

# Exercise 11: Genetic Algorithms versus Evolution Strategies

Summer Term 2024

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The goal of this exercise is to compare genetic algorithms with evolution strategies with respect to some selected runtime issues.

**Review:** Please, review the following questions from a traditional perspective:

1. What are typical settings for the mutation probability  $p_m$ ?
2. What are the resulting distributions of the offspring?
3. How do the two types of algorithm handle the step size  $\sigma$ ?

**To Do:** In the following you should explore the possible progress in a graphical as well as analytical way.

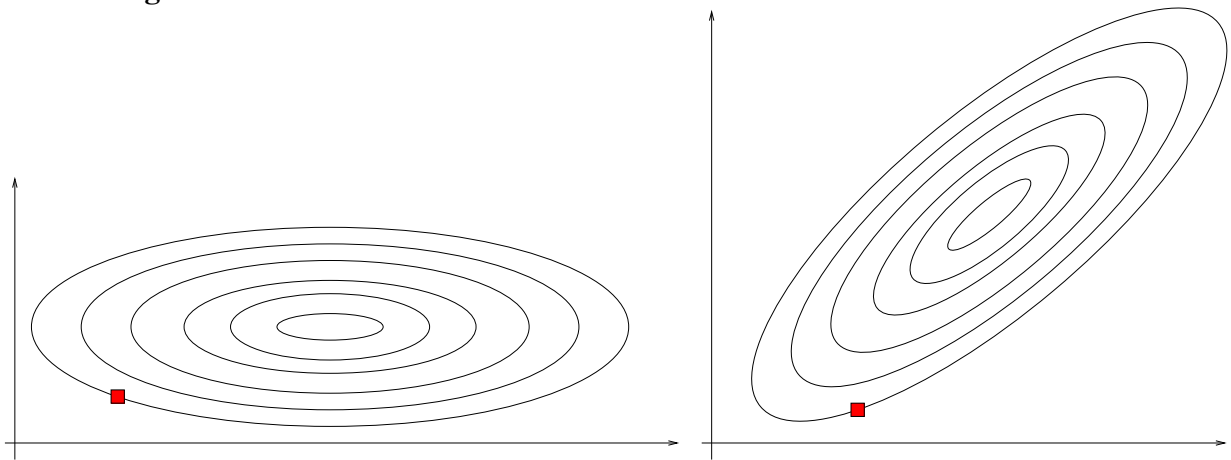
**Tasks:** All the figures below show the same quadratic fitness functions  $f(x_1, x_2) = x_1^2 + cx_2^2$ , with  $c > 1$  denoting an Eigenvalue. The difference is that on the right-hand-sides, the fitness functions are rotated. Such a rotation can be simply obtained by

$$\begin{bmatrix} z_1 \\ z_2 \end{bmatrix} = \begin{bmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

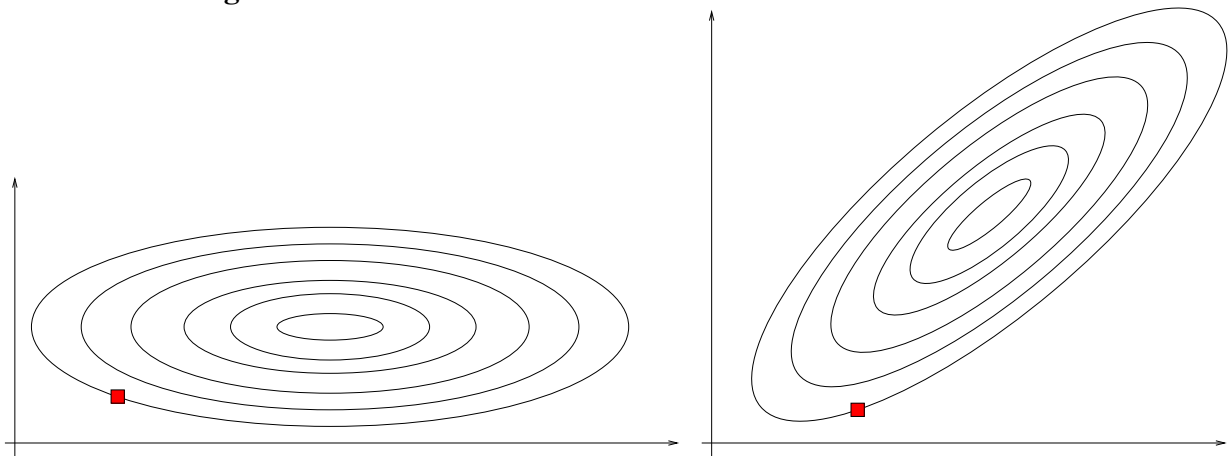
Assume that all the algorithms start at the little box in the lower left corner.

1. Illustrate the area in which a GA can improve the fitness. Please, consider both cases.
2. Illustrate the area in which an evolution strategy can improve the fitness. Please, do so for both cases.
3. Now, you should consider two parents as inserted in the third figure. Please, indicate the effect of cross over.

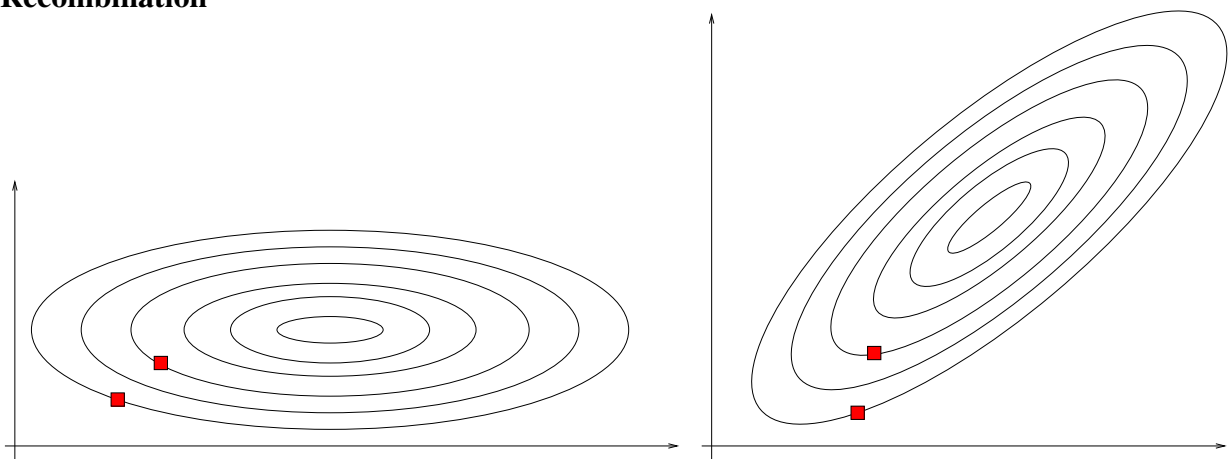
## Genetic Algorithm



## Evolution Strategies



## Recombination



Have fun, Theo and Ralf.