APM 523 Optimization   class webpage: http://plato.asu.edu/APM523

Course Description

Theory and practice of continuous optimization with basics on discrete optimization. Needed background, unconstrained optimization. Lagrange multipliers, Karush-Kuhn-Tucker (KKT) conditions, and duality theory. Algorithms for nonlinearly constrained nonlinear optimization including nonconvex cases. Interior point methods for convex optimization.
Least squares and nonlinear systems of equations.
Applications to various engineering problems.

Course Overview

In addition to the course description above, an overview of the course topics are itemized below:

1. Background in linear algebra and vector spaces
2. Available optimization resources
3. Modeling languages such as AMPL, full version provided in all operating systems
4. Convex sets and functions
5. Linear Programming and branch and cut
6. Gradient, conjugate gradient, and quasi-Newton methods
7. Automatic differentiation
8. Necessary and sufficient optimality conditions (KKT)
9. Interior point methods for linear and nonlinear problems
10. Applications in classical and modern (such as financial engineering) fields

Students will do at least eight assignments. Two of those are major programming assignments in the language of the student's choice and requiring one to two weeks each. The others will be selected problems from the book or short computer projects that can be done with existing software, preferably online through the NEOS gateway (http://neos-server.org). There will be one in-class exam in the last weeks of the semester.

The required material includes the textbook:
J. Nocedal and S. Wright, Numerical Optimization, Springer 1996
which is available freely as e-book from the ASU library

Student Learning Outcomes

Students completing APM 523 will be able phrase a wide range of engineering and other problems as optimization problems and solve them with either online tools or downloadable software they learnt about in class. They will have an understanding of both optimization theory and algorithmic theory plus a rich knowledge about available optimization resources and tools.

More details for Fall 20:

Topics from book:
    ch1, ch2, ch3, parts of chs5-8, ch12, ch14, ch15, parts of ch16
Projects: QAP, LP/MILP, Nonlinear Least Squares, QCP, SDP, Unconstrained Optimization

There may be a few topics covered that are not in the book, such as

    Mixed-integer programming, linear and nonlinear
    traveling salesman problems
    global optimization
    semidefinite programming