GENETIC ALGORITHM

By

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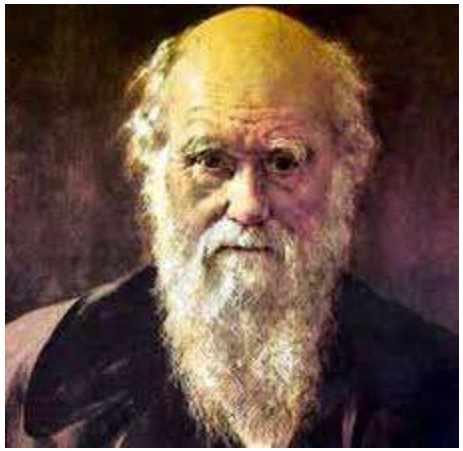
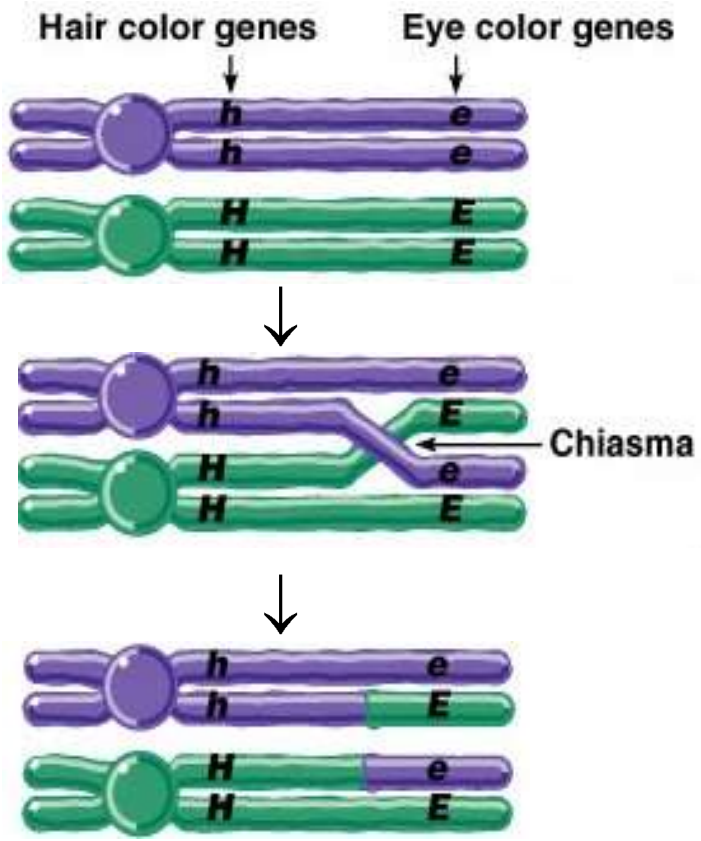
DARWIN'S EVOLUTION THEORY

- Survival of the Fittest
- Natural selection



Sir Charles Darwin

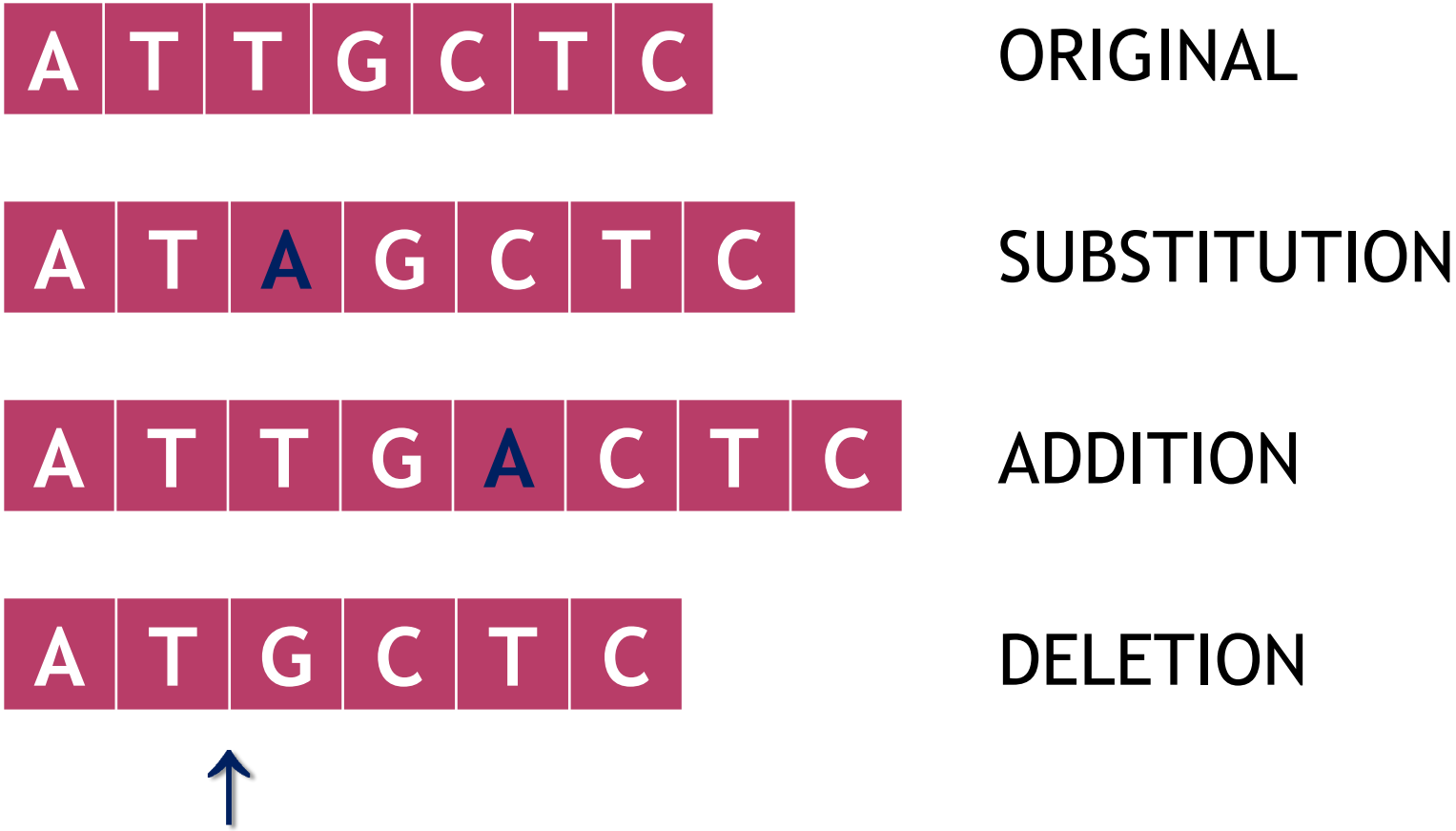
EVOLUTION AT THE GENE LEVEL

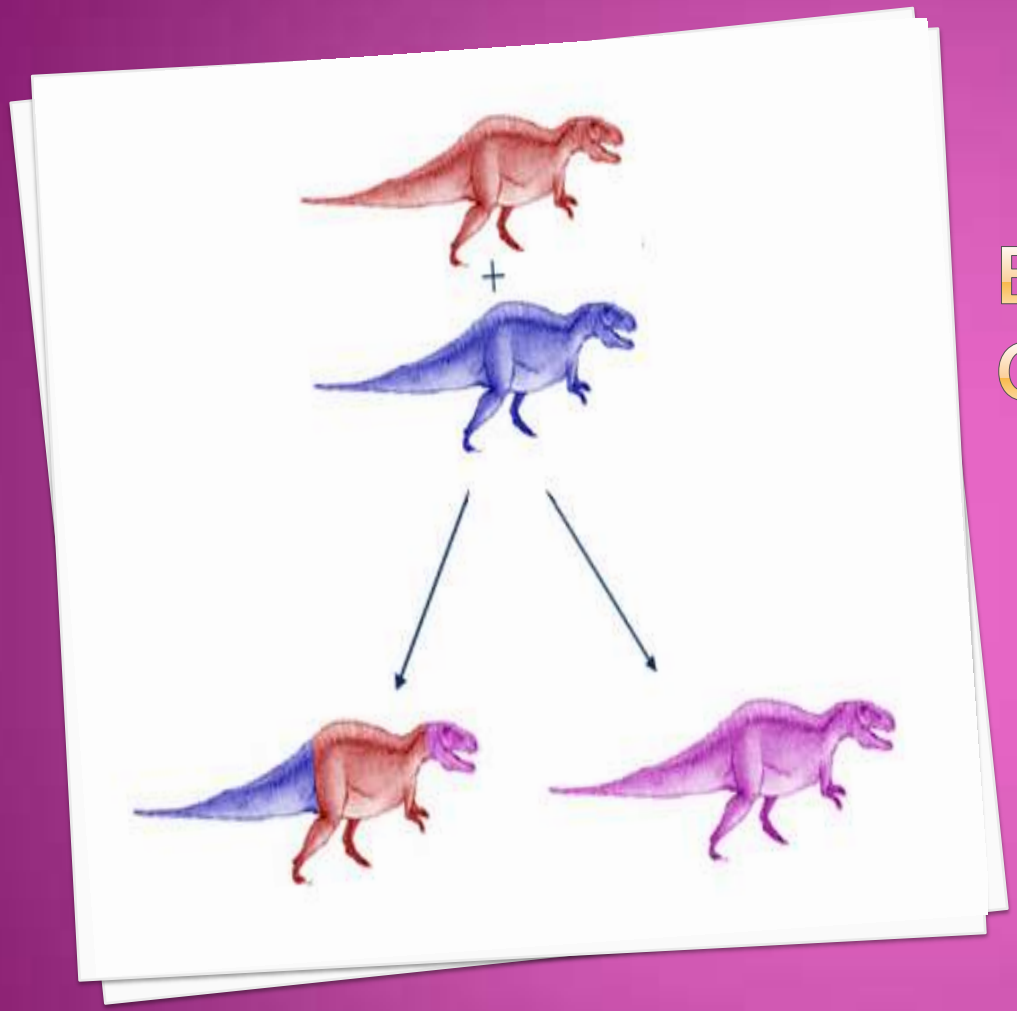


Genetic Crossover

- Chromosomes from two different parents
- Chromatids from each overlap at Chiasma
- Recombinant chromosomes are form
- Further passed on to the progeny

EVOLUTION AT THE MOLECULAR LEVEL

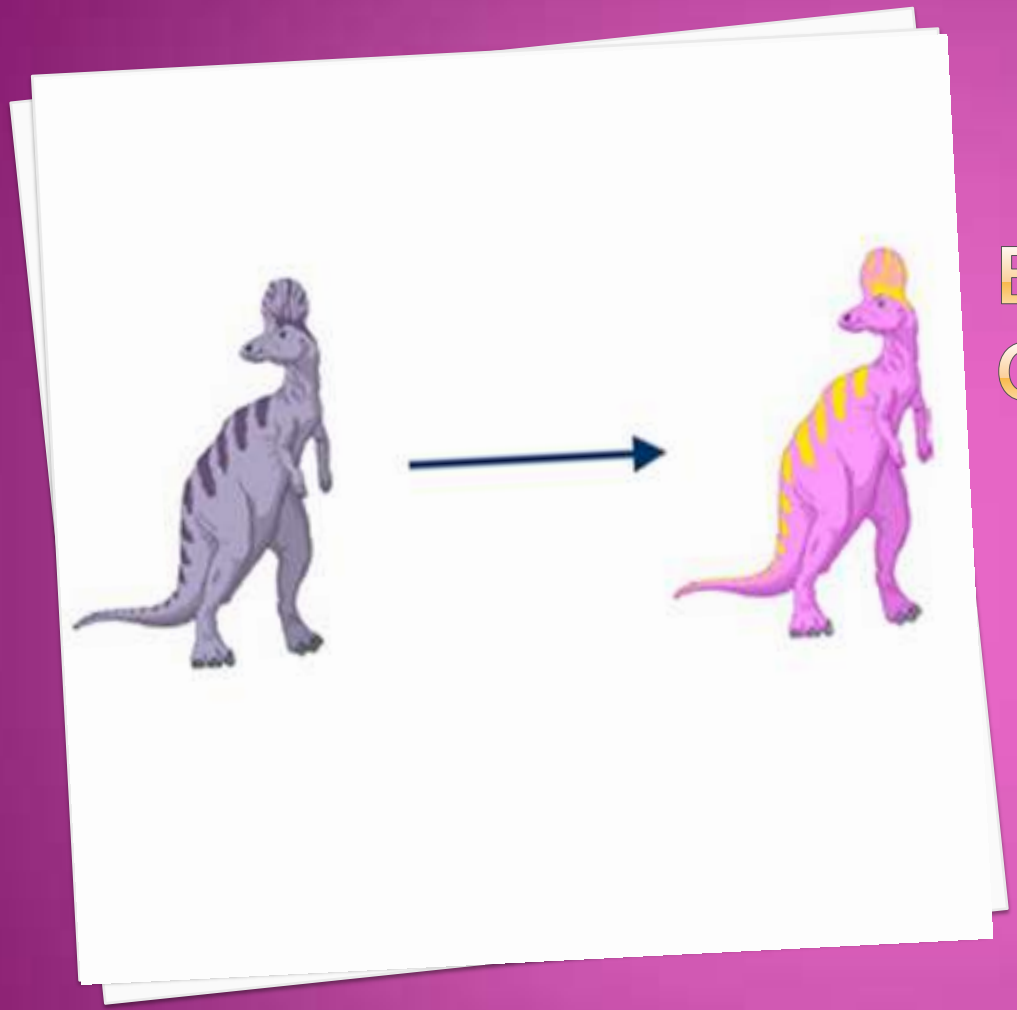




EVOLUTION DUE TO GENETIC CROSSOVER

Offsprings have combinations of features inherited from each parent

Image adapted from http://www.wpdipart.com



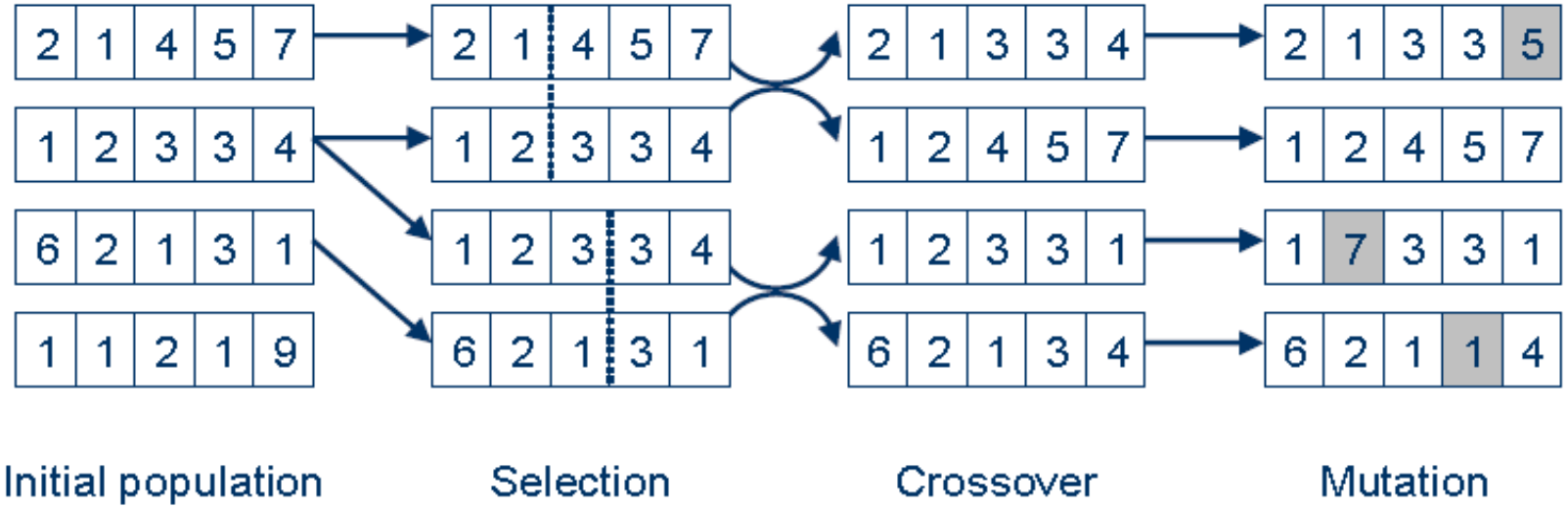
EVOLUTION DUE TO GENETIC MUTATION

Random changes are observed

Image adapted from http://www.wpdipart.com

THE ALGORITHM

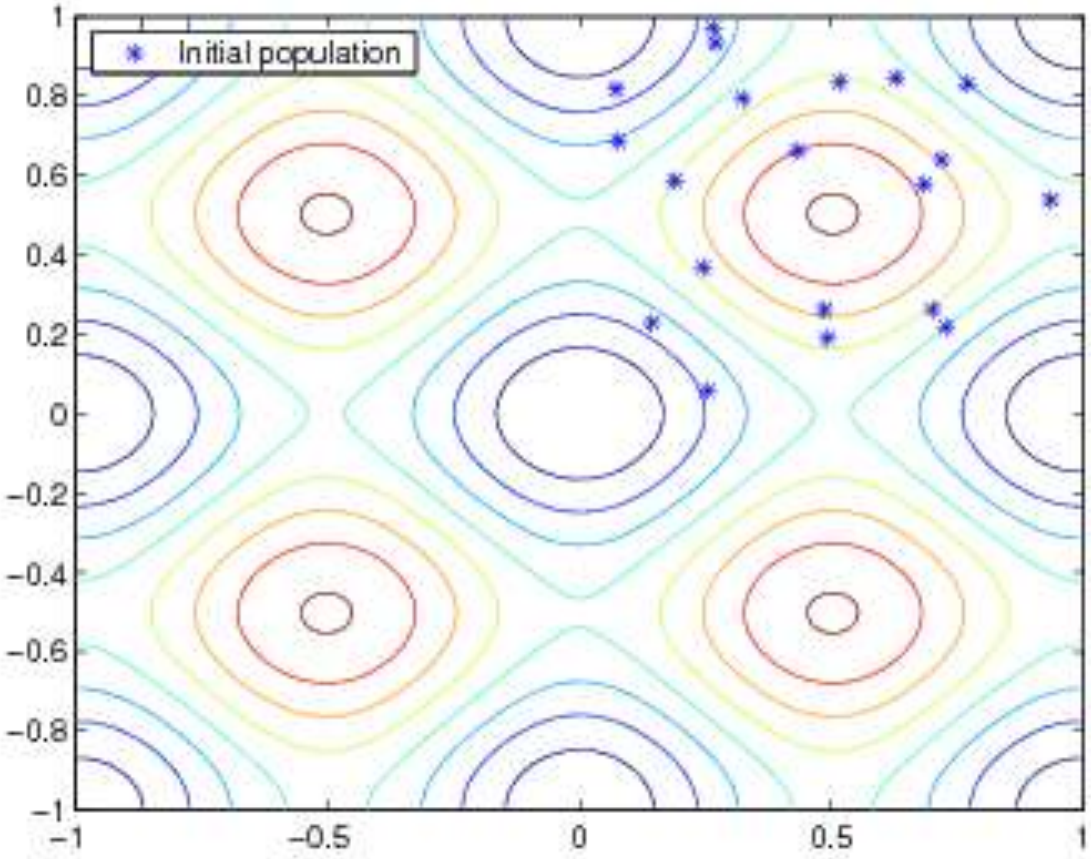
Genetic Algorithm is a type of local search that mimics evolution by taking a population of **strings** which encode possible solutions and combines them based on a **fitness function** to produce individuals that are more fit.



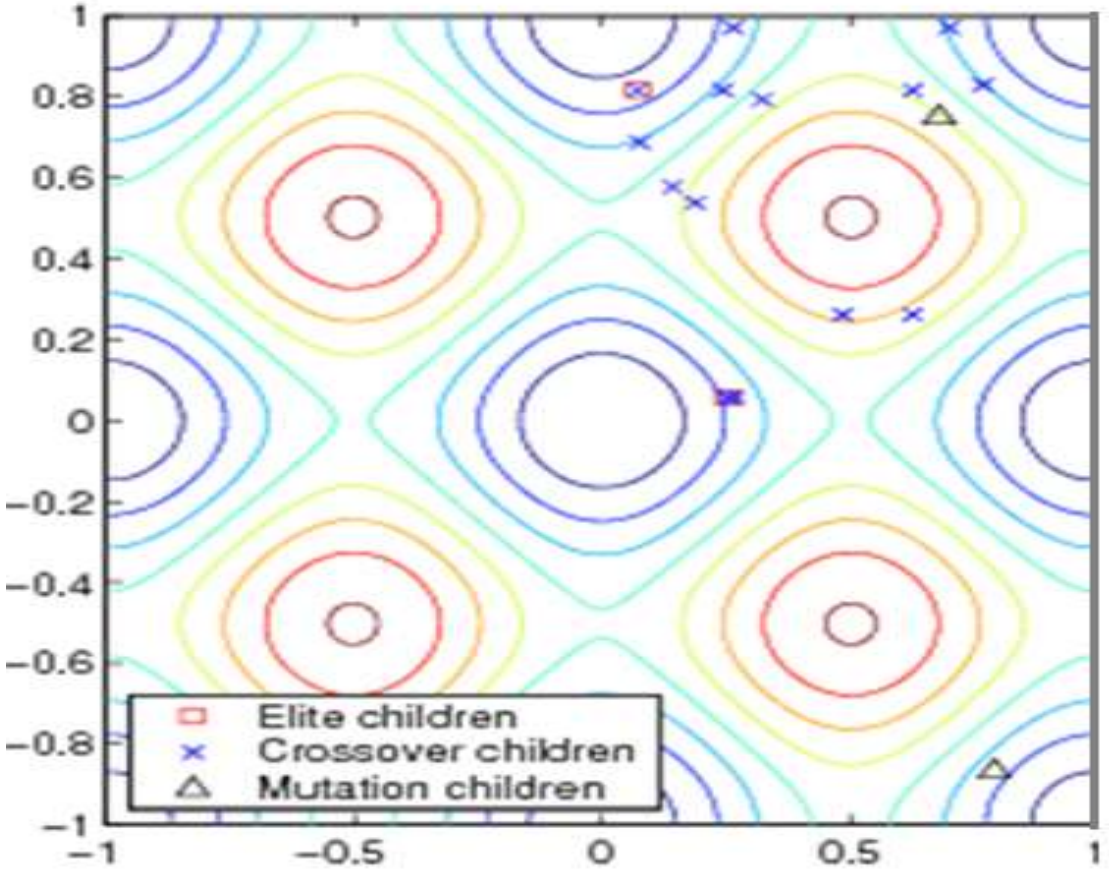
FOR INSTANCE

1) Encoding the two numbers into binary strings
   Parent 1=3.273672 =>11.0100011000001
   Parent 2=3.173294 =>11.0010110001011
2) Randomly choose a crossover point; let suppose be it at bit 6, and we split the gene at position six.
   Parent 1=>3.273672=>11.010---0011000001
   Parent 2=>3.173294=>11.001---0110001011
3) Swapping the two tails ends of binary strings.
   Child 1=>11.010---0110001011
   Child 2=>11.001---0011000001
4) Recombining the two binary strings to get two new offspring.
   Child 1=>11.0100110001011
   Child 2=>11.0010011000001
5) Decoding the binary strings back into floating point numbers.
   Child 1=3.298218
   Child 2=3.148560

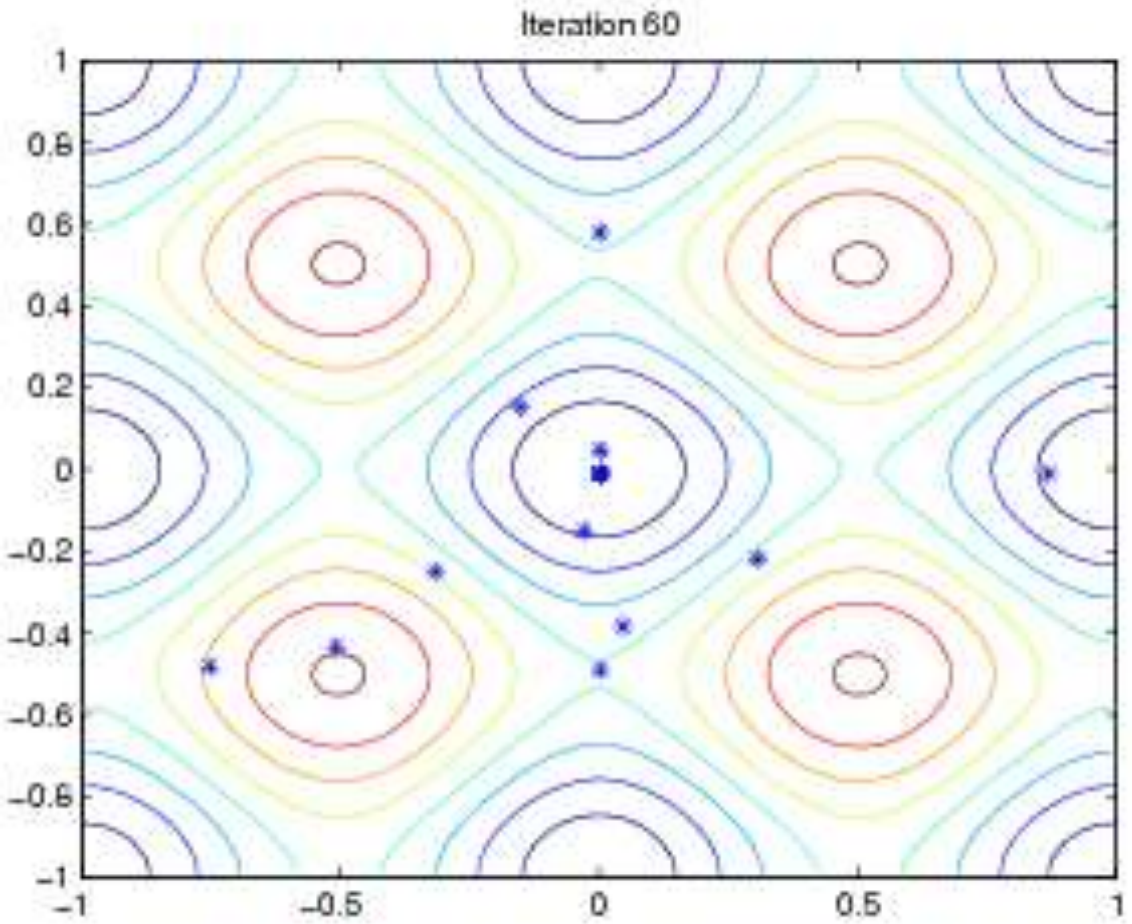
WALKING THROUGH GENERATIONS



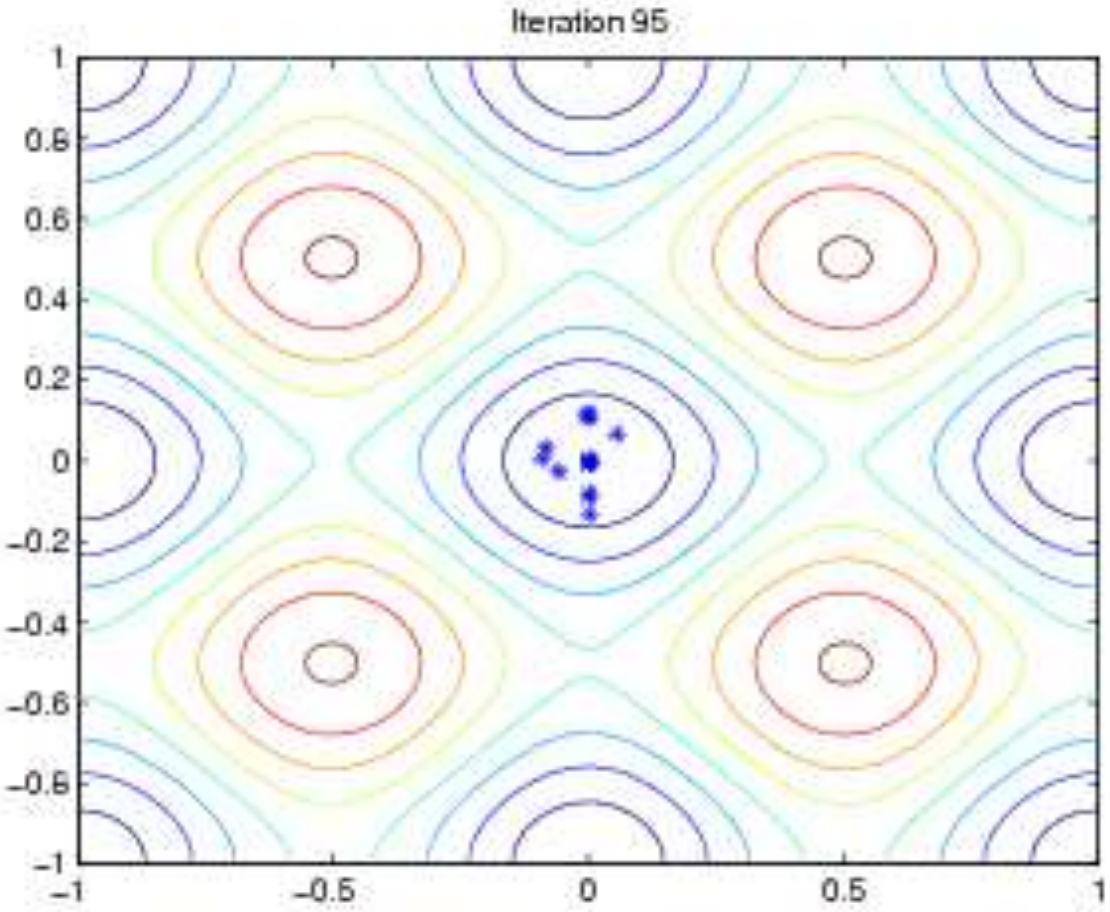
Zeroth Generation



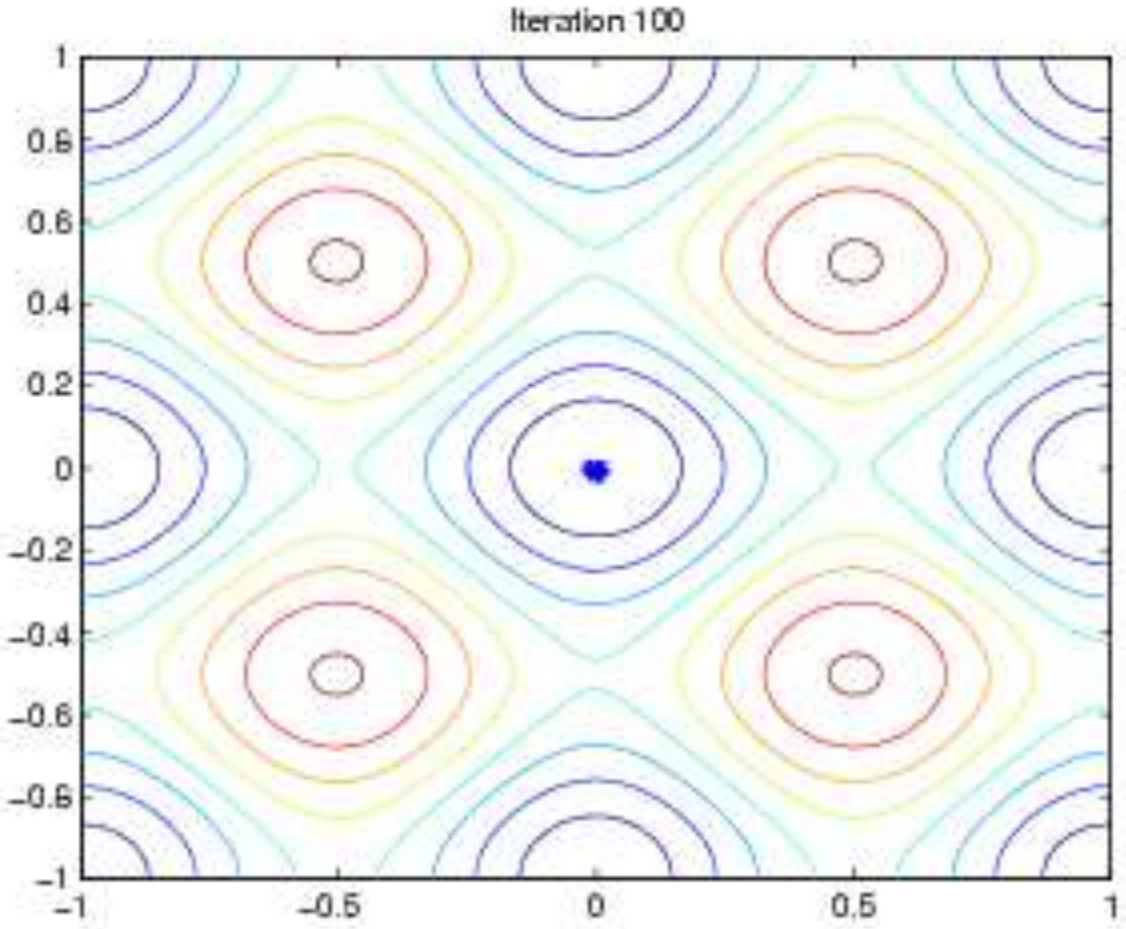
First Generation



60th Generation



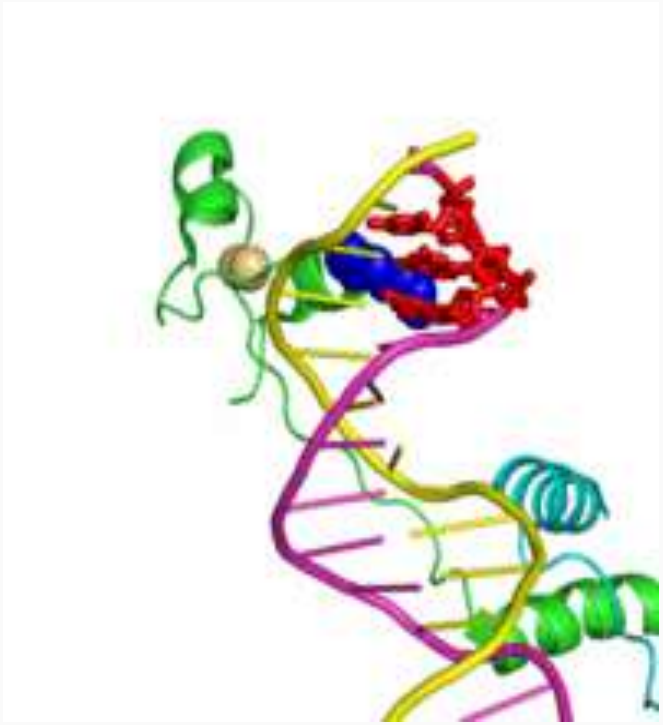
95th Generation



100th Generation

REAL WORLD USES

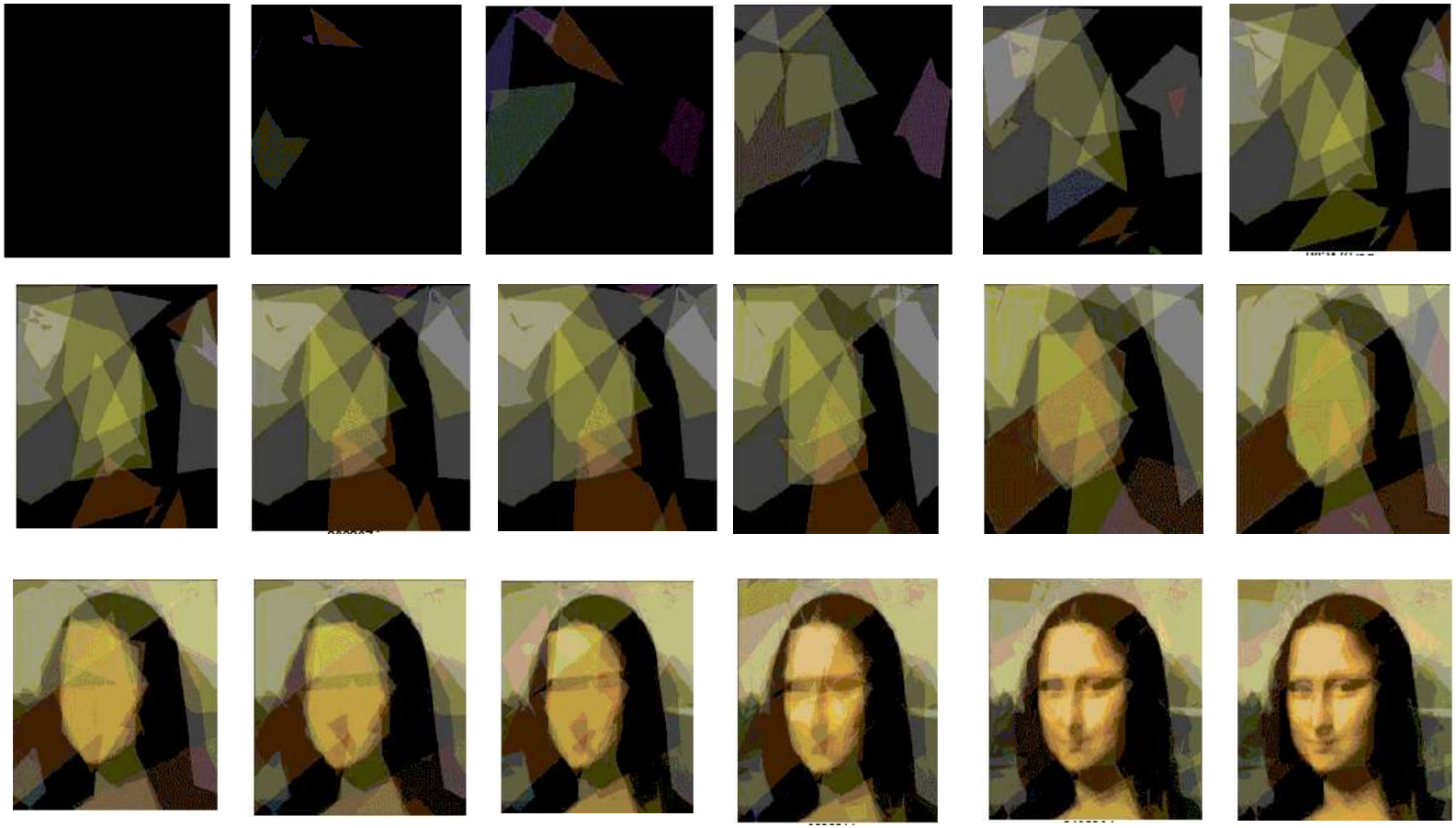
- Artificial Intelligence
- Automotive Design
- Computer Gaming
- Predicting Protein Structure
- Optimization Problems
- Music
- Business



BIOLOGY AND CHEMISTRY

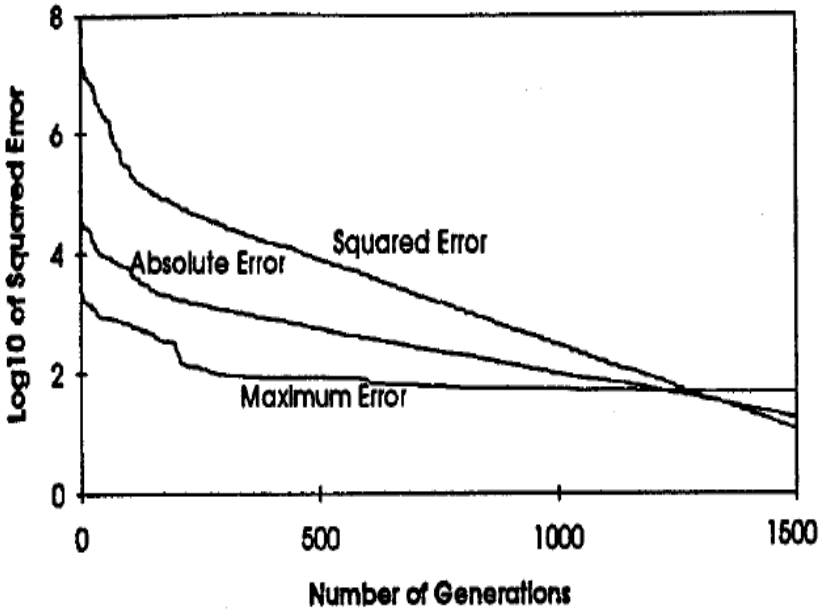
Helps to determine the accurate torsion angles and predict protein structure

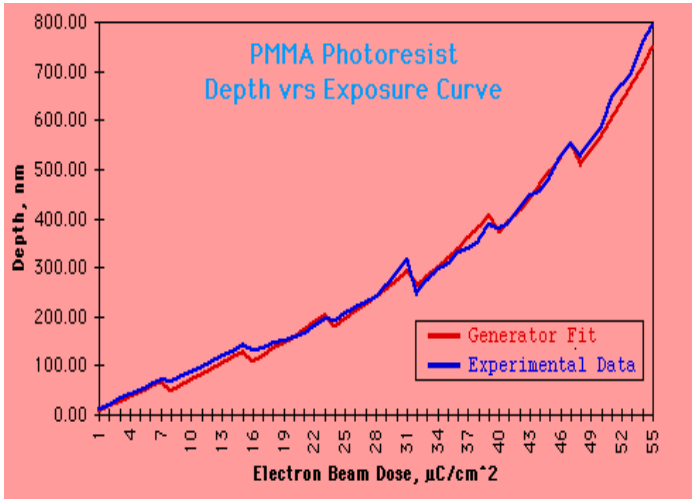
DEVELOPING IMAGES



Evolution of Monalisa : Roger Alsig Weblog

CURVE FITTING

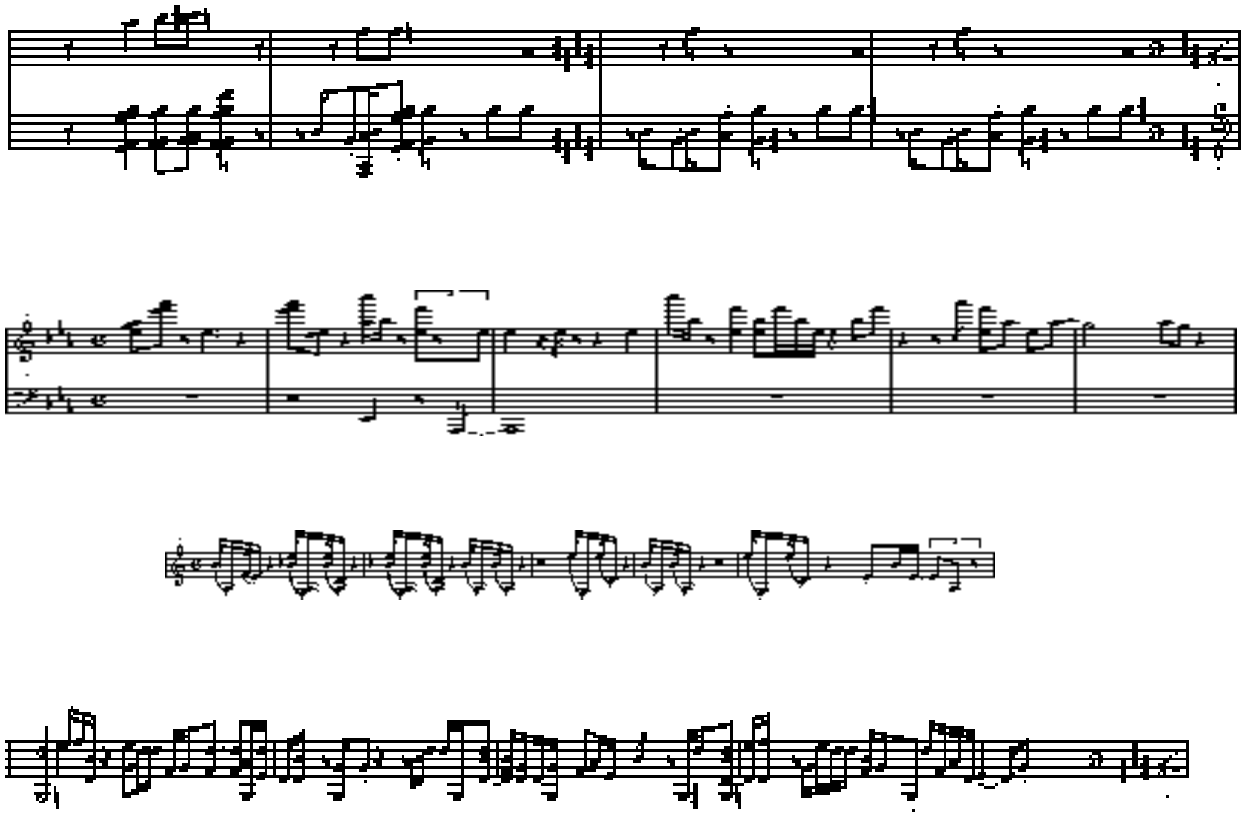




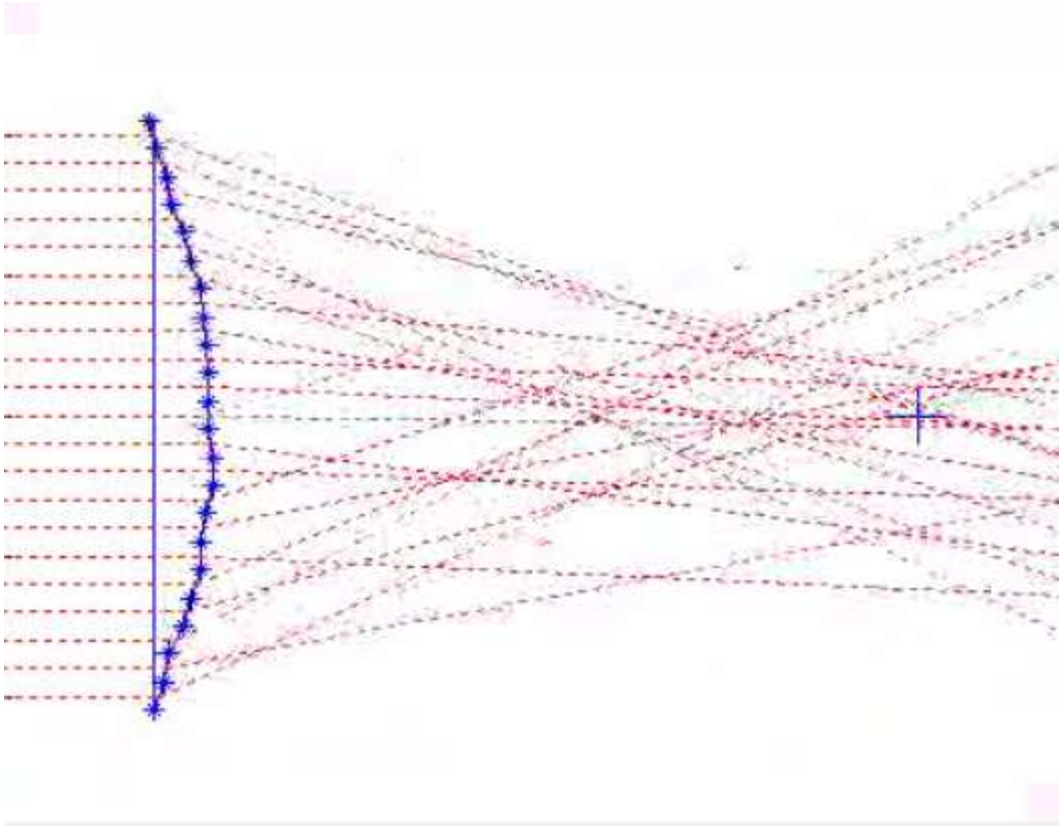
Minimizing total error over the set of data points

Source:http://www.geneticprogramming.org

MUSIC

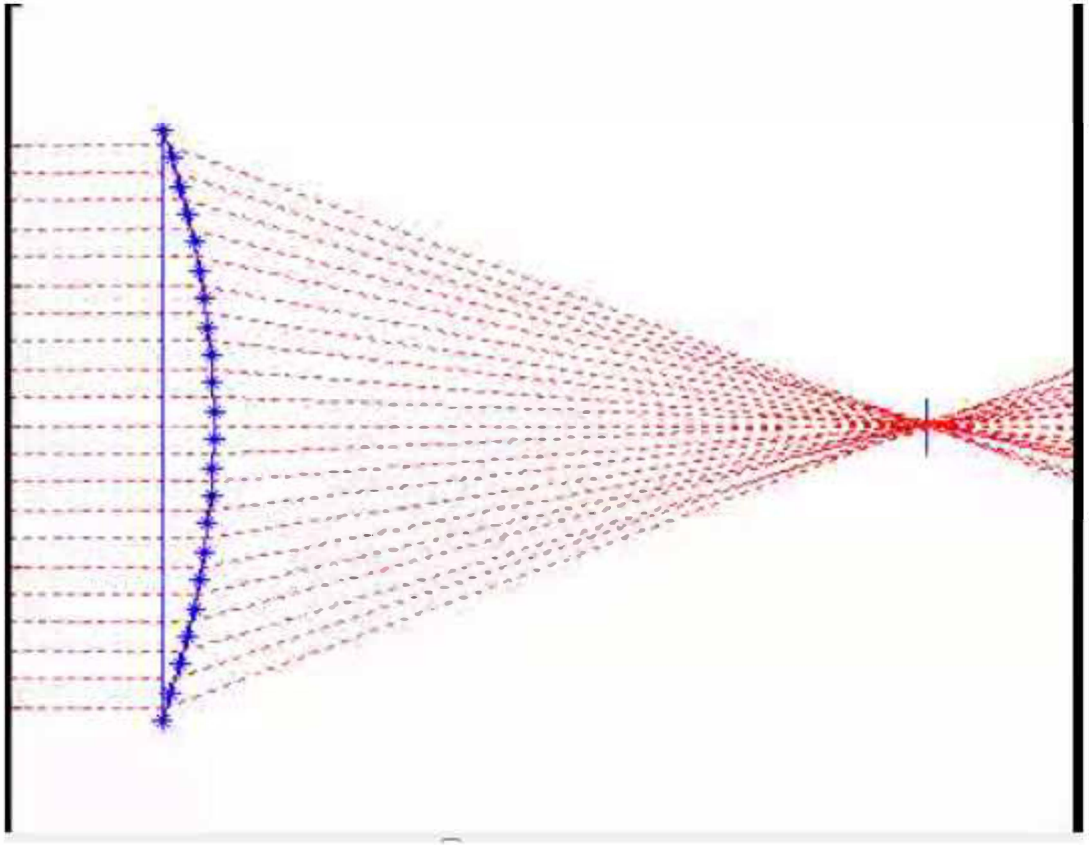


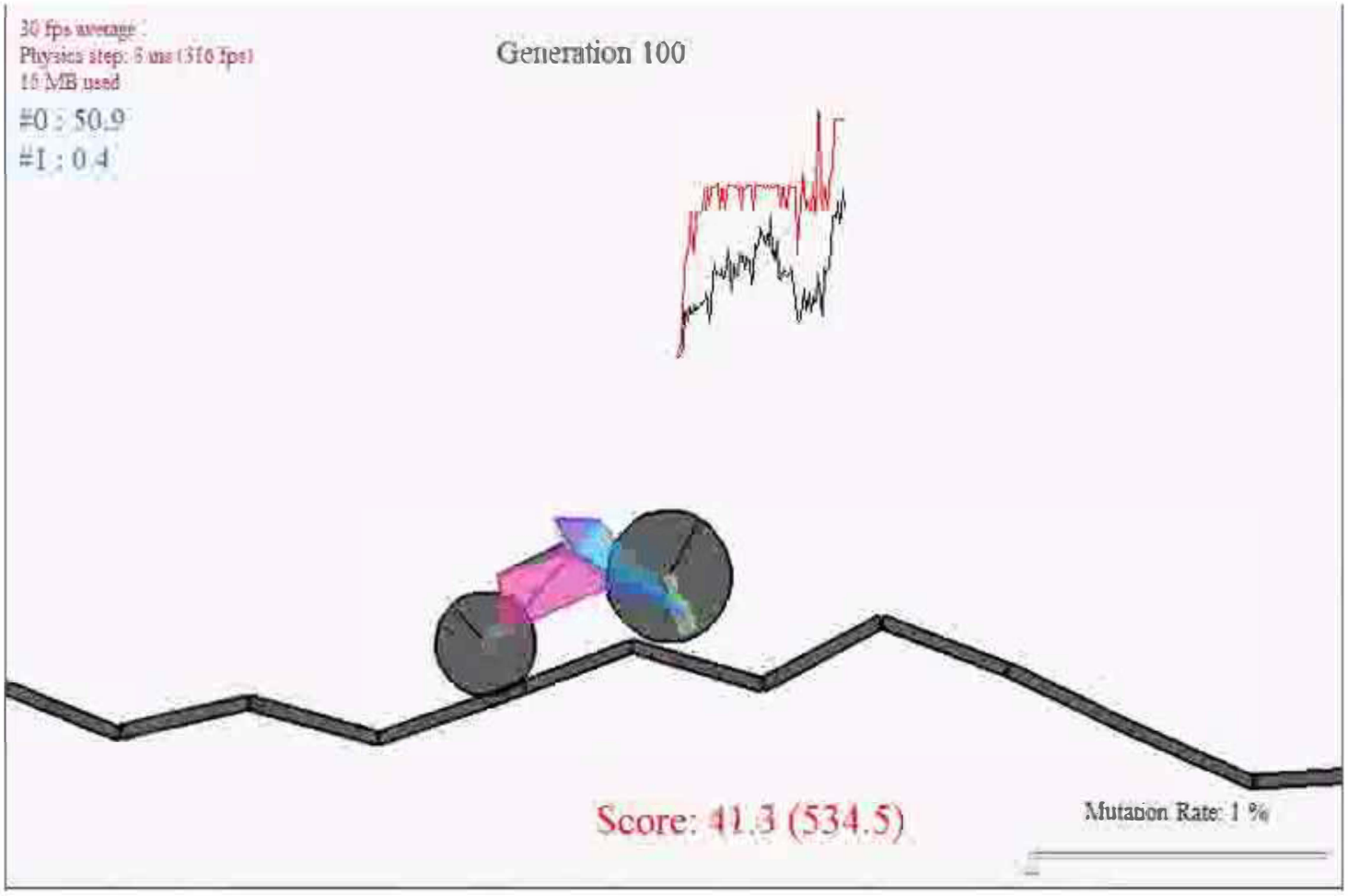
Musical examples of variations output to get perfect music.
Fitness function determinant here is human ear



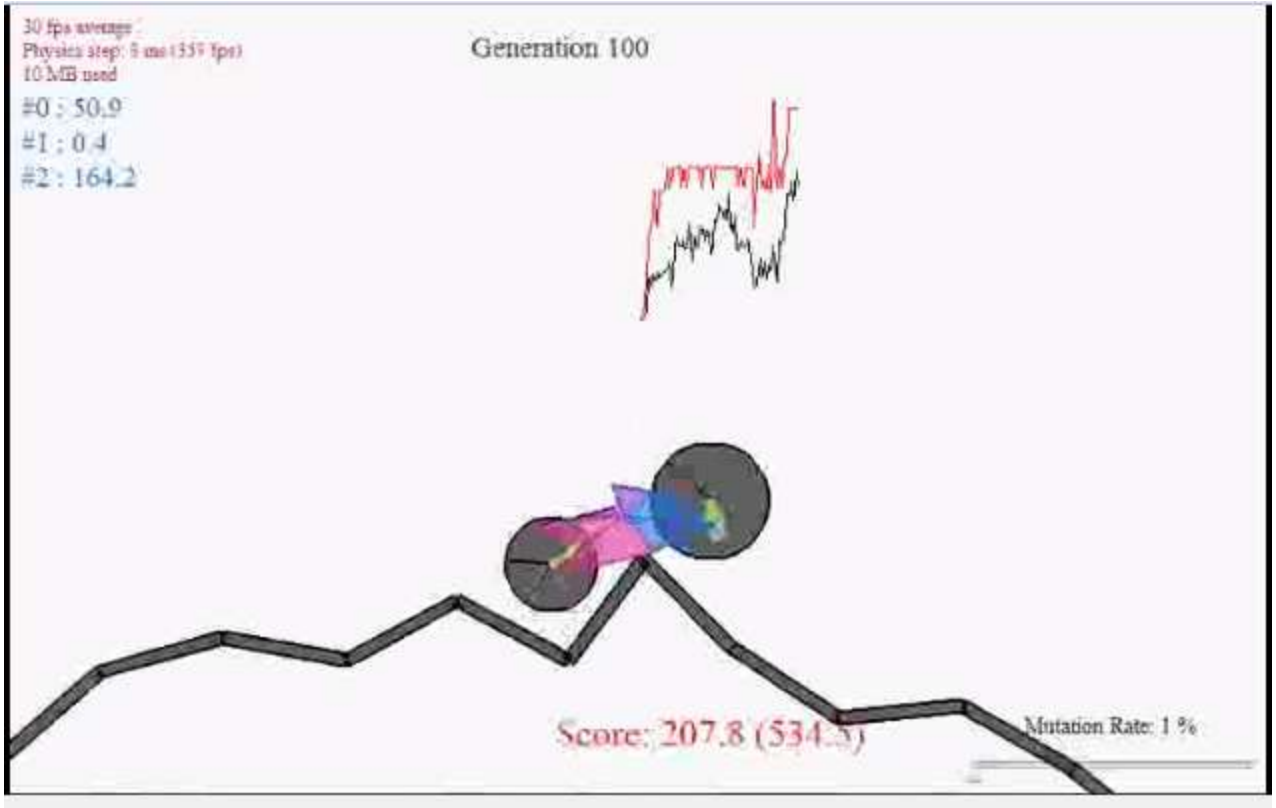
Optimization of an optical surface for a smooth refraction to be focused on a single point

Source: Youtube





Optimization of aerodynamics of a Car for a smooth drive on a crooked path


Generation 100
#0 : 50.9
#1 : 0.4
#2 : 164.2
Score: 207.8 (534.5)
Mutation Rate: 1 %

20 fps average
Physics step: 5 ms (101 fps)
12 MB used
Generation 100
#0 : 50.9
#1 : 0.4
#2 : 164.2
#3 : 267.2
Score: 5.5 (534.5)
Mutation Rate: 1 %

FEATURES

ADVANTAGES

- No training required
- Efficient even during
  Multi-modal or
  n-dimensional search space
- Can work for non-linear equations too
- Efficient

LIMITATIONS

- Do not work well when the population size is small and the rate of change is too high.
- If the fitness function is chosen poorly or defined vaguely, the Genetic Algorithm may be unable to find a solution to the problem, or may end up solving the wrong problem

GA SOFTWARES

- **GAOT**- Genetic Algorithm Optimization Toolbox in Matlab
- **JGAP** is a Genetic Algorithms and Genetic Programming component provided as a Java framework
- **Generator** is another popular and powerful software running on Microsoft Excel

CONCLUSION

- Genetic Algorithm is related to “solving problems of everyday interest” in many diverse fields.
- However, several improvements can be made in order that Genetic Algorithm could be more generally applicable. Future work will continue through evolution and many more specific tasks

REFERENCES

- Introduction to Genetic Algorithms -Axcelis
http://www.axcelis.com:80/articles/itga/application.html

- How Genetic Algorithm works
http://www.mathworks.in/help/toolbox/gads/f6187.html

- Introduction to Bioinformatics
By Sundararajan & R. Balaji

- Functioning of a Genetic Algorithm
http://www.rennard.org/alife/english/gavintrgb.html#gafunct

THANK YOU!