CSE 207 Class Test 4 (Open Book), Section - A, Answer Sheet
NP-Completeness and Approximation Algorithms

28 May, 2011. Full marks: 20. Time: 15 min.

Student No..... Name: .....

True/False with Justification ($10 * (1 + 1) = 20$) marks.

For each of the following statement write "T" for true or "F" for false and write a **one-sentence** justification of your answer. Writing more than one sentence for justification may incur penalty. (For a "false" statement, sometimes a justification may be simply the correct statement.)

1. The class P is a subset of the class NP.

   Ans: T. Because, by the second definition of NP (poly time verifiable by deterministic machine) also applies to P.

2. For proving a problem P1 to be NP-hard by a reduction from a known NP-hard problem, the reduction should be polynomial.

   Ans: T. Otherwise, it is meaningless, because we could find exact solutions in exponential time.

3. An optimization problem has an equivalent decision problem.

   Ans: T. Run the decision version from lowest possible value of the solution to its highest possible value, which is usually polynomial.

4. A problem P1 is NP-complete means, it is proven that having a polynomial time solution for P1 is impossible.

   Ans: F. "Proven" is a wrong word here, it should be "widely believed". Or, "having a poly solution to P1 would imply a poly solution to all problems in NP".

5. A polynomial-time reduction from P1 to P2 means P1 is at least as hard as P2.

   Ans: F. P2 is at least as hard as P1.

6. Proving a problem P1 to be in the class NP means, sowing that given a certificate of the solution of P1, it is possible in polynomial time to verify whether the certificate is a correct solution or not by a non-deterministic machine.

   Ans: F. It should be "deterministic machine" instead of "non-deterministic machine".

7. It is possible to have an approximation algorithm whose approximation ratio $\rho = 1$.

   Ans: F. $rho = 1$ means optimal solution, which is not known.

8. The 2-approximation algorithm for geometric TSP that we learned in the class will also work as a 2-approximation algorithm for general TSP.

   Ans: F. General TSP does not follow "triangle inequality", which is used in this approximation algorithm.

9. It is possible for all NP-complete problems to have a constant-factor approximation algorithm.

   Ans: F. For example, general TSP, it can not have a constant factor approximation algorithm, for any constant, even as large as 1000.

10. An approximation algorithm should be polynomial.

    Ans: T. Otherwise, we could find exact solutions in exponential time.