NUMERICAL ANALYSIS AND SOFTWARE

CS/MATH 5486  CRN 18145/18754  MWF 10:10–11:00  McBryde 224

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Office hours: MW 11:00–12:30 in Torg 2000, and by appointment.


Grading: The final grade will be based on attendance and class participation (35%), an installation report on LANCELOT/GALAHAD or some other optimization software (15%), a class presentation (20%) and accompanying class notes (15%), and a report on a nontrivial application of LANCELOT/GALAHAD or some other optimization software (15%).

The class presentation may be done individually or in teams, comprising a minimum of one class period and a maximum of two class periods, per individual. The class presentation shall be based on chapters in books and/or journal articles, shall involve a minimum of three sources, and shall be accompanied by written notes distributed to the class prior to the presentation. These written notes shall be complete sentences written in good English, designed to be worth saving. Simply copying from a source or saying “see [xx] for details” is taboo. The appropriate length is between 3 and 10 pages (single spaced) per individual, including references and figures.

There will be designated hecklers for each presentation, whose duty is to question and clarify the presentation. The entire class shall grade each presentation and set of notes—I will average the class mean assigned grade with my own assessment.

Course outline:
Linear algebra review.
Linear programming.
Data structures for large scale LP.
Theorems of the alternative.
Convexity.
Saddlepoint optimality theorems.
Fritz John and Kuhn-Tucker theorems.
Quasi-Newton and homotopy methods for nonlinear systems of equations.
NEOS. GAMS. SNOPT. MINOS. QPSOL. MINPACK. HOMPACK90. LANCELOT/GALAHAD.
ODRPACK95. VTDIRECT95.
Current research topics.

Bibliography:

Appropriate topics for presentations (with team sizes in parentheses) are:

Linear programming (≤ 2).
Quadratic programming (≤ 2).
Extended linear-quadratic programming (≤ 2).
Unconstrained optimization: univariate functions (1), nonsmooth functions (1), conjugate directions (1), direct search (1), quasi-Newton (≤ 2), trust region (≤ 3), sums of squares (≤ 2), large-scale problems (≤ 3).
Constrained optimization: linear equality constraints (1), linear inequality constraints (≤ 2), penalty and barrier functions (≤ 2), reduced-gradient and gradient projection (≤ 3), simple bound constraints (1), augmented Lagrangian (≤ 3), projected Lagrangian (≤ 2), integer variables (≤ 2).
Nonlinear equations: quasi-Newton (≤ 3), trust region (≤ 3), homotopy (≤ 3).

Two extremely important Web sites for numerical analysis software (including optimization) are:

http://gams.nist.gov/
http://www.netlib.org/

The Web address for GALAHAD is

http://galahad.rl.ac.uk/galahad-www/