Directed Study Proposal

Game theory has its application ranging from theoretical computer science to practical implementations, especially in areas involving automatic interaction and coordination of intelligent agents, such as robotics, cloud computing, network security, machine learning, and resource management. Graph theoretical ideas are also highly utilized by computer science and its applications, especially in areas such as data mining, image capturing, networking etc. These two concepts and related mathematical theorems often come up in many of my computer science classes. As students specialized in combined honors in computer science and mathematics, we want to participate in a directed study about games on random graphs, to enhance our knowledge and make connections between theory and applications. We hope to have professor Omer Angel to be our supervisor, since his research focus is probability theory, random maps, percolation, random graphs, and many more disciplines of relevance.

Through this directed study, we hope to have a broader and deeper understanding of games on large random graphs and their variations, rules, strategies, and applications. We will start by reading related research papers. One of the papers provided by professor Omer is *Game on Random Boards* by Basu et al’, in which they introduced the game of Trap on large random graphs and its variation in higher dimensions or different lattices. Trap is a two-player game where each player takes turns to move a token on vertices of a graph, and a player wins if his opponent has no possible moves. The process of bootstrap percolation and site percolation was used to determine the possibility of finding winning strategies. This study also teaches us a lot about properties of the underlying graph, such as the cardinality of the maximum matching. In order to have a better understanding, we plan to write programs to simulate the game on a larger scale. There are also a lot of unanswered questions and unconsidered variations that we can work on.

During January and February, the plan of this directed study is to start with reading two main papers (including the one mentioned above) and some more related research papers that are in the reference list of these two papers. We will to find a more specific problem with suitable difficulty to work on, such as extending the proof of some theorems in these papers by considering different cases. We will also write computer simulations to gain a deeper understanding of the problem, and meet weekly or biweekly with professor Omer to discuss our progress. In March, we will start writing a report paper about what we have learned, the methods that we have tried and why they succeed or failed. By the end of the semester, we will conclude with this summary report and a presentation. We sincerely hope you consider our proposal and register us to the directed study course.

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