CS 294-5: Scribe notes for Wednesday, September 10, 2003

Comments on correlated equilibrium

- Correlated equilibrium is a relaxation of the NE concept.
- For 4 or more players, direct communication is enough to reach correlated equilibria (no need of intermediaries).
- The paper "A cryptographic solution to a game theoretic problem" by Dodis, Halevi and Rabin, in "Lecture notes in computer science", 2000, shows how cryptography can be used for games with two players.
- Correlated eq. is a more relaxed solution concept than NE, and its computation is easier. It can be computed by a linear prgram, but gets expensive for many players.
- See the paper: "Correlated equilibria in graphical games" by Kakade, Kearns, Langford and Ortiz, E-Commerce 2003, for correlated equilibria in multiplayer games.

Individually Rational (IR) / Enforceable Outcomes

- IR region: see figure 1 (max-min against all other players).
- Thm: IR outcomes $\equiv$ enforceable by a contract.
- sketch of proof: $\subseteq$ direction: If action is not IR, then it's not enforceable, because players will play max-min. $\supseteq$direction: by threat. if anybody deviates from the contract, she'll be punished by all other players (in coalition) using the min-max for that player; therefore, she has no incentive to deviate.
- Strictly IR: same as IR, except that it does not include the borders. That is, we require that everything will be strictly above the min-max.
- Disadvantage of contracts: they are not always possible in real life, due to private information.
- Thm (Folk): SIR$\equiv$payoff combinations of the repeated game $\pm\varepsilon$ (approximation). That is, when contracts are not possible, it is possible to enforce the same behavior by repetition (repeated game).
- Repeated game: $S_i^{RG} : (X_j S_j)^* \to S_i$ (where S_i is the strategy space for player i in the single-shot game)
- $p(S^{RG}) = lim_{k\to\infty} \frac{1}{k} \sum p(s^j)$, if the limit exists.
- proof of Folk thm: by threat.
- complexity issues in finitely repeated games (see paper by Papadimitriou and Yannakakis, STOC '04): results are summarized in figure 2.

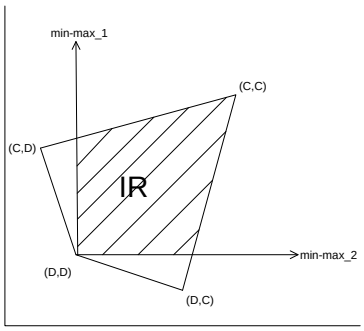

Figure 1: IR region

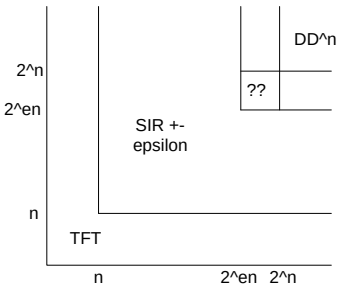

Figure 2: strategies with respect to complexity issues in finitely repeated games

Evolutionary games

- references: Axelrod, John Maynard Smith
- ESS (Evolutionary Stable Strategy): Strategy S is an ESS if $p(s, (1-\varepsilon)s + \varepsilon t) > p(t, (1-\varepsilon)s + \varepsilon t)$ for all t.
- TFT (Tit-for-tat) is ESS in the repeated prisoner's dilemma (easy to show).
- Some games do not have ESS.
- A legend: telling whether a game has an ESS is NP-hard (unknown whether it's true or not).
- The max ε for which the above expression holds is called the resistance of strategy s against t.