Introduction to Numerical Analysis
Day 1: Introduction

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Outline

Introduction

Recommended books:

- Burden, R. L., Faires, J. D., Burden, A. M. (2015). Numerical analysis. Cengage learning.

Complementary books:

- Howard, J. P. (2017). Computational Methods for Numerical Analysis with R. Chapman and Hall/CRC.
- Fieller, N. (2018). Basics of matrix algebra for statistics with R. Chapman and Hall/CRC.
- Axler, S. (2015). Linear algebra done right. Springer.

What is Numerical Analysis?

"Formal" definition

Numerical Analysis is a branch of mathematics that solves mathematical problems in computers to find numerical responses, contrary to symbolic responses. The numerical solutions provide responses to practical applications and for the real world. Instead, symbolic solutions are exact, but can be hard or impossible to find [1].

Objectives

- Computational efficiency to find a solution.
- Accurary of the solution (how close we are of the real solution).
- Level detail of the found solution.

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Numerical analysis can be applied in different fields. For example, any field where the computers are used to solve mathmatical problems.

What is Numerical Analysis?

Numerical Analysis is not only focused in the search of numerical solutions, but also in to find usables estimations from those solutions. From the error we already knew how feasible our estimations are.

What is Numerical Analysis?

Disadvantages

- Size of the data
- Appropriate algorithms to solve numerical problems (its characteristics and benefits).

How to deal with those disadvantages?

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How to deal with those disadvantages? Using parallel computation to complex operations!

Unfortunately, parallel compute does not be seen in this course

Course objectives

General

- Train to the student with toolsto solve problems in the modelling, simulation and approximation.
- Promote the team work
- Improve the comunication techniques in Numerical Analysis

Specifics

- Solve mathematical problems using programming software
- Develop algorithms to find an approximated solution
- Analysis and comprehension of the solved problems

Course structure

Contents

- Introduction to R
- Vectors and matrices
- Linear algebra
- Matrix decomposition
- Linear equations and least squares method
- Interpolation and Polynomial approximation
- Root finding and optimization
- Monte Carlo method

Course structure

Software

- R (main)
  - The R project: www.r-project.org
  - For Windows, MacOSX, Linux
- Python (optional)
  - https://www.python.org/
- Matlab (optional)
  - https://www.mathworks.com/

The lectures will be based completely in R but the student can choose any of the ones mentioned before.

See you next class!...

Howard, J. P. (2017). Computational Methods for Numerical Analysis with R. CRC Press.