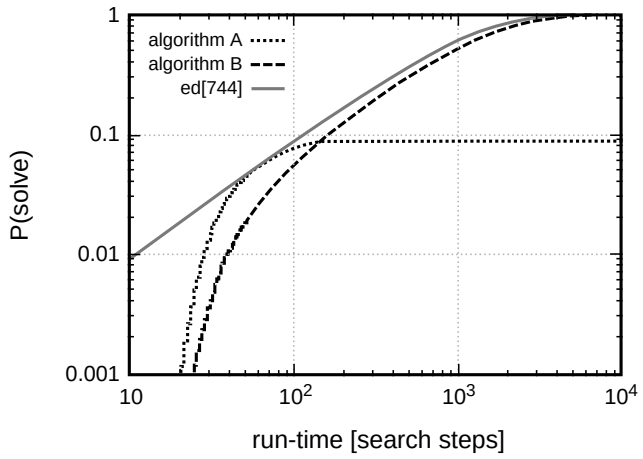
This assignment covers Modules 6 and 7. It is due on Tue, 22 Mar 2005 at the beginning of class.

Problem 1 (Knowledge test, 3 marks) Explain the difference between a run-time distribution (RTD), a solution quality distribution (SQD), and a search cost distribution (SCD).

Problem 2 (Problem solving; 5 marks) You are comparing the performance of two SLS algorithms A and B for a combinatorial decision problem. Applied to a well-known benchmark instance, these algorithms were found to exhibit the RTDs shown below.



What do you learn from these RTDs? Which further experiments do you suggest to decide which algorithm is superior?

Problem 3 (Problem solving; 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.

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.

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)

(Your answers should be as concise and precise as possible; focus on the major issues.)

Problem 4 (Problem solving; 2 marks) Give an example for a landscape that has no local minimum other than the global optimum and is yet very hard to search for any standard SLS method.