Modelling Convergence Course

AESM1305

M.Sc. Track GeoEnergy Engineering

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1 Introduction

This document summarizes the reading material for the Modelling Convergence Course. This course is part of the bigger Geo-Energy Engineering Challenge course which in turn is part of the GeoEnergy Engineering track. This convergence course covers the basics of the following topics:

- Basic programming in Python
- Basic understanding of Linear Algebra
- Basic understanding of Numerical Methods
- Basic understanding of Statistics

Each section in this document provides a summary for the reading and self-study material of this course.

2 Programming

The programming in this course will be done in Python. This is in line with the demand of the professional market. Programming is already a vital ingredient in many engineering applications and will continue to be so. Therefore, having a basic understanding of Python, and programming principles, will be a vital tool in your engineering toolbox. This section contains lists on video tutorials, online courses, books, and simple online exercises.

2.1 Video tutorials and online courses

- Giraffe Academy

- Introduction to Python: Fundamentals (Microsoft)
- Python for Data Science (UC San Diego)
- Introduction to Python for Data Science (Microsoft)

NOTE: You don't need to pay for the edX courses if you want to view the videos. Just make account on edX, enroll in this course, and finally "Select Audit" instead of "Certificate". These videos and courses can be used to re-iterate certain concepts discussed in the lecture and exercises. It is not expected from you that you, neither should you, follow each course exactly. Pick relevant pieces that you struggle to understand.

2.2 Books

- A Byte of Python
- Foundations of Python Programming
- Programming for Computations – Python

These books are excellent sources for anyone who wants to Master Python and use it for Mathematical or Engineering purposes. Again, it is expected that you go over certain exercises (which are highlighted during the lecture) in these books, it is not expected go over the full extend of the book for this course.

2.3 Simple Online Exercises

- W3 Resource
- Python3 Course
- Introduction to Numpy
- Python Tutorial

Exercises from these sources will be highlighted during the lecture for your self-study sessions. You can obviously pick any exercise on any topic that you struggle to understand, practice truly makes prefect in programming.

2.4 For previous MATLAB users

- Numpy for MATLAB users
- Syntax of MATLAB vs Python
- Python cheat-sheet
- Another cheat-sheet

3 Linear Algebra

The linear algebra recap of the modeling convergence course is mainly inspired on the lecture given by Prof. Gilbert Strang at the Massachusetts Institute of Technology (MIT). Therefore, the most obvious reference would be his video lectures and accompanying book:

- Video Lectures
- Book

Another book which is mostly suggested to BSc Linear Algebra is (link to e-book): Linear Algebra and its Applications. You can also access this book through the search function of our University Library Website. Again, these sources should be used as a guide for concepts that are unclear from the lectures alone. Also, you are only expected to know the concepts discussed in the lectures which covers a small portion of the video lectures and book(s).

If you want to practice some more exercises on linear algebra, the following link might be helpful as well: a compilation of exercises and solutions for a Linear Algebra course taught at Portland State University.

4 Numerical Methods

Basics of numerical analysis and methods you can find using two links below:

- Introduction to numerical analysis
- Lectures on numerical analyis

Some of these concepts and approaches will be explained in the lectures.

5 Statistics

The statistics part of the modeling convergence course consists of several exercises and theory which can be found in the following two books:

- A Modern Introduction to Probability and Statistics
- Basic Linear Geostatistics

During the lecture it will be highlighted which concepts we will focus and are most important for you.