

## 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
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**Lecturers in academic year 2024-2025**

Saeyns, Yvan

WE02 lecturer-in-charge

**Offered in the following programmes in 2024-2025**

[Bachelor of Science in Computer Science](#)

crdts	offering
6	A

**Teaching languages**

Dutch

**Keywords**

Knowledge representation and inference, machine learning, search and heuristics, neural 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, alpha-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
  - Hidden 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 edition) 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 zitting.