Functions approximation

Introducing

Description

Part 1: Data Representation Using Splines (7h30 Lectures, 7h30 Tutorials, 10h Lab Work)
I.1 Interpolation splines (2 Lectures / 2 Tutorials / 1 Lab Session)
I.2 Smoothing splines (2 Lectures / 2 Tutorials / 1 Lab Session)
I.3 B-splines and least squares splines (2 Lectures / 2 Tutorials / 2 Lab Sessions)

Part 2: Data Representation Using Neural Networks (2h30 Lectures, 2h30 Tutorials, 5h Lab Work)
II.1 Adjunction (1 Lecture / 1 Tutorial / 1 Lab Session)
II.2 Neural networks as an approximation method and automatic differentiation (1 Lecture / 1 Tutorial / 2 Lab Sessions)

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
1.The approximation of data using splines, either through interpolation or smoothing.
2.The link with geometry generation in CAD and the capabilities for image processing.
3.Automatic differentiation and the structure of a neural network.
4.Object-oriented programming in Python.

The student should be able to:
1.Determine and calculate the interpolation spline, the smoothing spline, and the least squares spline for nn points.
2.Construct a B-Spline curve for nn points and a B-Spline surface.
3.Interpolate and filter an image using splines.
4.Design a basic neural network.
5.Develop an automatic differentiation library in Python.

Necessary prerequisites

Multivariable function differentiation, unconstrained optimization (existence, first-order Euler equations, gradient algorithms), linear algebra (matrix systems, scalar product, adjunction). Strong knowledge of Python.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse