GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

| | | | |
|---|---|---|---|
| Subject name and code | Genetic Algorithms, PG_00047706 | | |
| Field of study | Automatic Control, Cybernetics and Robotics | | |
| Date of commencement of studies | October 2020 | Academic year of realisation of subject | 2023/2024 |
| Education level | first-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 4 | Language of instruction | Polish |
| Semester of study | 7 | ECTS credits | 3.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Decision Systems and Robotics -> Faculty of Electronics, Telecommunications and Informatics | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Tomasz Białaszewski | |
| | Teachers | dr inż. Tomasz Białaszewski | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 15.0 | 0.0 | 0.0 | 15.0 | 0.0 | 30 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 30 | 3.0 | 42.0 | 75 |

**Subject objectives**

The main goal of the subject is to acquaint students with evolutionary algorithms. The lecture covers the following issues : evolutionary optimization techniques; encoding and decoding of parameters; methods of assessment of the fitness degree; selection methods of individuals; genetic operations; replacement strategies. scaling methods; niching methods. multi-objective optimization methods

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W01] Knows and understands, to an advanced extent, mathematics necessary to formulate and solve simple issues related to the field of study | Student knows the problems associated with the implementation of numerical methods algorithms<br><br>Student has knowledge of genetic and optimization algorithms.<br><br>Student describes the basic optimization algorithms.<br><br>Student defines the concepts used in genetic algorithms. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |
| [K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn | Student is able to apply genetic algorithms in control theory problems<br><br>Student explains the rules for assessing the solutions of multi-criteria tasks used in optimization methods | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment |
| [K6_W21] Knows and understands the basic methods of decision making as well as methods and techniques of design and operation of automatic regulation and control systems, computer applications for controlling and monitoring dynamic systems. | Student explains the basic mechanisms used in genetic algorithms.<br><br>Student demonstrates the use of genetic algorithms | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |

| | |
|---|---|
| Subject contents | 1. Organization of classes and principles of assessment<br>2. Biological foundations of genetic approach<br>3. Optimization methods survey<br>4. Classification of search methods<br>5. Basis of genetic algorithms<br>6. Encoding and decoding of parameters<br>7. Assessment of the fitness degree<br>8. Selection methods of individuals<br>9. Genetic operations<br>10. Replacement strategies<br>11. Scaling methods<br>12. Scheme theory<br>13. Niching methods<br>14. Multi-objective optimization problems<br>15. Genetic programming<br>16. Evolutionary algorithms in multi-objective parametrical i strukturalnej optimization of systems |
| Prerequisites and co-requisites | |

Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Assessment in the form of exam | 50.0% | 60.0% |
| Execution of project | 25.0% | 40.0% |

Recommended reading

Basic literature


Arabas J.: Wykłady z algorytmów ewolucyjnych. WNT, Warszawa 2001.

Berg P., Singer M.: Język genów, poznawanie zasad dziedziczenia. Prószyński i S-ka, Warszawa 1997.

Goldberg D.E.: Genetic algorithms in search, Optimisation and Machine Learning. Addison-Wesley, Massachusetts 1989.

Michalewicz Z., Fogel D. B.: How to solve it: Modern Heuristics. 2nd edition, Springer-Verlag, Berlin 2004.

Michalewicz Z.: Genetic Algorithms + Data Structures = Evolution Programms, Springer-Verlag, 3rd edition, Heidelberg - Berlin 1996.

Miller R. E.: Optimization. Foundations and applications. A Wiley-Interscience Publication, John Wiley & Sons, Inc. New York 2000.

Obuchowicz A.: Evolutionary Algorithms for Global Optimization and Dynamic System Diagnosis. Lubusky Scientific Society in Zielona Góra 2003.

Rutkowski L.: Metody i techniki sztucznej inteligencji. Wydawnictwo Naukowe PWN, Warszawa 2005.


Supplementary literature


Koza J. R.: Genetic Programming: On the Programming of Computers by Means of Natural Selection. The MIT Press, MA, Cambridge 1992.

Man K.S, Tang K.S., Kwong S., Lang W.A.H.: Genetic Algorithms for Control and Signal Processing. Springer-Verlag, London 1997.

| | | |
|---|---|---|
| | eResources addresses | |
| Example issues/ example questions/ tasks being completed | 1. Is it possible that a genetic algorithm without the mutation mechanism peaked global fitness function?<br>2. The population consists of 4 individuals with the following fitness degrees: 169, 576, 64 and 361. Determine the scaled fitness degree of individuals using the linear scaling with the multiplication factor equal to 2.<br>3. Assuming that an individual matching the pattern S has a degree of adaptation higher than the average of adapting the current population of 25%, determine in which generation scheme that monopolize population of 20, 50, 100 and 200 individuals. For calculations ignore the effect of crossover and mutation.<br>4. Please give the principle of mutation for trialleic coding.<br>5. List and briefly review the operations of crossing with floating-point representation.<br>6. A solution space contains 2097152 points. Enter the lower and upper estimate of the number of patterns processed during the evolutionary cycle to encode binary and octal encoding. Assuming that the population consists of 50 individuals. | |
| Work placement | Not applicable | |