COURSE SYLLABUS

Academic year 2024-2025

1. Programme Information

1.1. Higher education institution	Lucian Blaga University of Sibiu
1.2. Faculty	Faculty of Engineering
1.3. Department	Department of Computer Science and Electrical and Electronics Engineering
1.4. Field of study	Computer Science and Information Technology
1.5. Level of study	Master
1.6. Programme of study/qualification	ADVANCED COMPUTING SYSTEMS

2. Course Information

2.1. Name of course	Multiagent Systems				Cod	ACS.305.RA	
2.2. Course coordinator	Assist. Prof. Vasile CRĂCIUNEAN, PhD						
2.3. Seminar/laboratory coordinator	Assist. Prof. Bălă Constantin ZAMFIRESCU, PhD						
2.4. Year of study[1]	2	**2.5.** Semester[2]	3	**2.6.** Evaluation form[3]	E		
2.7. Course type[4]	A	**2.8.** The formative category of the course[5]	R				

3. Estimated Total Time

3.1. Course Extension within the Curriculum – Number of Hours per Week					
3.1.a. Lecture	3.1.b. Seminar	3.1.c. Laboratory	3.1.d. Project	3.1.e. Other	Total
1		2			**3**
3.2. Course Extension within the Curriculum – Total Number of Hours within the Curriculum					
3.2.a. Lecture	3.2.b. Seminar	3.2.c. Laboratory	3.2.d. Project	3.2.e. Other	Total[6]
14		28			**42**

Time Distribution for Individual Study[7]	**Nr. ore**
Learning by using course materials, references and personal notes	12
Additional learning by using library facilities, electronic databases and on-site information	13
Preparing seminars / laboratories, homework, portfolios and essays	42
Tutorial activities[8]	12
Exams[9]	4
3.3. Total Individual Study Hours[10] ***(NOSI$_{sem}$)***	**83**
3.4. Total Hours in the Curriculum (*NOAD$_{sem}$*)	**42**
3.5. Total Hours per Semester[11] **(*NOAD$_{sem}$* + *NOSI$_{sem}$*)**	**125**
3.6. No. of Hours / ECTS	**25**
3.7. Number of credits[12]	**5**

4. Prerequisites (if needed)

4.1. Courses that must be successfully completed first (from the curriculum)[13]	Basic courses in informatics (programming, algorithms), software engineering, and artificial intelligence.
4.2. Competencies	Operating systems, programming

5. Conditions (where applicable)

5.1. For course/lectures[14]	Video Projector, On-line platforms, Journal papers, etc.
5.2. For practical activities (lab/sem/pr/app)[15]	Cisco CCNA Security Bundle

6. Specific competencies acquired[16]

Number of credits assigned to the discipline[17]		5	Credits distribution by competencies[18]
6.1. Professional competencies	PC2	analyses test data	0,5
	PC7	conceives product design	0,5
	PC9	defines technical requirements	0,5
	PC10	carries out research activities at interdisciplinary level	0,5
	PC15	conducts scientific research	0,5
	PC30	synthesizes information	0,5
6.2. Transversal competencies	TC1	demonstrates commitment	0,5
	TC2	manages personal development	1
	TC3	takes responsibility	0,5

7. Course objectives (resulted from developed competencies)

7.1. Main course objective	• Mastering the basic theoretical concepts as regards the design, analysis and implementation of agent-oriented systems for complex problems; • To get insides on the critical issue of "computing as interaction" (i.e. orchestration, choreography) by experimenting the coordination mechanism (direct and indirect) in simple, yet scalable, multi-agent/service-oriented systems architectures
7.2. Specific course objectives	• Understanding what a complex system is, and engineering methods to master this complexity management • Working with interaction protocols • Learning to employ advanced abstractions in engineering complex systems (of systems)

8. Content

8.1. Lectures[19]		**Teaching methods**[20]	**Hours**
Lecture 1	Introduction. Agent: environments, description, composition, rules.	Exposition,discussions	2
Lecture 2	Multi-agent systems: architecture, agent types, lifecycle management, consistency, modelling other agents, cognitive concepts	Exposition,discussions	2
Lecture 3	Organization: contracts, commitment, conventions, policies, negotiation	Exposition,discussions	2
Lecture 4	Communication: speech acts, semantics, interaction patterns, business protocols, ACL and web services	Exposition,discussions	2

Lecture 5	Semantic service selection: ontologies, matchmaking	Exposition,discussions	2
Lecture 6	Social service selection: reputation mechanisms, recommender techniques, referrals, trust, identity	Exposition,discussions	2
Lecture 7	Economic service selection: market environments, auctions	Exposition,discussions	2
		Total lecture hours:	**14**

8.2. Practical activities (8.2.a. Seminar[21]/ 8.2.b. Laboratory[22]/ 8.2.c. Project[23])		**Teaching methods**	**Hours**
Lab 1	Models, agent-based models, modeling cycle. Introduction to NetLogo	Exercise, experiment	2
Lab 2	Describing and formulating ABM: ODD protocol	Exercise, experiment	2
Lab 3	Analyzing and testing ABM	Exercise, experiment	2
Lab 4	Interaction protocols	Exercise, experiment	2
Lab 5	Emergence, observation, sensing	Exercise, experiment	2
Lab 6	Adaptive behavior	Exercise, experiment	2
Lab 7	Prediction and interaction	Exercise, experiment	2
Lab 8	Patterns for model structure	Exercise, experiment	2
Lab 9	Theory development	Exercise, experiment	2
Lab 10	Parametrization and calibration	Exercise, experiment	2
Lab 11	Model analysis	Exercise, experiment	2
Lab 12	Individual project work	Exercise, experiment	2
Lab 13	Models, agent-based models, modeling cycle. Introduction to NetLogo	Exercise, experiment	2
Lab 14	Describing and formulating ABM: ODD protocol	Exercise, experiment	2
		Total seminar/laboratory hours:	28

9. Bibliography

10. Recommended Bibliography	• Michael Wooldridge (2009). An Introduction to Multi-Agent Systems - Second Edition, John Wiley & Sons • Brian Henderson-Sellers, Paolo Giorgini (2005). *Agent-oriented methodologies,* Idea Group. • Munidar P. Singh and Michael N. Huhns, Service –Oriented Computing: Semantics, Processes, Agents, John Wiley & Sons, 2005 • Filip F.G., C.B. Zamfirescu, C. Ciurea (2017). Computer-supported Collaborative Decision Making. Springer • S. Railsback and V. Grimm. Agent-Based and Individual-Based Modelling. 2nd edition
11. Additional Bibliography	• The Journal of Artificial Societies and Social Simulation • Netlogo

12. Conjunction of the discipline's content with the expectations of the epistemic community, professional associations and significant employers of the specific study program[24]

Students will acquire research skills and synthesis abilities preparing them for the transition to a new stage of doctoral admission.
It is carried out through regular discussions in a formal and informal setting with the representatives of the profile companies.

13. Evaluation

Activity Type	11.1 Evaluation Criteria	11.2 Evaluation Methods		11.3 Percentage in the Final Grade	Obs.[25]
11.4a Exam / Colloquy	• Theoretical and practical knowledge acquired (quantity, correctness, accuracy)	Tests during the semester[26]:	25%	100%	CPE
		Homework:	25%		
		Other activities[27]:	0%		
		Final evaluation:	50%		
11.5 Minimum performance standard[28] The final assessment will include written work consisting of (partial) grid tests and problems. • Knowledge, understanding and explaining the basics of evolutionary computing. • Constant interest to acquire discipline. • Partial fulfilment (50%) of homework, essays and tests given during the semester.					CPE

The Course Syllabus will encompass components adapted to persons with special educational needs (SEN – people with disabilities and people with high potential), depending on their type and degree, at the level of all curricular elements (skills, objectives, contents, teaching methods, alternative assessment), in order to ensure fair opportunities in the academic training of all students, paying close attention to individual learning needs.

Filling Date: 12.09.2024
Department Acceptance Date: 16.09.2024

	Academic Rank, Title, First Name, Last Name	Signature
Course Teacher	Assist. Prof. Vasile CRĂCIUNEAN, PhD	
Study Program Coordinator	Prof. Adrian FLOREA, PhD	
Head of Department	Assoc. Prof. Radu George CREȚULESCU, PhD	
Dean	Prof. Maria VINȚAN, PhD	

[1] *1-4 for bachelor, 1-2 for master*
[2] *1-8 pentru licență, 1-3 pentru master*
[3] *Exam, colloquium or VP A/R - from the curriculum*
[4] *Course type: R = Compulsory course; E = Elective course; O = Optional course*
[5] *Formative category: S = Specialty; F = Fundamental; C = Complementary; I = Fully assisted; P = Partially assisted; N = Unassisted*
[6] *Este egal cu 14 săptămâni x numărul de ore de la punctul 3.1 (similar pentru 3.2.a.b.c.)*
[7] *The following lines refer to individual study; the total is completed at point 3.37.*
[8] *Between 7 and 14 hours*
[9] *Between 2 and 6 hours*
[10] *The sum of the values from the previous lines, which refer to individual study.*
[11] *The sum (3.5.) between the number of hours of direct teaching activity (NOAD) and the number of hours of individual study (NOSI) must be equal to the number of credits assigned to the discipline (point 3.7) x no. hours per credit (3.6.)*
[12] *The credit number is computed according to the following formula, being rounded to whole neighbouring values (either by subtraction or addition*

$$No.credits = \frac{NOCpSpD \times C_C + NOApSpD \times C_A}{TOCpSdP \times C_C + TOApSdP \times C_A} \times 30\ credits$$

Where:

- NOCpSpD = Number of lecture hours / week / discipline for which the credits are calculated
- NOApSpD = Number of application hours (sem./lab./pro.) / week / discipline for which the credits are calculated
- TOCpSdP = Total number of course hours / week in the Curriculum
- TOApSdP = Total number of application hours (sem./lab./pro.) / week in the Curriculum
- C_C/C_A = Course coefficients / applications calculated according to the table

Coefficients	**Course**	**Applications (S/L/P)**
Bachelor	2	1
Master	2,5	1,5
Bachelor - foreign language	2,5	1,25

[13] *The courses that should have been previously completed or equivalent will be mentioned*
[14] *Board, video projector, flipchart, specific teaching materials, online platforms, etc.*
[15] *Computing technology, software packages, experimental stands, online platforms, etc.*
[16] *Competences from the Grids related to the description of the study program, adapted to the specifics of the discipline*
[17] *Din planul de învățământ*
[18] *Creditele alocate disciplinei se distribuie pe competențe profesionale și transversale în funcție de specificul disciplinei*
[19] *Titluri de capitole și paragrafe*
[20] *Exposition, lecture, board presentation of the studied topic, use of video projector, discussions with students (for each chapter, if applicable)*
[21] *Discussions, debates, presentations and/or analyses of papers, solving exercises and problems*
[22] *Practical demonstration, exercise, experiment*
[23] *Case study, demonstration, exercise, error analysis, etc.*
[24] *The relationship with other disciplines, the usefulness of the discipline on the labour market*
[25] *CPE – Conditions Exam Participation; nCPE – Does Not Condition Exam Participation; CEF - Conditions Final Evaluation; N/A – not applicable*
[26] *The number of tests and the weeks in which they will be taken will be specified*
[27] *Scientific circles, professional competitions, etc.*
[28] *The minimum performance standard in the competence grid of the study program is customized to the specifics of the discipline, if applicable*