SYLLABUS

1. Information on the study programme

1.1. Higher education institution	West University of Timisoara
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Computer Science
1.4. Study program field	Computer Science
1.5. Study cycle	Master
1.6. Study programme / Qualification	ARTIFICIAL INTELIGENCE AND DISTRIBUTED COMPUTING

2. Information on the course

2.1. Course title			Fundamentals of Artificial Intelligence				
2.2. Lecture instructor			Darian Onchis, Pedro Real, Flavia Micota, Daniela Zaharie, Mircea Marin, Adrian Popescu				
2.3. Seminar / laboratory instructor			Darian Onchis				
2.4. Study year	I	2.5. Semester	I	2.6. Examination type	E	2.7. Course type	Obl.

3. Estimated study time (number of hours per semester)

3.1. Attendance hours per week	3	out of which: 3.2 lecture	2	3.3. seminar / laboratory	1
3.4. Attendance hours per semester	42	out of which: 3.5 lecture	28	3.6. seminar / laboratory	14

Distribution of the allocated amount of time*	**Hours**
Study of literature, course handbook and personal notes	23
Supplementary documentation at library or using electronic repositories	20
Preparing for laboratories, homework, reports etc.	50
Exams	6
Tutoring	6
Other activities (discussions)	3

3.7. Total number of hours of individual study	108
3.8. Total number of hours per semester	150
3.9. Number of credits (ECTS)	5

4. Prerequisites (if it is the case)

4.1. curriculum	Algorithmics, Probability and Statistics, Programming
4.2. competences	Undergraduate knowledge of Algorithmics and Statistics

5. Requirements (if it is the case)

5.1. for the lecture	Lecture room
5.2. for the seminar / laboratory	Computer room

6. Specific acquired competences

Professional competences	• Fundamentals of Artificial Intelligence, Algorithmic applications of Artificial Intelligence
Transversal competences	• Project work, team work

7. Course objectives

7.1. General objective	Introduction in Artificial Intelligence
7.2. Specific objectives	Presentation of main topics of Artificial Intelligence and specific applications

8. Content

8.1. Lecture	**Teaching methods**	**Remarks, details**
C1. Opening remarks about the course, course logistics, course content, history of AI (Dartmouth Summer Research Project on Artificial Intelligence), subdomains of AI and AI today.	Lecture, exemplification, demonstration	2h
C2. Recap of mathematical and programming tools: vectors, dot products, geometric interpretations, taking gradients, discrete random variables and probability distributions, mean, variance, basic big-O notation, complexity, recurrence, Python, Colab or Kaggle notebooks.	Lecture, exemplification, demonstration	2h
C3. Introduction into supervised machine learning, regression, classification, and gradient descent. Neural networks and the backpropagation algorithm.	Lecture, exemplification, demonstration	2h
C4. Solving problems by searching. Uninformed and informed search strategies. Heuristic functions.	Lecture, exemplification, demonstration	2h, [2] Chapter 3

C5. Strategies for optimization problems. Deterministic strategies (hill-climbing). Stochastic strategies (simulated annealing, evolutionary algorithms)	Lecture, exemplification, demonstration	2h, [2] Chapter 4
C6. Strategies for constraint satisfaction problems. Constraint propagation. Search strategies (intelligent backtracking, constraint learning)	Lecture, exemplification, demonstration	2h, [2] Chapter 5
C7.Logical agents and inference in first order logic	Lecture, exemplification, demonstration	2h [2] Chapters 8, 9
C8 Probabilistic reasoning. Probability theory reminder. Naïve Bayes models. Bayesian networks.	Lecture, exemplification, demonstration	2h [2] Chapters 12, 13
C9. Intelligent agents, Markov decision processes, evaluating policies and finding the optimal value with value iteration. Reinforcement learning, Q-learning and SARSA.	Lecture, exemplification, demonstration	2h
C10. Artificial intelligence with computational topology/	Lecture, exemplification, demonstration	2h
C11. Intro to unsupervised learning (clustering, clustering and deep unsupervised learning.	Lecture, exemplification, demonstration	2h
C12. Transfer Learning and Incremental Learning.	Lecture, exemplification, demonstration	2h
C13. AI and Society. Applications in media & fake news, social networks, medicine, autonomous transport systems.	Lecture, exemplification, demonstration	2h

C14. Recap. Ethics of AI. PROJECTS PRESENTATION (all professors).	Lecture, exemplification, demonstration	2h

Recommended literature

[1] Stuart Russell, „The history and future of AI", Oxford Review of Economic Policy 37 (3), 509-520, 2021
[2] Stuart Russell, Peter Norvig, „Artificial intelligence: a modern approach", global edition 4th, Foundations 19, 23, 2021
[3] Tom Mitchell, „Machine Learning", McGraw-Hill, 1997
[4] Christopher Manning, Hinrich Schuetze, „Foundations of Statistical Natural Language Processing",; MIT Press, 2009
https://cs50.harvard.edu/ai/2020/, https://cs50.harvard.edu/ai/2020/weeks/0/
https://stanford-cs221.github.io/spring2022/, https://stanford-cs221.github.io/spring2022/modules/
http://ai.stanford.edu/~nilsson/mlbook.html

8.2. Seminar / laboratory	**Teaching methods**	**Remarks, details**
L1. Introduction to AI algorithms. Presentation of the Colab and Kaggle platforms.	Dialog, Problem posing, Implementation	2h
L2. Implementation from scratch of basic neural networks for classification and regression.	Dialog, Problem posing, Implementation	2h
L3. Implementation of search-based algorithms	Dialog, Problem posing, Implementation	2h,
L4. CSP solvers	Dialog, Problem posing, Implementation	2h
L5. Probabilistic programming	Dialog, Problem posing, Implementation	2h
L6. Applications in media & fake news, social networks, medicine, autonomous transport systems.	Dialog, Problem posing, Implementation	2h
L7. Practical applications	Dialog, Problem posing, Implementation	2h

Recommended literature

[1] Stuart Russell, Peter Norvig, „Artificial intelligence: a modern approach", global edition 4th, Foundations 19, 23, 2021
[2] Tom Mitchell, „Machine Learning", McGraw-Hill, 1997
[3] François Chollet, „Deep Learning with Python", November 2017, ISBN 9781617294433
[4] Lab materials: https://darianonchis.wordpress.com/ or Google Classroom
[5] http://scikit-learn.org/stable/
[6] https://www.tensorflow.org/
[7] https://keras.io/

[8] https://colab.research.google.com
[9] https://www.kaggle.com/
[10] OR-tools https://developers.google.com/optimization/cp/cp_solver
[11] https://pypi.org/project/CSP-Solver/
[12] https://www.pymc.io/projects/docs/en/stable/learn.html

9. Correlations between the content of the course and the requirements of the professional field and relevant employers.

The course follows the overall structure of S. Russel and P. Norvig text book on AI which is world-wide adopted by universities. The contents of the course are related but not significantly overlapping with the Machine Learning and Data Mining course. The course is intended to follow the needs of the IT companies active in the field.

10. Evaluation

Activity	10.1. Assessment criteria	10.2. Assessment methods	10.3. Weight in the final mark
10.4. Lecture	Knowledge of main artificial intelligence approaches	Project defense: theoretical part and related questions	40%
	Applications of selected algorithms	Project defense: application part	30%
10.5. Seminar / laboratory	Usage of specific Artificial Intelligence software	Laboratory assignments	30%
10.6. Minimum needed performance for passing			
Knowledge of at least three basic Artificial Intelligence algorithms. Realization of a project. Correct usage of the presented Artificial Intelligence software packages.			

Date of completion 04.09.2023 | Signature (lecture instructor) | Signature (seminar instructor)

Date of approval | Signature (director of the department)