IE 440 NONLINEAR MODELS IN OPERATIONS RESEARCH

Day and Time   : M 13:00 – 15:00   W 13:00 – 14:00
Classroom   : M 3120   M 2230
Instructor   : İ. Kuban Altınel
Office/Phone   : Old Engineering Building, Ext. 6407
Office Hours   : M 11:00 – 13:00   W 11:00 – 13:00
Teaching Assistant : Cemil Dibek
Office   :
Office Hours   : TBA

Grading

    Quizzes   : 10% per quiz (2 midterm-like quizzes), Close book.
    Programs   : 10% (6 programs. The lowest grade will be dropped)
    Midterm   : 25%, Close book.
        Eligibility : Any registered student may take the midterm exam.
        Makeup   : NO MAKEUP. ABSENCE WILL BE GIVEN 0 WHATEVER THE REASON IS!
    Final   : 40%, Close book.
        Eligibility : Only registered students with a 70 overall weighted average or above, if they were
                     given full grade at the final exam, e.g. 100, may enter.
        Makeup   : Only registered students who are eligible to take the final will be given a makeup
                     exam if he/she fails the course or he/she is absent at the final exam with an officially
                     accepted excuse.
    Attendance   : 5 %

Textbook: There is no textbook.
References: 1. Practical Methods of Optimization, R. Fletcher
                 2. Linear and Nonlinear Programming, 2nd edition, D. Luenberger
                 3. Introduction to the theory of neural computation, J. Hertz, A. Krogh, R. G. Palmer
                 4. Neural Networks in optimization, Z-S Zhang
                 5. Past IE 303 and IE 485 exams and their solutions
                 THEY ARE ALL AVAILABLE **ON RESERVE** AT THE LIBRARY.

IE 440 TENTATIVE PLAN

1. NONLINEAR OPTIMIZATION IN ONE DIRECTION
   Analytical optimization, Iterative optimization, Convergence, Speed of convergence, Search methods,
   Approximation methods.

2. CONVEXITY
   Convex sets, Convex functions, Gradient, Hessian, Eigenvalues and eigenvectors, Positive definiteness.

3. NONLINEAR UNCONTRAINED OPTIMIZATION IN MANY DIRECTIONS
   Necessary and sufficient conditions, Search methods (coordinate search, pattern search, simplex search),
   Descent directions and steepest descent method, Newton's method, Davidon-Fletcher-Powell and
   Broyden-Fletcher-Goldfarb-Shanno methods.

4. CONSTRAINED NONLINEAR OPTIMIZATION
   Necessary and sufficient conditions, Saddle point problem and its relation with convex programs,
   Reduced gradient and generalized reduced gradient methods.

5. NEURAL NETWORKS
   Supervised learning and back propagation algorithm, Unsupervised learning and self-organizing maps.

6. MACHINE LEARNING
   Learning as an optimization problem, Discriminant design, Support vector machines.

IE 440 TENTATIVE PROGRAM

WEEK	MONTH	DAY	TENTATIVE DAILY OUTLINE
1	September	28M	Nonlinear model examples
		30W	"
2	October	05M	Nonlinear optimization in one variable
		07W	"
3		12M	Convexity
		14W	"
4		19M	Unconstrained nonlinear optimization in many variables
		21W	"
5		26M	"
		28W	"
6	November	02M	Constrained nonlinear optimization in many variables
		04W	"
7		09M	"
		11W	"
8		16M	"
		18W	Neural Networks – Simple Perceptrons
9		23M	"
		25W	Neural Networks – Multi-layer Perceptrons
10		30M	"
	December	02W	Neural Networks – Self-organizing maps
11		07M	"
		09W	"
12		14M	Machine Learning
		16W	"
13		21M	"
		23W	"