

## Artificial Intelligence (C003756)

Course size (nominal values; actual values may depend on programme)  
 Credits 6.0 Study time 180 h Contact hrs 60.0 h

### Course offerings and teaching methods in academic year 2020-2021

Offering	Language	Teaching Method	Hours
A (semester 1)	Dutch	project	15.0 h
		seminar: coached	5.0 h
		exercises	
		lecture	30.0 h
		seminar: practical PC room classes	10.0 h

### Lecturers in academic year 2020-2021

Saeyns, Yvan WE02 lecturer-in-charge

### Offered in the following programmes in 2020-2021

Programme	crdts	offering
<a href="#">Bachelor of Science in Computer Science</a>	6	A

### Teaching languages

Dutch

### Keywords

### 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

#### Fundamental issues

- Overview of AI problems, examples of successful recent AI applications
- What is intelligent behavior?
  - The Turing test
  - Rational versus non-rational reasoning
- Problem characteristics
  - Fully versus partially observable
  - Single versus multi-agent
  - Deterministic versus stochastic
  - Static versus dynamic
  - Discrete versus continuous
- Nature of agents
  - Autonomous versus semi-autonomous
  - Reflexive, goal-based, and utility-based
  - The importance of perception and environmental interactions
- Philosophical and ethical issues

#### Basic Search Strategies

- Problem spaces (states, goals and operators), problem solving by search

- Factored representation (factoring state into variables)
- Uninformed search breadth-first, depth-first, depth-first with iterative deepening)
- Heuristics and informed search (hill-climbing, generic best-first, A\*)
- Space and time efficiency of search
- Two-player games (introduction to minimax search)
- Constraint satisfaction (backtracking and local search methods)

### **Basic Knowledge Representation and Reasoning**

- Review of propositional and predicate logic
- Resolution and theorem proving (propositional logic only)
- Forward chaining, backward chaining
- Review of probabilistic reasoning, Bayes theorem

### **Basic Machine Learning**

- Definition and examples of broad variety of machine learning tasks, including classification
- Inductive learning
- Simple statistical-based learning, such as Naive Bayesian Classifier, decision trees
- The over-fitting problem
- Measuring classifier accuracy

### **A selection of the following topics will be taught:**

- Advanced Search,
- Advanced Representation and Reasoning
- Reasoning Under Uncertainty
- Agents
- Natural Language Processing
- Robotics
- Perception and Computer Vision

Initial competences

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 Translate a natural language (e.g., English) sentence into predicate logic statement. [Usage]
- 13 Convert a logic statement into clause form. [Usage]
- 14 Apply resolution to a set of logic statements to answer a query. [Usage]
- 15 Make a probabilistic inference in a real-world problem using Bayes' theorem to determine the probability of a hypothesis given evidence. [Usage]
- 16 List the differences among the three main styles of learning: supervised, reinforcement, and unsupervised. [Familiarity]
- 17 Identify examples of classification tasks, including the available input features and output to be predicted. [Familiarity]
- 18 Explain the difference between inductive and deductive learning. [Familiarity]
- 19 Describe over-fitting in the context of a problem. [Familiarity]
- 20 Apply the simple statistical learning algorithm such as Naive Bayesian Classifier to a classification task and measure the classifier's accuracy. [Usage]

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

Lecture, project, seminar: coached exercises, seminar: practical PC room classes

#### Learning materials and price

#### References

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

#### Course content-related study coaching

#### Evaluation methods

end-of-term evaluation and continuous assessment

#### Examination methods in case of periodic evaluation during the first examination period

Written examination with open questions

#### Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions

#### Examination methods in case of permanent evaluation

Oral examination, skills test, report

#### Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

#### Calculation of the examination mark