Topics in Convex Optimisation (M16)

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Mathematical optimisation problems arise in many areas of science and engineering, including statistics, machine learning, robotics, signal/image processing, and others. This course will cover some techniques known as *convex relaxations*, to deal with optimisation problems involving polynomials, which are in general intractable. The emphasis of the course will be on semidefinite programming which is a far-reaching generalization of linear programming. A tentative list of topics that we will cover include:

- From linear programming to conic programming. Duality theory.
- Semidefinite optimisation and convex relaxations. Sums-of-squares and moment problems.
- Applications: binary quadratic optimisation and rounding methods (e.g., Goemans-Williamson rounding), stability of dynamical systems, matrix completion/low-rank matrix recovery, etc.

Pre-requisites

This course assumes basic knowledge in linear algebra and analysis. Some knowledge of convex analysis will be useful.

Literature

1. A. Ben-Tal and A. Nemirovski, *Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications*, SIAM, 2001 (http://dx.doi.org/10.1137/1.9780898718829).
2. G. Blekherman, P. Parrilo, R. Thomas, *Semidefinite optimization and convex algebraic geometry*, SIAM 2013 (http://dx.doi.org/10.1137/1.9781611972290).
3. S. Boyd, L. Vandenberghe, *Convex Optimization*, Cambridge University Press, 2004 (http://web.stanford.edu/~boyd/cvxbook/).

Additional support

Three examples sheets will be provided and three associated examples classes will be given. There will be a one-hour revision class in the Easter Term.