SYLLABUS

Empirical Research Methods for Computer Scientists

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babes-Bolyai University
1.2. Faculty	Faculty of Mathematics and Computer Science
1.3. Department	Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Master
1.6. Study programme/Qualification	Software engineering
1.7. Form of education	Full time

2. Information regarding the discipline

2.1. Name of the discipline	**Empirical Research Methods for Computer Scientists**					Discipline code	**MME8190**
2.2. Course coordinator							
2.3. Seminar coordinator							
2.4. Year of study	1	2.5. Semester	2	2.6. Type of evaluation	E	2.7. Discipline regime	Optional

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/project	**2**
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)					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:					0
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	room with video projector, Internet
5.2. for the seminar /lab activities	room with video projector, Internet

6.1. Specific competencies acquired [1]

[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.

Professional/essential competencies	• advanced programming skills in high-level programming languages • use of software tools in an interdisciplinary context
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 student knows: • The graduate has the necessary knowledge for literature review. • The graduate has the necessary skills to use research support tools.
Skills	The student is able to: • The graduate is able to define/identify/understand research problems in computer science. • The graduate is able to write a scientific/technical report.
Responsibility and autonomy:	The student has the ability to work independently to obtain: • The graduate has the ability to understand and communicate information effectively. • The graduate has the ability to observe and obtain information from various sources.

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	•

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	Interactive exposure Explanation	

Peer review (anonymous+live)	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
Literature review. Theory.	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
Research questions	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
Comparison of methods	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	

Experiments	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
Quantitative analysis	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
Qualitative analysis (1)	Presentation, Conversation, Problematizations, Discovery, Other methods – individual study, exercises	
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

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.1 Course	-be able to implement course concepts - apply techniques for different classes of research investigations	Project -documentation -design -continous observations	50%
10.2 Seminar/laboratory	- know the concepts discussed during the lectures and applied during seminars	Assignments	40%
	- class participation and in-class presentations	Class participation	10%

10.6 Minimum standard of performance
• 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

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

Not applicable.

Date: ...	Signature of course coordinator Assoc. Prof. dr. Vescan Andreea	Signature of seminar coordinator Assoc. Prof. dr. Vescan Andreea
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.*".