INSTRUCTOR: Bahman Kalantari (kalantar@cs.rutgers.edu)

LECTURE: Thursday 5:00-8:00 PM, LSH-B267, LIV (Livingston).

OFFICE HOURS: Wed 12:00-1:00 PM, Hill Center 444 (also by appointment).

TA: TBA

PREREQUISITES: DCS graduate study admission requirements or permission of Instructor (Elements of Linear Algebra, Calculus and Multivariable Calculus).

GRADING: The better of (I) and (II); or Option (III).
(I) HWKS (4 written, a MATLAB Program) %30; Midterm %30; Final %40.
(II) HWKS (4 written, a MATLAB Program) %30; Final %70.
(III) HWKS (4 written) %20; Midterm %20, Final %20; A Substantial MATLAB Program %40.

All programming assignments must be discussed and approved by the instructor.

LECTURE DATES: Sept 7, 14, 21, 28; Oct 5, 12, 19, 26; Nov 2, 9, 16, 21 (Tue), 30; Dec 7.


COURSE OUTLINE:

- The convex hull membership problem (CHM) and its generalization: An introduction to linear programming (LP) and support vector machine (SVM) problems. A distance duality and the triangle algorithm, a geometric algorithm for CHM and SVM.
- Farkas lemma, Gordan theorem, geometric interpretations. Algorithmic applications.
- The dual simplex method. The primal-dual method for LP and some applications.
- Game theory and von Neumann’s min-max theorem.
• The triangle algorithm: A fully polynomial-time approximation scheme for CHM and for algorithmic separation of convex sets. The particular case of SVM.

• Khachiyan’s ellipsoid method for LP. Connections to CHM. Notions of size of LP, rounding, precision, and polynomial-time algorithms.

• Karmarkar’s algorithm and variations, connections to CHM.

• Some properties of convex functions. Taylor theorem.

• The positive semidefinite diagonal matrix scaling problem, connections to CHM. Scaling dualities. Polynomial time potential-reduction and path-following Newton methods for matrix scaling/linear programming problems.

• Strongly polynomial-time algorithms. Total unimodularity and structured LP. Topics from: shortest paths, mean cycles, max flows, bipartite matching, min-cost flows, multicommodity flows, minimum spanning tree, general weighted matching problem, TSP, and magic labeling problem.

**TEXT:** Lecture notes will be made available. Also some literature articles.

**OTHER REFERENCES** (to be placed on reserve at Math Library, Hill Center)


Introduction to Linear Optimization by Bertsimas & Tsitsiklis, Athena Scientific, 1997)

