Julia@GeoPlanet
- ***COURSE SYLLABUS***

1.	**Course title:** *Scientific programming in Julia*	
2.	**Lecturers:** *Dr Przemysław Szufel, Prof. Piotr Gawron*	
3.	**Field, type and level of studies, year of study:** *all disciplines, all years of study*	
4.	**Course character:** *GeoPlanet interdisciplinary workshop*	
5.	**Teaching method:** *in-person, lectures and hands-on numerical workshop*	
6.	**Language:**	*English*
7.	**Course type and number of hours:** *3 day workshop, 8 hours each day*	
8.	**Estimated load of student's independent work:**	*24 h*
9.	**Total workload and number of ECTS points:**	*48 h, 1,5 ECTS*
10.	**Short description and main focus of the course:** *The course will cover introduction to Julia programming language, elements of machine learning, introduction to neural networks, and introduction to distributed computing.* *Day I* 1. *Basics* a. *What is the Julia language - motivation and key design concepts, managing virtual environment and packages* b. *Installing and running Julia, Julia IDE (VS Code, Jupyter notebook)* c. *Getting help in Julia and available resources about Julia* d. *Basic data structures (dictionaries, tuples, matrices, structures)* 2. *Working with data sources* a. *Simple Delimited Files* b. *CSV* c. *JSON* d. *Microsoft Excel* e. *Apache Arrow*	

3. *Data Visualizations with Plots.jl*
    a. *Working with Plots.jl and backends, aimations*
    b. *Plots for scientific reports, LaTeX integration*

4. *Data transformations (use case scenario illustrated with a simple GLM model)*
    a. *Introduction to Data Frames*
    b. *data transformations*

Day II - TBA

Day III

1. *Managing virtual environments and packaging code*
    a. *Virtual environment*
    b. *Creating packages*
    c. *GitHub integration of Julia packages*
    d. *Unit testing*

2. *Julia Performance condiderations*
    a. *Code benchmarking*
    b. *Basic performance considerations*

3. *Scaling_out_Computations*
    a. *Single Instruction Multiple Data (SIMD)*
    b. *Green threading*
    c. *Multi-threading*
    d. *Parallel computing*
    e. *Distributed computing and running Julia clusters*

11. **References:**

Introductory

- *Follow the installation instructions: https://julialang.org/downloads/platform/*
- *For quick start look at http://bogumilkaminski.pl/files/julia_express.pdf*
- *Main page of Julia*
- *Julia foundations by Danielle Navarro*
- *Julia in VSCode*

Moderate

- *Data Frames by Danielle Navarro*
- *Plotting by Danielle Navarro*

Extensive

- *Julia manual*
- *Documentation for Flux.jl — neural networks library in Julia*
- *Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. Published by Cambridge University Press. — an excellent introductory book to machine learning.*
- *The git book*
- *Julia academy*

12. **Prerequisites:**

	basic knowledge in programming, calculus and linear algebra	
13.	**Educational outcomes:**	**PQF level 8 codes:**
	Knowledge: *The student knows and understands (a) the basic and advanced features of the Julia programming language and the basic techniques of machine learning, (b)the methodology of scientific research (with Julia programming language) (c) the main scientific developments in the academic discipline essential to the study program.*	*P8S_WG*
	Practical Skills: *Student is able to: (a) analyze and creatively synthesize scientific and creative achievements to identify and solve (numerical) research problems as well as those related to innovative and creative activities, (b) independently plan one's own development as well as inspire the development of others, (c) participate in the exchange of experiences and ideas, also in the international community, (d) take advantage of programming skills to creatively identify, formulate and innovatively solve complex problems or perform research activities, (e) perform critical analysis and evaluation of the results of scientific research, expert activities and other works of a creative nature and their contribution to knowledge.*	*P8S_UW*
	Social Skills: *Student is ready to: (a) conduct independent research (own numerical programme) which contributes to existing scientific and creative achievements, (b)critically evaluate the achievements in scientific programming, (c) critically evaluate one's contributions to the development of that field, (d) recognize the value of knowledge in solving cognitive and practical problems*	*P8S_KK*
14.	**Evaluation of the educational outcomes:**	
	Program written in Julia	
15.	**Criteria to complete the course:**	
	final grade depends on the evaluation of the report	
16.	**Contact with the lecturer:**	
	Piotr Gawron <*gawron@camk.edu.pl*>, *Przemysław Szufel* <*pszufe@sgh.waw.pl*>	