SYLLABUS

Name: ***Evolutionary Algorithms (MakAu-DS>SM1EA19)***
Name in Polish:
Name in English: ***Evolutionary Algorithms***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau3/course/view.php?id=389

Short description:

The aim of the course is to familiarize students with issues related to evolutionary algorithms (EA) and their applications in engineering, particularly in the fields of automation, electronics, data science, and biocybernetics. The course emphasizes the relationships between evolutionary algorithms, optimization theory, and learning methods. Students will also have the opportunity to gain practical experience with these methods during laboratory sessions. Form of classes: contact (in-person).

Description:

ECTS credits: 3.
Total workload: 75 hours (35 contact hours, 40 hours of student's individual work).
Types of contact hours:
- lecture: 15 hours,
- laboratory: 15 hours,
- other (e.g. test and report revision, discussion): 5 hours.

Student's individual work includes preparation for laboratory classes, implementation of evolutionary algorithm methods, report writing, and preparation for tests.

Lecture:
- Introduction to evolutionary learning and optimization.
- Genetic algorithms, evolutionary strategies, and genetic programming.
- Basic and advanced concepts of evolutionary computation; applications in engineering, automatic control, electronics, and cybernetics.
- Fitness functions, selection mechanisms, and population management; stopping criteria; performance evaluation; computational complexity in evolutionary algorithms
- Memetic algorithms.
- Simulated annealing: probabilistic foundations and connections to optimization theory.
- Artificial immune systems.
- Swarm intelligence: ant colony optimization and particle swarm optimization.
- Bat algorithm, firefly algorithm, flower pollination algorithm, and other nature-inspired optimization techniques.

Laboratory:
- Combinatorial optimization: genetic algorithms, ant colony optimization.
- Multimodal optimization: evolutionary strategies, particle swarm optimization.
- Data analysis and performance comparison of optimization methods.

Bibliography:

- A.E. Eiben, J.E. Smith, Introduction to Evolutionary Computing, Springer-Verlag Berlin Heidelberg 2015.
- Z. Michalewicz, Genetic Algorithms + Data Structures = Evolution Programs, Springer-Verlag Berlin Heidelberg, 1996.
- D. Simon, Evolutionary Optimization Algorithms (Biologically-Inspired and Population-based Approaches to Computer Intelligence), John Wiley & Sons, Inc., 2013.
- R.S. Sutton, A.G. Barto, Reinforcement Learning: An Introduction, The MIT Press, Cambridge, Massachusetts, London, England, 2017.
- X. Yu, M. Gen, Introduction to Evolutionary Algorithms, Springer-Verlag London Limited, 2010.

Learning outcomes:

At the completion of the course, the student:
- understands the concept of evolutionary algorithms and their role in modelling, optimization, and data analysis (laboratory report) – K2A_W10,
- understands the principles behind basic types of evolutionary algorithms (laboratory report, test, final test) – K2A_W10, K2A_W16,
- is able to implement selected evolutionary algorithms (laboratory report) – K2A_W10, K2A_U01,
- is able to analyze an exemplary dataset and assess the performance of a selected evolutionary computation method (laboratory report) – K2A_U01, K2A_U07, K2A_U12.

Assessment methods and assessment criteria:

Students are required to pass the final written test (T), complete all laboratory exercises, and achieve a passing grade on each laboratory report (minimum 3.0 points per report).

The passing criterion for the final test is achieving a minimum score of 2.75 points, which corresponds to at least 55% correct answers. A student may be exempted from the final test based on the results of quizzes (tests). Quizzes are graded on a scale from 2.0 to 5.0, in 0.5-point increments. To qualify for exemption, the student must obtain at least three grades of 3.0 or higher and achieve an average score of at least 2.75 across all quizzes. Absence during a quiz results in a score of 0.

Laboratory exercises (reports) are graded on a scale from 2.0 to 5.0, in increments of 0.5. The final laboratory grade (L) is calculated as the arithmetic mean of the grades obtained for individual laboratory tasks. Missed laboratory classes can be made up on dates specified in the course schedule.

The final grade (FG) is calculated as the average of the written test grade (T) and the laboratory grade (L), according to the formula:
FG = (T + L) / 2.

Final grades are rounded based on the following rules:
[3.00 – 3.25) → 3.0,
[3.25 – 3.75) → 3.5,
[3.75 – 4.25) → 4.0,
[4.25 – 4.75) → 4.5,
[4.75 – 5.00] → 5.0.

The syllabus is valid from academic year 2025/26 and its content cannot be changed during the semester.

Element of course groups in various terms:

Course group description	First term	Last term
missing group description in English (MakAu>SM1-DS-19)	2020/2021-L	
Automation, electronics and informatics sem. 1 (AEIAu>SM_1)	2024/2025-Z	

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	3	2020/2021-L	