GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Artificial Intelligence (C003756)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 1)	Dutch	Gent	seminar
			lecture

Lecturers in academic year 2024-2025

Saeys, Yvan	WE02	lecturer-in-charge

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Bachelor of Science in Computer Science	6	A

Teaching languages

Dutch

Keywords

Knowledge representation and inference, machine learning, search and heuristics, neuaral networks and deep learning, natural language processing

Position of the course

Artificial intelligence (AI) is the study of solutions for problems that are difficult or impractical to solve with traditional methods. It is used pervasively in support of everyday applications such as email, word-processing and search, as well as in the design and analysis of autonomous agents that perceive their environment and interact rationally with the environment. The solutions rely on a broad set of general and specialized knowledge representation schemes, problem solving mechanisms and learning techniques. They deal with sensing (e.g., speech recognition, natural language understanding, computer vision), problem-solving (e.g., search, planning), and acting (e.g., robotics) and the architectures needed to support them (e.g., agents, multi-agents).
The study of Artificial Intelligence prepares the student to determine when an AI approach is appropriate for a given problem, identify the appropriate representation and reasoning mechanism, and implement and evaluate it.

Contents

Introduction to AI
- History of AI
- Turing Test
- Applications of AI today
- Ethical aspects of AI

Searching and planning
- Search problems
- Search strategies: uniformed search (DFS, BFS, UCS), Informed search (heuristics, greedy search, A*), graph search
- Adversarial search: adversarial games, minimax, alfa-beta pruning, expectimax
- Constraint satisfaction problems:
  - Backtracking
  - Heuristics
  - CSPs and tree search
  - Local search
- Metaheuristics
  - Genetic Algorithms

- Estimation of Distribution algorithms
- Nature inspired search

Knowledge representation and inference

- Bayesian networks:
  - (conditional) independence
  - inference
  - d-separation
  - Bayesian classifiers
  - Markov models
  - Hidden Markov models (Viterbi algorithm)
- Reinforcement learning

Neural networks

- introduction to supervised learning
- Backpropagation
- Auto-encoders
- Deep neural networks
- Generative AI

Interacting with the environment

- Natural language processing
  - Basics of speech recognition
  - Hiden Markov Models for ASR
  - Transformer models
  - Applications of NLP
- Explainable AI

Basics of Robotics

- Computer vision (basics)
- Simultaneous localization and mapping (SLAM)

Initial competences

Starting competences include a good knowledge of data structures and algorithms, basics of probability and statistics, programming in Python

Final competences

1 Describe Turing test and the Chinese Room thought experiment. [Familiarity]
2 Differentiate between the concepts of optimal reasoning/behavior and human-like reasoning/behavior. [Familiarity]
3 Determine the characteristics of a given problem that an intelligent system must solve. [Assessment]
4 Formulate an efficient problem space for a problem expressed in natural language (e.g., English) in terms of initial and goal states, and operators. [Usage]
5 Describe the role of heuristics and describe the trade-offs among completeness, optimality, time complexity, and space complexity. [Familiarity]
6 Describe the problem of combinatorial explosion of search space and its consequences. [Familiarity]
7 Select and implement an appropriate uninformed search algorithm for a problem, and characterize its time and space complexities. [Usage]
8 Select and implement an appropriate informed search algorithm for a problem by designing the necessary heuristic evaluation function. [Usage]
9 Evaluate whether a heuristic for a given problem is admissible/can guarantee optimal solution. [Assessment]
10 Formulate a problem specified in natural language (e.g., English) as a constraint satisfaction problem and implement it using a chronological backtracking algorithm or stochastic local search. [Usage]
11 Compare and contrast basic search issues with game playing issues. [Familiarity]
12 Make a probabilistic inference in a real-world problem using Bayes' theorem to determine the probability of a hypothesis given evidence. [Usage]
13 Identify examples of classification tasks, including the available input features and output to be predicted. [Familiarity]
14 Explain the difference between inductive and deductive learning. [Familiarity]
15 Describe over-fitting in the context of a problem. [Familiarity]
16 Describe how AI techniques can be made more interpretable

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Study material

Type: Handouts

Name: Lecture material'
Indicative price: Free or paid by faculty
Optional: no
Additional information: Lecture material will be made available through Ufora

References

"Artificial Intelligence: A Modern Approach" (3rd ediction) Stuart Russell and Peter Norvig ISBN-13: 978-0136042594

Course content-related study coaching

Personal contact with the lecturer, by e-mail or by appointment

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Oral assessment, Skills test, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Calculation of the examination mark

Niet-periodegebonden evaluatie: individuele opdrachten (40%) + periodegebonden: examen (60%). Om te kunnen slagen voor het opleidingsonderdeel moet een student minstens 10/20 behalen voor de niet-periodegebonden evaluatie. Is aan deze voorwaarde niet voldaan, dan kan een student niet meer dan 8/20 halen voor dit vak.
Indien niet geslaagd voor de niet-periodegebonden evaluatie, kan de student als compenserende activiteit een projectwerk maken voor de 2e zittijd.