Notation

- Individual: $\vec{a} \in I$.

- Individual space: $I = I\!R^n \times S$.

- Strategy parameters: S.

- Population: $P^{(t)} = \{\vec{a}_1, \ldots, \vec{a}_n\} \in I^k$, $k \in \{\mu, \lambda\}$.

- Recombination: $\mathbf{rec} : I^\mu \to I$.

- Mutation: $\mathbf{mut} : I \to I$.

- Selection: $\mathbf{sel}_\mu^k : I^k \to I^\mu$, $k \in \{\lambda, \mu + \lambda\}$.

- Generation transition: $opt_{ES}(P^{(t)}) : I^\mu \to I^\mu$

$$opt_{ES}(P^{(t)}) = \mathbf{sel}_\mu^k(\sqcup_{i=1}^\lambda \{\mathbf{mut}(\mathbf{rec}(P^{(t)}))\} \sqcup Q)$$

$(k = \lambda + |Q|, Q \in \{P^{(t)}, \emptyset\})$.

- Realization of a normally distributed random variable: $z \sim \mathrm{N}(\zeta, \sigma^2)$.

Random number generation:

$$z_1 = \sqrt{-2\ln u_1} \sin(2\pi u_2) \quad , \quad z_2 = \sqrt{-2\ln u_1} \cos(2\pi u_2)$$

$u_1, u_2 \sim \mathrm{U}((0, 1])$, $z_1, z_2 \sim \mathrm{N}(0, 1)$.