



Genetic Algorithms

Introduction to Artificial Intelligence

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The Traditional Approach

- Ask an expert
- Adapt existing designs
- Trial and error

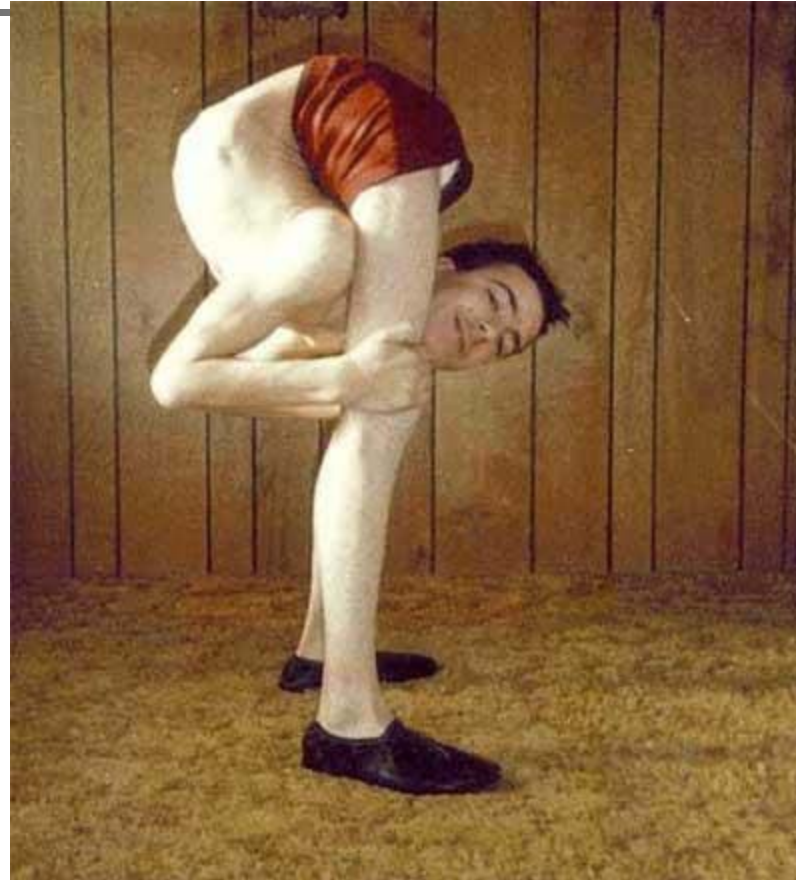


Nature's Starting Point



Alison Everitt's "A User's Guide to Men"

Optimised Man!





Comparisons

- Traditional
 - best guess
 - may lead to local, not global optimum
- Nature
 - population of guesses
 - more likely to find a better solution



More Comparisons

- Nature

- not very efficient
 - at least a 20 year wait between generations
 - not all mating combinations possible

- Genetic algorithm

- efficient and fast
 - optimization complete in a matter of minutes
 - mating combinations governed only by "fitness"



Example: Karl Sim's creatures

- Creatures

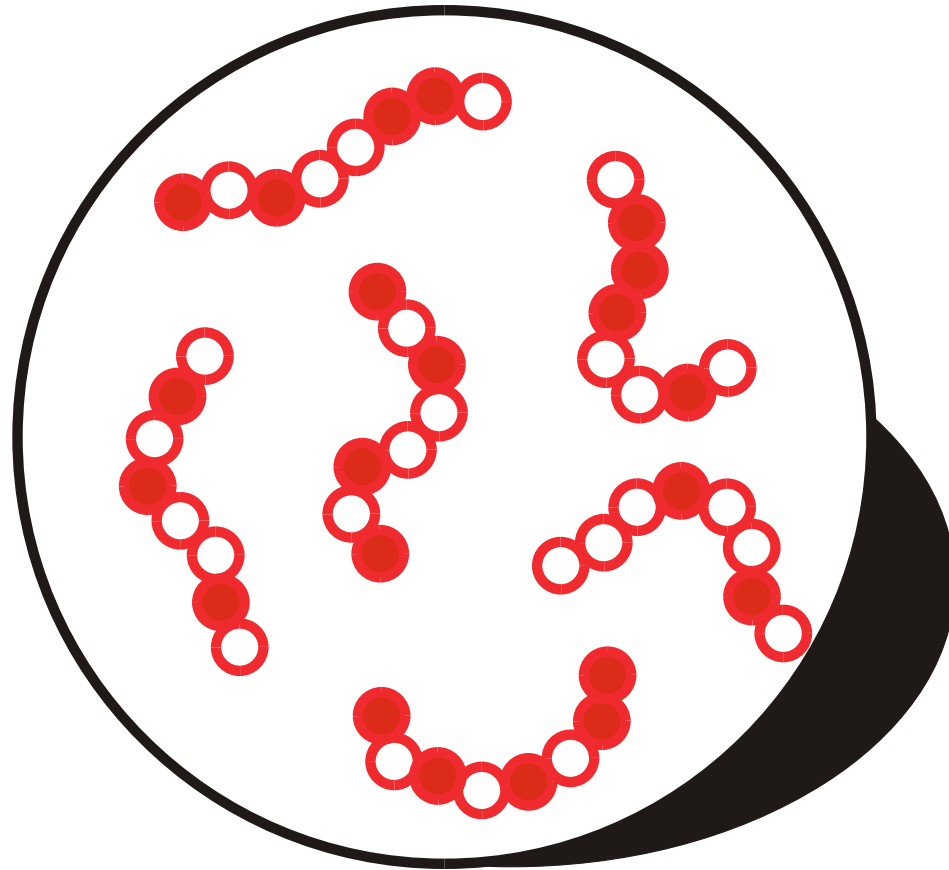


The Genetic Algorithm Approach

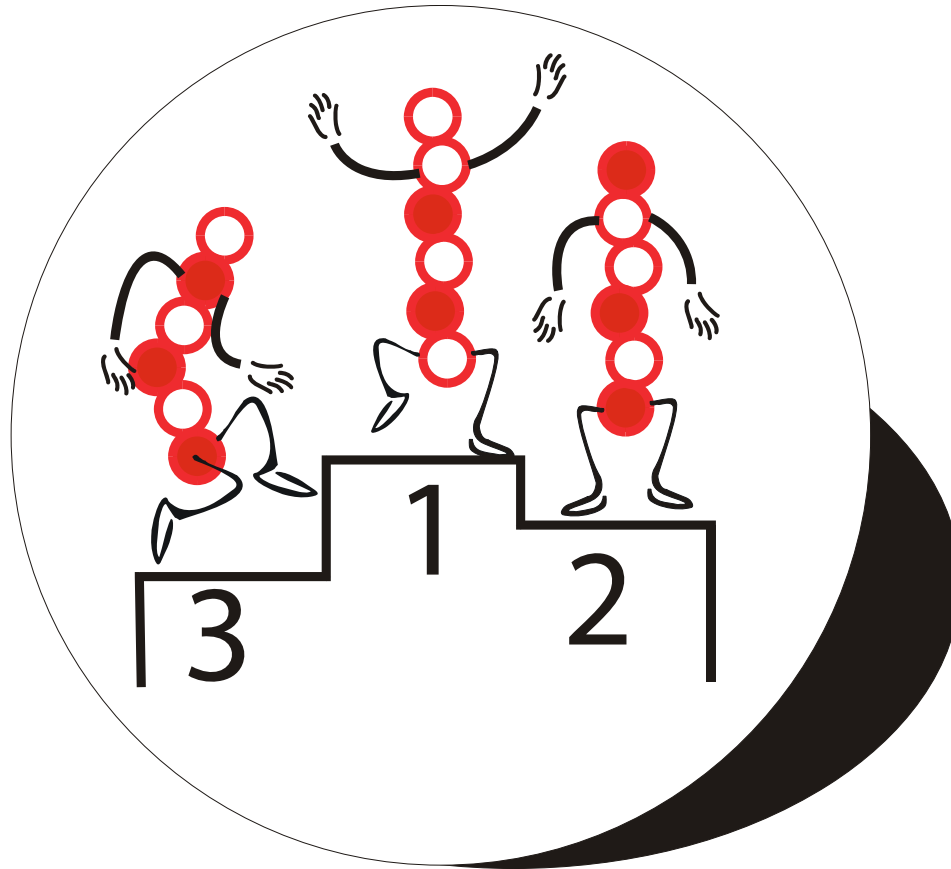
- Define limits of variable parameters
- Generate a random population of designs
- Assess “fitness” of designs
- Mate selection
- Crossover
- Mutation
- Reassess fitness of new population



A "Population"

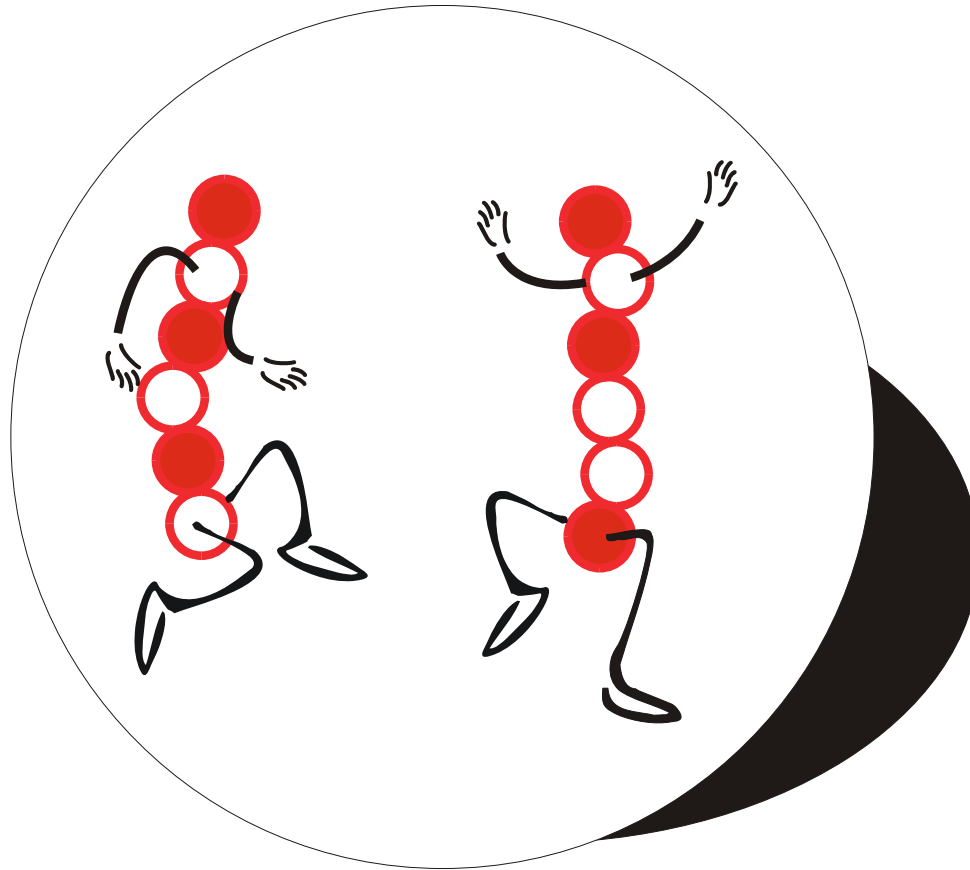


Ranking by Fitness:



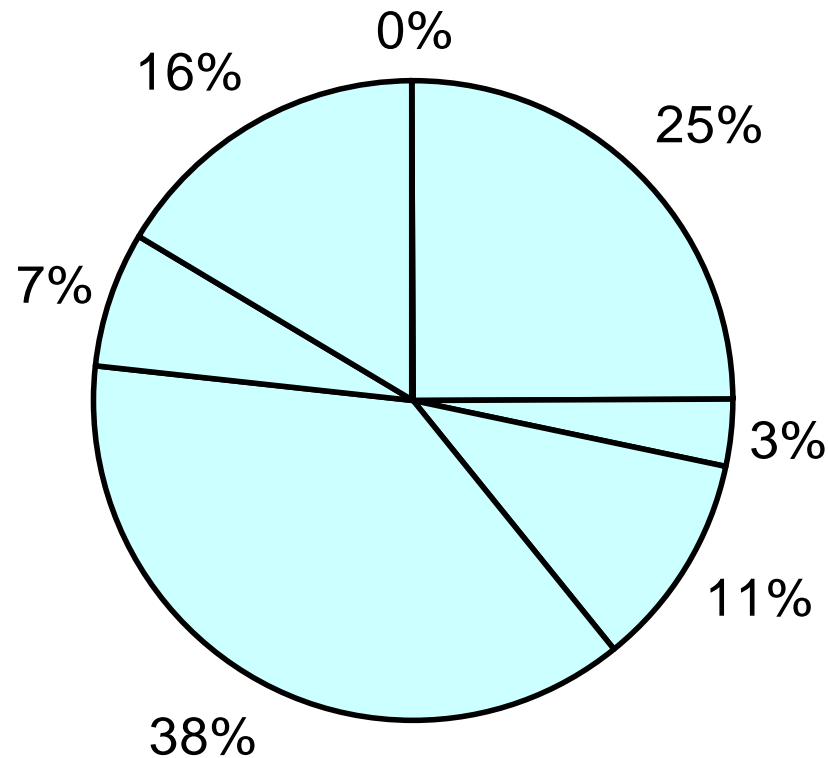
Mate Selection:

Fittest are copied and replaced less-fit



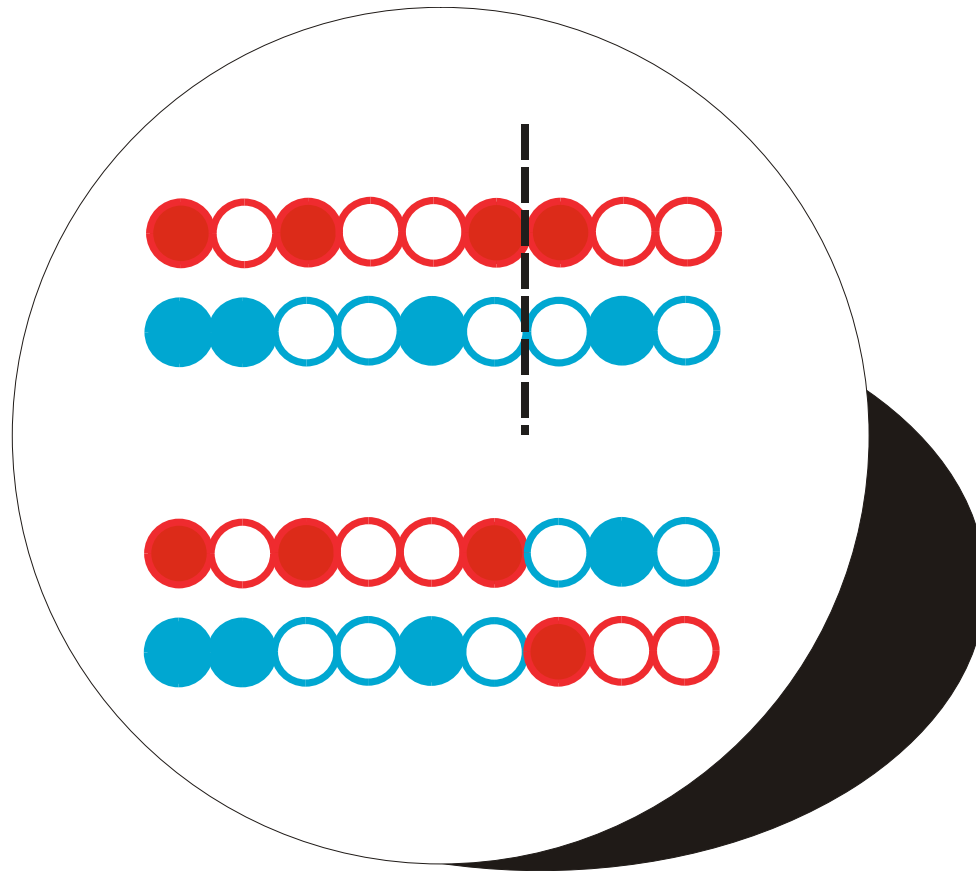
Mate Selection Roulette:

Increasing the likelihood but not guaranteeing the fittest reproduction



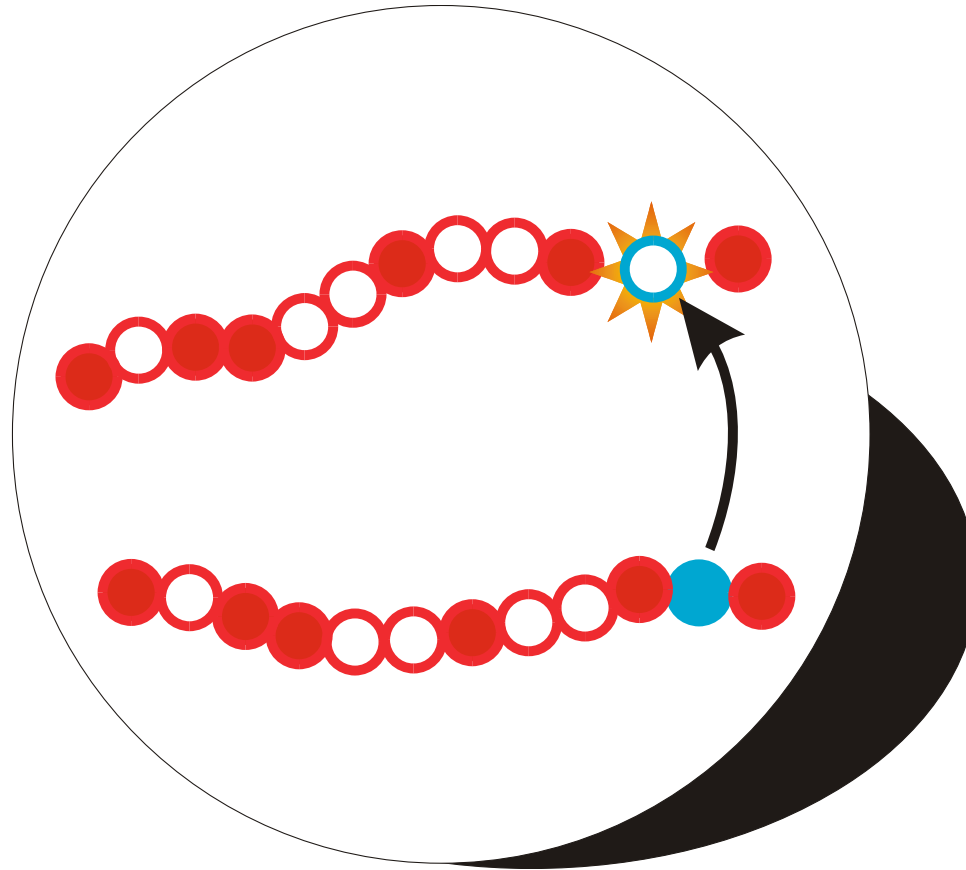
Crossover:

Exchanging information through some part of information (representation)

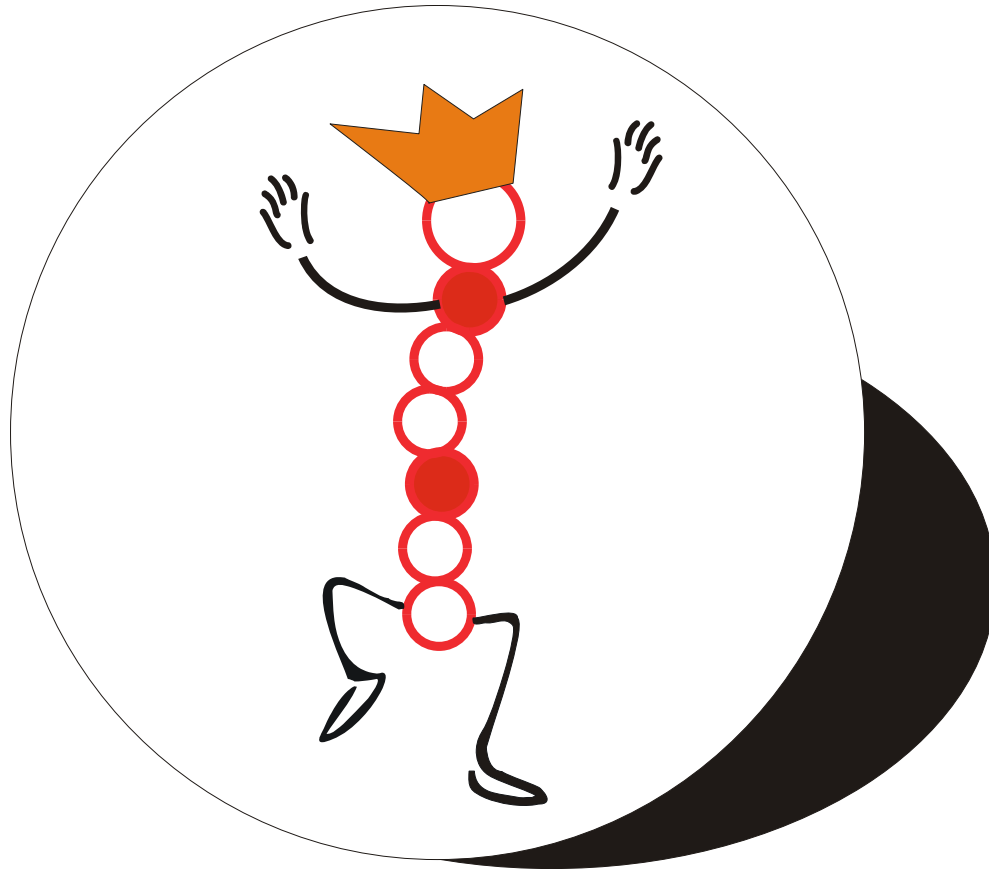


Mutation:

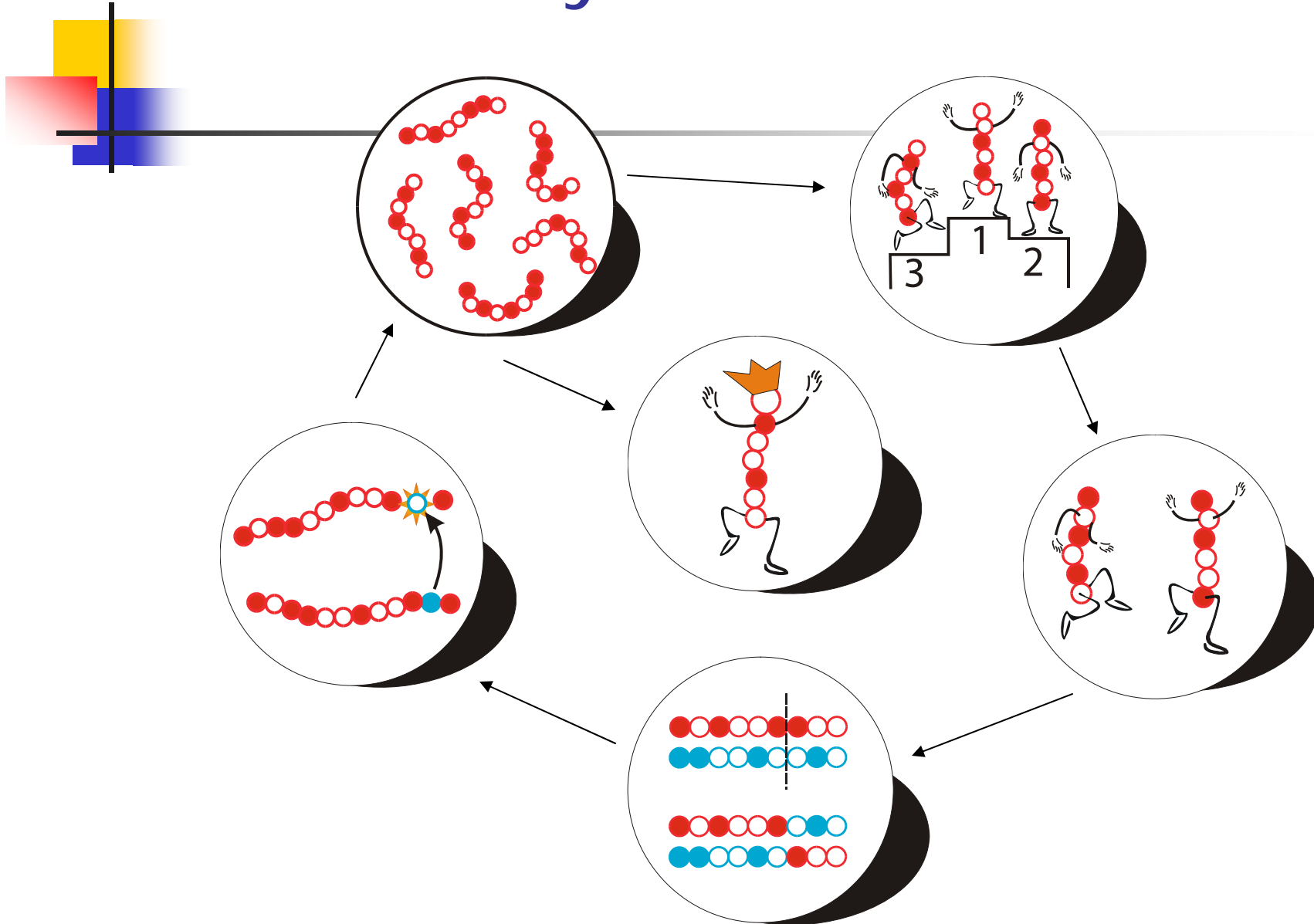
Random change of binary digits from 0 to 1 and vice versa (avoid local minima)



Best Design



The GA Cycle





Genetic Algorithms

Adv:

- Good to find a region of solution including the optimal solution. But slow in giving the optimal solution



Example

- Mutation and cross over example
- The created image would be eaten
 - <http://www.caplet.com/MannaMouse.html>
- Genetic Programming
 - Guiding a truck into a desired pose (Truck applet0)
 - <http://www-cse.uta.edu/~cook/ai1/lectures/applets/gatd/gatd.html>
- Fast TSP solver