CSE 207 Class Test 4, Section-B (Open Book), 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. It is widely believed that the two classes NP and NPC are the same.

   Ans: F. Widely believed that they are not the same.

2. For proving a problem 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 can be solved by its decision version with an extra factor of polynomial time.

   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, if it is possible to solve P1 in polynomial time, then only the problems in the class NPC will be solved in polynomial time.

   Ans. F. Not only the NPC problems but also all the problems in NP will be solved.

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. A problem P1 is in the class P implies that P1 is also in the class NP, because 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. Here the first statement is true, but the reason is not. It should be "... deterministic machine".

7. For some NP-complete problems, it is possible to have an approximation algorithm with approximation ratio $\rho = 1 + \varepsilon$, for any $\varepsilon > 0$.

   Ans: T. For example, geometric TSP. This type of approximation algorithms are called PTAS.

8. For some constant ρ, a ρ-approximation algorithm for geometric TSP will also work as a ρ-approximation algorithm for general TSP.

   Ans: F. May not be, because, general TSP does not follow "triangle inequality".

9. Definition of an approximation ratio, $\rho = \frac{Optimal\ Solution}{Approximate\ Solution}$.

   Ans: F. Not always. The above ratio is for maximization problem. For minimization problem it is $\rho = \frac{Approximate\ Solution}{Optimal\ Solution}$.

10. An approximation algorithm should be polynomial.

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