Unsupervised Evolutionary Art

Complex Systems Seminars

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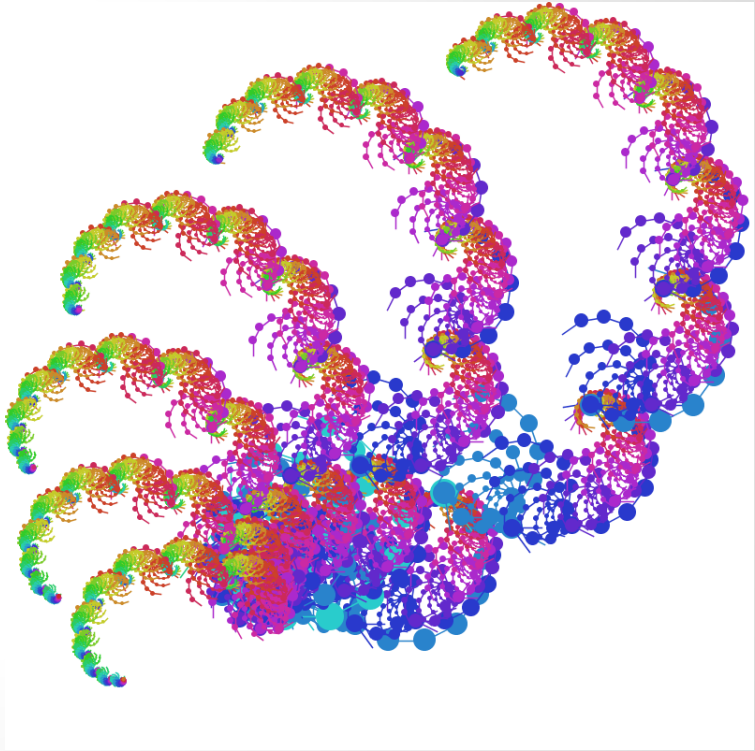
Plan of the presentation

- Short example
- Introduction
- Aesthetic measures
- How to
- Results
- Applications

Short example

Computer-generated

Evolutionary Algorithms



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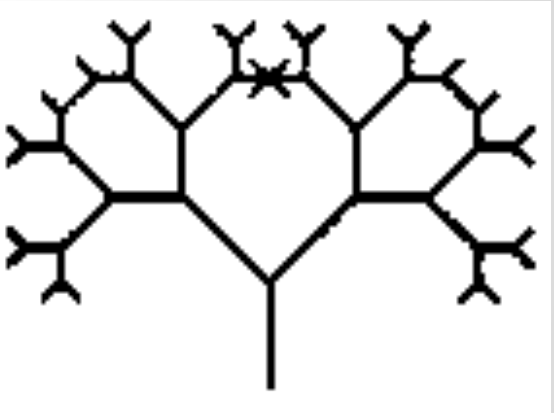
Introduction

Richard Dawkins - ‘Biomorphs’



9 Genes

- 3 - width
- 5 - height
- 1 - branch depth

Can generate >118 billion different biomorphs

Introduction continued

- Genetic Algorithms
  - Crossover, mutation, etc
- Interactive evolutionary computation (IEC)
  - Human interaction - fitness function
  - Restrictions
  - User fatigue

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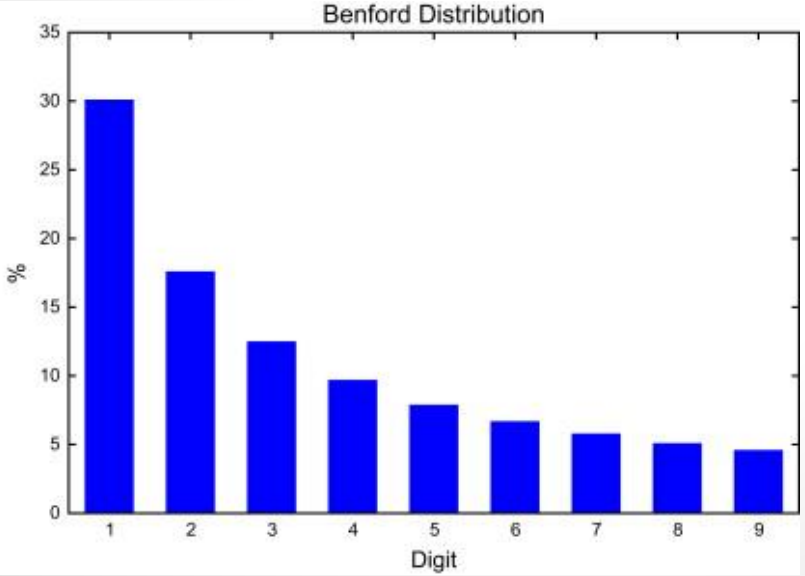
Aesthetic measures

- Benford's law

$$d_{total} = \sum_{i=1}^{9} (H_{image}(i) - H_{benford}(i))$$

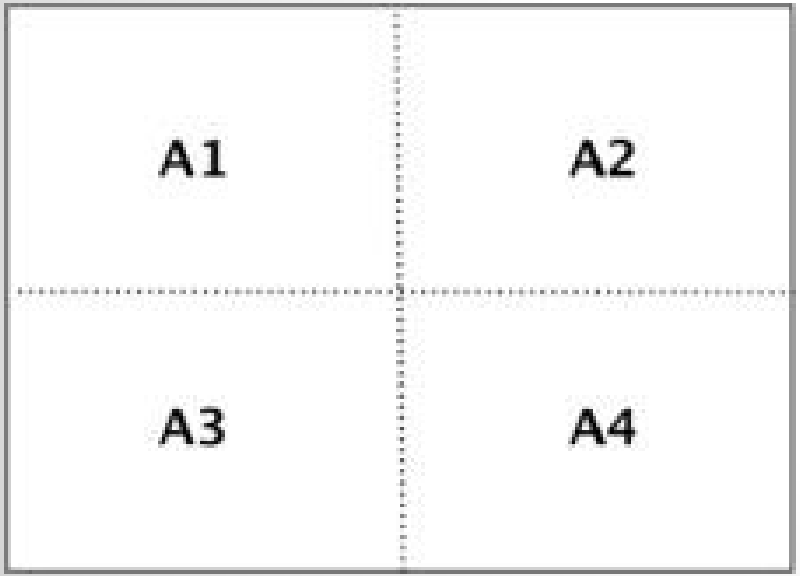
1	30.1%
2	17.6%
3	12.5%
4	9.7%
5	7.9%
6	6.7%
7	5.8%
8	5.1%
9	4.6%



$$M_{bl}(I) = \frac{d_{max} - d_{total}}{d_{max}}$$

Aestethic measures

- Reflectional symmetry



$$S_h(I) = s(A_{left}, A_{right})$$

$$S_v(I) = s(A_{top}, A_{bottom})$$

$$S_d(I) = \frac{s(A_1, A_4) + s(A_2, A_3)}{2}$$

$$M(I) = \frac{S_h(I) + S_v(I) + S_d(I)}{3}$$

Aesthetic measures

- Information theory

$$M_{it}(I) = -\sum_{i=0}^{N} p(x_i) \cdot \log(p(x_i))$$

where $p(x_i)$ refers to the probability of intensity x_i ($in [0, .., 255]$), which is the frequency of that value divided by the number of pixels in the image. An image I will score high on M_{it} if its intensity values are distributed in a uniform way.

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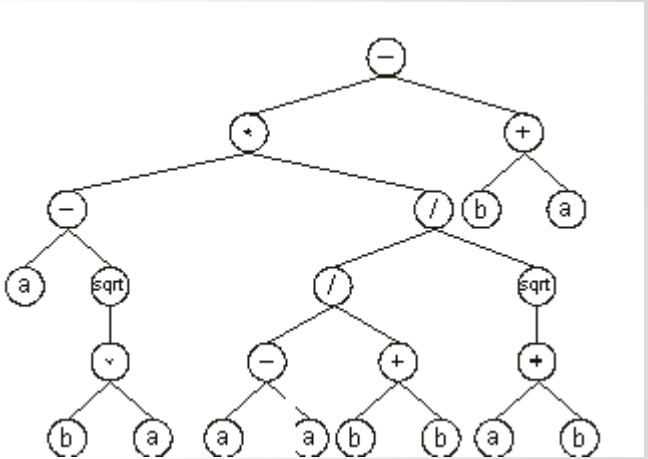
How to

- Initialize population
- Evaluate
- Apply aestethic measure
- Form next generation
- Repeat



Color map the function values

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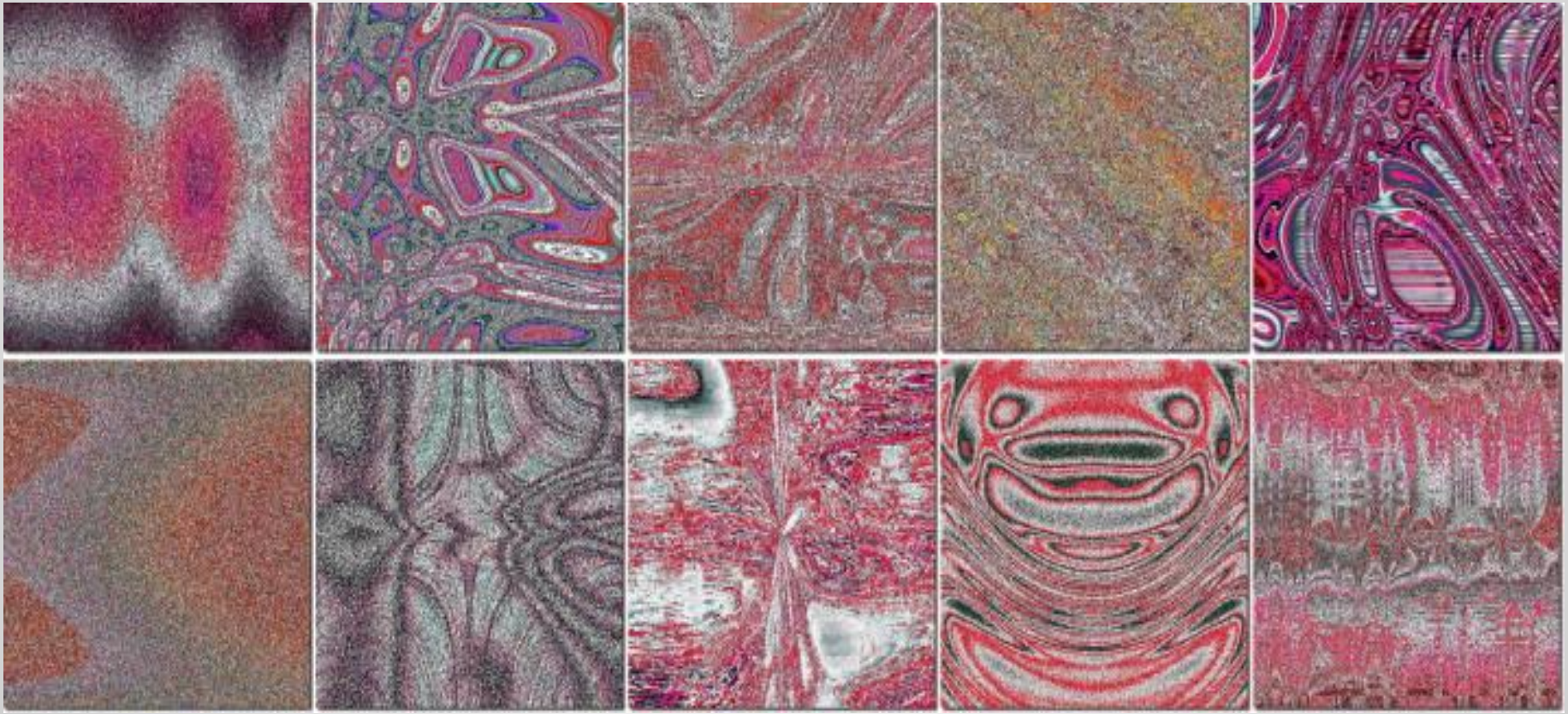
Results - Benford's Law



Results - Reflectional symmetry

Results - Information theory

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Applications

- Cool pictures
- Don’t have to be artistic
- Galapagos