1. Course title: MACHINE LEARNING, Evolutionary algorithms

2. Course code: ML_EA


4. Level of studies: MSc programme

5. Mode of studies: intramural studies

6. Field of study:
   CONTROL, ELECTRONIC AND INFORMATION ENGINEERING (MACRO)

7. Profile of studies: ACADEMIC

8. Programme: DATA SCIENCE

9. Semester: 1

10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science

11. Course instructor: Dr hab. inż. Robert Czabański

12. Course classification: common courses

13. Course status: compulsory

14. Language of instruction: English


16. Course objectives: The aim of the course is making students familiar with issues related to evolutionary algorithms and their applications to engineering constructions in automation, electronics, informatics and biocybernetics. Relations between evolutionary algorithms and optimization theory and classification methods are underlined.

17. Description of learning outcomes:

<table>
<thead>
<tr>
<th>Nr</th>
<th>Learning outcomes description</th>
<th>Method of assessment</th>
<th>Teaching methods</th>
<th>Learning outcomes reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Student understands the notion of evolutionary algorithms and their importance to modeling, optimization, classification, data analyses</td>
<td>Credit</td>
<td>Lecture</td>
<td>K2A_W20, K2A_W25</td>
</tr>
<tr>
<td>2.</td>
<td>Student understands ideas and constructions behind basic types of evolutionary algorithms, genetic, memetic, simulated annealing, ant colony, particle swarm, nature inspired.</td>
<td>Credit</td>
<td>Lecture</td>
<td>K2A_W20, K2A_W26</td>
</tr>
<tr>
<td>3.</td>
<td>Student is able to elaborate, in R and Python environment, implementations of chosen evolutionary algorithms.</td>
<td>Laboratory tasks</td>
<td>Laboratory</td>
<td>K2A_U05, K2A_U09</td>
</tr>
<tr>
<td>4.</td>
<td>Student is able to compare and validate quality of different evolutionary algorithms.</td>
<td>Laboratory tasks</td>
<td>Laboratory</td>
<td>K2A_U09, K2A_U10</td>
</tr>
</tbody>
</table>
5. Student is able to perform analysis of the exemplary dataset, with the use of the chosen evolutionary algorithms.

<table>
<thead>
<tr>
<th>Laboratory tasks</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K2A_U04, K2A_U08, K2A_K06</td>
</tr>
</tbody>
</table>

18. Teaching modes and hours
Lecture 15 / BA/MA Seminar / Class / Project / Laboratory 15

19. Syllabus description:

Lecture:
1. Introductory facts on evolutionary algorithms for learning and optimization. Evolutionary programming, evolutionary strategies.
2. Applications of evolutionary algorithms in engineering, automatic control, electronics, biocybernetics.
4. Genetic algorithms, Memetic algorithms
5. Simulated annealing, probabilistic background and relations to optimization theory.
6. Ant colony optimization, particle swarm algorithms
7. Immune algorithms, nature inspired programming

Laboratory:
1. Application of genetic algorithm for the traveling salesman problem
2. Software development for the estimation problem by using a chosen evolutionary algorithm
3. Analysis of a real dataset by using evolutionary algorithm. Comparison to application of a publicly available tool.

20. Examination: semester NO

21. Primary sources:
D. Simon, (2013), Evolutionary optimization algorithms, Wiley.

22. Secondary sources:

23. Total workload required to achieve learning outcomes

<table>
<thead>
<tr>
<th>Lp.</th>
<th>Teaching mode</th>
<th>Contact hours / Student workload hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>15/30</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>/</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>15/30</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>/</td>
</tr>
<tr>
<td>5</td>
<td>BA/MA Seminar</td>
<td>/</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>/</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>30/360</td>
</tr>
</tbody>
</table>

24. Total hours: 90

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 1

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2

26. Comments:
Approved:

........................................................................................................
........................................................................................................
(date, Instructor's signature) (date, the Director of the Faculty Unit signature)