CS 591: Computational Game Theory **Spring 2018**

Problem Set 5

Lecturer: Prof. Peter Chin *Due: May 2, 2018*

◇ Please email the written portion (either type up your answer or scan your handwritten solution) & code and report to `kenzhou@bu.edu` by 23:59PM on the due date.

◇ Late policy: there will be a penalty of 10% per day, up to three days late. After that no credit will be given.

1. **N-person games, via program**

   (a) Write out carefully that every N-person finite non-cooperative game has an equilibrium point. Feel free to assume Brower's fixed point theorem. please be as precise as you can in your proof.

   (b) Write a pseudo code that can find an *approximate* fixed point of $f : B^2 \to B^2$. Note, finding an exact solution is an NP-hard problem. If you can implement your pseudo code, you will get extra credit. However, it will be sufficient for you to do a literature search and find some heuristic method (for example one that GAMBIT uses) and at least write out the key steps in the algorithms. For example, you can start with some papers by Prof. Xi Chen at Columbia University:

      i. Xi Chen and Xiaotie Deng, Matching Algorithmic Bounds for Finding a Brouwer Fixed Point, Journal of the ACM 55 (3), 2008. [STOC 05]

      ii. Xi Chen, Xiaoming Sun and Shang-Hua Teng, Quantum Sepration of Local Search and Fixed Point Computation, Algorithmica 56: 364?382, 2010. [COCOON 08]

      iii. Xi Chen and Shang-Hua Teng, Paths Beyond Local Search: A Tight Bound for Randomized Fixed-Point Computation. [FOCS 07]

      iv. Xi Chen and Xiaotie Deng, A Simplicial Approach for Discrete Fixed Point Theorems, Algorithmica 53 (2):250?262, 2009. [COCOON 06]

      v. Xi Chen and Xiaotie Deng, On the Complexity of 2D Discrete Fixed Point Problem. Theoretical Computer Science 410 (44), 2009. [ICALP 06]

      vi. Xi Chen and Xiaotie Deng, Lattice Embedding of Direction-Preserving Correspondence Over Integrally Convex Set. [AAIM 06]