This assignment covers Modules 5–7. It is due on Mon, April 22, 2002.

Problem 1 (7 marks) Show how a genetic local search algorithm (see Chapter 2, Figure 2.11 of the book) can be modelled as a GLSM. Specify all components of the GLSM; you do not have to give a formal definition, but your description needs to be technically precise and concise.

Problem 2 (7 marks) Genetic Algorithms (GAs) have many parameters that can be set in different ways (*i.e.*, probability of crossover, population size, probability of mutation, etc.).

In order to find approximately optimal settings for the crossover and mutation probabilities when solving the Travelling Salesperson Problem (TSP), a scientist carried out the following experiment. She took 10 randomly generated benchmark instances of the TSP. For each problem instance and parameter setting, she ran the same GA 10 times and marked down the number of generations it took to find an optimal solution. For each parameter setting she computed the average number of generations over the 100 runs (10 problem instances times 10 runs). The averages are reported in Tables 1 and 2 below. Note that each parameter was tested separately. More precisely, in Table 1, the mutation rate was kept constant at 0.01 and in Table 2 the crossover rate was kept constant at 0.5. The scientist concluded that an approximately optimal setting is a mutation rate of 0.008 and a crossover rate of 0.4.

crossover rate	average # of generations
0.3	2,500,000
0.4	2,000,000
0.5	2,100,000
0.6	2,300,000
0.7	2,300,000

Table 1: (mutation rate = 0.01)

mutation rate	average # of generations
0.006	2,000,000
0.008	1,700,000
0.010	2,100,000
0.012	2,600,000
0.014	2,500,000

Table 2: (crossover rate = 0.5)

As a colleague, you have been asked for your professional opinion on the methodology. Explain the problems/pitfalls of the methodology as outlined above and suggest improvements. (Your answers should be as concise and precise as possible; focus on the major issues.)

Problem 3 (6 marks) All NP-complete combinatorial decision problems can be encoded into SAT, and often, various encoding schemes are possible. List at least three search space features that can potentially help you decide which of two given encoding schemes would

yield SAT instances that are easier to solve with existing SLS algorithms for SAT and briefly discuss the application of these features as well as their merits and disadvantages in the given context.