

## 2001 Fall MSCS Exam – 1998 and Prior

Answer two out of four.

1. A set of  $n$  independent programs must be executed by deadline  $D$ , where  $D$  is a positive integer. Two identical processors are available. The durations  $d_i$  of the execution of each program  $i$  on each of the processors is given. You need to assign the  $n$  programs to the two processors so that all the programs will be executed by the deadline  $D$ .

Describe your solution; does it solve the problem for all instances? Is the problem in  $P$ ? Is it in  $NP$ ? Is it  $NP$ -complete?

2. Assume a communication network with  $n$  nodes in which the delay  $d(i, j)$  caused by a direct connection between nodes  $i$  and  $j$  (whenever it exists) are given. Assume also that the shortest delay between all pairs of nodes has been computed. Let  $(v, w)$  be a new direct connection that has been added to the network with a delay  $d(v, w)$ . Describe an  $O(n^2)$  algorithm for updating the shortest delay between all pairs of nodes.
3. You have a list of air line flight prices between pairs of cities, but not all cities have a direct connection. Your company has employees scattered all over the country. Explain an algorithm to determine what city you should hold your company-wide meeting in, if you want to minimize the expenses of sending everyone to that city.
4. Your company is building an airplane, and there are several subassemblies that need to be constructed; some of them must be completed before others can begin. For example, attachment of wings takes 3 days, but that cannot begin until both the wings and the fuselage are complete. There are no cyclic dependencies; to be precise, there is never an occurrence where you need  $A$  to complete  $B$ ,  $B$  to complete  $C$ , and  $C$  to complete  $A$ . Design an algorithm to determine the earliest date that the airplane can be finished, assuming you have enough employees to work on all parts at the same time.