INF3490 exercise answers - week 4 2013

Problem 1

In the island model, every individual has a uniform low probability of migrating to any other island, while in the diffusion model individuals can in effect only migrate one step each generation. With a 3×5 grid it would take $(3-1)+(5-1)=6$ generation to migrate to the other corner with 4 neighbors, and $\max\{(3-1),(5-1)\}=4$ generations with 8 neighbors.

Problem 2

	Left	Right
$\min f_1$, $\min f_2$	$\{1,2,5,7\}$	$\{1\}$
$\min f_1$, $\max f_2$	$\{1,3\}$	$\{1,2,3,4\}$
$\max f_1$, $\min f_2$	$\{7,8\}$	$\{1,2,5,7,8\}$
$\max f_1$, $\max f_2$	$\{3,4,6,8\}$	$\{4,6,8\}$

Problem 3

- $w_1 = 1$, $w_2 = 1$: left: 8, right: 8
- $w_1 = 1$, $w = -1$: left: 1, right: 4

Problem 4

Hybrid initialization can lead to very uneven initial coverage of the search space, which might hamper the search. Hybrid crossover and mutation, as well as (Lamarckian) local search before evaluation will lead solutions towards clusters near (local) optima.

Problem 5

One way would be to randomly deselect items until the solution is under budget. One might also consider a greedy approach that iteratively deselects the items of least worth until the budget is met. One could even consider this as a smaller 0-1 knapsack problem from only the selected items and optimize that using some potentially completely different algorithm.

Problem 6

The evaluation is usually the most computationally intensive part of the algorithm, and is invariant across optimization algorithms since it is strictly problem-dependent. In contrast, the amount of computation done in one generation can vary a lot (e.g. because of different parent or offspring population sizes), as can the CPU time (because of differences in how optimized the code is in the different algorithms, etc.).

Problem 7

Probability of not finding a solution in any runs: $(1-P_i)^R$. Probability of finding at least one:

$$\begin{aligned} z &= 1-(1-P_i)^R \\ 1-z &= (1-P_i)^R \\ \log(1-z) &= R\log(1-P_i) \\ R &= \frac{\log(1-z)}{\log(1-P_i)} \end{aligned}$$

Problem 8

- $z = \frac{100-200}{\sqrt{20000/30}} = -3.873 \Rightarrow P < 0.001$
- $z = \frac{100-150}{\sqrt{20000/30}} = -1.936 \Rightarrow 0.1 < P < 0.05$
- $z = \frac{100-150}{\sqrt{(15625+4356)/30}} = -937 \Rightarrow 0.1 < P < 0.05$