Honors Option Proposal for CMSC452

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In the course CMSC452 - "Elementary Theory of Computation", Dr. Gasarch will cover various topics in Theoretical Computer Science. The content of the course will feature regular and context free languages, time complexity, P vs NP, Turing completeness, and set theory. The additional work that I am proposing will expand on NP-Completeness. This topic deals with proving that certain problems are hard to solve.

One specific problem is the Hamiltonian Cycle Problem: given a graph, is there a cycle that visits every vertex once? There are also natural variants to this problem that I plan to show are NP-Complete:

1. {G — G is a directed graph with a directed Ham Cycle}
2. {G — G is a directed graph with a directed Ham Path}
3. {G — G is an undirected graph with an undirected Ham Cycle}
4. {G — G is an undirected graph with an undirected Ham Path}
5. {G — G is an undirected planar graph with an undirected Ham Path}

The fifth problem has some meta-proof issues. In other words, there is a proof that the problem has to be difficult.

For my honors project, I will independently research these problems and write a paper detailing the proofs. The writeup of the first four problems will be due on October 15th. The writeup of the fifth problem will be due on December 1st. In addition to the paper, I will give a talk to the rest of the class on these problems. Dr. Gasarch will also feature me in his complexity seminar where I will talk about my paper to his colleagues.

This material is beyond the scope of this course because the NP-Completeness proofs done in class are simple. The first four problems are too hard for the undergraduate level and would be featured in a graduate complexity course. Dr. Gasarch has told me that the fifth one is much harder and would probably not even be in a graduate course. The proofs that the proof is hard is cutting edge research; it was discovered last year.

Doing this project will give me a lot of insight into the world of Theoretical Computer Science. I think that it will be a great segway into the work that I am considering doing in graduate school. The project is also a guarunteed way for me to gain exposure to Dr. Gasarch and his colleagues.