CSCI 403:
Sample Questions 2

The midterm will cover more than just these topics, so consider these a set of sample questions rather than a sample exam.

1. Prove that the following is NP-complete: given a graph $G$ on $n$ nodes, does it have two simple cycles of length $n/2$ each (assume $n$ is even) that do not intersect? They should not share any vertices.

Given that large loops are concerned, what would you reduce from? Would you add something to your graph?

2. Prove that 4-CNF-SAT is NP-complete. Hint: Reduce from 3-CNF-SAT. You can use a reduction similar to the one from SAT to 3-CNF-SAT, only easier.

3. Does my graph (undirected, unweighted, with $n$ vertices) contain a path from vertex $s$ to vertex $t$ of length at most $n$? Is this NP-complete? Prove. Hint: Is it?

4. Consider the change-making problem. If the set of coins contains a penny, argue that the greedy algorithm always returns a feasible answer. Does it always return an optimal answer? (ie, the smallest number of coins)

5. How would you perform matrix chain multiplication as a greedy algorithm?

6. Consider the following greedy algorithm for solving 3-CNF-SAT (how’s that for combining topics?): I look at each variable $x_i$: I count how many times it occurs and how many of those where it is negated. If more than half are negated, I assign a value of 0 (False) to it, otherwise I assign 1. Show that this will not always give a satisfying assignment by giving a counterexample. Next, show that this will not work because it would imply $P=NP$. 