In the name of God

Department of Physics
Shahid Beheshti University

OPTIMIZATION METHODS IN PHYSICS

Exercise Set 3

(Due Date: 1400/07/30)

1. Traveling Salesman Problem (TSP):

A : According to the given map (Fig. 1), write a program to find paths with minimum distance passed by salesman and visit each city ones. Try to write your program in deterministic and random approaches.
B : Suppose that C-city must be visited twice.
C : Suppose that A-city and D-city must be visited three times.
D : Suppose that F-city must be visited just before G-city.

2. Two dimensional spin-Glass example. In a typical spin-glass system the system exhibit not only ferromagnetic but also anti-ferromagnetic interactions. Suppose that we have 3×3 network of spins (Fig. 2). The mathematical description of such system as an optimization problem are:

$$X = \{1, -1\}$$

$$\mathcal{H}(\sigma) = -\sum_{\langle i,j \rangle}^{9} J_{ij}\sigma_i\sigma_j$$

here $J_{ij} = +1$ is for ferromagnetic (represented by solid line) and $J_{ij} = -1$ is assigned for the anti-ferromagnetic case (represented by jagged line).According to the figure, find the configuration for which the hamiltonian to be minimized. Discuss about the uniqueness of your results.

3. The queen problem. This a famous game in which we have the N Queen at the $N \times N$ chessboard and the problem is that the placing N chess queens on the chessboard so that no two queens attack each other in the same row and column and diagonal direction. Suppose we have $N = 4$ (Fig. 3). Write an algorithm and computer program to solve the problem. Explain the advantages and disadvantages of your program.

Good luck, Movahed

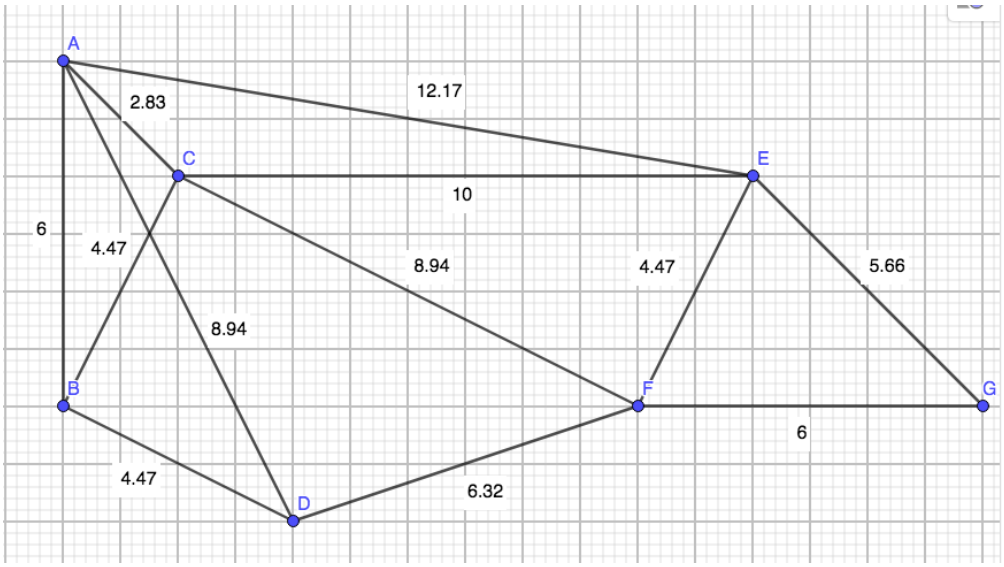

Figure 1: The map for TSP.

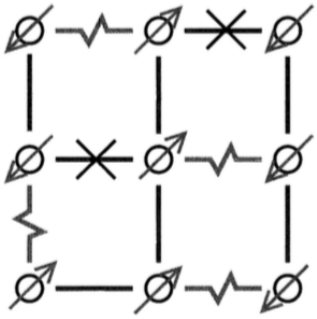

Figure 2: Two-dimensional spin glass.

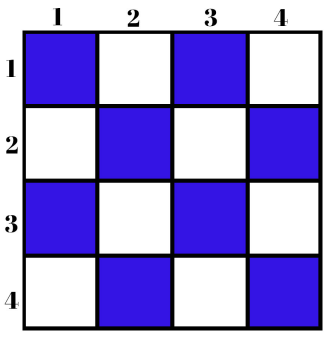

Figure 3: The 4-queen problem.