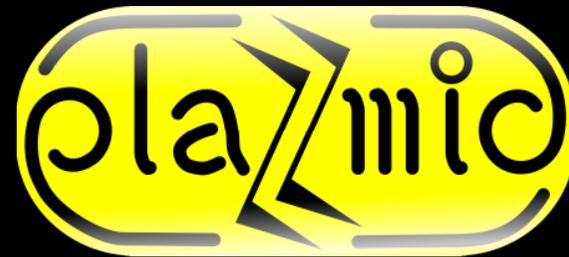
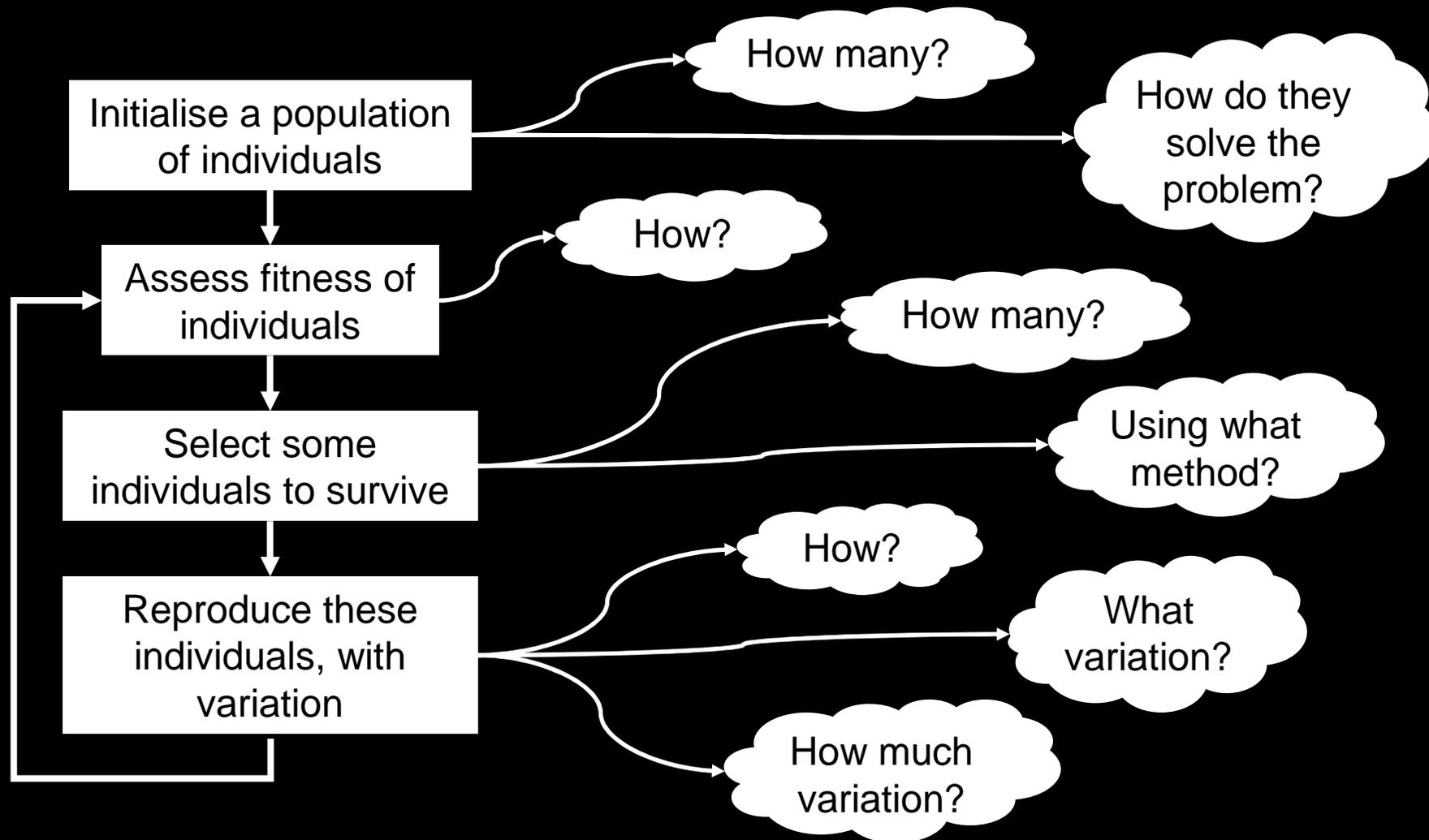


Emergent Evolution allows Meta Evolution

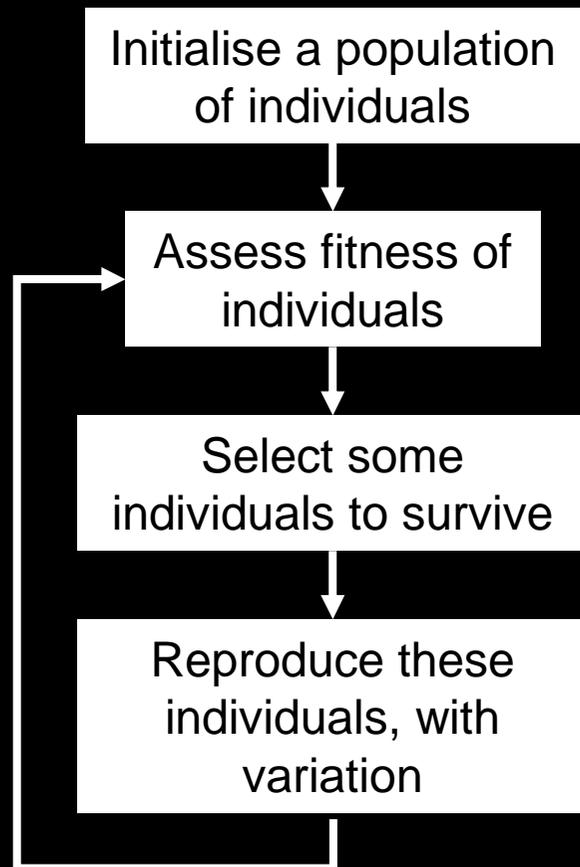
Adam Nellis
University of York



Evolutionary Algorithms



Parts of an Evolutionary Algorithm

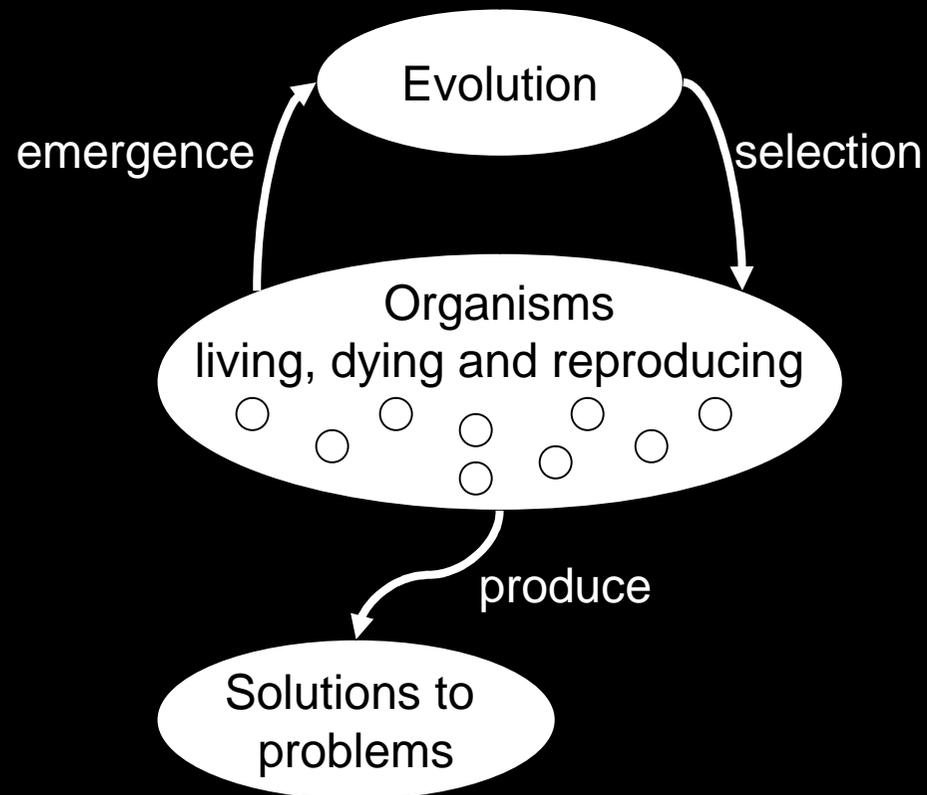
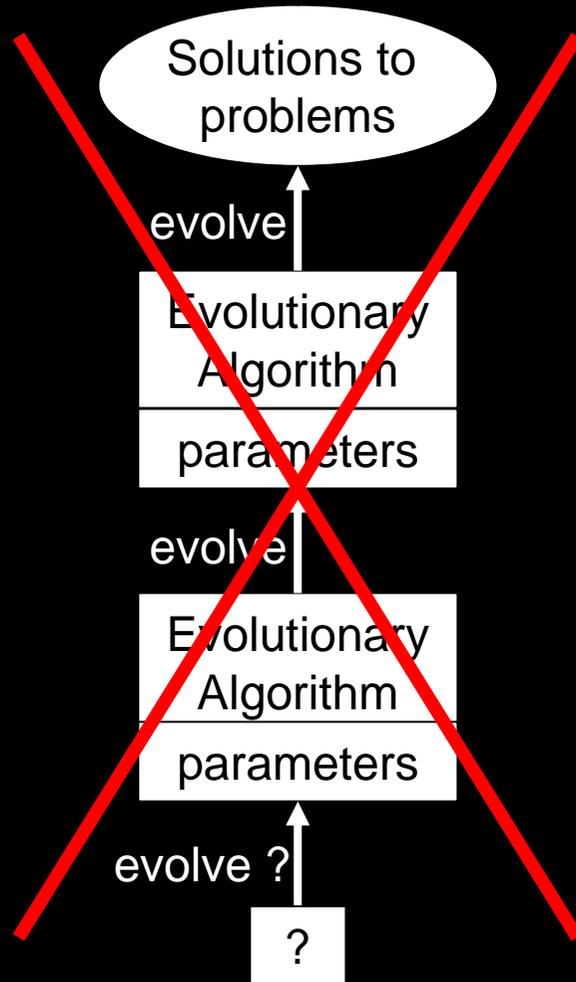


1. A problem to solve
2. A population of candidate solutions to the problem
3. A way of improving the quality of solutions in the population

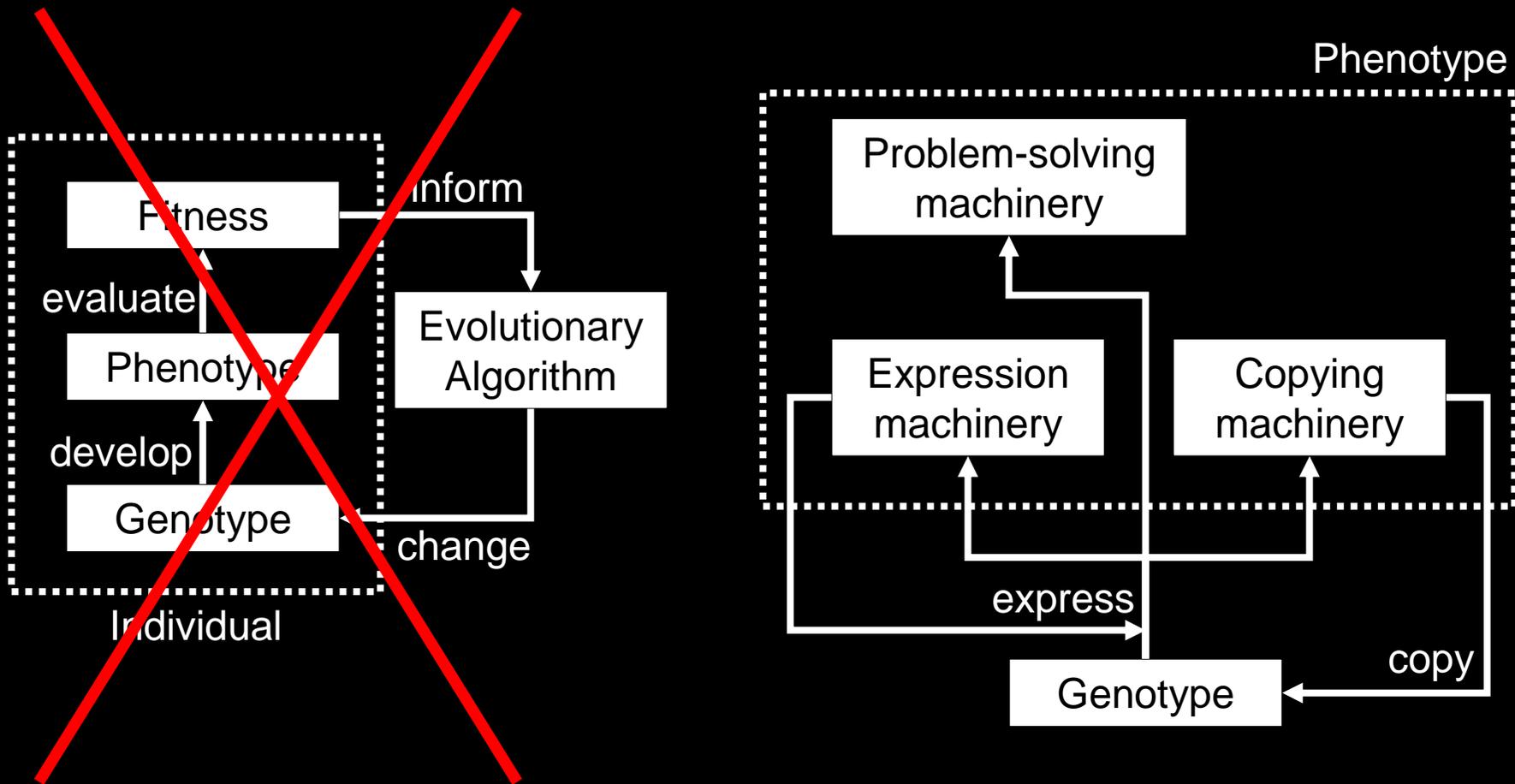
Evolution is not Evolutionary Algorithms

- Evolution is just:
 - Variation, inheritance and selection
- It happens because:
 - Individuals reproduce
 - Reproduction is not perfect
 - Resources are limited (so there is selection)
- Over time, this makes fitter individuals
 - But what is an “individual”?

Emergent Evolution



Evolutionary Algorithm in the phenotype

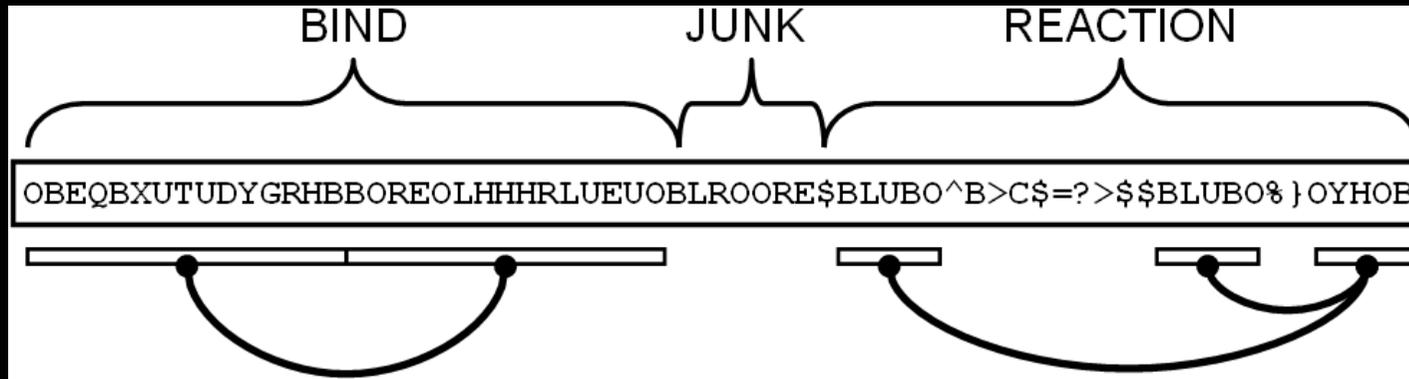


How? Individuals that are alive!

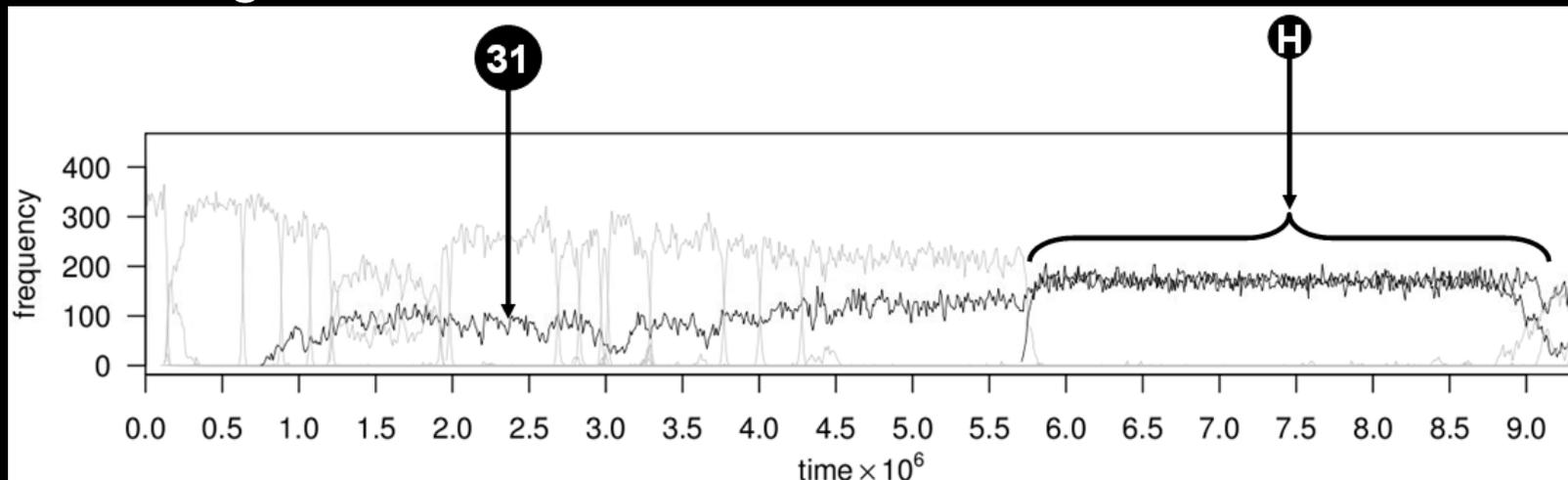
1. Perform a task (solve the application problem)
2. Metabolise food to gain energy
3. Use energy to express genes to do points 1 and 2
4. Copy my genes (imperfectly), to reproduce
5. Encode all of the above functionality in the genes

Example – Stringmol

A self-copying machine



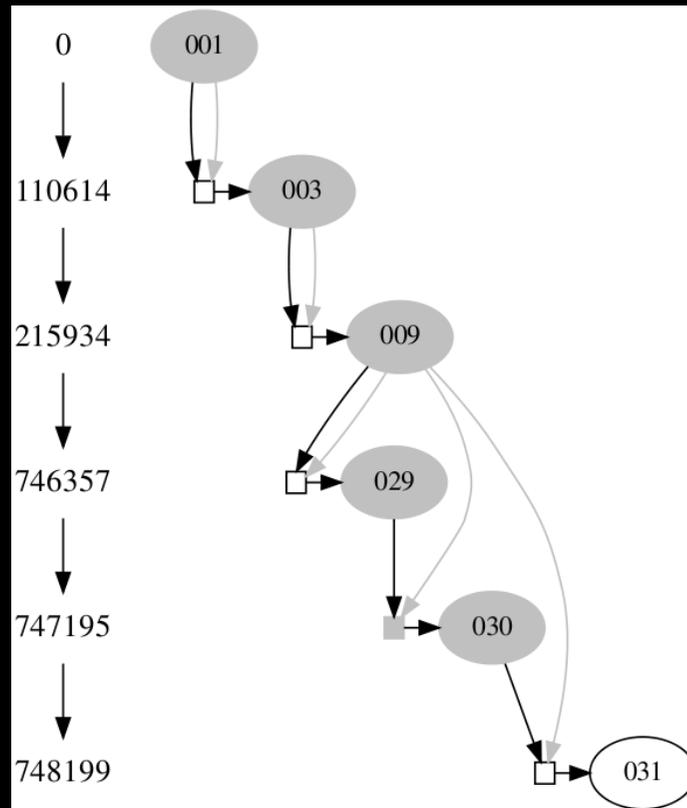
Evolving over time



Large-scale mutation

09: OBEQBXUUUDYGRHBBOSEOLHHRLUEUOBLROORE\$BLUBO^B>C\$=?>\$\$BLUBO%}OYHOB

31: BBOSEOLHHRLUEUOBLROORE\$BLUBO^B>C\$=?>\$\$BLUBO%}OYHOB



09: OBEQBX...UOBLROORE\$BLUBO^B>C\$=?>\$\$BLUBO%}OYHOB

29: OBEQBX...UOBLROORE\$BLUBP^B>C\$=?>\$\$BLUBO%}OYHOB

30:
OBEQBXUUUDYGRHBBOSEOLHHRLUEUOBLR
OORE\$BLUBP^B>C\$=?>\$\$BLUBO%}OYHO
OBEQBXUUUDYGRHBBOSEOLHHRLUEUOBLR
OORE\$BLUBO^B>C\$=?>\$\$BLUBO%}OYHOB

Summary

- Meta evolution via emergent evolution
 - Not by evolving parameters in a hardcoded algorithm
- Richer individuals
 - That have the Evolutionary Algorithm as part of their phenotype
- Example of large-scale-mutation
 - Strings copying each other with per-character mutation
 - Evolved a large-scale macro-mutation