**SYLLABUS**

**1. Date despre program**

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|---|---|
| 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 Analysis |

**2. Information regarding the discipline**

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline | Grid, Cluster and Cloud Computing | | | | | | |
| 2.2 Course coordinator | PhD Assoc. Prof. Darabant Sergiu Adrian | | | | | | |
| 2.3 Seminar coordinator | PhD Assoc. Prof. Darabant Sergiu Adrian | | | | | | |
| 2.4. Year of study | 1 | 2.5 Semester | 2 | 2.6. Type of evaluation | E | 2.7 Type of discipline | Compulsory |

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

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Hours per week | 4 | Of which: 3.2 course | 2 | 3.3 seminar/laboratory | 1 sem +1 pr |
| 3.4 Total hours in the curriculum | 56 | Of which: 3.5 course | 28 | 3.6 seminar/laboratory | 28 |
| Time allotment: | | | | | Hours |
| Learning using manual, course support, bibliography, course notes | | | | | 30 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 30 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 50 |
| Tutorship | | | | | 14 |
| Evaluations | | | | | 20 |
| Other activities: ..... | | | | | 0 |

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| 3.7 Total individual study hours | 144 |
| 3.8 Total hours per semester | 200 |
| 3.9 Number of ECTS credits | 8 |

**4. Prerequisites** (if necessary)

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| 4.1. curriculum | • Operating Systems, Computer Networks |
| 4.2. competencies | • Average to good knowledge of Java and .NET programming. |

**5. Conditions** (if necessary)

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| 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 | • Laboratory with Internet connected computers. Possibility to run virtualization solutions |

**6. Specific competencies acquired**

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| **Professional competencies** | • Ability to design and implement parallel methods for solving complex problems with large input data using the Cloud based programming paradigms<br>• Ability to apply different parallelization paradigms<br>• Acquire theoretical and practical knowledge on grid and cloud environments. |
| **Transversal competencies** | • Ability to continuously learn, understand and apply the most recent research results in computer science.<br>• Ability to work independently and/or in a team in order to solve problems in defined professional contexts |

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

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|---|---|
| 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 of 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.<br>• Acquire the fundamental knowledge that allows parallelizing and solving large and complex problems on scalable systems.<br>• 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 | |

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|---|---|---|
| 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 Worker Roles. Web Roles, SQL Azure. Message Queues. Blobs | 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. Eucalyptus. Google App Engine, 10gen. | 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 |
|---|---|---|
| 1. Concurrent programming | Explanation, debate, dialogue, case studies, example, proofs | |

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|---|---|---|
| 2. Virtualization Environments: VMWare. HyperV. Configuration and setup. | Explanation, debate, dialogue, case studies, example, proofs | |
| 3. Hadoop Virtual Machine configuration. HDFS and Hadoop services Initialization. | Explanation, debate, dialogue, case studies, example, proofs | |
| 4. Developping Hadoop applications using the Hadoop Eclipse Pug-in | Explanation, debate, dialogue, case studies, example, proofs | |
| 4. Microsoft Azure: Web Services | Explanation, debate, dialogue, case studies, example, proofs | |
| 6. Azure: worker roles, blobs, message queues. | Explanation, debate, dialogue, case studies, example, proofs | |
| 7. SQL Azure, HBase. | 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**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade (%) |
|---|---|---|---|
| 10.4 Course | - know the basic principle of the domain;<br>- apply the course concepts<br>- problem solving | Written exam/Paper presentation | 50% |
| 10.5 Seminar/lab activities | - be able to implement course concepts and algorithms<br>Semester Project: developping a Hadoop and an Azure application on a defined problem. | Semester project Evaluation | 50% |
| 10.6 Minimum performance standards | | | |
| • At least grade 5 (from a scale of 1 to 10) at both written exam and laboratory work. | | | |

Date Signature of course coordinator Signature of seminar coordinator

26/04/2023... Assoc Prof. Dr. Adrian Sergiu DARABANT Assoc. Prof. Adrian Sergiu DARABANT

Date of approval Signature of the head of department

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