ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Institute of Biomatics and Applied Artificial Intelligence						
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Programming robots in ROS	NBVPR0EBNE	4	full-time	1		2
Responsible person for the subject: Péter GALAMBOS			Classification: Associate professor			
Subject lecturer(s): Tamás NAGY						
Prerequisites:	NIXSF1EBNE	Software Design and Development I.				
Way of the assessment:	Midterm grade					

Course description	
Goal:	The Robot Operating System (ROS) is a platform widely used in research and also in the industry. The students will learn how to develop ROS applications in Python programming language. The aim of the course is to get the students acquainted with ROS 2, and also to give them an opportunity to practice Python.
Course description:	ROS introduction, setting up the development environment. ROS 1 and ROS 2. Implement ROS packages in Python. Basic ROS communication, implementing publishers and subscribers. Principles of robotics, programming a simulated robot in joint and workspace. ROS 2 Launch, ROS 2 Param, ROS 2 Bag. Acquisition and processing of sensory data in ROS. Programming da Vinci surgical robot in simulated environment. Define custom messages. ROS 2 service and action.

Lecture schedule	
Education week	Topic
1.	ROS introduction. Setup the development environment. ROS 1 and ROS 2.
2.	Linux principles. ROS principles. Running examples. ROS package. Basics of ROS communication, implementation of publisher and subscriber.
3.	Python principles. Practicing ROS communication, solving examples.
4.	Versioning, Git. Project labor I.
5.	Principles of robotics. Programming a da Vinci surgical robot in simulated environment I.
6.	Principles of robotics. Programming a da Vinci surgical robot in simulated environment II.
7.	ROS 2 Launch, ROS 2 Param, ROS 2 Bag.
8.	Kinematics, inverse kinematics, programming a simulated robot arm in joint space and workspace I.
9.	Kinematics, inverse kinematics, programming a simulated robot arm in joint space and workspace II.
10.	Kinematics, inverse kinematics, programming a simulated robot arm in joint space and workspace III.
11.	Project labor II.
12.	ROS 2 service and action I.
13.	ROS 2 service and action II.
14.	Project presentations.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Student participation in the lectures and labs is required (min 70%). The project and the classroom test are required to complete during the midterm.**

Assessment schedule	
Education week	Topic

7.	Principles of ROS, publisher, subscriber. Python principles. Principles of robotics.
13.	ROS 2 Launch, ROS 2 Param, ROS 2 Bag. Kinematics, Inverse kinematics.
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
To pass the course, the 2 classroom tests and the project must be passed (grade 2). Final grade = 0.25*test1 + 0.25*test2 + 0.5*project	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**One of the two exams can be retaken in the last week of the semester. In the mid-term replacement session, one ZH or the presentation of the project can be retaken.**
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 lecture and lab. practice materials published on the webpage of the course.**
Recommended:	- Anderson, Brian DO, and John B. Moore. Optimal filtering. Courier Corporation, 2012 - Grewal, Mohinder S., and Angus P. Andrews. Kalman filtering: Theory and Practice with MATLAB. John Wiley & Sons, 2014. - Koubâa, Anis, ed. Robot Operating System (ROS). Cham: Springer, 2017. - ROS 2 tutorial: https://docs.ros.org/en/foxy/Tutorials.html - M. Quigley et al., “ROS: an open-source Robot Operating System,” in Proc. of the ICRA workshop on open source software, Kobe, Japan, 2009, vol. 3.
Other references:	