Department of Electrical and Computer Engineering
New Jersey Institute of Technology
FALL 2015

ECE 744: Optimization for Communication Networks

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Text books:

1. E. K. P. Chong and S. H. Zak, "An Introduction to Optimization," 3rd ed, John Wiley & Sons, 2008, ISBN 978-0-471-75800-6.
2. S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press 2004. (Available online at http://www.stanford.edu/—boyd/cvxbook/)
3. D. Bertsekas and J. N. Tsitsikalis, Parallel and Distributed Computation: Numerical Methods, Athena Scientific, 1997.
4. MacKenzie, Allen B., and Luiz A. DaSilva. "Game theory for wireless engineers." *Synthesis Lectures on Communications* 1.1 (2006): 1-86.

References:

1. D. Bertsekas, A. Nedi'c, and A. Ozdaglar, Convex Analysis and o ptimization. Athena Scientific, 2003.
2. Osborne, Martin J. *An introduction to game theory.* Vol. 3. No. 3. New York: Oxford University Press, 2004.
3. Miettinen, Kaisa. *Nonlinear multiobjective optimization.* Vol. 12. Springer, 1999.

Course Description:

The design of current wireless networks is increasingly faced with the challenge of guaranteeing given quality-of-service or cost constraints, while providing optimal performance in terms of resource utilization. In addition, the emerging paradigm of decentralized wireless networks, such as ad hoc and sensor networks, calls for optimization techniques to be performed in a distributed, and possibly competitive, fashion by different radio transceivers. This course covers the basic analytical and algorithmic tools that enable such centralized and decentralized optimization. Specific topics include single-objective convex optimization (duality, optimality conditions, algorithms) and fundamentals of multi-objective optimization and game theory.

Prerequisite: Basic knowledge of linear algebra and computer networks.
Course learning outcomes (CLO): The student should be able to

1. Understand the basics of optimization theory.
2. Understand the convex functions and convex sets.
3. Formulate a problem using convex optimization and game theory.
4. Master the Lagrange Duality and the KKT method for solving optimization problems.
5. Understand the different numerical methods for solving optimization problems.
6. Apply convex optimization methods and game theory to analyze and design communication networks.

List of topics to be covered

Week(s) Topic(s)

1. Revision of linear algebra, the derivative matrix, basic conditions for local minimizers
2. Linear Programming
3. Convex sets
4. Convex functions
5. Convex Optimization problems
6. Lagrange Duality
7. KKT conditions
8. Numerical optimization methods

9-10 Formulation of optimization problems in communications networks

11. Pareto optimality, Best responses and Nash equilibrium
12. Non-cooperative strategic and repeated games.
13. Variational Inequality theory
14. Application of Game theory in communication networks

Grading Criteria:	Project	40%
	Midterm:	30%
	Final exam:	30%

Office Hours: Tuesdays: 4:30-5:45 or by appointment.
Honor Code: The NJIT Honor Code will be upheld; any violations will be brought to the immediate attention of the Dean of Students.