponding computational method. Practical development problems, option for independent problem disposals and test in a simulation environment and real robot arm.

Lecture schedule	
Education week	Topic
1.	General introduction; Mechatronical/driver properties of industrial manipulators
2.	Basic concepts of robotics; Lab.: joint space commands
3.	Lab.: Cartesian-space commands; Experiences of dev. projects with manipulators
4.	Algebra rehearsal; Theory of 2D transformations
5.	Lab.: applications of 2D transformations; Theory of 3D transformations
6.	Lab.: applications of 3D transformations; Theory of 3D orientation descriptions
7.	Lab.: computations with orientations; Theory of quaternions for orientation description, practical questions
8.	Mid-term exam; Kinematical modelling, Denavit-Hartenberg convention
9.	Retake mid-term exam; Robot calibration: motivation and applicability
10.	Analytic and numeric methods for the inverse kinematical task; Lab.: experiments with the methods
11.	Basics of diff. kinematics, Jacobian-matrix; Lab.: diff. kinematical computations on robot arm and mobile platform
12.	Kinematical properties of manipulators, inverse diff. kinematical task; SVD based computation of kinematical properties from the Jacobian-matrix
13.	Mid-term exam; Dynamics rehearsal
14.	Retake mid-term exam; Dynamical modelling and its applications
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Taking the two mid-term tests with at least satisfactory results and taking the exam.

Assessment schedule

Education week	Topic
8	Basic concepts of robotics; Concepts related to the 3D Cartesian space
13	Kinematic and differential kinematic modelling and the corresponding methods

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	According to the level of detail.

Type of the exam (to be filled out only for subjects with exams)

Written. One given topic must be elaborated.

Calculation of the exam mark (to be filled only for subjects with exams)

A final grade is offered, if the sum of the points of the mid-term exams (max. 75) and the points got for the optional hand-out exercises is more than 75 (and both of the exams are at least satisfactory). Over 87 points, this grade is excellent; below that is good.

Final grade calculation methods:

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	
Recommended:	[1] Sciavicco, L., Siciliano, B., Villani, L., & Oriolo, G. (2011). Robotics: Modelling, planning and Control, ser. Advanced Textbooks in Control and Signal Processing. ISBN: 978-1846286414 [2] Lynch, Kevin M., and Frank C. Park. Modern robotics. Cambridge University Press, 2017. ISBN: 978-1107156302
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Robotics and data science in medicine	NBXRS1EMNF	4	full-time	3	0	0
Responsible person for the subject: Dr. HAIDEGGER Tamás			Classification: associate professor			
Subject lecturer(s): Dr. HAIDEGGER Tamás, Nagyné ELEK Renáta						
Prerequisites:	-					
Way of the assessment:	exam					

Course description	
Goal:	The aim of the subject is to learn about the main directions of computer-integrated surgery, modern medicine and service robots.
Course description:	The course presents the most important technological trends in computer-integrated surgery, e.g.: robot-assisted surgery, surgical skills assessment, image-guided surgery, neural network-based medical image processing, medical imaging. The course introduces service robots, their use and standardization.

Lecture schedule	
Education week	Topic
1.	Introduction of service robots and computer-integrated surgery
2.	Laboratory demonstration at the Antal Bejczy Center for Intelligent Robotics
3.	Basics of robotics
4.	Da Vinci Surgical System
5.	Medical imaging
6.	Surgical autonomy
7.	Image-guided surgery
8.	Project practice lab
9.	Surgical skills assessment
10.	AR/VR
11.	Neural networks
12.	Da Vinci competitors
13.	Business considerations in modern medicine
14.	Midterm, project presentation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Midterm and project work (satisfactory results for both)**

Assessment schedule	
Education week	Topic
14	Midterm 1-13. week lectures, Project presentation

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	
Type of the exam (to be filled out only for subjects with exams)	
Final garden = 0.5*Midterm + 0.5* orihect work	
Calculation of the exam mark (to be filled only for subjects with exams)	
A minimum of 50% must be achieved in each part.	
Final grade calculation methods:	

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References	
Obligatory:	Lectures
Recommended:	D'Ettorre, Claudia, et al. "Accelerating Surgical Robotics Research: Reviewing 10 Years of Research with the dVRK." arXiv preprint arXiv:2104.09869 (2021).
Other references:	

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Institute of Applied Mathematics			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Control theory in robotics	NMXCT1EMNF	4	full-time	2	0	2
Responsible person for the subject: Prof. Dr. TAR József			Classification: professor			
Subject lecturer(s): Prof. Dr. TAR József						
Prerequisites:	-					
Way of the assessment:	mid-term grade					

Course description	
Goal:	To provide the Students with the fundamental methods used in the control of robots of open kinematic chain.
Course description:	Kinematics and differential inverse kinematics of redundant open kinematic chains. The Compued Torque Control based on precise dynamic model. The Robust Variable Structure/Sliding Mode Control. Fractional order calculus-inspired kinematic design;Adaptive control solutions based on imprecise dynamic models: Lyapunov's stability definitions; Lyapunov's 2nd or "direct" method; a classical example: Adaptive Inverse Dynamics Controller for Robots; Alternatives of the Lyapunov function-based adaptive methods: Banach's fixed point theorem; Adaptive control based on Banach's fixed point theorem; Model Reference Adaptive Control; Programming and documentation issues for the laboratory exercises.

Lecture schedule	
Education week	Topic
1.	Setting the direct kinematic task for open kinematic chain; Parameters of the rotation operators: embedded hypersurface, tangent space, constant directional lines as matrix exponentials, transformed tangents as rotated rotational axles; the right handed convention, the Rodrigues formula and the relationship between the rotational matrix and the axle, and angle of rotation; Setting the differential inverse kinematic task using homogeneous coordinates and matrices;
2.	Solution of the differential inverse kinematic task as a problem of optimization under constraints: use the Gradient Descent, the Newton-Raphson method, Lagrange's reduced gradient and multipliers, the Auxiliary Function, Moore-Penrose generalized inverse, kinematic singularities, task deformation by Levenberg and Marquardt.
3.	Preparation for the laboratory work: basics in Julia language: variable types, arrays, global and local variables and their use in functions and cycles; Declaration and calling of functions, variable lists; PyPlot and Matplotlib. Efficient way of making documentation: LATEX, TexStudio.
4.	Euler-Lagrange equations of motion with respect to an inertial system of reference: physical interpretation of the generalized forces and their use in the motion control. The Computed Torque Control.
5.	Kinematic design for damping the trajectory tracking error using the joint coordinates: exponentially damped polynomials, Lyapunov equation with more general PID-type error feedback control. Conditions for stability (from the Jordan canonical form) .

6.	Adaptive Control: Lyapunov's 2nd or "direct" method; Stability definitions, the function class κ ;Quadratic Lyapunov functions; model parameter tuning, Adaptive Inverse Dynamics Control.
7.	Alternative methods for parameter identification: the Particle Swarm Optimization;
8.	The Banach space as metric space; Contractive mapping in Banach spaces; Banach's Fixed Point Theorem; Fixed Point Iteration.
9.	Use of the fixed point iteration in adaptive control: transforming the control task into a fixed point iteration, deformation functions; Differentially approximately direction keeping functions. Stability / convergence conditions. Effects of too slow iteration and quitting the range of convergence.
10.	Modeling, effects and filtering measurement noises.
11.	Underactuated robot, parasite dynamics, relative order of the control task; The use of simple affine models and fixed point iteration to evade state measurement/estimation problems.
12.	Improvement of the conventional PID-type kinematic design by fractional order calculus-inspired approximations: multiple error integrals, approximation with sequences, approximation of lower order control in higher order control design.
13.	Model Reference Adaptive Controller using Fixed Point Iteration.
14.	

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. All homeworks are required to complete during the midterm.

Assessment schedule

Education week	Topic
	Conventional tests and assesments are not relevant in this subject area. The Students have to submit the program code and the documentation of the results of a complex task in which some control method is applied in the control of a given dynamical model.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Irrelevant for a midterm grade-basec course.

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

Achieved result	**Grade**
89%-100%	excellent (5)

	76%-88<%	good (4)	
	63%-75<%	average (3)	
	51%-62<%	satisfactory (2)	
	0%-50<%	failed (1)	

References	
Obligatory:	Free of charge available lecture notes and sample programs, sample documentation materiels.
Recommended:	[1] J. Somló, B. Lantos, and P.T. Cát. Advanced Robot Control. Akadémiai Kiadó, Budapest, 2002. [2] J.K. Tar, J.F. Bitó, L. Nádai, and J.A. Tenreiro Machado. Robust Fixed Point Transformations in adaptive control using local basin of attraction. Acta Polytechnica Hungarica, 6(1):21–37, 2009. [3] J.K. Tar, J.F. Bitó, and I.J. Rudas. Replacement of Lyapunov's Direct Method in Model Reference Adaptive Control with Robust Fixed Point Transformations. In Proc. of the 14th IEEE Intl. Conf. on Intelligent Engineering Systems, Las Palmas of Gran Canaria, Spain, pages 231–235, 2010. [4] J.K. Tar, L. Nádai, and I.J. Rudas. System and Control Theory with Especial Emphasis on Nonlinear Systems. Typotex, Budapest, Hungary, 1st edition, 2012. [5] Hazem Issa and József K. Tar. Improvement of an adaptive robot control by particle swarm optimization-based model identification. Mathematics, 10(19), 2022. [6] Bence Varga, Richárd Horváth, and József K. Tar. Fractional order calculus-inspired kinematic design in adaptive control. In Andreas Müller and Mathias Brandstötter, editors, Advances in Service and Industrial Robotics, pages 218–225, Cham, 2022. Springer International Publishing. [7] Awudu Atinga, János F. Bitó, and József K. Tar. On the simulation of lower order control strategies for higher order systems, 2022. Accepted for publication in IEEE Joint 22nd International Symposium on Computational Intelligence and Informatics and 8th International Conference on Recent Achievements in Mechatronics, Automation, Computer Science and Robotics (CINTI-MACRo 2022).
Other references:	

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
High Availability Embedded Systems	NKXHA1EMNF	4	full-time	2	0	1
Responsible person for the subject: Prof. Dr. MOLNÁR András			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	Students will gain a comprehensive understanding of the expected reliability and failure rates of complex systems. They will be able to design systems where availability is critical and to operate redundant systems. Understand the advantages and disadvantages of redundancy. They will be able to propose the most advantageous redundant system in the design phase of complex systems, based on economic, operational and reliability criteria.
Course description:	Service, concept of minimum service. Majority redundancy. Mass, volume consumption issues for majority redundant systems. Redundant systems. Design of voting, selecting circuits. Redundant systems based on quality characteristics. High reliability systems implemented by master-slave systems. Nature and probability of failure of components. Probability of failure of complex systems, estimation of their life expectancy.

Lecture schedule	
Education week	Topic
1.	Basic concepts, formulation of reliability targets, definition of minimum service.
2.	Fault detection, locating faults within the system, detecting faults.
3.	Case studies of accidents caused by faults, analysing them, drawing conclusions.
4.	Majority redundant systems, voting circuits, weight, consumption, size problems.
5.	Redundant systems.
6.	Redundant systems based on quality characteristics.
7.	Hybrid (Master-Slave) redundant systems.
8.	Probability of failure of complex systems (parallel and series connected units). Lifetime of complex systems, failure probabilities and characteristics of specific periods of their lifetime.
9.	Battery packs, reliability of point series/parallel systems, failure modes and their probability of occurrence.
10.	Specific cases where the duplication of building blocks of systems has a safety reducing effect.
11.	Calculations to determine the availability of real systems.
12.	Redundant systems demonstrated by practical simulations (examples of physical implementation).
13.	Midterm exam
14.	Midterm exam (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Pass at least 51% of the midterm exam

Assessment schedule

Education week	Topic
13.	Midterm exam from lecture and lab
14.	Midterm exam from lecture and lab (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

0% - 59%: fail (1)
60% - 69%: pass (2)
70% - 79%: satisfactory (3)
80% - 89%: good (4)
90% - 100%: excellent (5)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Once during the examination period according to rules.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References

Obligatory:	Kónya Tamás: Nagy megbízhatóságú elektronikus rendszerek elmélete, Budapest, 2007. május. 14. https://mek.oszk.hu/08300/08381/08381.pdf Gáti B. az all: REPÜLŐGÉPEK RENDSZEREI ÉS AVIONIKA, ISBN 978-963-279-613-0
Recommended:	REDUNDANCIA, https://www.nye.hu/ktit/sites/www.nye.hu.ktit/files/dokumentumok/E_segedletek/Kozlekautomat/NYE_kozlaut_ea_II_2017.pdf
Other references:	Lecture slides available at at https://elearning.uni-obuda.hu/

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Biomatics and Applied Artificial Intelligence Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Introduction to cyber security - security awareness	NBXIC1EMNF	4	full-time	1	0	1
Responsible person for the subject: Dr. PÓSER Valéria			Classification: associate professor			
Subject lecturer(s): Dr. PÓSER Valéria, SZARVÁK Anikó						
Prerequisites:	-					
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course gives a general overview of current challenges in cybersecurity from the primary perspective of a conscious computer user. Various aspects of personal and (small) business cyber hygiene is examined together with related technologies with the aim of achieving a common mental basis for more specialized studies in security.
Course description:	Following broad introduction of general aims and terminology of cybersecurity, students are introduced to security aspects and threats regarding common day-to-day activities, like web browsing, direct messaging, installing of applications or using social media. A broad overview and introduction to applied cryptography is followed by practical considerations regarding modern cryptosystems and their features. Various supplementary topics, like data management, contingency planning, user authentication and authorization, risk management and social engineering are also examined.

Lecture schedule	
Education week	Topic
1.	General introduction to cybersecurity – goals and requirements, basic concepts and definitions, history and trends
2.	Cyber threat landscape – threat and defense actors, targets (attack surface), major techniques and tools (attack vectors), public threat resources and services, white and dark markets, major incidents (case studies)
3.	Browsing the web – general security of web mechanisms (browsers and servers, DNS, URL, HTTP, HTML, DOM, scripting), web identity and tracking, malicious web services, common threats, case studies
4.	E-mail services and direct messaging platforms – email mechanisms (MUA, MTA, SMTP, MIME), direct messaging platforms, distribution and subscription services, common threats, case studies
5.	GDPR
6.	Social media and cloud data sharing platforms – data driven economy, right to be forgotten, user profiling and tracking, bots and trolls, cyberbullying, incidents, and case studies. OSINT
7.	Secure password storage and verification, password policies, password cracking, personal and collaborative password security/management. Secure use of application credentials.
8.	Zero Trust Architecture.
9.	Digital identity, user authentication (three factors), authorization and access control, access control models (ACL, DAC, MAC, RBAC, ABAC, Bell-LaPadula), access control of devices, accounts and sessions, auditing, and

	accountability. Major authentication/authorization technologies (Active Directory, LDAP, Radius, Kerberos, EAP, OpenID, SAML).
10.	Assets in cybersecurity – personal, corporate and public data, networked services and cloud infrastructure, people and processes, supply chains, internal requirements (policies), external requirements (laws, directives, guidelines and sectoral requirements in EU and Hungary).
11.	Critical data and service management – identification of important assets, backup and archival strategies, long time preservation, high availability, contingency planning, disaster recovery.
12.	The human factor – threats and techniques of social engineering, case studies
13.	Theoretical test
14.	Extra Theoretical test

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. All homeworks and the classroom test are required to complete during the midterm.

Assessment schedule

Education week	Topic
13	All topics
14	Extra Theoretical test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Extra Theoretical test at week 14. Substitution of the signature: once during one of the first 10 working days of the examination period.

Type of the exam (to be filled out only for subjects with exams)

Theoretical test

Calculation of the exam mark (to be filled only for subjects with exams)

A minimum of 50% must be achieved.

Final grade calculation methods:

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	Class materials published in Moodle.
Recommended:	• Ciampa Mark D : Security Awareness - Applying Practical Security in Your World, ISBN: 9781305500372

	• David Willson, Henry Dalziel: Cyber Security Awareness for Accountants and CPAs, Syngress Media 2015, ISBN: 9780128047224 David Willson, Henry Dalziel: Cyber Security Awareness for Corporate Directors and Board Members, Syngress Media 2015, ISBN: 9780128047569
Other references:	

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Advanced network technologies and their security	NKXAT1EMNF	4	full-time	2	0	2
Responsible person for the subject: Balázsné Dr. KAIL Eszter			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NKXNT1EMNF	Network technologies				
Way of the assessment:	exam					

Course description	
Goal:	The course aims the students to be able to plan, configure and manage medium and large size corporate or Internet Service Provider (ISP) networks with advanced security considerations. Further goal is to introduce the basics of network automation, the Software Defined Networking (SDN) and Network Function Virtualization (NFV). Networks may include standard IT networks such as the local area network, wireless network, mobile network, Internet, intranet, as well as newer developments such as RFID, NFC, WPAN and ZigBee in the consumer and IoT domains, with their specific architectures and, above all, their risk and security assessment. In addition, specific aspects critical infrastructure will be examined, and the measurable indicators of network will be analyzed.
Course description:	The curriculum introduces LAN and WAN design concepts and network scaling possibilities. The course familiarizes the advanced routing concepts (segment routing, multicast routing, BGP, MPLS) and its vulnerabilities, VPN technologies (SSL VPN, MPLS VPN, DMVPN), Next generation firewall and IDS/IPS technologies.

Lecture schedule	
Education week	Topic
1.	Basics of LAN and WAN design, overview of routing and switching technologies
2.	Advanced routing technologies - BGP
3.	Advanced routing technologies - MPLS
4.	Advanced routing technologies – multicast and segment routing
5.	Vulnerabilities of routing protocols and techniques
6.	VPN technologies – MPLS VPN, DMVPN
7.	VPN technologies – SSL VPN
8.	Next generation Firewalls and IDS/IPS
9.	Vulnerability and risk assessment in different networks – wireless and mobile network
10.	Vulnerability and risk assessment in different networks – RFID, WPAN, Zigbee
11.	SDN, NFV
12.	SDN, NFV security
13.	Lab exam
14.	Lab exam (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The students are required to attend at least 70% of the classes, and pass the laboratory exam with at least a satisfactory result.

Assessment schedule	
Education week	Topic

13.	Lab exam
14.	Lab exam (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	During the first week of the exam period the laboratory exam can be replaced

Type of the exam (to be filled out only for subjects with exams)
Oral exam based on predefined topics.
Calculation of the exam mark (to be filled only for subjects with exams)
The final grade is the average of the laboratory and the theoretical exam.
Final grade calculation methods:
References

Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	Omar Santos: CCNP and CCIE Security Core; Official Cert Guide, Cisco Press, 2020, ISBN: 0135971977 Edgeworth Brad: CCNP and CCIE Enterprise Core, Official Cert Guide, Cisco Press, 2019, ISBN13: 9781587145230 Andrew Tanenbaum, Nick Feamster, David Wetherall: Computer Networks, Sixth Edition, Pearson Education Limited, 2022, ISBN: 978-1292374062
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
IT compliance, audit and risk analysis	NBXIT1EMNF	4	full-time	2	0	1
Responsible person for the subject: Dr. PÓSER Valéria			Classification: associate professor			
Subject lecturer(s): SZARVÁK Anikó						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The goal of the course is to introduce students the concepts and methods related to IT audit and familiarize them with tasks and processes of IT audit in an enterprise environment. The further aim is to prepare students to be able to perform and evaluate a risk assessment.
Course description:	The course will provide insight into the types of IT audit, the auditor's tasks and responsibilities, as well as the aspects and expectations of documentation and its requirements. It will also introduce students to the theory and practice of corporate governance and development requirements, and through case studies and project work, students will learn methods and solutions for auditing different systems and areas (operations, critical infrastructure, corporate assets).

Lecture schedule	
Education week	Topic
1.	Introduction
2.	Types of IT audit
3.	IT auditor's responsibilities and tasks
4.	The structure, content and requirements of audit documentation
5.	The process and requirements of the IT audit, standards and regulations
6.	Analysis of controls
7.	Corporate regulators
8.	Analysis of development and operation

9.	Protection of corporate assets
10.	The goals and methods of risk assessment
11.	The process and steps of risk assessment
12.	Evaluation of IT security assessment
13.	Summary, Theoretical test
14.	Retake test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. All homeworks and the classroom test are required to complete during the midterm.

Assessment schedule	
Education week	Topic
13.	All topics - test
14.	All topics - retake test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Written test (quiz type).

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)

51%-62<%	satisfactory (2)
0%-50<%	failed (1)

Final grade = theoretical test

A minimum of 50% must be achieved.

References	
Obligatory:	Lecture notes
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Open source SOC development in practice I.	NBXOS1EMNF	4	full-time	2	0	2
Responsible person for the subject: Vörösné Dr. BÁNÁTI-BAUMANN Anna			Classification: senior lecturer			
Subject lecturer(s): Vörösné Dr. BÁNÁTI-BAUMANN Anna						
Prerequisites:	-					
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to familiarise students with the purpose and tasks of a SOC, the different open source solutions, log management tools and procedures. The students will develop their own SOC instance in a project work, where a SIEM system will be implemented with the most common use cases and corresponding alarms. They will add additional components to the SOC, such as IDS/IPS systems and a honeypot solution of their choice, while also learning about the tasks and types of these devices.
Course description:	The course reviews the purpose, function and key components and requirements of a SOC. The course is lab oriented and reinforces the development of a project approach in the students. During the semester, while learning the theoretical basics, students in groups of 4 will develop their own SOC instance in the cloud, including log management, monitoring, SIEM, honeypot, IDS/IPS and alerting solutions.

Lecture schedule	
Education week	Topic
1.	Introduction to Security Operation Center
2.	Requirements and quality indicators of SOC
3.	Roles in SOC: SOC operator, Threat analyst, Incident Manager
4.	SOC and incident management
5.	Investigating open source solutions
6.	Log management
7.	Log collectors, Log sources and log analysis
8.	Security and Information Event Management (SIEM)
9.	Monitoring tools and techniques
10.	Intrusion detection and prevention systems
11.	Honeypots
12.	Alerting mechanism in SOC
13.	Summary, project work presentation I.
14.	Project work presentation II.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. Students in groups of 4 will have to develop their own SOC instance in the cloud, including log management, monitoring solution, honeypot, IDS/IPS system and alerting solution. The midterm requirement is to implement, document and present the development in weeks 13 and 14.

Assessment schedule	
Education week	Topic
13	project work presentation I.
14	project work presentation II.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Theoretical test

Calculation of the exam mark (to be filled only for subjects with exams)

A minimum of 50% must be achieved.

Final grade calculation methods:

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	Lecture notes
Recommended:	The documentation of applied solutions
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Open source SOC development in practice II.	NBXOS2EMNF	4	full-time	2	0	2
Responsible person for the subject: Vörösné Dr. BÁNÁTI-BAUMANN Anna			Classification: senior lecturer			
Subject lecturer(s): Vörösné Dr. BÁNÁTI-BAUMANN Anna						
Prerequisites:	NBXOS1EMNF	Open source SOC development in practice I.				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to further enhance the students' knowledge of the operation and tasks of a security operation centre. During the course, they will be introduced to additional tasks and solutions (such as Threat Intelligence, vulnerability assessment, asset management and endpoint protection), both in theory and in practice, during a development.
Course description:	The course further discusses the tasks and components of SOC, complementing the theoretical and practical knowledge acquired in Course I. The course introduces the areas, tools and methods of endpoint protection, asset management and vulnerability assessment and Threat Intelligence. During the semester, while learning the theoretical basics, students will work in groups of 4 to further develop the previously created SOC instance and add additional components: endpoint protection, asset management and vulnerability assessment.

Lecture schedule	
Education week	Topic
1.	Overview of SOC (summary of the previous course)
2.	Introduction to Threat Intelligence
3.	Open-source solutions - OSINT
4.	Vulnerabilities - types and databases
5.	Vulnerability assessment in SOC
6.	Action plans
7.	Asset management - goals and methods
8.	Asset management - open-source solutions
9.	Endpoint protection - goals and methods
10.	Endpoint protection - open-source solutions
11.	Implementation and integration in SOC
12.	Audit of a SOC
13.	Summary, project work presentation I.
14.	Project work presentation II.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the lectures and labs is required. Students in groups of 4 will have to develop their own SOC instance in the cloud, including log management, monitoring solution, honeypot, IDS/IPS system and alerting solution. The midterm requirement is to implement, document and present the development in weeks 13 and 14.

Assessment schedule	
Education week	Topic
13	project work presentation I.
14	project work presentation II.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Theoretical test

Calculation of the exam mark (to be filled only for subjects with exams)

A minimum of 50% must be achieved.

Final grade calculation methods:

Achieved result	**Grade**
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	Lecture notes
Recommended:	Documentation of applied solutions
Other references:	

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Institute of Cyberphysical Systems			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
AI-based solutions for cyber defence	NKXAS1EMNF	4	full-time	2	0	2
Responsible person for the subject: Balázsné Dr. KAIL Eszter			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	Students gain a sound overview of selected areas of artificial intelligence as well as practical and methodological knowledge and skills in the application of AI methods and algorithms. This includes the ability to evaluate the performance and selection of suitable techniques for the respective problem domain. They are able to assess the goodness of the results of such techniques.
Course description:	The subject introduces the basics of Machine learning and neural networks, and It also provides insights into different areas of cyber defense where AI-based techniques can be used to achieve more effective results.

Lecture schedule	
Education week	Topic
1.	Overview and introduction, Intelligent agents
2.	Representation of knowledge and problems, Problem solving by search, adversarial search, heuristics
3.	Knowledge, reasoning, planning, Uncertain knowledge and reasoning
4.	Machine Learning and Data Mining
5.	Neural Networks
6.	Learning by reinforcement
7.	Detecting email cybersecurity threats
8.	Malware threat detection
9.	Advanced malware threat detection
10.	Network anomaly detection – log and traffic analysis
11.	Securing users authentication and user profiling
12.	Automatic Intrusion detection
13.	Project presentation
14.	Project presentation (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The students are required to attend at least 70% of the classes. Students in groups of 4 will be required to complete a project work in which one of the five cyber security topics will be implemented, documented and presented.

Assessment schedule	
Education week	Topic
13	Project presentation
14	Project presentation (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	During the first week of the exam period the project presentation can be replaced
Type of the exam (to be filled out only for subjects with exams)	
Oral exam based on predefined topics.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The grade is the average of project work and oral exam.	
Final grade calculation methods:	
References	
Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	Soma Halder, Sinan Ozdemir: Hands-On Machine Learning for Cybersecurity, Packt Publishing 2018, ISBN-13: 978-1788992282 Daniel Ventre: Artificial Intelligence, Cybersecurity and Cyber Defence, Wiley-ISTE 2020, ISBN: 9781786304674 Rudolph Russell: Neural Networks: Easy Guide To Artificial Neural Networks, 2018, ISBN: 978-1718898424
Other references:	

			Semester 4. of the curriculum			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Devices of mobile and computer games	ATXDMCEMNF	4	full-time	2	0	1
Responsible person for the subject: Prof. Dr. Györök György			Classification: professor			
Subject lecturer(s): Beszédes Bertalan						
Prerequisites:	none					
Way of the assessment:	written test					

Course description	
Goal:	This course targets to overview the details of the most common controlling technologies, with the help of a high-level simulation software. In our interpretation the simulated model is integrated into a microcontroller-based development board with the most widely used sensors and actuators. The solution to a given design task allows to master the following skills: standalone problem solving, system specification; hardware implementation of a given function; to use a new development environment; independent processing of literature; knowledge of parts, use of catalogs; preparing technical documentation, master simulation and programming skills.
Course description:	The course contains the following elements: Description of the simulation software, integrating MATLAB and µCs, the role of sensors and actuators in controls. A brief overview of sensors and actuators, their grouping according to different aspects. Detailed theoretical and practical demonstration of the used sensors and actuators through practical examples. Necessary competencies: Fundamentals of electronics, electronics technology, the knowledge of essential electronics circuit symbols and electronics circuit diagrams, basic designing, and problem-solving skills.

Lecture schedule	
Education week	Topic
1.	Introduction the role of sensors in control and automation
2.	Sensor types, classification and measurement units
3.	Theoretical and practical demonstration of sensor operation I.
4.	Theoretical and practical demonstration of sensor operation II.
5.	Theoretical and practical demonstration of sensor operation III.
6.	Theoretical and practical demonstration of sensor operation IV.
7.	Thermal imaging cameras I.
8.	Thermal imaging cameras II.
9.	Virtual Reality Systems I.
10.	Virtual Reality Systems II.
11.	Point clouds I.
12.	Point clouds II.
13.	Test
14.	Replacement test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	-

Assessment schedule	
Education week	Topic
13	Written test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
0-50 percent: 1; 51-70 percent: 2; 71-80 percent: 3; 81-90 percent: 4; 91-100 percent: 5.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	online test

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:
0-50 percent: 1; 51-70 percent: 2; 71-80 percent: 3; 81-90 percent: 4; 91-100 percent: 5.

References	
Obligatory:	They are published on the relevant Moodle course
Recommended:	[1] Charles Bell. Beginning Sensor Networks with Arduino and Raspberry Pi. Apress; 1st ed. edition (November 22, 2013). 372 p. ISBN-10: 9781430258247, ISBN-13: 978-1430258247, ASIN: 1430258241
Other references:	[2] William C. Dunn. Introduction to Instrumentation, Sensors, and Process Control (Artech House Sensors Library). Artech House Publishers (October 31, 2005). 354 p. ISBN-10: 1580530117, ISBN-13: 978-1580530118 [3] Nathan Ida. Sensors, Actuators, and their Interfaces: A multidisciplinary introduction (Materials, Circuits and Devices). Scitech Publishing (December 12, 2013). 784 p. ISBN-10: 1613530064, ISBN-13: 978-1613530061

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Institute of Applied Mathematics			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Machine intelligence	NMXMI1EMNF	4	full-time	3	0	0
Responsible person for the subject: Prof. Dr. TAKÁCS Márta			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is for the students to get to know the most important machine intelligence models among the artificial intelligence procedures. Within the description of the learning algorithms of machine intelligence methods, the main characteristics and representatives of supervised and unsupervised learning algorithms are introduced. Within this, they learn about fuzzy-based systems, basic types of neural networks, hybrid Anfis systems, basic concepts of deep learning procedures, and data set analysis methods. They become familiar with the algorithms of clustering and classification procedures and the editing of cognitive maps. With the help of the Matlab program and related packages of other software platforms, they acquire basic knowledge of machine intelligence methods and problem solving with the described software, including control problems, risk management and decision-making problems.
Course description:	

Lecture schedule	
Education week	Topic
1.	From artificial intelligence to the development of machine intelligence models.
2.	Learning algorithms of machine intelligence methods. Supervised and unsupervised learning algorithms.
3.	Fuzzy based systems I.
4.	Fuzzy based systems II.
5.	Artificial neural networks, hybrid systems, Anfis
6.	1st midterm exam
7.	Basic concepts of deep learning procedures
8.	Data set analysis methods. Algorithms of clustering and classification procedures I
9.	Data set analysis methods. Algorithms of clustering and classification procedures II
10.	Cognitive maps
11.	Novel application topics
12.	2nd midterm exam
13.	Individual project presentation
14.	Replacement of the midterm exams and late project presentation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The student can only get the signature if- During the semester, the student needs to write the midterm exams (maximum possible score 20 points/midterm exam), minimum performance 30%. It is possible to replace the midterm exams at a pre-arranged time, in the 14th week of the semester.-

	Work on one of the related topics in a 4-6 page homework/individual project, submit it in writing form of an essay (together with the completed software solutions of the project), and defend it in an online presentation in weeks 13 or 14, as a ppt or other presentation platform accompanied by 8-10 slides (maximum possible score 25). It is possible to replace the submission at a pre-arranged time, in the 14th week of the semester- During the year, the student prepares/develops homework from class to class related to the actual presented topics, which can count towards the end-of-year grade (up to 35 points).In order to complete the signature, the student must have a score of at least 30% in each of the prerequisites.

Assessment schedule

Education week	Topic
every week	Consultation time, arranged in advance by email, and on Monday, between 18.00-19.00 on the consultation platform of the Ms Teams system, and in person on Wednesday, 18.30-19.30. during the semester class period.
6th and 12th week	midterm exams
14th week	replacements

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	In the 14th week, there will be an opportunity to replace the midterm exams and to submit missed homework and project. In the absence of the unsuccessful midterm exams and unsuccessful prepared projects, it will be possible to replace them for the signature once within the first 10 days of the exam period, at a predetermined time. The person entitled to a signature replacement is the person who has written his midterm exams or their replacements, has homework and a project, but did not achieved the 30% requirement. Those who did not present at the midterm exams or their regular replacements, did not submit homework and projects, and were absent from more than half of the classes without proof, are not entitled to the signature replacement.

Type of the exam (to be filled out only for subjects with exams)

Written and/or oral and project preparation. In details:
To complete the signature, the student must have a score of at least 30% in each of the prerequisites (midterm exams, project and homework).
Based on the points received for fulfilling the requirements, if the student obtains a total of at least 51 points, he/she defends his/her homework in an oral discussion (online, if the current regulations provide for it) at one of the previously announced exam dates, and can have a recommended grade (see the table under the exam heading). If the student does not accept this grade, or if he/she has less than 50 points from the mid-semester points, he/she can take an oral/written exam from the course material during the exam period (up to 50 points can be obtained at the exam).In the absence of the unwritten midterm exams and project, it will be possible to replace requirements for the signature once within the first 10 days of the exam period, at a predetermined time. The person entitled to a signature replacement is one who has written midterm exams or/and there replacements, submitted a project assignment, but did not achieved the 30% requirement. Those who did not present at the midterm exams or their regular replacements, did not submit homework and projects, and were absent from more than half of the classes without proof, are not entitled to the signature replacement.

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade = 0.5*theoretical test + 0.5*practice exam
A minimum of 50% must be achieved in each part.

Final grade calculation methods:	
Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References	
Obligatory:	notes and presentations prepared by the lecturer, uploaded to the actual Moodle page
Recommended:	Stuart Russell, Peter Norvig, Artificial Intelligence A Modern Approach,*Third Edition*, Pearson Education (2010), ISBN 9 78-0-13-604259-4 Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning,Cambridge University Press (2020), ISBN: 978-1108455145 Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons, Ltd.(2010) ISBN: 978-0-470-74376-8
Other references:	

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			Semester 3. of the curriculum			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mobile Applications I.	ATXMA1EMNF	4	full-time	1	0	2
Responsible person for the subject: Nagyné Dr. Hajnal Éva			Classification: associate professor			
Subject lecturer(s): Márton Huszics						
Prerequisites:	-					
Way of the assessment:	mid-term mark					

Course description	
Goal:	During the curse students have to be introduced into Android RAD tool features. They study the Android operating system and it's programming, standard and custom libraries.
Course description:	The students have to know the development environment, compilation, debugging and android process and activities life cycle. They skill in database connection, CRUD operations. They learn about hardware control: device orientation, accelerometer, GPS, camera and networking, web services.

Lecture schedule	
Education week	Topic
1.	Introduction to Android Studio. Graphics interface
2.	Java basics
3.	Data storage
4.	GPS handling, location, Google Maps and other alternative solutions
5.	Accelerometer, giroscope
6.	Other sensors
7.	File handling
8.	Data-base operations, CRUD
9.	Data-base operations, CRUD
10.	Project
11.	Optimization, Android Market
12.	Test (paper and computer)
13.	Project demonstration
14.	Replacement

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Do the project work and minimum50% in the written test**

Assessment schedule	
Education week	Topic
12	Written and computer test

13	Project demonstration

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
mean of written test and the homework Written test 0-50 percent: 1; 51-70 percent: 2; 71-80 percent: 3; 81-90 percent: 4; 91-100 percent: 5.
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	**Written test**

Type of the exam (to be filled out only for subjects with exams)
Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:

References	
Obligatory:	Michael Fazio: Kotlin and Android Development featuring Jetpack: Build Better, Safer Android Apps ISBN-13: 978-1680508154
Recommended:	John Horton: Android Programming for Beginners
Other references:	e-learning materials in Moodle

			Semester 3. of the curriculum			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Software Tools of Game Development	ATXSTGEMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Vakulya Gergely			Classification: associate professor			
Subject lecturer(s): Éva Hajnal, Gaye Ediboglu Bartos						
Prerequisites:	-					
Way of the assessment:	exam					

Course description	
Goal:	The goal is to study the basics of game development. Computer graphics and its mathematical background, game types and their features
Course description:	Game types. Image types, image creation. Main features the object-oriented model of a game engine. Unity, Ogre3D, XNA examples Coordinates. Coordinate transformations. Homogenous coordinates. Viewing. Types of projections. Perspective. Depth of field and its software simulation. The graphics card, graphics pipeline, DirectX. Resources. Memory handling. Programming of shaders with HLSL. Projection of the movements. Visualization of an environment. Water surface and terrain. Shades. Calculation of physics. Rigid bodies. Collision and collision detection. Particle systems and nets. Physical animations. Data structures in graphics engines. Surface, texture. Light effects. Global illumination Ray tracing. Animation

Lecture schedule	
Education week	Topic
1.	Basic concepts.Game types.
2.	Image types, image creation. Main features the object-oriented model of a game engine. Unity, Ogre3D, XNA examples Graphics. Main elements.
3.	Coordinates. Coordinate transformations. Homogenous coordinates.
4.	Viewing. Types of projections. Perspective. Depth of field and its software simulation.
5.	The graphics card, graphics pipeline, DirectX. Resources. Memory handling.
6.	Programming of shaders with HLSL. Projection of the movements. Visualization of an environment. Water surface and terrain. Shades. Calculation of physics. Rigid bodies. Collision and collision detection. Particle systems and nets Physical animations
7.	Data structures in graphics engines
8.	Surface, texture
9.	Light effects. Global illumination
10.	Ray tracing
11.	Animation
12.	HDRI Case study. FPS game development. Test
13.	Project demonstration

14.	Project demonstartion
Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**participate in the labs** **successful project**
Assessment schedule	
Education week	Topic
13	project demonstration
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**resubmission of the project**
Type of the exam (to be filled out only for subjects with exams)	
oral exam	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
Mean of the exam mark and the project mark	
References	
Obligatory:	Steve Marschner: Fundamentals of Computer Graphics ISBN: 13:978-1-4822-2941-7
Recommended:	Alan Thorn: Game Development Principles ISBN 10 : 9781285427065 ISBN 13 : 1285427068
Other references:	Presentations shared in the Moodle system

			Semester 4. of the curriculum			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Multiplatform Graphical Applications	ATXMGREMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Vakulya Gergely			Classification: associate professor			
Subject lecturer(s): Éva Hajnal PhD, Gaye Ediboglu Bartos						
Prerequisites:	-					
Way of the assessment:	mid-term mark					

Course description	
Goal:	Usage and software solutions for modern peripherals (Kinect sensor, leap motion etc.). Virtual reality, augmented and extended reality software development. Immersion systems and the role of the immersion
Course description:	Usage and software solutions for modern peripherals (Kinect sensor, leap motion etc.). Virtual reality, augmented and extended reality. Immersion systems and the role of the immersion. Reality. Rendering in VR. Graphics and visualization. Audio- and haptic representation. Homogeneous transformations. Interactions with virtual world. Manipulation, Navigation. Collaborations. Physical modeling. Collision detection. Deformations. Calculations of forces. Connection between virtual and real physics. Extended reality systems. Information layer. Pasting virtual elements into the reality and real elements into the virtual reality. Image based modelling, 3D reconstruction. VR standards. Network, internet solutions. Human factor. Health problems. VR sickness. Good practices

Lecture schedule	
Education week	Topic
1.	Virtual reality and extended reality. Immersion systems and the role of the immersion.
2.	Rendering in VR. Graphics and visualization.
3.	Audio- and haptic representation
4.	Interactions with virtual world. Manipulation, Navigation. Collaborations
5.	Physical modeling. Collision detection. Deformations. Calculations of forces. Connection between virtual and real physics.
6.	Extended reality systems. Information layer.
7.	Pasting virtual elements into the reality and real elements into the virtual reality. Image based modelling, 3D reconstruction
8.	VR standards. Network, internet solutions.
9.	Human factor. Health problems. VR sickness.
10.	Good practices.
11.	Test
12.	Project
13.	Project demonstration

14.	Project demonstration
Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	
Assessment schedule	
Education week	Topic
11	Written test
13	Project demonstration
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
mean of written test and the project Written test 0-50 percent: 1; 51-70 percent: 2; 71-80 percent: 3; 81-90 percent: 4; 91-100 percent: 5.	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**writtem test. project resumission**
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	Alan Thorn: Game Development Principles ISBN 10 : 9781285427065 ISBN 13 : 1285427068
Recommended:	Penny de Byl: Holistic Game Development With Unity ISBN 10 : 9781317497233 ISBN 13 : 1317497236
Other references:	Presentations shared in Moodle system

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			Semester 4. of the curriculum			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mobile Applications II.	ATXMA2EMNF	4	full-time	1	0	2
Responsible person for the subject: Nagyné Dr. Hajnal Éva			Classification: associate professor			
Subject lecturer(s): Márton Huszics						
Prerequisites:	-					
Way of the assessment:	mid-term mark					

Course description	
Goal:	Students learn about mobile application development in the iOS environment, and learn how to program the IOS operating system and its graphic interface.
Course description:	TheyStudents get to know the basic principles of IOS programming, programming different sensors and optimize and publish the code of mobile applications. They get acquainted with iOS-based data storage and data management, and the file management. Students gain insight into web application development

Lecture schedule	
Education week	Topic
1.	Native Android development
2.	IOS Lifecycle and its programming
3.	IOS UI
4.	Sensors
5.	Map
6.	Data-base operations, CRUD
7.	Data-base operations, CRUD
8.	Cross-platform development
9.	Project
10.	Project
11.	Optimization, Apple Store
12.	Test (paper and computer)
13.	Project demonstration
14.	Replacement

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Do the project work and minimum50% in the written test**

Assessment schedule	
Education week	Topic
12	Written and computer test
13	Project demonstration

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
mean of written test and the homework Written test 0-50 percent: 1; 51-70 percent: 2; 71-80 percent: 3; 81-90 percent: 4; 91-100 percent: 5.	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**written test**
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	The Swift Programming Language (Apple Book) https://docs.swift.org/swift-book/
Recommended:	Jon Hoffman: Mastering Swift 5.3 - Sixth Edition ISBN: 9781800562158
Other references:	Feipeng Liu: Android Native Development Kit Cookbook ISBN: 9781849691505 Semmy Purewal: Learning Web App Development ISBN: 9781449370190

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			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
GIS programming	AGXGIPGMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Nagy Gábor József			Classification: senior lecturer			
Subject lecturer(s): Dr. Nagy Gábor József						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	Acquisition of geoinformatics programming skills. Getting to know the algorithms behind spatial analyses.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	Basics of the Python programming language
2.	Object-oriented programming in Python
3.	Python Programming Exercises (Reserve)
4.	Simple spatial tasks
5.	Commonly used modules (NumPy, GDAL, OGR)
6.	A brief overview of QGIS
7.	Simple spatial (database) queries in QGIS (SF-SQL)
8.	Complex spatial (database) queries in QGIS (SF-SQL)
9.	Python programming options within QGIS
10.	Easier programming tasks in QGIS
11.	QGIS module development in Python
12.	Practice
13.	Practical report and written test
14.	Replacements (reserve)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	• Completion of at least 50 percent of the practical report and written test • Completing all assigned tasks at an acceptable level and solving the self-tests with a specified score by the appointed time in the last week of the diligence period at the latest

Assessment schedule	
Education week	Topic
13	From the material of the topics delivered during the semester.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The written test and the practical report can be replaced or corrected once (at a separately announced time, or if there is a class every 14 weeks, then in the last week). How to replace the signature: As part of the signature replacement exam, there is an additional opportunity for the replacement, and applicants are also given a reprieve for mid-semester assignments and self-tests until the date of the signature replacement exam.
Type of the exam (to be filled out only for subjects with exams)	
oral and practical	
Calculation of the exam mark (to be filled only for subjects with exams)	
The average of the exam and midterm score.	
Final grade calculation methods:	
2: from 50%, 3: from 60%, 4: from 70%, 5: from 85%	
References	
Obligatory:	Iványi A. (ed.): Algorithms of Informatics. Vol. 1. Foundations. 2007. mondAT Kiadó. ISBN 13: 9789638759610 Iványi A. (ed.): Algorithms of Informatics. Vol. 2. Applications. 2007. mondAT Kiado. ISBN 13: 9789638759627 Iványi A. (ed.): Algorithms of Informatics. Vol. 3. Selected topics 2013. Mondat Kft.
Recommended:	Peter Wentworth, Jeffrey Elkner,Allen B. Downey and Chris Meyers: How to Think Like a Computer Scientist, Learning with Python 3 (RLE) https://buildmedia.readthedocs.org/media/pdf/howtothink/latest/howtothink.pdf
Other references:	Other educational materials published on the educational portal

			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Spatial data collection	AGXTADGMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. Tóth Zoltán			Classification: associate professor			
Subject lecturer(s): László Gergely Tibor, Dr. Tóth Zoltán						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The goal of the subject is to introduce students with the theory of spatial data collection techniques and to execute the practical application of the learned geodetic measurement techniques in real conditions. The main topics of the subject are: traditional horizontal and vertical data collection methods, spatial data collection with GNSS technology, laser scanners (with point-cloud processing) and mobile mapping systems (and its historical overview, system components: scanner, camera, GNSS, INS), data integration and data conversion for GIS systems. The documentation of the performed measurements and processing consists of technical descriptions and the calculation and drawing parts.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	Horizontal data collection procedures 1.
2.	Horizontal data collection procedures 2.
3.	Altitude data acquisition technologies 1.
4.	Altitude data acquisition technologies 2.
5.	Terrestrial static laser scanning
6.	Ground Mobile Laser Scanning SLAM Algorithms
7.	Aerial laser scanning and its engineering applications
8.	1st written test
9.	Point cloud production based on image matching
10.	GNSS technology in engineering practice
11.	INS measurements
12.	Camera calibration
13.	Determination of sensor eccentricity
14.	2nd written test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Conditions for obtaining the signature: writing two essays on two complex project tasks during the semester. Completion of two mid-semester written tests.

Assessment schedule	
Education week	Topic
8	Horizontal and elevation data collection procedures. Terrestrial static, mobile and aerial laser scanning.
14	GNSS, INS technology. Point cloud generation based on image matching. Camera calibration and determination of sensor eccentricity.
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
There is a written assessment twice, where a performance of at least 50% must be achieved. It is possible to replace an unsuccessful exam - outside of teaching time - once. The written test questions include the previous theoretical material and the knowledge acquired in the exercises related to the topic. Two complex measurement and processing project tasks must be completed. The mid-term mark is the average of the two written tests and the two assignments. The percentage points for each grade are: 2: from 60%, 3: from 70%, 4: from 80%, 5: from 90%.	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In case of absence, the exercises must be replaced at an agreed time. In case of justified absence, the exercises can be replaced free of charge, in the case of unjustified absence, a special procedure fee is charged. Written tests can be replaced once. The signature can be replaced once, in the first ten days of the exam period.
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	John Walker, Joseph Awange: Surveying for Civil and Mine Engineers, 2020. (ISBN 978-3-030-45803-4)
Recommended:	Alojz Kopáčik Ján Erdélyi Peter Kyrinovič (2020): Engineering Surveys for Industry, ISBN 978-3-030-48308-1 ISBN 978-3-030-48309-8 (eBook) https://doi.org/10.1007/978-3-030-48309-8
Other references:	ppt materials of lectures

			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Application of UAV technology	AGXUAVGMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. habil. Jancsó Tamás			Classification: associate professor			
Subject lecturer(s): Dr. habil. Jancsó Tamás						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to acquaint students with the data collection methods and requirements of UAV technology. It deals with the possibilities of automated data collection of UAV technology, data integration into geoinformatics systems. It covers state-of-the-art sensors, software that supports flight mission plans and evaluation. It discusses in detail image processing, adjustment, error filtering methods and algorithms that support automated data acquisition. It introduces cloud-based services related to UAV technology and the end products that can be produced. We present the entire technological process through complex, project-based practical examples. Through application examples, state-of-the-art technologies for products and evaluation methods that can be produced with UAV technology are presented in a project-oriented way, primarily from a practical point of view.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	AUV platforms and their areas of application
2.	UAV sensors, camera calibration, properties of digital images
3.	Creating a flight plan, establishing and measuring alignment points
4.	Legal background, execution of flights
5.	Evaluation supporting software
6.	Automated image processing procedures - preprocessing
7.	Automated image processing procedures - image matching
8.	1st written test
9.	Block triangulation, accuracy testing
10.	Producible final products, cloud services - orthophoto, orthophoto mosaics
11.	Producible final products, cloud services - DDM/DFM, volume calculation
12.	Final products that can be produced - linear evaluation, mapping
13.	Final products that can be produced - basics of image classification
14.	2nd written test
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Conditions for obtaining the signature: writing two essays on two complex project tasks during the semester. Completion of two mid-semester written tests.

Assessment schedule

Education week	Topic
8	UAV platforms, areas of application, flight plan, evaluation software, legal background, automated image processing procedures.
14	Block triangulation, cloud services, final products that can be produced.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	In case of absence, the exercises must be replaced at an agreed time. In case of justified absence, the exercises can be replaced free of charge, in the case of unjustified absence, a special procedure fee is charged. Written tests can be replaced once. The signature can be replaced once, in the first ten days of the exam period.

Type of the exam (to be filled out only for subjects with exams)

The written and oral exam consists of two parts. In the first part, students have to answer three questions (drawn from predefined items) in writing. In the second part, the written answers must be presented orally.

Calculation of the exam mark (to be filled only for subjects with exams)

There are two written tests, where a performance of at least 50% must be achieved. It is possible to replace an unsuccessful test - outside of teaching time - once. The written test questions include the previous theoretical material and the knowledge acquired in the exercises related to the topic. An essay has to be prepared on two complex tasks, for which a grade will be assigned. Condition of the offered mark: two written tests. In addition, the average calculated from the average of written tests and the average of the marks received for complex assignments is at least 4.0, as well as active attendance of lectures (number of absences at most 2). The recommended grade is 4 if the average is between 4.0-4.5, 5 if the average is above 4.5. The exam mark is determined 50% by the performance of the mid-term assignments and 50% by the exam performance.

Final grade calculation methods:

The exam mark is determined 50% by the performance of the mid-term assignments and 50% by the exam performance. Each part must be at least sufficient. Percentage limits for each grade: 2: from 50%, 3: from 60%, 4: from 70%, 5: from 85%

References

Obligatory:	David R. Green, Billy J. Gregory, Alexander Karachok: Unmanned Aerial Remote Sensing: UAS for Environmental Applications, Taylor & Francis (2020), 363 p., ISBN-13: 978-1482246070 Amy E. Frazier, Kunwar K. Singh (eds.): Fundamentals of Capturing and Processing Drone Imagery and Data,Taylor & Francis (2021), 361 p., ISBN13 (EAN): 9780367245726
Recommended:	James S. Aber, Irene Marzolff, Johannes Ries, Susan Elizabeth Ward Aber: Small-Format Aerial Photography and UAS Imagery: Principles, Techniques and Geoscience Applications 2nd Edition, Elsevier (2019), 394 p., ISBN-13: 978-0128129425

Other references:	ppt presentations of lectures

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			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Remote sensing	AGXTAVGMNF	4	full-time	2	0	2
Responsible person for the subject: Verőné Dr. Wojtaszek Malgorzata			Classification: associate professor			
Subject lecturer(s): Verőné Dr. Wojtaszek Malgorzata						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of teaching the subject is for the student to become familiar with remote sensing as the physical principles of modern data acquisition and data acquisition technologies, with particular regard to resource research and environment monitoring satellite systems. The student gets to know the theoretical background of digital image processing, the methods of data evaluation, the software and algorithms required for this.
Course description:	The subject deals with the integration of data from multiple sources and the possibilities of practical application, e.g. in land cover mapping, agriculture, environmental protection. In accordance with the nature of the course (75% practice), in addition to the practical knowledge of digital image processing, the entire process of the task based on remote sensing is explained to the students in the form of several case studies, from data acquisition to the production of thematic information and incorporation into decision-making. The mini-project prepared on the selected topic provides an opportunity for the practical application of technology, critical analysis, and independent decisions with the awareness of responsibility.

Lecture schedule	
Education week	Topic
1.	Basic concepts of remote sensing. The physical foundations of remote sensing: energy sources, the effect of the atmosphere on remote sensing. Reflectance and spectral properties of main land covers.
2.	Recording systems, data collection tools and methods: photographic type systems, scanning systems. Copernicus program. Satellite data search options, databases.
3.	Basics of optical satellite image processing. Preprocessing of remotely sensed data and its methods in theory and practice. Description of software background.
4.	Written test, report
5.	Thematic classification: basic and advanced methods in theory and practice
6.	The role of segmentation in image processing
7.	Methods of segment-based classification. Software specific solutions, algorithms.
8.	Examination of the accuracy of the thematic classification, issues of uncertainty.
9.	Written test, report
10.	Main application areas of remote sensing

11.	Mini-project: topic selection, data sources, methods
12.	Mini-project: independent work in the presence of the instructor
13.	Mini-project: presentation of results, conclusions, opportunities for further development
14.	Replacement option

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	2 written tests about theory, development of two independent tasks, creation of a mini-project

Assessment schedule	
Education week	Topic
4	Physical foundations of remote sensing, satellite data bases
10	Digital image analysis

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The written tests and practical reports can be replaced or corrected once (at a separately announced time or in the last week). Replacement of the signature: In the framework of the signature replacement exam, an additional replacement option is available.

Type of the exam (to be filled out only for subjects with exams)

Oral exam: one item consists of three questions. The questions refer to the following topics: a) physical foundations of remote sensing, b) image processing, c) application of remote sensing.

Calculation of the exam mark (to be filled only for subjects with exams)

The average of the answer given in the oral exam, the written ZH, reports and min-project (40%-30%-30%).

Final grade calculation methods:

≥ 90%:5, 90-80%: 4, 80-70%: 3, 70-60: 2, < 60%: 1

References	
Obligatory:	Lillesand T. M. et al. (2007): Remote sensing and image interpretation, John Wiley & Sons, Inc. ISBN 978-0-470-05245-7 Blaschke T., Lang S., Hay G. J.: Object-Based Image Analysis, Springer, 2008, ISBN: 978-3-540-77057-2 Verőné Wojtaszek M. et all (2020): IRSEL (Innovation on Remote Sensing Education and Learning) some modules of electronic Learning Materials. The LM will be available from November 2020 on the website of ÓE AMK. It was developed within the framework of the ERASMUS + international project
Recommended:	Pratt W.K.: Introduction to Digital Image Processing, CRC Press, 2014, ISBN: 978-1-4822-1669-1
Other references:	eCognition tutorial: https://openjicareport.jica.go.jp/pdf/12150314_03.pdf presentations (Moodle system)

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			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Geovisualization	AGXVIZGMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. habil. Pődör Andrea			Classification: associate professor			
Subject lecturer(s): Dr. habil. Pődör Andrea						
Prerequisites:	AGXTADGMNF	Spatial data collection				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to introduce the students to the concept of geovisualization with its practical applications, to understand the definition of geovisualization, to be able to distinguish the different methods of geovisualization. Identify the characteristics of the geovisualization process and relate these characteristics to today's cartographic systems and map use. Learn about the relevant abilities and skills that are necessary to work successfully in your geovisualization environment. Use a geovisualization application to interpret a geographic data. During the studies, the students use possible tools that enable them to explore the information behind the data by using the data in parallel with different visualization methods. Students get to know the methods and application areas of scientific visualization. They learn the technological procedures used in scientific visualization. Within the framework of the subject, students interpret the theoretical material through practical examples using the built-in modules of specific commercial (e.g. ArcGIS, Tableau) and open source (R) software. Creation of geovisualization to present the data of a specific sample area. Comparison of geovisualization procedures available in different software.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	Concept of geovisualization, examples of applications
2.	Information visualization: Examples and types
3.	Information visualization: Tools and techniques
4.	Information visualization and visual data mining
5.	Dendrogram: Definition, Example and Analysis
6.	Hierarchical clustering
7.	Agglomerative hierarchical clustering
8.	Classifying hierarchical clustering
9.	Multidimensional scaling in data analysis
10.	Multivariate Mapping
11.	Visualizing uncertainty
12.	3D visualization
13.	Project task
14.	Submission of project assignment, report

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The student must carry out project work in a sample area, the end result of which is a geovisualized display. Submission of successful project work: 2: from 50%, 3: from 60%, 4: from 70%, 5: from 85%

Assessment schedule	
Education week	Topic
8	Infovisualization tools
14	Special cases of geovisualization

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In case of absence, the exercises must be replaced at an agreed time. In case of justified absence, the exercises can be replaced free of charge, in the case of unjustified absence, a special procedure fee is charged. Written tests can be replaced once. The signature can be replaced once, in the first ten days of the exam period.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References	
Obligatory:	Dykes, J., MacEachren, A. M., & Kraak, M. J., (Eds.), (2004). Exploring geovisualization. Amsterdam: Elsevier. ISBN (Print)9780080445311 Dodge, M., McDerby, M., & Turner, M. (Eds.). (2011). Geographic visualization: Concepts, tools and applications. John Wiley & Sons. ISBN: 978-0-470-51511-2 Slocum, T. A., McMaster, R. B., Kessler, F. C., & Howard, H. H. (2009). Thematic cartography and geovisualization ISBN: 9781292055442, 1292055448
Recommended:	Smith, M. J., Hillier, J. K., Otto, J. C., & Geilhausen, M. (2013). Geovisualization. In Treatise on Geomorphology (Vol. 3, pp. 299-325). Elsevier Inc.. https://doi.org/10.1016/B978-0-12-374739-6.00054-3
Other references:	ppt presentations of lectures

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
GIS project management	AGXGISGMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. habil. Pődör Andrea			Classification:			
Subject lecturer(s): László Gergely Tibor						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course starts with an overview of the basic concepts of GIS management. Within this, we discuss the importance of the environment: internal, company-specific and external environment. Students get to know the concept of GIS project management as a profession-specific branch of management, from project planning to project marketing and monitoring of the completed project. During the semester, we go through the implementation process of a GIS: from project idea to commissioning. This includes the assessment of user needs, planning based on information needs, and its work parts. The most important element of the subject and the projects is the logical framework matrix, which can be used in sufficient detail to derive the entire project documentation, and the Gantt chart of the project is also created based on this. We delve into data and IT management and deal in detail with the profitability aspects of the project based on cost and benefit analysis. Quality assurance. Change management. The place, role and effects of GIS in the organization. Development trends.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	About geospatial applications in general, social and economic applications
2.	Grouping of geospatial applications
3.	Characteristics of modern geospatial applications
4.	Land Information Systems (LIS)
5.	1st written test
6.	Utility geospatial information systems
7.	Municipal geospatial applications
8.	Traffic information systems
9.	The situation of local government GIS in Hungary
10.	2nd written test
11.	International outlook
12.	Consultation
13.	Consultation
14.	Replacements
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Completion of two written tests at least on a sufficient level, continuous presentation of project tasks according to the schedule.

Assessment schedule

Education week	Topic
5	Themes of the first 4 weeks
10	Themes of the week 6-9

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

At least a sufficient grade of written tests, and an accepted project assignment.

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Written tests can be replaced once in the last week at the end of the semester. Incorrect project assignments must be replaced on the following week. After 14 days of late submission, the student cannot receive a signature.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References

Obligatory:	Peter L. Croswell, PMP, GISP, CMS: The GIS Management Handbook - Second Edition 2019, ISBN13: 978-0-9824093-1-2
Recommended:	David A. Holdstock: Strategic GIS planning and management in local government, CRC Press, 2017, 260 pp., ISBN 10: 146655651X
Other references:	Materials uploaded to the educational portal

ÓBUDA UNIVERSITY
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Dean's Office			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Thesis work I.	NDDDM1EMNF	8	full-time	0	0	0
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Dean's Office			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Thesis work II.	NDDDM2EMNF	10	full-time	0	0	0
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NDDDM1EMNF	Thesis work I.				
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Dean's Office			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Thesis work III.	NDDDM3EMNF	12	full-time	0	0	0
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NDDDM2EMNF	Thesis work II.				
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
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Dean's Office			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mentoring		0	full-time	0	1	0
Responsible person for the subject: Dr. VAJDA István			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	signature					

Course description	
Goal:	Students get acquainted with the structure and life of the university, and they can manage issues occurring during their studies.
Course description:	Documents regulating students life (e.g. Study And Examination Regulations Of Óbuda University), types of stipends and other allowances, fees, students administrative commitments, the student government. Curriculum, the net of subjects, sample curriculum, prerequisites, criteria, distance training courses, KMOOC. Ways of assessments, midterm tests, exams, how to register for an exam, midterm grade. Special professional modules. Degree project, thesis. Available services in the university, open lab, library, psychologist, Students' Public Centres. The Neptun, Moodle and Teams systems. Cooperative studies. Erasmus, TDK conferences, working as a demonstrator. Community programmes.

Lecture schedule	
Education week	Topic
1.	Voting for students leaders. The university, faculties, buildings, classrooms.
2.	Studying system of a university, lectures, practical lessons, labs. Ways of assessment (signature, midterm grade, midterm tests, exams, homework, projects.)
3.	The net of subjects (prerequisites). Types of stipends, how to calculate the study stipend. Hungarian state (partial) stipend, state supported, subject to tuition fee payment Rules of reclassification.
4.	Methods of efficient learning.
5.	Special professional modules. Distance training courses, K-MOOC. Degree project, thesis..
6.	Library services. Directory databases.
7.	Students' Public Centres and their services. Services of the university psychologists.
8.	Making plans for the future studies, based on the experiences of the first midterm tests.
9.	TDK conferences. How to become a demonstrator?
10.	Cooperative studies.
11.	The Erasmus system.
12.	Plan for the exam period. How to register for an exam. Exam fees.
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students have to visit the lessons regularly. Absence can not be higher as 30% of the lessons.

Assessment schedule	
Education week	Topic
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	Document uploaded into the MOODLE system.

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Cloud computing systems	NKVCC1EMNF	4	full-time	2	0	2
Responsible person for the subject: Dr. habil. LOVAS Róbert			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The course focuses on the system-level theory, design issues and key practical implementations of cloud computing as middleware at an advanced level, focusing on open source practices (OpenStack) and infrastructure services (IaaS). Students will learn about the theoretical background and practical application of modern infrastructure building tools using different Infrastructure-as-Code tools. Furthermore, software container based (Docker) tools will be introduced, with a focus on their distributed deployment using some cluster building tools (Docker Swarm, Kubernetes). Finally, the design and development of platform services for various Big Data and IoT domains using these tools will be presented through a case study.
Course description:	The course provides a short overview on theoretical and practical knowledge concerning public, private, and hybrid clouds from the aspects of users, system engineers, and operators. The students get acquainted with the types of services (IaaS/PaaS/Saas) offered by clouds, and the main characteristics of their implementations, as well as their typical solutions. Some selected components of cloud, as a middleware, are discussed in details; starting from the block and object stores (e.g. Cinder/Swift), through the components responsible for the authentication (e.g. Keystone), ending with the telemetry and orchestration tools (e.g. Ceilometer/Heat). In the field of platform services, the students get a short overview on the cloud based deployments and use cases of Big Data tools.

Lecture schedule	
Education week	Topic
1.	Introduction
2.	OpenStack: Basics
3.	OpenStack: Keystone, Glance
4.	OpenStack: Nova, Neutron
5.	OpenStack: Cinder, Swift
6.	OpenStack: Heat, Ceilometer
7.	Docker: Container technology
8.	Distributed container platform (Docker Swarm, Kubernetes)
9.	Cloud orchestration tools (Terraform)
10.	AWS: EC2 (IaaS)
11.	AWS: S3
12.	MS Azure (PaaS)
13.	Midterm test
14.	Midterm test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Passing at least 51% of the midterm test Complition of the project work

Assessment schedule	
Education week	Topic
13	Midterm test
14	Replacement occasion of the midterm test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The final grade is determined by the midterm test

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In week 14, the midterm test can be replaced or retake. A minimum of 51% must be achieved to pass the subject.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:
0% - 50%: fail (1) 51% - 62%: pass (2) 63% - 75%: satisfactory (3) 76% - 88%: good (4) 89% - 100%: excellent (5)

References	
Obligatory:	T. Fifield et al., OpenStack operations guide, First edition. Sebastopol, CA: O'Reilly Media, Inc., 2014, ISBN: 978-1-4919-0630-9 M. Dorn, Preparing for the Certified OpenStack Administrator exam: a complete guide for test takers. Birmingham, UK: Packt Publishing, 2017, ISBN: 978-1-78712-120-1 Y. Brikman, Terraform: up and running: writing infrastructure as code, Third edition. Sebastopol, CA: O'Reilly, 2022, ISBN: 978-1-09-811674-3
Recommended:	
Other references:	The slides and material used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Biomatics and Applied Artificial Intelligence Institute			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Digital Quantitative microscopy	NBVDQ1EMNF	4	full-time	2	0	0
Responsible person for the subject: Prof. Dr. KOZLOVSZKY Miklós			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
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Biomatics and Applied Artificial Intelligence Institute			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Product Development of Medical Equipment	NBVPD1EMNF	4	full-time	2	0	0
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
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			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Recent Advances in Intelligent Systems	NBVRA1EMNF	4	full-time	4	0	0
Responsible person for the subject: Prof. Dr. KOVÁCS Levente			Classification: professor			
Subject lecturer(s):						
Prerequisites:	-					
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	Outstanding lectures by internationally renowned experts on his subjects, which will take place at a later date. Students can find out about this through the Neptun system in the letter sent during the registration week. The dates of the program can also be found on the website http://conf.uni-obuda.hu.

Lecture schedule	
Education week	Topic
1.	Mini-symposium lectures
2.	Mini-symposium lectures
3.	University Day Lectures
4.	
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14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The course ends with a mid-term ticket. To obtain this, you must: - MANDATORY attendance at declared international symposia, - preparation of a 10-minute narrated PPT lecture related to one of the lectures.

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Due to the presence of internationally listed speakers, it is not possible to make up for missed performances.

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

References

Obligatory:	
Recommended:	
Other references:	

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			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
GIS project management	AGXGISGMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. habil. Pődör Andrea			Classification:			
Subject lecturer(s): László Gergely Tibor						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course starts with an overview of the basic concepts of GIS management. Within this, we discuss the importance of the environment: internal, company-specific and external environment. Students get to know the concept of GIS project management as a profession-specific branch of management, from project planning to project marketing and monitoring of the completed project. During the semester, we go through the implementation process of a GIS: from project idea to commissioning. This includes the assessment of user needs, planning based on information needs, and its work parts. The most important element of the subject and the projects is the logical framework matrix, which can be used in sufficient detail to derive the entire project documentation, and the Gantt chart of the project is also created based on this. We delve into data and IT management and deal in detail with the profitability aspects of the project based on cost and benefit analysis. Quality assurance. Change management. The place, role and effects of GIS in the organization. Development trends.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	About geospatial applications in general, social and economic applications
2.	Grouping of geospatial applications
3.	Characteristics of modern geospatial applications
4.	Land Information Systems (LIS)
5.	1st written test
6.	Utility geospatial information systems
7.	Municipal geospatial applications
8.	Traffic information systems
9.	The situation of local government GIS in Hungary
10.	2nd written test
11.	International outlook
12.	Consultation
13.	Consultation
14.	Replacements
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Completion of two written tests at least on a sufficient level, continuous presentation of project tasks according to the schedule.

Assessment schedule

Education week	Topic
5	Themes of the first 4 weeks
10	Themes of the week 6-9

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

At least a sufficient grade of written tests, and an accepted project assignment.

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Written tests can be replaced once in the last week at the end of the semester. Incorrect project assignments must be replaced on the following week. After 14 days of late submission, the student cannot receive a signature.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References

Obligatory:	Peter L. Croswell, PMP, GISP, CMS: The GIS Management Handbook - Second Edition 2019, ISBN13: 978-0-9824093-1-2
Recommended:	David A. Holdstock: Strategic GIS planning and management in local government, CRC Press, 2017, 260 pp., ISBN 10: 146655651X
Other references:	Materials uploaded to the educational portal

ÓBUDA UNIVERSITY
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			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Urban Analytics	AGVVTIGMNF	4	full-time	1	0	2
Responsible person for the subject: Dr. habil. Pődör Andrea			Classification:			
Subject lecturer(s): Dr. habil. Pődör Andrea						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to introduce students to the research area of urban GIS. Cities and urbanization are playing an ever-increasing role in the life of humanity, so special GIS solutions related to this are important for the preparation of students. In order to get to know the cities better, the interpretation of new data sets required in the given area, the use of various statistical and IT skills for the proper processing of the data. The student gets a comprehensive knowledge of the special areas of urban GIS. They become familiar with sensor networks and the processing and analysis of the data obtained from them. Complex geospatial analyzes include data integration and other spatial data: appropriate integration and interpretation of weather and population data. Students plan and implement procedures related to community data collection (crowdsourcing, VGI). They examine the quality and reliability of the data obtained in this way, compare it with official data, and analyze the possibilities of data integration. The students' task is to integrate official data for a sample area and data obtained through community data collection and analyze them using the most accepted methods of spatial statistics. The built-in modules of specific commercial (e.g. ArcGIS) and open source (GeoDA, R,) software are used in the course.
Course description:	As specified in the semester lecture schedule.

Lecture schedule	
Education week	Topic
1.	The problem of urbanization
2.	City big data, city data available for free
3.	Traditional city data - statistical data
4.	Static and real-time data
5.	Typical display procedures and platforms
6.	Most frequently installed sensors in the city
7.	Active and passive data collection, the possibility of crowdsourcing in cities
8.	Planning urban data collection
9.	Execution of data collection, processing
10.	Examination of the reliability and accuracy of data collection
11.	Data analysis - special indexes
12.	Display data
13.	Models (ESDA)
14.	Submission of project assignment, report

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Conditions for obtaining the signature: completion of two mid-semester written tests during the semester.

Assessment schedule	
Education week	Topic
8	City data.
14	Modeling urban processes.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The student must carry out project work in a specific area of an urbanized area, which includes the work parts of data collection, processing, analysis, and visualization. Submission of successful project work: 2: from 50%,3: from 60%, 4: from 70%, 5: from 85%.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In case of absence, the exercises must be replaced at an agreed time. In case of justified absence, the exercises can be replaced free of charge, in the case of unjustified absence, a special procedure fee is charged. Written tests can be replaced once. The signature can be replaced once, in the first ten days of the exam period.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References	
Obligatory:	Singleton, Alex, Spielman, Seth E., Folch, David C. 2018. Urban Analytics. Thousand Oaks, CA: SAGE Publications Ltd. ISBN-10: 1473958636
Recommended:	Ripley, B.D., 1981. Spatial statistics. John Wiley & Sons, New York. ISBN: 978-0-471-69116-7 Greene, R. P., & Pick, J. B. (2012). Exploring the urban community: A GIS approach. Prentice Hall. ISBN-10: 0321751590 Biljecki, F., & Ito, K. (2021). Street view imagery in urban analytics and GIS: A review. Landscape and Urban Planning, 215, 104217.
Other references:	ppt presentations of lectures