# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Artificial intelligence [S1SI1E>AINT]

## Course

Field of study
Artificial Intelligence

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
english

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

## Number of credit points

5,00

## Coordinators

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## Lecturers

## Prerequisites

Basic knowledge regarding: calculus, linear algebra, probability theory and statistics, algorithms and data structures. Basic skills regarding programming in Python. Social competences in critically evaluating received knowledge and content and being ready to recognize the importance of knowledge and scientific research related to artificial intelligence in solving practical problems of key importance.

## Course objective

The objective of this course is to introduce the fundamental concepts, and techniques of artificial intelligence (AI). It presents an introduction to the foundations of classical and modern AI, covering basic problems and challenges, also from a philosophical perspective. The course aims to provide a broad introduction, covering a range of approaches (symbolic, and statistical), using a common framework. The course should prepare students for studying these topics in more detail on specialised courses in the subsequent semesters.

## Course-related learning outcomes

Knowledge:
The students:
1. have a detailed, well-grounded knowledge of fundamental computer science problems within the scope of artificial intelligence including problem solving by searching, machine learning, knowledge representation, reasoning, and handling uncertainty -- [K1st_W3]
2. know and understand the basic techniques, methods, algorithms, and tools used for solving computer problems as well as problems in artificial intelligence, including an automated recognition of patterns in data of different types and their synthesis to knowledge, conclusions, and recommendations -- [K1st_W4]
3. have a basic knowledge of life cycle and processes taking place in computer and, in particular, AI-based software and hardware -- [K1st_W7]
4. know cybersecurity and ethical issues related to the creation and use of computer and, in particular, AI-based systems -- [K1st_W9]

Skills:
The students:
1. are able to collect information from the appropriate sources of different nature, perform its critical analysis, interpretation and synthesis as well as comprehensively justify the formulated opinions, especially in the context of artificial intelligence -- [K1st_U1]
2.can formulate and solve complex problems within the scope of computer science and, in particular, artificial intelligence, by applying appropriately selected methods (including analytical, simulation or experimental approaches) --[K1st_U3]
3. can efficiently plan and carry out experiments related to various aspects of artificial intelligence, including computer measurements and simulations, interpret the obtained results and draw conclusions based on the experimental outcomes -- [K1st_U4]
4. can carry out a critical analysis and an assessment of the functioning of both computer systems and AI methods --[K1st_U7]
5. can design - following a pre-defined specification - and create an IT system that uses AI by first selecting and then using the available methods, techniques and computer tools (including programming languages) -- [K1st_U8]
6. can adapt the existing algorithms as well as formulate and implement the novel algorithms, including the algorithms typical for different streams of AI, using at least one well-known tool [K1st_U9]
7. can retrieve, analyze and transform different types of data, protect it against undesired access, and carry out data synthesis to knowledge and conclusions useful for solving a variety of problems that occur in the work of a computer scientist - a specialist in the field of AI, including issues of industrial, business, and administrative nature -- [K1st_U10]
8. can adapt and make use of the models of intelligent behavior as well as computer tools simulating such a behavior--[K1st_U11]
9. can plan and carry out life-long learning, and are aware of the possibilities of further studies (Master and Ph.D. programs, post-graduate studies, courses and exams organized by the universities, companies, and professional organizations) -- [K1st_U16]

Social competences:
The students:
1. understand that knowledge and skills quickly become outdated in computer science and, in particular, AI, and perceive the need for constant additional training and raising one"s qualifications -- [K1st_K1]
2. are aware of the importance of scientific knowledge and research related to computer science and AI in solving practical problems which are essential for the functioning of individuals, firms, organizations as well as the entire society -- [K1st_K2]
3. know the examples of poorly functioning AI systems, which led to the economic, social or environmental losses -- [K1st_K3]
4. can think and act in an enterprising way, finding the commercial application for the created AI-based systems, having in mind the economic benefits as well as legal and social issues -- [K1st_K5]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
a) lectures: based on answers to questions asked during the lectures,

b) labs: answering questions posed during the classes, solving mini-problems and presenting the solution to other students.
Total assessment:
a) lectures: based on answers to questions in an exam (involving multiple choice questions, short answer questions, and micro problems to be solved). At least 50% of points required to pass.
b) labs: assessment based on students" solving theoretical and practical tasks. Tasks solved individually or in groups, during classes or as homework. Passing the course requires collecting at least 50% of the total points.

## Programme content

1. What is AI? (Strong and weak AI. The Turing test. Chinese room argument)
2. Intelligent Agents (Agents and environments. What is a good behavior?)
3. Problem Solving
- Solving Problems by Searching (Local and heuristic search)
- Adversarial Search and Games (Min-max search algorithm, alpha-beta pruning, Monte Carlo Tree Search)
4. Knowledge and reasoning
- Logical Agents (Knowledge-based agents. Logic in general including models and entailment. Inference rules.)
- First-Order Logic
- Classical Planning
- Knowledge Representation (semantic networks, description logic, ontologies)
6. Uncertain Knowledge and Reasoning
- Probabilistic Reasoning (casuality, Bayesian Networks)
- Probabilistic Reasoning over Time (Hidden Markov Models)
- Making Complex Decisions (Markov decision process)
7. Learning
- Basic concepts and building blocks of a machine learning system. Forms of learning: supervised, unsupervised, reinforcement learning.
- Deep learning (Mixing and matching models, loss functions and optimizers. Computation graphs)
- Reinforcement Learning (Learning from rewards, Q-learning, generalization in reinforcement learning)
8. Philosophy, Ethics, and Safety of AI

## Teaching methods

Lectures: multimedia presentations (theory, examples, quizes, exercises), examples presented on black board.
Laboratory classes: multimedia presentations, problem solving in groups, discussion, solving assigned tasks.

## Bibliography

Basic
1. Russell, S. & Norvig, P. (2016). Artificial Intelligence: A Modern Approach (3rd ed.). Prentice Hall Press, Upper Saddle River, NJ, USA.
Additional
1. Ben-Ari, M. (2012). Mathematical logic for computer science, Springer Publishing Company, 3rd edition, 2012
2.Kowalski, R.A. (2011). Computational Logic and Human Thinking - How to be Artificially Intelligent, Cambridge University Press.
3. Nau, D., Ghallab, M., & Traverso, P. (2004). Automated Planning: Theory & Practice. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.
4. Baader, F., Calvanese, D., McGuinness, D. L., Nardi, D., & Patel-Schneider., P.F. (2010). The Description Logic Handbook: Theory, Implementation and Applications (2nd ed.). Cambridge University Press, New York, NY, USA.
5. Allemang, D., & Hendler, J.A. (2011). Semantic Web for the Working Ontologist - Effective Modeling in RDFS and OWL, Second Edition. Morgan Kaufmann.
6. Uschold, M. (2018). Demystifying OWL for the Enterprise. Synthesis Lectures on the Semantic Web: Theory and Technology, Morgan & Claypool Publishers.
7. Pearl, J., Mackenzie, D. (2018). The Book of Why. New York: Basic Books.

8. Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O"Reilly Media Company.
9. Goodfellow I., Bengio Y., & Courville, A. (2016). Deep Learning. The MIT Press.
10. Chollet, F. (2017). Deep Learning with Python. Manning.
11. Bostrom, N. (2014). Superintelligence: Paths, Dangers, Strategies. Oxford, UK: Oxford University Press.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 125 | 5,00 |
| Classes requiring direct contact with the teacher | 62 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 63 | 2,50 |