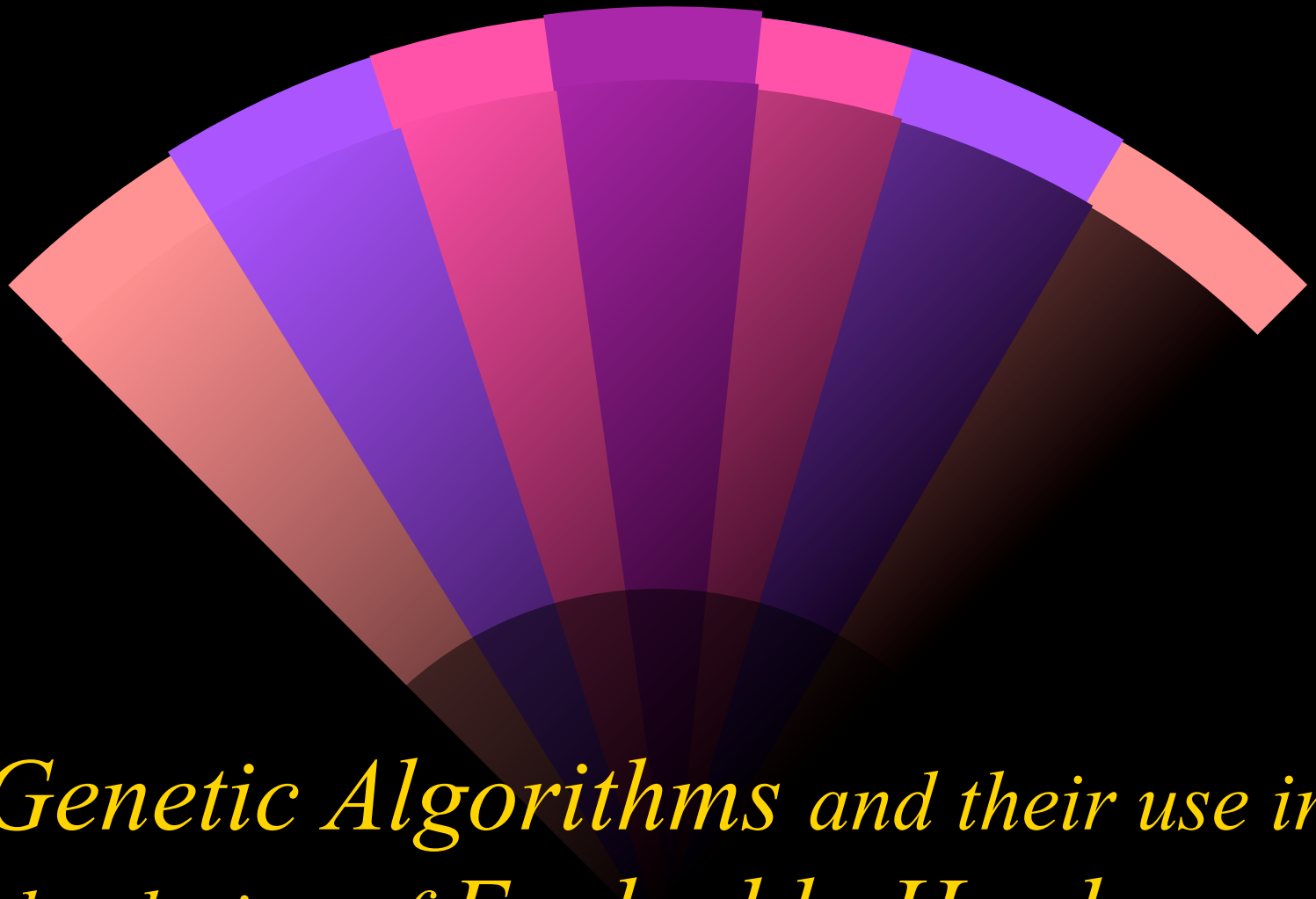
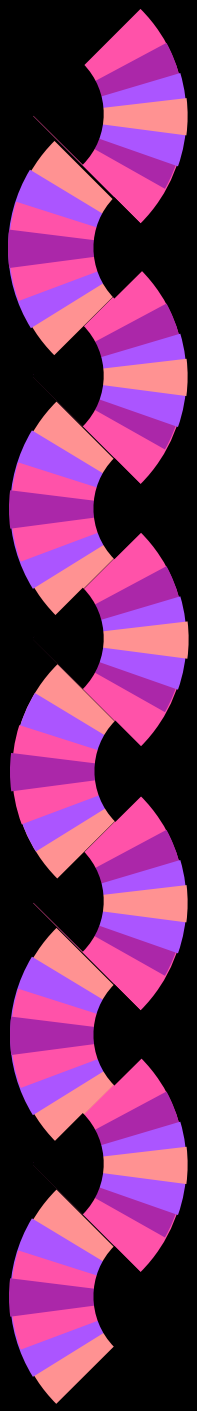


Genetic Algorithms and their use in the design of Evolvable Hardware.

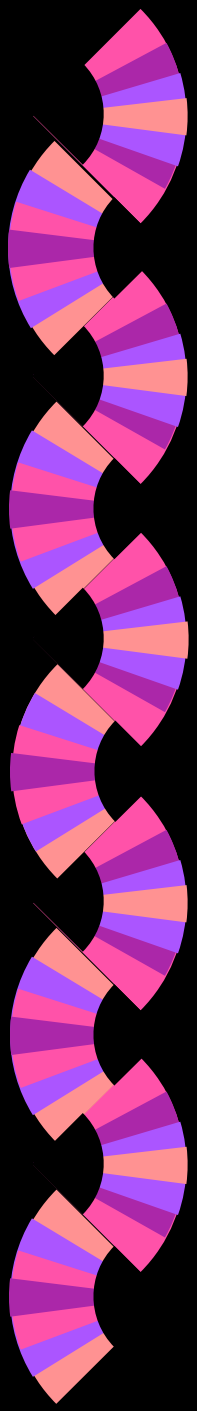
Abhishek Joglekar & Manas Tungare.



Concept of Genetic Algorithms

- Modeled on Biological Evolution
- Idea of Optimization in Nature

- *Nature's method to evolve optimal solutions without the hindrance of preconceived knowledge.*
  - Prof. John Koza



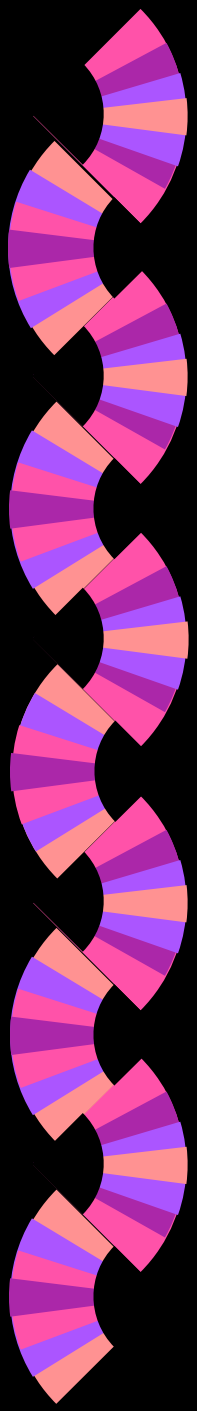
Biological Background

- Survival of the Fittest *-Charles Darwin*
- The best genes are transferred to the next generation.
- The Reproduction Process
- Fitness of an Individual.

Development of a GA:

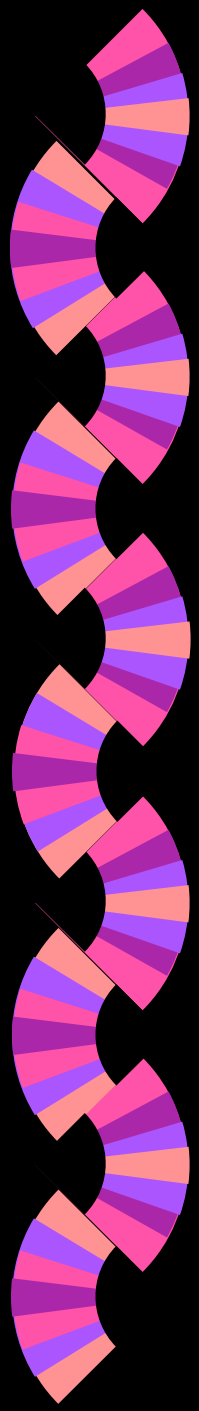
```
Simple_Genetic_Algorithm()
      {
      Initialize the Population;
      Calculate Fitness Function;

      While(Fitness Value != Optimal Value)
            {
            Selection;
            Crossover;
            Mutation;
            Calculate Fitness Function;
            }
      }
```



Steps in a Genetic Algorithm:

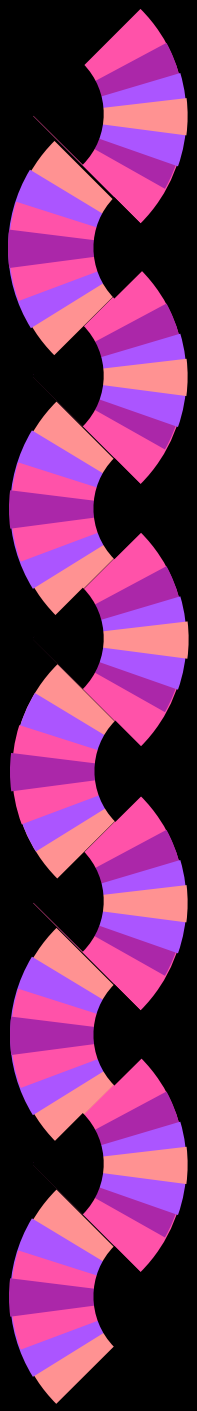
- Population
- Selection
- Encoding
- Crossover
- Mutation
- Elitism
- Offspring



Examples:

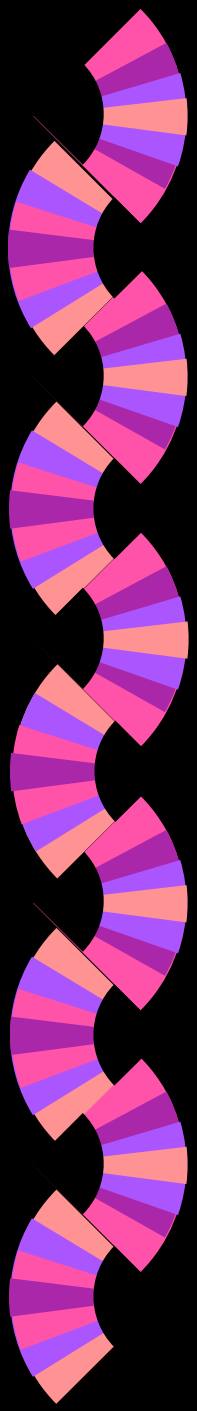
- Genetic Algorithm examples in Java

- The working : A simple applet
- The mechanics : Minimization of a Function



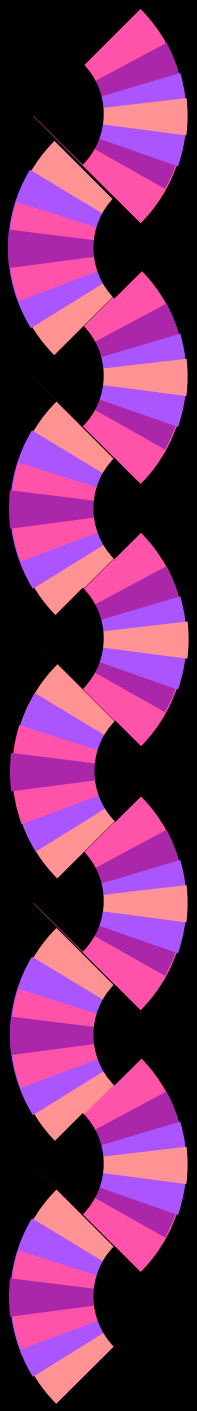
Evolvable Hardware

- Autonomous Adaptation
- On-line Adaptation
- Un-supervised Learning
- Characteristics of Problem not known in advance.
- “Intelligent” Machines



Why GA's for EHW ?

- *Why GA's are an effective solution to developing Evolvable Hardware*
- Configuration Bits = Chromosomes
- Fitness Function = Performance
- No knowledge of search-space required
- Continuous Reconfiguration

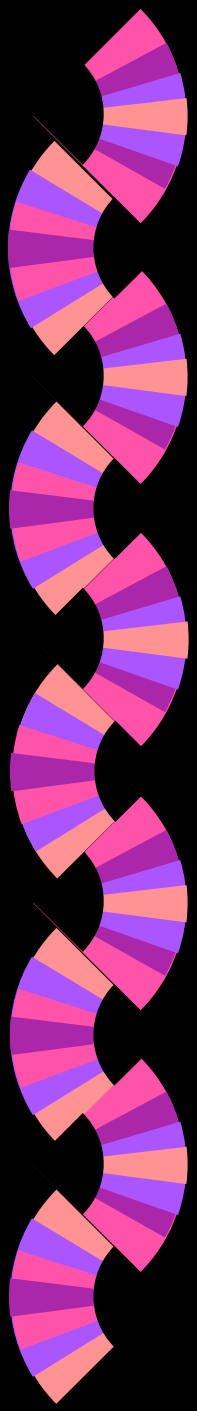


Why Evolvable Hardware ?

- *The utility and importance of Evolvable Hardware in ...*
- Data Compression Hardware
- Artificial Neural Networks
- Ontogenic Neural Networks

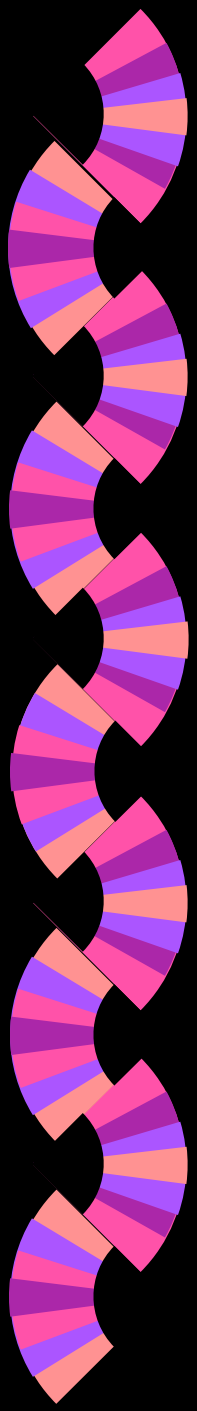
The GRD Chip: A practical implementation

- Genetic Reconfiguration of DSP's.
- In April 1999, by Japanese Scientists.
- 32-bit RISC Processor @ 100 MHz (NEC V830).
- Binary Tree Network of 15 16-bit DSP's @ 33 MHz.



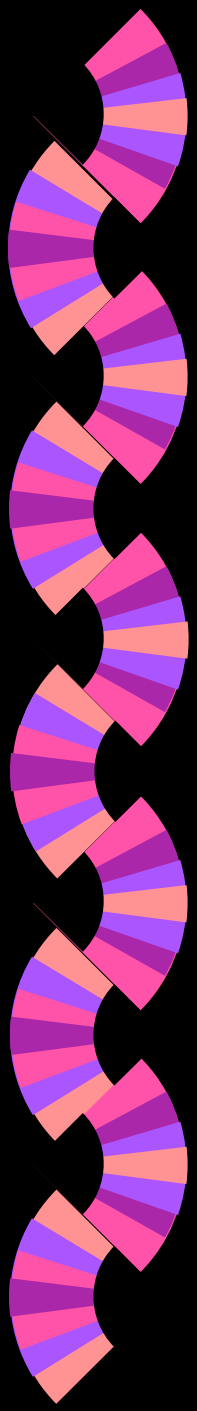
Applications of the GRD Chip

- Dynamic Reconfiguration of DSPs
- Embedded Systems in practical Industrial Applications.
- Ontogenic Neural Networks
- Adaptive Equalization



Scope & Limitations:

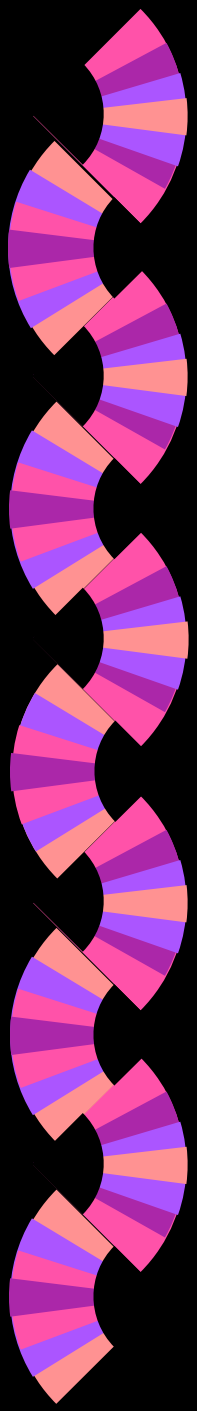
- Excellent Solution, but not for all problems
- Vast Search Space
- Embryonic Circuits (LC, RC, etc)



Concluding Remarks:

- A promising area
- Although a rich set of methods is available, a lot of options are open to research.
- Scope for further research & development are immense

Questions ?



Reference:

- This paper is available online at:

  http://www.manastungare.com/articles/

- *Our sincere thanks to:*
  Prof. Sasi Kumar, NCST.