

Application of Genetic Algorithm to DARWIN Core Design Optimisation

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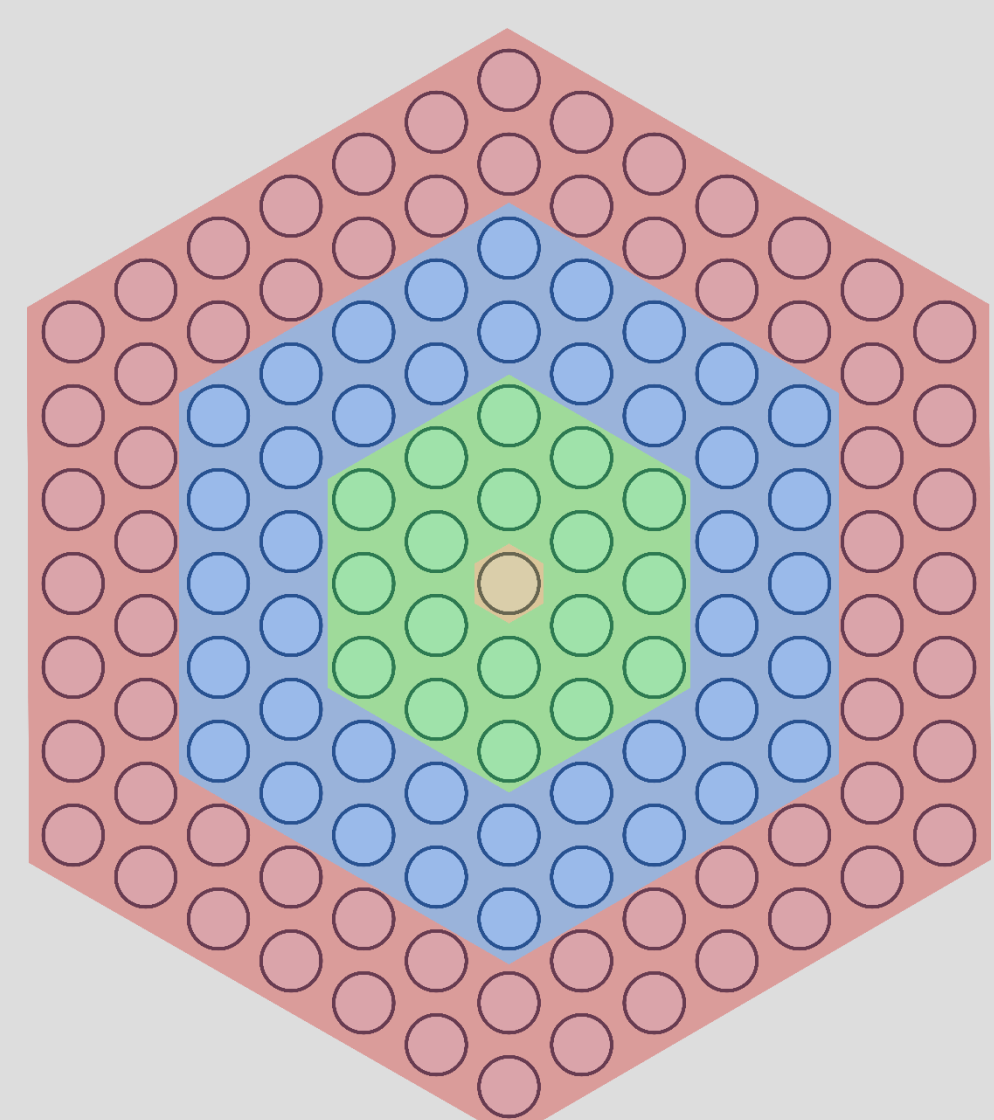
darwin.ijs.si



DARWIN

DARWIN's genome

- Dispatchable Adaptive Reactor With Interchangeable compoNents
- Single-objective optimisation with genetic algorithm
- 2D hexagonal fuel assembly in infinite lattice divided on 4 fuel regions

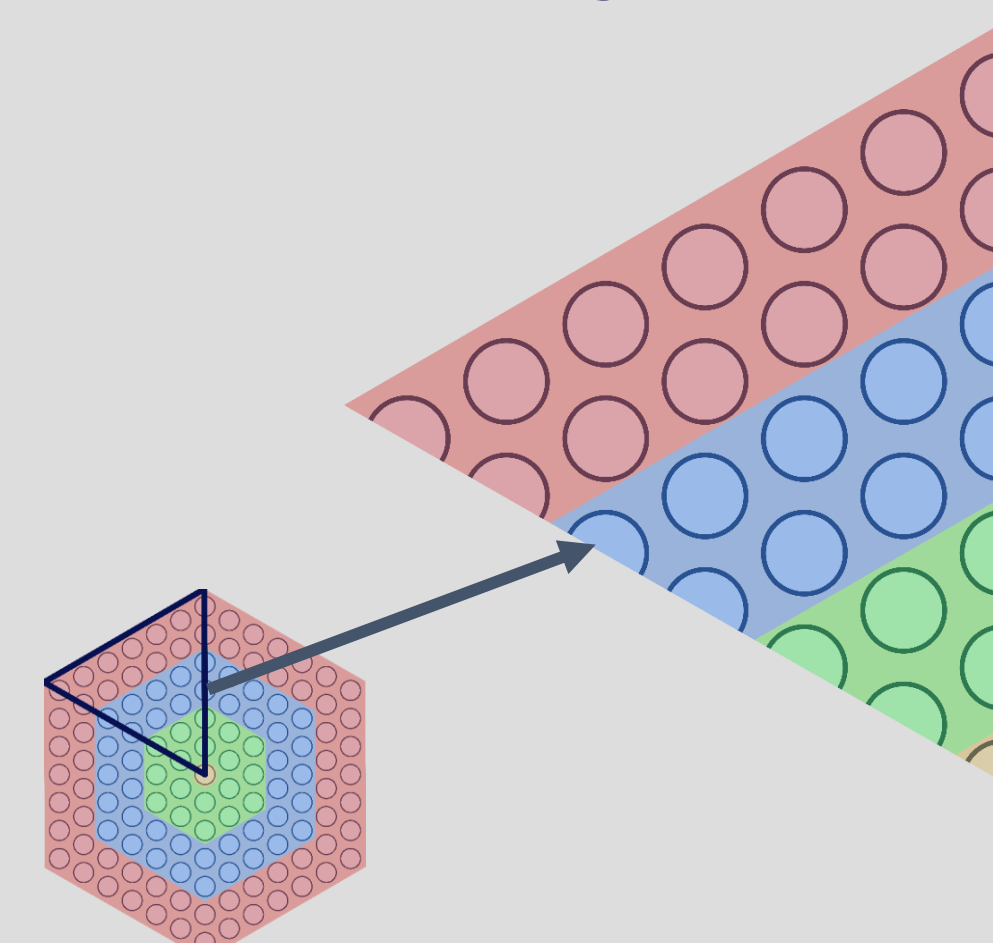


Fuel region 1
Fuel region 2
Fuel region 3
Fuel region 4

- Fuel region's genes:
 - Fuel type $\in \{\text{UO}_2, \text{MOX}, \text{UZrH}, \text{UYH}\}$
 - U enrichment $\in [3\%, 10\%]$
 - U ratio $\in [10\%, 50\%]$
- 4 region $\times$ 3 genes/region = 12 genes
- Only candidates with coolant temperature feedback $\alpha_c \leq 0$

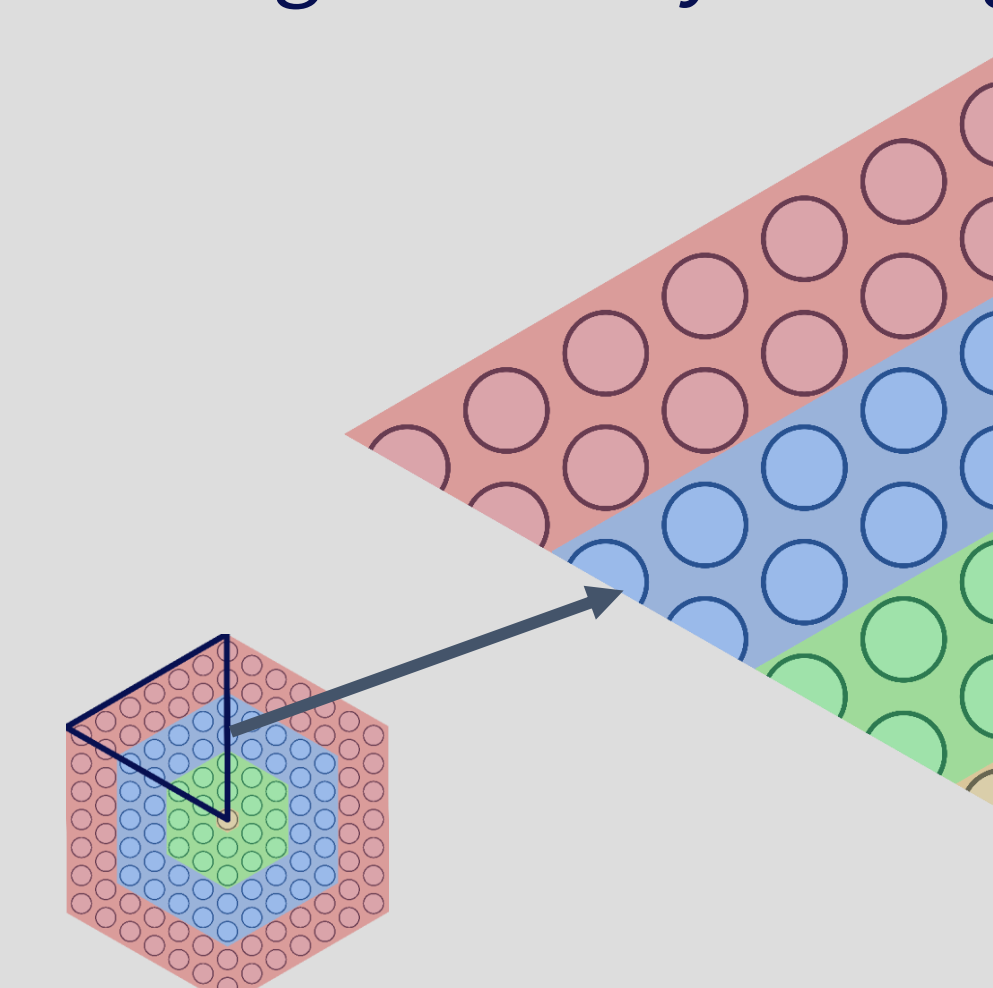
Optimised solution

Longest fuel cycle length in units of time: **26.6 years**



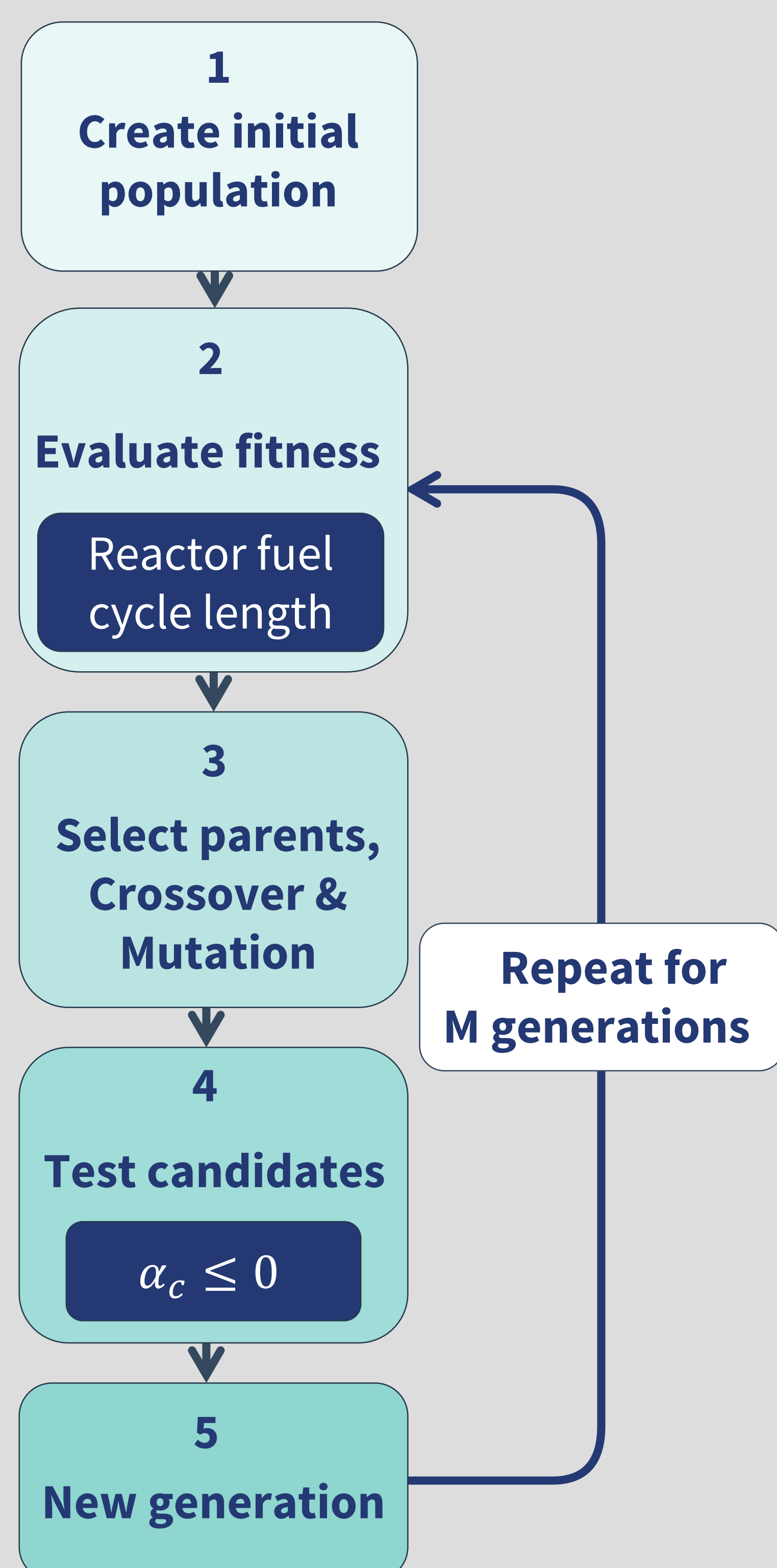
UO ₂	10% U enr.	
MOX	3.2% U enr.	13.9% of UO ₂
MOX	4.1% U enr.	41.6% of UO ₂
UZrH	8.8% U enr.	20.3% of U

Longest fuel cycle length in units of fuel utilisation: **341 MWd/kgHM**

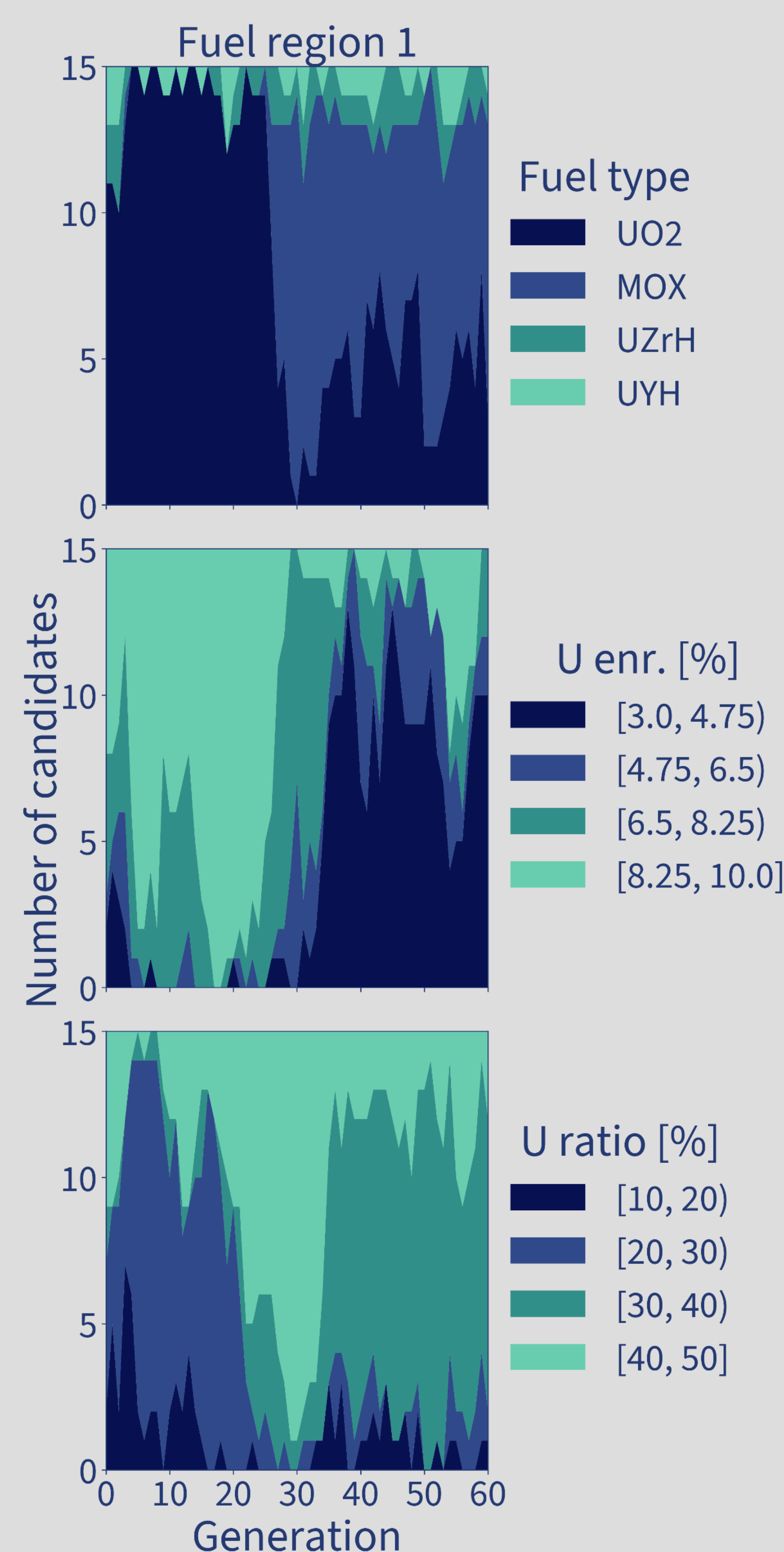


MOX	3.2% U enr.	33.8% of UO ₂
UZrH	10% U enr.	42.9% of U
UO ₂	8.9% U enr.	
MOX	9.8% U enr.	24.1% of UO ₂

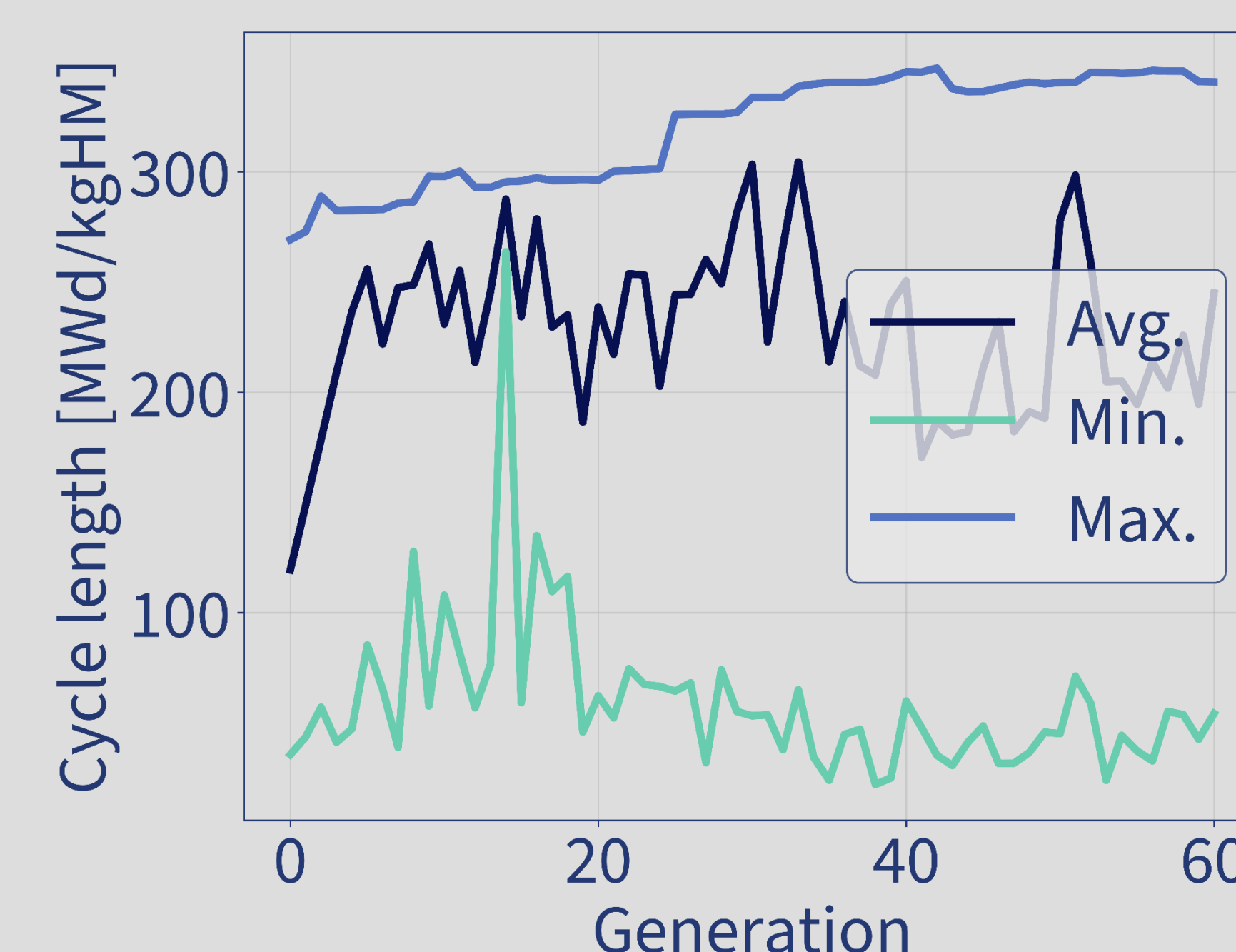
How it works?



How the genes evolve?



How good is the optimisation?



Check more:



https://anze-mihelcic.github.io/genetic_algorithm_NENE2026/

Is there any correlation between cycle length and initial k_{eff} ?

