

# Genetic Algorithms

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# Modern Applications

- Computational Creativity
- Marketing Design and Discovery

# Computational Creativity

- The challenge: make a computer as creative as a human.
- Paint pictures
- Write songs
- Tell jokes

# Computational Creativity

- How does the machine know what looks good?
- Let the human be the fitness function!
  
- DEMO: Electric Sheep
- DEMO: Kandid

# Electric Sheep

Screensaver that animates fractal flame renderings based on user submitted genomes.

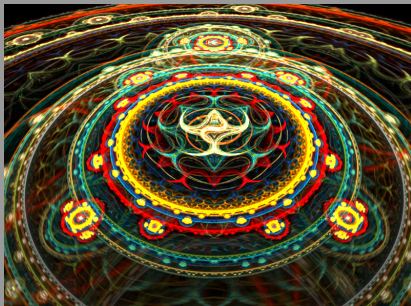


Figure: Example of fractal frame

# How is it a genetic algorithm?

Genome Input data into fractal flame algorithm

Fitness Function User submitted feedback

Offspring Generation Cross over/mutation

Project home: [electricsheep.org](http://electricsheep.org)

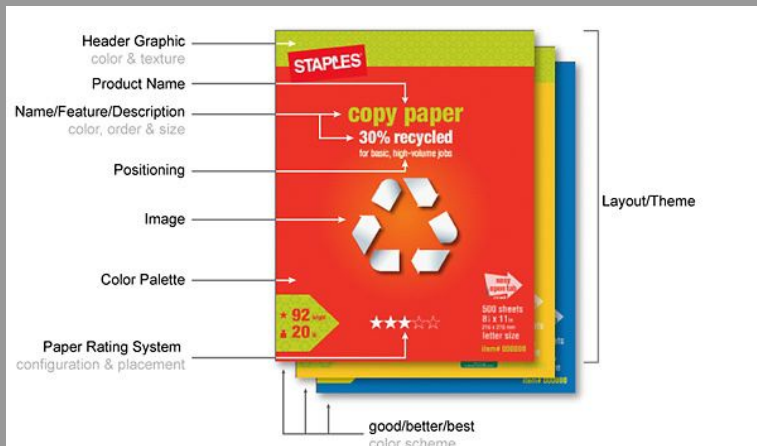
Current generation: <http://v2d7c.sheepserver.net/cgi/best.cgi>

# Other computer generated art

# Building the Perfect Paper

- The problem: Staples needs a new look for its paper
- The solution: Market research using GAs
- Affinova uses GAs to determine which packaging will be most successful

# Building the Perfect Paper: The Components





# Building the Perfect Paper: The Results



# Conway's Game of Life

- Any live cell with fewer than two live neighbours dies.
- Any live cell with more than three live neighbours dies.
- Any dead cell with exactly three live neighbours becomes a live cell.

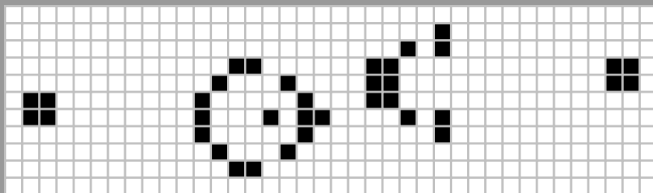
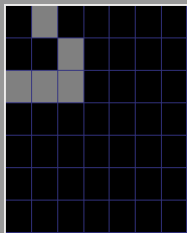


Figure: Gosper Glider Gun

# Genome

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$



# Fitness Function

Number of time steps completed before

- All cells die
- The game board enters a previous state

Also explored:

- Longest loop

# Breeding

$$\begin{pmatrix} A & A & A & A & A & A \\ A & A & A & A & A & A \\ A & A & A & A & A & A \\ A & A & A & A & A & A \\ A & A & A & A & A & A \\ A & A & A & A & A & A \end{pmatrix}$$

$$\begin{pmatrix} B & B & B & B & B & B \\ B & B & B & B & B & B \\ B & B & B & B & B & B \\ B & B & B & B & B & B \\ B & B & B & B & B & B \\ B & B & B & B & B & B \end{pmatrix}$$

$\Rightarrow$

$$\begin{pmatrix} A & A & A & A & A & A \\ A & B & B & B & A & A \\ A & B & B & B & A & A \\ A & B & B & B & A & A \\ A & B & B & B & A & A \\ A & A & A & A & A & A \end{pmatrix}$$

$$\begin{pmatrix} B & B & B & B & B & B \\ B & A & A & A & B & B \\ B & A & A & A & B & B \\ B & A & A & A & B & B \\ B & A & A & A & B & B \\ B & B & B & B & B & B \end{pmatrix}$$

# Reflections

- GAs can be used for something other than optimizing equations
- Haven't eliminated the human factor, yet
- It isn't easy to improve on a user base of over 500,000 computers

# Questions?