Evolutionary Strategies

Exercise 1: CMA-ES

Assume we have drawn the current population $\mathbf{x}_{1:\lambda}$ from the bivariate Gaussian distribution $\mathcal{N}(\mathbf{m}^{[0]}, \mathbf{C}^{[0]})$ with $\mathbf{m}^{[0]} = (1,1)^\top, \mathbf{C}^{[0]} = \mathbf{I}$, such that

Id	x_1	x_2	Fitness value
1	1.14	0.24	0.67
2	1.54	-0.86	0.41
3	2.1	2.16	0.09
4	1.5	2.69	0.09
5	1.25	0.51	0.47
6	0.92	2.19	0.15

We want to do a simplified CMA-ES update step:

- Assume the parent number $\mu = 3$.

- Find $\mathbf{m}^{[1]}$ by updating $\mathbf{m}^{[0]}$ in the mean weighted[1] direction of $\mathbf{x}_{1:\mu}$ with stepsize 0.5.

- Compute $\mathbf{C}_\mu$, the (unweighted) sample covariance of $\mathbf{x}_{1:\mu}$ w.r.t. $\mathbf{m}^{[0]}$, and compute

$$\mathbf{C}^{[1]} = (1 - c) \cdot \mathbf{C}^{[0]} + c \cdot \mathbf{C}_\mu$$

  with $c = 0.1$.

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[1]Simply scale the fitness values such that they sum up to one.