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 2021	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Optional subject group 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_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. Student demonstrates the use of genetic algorithms	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[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 Student explains the rules for assessing the solutions of multi-criteria tasks used in optimization methods	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[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 Student has knowledge of genetic and optimization algorithms. Student describes the basic optimization algorithms. Student defines the concepts used in genetic algorithms.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects

Subject contents

1. Organization of classes and principles of assessment

2. Biological foundations of genetic approach

3. Optimization methods survey

4. Classification of search methods

5. Basis of genetic algorithms

6. Encoding and decoding of parameters

7. Assessment of the fitness degree

8. Selection methods of individuals

9. Genetic operations

10. Replacement strategies

11. Scaling methods

12. Scheme theory

13. Niching methods

14. Multi-objective optimization problems

15. Genetic programming

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
Execution of project	25.0%	40.0%
Assessment in the form of exam	50.0%	60.0%

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	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Is it possible that a genetic algorithm without the mutation mechanism peaked global fitness function? 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. 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. 4. Please give the principle of mutation for trialleic coding. 5. List and briefly review the operations of crossing with floating-point representation. 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	