Major Changes: There have been no major changes in the scope of my project. I’m continuing to try to prove tight bounds for the query complexity of non-adaptive quantum approximate counting using Grover iterations. One minor change in scope is that I’m trying to see if I can prove something about how the bounds change in terms of the number of rounds of non-adaptivity.

What I Have Accomplished Since My Last Meeting: I’ve written up more formally the baseline algorithm my mentor and I had looked at before the break, which uses one round of non-adaptivity and has a query complexity of $O(\sqrt{N}/\epsilon^2)$; I’ve attached this on my webpage. I’ve also been trying to find an algorithm that does better than this baseline. While I haven’t yet found one that works with one round of non-adaptivity as desired, I discussed with my mentor a recursive algorithm that can do better than the baseline given $O(1)$ many rounds of non-adaptivity. If we allow $K$ rounds of non-adaptivity, the algorithm has $O(\sqrt{N}/\epsilon^x)$ query complexity, where $x$ is $(1 + 1/(2^K - 1))$. It is interesting that the required run-time seems to drop really quickly with the number of rounds of non-adaptivity allowed, and I think looking at this further might be helpful.

Meeting Your Milestone: I have met my milestone of having explored at least three ideas by this point, though I have not proved any tight bounds yet. Moving forward, I will try to think more deeply about the ones that seem most promising and prove something using them.

Surprises: There have not been any major surprises in my project since my last bi-weekly status meeting. One minor surprise was that I thought that the method of using the KL-divergence to lower bound the mean squared error would work directly (as it seems to work well for similar problems) – however, this did not turn out to be straightforward and I have to think more about techniques to lower bound the query complexity.

Looking Ahead: I will try to find ways to improve the current recursive algorithm and get tighter bounds; in particular, if I can find one that gets to the point of $O(\sqrt{N}/\epsilon)$ given $O(\log(N))$ many rounds of non-adaptivity, then that might help to indicate that it is tight and it could be possible to prove lower bounds based on the insight gained from the recurrence. I think I should also more closely read a related paper by Paul Burchard and learn more about the adversary method in the quantum setting as it seems like it could be relevant.

Revisions to Your Future Milestones: I don’t have any revisions to future milestones - like before, they involve thinking about and developing more ideas.

Resources Needed: I have all of the resources I need to complete my 15-400 project.