Advanced Mathematics for Scientific Challenges

2019-2020

Learning Objectives

- Efficient methods for optimization problems: linear programming and convex optimization
- Homological techniques for shape analysis of point cloud data
- Ability to select suitable methods depending on each problem and its solution constraints

Assessment

Course marks will be based on assignments and resolution of exercises

Teaching Blocks

1. Optimization (Àngel Jorba, angel@maia.ub.es)

    1.1. Elements of convex analysis

    1.2. Linear optimization. The simplex method

    1.3. One-dimensional optimization

    1.4. Nonlinear unconstrained optimization

    1.5. Nonlinear constrained optimization

2. Topological data analysis (Carles Casacuberta, carles.casacuberta@ub.edu)

    2.1. Persistent homology of a point cloud

    2.2. Persistence intervals and barcodes

    2.3. Stability against noise

    2.4. Algorithms and software for persistent homology

    2.5. Applications to data analysis, imaging and geometry

References

U. Bauer, M. Kerber, J. Reininghaus and H. Wagner, PHAT – Persistent Homology Algorithms Toolbox, *Journal of Symbolic Computation* 78 (2017), 76-90

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H. Edelsbrunner and J. Harer, Persistent homology: A survey, in: *Surveys on Discrete and Computational Geometry*, Contemp. Math. 453, Amer. Math. Soc., Providence, 2008, 257-282

R. Ghrist, Barcodes: The persistent topology of data, *Bull. Amer. Math. Soc.* 45 (2008), 61-75

M. Minoux, *Mathematical Programming; Theory and Algorithms*, John Wiley & Sons, 1986