Research Proposal:
Shortest Path Problems

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For my clinic project last semester, I was working with shortest path problems. In particular our team examined algorithms to find shortest paths in time dependent graphs, or graphs where the traversal time of edges changes over time. As I was doing research on this problem I came across several other interesting shortest path problems.

The traditional, non-time-dependent shortest path problem can be solved efficiently with Dijkstra’s algorithm. For our clinic project we have found that a modified version of this algorithm can be used to solve the time dependent problem. However, several other problems cannot be addressed with either of these algorithms. One might need to find shortest paths in graphs where the edges weights are not certain but can be described with some probability function. There are also many applications for algorithms to find paths that minimize some function of time and some other weight, such as cost or distance. Or one could imagine a use for algorithms which find not the shortest path, but a path which arrives within a certain time window with penalties for arriving early or late.

For my thesis, I would like to examine work that has been done so far in these areas and hopefully find an opportunity to develop some algorithms on my own. After working with shortest path algorithms for the last year, I think I have sufficient background to begin research. In preparation for our clinic project, our team did a lot of research on shortest path problems. My notes from this research should give me a good place to start researching these other topics.