

SYLLABUS

AI Solutions-based Projects Development

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	Department of Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Artificial Intelligence
1.7. Form of education	Full time

2. Information regarding the discipline

2.1. Name of the discipline	AI Solutions-based Projects Development			Discipline code	MLE5211		
2.2. Course coordinator	Assoc. Prof. Vescan Andreea, PhD						
2.3. Seminar coordinator	Assoc. Prof. Vescan Andreea, PhD						
2.4. Year of study	3	2.5. Semester	5	2.6. Type of evaluation	C	2.7. Discipline regime	DS

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

3.1. Hours per week	1	of which: 3.2 course	0	3.3 seminar/laboratory/project	1LP 3P
3.4. Total hours in the curriculum	14	of which: 3.5 course	0	3.6 seminar/laboratory/project	14
Time allotment for individual study (ID) and self-study activities (SA)					hours
Learning using manual, course support, bibliography, course notes (SA)					3
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					9
Tutorship					2
Evaluations					2
Other activities:					
3.7. Total individual study hours					36
3.8. Total hours per semester					50
3.9. Number of ECTS credits					2

4. Prerequisites (if necessary)

4.1. curriculum	<ul style="list-style-type: none"> • Research methodology in computer science
4.2. competencies	<ul style="list-style-type: none"> • Programming knowledge in at least one high-level programming language

5. Conditions (if necessary)

5.1. for the course	<ul style="list-style-type: none"> •
5.2. for the seminar /lab activities	<ul style="list-style-type: none"> • none

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	<ul style="list-style-type: none"> • supervise software development • analyze software specifications • define the process • develop the prototype for the software • design the IT system
Transversal competencies	<ul style="list-style-type: none"> • show initiative • work in teams • assume responsibility • think analytically

6.2. Learning outcomes

Knowledge	<p>The student knows:</p> <ul style="list-style-type: none"> • The graduate has knowledge of programming, mathematics, engineering and technology and has the skills to use them in creating complex computer systems. • The graduate has the necessary knowledge to review the literature and use international databases and international digital research libraries.
Skills	<p>The student is able to</p> <ul style="list-style-type: none"> • The graduate is able to formally describe issues addressed in various areas, and to model them as problems that can be addressed using Artificial Intelligence techniques. • The graduate is able to design and implement software systems that are using methods of Artificial Intelligence and to evaluate their performance. • The graduate has the ability to develop, design and create new applications, systems or products using best practices in the field of Computer Science.
Responsibility and autonomy:	<p>The student has the ability to work independently to obtain</p> <ul style="list-style-type: none"> • The graduate has the necessary knowledge to select and use the appropriate training procedures to facilitate the process of assimilation of knowledge.

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

7.1 General objective of the discipline	<ul style="list-style-type: none"> • This activity involves acquiring the knowledge and skills necessary for a process of managing a software application of medium complexity, which uses solutions from the field of artificial intelligence, including the research work that the student does with the aim of realizing the project and a related scientific report.
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7.2 Specific objective of the discipline	<ul style="list-style-type: none"> • Upon completion of this course, the student must: <ul style="list-style-type: none"> ○ To have documentation skills on a certain topic related to artificial intelligence. ○ To identify the main elements that constitute success factors in a project with artificial intelligence solutions. ○ To implement the proposed solution, using artificial intelligence techniques. ○ To respect an Agile project development process. ○ To be able to make a research report content. ○ To know how to write a research report in several iterations.
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8. Content

8.1 Course	Teaching methods	Remarks
Bibliography		
8.2 Seminar / laboratory	Teaching methods	Remarks
Lab 1. Assignment A1, A5 Tasks: A1: Establishing the theme of the project. Identification of solutions using artificial intelligence techniques A5: AI-enabled system. Application development (to implement the selected AI-enabled system) Work A1: Lab1+home Work A5: Lab1 + Lab2 + Lab3 + Lab4 + Lab5 + Lab6 + home Delivery A1 in Lab 2 Delivery A5 in Lab 7	Conversation, debate, case studies	
Lab 2: Assignment A2 Engineering Concerns for AI-Enabled Systems Identify and discuss key engineering challenges (e.g., data quality, model robustness, explainability, security, privacy). Work: Lab2+Lab3+home Delivery A2 in Lab 4	Conversation, debate, case studies	
Lab 4: Assignment A3 Software Architecture of AI-Enabled Systems Explore the architectural patterns, components, and deployment strategies unique to AI-enabled systems, and analyze tradeoffs in real-world scenarios. Work: Lab4+Lab5+home Delivery A3 in Lab 6	Conversation, debate, case studies	
Lab 6: Assignment A4 Fairness Measures in AI-Enabled Systems To understand the concept of fairness in AI systems, explore common fairness metrics, and apply these measures to evaluate and improve the fairness of AI models. Work: Lab6+home Delivery A6 in Lab 7	Conversation, debate, case studies	
Lab 7: Delivery A5 in Lab 7 Delivery A6 in Lab 7	Conversation, debate, case studies	

Bibliography

- to be decided by student based on his/her research topic
- Internet resources on software projects and on the particular topics of the projects

Bibliography (for this assignment 1)

1. Gebremariam Assres, Guru Bhandari, Andrii Shalaginov, Tor-Morten Gronli, and Gheorghita Ghinea. 2025. State-of-the-Art and Challenges of Engineering ML- Enabled Software Systems in the Deep Learning Era. *ACM Comput. Surv.* 57, 10, Article 248 (October 2025), 35 pages. <https://doi.org/10.1145/3731597>
2. Amershi, S., Begel, A., Bird, C., DeLine, R., Gall, H., Kamar, E., ... & Zimmermann, T. (2019). Software Engineering for Machine Learning: A Case Study. In *Proceedings of the 41st International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP)*, pp. 291–300. <https://ieeexplore.ieee.org/document/8804457>
3. Gilberto Recupito, Fabiano Pecorelli, Gemma Catolino, Valentina Lenarduzzi, Davide Taibi, Dario Di Nucci, Fabio Palomba, Technical debt in AI-enabled systems: On the prevalence, severity, impact, and management strategies for code and architecture, *Journal of Systems and Software*, Volume 216, 2024, 112151, ISSN 0164-1212, <https://doi.org/10.1016/j.jss.2024.112151>
4. Vladislav Indykov, Rebekka Wohlrab, and Daniel Strüber. 2025. Quality trade-offs in ML-enabled systems: a multiple-case study. *Proceedings of the 40th ACM/SIGAPP Symposium on Applied Computing*. Association for Computing Machinery, New York, NY, USA, 1730–1737. <https://doi.org/10.1145/3672608.3707754>
5. Vladislav Indykov. 2024. Component-based Approach to Software Engineering of Machine Learning-enabled Systems. In *Proceedings of the IEEE/ACM 3rd International Conference on AI Engineering - Software Engineering for AI (CAIN '24)*. Association for Computing Machinery, New York, NY, USA, 250–252. <https://doi.org/10.1145/3644815.3644976>

Bibliography (for this assignment 2)

1. H. Washizaki *et al.*, "Software-Engineering Design Patterns for Machine Learning Applications," in *Computer*, vol. 55, no. 3, pp. 30-39, March 2022, doi: 10.1109/MC.2021.3137227.
2. Fiorella Zampetti, Vittoria Nardone, and Massimiliano Di Penta. 2022. Problems and solutions in applying continuous integration and delivery to 20 open-source cyber-physical systems. In *Proceedings of the 19th International Conference on Mining Software Repositories (MSR '22)*. Association for Computing Machinery, New York, NY, USA, 646–657. <https://doi.org/10.1145/3524842.3527948>
3. Bojan Karlaš, Matteo Interlandi, Cedric Renggli, Wentao Wu, Ce Zhang, Deepak Mukunthu Iyappan Babu, Jordan Edwards, Chris Lauren, Andy Xu, and Markus Weimer. 2020. Building Continuous Integration Services for Machine Learning. In *Proceedings of the 26th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (KDD '20)*. Association for Computing Machinery, New York, NY, USA, 2407–2415. <https://doi.org/10.1145/3394486.3403290>
4. G. A. Lewis, I. Ozkaya and X. Xu, "Software Architecture Challenges for ML Systems," *2021 IEEE International Conference on Software Maintenance and Evolution (ICSME)*, Luxembourg, 2021, pp. 634-638, doi: 10.1109/ICSME52107.2021.00071.
5. Roger Nazir, Alessio Bucaioni, Patrizio Pelliccione, Architecting ML-enabled systems: Challenges, best practices, and design decisions, *Journal of Systems and Software*, Volume 207, 2024, 111860, ISSN 0164-1212, <https://doi.org/10.1016/j.jss.2023.111860>.

Bibliography (for this assignment 3)

1. H. Washizaki *et al.*, "Software-Engineering Design Patterns for Machine Learning Applications," in *Computer*, vol. 55, no. 3, pp. 30-39, March 2022, doi: 10.1109/MC.2021.3137227.
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3. Bojan Karlaš, Matteo Interlandi, Cedric Renggli, Wentao Wu, Ce Zhang, Deepak Mukunthu Iyappan Babu, Jordan Edwards, Chris Lauren, Andy Xu, and Markus Weimer. 2020. Building Continuous Integration Services for Machine Learning. In *Proceedings of the 26th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (KDD '20)*. Association for Computing Machinery, New York, NY, USA, 2407–2415. <https://doi.org/10.1145/3394486.3403290>
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Bibliography (for this assignment 4)

1. d' Aloisio, G., Di Sipio, C., Di Marco, A. *et al.* How fair are we? From conceptualization to automated assessment of fairness definitions. *Softw Syst Model* (2025). <https://doi.org/10.1007/s10270-025-01277-2>
2. Salla Westerstrand, Fairness in AI systems development: EU AI Act compliance and beyond, *Information and Software*

Technology, Vol 187, 2025, ISSN 0950-5849, <https://doi.org/10.1016/j.infsof.2025.107864>

3.Thanh Nguyen, Maria Teresa Baldassarre, Luiz Fernando de Lima, and Ronnie de Souza Santos. 2024. From Literature to Practice: Exploring Fairness Testing Tools for the Software Industry Adoption. In Proceedings of the 18th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM '24). ACM, 549–555. <https://doi.org/10.1145/3674805.3695404>

4.McCarthy, M.B., Narayanan, S. Fairness–accuracy tradeoff: activation function choice in a neural network. *AI Ethics* **3**, 1423–1432 (2023). <https://doi.org/10.1007/s43681-022-00250-9>

5.Zeyu Sun, Zhenpeng Chen, Jie Zhang, and Dan Hao. 2024. Fairness Testing of Machine Translation Systems. *ACM Trans. Softw. Eng. Methodol.* **33**, 6, Article 156 (July 2024), 27 pages. <https://doi.org/10.1145/3664608>

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7.Zhenpeng Chen, Jie M. Zhang, Max Hort, Mark Harman, and Federica Sarro. 2024. Fairness Testing: A Comprehensive Survey and Analysis of Trends. *ACM Trans. Softw. Eng. Methodol.* **33**, 5, Article 137 (June 2024), 59 pages. <https://doi.org/10.1145/3652155>

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

- This course follows the IEEE and ACM curriculum recommendations for the study of computer science.
- The completion of a study program implies the initiation of a research activity.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course			
10.5 Seminar/laboratory	Understand and analyze the unique engineering challenges involved in designing, building, and maintaining AI-enabled systems.	Each activity has a deadline and a corresponding grade	Final Grade = 10% * A1 + 20%*A2+20%*A3+20%*A4+30%*A5
10.6 Minimum standard of performance			
<ul style="list-style-type: none"> • A minimum grade of 5 is required for passing the discipline. • Attend 90% of lab activities during semester. 			

11. Labels ODD (Sustainable Development Goals)²

Not applicable.

Date:	Signature of course coordinator	Signature of seminar coordinator
...	Assoc. Prof. Vescan Andreea, PhD	Assoc. Prof. Vescan Andreea, PhD

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.*”.