SYLLABUS

Grid, Cluster and Cloud Computing

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeş Bolyai University
1.2. Faculty	Faculty of Mathematics and Computer Science
1.3. Department	Department of Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Master
1.6. Study programme/Qualification	High Performance Computing and Big Data Analytics
1.7. Form of education	Full-Time

2. Information regarding the discipline

2.1. Name of the discipline			Grid, Cluster and Cloud Computing			Discipline code	**MME8004**
2.2. Course coordinator			PhD. Prof. Adrian Sergiu DARABANT				
2.3. Seminar coordinator			PhD. Prof. Adrian Sergiu DARABANT				
2.4. Year of study	**1**	2.5. Semester	2	2.6. Type of evaluation	**E**	2.7. Discipline regime	**Compulsory**

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**2**	of which: 3.2 course	**2**	3.3 seminar/laboratory/ project	1 sem+ 1 pr
3.4. Total hours in the curriculum	**56**	of which: 3.5 course	**28**	3.6 seminar/laboratory/ project	**28**

Time allotment for individual study (ID) and self-study activities (SA)	**hours**
Learning using manual, course support, bibliography, course notes (SA)	30
Additional documentation (in libraries, on electronic platforms, field documentation)	30
Preparation for seminars/labs, homework, papers, portfolios and essays	30
Tutorship	10
Evaluations	19
Other activities:	-

3.7. Total individual study hours	**119**
3.8. Total hours per semester	**175**
3.9. Number of ECTS credits	**7**

4. Prerequisites (if necessary)

4.1. curriculum	Operating Systems, Computer Networks
4.2. competencies	Average to good knowledge of Java, Python or .NET programming.

5. Conditions (if necessary)

5.1. for the course	Classroom with Internet Connection and Cloud test infrastructure for: Amazon, Microsoft and faculty own private cloud.
5.2. for the seminar /lab activities	Laboratory with Internet connected computers. Possibility to run virtualization solutions

6.1. Specific competencies acquired [1]

Professional/ essential competencies	• use of software tools in an interdisciplinary context • advanced programming skills in high-level programming languages
Transversal competencies	• efficient development of organized activities in an interdisciplinary group and the development of empathetic abilities for interpersonal communications, to relate to and cooperate with various groups • use of efficient methods and techniques to learn, inform, research and develop the abilities to bring value to knowledge, to adapt at the requirements of a dynamical society and to communicate efficiently in Romanian language and in an international language

6.2. Learning outcomes

Knowledge	• The graduate has the necessary knowledge for literature review. • The graduate has knowledge related to programming, mathematics, engineering and technology and has the skills to use them to create complex information technology systems. • The graduate has the necessary knowledge for database design, analysis and administration.
Skills	• The graduate is able to present and explain methods, algorithms, paradigms and techniques used in various branches of computer science. • The graduate is able to define/identify/understand research problems in computer science.
Responsibility and autonomy:	• The graduate has the ability to observe and obtain information from various sources. • The graduate has the ability to understand and communicate information effectively.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Be able to understand and use the theory and basic applications on Grid, Cluster and especially cloud computing.
7.2 Specific objective of the discipline	• Acquire the main skills and abilities to work with scalable systems that allow solving large problems by dividing them in parallel sub problems, or by dividing the input data and process it in parallel bulks. • Acquire the fundamental knowledge that allows parallelizing and solving large and complex problems on scalable systems. • Acquire the necessary knowledge for operating a virtualized cloud platform

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction: definitions, roles, taxonomies	Exposure: description, explanation, examples, discussion of case studies	
2. Distributed Processing versus parallel processing	Exposure: description, explanation, examples, discussion of case studies	
3. Hardware architecture, protocols and cloud/cluster technologies.	Exposure: description, explanation, examples, discussion of case studies	
4. Virtualization technologies.	Exposure: description, explanation, examples, discussion of case studies	

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

5. Concurrent and parallel programming: advantages and pitfalls	Exposure: description, explanation, examples, discussion of case studies	
6. Map-Reduce	Exposure: description, explanation, examples, discussion of case studies	
7. Hadoop. Distributed Filesystems: HDFS. Architecture and features.	Exposure: description, explanation, examples, discussion of case studies	
8. HBase	Exposure: description, explanation, examples, discussion of case studies	
9. Hadoop Test Environment setup. Developing applications on Hadoop.	Exposure: description, explanation, examples, discussion of case studies	
10. Microsoft Azure: fundamental concepts. Windows Azure service model.	Exposure: description, explanation, examples, discussion of case studies	
11. Microsoft Azure Services.	Exposure: description, explanation, examples, discussion of case studies	
12. Cloud database systems.	Exposure: description, explanation, examples, discussion of case studies	
13. Amazon Web Services	Exposure: description, explanation, examples, discussion of case studies	
14. Recap.	Exposure: description, explanation, examples, discussion of case studies	

Bibliography

1. G. Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly, 2009, ISBN:978-0-596-15636-7
2. Chris Hay, Brian H Prince, Azure in Action, Manning Publication, 2011.
3. Tom White, Hadoop: The Definitve Guide, O'Reilly, ISBN: 978-0-596-52197-4, 2011
4. Jimmy Lin, Chris Dyer, Data-Intensive Text Processing with MapReduce, Morgan and Claypool Publishers, ISBN-10: 1608453421, 2010.
5. Foster, Ian; Carl Kesselman (1999). The Grid: Blueprint for a New Computing Infrastructure. Morgan Kaufmann Publishers. ISBN 1-55860-475-8
6. Li, Maozhen; Mark A. Baker (2005). The Grid: Core Technologies. Wiley. ISBN 0-470-09417-6
7. Anil Desay, The Definitive Guide to Virtual Platform Management, 2010, Ca technologies, download http://nexus.realtimepublishers.com/dgvpm.php
8. R. Jennings, Cloud Computing with the Windows Azure Platform (Wrox Programmer to Programmer), Wrox, 2009, ISBN: 978-0470506387
9. D. Sanderson, Programming Google App Engine Build and Run Scalable Web Apps on Google's Infrastructure, O'Reilly, 2009., ISBN:978-0-596-52272-8
10. Andy Oram (ed), Peer-to-peer Harnessing the power of disruptive technologies, O'Reilly, 2001, ISBN: 978-0596001100
11. * * *, http://code.google.com/intl/ro-RO/appengine/docs/

8.2 Seminar / laboratory	Teaching methods	Remarks
Concurrent programming	Explanation, debate, dialogue, case studies, example, proofs	
Virtualization types. Virtualization Environments: VMWare. HyperV. Configuration and setup.	Explanation, debate, dialogue, case studies, example, proofs	
Hadoop Virtual Machine configuration. HDFS and Hadoop services Initialization.	Explanation, debate, dialogue, case studies, example, proofs	
Developing a Map-Reduce application	Explanation, debate, dialogue, case studies, example, proofs	
AWS Services.	Explanation, debate, dialogue, case studies, example, proofs	
Azure: services	Explanation, debate, dialogue, case studies, example, proofs	
Cloud databases	Explanation, debate, dialogue, case studies, example, proofs	

Bibliography:

1. Chris Hay, Brian H Prince, Azure in Action, Manning Publication, 2011.
2. Tom White, Hadoop: The Definitve Guide, O'Reilly, ISBN: 978-0-596-52197-4, 2011
3. Jimmy Lin, Chris Dyer, Data-Intensive Text Processing with MapReduce, Morgan and Claypool Publishers, ISBN-10: 1608453421, 2010.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course respects the IEEE and ACM Curriculla Recommendations for Computer Science studies;
- The course exists in the studying program of all major universities in Romania and abroad;
- The content of the course covers the most important aspects necessary for applying the cloud technologies into a production environment or for solving real problems in a company.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	- know the theoretical principles of the domain; - apply the course concepts - problem solving	Written exam/Paper presentation	50%
10.5 Seminar/laboratory	- be able to implement course concepts and algorithms - Semester Project: developping a Hadoop and an Azure application on a defined problem.	Semester project Evaluation	50%
10.6 Minimum standard of performance			
At least grade 5 (from a scale of 1 to 10) at both written exam and laboratory work.			

11. Labels ODD (Sustainable Development Goals)[2]

Not applicable.

Date:
15/04/2025

Signature of course coordinator
PhD Prof. Adrian Sergiu DARABANT

Signature of seminar coordinator
PhD Prof. Adrian Sergiu DARABANT

Date of approval:
_____

Signature of the head of department
Assoc.prof.phd. Adrian STERCA

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*".