<u>Assignment Questions</u>

Date: 22/07/2019

Q.1. Consider the following decision problem:

K-Color: Given a graph G, can we use at most K-Colors to color G such that no two adjacent vertices have the same color.

- Show that 2-Color is in P.[Hint: Bipartite Graph]
- Show that 3-Color is in NP-Complete. [Hint: Show that 3-SAT can be reduced to 3-Color in Polynomial time.

Q.2. Consider the "Sum of Subset" problem.

- Show that "Sum of Subset" is NP-Complete.
  [Hint: Show that 3-SAT can be reduced to "Sum of Subset" in Polynomial time. Take an instance of 3-SAT and convert it to Sum of Subset instance. Solve Sum of Subset problem and obtain the truth assignments for 3-SAT.]

Q.3. Show that "HAM-CYCLE" is NP-Complete. [Hint: Reduce 3-SAT to HAM-CYCLE.]
HAM-CYCLE: Given a graph G, does there exist Hamiltonian cycle in G?

Q.4. Define: 3-Dimensional Matching problem. Compare it with Bipartite Matching problem. Classify both of the problems i.e. whether they are in P or NP.

Q.5. Consider the following problem. You are managing a Communication Network, modeled by a directed graph G=<V, E>. There are C users who are interested in making use of this Network. User i(for each i=1,2,….,c) issues a request to reserve a specific path P_i in G on which to transmit data. You are interested in accepting as many of the path requests as possible, subject to the following restriction: if you accept P_i and P_j, then P_i and P_j cannot share any nodes.

Thus the Path selection problem asks: Given a directed graph G=<V, E>, a set of requests P_1, P_2,……,P_c- Each of which must be a Path in G- and a number K, is it possible to select at least K of the paths so that no two of the selected paths share any nodes? **Prove that Path Selection is NP-Complete.**

Q.6. The set partition problem takes as input a set S of numbers. The question is whether the numbers can be partitioned into two sets A and such that . Show that the Set Partition Problem is NP-Complete.

Q.7. Given an integer M * N matrix A and an integer m-vector b, **the 0-1 integer programming problem** asks whether there exists an integer n-vector x with elements in the set {0,1} such that Axb. Prove that 0-1 integer Programming is NP-Complete. [Hint: Reduce from 3-CNF-SAT.]