

- COURSE SYLLABUS

1.	Course title:	
	<i>Elements of scientific programming with Python</i>	
2.	Lecturer:	
	<i>dr inż. Piotr Klejment</i>	
3.	Field, type and level of studies, year of study:	
	<i>all years of study, IT tools for scientists</i>	
4.	Course character:	
	<i>monographic lecture</i>	
5.	Teaching method:	
	<i>traditional or traditional + on-line</i>	
6.	Language:	<i>English</i>
7.	Course type and number of hours:	
	<i>Lecture, 24 h</i>	
8.	Estimated load of student's independent work:	<i>16 h</i>
9.	Total workload and number of ECTS points:	<i>40 h, 2 ECTS</i>
10.	Short description and main focus of the course:	
	<p><i>GENERAL DESCRIPTION</i></p> <p><i>Python is one of the most important and useful programming languages in the world of Earth sciences. The main goal of this course is to present Python in tight connection with mathematical applications and to show how to use Python for scientific and computational purposes. Students with no previous contact with the Python language can participate in the course - the demonstrated issues will be discussed from scratch, and the goal is to reach an intermediate level at the end.</i></p> <p><i>COURSE OUTLINE</i></p> <p><i>1) Python – basic syntax and program structure, functions, Object-Oriented Programming. Python libraries - Pandas for the analysis of data sets, NumPy and SciPy calculation modules with effective numerical algorithms, Matplotlib and Seaborn plotting modules for graphical representation of calculation results, SymPy for combining symbolic and numerical calculations.</i></p>	

	<p>2) Numerical methods with Python for solving equations that can be applied to geoscience problems – Linear Algebra, Systems of Linear Equations, Eigenvalues and Eigenvectors, Interpolation, Numerical Differentiation and Integration, Ordinary Differential Equations: Initial-Value Problems and Boundary-Value Problems, Fourier Transform.</p> <p>3) Statistical methods for the analysis and interpretation of data - Averaging, Variance, Standard Deviation, Skewness, Kurtosis, Moments and others, Estimating Population Parameters, Distribution Functions, Correlation and Regression, Monte Carlo Methods.</p> <p>4) Parallel Programming - running calculations in parallel on many processors of the same computer, an example of a more advanced application of Python - Natural Language Processing.</p>				
11.	References:				
	books, on-line resources				
12.	Prerequisites:				
	basic computer literacy, familiarity with computer languages would be an asset.				
13.	<table border="1"> <tr> <td data-bbox="223 840 1050 1400"> Educational outcomes: Knowledge: Student knows and understands: (P8S_WG) the world's achievements relating to: theoretical foundations, general and selected specific issues of the solving of numerical problems at a level enabling the revision of existing paradigms; the main scientific developments in the academic or artistic disciplines essential to the study programme; the methodology of scientific research (with computer programming language Python) rules for dissemination of scientific results (from numerical simulations) </td> <td data-bbox="1050 840 1447 1400"> PQF level 8 codes: P8S_WG </td> </tr> <tr> <td data-bbox="223 1400 1050 2072"> Practical Skills: Student is able to: (P8U_U) analyse and creatively synthesise scientific and creative achievements to identify and solve (numerical) research problems as well as those related to innovative and creative activities; contribute new elements to these achievements; independently plan one's own development as well as inspire the development of others; participate in the exchange of experiences and ideas, also in the international community (P8S_UW) take advantage of programming skills to creatively identify, formulate and innovatively solve complex problems or perform research activities, especially: to define the aim and subject of the research, formulate a research hypothesis, develop research methods, techniques and tools and use them creatively draw conclusions on the basis of research results; perform critical analysis and evaluation of the results of </td> <td data-bbox="1050 1400 1447 2072"> P8U_U, P8S_UW </td> </tr> </table>	Educational outcomes: Knowledge: Student knows and understands: (P8S_WG) the world's achievements relating to: theoretical foundations, general and selected specific issues of the solving of numerical problems at a level enabling the revision of existing paradigms; the main scientific developments in the academic or artistic disciplines essential to the study programme; the methodology of scientific research (with computer programming language Python) rules for dissemination of scientific results (from numerical simulations)	PQF level 8 codes: P8S_WG	Practical Skills: Student is able to: (P8U_U) analyse and creatively synthesise scientific and creative achievements to identify and solve (numerical) research problems as well as those related to innovative and creative activities; contribute new elements to these achievements; independently plan one's own development as well as inspire the development of others; participate in the exchange of experiences and ideas, also in the international community (P8S_UW) take advantage of programming skills to creatively identify, formulate and innovatively solve complex problems or perform research activities, especially: to define the aim and subject of the research, formulate a research hypothesis, develop research methods, techniques and tools and use them creatively draw conclusions on the basis of research results; perform critical analysis and evaluation of the results of	P8U_U, P8S_UW
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	<p><i>scientific research, expert activities and other works of a creative nature and their contribution to knowledge;</i></p> <p><i>transfer the results of research studies to the economic and social spheres</i></p>	
	<p>Social Skills: Student is ready to:</p> <p><i>(P8U_K) conduct independent research (own numerical simulations) which contributes to existing scientific and creative achievements;</i></p> <p><i>assume professional and public challenges taking into consideration: their ethical dimension, responsibility for their results and develop models of good practice in such situations</i></p> <p><i>(P8S_KK) critically evaluate the achievements in scientific programming;</i></p> <p><i>critically evaluate one's contributions to the development of that field;</i></p> <p><i>recognize the value of knowledge in solving cognitive and practical problems</i></p>	P8U_K, P8S_KK
14.	Evaluation of the educational outcomes:	
	<i>projects (homework assignments) + lecture activities + tests</i>	
15.	Criteria to complete the course:	
	<i>achieving the appropriate threshold of points from all tests and activities + attendance</i>	
16.	Contact with the lecturer:	
	<i>email (pklejment@igf.edu.pl), possible personal consultations</i>	