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34414 - FX - Network Flows

Coordinating unit: 200 - FME - Faculty of Mathematics and Statistics

Teaching unit: 715 - EIO - Department of Statistics and Operations Research

Academic year: 2010

Degree: MASTER IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2006). (Teaching unit Optative)
DOCTORATE IN STATISTICS AND OPERATIONAL RESEARCH (Syllabus 2007). (Teaching unit Optative)

ECTS credits: 5 Teaching languages: Catalan

Teaching staff

Coordinator: HEREDIA CERVERA, FRANCISCO JAVIER

Others: NABONA FRANCISCO, NARCÍS

Prior skills

Operations Research. Continuous optimization. Large-scale optimisation. Modelling in mathematical programnig

Teaching methodology

The teaching method will combine traditional expository sessions regarding theory and laboratory sessions/extra support problems/extra sessions on theory. The teaching method will require specified learning materials for following the subject and for completion of the work sessions.

Learning objectives of the subject

This is an advanced course on model building and the optimization of network flow problems. Its goals are:

* That the student will know which are the principal problems of network flows (shortiest path, maximum flow, minimum cost, etc.) and its relevance to the environment of decision-making models.
* That the student knows how to formulate and solve ¿through computation¿decision-making problems such as network flows of different types.
* That the student knows which are the principal algorithms that permit the solution of network flow problems, their theoretical properties and implementation characteristics.

Content

Introduction

Description:
Network Flow Problems and Their Applications. Basic Concepts of Graph Theory. Basic Design Concepts and Algorithm Analysis.

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Shortest Path Problems.

Description:
Definition and the Model-Building Hypothesis. Applications. Aplicaciones. Implementations of Dijkstra¿s Generic Label-Setting Algorithm: Inverse, Dial, Heap, etc. Label-Correcting Algorithms: Implementation, Pseudo-Polynomials and Polynomials. All Pairs Shortest Path Problems: Dantzig¿s and Floyd-Warshall¿s Algorithms.

Maximum Flow Problems.

Description:
Definition and the Model-Building Hypothesis. Applications. Augmenting Path Algorithms: Ford-Fulkerson. Max-Flow Min-Cut Theorem. Preflow-Push Polynomial Algorithms: FIFOand Scaling Algorithms.

Minimum Cost Flow Problems.

Description:
Definition and the Model-Building Hypothesis. Applications. Basic Algorithms: Cycle Canceling, Successive Shortest Paths, Out-Of-Kilter. Polynomial Algorithms: Capacity Scale Algorithm. Simplex Algorithm for Minimum Cost Flow. The Frank-Wolfe Algorithm.

Minimum Spanning Trees.

Description:
Application Examples. Kruskal Algorithm. Prim Algorithm. Sollin Algorithm.

Multi-Item Problems.

Description:
Definition and the Model-Building Hypothesis. Applications. Optimal Conditions. Lagrangian Relaxation. Application of the Dantzig Decomposition. Primal Partitioning.

Nonlinear Flow Problems.

Description:
Definition and the Model-Building Hypothesis. Nonlinear Flow with Convex Costs. Nonlinear Flow, Whatever the Cost: Murtagh-Saunders's Specialized Algorithm.

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Generalized Flow Problems.

Description:
Definition and the Model-Building Hypothesis. Applications. Augmented Forests and Optimal Conditions. Simplex Algorithm for Generalized Flows.

Qualification system

A partial exam and a final exam.
The final note will comprise 60% theory and 40% class work.

Bibliography

Basic:

Ahuja, R. K.; Magnanti, T.L.; Orlin, J.B. *Network flows: theory, algorithms, and applications.* Englewood Cliffs, N.J.: Prentice Hall, 1993. ISBN 013617549X.

Bertsekas, Dimitri P. *Network optimization: continuous and discrete models.* Belmont, MA: Athenea Scientific, 1998. ISBN 1886529027.

Fourer, R.; Gay, D.M.; Kernighan, B.W. *AMPL: a modeling language for mathematical programming.* 2nd ed. Pacific Grove, CA: Thomson/Brooks/Cole, 2003. ISBN 0534388094.

Taha, Hamdy A. *Operations research: an introduction.* New Jersey: Prentice Hall International, 2007. ISBN 0131889230.

Kennington J.L.; Helgason R.V. *Algorithms for Network Programming.* New York: John Wiley & Sons, 1980. ISBN 047106016X.

Others resources:

Hyperlink

http://www.ise.ufl.edu/ANO/

http://web.mit.edu/jorlin/www/15.082/15082_syllabus_2003.html

http://www-b2.is.tokushima-u.ac.jp/~ikeda/suuri/main/index.shtml