UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Approximation Methods and Models

2627-1-F4002Q022

Aims

In line with the educational objectives of the Degree in Mathematics, the course aims to introduce and to study methods for approximating data both from a theoretical and a practical point of view.

The expected learning outcomes include:

Knowledge

- Knowledge and understanding of the fundamental definitions and statements, as well as the proofs of cruciual theorems.
- Knowledge and understanding of issues that intervene in this field and know how to identify the most appropriate methodology in relation to the situations addressed.

Abilitity

- Ability to translate the theory studied in concrete examples through the construction of algorithms and their implementation.
- Ability to choose the most appropriate numerical method inrelation to the proposed problem.
- Ability to critically analyse the results of the proposed examples and exercises and know how to recognize and analyse the problems that arise in the light of the theory studied.
- Ability to expose, communicate and argue in a clear andprecise way both the theoretical contents of the course andtheir applications to specific situations.

Contents

Classical approximation techniques in dimension one. Multivariate approximation, kernel and mesh-free methods

Detailed program

Polynomial interpolation and least squares approximation in one dimension. Spline space and its bases. B-spline basis, spline interpolation. B-spline curves.

Multivariate approximation.

The problem of interpolating sparse data.

Radial bases.

Interpolation with radial bases.

Positive definite radial bases.

Interpolating sparse data with polynomial precision.

Conditionally positive definite radial bases.

Estimation of interpolation error.

Stability and conditioning of interpolation with radial bases.

Algorithms.

Data fitting with radial bases.

Prerequisites

Fundamental courses of the bachelor degree in Mathematics: Basic knowledge of Linear Algebra, Analysis, Numerical Analysis, and Matlab.

Teaching form

56 hours of in-person, lecture-based teaching (8 ECTS

The course will be held in Italian. The teaching hours will illustrate definitions, results technical demonstrations and examples relevant to the addressed issues. Some of the lessons will be devoted to the implementation of the algorithms that will be used to apply to practical examples as studied from the theoretical point of view.
The lessons will be recorded.
The course is delivered in Italian.

Textbook and teaching resource

Gregory E. Fasshauer: Meshfree Approximation Methods with Matlab, World Scientific

Holger Wendland: Scattered data approximation, Cambridge Press

Larry Schumaker: Spline fuctions, basic theory, Cambridge Press

L. Piegl- I. Tiller: The NURBS book., Springer

e-learning page of the course

Recorded lessons

Semester

I

Assessment method

The exam is oral and consists of

- A presentation by the student of a project assigned during the course to test the acquisition of the expected skills. The project can also be developed within a working group.
- Questions about the theory presented in the course that aim to verify the knowledge of the proposed themes, and the ability to critically review the definitions, statements, demonstrations and numerical issues presented during the course.

The two parties equally contribute to the determination of the final grade.

Mark range 18-30/30

Evaluation criteria
The correctness of the answers, the completeness and the ability to argue with clarity, precision and critical sense both the project and the topics of the program are evaluated.

Evaluation rubric
The evaluation rubric is available here

Office hours

by appointment (please write to milvia.rossini@unimib.it).

Sustainable Development Goals