COS 511: Project Proposal

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We are interested in exploring the connection between machine learning and game theory. In particular, how machine learning can benefit game theory such as solving a game or reaching an equilibrium more efficiently. One problem of many game theoretic applications we discovered while surveying over some paper is that they mostly assume complete availability of information in the games, which unfortunately, is not always the case. The paper [1] suggested that machine learning might be a solution to this problem. Also, repeated application of a machine learning algorithm to the game might speed-up the achievement of the equilibrium [2].

One particular game theorectic application we are interested in improving with machine learning techniques is online auction. Several research has already been conducted in this domain. [3] mentioned that sponsored search hosts an online auction among the advertisers to bid for the advertisements that the latter wish to present to the customers. The achievement of the equilibrium state in this case is also an application of the machine learning algorithms to game theory.

As a part of this project study, we plan to study these three papers - [2], [1], [3] - in detail (more related papers, if necessary) and attempt to improve upon the algorithms proposed. If our attempt is successful we plan to apply that algorithm to a real game and test the results and verify the validity of the algorithm compared to the state-of-the-art models.

References

[1] A Blum PI, M Blum, M Kearns, T Sandholm, and MT Hajiaghayi. Machine learning, game theory, and mechanism design for a networked world. NSF proposal, 2006.

[2] Yoav Freund and Robert E. Schapire. Game theory, on-line prediction and boosting. In *Proceedings of the Ninth Annual Conference on Computational Learning Theory*, COLT '96, pages 325–332, New York, NY, USA, 1996. ACM.

[3] Di He, Wei Chen, Liwei Wang, and Tie-Yan Liu. A game-theoretic machine learning approach for revenue maximization in sponsored search. In *Proceedings of the Twenty-Third International Joint Conference on Artificial Intelligence*, IJCAI'13, pages 206–212. AAAI Press, 2013.