ECE1657
PROJECT PROPOSAL

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Abstract
Following is a project proposal submitted to Prof. Lacra Pavel. I want this proposal to be considered as my final project for the course ECE1657 which would then be used for evaluation of my final grade in the course.

Project Proposal
As my final course project for ECE1657 Game Theory and Evolutionary Games I would like to evaluate, compare and simulate Fictitious Play (FP) and smooth/stochastic-Fictitious Play (sFP) as two type of learning algorithms for finite action game. I would like to explore the criterion of convergence of the two algorithms and would like to compare the two algorithms in terms of parameters like convergence rate, computational complexity, and the type of games for which each algorithm guarantees convergence. Fictitious play as a learning algorithm was first introduced by Brown. The original algorithm introduced by G.W. Brown was an Alternate Fictitious Play (AFP) which is not so popular these days. In AFP players update their strategies in alternate moves. Their updated strategy is the myopic best response to other players action. Players start with some initial belief about other players and then update those belief after every iteration and behave rationally by playing the best response to their updated beliefs. Other more common version of fictitious play is Simultaneous Fictitious Play (SFP), its similar to AFP with the only difference being that the players update their strategies together. SFP is simpler to study since it treats players symmetrically. Another classification of the algorithm is based on the considered time interval for iteration [i.e. Discrete Time Fictitious Play (DTFP) and Continuous Time Fictitious Play (CTFP)]. As a part of my project I would like to implement and study Discrete Time Simultaneous Fictitious Play.
For games with more than two players implementation of fictitious play algorithm becomes more challenging. Now one needs to decide if the players respond to the joint empirical distribution of their belief about the other players or should they respond to marginal empirical distribution of their beliefs about other players. Traditionally product of marginal distribution of the player's belief about other players is what the players are considered to respond to.
In DTFP or CTFP, each player plays a pure strategy best-response to their updated belief about the other players. Stochastic Fictitious Play (sFP) is a natural extension of DTFP or CTFP, where for each strategy update the players are allowed to choose a mixed strategy best response to their opponent, because the best response mapping from which a player chooses their myopic best response is bigger than the set of myopic best response choices in the DTFP of CTFP.
I would like to compare the two algorithms and then try to check of either of the algorithms can give all the Nash equilibriums of a game with multiple Nash equilibriums and then try to explore the conditions for the game when these algorithms guarantee convergence. It is worth mentioning that if either of the algorithm converges then the limit to which these algorithms converge is a Nash equilibrium.
There are proofs for guaranteed convergence of Fictitious Play algorithm for a 2XN two player non-degenerate ordinal potential games which I would like to study in detail along with the proof for Global Convergence of sFP for a few classes of games.
As of now I have only planned on doing things mentioned above for my project but if the time permits then I would like to explore more and add something new to the project something that has not been done before.