

CDS 270 (Fall 09) - Lecture 2 (Oct 6, 09)

A few important dates related to projects:

- Proposal submission: October 23rd, midnight.
- Final reports are due Dec 7th, midnight.
- Time of oral presentations - TBD.

Please talk to us as you write your proposals, work on the projects, and write your reports. There is a lot of freedom in choosing the topic. If you need help in choosing a topic, talk to us and we will try to find an appropriate topic.

The following is a list of concepts covered in this lecture. A good reference for these subjects is the book “Convex Optimization” by Stephen Boyd and Lieven Vandenberghe (Cambridge University Press), also available at <http://www.stanford.edu/~boyd/cvxbook/>. Most of the material in this note is from sections 2.1-2.3 and 3.1-3.2 of this book.

- Definition of a convex set, examples (hyperplane, Euclidean ball, Polyhedra).
- Definition of convex cones, examples (second order cone, positive semidefinite cone).
- Properties of positive semidefinite matrices (real eigenvalues and orthonormal eigenvectors, eigenvalues are nonnegative, existence of unique, symmetric square root).
- Operations (on sets) that preserve convexity (intersection, affine maps), use of these to show the convexity of the positive semidefinite cone and ellipsoids).
- Definition of a convex function.
- Ways to show that a function is convex (check the definition, first and second order conditions, restriction to a line), examples. Proof of that a local optimizer of a convex function is also a global optimizer follows from the first order conditions.
- Operations (on functions) that preserve convexity (nonnegative weighted sums, composition with an affine map, pointwise max).