# Evolutionary programming

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# Introduction

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# Basic evolutionary process

- One or more populations of **individuals competing** for limited resources.
- The notions of **dynamically changing** populations due to birth and death of individuals.
- A concept of **fitness** which reflects the ability of an individual to survive and reproduce.
- A concept of **variational inheritance**: offspring closely resemble their parents but are not identical.

Evolutionary algorithms are useful for problem solving due to its *complex adaptive behaviour* emulation. Not so different from how humans search for solutions to any problem:

- Formulating solutions,
- then **evaluating** them:
- the best ones are used, the less useful ones are usually **discarded** and
- some of them are ***mutated*** or ***recombined*** to create new ones, maybe better.

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# Evolutionary programming

Fogel proposed modeling individuals as finite state machines.
Also, he proposed sexual and asexual reproduction of individuals in the algorithm.
The program should start with a N number of initial individuals; and the next generation is determined by combining new individuals into a 2N population, raking them and selecting the best N individuals.

# Problem solving

Since simple rules could demonstrate complex behaviour and some sort of intelligent exploration in a space of possible solutions, we can use EAs to solve problems.

# Problem solving

Each problem should be modeled in order to find

- An individual definition that satifies the problem's solution space characterization.
- A fitness function that describes correctly our problem's behaviour.
- A **variation operator** that generates new individuals from existing ones.
- A **selection operator** that selects the best individuals from the population.

# Problem solving

This can be applied, for example , not only to simple problems (like function maximization/minimization) but to more complex ones like ANN's weights tuning, scheduling, energy consumption optimization, etc.