Università degli Studi della Basilicata
DIPARTIMENTO DI MATEMATICA, INFORMATICA ED ECONOMIA

NUMERICAL ANALYSIS I (CFU 12) (Sem: I+II)

LAUREA TRIENNALE IN **MATEMATICA**

TEACHER: Maria Carmela De Bonis (mod. A) e Laurita Concetta (mod. B)

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Educational objectives
To know the main methods for the approximation of data and functions and for the numerical calculation of definite integrals. To be able to choose between antagonists methods for solving a specific problem (eg, comparing the order of convergence, stability of algorithms, computational cost). To achieve a good level in programming algorithms, for example, in Matlab, in order to apply the studied numerical methods. To be able to read the numerical results provided by the machine.

Detailed contents

Part A

Internal format of data
Single and double precision. Absolute and relative error. Machine precision. Conditioning of a problem and algorithm stability. Numerical cancellation.

Numerical methods for linear systems
Condition number. Back and forward substitution. Gauss elimination, LU factorization with applications. Pivoting. Cholesky factorization. Iterative methods: Jacobi and Gauss-Seidel methods with convergence study. Overelaxing. Sparse matrices. Overdetermined systems. SVD decomposition.

Part B

Approssimation of zeros of functions
Bisection and Newton methods. Convergence order. Multiple zeros. Zeros of polynomials. Cauchy and Cartesio theorems**.** Sturm sequences.

Approximation of functions and data
Algebraic polynomial approximation by Lagrange interpolation. Interpolation by piecewise polynomial functions. Spline functions. Least squares approximation.

Numerical integration
Quadrature formulas. Stability, convergence, degree of accuracy, error estimation. Newton-Cotes quadrature rules. Quadrature formulas of interpolatory type. Gaussian quadrature formulas. Cubature rules.

Prerequisites
The knowledge of the arguments from Calcolus and Linear Algebra, basics of computer science and programming fundamentals .

Teaching methods
Lectures and laboratory exercises

Assessment methods
Oral and practical exam

Bibliography
G. Monegato, Fondamenti di calcolo numerico, CLUT (Torino)
Notes and handouts of the teacher.