# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Artificial intelligence in robotics [S2AiR2-RiSA>SIwR]

## Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Autonomous Robots and Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

prof. dr hab. inż. Piotr Skrzypczyński
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## Lecturers

## Prerequisites

Student starting this course should have extended knowledge of programming practice, architecture of computer systems and operating systems, linear algebra and optimization. He should also have the ability to obtain information from the indicated sources.

## Course objective

The module aims to provide to the students basic concepts, methods and algorithms regarding the foundations of artificial intelligence and its selected areas related to robotics. Important specific goals include understanding the problem of knowledge representation and becoming familiar with selected methods of its representation, including uncertain and incomplete knowledge, becoming familiar with methods of inference, building and searching state spaces, becoming familiar with probabilistic methods used in artificial intelligence. The lecture gives also a general introduction to machine learning with selected statistical learning and classification algorithms. All discussed issues are illustrated with examples related to robotics.

## Course-related learning outcomes

Knowledge:

K2_W2 has structured and in-depth knowledge of artificial intelligence methods and their applications in automation and robotics systems;
K2_W9 has a structured and deep knowledge of adaptive systems

Skills:
K2_U10 is able to determine models of simple systems and processes, as well as use them for the purposes of analysis and design of automation and robotics systems; K2_U26 is able to construct an algorithm for solving a complex measuring and computing-control task and implement, test and run it in a selected programming environment on a microprocessor platform;
K2_U25 is able to construct an algorithm to solve a complex and non-typical engineering task and a simple research problem and to implement, test and run it in a selected programming environment for selected operating systems operating systems;

Social competences:
K2_k2 understands the need and knows the possibilities of continuous training - raising professional, personal and social competences, is able to inspire and organize the learning process

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

ecture: written exam (checking theoretical knowledge) in the field of lectures: concepts, methods, algorithms.Laboratories: checking practical skills in the field of implementation of selected methods introduced during the lecture, evaluation of reports.

## Programme content

Introduction - brief history of AI and relationships with robotics, definitions and areas of application
Types and architectures of AI systems, examples of applications in robotics.
Representation and processing of symbolic information.
Rule and expert systems, knowledge-based systems.
The concept of state space and search algorithms.
Methods for representing uncertain and incomplete knowledge and their application in robotics.
Probabilistic methods in AI and Bayesian networks.
Probabilistic graph models.
Semantic networks.
Agent concepts and (multi)agent systems.
Introduction to supervised and unsupervised machine learning.
Statistical learning systems.
Final remarks - directions of joint development of AI and robotics.

Laboratory (each topic includes from 3 to 3 classes)

Knowledge representation methods and rule systems.
Searching the space of states in robotics (Dijkstra, Floyd-Warshall, A*)
Uncertain and incomplete knowledge - fuzzy reasoning in robotics.
Application of the Bayes rule and Bayesian networks.
Application of graph models in robotics (conditional random fields)
Selected methods of statistical learning (classifiers)

## Course topics

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## Teaching methods

. Lecture: multimedia presentation, illustrated with examples2. Laboratory exercises: carrying out the tasks given by the teacher - practical exercises

## Bibliography

Basic:
3.. Russell S., Norvig P., Artificial Intelligence: A Modern Approach, 3rd Ed., Pearson, 3
3
.3. Nilsson N. J., Artificial Intelligence: A New Synthesis, Morgan Kaufmann, 39983. Flasiński M., Wstęp do sztucznej inteligencji, PWN, 3
33.4. Rutkowski L., Metody i techniki sztucznej inteligencji. PWN, 3
9

Additional:
1. Koronacki J., Ćwik J., Statystyczne systemy uczące się. wyd. 2, EXIT, 2008.2. Cichosz P., Systemy uczące
się, WNT, 2009.3. Krawiec K., Stefanowski J., Uczenie maszynowe i sieci neuronowe. Wyd. Politechniki Poznańskiej, 2004.4. Bolc L., Borodziewicz W., Wójcik M., Podstawy przetwarzania informacji niepewnej i niepełnej, PWN, 1991.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,00 |
| Classes requiring direct contact with the teacher | 60 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 40 | 1,50 |