UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Computational Physics Laboratory

2223-3-E3001Q066

Aims

Learning the basis of numerical calculus and how to solve scientific problems with a computer.

Contents

Basic concepts of numerical analysis; deterministic methods for computing integrals; Monte Carlo methods and stochastic integration; probability distributions and central limit theorem; numerical solution of differential equations; zeros of a function

Detailed program

Basic concepts

- introduction to rounding error and truncation error
- storing numbers in a computer
- conditioning and stability

Deterministic integration of a function
Various deterministic techniques for the numerical calculation of integrals are presented: trapeziodal rule, Simpson, Bode, Romberg and Gauss methods. Special focus on the expected numerical accuracy.

Monte Carlo methods and probability distributions
Stochastic methods for computing integrals are discussed and compared with deterministic ones.

Differential equations
Main techniques for the numerical solution of a differential equation are presented: Euler, leap-frog and Runge-Kutta methods.

Zeros of a function
The bisection and the Newton-Raphson methods for computing the zeros of a functions are discussed.

Prerequisites

Teachings of previous years. No special prerequisites or particular coding skills are required other than very basic concepts like the general structure of a code and the definition of a variable, of an array, of a function and of a loop. The coding language can be chosen between C and Fortran.

Teaching form

Activity in carried out in the computer lab. In some initial theoretical lectures the numerical techniques useful for solving the exercises are presented; each student works individually with the support of the teacher in case of need.

Textbook and teaching resource

Teacher's notes available on elearning.unimib.it

Numerical Recipes
William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery
CAMBRIDGE UNIVERSITY PRESS

Semester

Twice a week in the first semester

Assessment method

In the computer lab the student has to solve numerically a number of execises by writing computer codes. The results of the study are presented in a report that each student has to write. The exam is oral and concerns the discussion of the solution of the exercises; at least two weeks in advance of the exam, the report (in pdf format) as well as the codes and the results of the numerical study have to be sent to the teacher by email. The overall evaluation takes into account the oral exam, the lab activity, the study that has been done and the final report.

Office hours

Anytime after an e-mail appointment.

Sustainable Development Goals

QUALITY EDUCATION