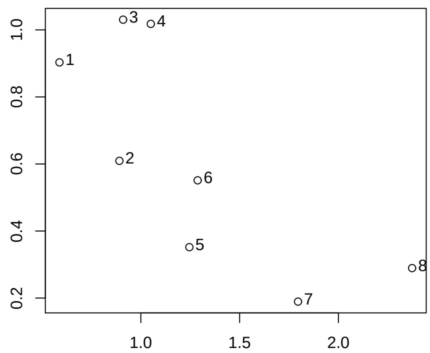
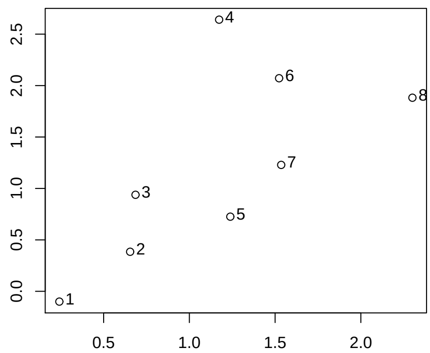
INF3490 exercises - week 4 2013

Problem 1

In what ways does the island model and the diffusion model handle migration differently? With the population arranged into a grid of 3×5 subpopulations, how many iterations would at least be needed for a mutation in one corner of the grid to reach the corner at the opposite end with 4 neighbors (N,S,E,W) and with 8 neighbors (N,NE,E,SE,S,SW,W,NW)?

Problem 2





For each of the two figures above, find the Pareto optimal set when

- Minimizing both f_1 and f_2
- Minimizing f_1, maximizing f_2
- Maximizing f_1, minimizing f_2
- Maximizing both f_1 and f_2

Problem 3

In the two figures above, what would be the maximum point when using weighted sum with the weights

- $w_1 = 1$, $w_2 = 1$
- $w_1 = -1$, $w_2 = 1$

Problem 4

Why can hybrid algorithms make it harder to maintain diversity?

Problem 5

In a 0-1 knapsack problem, how could you implement a repair mutation to transform infeasible solutions into feasible ones (i.e. make the sum of costs of the selected items go below the budget)?

Problem 6

Why is it usually better to use the number of fitness function evaluations as a time measure, rather than the number of generations, or the amount of CPU time spent?

Problem 7

If P_i is the probability of having found a solution of a certain quality (e.g. it is at least feasible, or it is good enough for the purpose) by generation i of some EA, how many independent runs would you need to do if you want to increase the probability to z?

Problem 8

We have two algorithms, of which we want to compare some metric (e.g. the best fitness) after a certain number of evaluations. Having done at least 30 runs of each algorithm, we can use the z-test to estimate the probability of the two algorithms performing equally good on average by calculating

$$z = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

$\|z\| \geq$	0.674490	1.281552	1.644854	1.959964	2.326348	2.575829	2.807034	3.090232	3.290527
$P \leq$	0.5	0.2	0.1	0.05	0.02	0.01	0.005	0.002	0.001

and then looking up the probability in the table above. $\bar{x}_A$and $\bar{x}_B$ are the averages of algorithm A and B respectively. Likewise $s_A$and s_B, and n_A and n_B are the standard deviations and the number of runs of the two algorithms. We usually say that the difference in averages is statistically significant when P is smaller than 0.05.

Find an approximate value for P in the following cases (assume 30 runs of both algorithms):

- The averages are 100 and 200, and both have a standard deviation of 100
- The averages are 100 and 150, and both have a standard deviation of 100
- The averages are 100 and 150, with standard deviations 125 and 66