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Seminar Series

Research Seminar

Limited-Trust Equilibrium and Social Network Games*

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Abstract: This presentation is in two parts: First we introduce a new notion of Limited-Trust in game theory and develop a new equilibrium, Limited-Trust Equilibrium (LTE) for players that are expected to interact for some long duration on non-identical (heterogeneous) games. We assume that the payoff matrix in these games is generated *iid* according to a distribution. Limited-trust is exhibited by a player that is willing to give up to a fixed limit δ in personal uttility provided the other player(s) benefit by at least as much. LTE should not be viewed as altruistic (because of the hard limit) nor "irrational" if in subsequent games other player(s) are inspired to reciprocate. The concept of Limited Trust can be applied to both simultaneous (Nash-like) and leader-follower (Stackelberg-like) games. Upon defining Limited Trust best response, we prove the existence of LTE for every n-player finite game. We also show that LTE is a subset of ε-equilibria. To well-round this part, we show that LTE results in higher personal and net utility than Nash equilibria on several common games. Therefore, LTE reduces the Price of Anarchy in these settings.

In the second part, we take the concept of LTE to social network games where players are competing to be "trusted" partners in collaborative and mutually beneficial economic activities. Each player/agent i can initiate a limited number $k_i > 0$ of games and selects the ideal partners from its one-hop neighborhood. For sake of computability we employ the LT leader-follower setting and study how players can learn the trust limits δ of their neighbors if they are not known *a priori*. Players can adjust their trust limits to be more attractive to partners. Through extensive numerical studies we develop two managerial insights: first, that trustworthy behavior drives an increase in the utility of all agents, and even modest level of trustworthiness may

easily improve net utility by as much as 14.5%. If only one agent exhibits modest trust among self-centered ones, it can increase its average utility by up to 25% in certain cases! Second, and counter-intuitively, when partnership opportunities are abundant agents become less trustworthy.

Keywords: Game Theory; Limited-Trust; Reciprocity; Long-term interactions; Social Networks; Partner Selection.

*Joint work with Tim Murray, PhD student, and Prof. Jugal Garg, ISE@UIUC

Biography: Rakesh Nagi is Donald Biggar Willett Professor of Engineering at the University of Illinois, Urbana-Champaign. He served as the Department Head of Industrial and Enterprise Systems Engineering (2013-2019). He also served as the Interim Director of the Illinois Applied Research Institute (2016-2018). He is an affiliate faculty in Computer Science, Electrical and Computer Engineering, Coordinated Science Laboratory, and Computational Science and Engineering. Previously he served as the Chair (2006-2012) and Professor of Industrial and Systems Engineering at the University at Buffalo (SUNY) (1993-2013). He received his Ph.D. (1991) and M.S. (1989) degrees in Mechanical Engineering from the University of Maryland at College Park, while he worked at the Institute for Systems Research and INRIA, France, and B.E. (1987) degree in Mechanical Engineering from University of Roorkee (now IIT-R), India.

He is a recipient of INFORMS Koopman Award from Military Application Society (2018), DARPA Graph Challenge, Champion (2020), Honorable Mention (2017, 2019), Finalist (2018), Innovation Award (2018, 2019), IIE Transactions on Design and Manufacturing, Best paper award from journal issues from July 2011 through June 2012 (2013), IIE Fellow Award (2010), UB?s “Sustained Achievement Award” in recognition of outstanding achievements in scholarly activity (2009), Business

First of Buffalo's "40 under Forty" award (2004), SME's Milton C. Shaw Outstanding Young Manufacturing Engineer Award (1999), IIE's Outstanding Young Industrial Engineer Award in Academia (1999), and National Science Foundation's CAREER Award (1996). He has over 200 papers in peer-reviewed scientific journals and conferences. Dr. Nagi's major research thrust is in the area of applied/military operations research and manufacturing/production systems. His recent research interests are in Location theoretic approaches to Facilities Design, Information Fusion, Intelligence Applications, Social Networks and Military Operations Research.