

# INF3490/INF4490 Exercises - Week 4

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$\mathbb{P}$  marks the programming exercises, we strongly recommend using the python programming language for these. Exercises may be added/changed after publishing.

## 1 Migration

In what ways does the island model and the diffusion model handle migration differently? With the population arranged into a grid of  $3 \times 5$  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)?

## 2 Evolution strategy(ES)

### 2.a

A common variant of evolution strategies used for (local) search is the  $(1+4)$  ES. How would this differ from the  $(1+1)$  ES in how the search space is explored? How does this, and  $(1+\lambda)$  in general, compared to hill climbing and greedy search?

### 2.b

What effect does an adaptive search strategy have on optimization performance?

### 2.c

How would it affect the search if the strategy parameters were mutated after the solution parameters instead of before?

## 3 ES Implementation

### $\mathbb{P}$ 3.a

Ignoring mutation, and starting with the population  $\{1, 2, 3, 4\}$ , implement and run 3 generations of a  $(4+8)$  ES maximizing  $g(x) = x$ , and observe what the end population looks like (use intermediary recombination).

### 3.b

If a  $(4, 8)$  ES had been used in Problem 3.a, what would the probability of the optimal solution ( $x = 4$ ) surviving the first generation have been?

### $\mathbb{P}$ 3.c

Repeat Problem 3.a with an EP with  $q = 2$ . How do the two algorithms compare?

## 4 Knapsack problem

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)?

## Corrections and suggestions

Corrections of grammar, language, notation or suggestions for improving these exercises are appreciated. E-mail me at: **olehelg@uio.no** or use **GitHub** to submit an issue or create a pull request.