Project First Milestone Report

So far: I have been meeting weekly with Sahil and Euiwoong to discuss our progress on the problem. Sahil and Euiwoong came up with a tentative idea to solve the problem on general bipartite graphs, and if their results are correct, a 2/3rd approximation for the maximum matching is possible in the current problem description, matching the 2/3rd approximation that was also a tight upper bound in the streaming setting. The idea is mostly an extension of the ideas used to achieve a 2/3rd approximation in Kapralov-Goel-Khanna (1), but picking the edges with a probability distribution. It is quite surprising that the streaming setting provides no additional power over the online setting in terms of the approximation possible.

Meeting Milestone: I have read through Kapralov-Goel-Khanna’s (1) paper on achieving a 2/3rd approximation in the streaming setting and understand the algorithm, and have some understanding of the analysis behind the generation of the bounds. Since we found a promising approach to pursue so quickly, I decided it would be a better use of time to research this approach instead of taking a lot of time to really understand all of the analysis.

Looking Forward: Since we have come up with a solution to the original problem we were considering so quickly, many of my original milestones will have to be changed. We are currently thinking about natural extensions of the problem before writing up our results, as it would be nice if we could find out more results and combine them into a paper. One extension we are working on is instead of having two batches, having three batches, and perhaps with more investigation we can extrapolate this to n-batches. Another extension we are considering is finding the maximum matching in a general graph, not just a bipartite graph. For the general graph, we have come up with an example in the three-phase setting where a 2/3rd approximation is not possible.

I think that setting concrete milestones for set dates doesn’t work well for theoretical computer science research because much time is spent just thinking about and investigating different approaches to the problem, and it is hard to estimate how long a problem or subproblem will take. Also, forcing writeups of approaches and analyses taken seems to interfere with the natural process of just thinking about a problem. Instead I believe that the biweekly meetings with Dr. Anupam Gupta next semester will help to keep me accountable with spending a sufficient amount of time on the research, and I also plan to continue meeting weekly with Sahil and Euiwoong.

Surprises: The biggest surprise was how fast we found a solution to the original problem. Going into the research I expected a slow buildup of results into a solution, but it turns out that Kapralov-Goel-Khanna(1) already did all of the work and we just had to adapt their results to our setting. This isn’t a bad surprise, but it is a wakeup call that I have to be ready to adapt to whatever pace the research presents.