UB - Department of Industrial and Systems Engineering
IE 670: Topics in Operations Research
Computational Game Theory
Fall 2013

This syllabus is subject to change.

1 Course Contact

- Class Time: 11:10am–12:30pm, Tuesday/Thursday
- Class Location: 341 Bell Hall
- Instructor: Dr. Changhyun Kwon
  - E-mail: chkwon@buffalo.edu
  - Office Location: 318 Bell Hall
  - Office Hours: TBA

2 Course Description

This course covers various topics regarding equilibrium models arising in management science, transportation science, regional science, and economics. Mathematical games are introduced with advanced methods in optimization. Theory and algorithms of variational inequalities and complementarity problems are used to analyze and compute equilibria. Other topics include price of anarchy, generalized Nash games, and leader-follower games. If time permits, theory and applications of differential games will be introduced.

3 Topics Covered

- Introductory Nonlinear Optimization
- Basics of Mathematical Games
- Spatial-Price Equilibrium
- Traffic Equilibrium
- Production-Distribution Equilibrium
- Variational Inequalities and Complementarity Problems
- Computational Methods
- Gap Functions
- Projective Dynamics
- Price of Anarchy
- Generalized Nash Games and Quasi Variational Inequalities
- Leader-Follower Games
- Congestion Pricing
- Differential Games

4 Prerequisites

A graduate course in optimization

5 Grading

- Exam 1: 25%
- Exam 2: 25%
- Final Project: 25%
- Homework Assignments: 25%

6 Key References

- Harker, P. T., and Pang, J. S. (1990). Finite-dimensional variational inequality and nonlinear complementarity problems: a survey of theory, algorithms and applications. *Mathematical programming*, 48(1-3), 161-220.
- Facchinei, F. and Pang, J.-S. (2003), *Finite-Dimensional Variational Inequalities and Complementarity Problems I and II*, Springer

7 Other References

- Konnov, I. (2007), *Equilibrium Models and Variational Inequalities*, Elsevier Science
- Intriligator, M. D. (1987). *Mathematical optimization and economic theory* (Vol. 39). Society for Industrial and Applied Mathematics.
- Nagurney, A. (1999), *Network Economics: A Variational Inequality Approach*, Springer
- Nagurney, A. and Zhang, D. (1995), *Projected Dynamical Systems and Variational Inequalities with Applications*, Springer
- Friesz, T. (2010), *Dynamic Optimization and Differential Games*, Springer
- Gabriel, S. A., Conejo, A. J., Fuller, J. D., Hobbs, B. F., and Ruiz, C. (2012). Complementarity modeling in energy markets. Springer.
- Daniele, P. (2006), *Dynamic Networks And Evolutionary Variational Inequalities*, Edward Elgar Pub
- Harker, P. T. (1991). Generalized Nash games and quasi-variational inequalities. *European Kournal of Operational Research*, 54(1), 81-94.
- Facchinei, F., Fischer, A., and Piccialli, V. (2007). On generalized Nash games and variational inequalities. *Operations Research Letters*, 35(2), 159-164.
- Pang, J. S., and Fukushima, M. (2005). Quasi-variational inequalities, generalized Nash equilibria, and multi-leader-follower games. *Computational Management Science*, 2(1), 21-56.
- Fukushima, M. (1992). Equivalent differentiable optimization problems and descent methods for asymmetric variational inequality problems. *Mathematical programming*, 53(1-3), 99-110.
- Florian, M., and Hearn, D. (1995). Network equilibrium models and algorithms. In: M.O. Ball, T.L. Magnanti, C.L. Monma and G.L. Nemhauser, Editor(s), *Handbooks in Operations Research and Management Science*, Elsevier, 1995, Volume 8, Chapter 6, Pages 485-550.

- Hearn, D., and Ramana, M. (1998). Solving congestion toll pricing models. In P. Marcotte and S. Nguyen (Eds.), *Equilibrium and Advanced Transportation Modeling*, Boston/Dordrecht/London: Kluwer Academic Publishers, Chapter 6, 109-124.
- Braess, D., Nagurney, A., and Wakolbinger, T. (2005). On a paradox of traffic planning. *Transportation Science*, 39(4), 446-450.
- Roughgarden, T., and Tardos, É. (2002). How bad is selfish routing? *Journal of the ACM*, 49(2), 236-259.