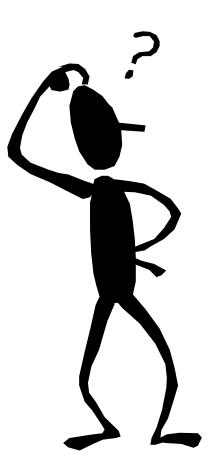




## **The Traditional Approach**

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

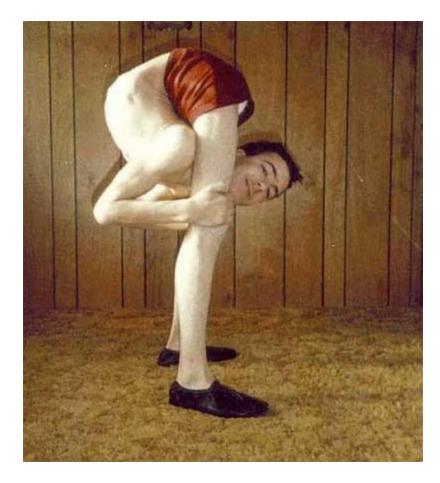


#### **Nature's Starting Point**



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

## **Optimised Man!**



# **Example: Pursuit and Evasion**

- Using NNs and Genetic algorithm
- <u>0 learning</u>
- <u>200 tries</u>
- <u>999 tries</u>

#### 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

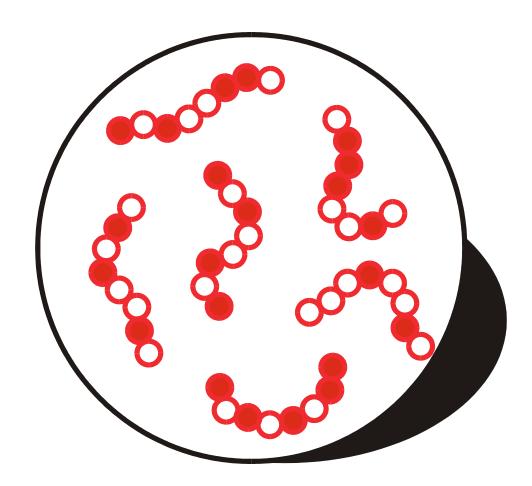
- not very efficient
  - at least a 20 year wait between generations
  - not all mating combinations possible
- Genetic algorithm
  - efficient and fast
    - optimization complete in a matter of minutes
    - mating combinations governed only by "fitness"

# 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

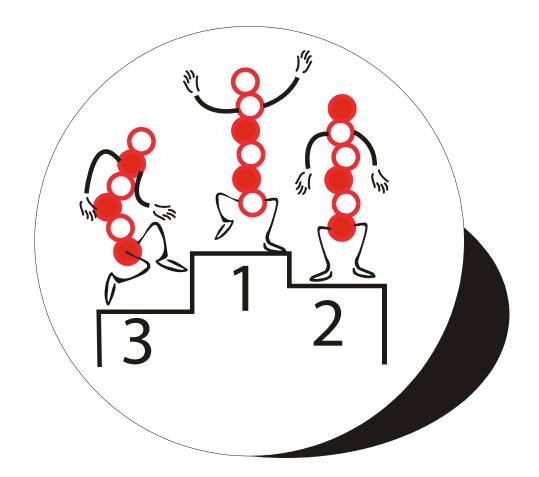




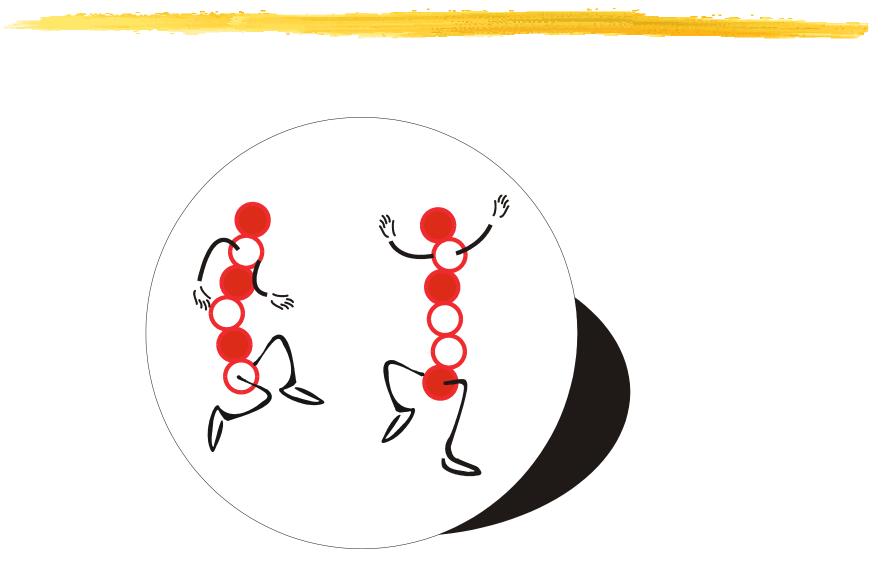


## **Ranking by Fitness:**



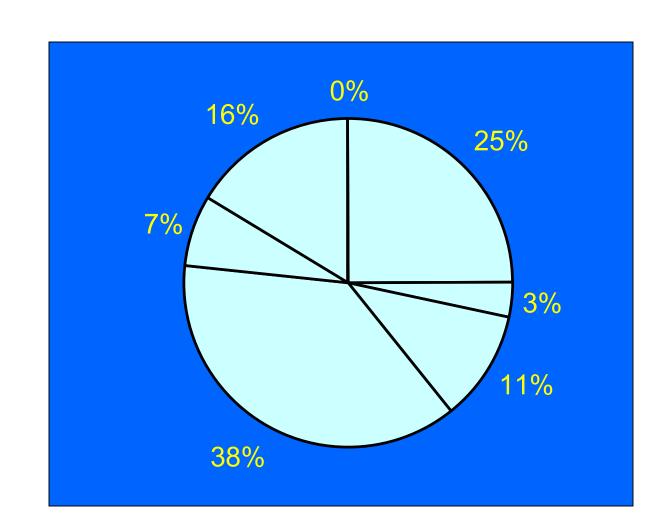


## Mate Selection: Fittest are copied and replaced less-fit



#### **Mate Selection Roulette:**

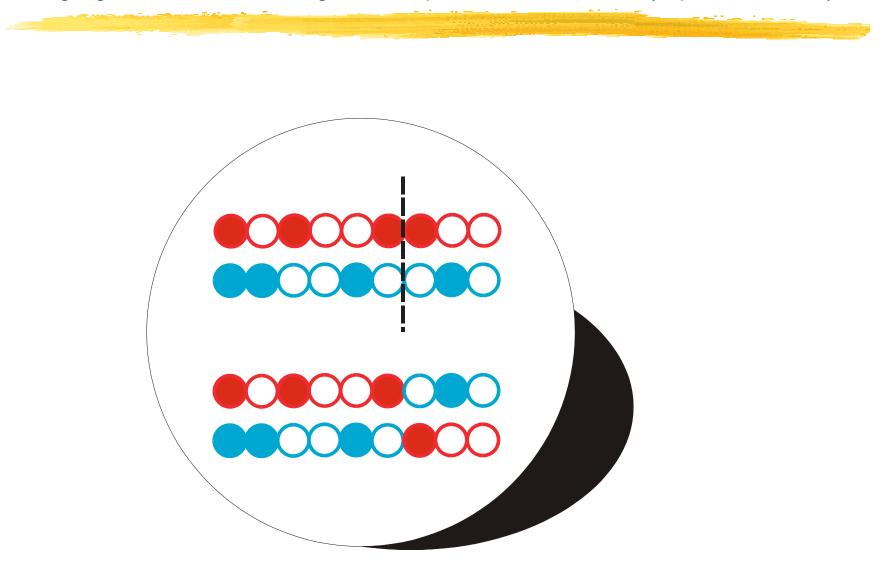
Increasing the likelihood but not guaranteeing the fittest reproduction



12

#### **Crossover:**

Exchanging information through some part of information (representation)



# **Mutation:**

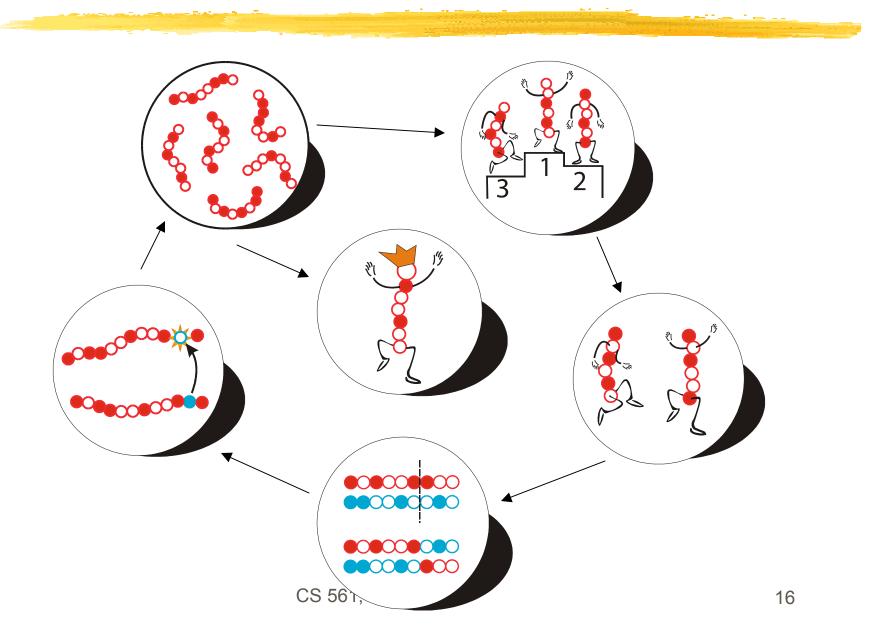
Random change of binary digits from 0 to 1 and vice versa (to avoid local minima)







## The GA Cycle



#### **Genetic Algorithms**

Adv:

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



•When applied to strings of genes, the approaches are classified as genetic algorithms (GA)

•When applied to pieces of executable programs, the approaches are classified as genetic programming (GP)

•GP operates at a higher level of abstraction than GA

#### **Example: Karl Sim's creatures**

- <u>Creatures</u>
- <u>Sea Horse</u>
- <u>Snake</u>





