LTCC Advanced Applied Course

Title: Graph algorithms and models

Basic details:

- Core audience: Advanced – Applied Maths
- Course format: Core (10h)

Course description:

- Keywords: Representing graphs. Node properties. Graph properties. Random graph ensembles. Models of real-world networks.
- Aims: The course will provide the students with a solid understanding of theoretical aspects and algorithms related to the computation of graph properties (components, paths, subgraphs, clusters, centrality), to the sampling of graphs from random ensembles, and to the modelling of real-world networks by means of random graphs.
- Syllabus: Computational complexity of graph problems. Representing and handling graphs. Node degree, clustering, centrality. Connected components. Distances and shortest paths. Small subgraphs. Cycles. Clusters and communities. Erdös-Rényi random graphs. Configuration model. Small-world graphs. Linear preferential attachment. Further models of real-world networks.
- Recommended readings:
  - V. Latora, V. Nicosia, G. Russo, "Complex Networks: Principles, Methods and Applications", Cambridge University Press (2017).
  - M. Newman, "Networks: an introduction", Oxford University Press (2010).
  - M. E. J. Newman, "The structure and function of complex networks", SIAM Review 45, 167-256 (2003).
  - S. Boccaletti, et al. "Complex Networks: Structure and Dynamics", Phys. Rep. 424, 175–308 (2006).
- Prerequisites:
  - (essential) Basic knowledge of graph theory (e.g., an undergraduate module in discrete mathematics or graph theory).
  - (essential) Rudiments of at least one programming language that can be sensibly used for scientific computing (almost any high-level language would fit the bill, including FORTRAN, C, C++, Java, Python, R, Matlab, Octave, but also Mathematica, Maple, Maxima, Sage, etc.).

Format:

- Assessment: one small project, focused either on the implementation of one of the algorithms discussed in the module, or on a theoretical aspect of one of the graph models described.
- Electronic lecture notes: Electronic lecture notes will be made available.
- Necessary facilities: blackboard/whiteboard, data projector.

Lecturer:
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