CME 304 and MS&E 315
Syllabus in Numerical Optimization

The general problem addressed in this course may be written as:

$$\min_x \ F(x) \ \text{ subject to } \ c(x) \geq 0,$$

where x is an n-vector, $c(x)$ is an m-vector, and $F(x)$ and the elements of $c(x)$ are twice continuously differentiable scalar functions. The course covers properties of the problem, knowledge of the optimality conditions and methods to solve this problem and various special forms: linear and quadratic programming, nonlinear equations, nonlinear least squares, etc. Specific methods covered are: modified Newton, quasi-Newton, steepest descent, nonlinear conjugate gradient, trust-region methods for unconstrained optimization, linesearch methods for all problems, simplex, barrier, penalty, sequential quadratic programming, reduced gradient, augmented lagrangian, sequential linearly constrained. Convergence analysis of algorithms for unconstrained problems. Various methods for solving matrix problems that are relevant to the efficient solution of KKT systems and to solving the sequence of linear problems that arise in optimization algorithm are also examined. This includes matrix factorization updating and the linear conjugate gradient algorithm. The intent of the course is to teach both analytical and properties of algorithms. Note that we do *not* assume convexity so there is a need to be able to distinguish minimizers from stationary points