Cyber-physical Systems Institute			Semester 5 of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Cloud Computing Services I	NIXFS1CBNE	3	full-time	2	0	0
Responsible person for the subject: Róbert Lovas Ph.D. habil			Classification: associate professor			
Subject lecturer(s): Attila Csaba Marosi Ph.D.						
Prerequisites:	NIXVT1FBNE	Virtualised storage systems				
Way of the assessment:	Midterm grade					

Course description	
Goal:	The course aims to introduce the operation, architecture, and service models (IaaS/PaaS/SaaS) of cloud computing systems, as well as to acquire the basic theoretical and practical knowledge of public, private, and hybrid cloud platforms from both the user and operator perspectives. Students will learn about container-based technologies and their orchestration solutions, as well as distributed databases and design patterns related to modern cloud-based architectures (e.g., scalability, high availability, data processing, and observability). Based primarily on open-source solutions, the creation and operation of a private cloud providing infrastructure services will also be presented step by step.
Course description:	Building, operation, and general use of the OpenNebula private cloud solution. Cloud orchestration, management of different cloud objects, applications, and the use of Docker container technology and Docker Swarm cluster. Creating distributed NoSQL databases on a container basis. Getting to know the different service models of cloud computing systems (IaaS/PaaS/SaaS). Presentation of different cloud-based architecture design patterns that show the modern challenges and solutions of scalability, high availability, static and dynamic data management, data processing and event processing, search and analytical systems, as well as observability.

Lecture schedule	
Education week	Topic
1.	Cloud and software models
2.	IaaS: APIs and development tools
3.	PaaS and SaaS: APIs and development tools
4.	OpenNebula: Open-source cloud and Edge computing platform
5.	Design patterns I: Scalability
6.	Design patterns II: High availability
7.	Design patterns III: Static and dynamic data management
8.	Design patterns IV: Databases
9.	Design patterns V: Data processing
10.	Design patterns VI: Event processing
11.	Design patterns VII: Search and analytics
12.	Design patterns VIII: Observability
13.	Midterm test
14.	Retake the midterm test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Midterm test written with at least 50%.

Assessment schedule	
Education week	Topic
13	Midterm
14	Midterm replacement

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

Type of the replacement	
Type of the replacement of the written test/mid-term grade/signature	According to HKR, within one of the first 10 working days of the exam period, the midterm grade can be replaced against a replacement fee.

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

The final grade will be calculated using the following scale:

Achieved result	Grade
87% - 100%	excellent (5)
75%- 86%	good (4)
64% -74%	satisfactory (3)
51% - 63%	pass (2)
0 - 50 %	failed (1)

References	
Obligatory:	Materials published in Moodle. B. A. Sosinsky, Cloud computing bible. Wiley, 2011, ISBN: 978-0-470-90356-8
Recommended:	B. Wilder: Cloud architecture patterns, O'Reilly, 2012, ISBN: 978-1-4493-1977-9 M. Young: Implementing cloud design patterns for AWS: create highly efficient design patterns for scalability, redundancy, and high availability in AWS Cloud. Birmingham, UK: Packt Publishing, 2015, ISBN: 978-1-78217-735-7 A. Mouat, Using docker. Beijing: O'Reilly Media, Inc., 2016, ISBN: 978-1-4919-1592-9 Tyler Akidau, Slava Chernyak, and Reuven Lax. 2018. Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing (1st. ed.). O'Reilly Media, Inc.
Other references:	The materials presented in class will become available on the Moodle page after lectures.