**Nazwa przedmiotu:**

Introduction to Artificial Intelligence

**Koordynator przedmiotu:**

Jarosław Arabas

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Computer Science

**Grupa przedmiotów:**

Technical Courses

**Kod przedmiotu:**

EARIN

**Semestr nominalny:**

8 / rok ak. 2015/2016

**Liczba punktów ECTS:**

6

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

- lectures attendance: 15 x 2 h = 30 h;
- preparation to lectures (reviewing slides, notes and a textbook): 30 h;
- laboratory attendance: 15 x 1 h = 15 h ;
- preparation to laboratories 45 h;
- project activity 60 h

total: 180h

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

2

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

4

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład:  | 30h |
| Ćwiczenia:  | 0h |
| Laboratorium:  | 15h |
| Projekt:  | 15h |
| Lekcje komputerowe:  | 0h |

**Wymagania wstępne:**

Students must have basic programming skills

**Limit liczby studentów:**

30

**Cel przedmiotu:**

Students will get a general picture of Artificial Intelligence with a stress on knowledge acquisition and its use in supporting decisions. Students will learn the knowledge representation methods (decision rules and decision trees), the way of inferring them from data, and the way in which they can be used for supporting decisions. The second objective is to preset the modern approach to Artificial Intelligence, in which problems are formulated as space searching tasks, and problem solving is equivalent to searching the space. In this context, several most popular search methods will be overviewed.

**Treści kształcenia:**

The lecture starts from the logic fundamentals of Artificial Intelligence and presents methods of automated inference in the predicate logic. Then the inference process is re-interpreted as a space searching task, and depth-first and breadth-first search methods are presented. Next step is the overview of decision rule inference methodologies, with a stress on Rough Sets. The process of searching for decision rules is again presented as a space searching task, and few searching techniques are introduced and compared. They include various versions of best-first heuristic search methods, and few selected metaheuristics, including simulated annealing, artificial immune and evolutionary methods. After that, decision trees inference is presented, in particular ID3 and C4.5 methods, and random forests.
Program of the lecture
1. Introduction (2h): weak and strong AI, concept of problem solving by searching, relation between the formulating the problem as a search task and its solvability.
2. Predicate logic(2h): basic concepts: formulas, logical functions, variables, relation to the set theory, normal forms.
3. PROLOG as an example system of inference in predicate logic (4h): example predicates, inference mechanism, substitution and unification.
4. Inference in predicate logic as a search task (2h): space of proofs, depth-first and breadth-first search.
5. Learning from data (2h): taxonomy of learning tasks, decision rules as a method to represent knowledge, concept of decision rules learning, ideas of AQ and Rough Set approach.
6. Rough Set approach (4h): indiscernibility relation, concepts of reduct and core indescernibility matrix, reduct derivation, decision rules inference as a searching task.
7. Heuristic search methods (4h): heuristic function, best-first search algorithms: uniform cost, greedy and A\*.
8. Metaheuristic search methods (4h): simulated annealing, artificial immune system, evolutionary algorithm, role of randomness in attaining global optimization.
9. Decision trees (4h): relation between decision trees and decision rules, learning decision tree from data (ID3), overview of problems with unbalanced attribute domains and examples, measures of quality of a tree, overlearning, C4.5.
10. Ensembles of learning systems (2h): idea of bootstrapping, reducing generalization error by bootstrapping, random forests.

The laboratory starts in the second week of the course and is held every second week. Each meeting takes two hours (except for the last one).
1. Writing example predicates in PROLOG (4h): searching paths in graphs, solving simple puzzles.
2. Introduction to R (2h).
3. Exercising Rough Set methology (2h): finding reducts of example information systems, learning role of attribute discretization.
4. Defining heuristic functions (4h): graph problems and board puzzles.
5. Exercising ID3 algorithm (2h): finding decision trees of example information systems, comparison to the Rough Set methodology, learning role of attribute discretization.
6. Bagging and random forests(1h).

During the project, students will realize a whole semester task. These tasks can be twofold:
1. Learning decision rules or decision trees from specific types of data, with the use of methods which are modifications of standard ones.
2. Implementation of programs of the following types:
a) PROLOG programs which solve decision supporting problems,
b) Board puzzles and board games with the use of heuristic function and heuristic search methods.
Project is implemented in two-person teams.

**Metody oceny:**

During the lab exercises it is possible to score up to 20 points:
5 points for exercise 1.
5 points for the exercise 3
5 points for the exercise 4
5 points for the exercise 5
The project is scored up to 30 points. The final exam is scored up to 50 points. Students are allowed to take an exam after they have completed the work on their project.
The final grade is based on the total number of points. To pass the exam, it is necessary to obtain minimum 10 points. Under that condition, the final grade is obtained according to the following pattern:
5.0: 91-100 points
4.5: 81-90 points
4.0: 71-80 points
3.5: 61-70 points
3.0: 51-60 points
2.0: 0-50 points
If the exam is not passes, the final grade is 2.0, regardless of the total number of points obtained.

**Egzamin:**

tak

**Literatura:**

1. G. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Addison-Wesley, 2008.
2. Z. Michalewicz, D. Fogel: How to solve it: modern heuristics, Springer, 2004.
3. S.Russell, P.Norvig, Artificial Intelligence: a modern approach, Prentice Hall, 2002.
4. http://www.roughsets.org.

**Witryna www przedmiotu:**

https://studia.elka.pw.edu.pl

**Uwagi:**

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt EARIN\_W01:**

knowledge about basic techniques of artificial intelligence

Weryfikacja:

tests

**Powiązane efekty kierunkowe:** K\_W08

**Powiązane efekty obszarowe:** T1A\_W03, T1A\_W04, T1A\_W07

### Profil ogólnoakademicki - umiejętności

**Efekt EARIN\_U01:**

ability to apply techniques of artificial intelligence to example case problems

Weryfikacja:

laboratory and project activities

**Powiązane efekty kierunkowe:** K\_U08

**Powiązane efekty obszarowe:** T1A\_U08, T1A\_U09

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt EARIN\_K01:**

realization of a project in small teams

Weryfikacja:

project

**Powiązane efekty kierunkowe:** K\_K04

**Powiązane efekty obszarowe:** T1A\_K03, T1A\_K04