SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeș-Bolyai University
1.2 Faculty	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	Applied Computational Intelligence

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Empirical Research Methods for Computer Scientists** Metode de cercetare empirică pentru experți în informatică				
2.2 Course coordinator			**Assoc. dr. Vescan Andreea**				
2.3 Seminar coordinator			**Assoc. dr. Vescan Andreea**				
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Optional**
2.8 Code of the discipline		MME8187					

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+1
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					36
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					42
Tutorship					10
Evaluations					11
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	•
4.2. competencies	•

5. Conditions (if necessary)

5.1. for the course	• course room with video projector, Internet
5.2. for the seminar /lab activities	• course room with video projector, Internet

6. Specific competencies acquired

Professional competencies	C2.4 Using proper criteria and methods for evaluation of software applications C3.2. Identifying and explaining the basic computer models appropriate to the field of application C4.4. Using simulation to study the behavior of realized models and evaluate performance CE1. Evaluating the quality and stability of the obtained solutions and comparing them with the solutions obtained by traditional methods
Transversal competencies	CT1 Application of organized and efficient work rules, of responsible attitudes towards the didactic and scientific domain, for the creative exploitation of their own potential according to the principles and rules of professional ethics CT2 Efficient conduct of activities organized in an interdisciplinary group and development of empathic capacity of interpersonal communication, networking and collaboration with diverse groups CT3 Use of effective methods and techniques of learning, information, research and development of the capacity to exploit knowledge, to adapt to the requirements of a dynamic society and communication in Romanian language and in a foreign language

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

7.1 General objective of the discipline	• Conduct a systematic literature review; identify gaps in the literature • Formulate and motivate research questions • Collect & analyse qualitative and quantitative data
7.2 Specific objective of the discipline	• Design empirical studies for different purposes (tool evaluation, phenomenon understanding), choose appropriate methods, advocate your choice • Run statistical tests and interpret the results • Code qualitative data • Draw conclusions from empirical data • Present results verbally and in writing

8. Content

8.1 Course	Teaching methods	Remarks
1. Course 1 Introduction- Course objectives & Assessments Intro to philosophy of science	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
2. Research Design: qualitative, quantitative, mixed methods Systematic Literature Review	• Interactive exposure • Explanation • Conversation	

	• Didactical demonstration	
3. Doing Research Finding good research questions Theory building Evidence and Measurements	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
4. Experiments Controlled experiments Quasi – experiments Sampling	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
5. Quantitative analysis Basic Stats Choosing a statistical model Statistical Power Analysis	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
6. Qualitative analysis Grounded theory Coding strategies Phenomenography	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
7. Interviews and Observation Conducting Interviews Focus Group Participant Observation	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
8. Case studies Single and multi-case Longitudinal Case studies	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
9. Survey Research Designing questionnaires Sample size	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
10. Intervention methods Action Research Pilot Studies	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
11. Replication Importance of replications Bias and influences Threats to validity	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
12. Publishing and reviewing	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
13. Projects by students (1) Workshop Peer review (anonymous+live)	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
14. Projects by students (2) Workshop Reflection/Debriefing Lessons learned	• Interactive exposure • Explanation • Conversation • Didactical demonstration	

Bibliography

Books:
[1] Forrest ShullJanice SingerDag I. K. Sjøberg, Guide to Advanced Empirical Software Engineering, Springer, 2008
[2] Seltman, Experimental Design and Analysis, 2018
[3] Michael Felderer, Guilherme Horta Travassos, Contemporary Empirical Methods in Software Engineering, Springer, 2020
[4] Cohen, P. (1995). Empirical Methods in Artificial Intelligence. MIT Press.
[5] James, Witten, Hastie and Tibshirani, An Introduction to Statistical Learning, with Applications in R

Articles
[1] Fagerholm F, Kuhrmann M, Münch J., Guidelines for using empirical studies in software engineering education, PeerJ Computer Science 3:e131, 2017
[2] Barbara Kitchenham, O. Pearl Brereton, David Budgen, Mark Turner, John Bailey, Stephen Linkman, Systematic literature reviews in software engineering – A systematic literature review, Information and Software Technology, Volume 51, Issue 1, 2009, Pages 7-15, ISSN 0950-5849,
[3] Arcuri A, Briand L (2011) A practical guide for using statistical tests to assess randomized algorithms in software engineering. In: International conference on software engineering, pp 1–10
[4] Carver JC (2010) Towards reporting guidelines for experimental replications: a proposal. In: The international workshop on replication in empirical software engineering, pp 2–5
[5] Carver JC, Juristo N, Baldassarre MT, Vegas S (2014) Replications of software engineering experiments. Empir Softw Eng 19(2):267–276
[6] Gomez OS, Juristo N, Vegas S (2014) Understanding replication of experiments in software engineering: a ´ classification. Inform Softw Technol 56(8):1033–1048.
[7] Shepperd M, Ajienka N, Counsell S (2018) The role and value of replication in empirical software engineering results. Inf Softw Technol 99:120–132
[8] Fagerholm F, Becker C, Chatzigeorgiou A, Betz S, Duboc L, Penzenstadler B, Mohanani R, Venters CC (2019) Temporal discounting in software engineering: a replication study. In: 13Th ACM/IEEE international symposium on empirical software engineering and measurement, IEEE, pp 1–12.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Literature review. Theory.	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
2. Research questions	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
3. Comparison of methods	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
4. Experiments	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	

5. Quantitative analysis	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
6. Qualitative analysis (1)	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
7. Qualitative analysis (2)	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
Bibliography The bibliography for the lectures. For each seminar, a set of 2-3 papers will be provided in advance to be read and discussed during the seminars.		

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 exists in the studying program of all major universities in Romania and abroad;
- The course „Applications of Data Science for Software Engineering" at Eindhoven University of Technology
- The course „Empirical Methods" at Carnegie Mellon University
- The course „Empirical Software Engineering: Bridging Research and Practice" at University of Victoria
- The course „Empirical Research Methods for Computer Scientists" at University of Toronto.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.1 Seminar activities	- know the concepts discussed during the lectures and applied during seminars	Assignments	40%
	- class participation and in-class presentations	Class participation	10%
10.2 Course	-be able to implement course concepts - apply techniques for different classes of research investigations	Project -documentation -design -continous observations	50%
10.6 Minimum performance standards			
• Seminar/Laboratory assignments work may not be redone in the retake session. • Project-based exam can be taken during the retake session. • Students from Previous Years to the current academic year			

- All the above rules apply to students from previous years.
- Seminar/Laboratory assignments must be redone during didactic activity time (in the 14 weeks before normal session).
- At least grade 5 (from a scale of 1 to 10) at written exam. The final grade computed with the given formula must be at least 5 in order to pass the exam. At least grade 5 (from a scale of 1 to 10) at project-based exams and laboratory/seminar activity

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Date	Signature of course coordinator	Signature of seminar coordinator
29 April 2024	Assoc. Prof. PhD. Andreea Vescan,	Assoc. Prof.

Date of approval	Signature of the head of department
.....	Assoc. Prof. PhD. Sterca Adrian