SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Automation and Computer Science
1.3	Department	Automation
1.4	Field of study	Systems Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/Qualification	Cyber Physical Systems
1.7	Form of education	Full time
1.8	Subject code	7.00

2. Data about the subject

2.1	Subject name				Big Data for Cyber-Physical Systems	
2.2	Course responsible/lecturer				Lecturer dr. eng. Sanislav Teodora – teodora.sanislav@aut.utcluj.ro	
2.3	Teachers in charge of seminars				Lecturer dr. eng. Sanislav Teodora – teodora.sanislav@aut.utcluj.ro	
2.4 Year of study		1	2.5 Semester	2	2.6 Assessment	Exam
2.7 Subject category		Formative category				DS
		Optionality				DI

3. Estimated total time

3.1 Number of hours per week	3	of which	3.2 Course	2	3.3 Seminar	0	3.3 Laboratory	1	3.3 Project	0
3.4 Total hours in the curriculum	42	of which	3.5 Course	28	3.6 Seminar	0	3.6 Laboratory	14	3.6 Project	0

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	20
(b) Supplementary study in the library, online and in the field	10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	20
(d) Tutoring	5
(e) Exams and tests	3
(f) Other activities	0
3.8 Total hours of individual study (summ (3.7(a)…3.7(f)))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	• Concepts of designing, implementation and exploitation of relational and non-relational databases • Programming concepts (SQL, Java, Python)
4.2	Competence	• Concepts of using computers

5. Requirements (where appropriate)

5.1	For the course	Classroom with appropriate equipment to support an ongoing lecture (multimedia equipment).
5.2	For the applications (seminar, laboratory, project)	Laboratory room equipped with computers, network, Internet connection, specialized software.

6. Specific competences

Professional competences	• C1 - Operating with methods, models, techniques and technologies specific to complex IT systems ○ C1.1 – Demonstration of advanced theoretical and practical concepts and principles related to the implementation of complex information systems ○ C1.2 - Using specific theories and tools for explaining the structure and the functioning of complex information systems ○ C1.3 – Building/using of models for various components of complex information systems ○ C1.5 - The foundation of the characteristics of complex information systems, based on modern theoretical and practical trends
Cross competences	N/A

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	Conveying the fundamental knowledge about the concept of Big Data and the understanding of how it can be leveraged in Cyber—Physical Systems
7.2	Specific objectives	Understanding of the characteristics and aspects associated with Big Data Familiarity with tools and platforms supporting Big Data Understanding of Big Data storage models Assimilation of techniques for Big Data analysis

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Introduction to Big Data. Definitions, characteristics. Traditional approach vs Big Data. Applicability in the context of Cyber-Physical Systems (CPSs).	4	Lectures, demos, discussions	N/A
Big Data Platforms. Apache Hadoop ecosystem.	4		
Apache Hadoop tools for Big Data processing and analysis. MapReduce. Apache Pig.	2		
Apache Hadoop tools for Big Data processing and analysis. Apache HIVE. Apache Sqoop.	2		
Apache Hadoop tools for Big Data processing and analysis. Apache HBase.	2		
Big Data platforms. Apache Spark Ecosystem. Resilient Distributed Datasets (RDDs).	4		
Apache Spark libraries. SparkSQL and DataFrames.	2		
Apache Spark libraries. Machine Learning library (MLLib and Spark ML).	2		
Apache Spark libraries. Spark Streaming. GraphX.	2		
Other Big Data Platforms.	2		
Review	2		

Bibliography

1. Big Data Management and Analysis for Cyber Physical Systems, Loon Ching Tang, Hongzhi Wang, Ed. Springer, ISBN: 9783031175473, 2022.
2. NoSQL Databases A Complete Guide - 2020 Edition, Gerardus Blokdyk, Ed. 5STARCooks, ISBN: 978-065-590-933-0, 2021.
3. ***, Apache Hadoop, https://hadoop.apache.org/docs/current/, 2024.
4. ***, Apache Hive, https://hive.apache.org/, 2024
5. ***, Apache Pig, https://pig.apache.org/, 2024

6. ***, Apache HBase, https://hbase.apache.org/, 2024
7. ***, Apache Spark, https://spark.apache.org/docs/latest/, 2024
8. Learning Spark, 2nd Edition, Jules S. Damji, Brooke Wenig, Tathagata Das, Denny Lee, Ed. O'Reilly Media, Inc., ISBN: 9781492050049, 2020.
9. Exploring, Visualizing, and Modeling Big Data with R, Okan Bulut, Christopher Desjardins, 2021, https://okanbulut.github.io/bigdata/.
10. Lectures notes available at https://users.utcluj.ro/~tsanislav/teaching.html#bdcps.

8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
Installation and configuration of Big Data platforms and understanding of the concept	2	Presentation of examples, exercises, description of software programming environments, additional explanations, discussions	N/A
Big Data exemplification using Apache Hadoop - MapReduce, Apache Hive, Apache Pig, Apache HBase	4		
Big Data exemplification using Apache Spark – RDDs, DataFrames, Machine Learning, Streaming	4		
Development of software application for CPSs using Big Data techniques	4		

Bibliography

1. Laboratory materials available at https://users.utcluj.ro/~tsanislav/teaching.html#bdcps.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

With the advancement of IT storage and processing technologies, Big Data has become a normality of our lives. Almost all industries are gearing up for the Big Data challenge by wanting to extract valuable insights from the data they store to address the challenges they face. The course content helps students manage large volumes of data (Big Data) in the context of Cyber-Physical Systems and beyond. The subject content is consistent with what is taught in other universities abroad.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The ability to operate with the assimilated knowledge; The capacity of their application in practice.	Oral exam (project presentation)	100%
10.5 Seminars /Laboratory/Project	The ability to operate with the assimilated knowledge; The capacity of their application in practice.	Regular examinations	A/R

10.6 Minimum standard of performance

- Acquiring the basic elements regarding the Big Data concept in Cyber-Physical Systems
- Solving practical problems using Big Data tools and platforms
- Laboratory: ADMITTED, Exam grade >=5

Date of filling in:		**Title Surname Name**	**Signature**
03.06.2024	Lecturer	Lecturer dr. eng. Sanislav Teodora	
		Lecturer dr. eng. Sanislav Teodora	

Date of approval by the Department of Automation Board ____ . ____ . 2024	Head of Departament of Automation Prof.dr.ing. Honoriu Vălean
Date of approval by the Faculty of Automation and Computer Science Council ____ . ____ . 2024	Dean Prof.dr.ing. Mihaela Dînșoreanu