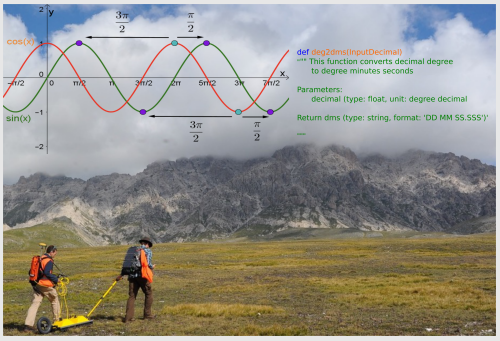

Intro. Scientific Programming in Python

Geow-M317-325-21-1

Instructor Info

R. Drews / W. Kappler

Office Hrs: on demand.

GUZ 3U37 / 3U35

Website

reinhard.drews@uni-tuebingen.de

Course Info

Prereq: None

Mondays

08:30-10.00

4F03

Lab Info

Wednesdays

16:00 - 20:00

4F03

Module Context

World-wide technical advances in monitoring the surface and sub-surface result in a new data environment for modern Geo- and Environmental sciences. Problem solving increasingly requires rigorous models and also integration of observations varying in space and time. Extracting the relevant information is achieved with computational methods that also require an understanding of the underlying mathematical principles. The goals of the 6 ECTS module *Data and Modelling Methods in Geo- and Environmental Sciences* are (1) that students are able to understand selected mathematical concepts, (2) that they can implement them computationally, and (3) that they can apply them to geo- and environmental related problems. The module is subdivided into several 2 ECTS containers which are graded individually, and which can be combined to complete the full module. For the WS 2021-2022 available containers are:

Data and Modelling Methods in Geo- and Environmental Sciences (WS 22/23)

Scientific Programming (Python)	Drews & Kappler
Scientific Programming (Matlab)	Zarfl
Time Series Analysis 1	Rehfeld
Machine Learning 1	Goswami
Machine Learning 2	Goswami

A similar module will also exist in the SS, e.g., with courses pertaining to Finite Element Method (Cirpka), Principles of Model Calibration (Finke), GIS (Zarfl), Advanced Time Series Analysis (Rehfeld), and Geostatistics (Haslauer).

Container Content

The goal of the course is to provide an introduction into scientific computing, data analysis and programming using Python. Specifically, students will gain knowledge with respect to i) reading, writing, manipulating and plotting data ii) matrix algebra, solving linear equation systems and linear regression, iii) programming loops and conditional statements and writing functions and iv) solving simple differential equations and parameter inference. Weekly homework will be followed by final oral exam.

Grading

Grading is based on small group projects (max. 4 members) which need to be solved at the end of the course. The results of the project will need to be presented in an oral presentation with questions directed to the individual group members. The presentations will take place shortly after the container has finished to minimize overlap with other containers.

Preparation

In case you plan to use your own computer it is helpful that you have a running Python version already installed. We provide a virtual environment that can be run on any computer, please check the first exercise sheets prior to the lecture start. This will save us some time.

FAQs

Is this course hard?

Not sure. If you have some technical affinity combined with some desire to problem solve you are off to a good start. If you don't have these skills definitely take the course.

How to pass the exam?

Show us that you mastered programming and actively worked with the exercises. For top grades you need to impress us by transferring some skills to problems that we may not have treated in class.

Why do I have to suffer through this?

You don't as there are other containers to choose from. However, it will be a useful baseline for other containers, and hopefully equip you with technical skills needed for MSc projects. Some people say that programming experience helps you to find jobs.

Can I call myself a computer scientist after this course?

Not quite. But you can talk to them better than before.

This container stuff is confusing.

You will get the hang of it. It will continuously evolve and is designed to give you plenty of options to develop skills in areas that interest you. Don't hesitate to give us feedback.

Combination with other containers

Many other containers in this module will use some sort of programming expertise as pre-requiste. No other introduction will be provided. Not all containers will default to Python, however, from our experience students who have mastered Python can transition to, e.g., Matlab comparatively easily.

Material

In addition to the countless online resources some books (also available as online resource via the UB) may be helpful:

- *Earth Observation using Python: A Practical Programming Guide*, Esmaili R., 978-1-119-60688-8
- *Introduction to Python in Earth Science Data Analysis*, Petrelli M., ISBN 978-3-030-78055-5
- *A Primer on Scientific Programming with Python*, Langtangen H. P., ISBN 978-3-662-49887-3

Some URLs that we would recommend:

`https://www.studytonight.com/python/python-syntax-and-example`

`https://www.studytonight.com/numpy/python-numpy-arrays`

`https://www.studytonight.com/matplotlib/general-concepts-in-matplotlib`

`https://www.w3schools.com/python/python_syntax.asp`

Course organization

All course organization will be handled via Ilias. During class time we will give you lots of time to do work yourself. Use it.