CMPS/EECE 500
One of the previous Final Exams

Name:_____

1. Briefly describe priority queue. What is the preferred data structure for implementing a priority queue? What are the pros and cons in using such data structure? What is the time complexity of building a priority queue of N integers? If the integers 20,18,19,16, 15 and 10 are added in the given order to an empty priority queue that maintains the lowest value in the root, draw the priority queue showing the values of all the nodes.

2. Briefly describe NP class.
   Compare and contrast decision problem and optimization problems.
   $P \neq NP$ is a conjecture. John, a brilliant CACS Ph.D. student, has developed an algorithm to solve an NP-complete problem. He has demonstrated it by implementing his algorithm on his PC and running it with few data sets each is in the order of few hundreds. The running time of his algorithm on his data sets are consistently in the order of few minutes. His advisor was stunned and they are planning to have a press conference to announce the "so called breakthrough." What advice, if any, you may provide to the student and his advisor before they go public with the results?

3. Show that 3SAT is NP. Assuming SAT is NP-complete, show that 3SAT is NP-complete. (Show all the relevant steps)

4. You are given a problem to solve that is known to be NP-complete. What steps you must take to solve the given problem? (Describe each step succinctly).

5. Describe the algorithm that we discussed in the class to solve 3p-sat problem approximately. Briefly mention all the salient features of the algorithm

6. A. Describe maximum clique and minimum vertex cover problem.

   B. Using the approximation techniques discussed in the class, solve the vertex cover problem of the following graph. Comment on the quality of the solution. The bidirectional connectivity of the nodes of the graph is shown in Table 1.

	A	B	C	D	E	F	G
A		X	x				
B	X		X			x	x
C	X	X		X	X	x	
D			X		X		
E			X	X			
F		X	X				
G		X					

Table 1

6) Maximum clique problem

Given a group of vertices some of which have edges in between them, the maximal clique is the largest subset of vertices in which each point is directly connected to every other vertex in the subset. Every time a new point is added the number of total cliques that must be searched at least doubles, Hence we have an exponentionally growing problem.

7 Obtain the tight bounds of the following
(a). $\sum i^3 a^i$ (for a >1)
(b). log(n!)

8 Mark, a CACS student who did not take CMPS 500, argues that divide and conquer is better than dynamic program to solve **any problem** since there is no need to compute a sub-problem more than once. Explain to Mark the merits of each method and when and how each method is applicable to solve problems. Do not forget to explain him the limitations.

9 (5 pts) If you learn anything from this class that will help you in the future, briefly mention 2 important things you have learned in this class?

What other courses would have enriched your life if you think **this course was a waste of your time.**