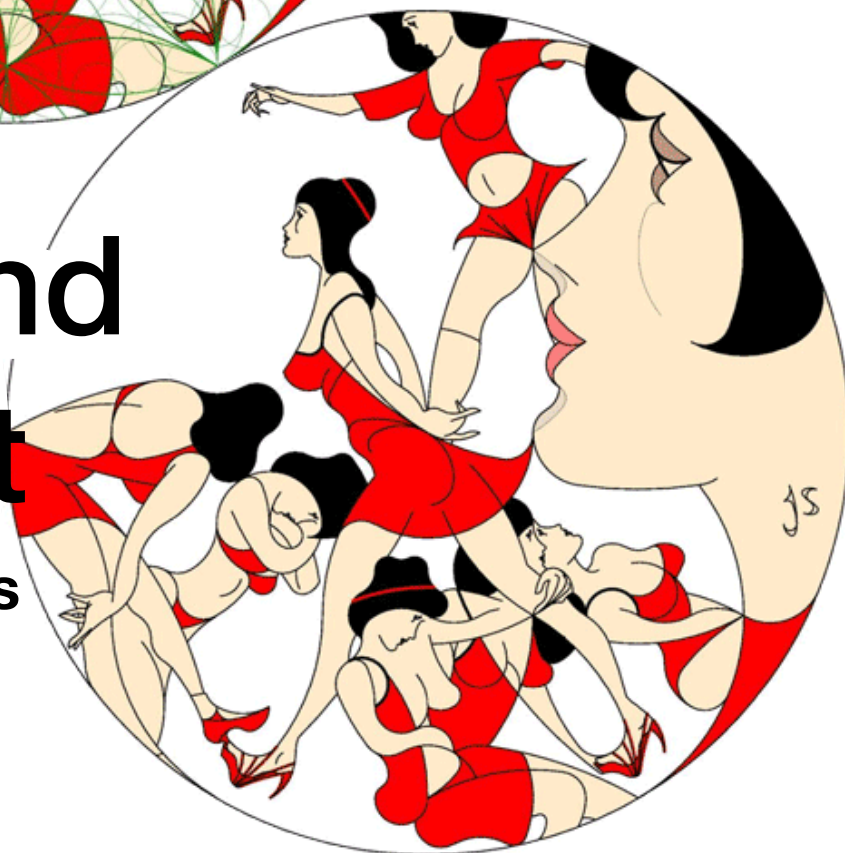


Jürgen Schmidhuber's

Theory of Beauty and Low-Complexity Art

How compression shapes our preferences



What is Low-Complexity art?

- Achieves two goals:
 1. The drawing “looks right”
 2. (a) Kolmogorov complexity is minimized, (b) informed observer should be able to perceive algorithmic simplicity
- Jürgen predicts that an observer will be fond of art which satisfies both goals
- That regularities and repetition of stylistic choices in visual data reduce the processing demands on observer
- Subjectivity in visual preferences, and ability of observer to recognize simplicity of algorithm

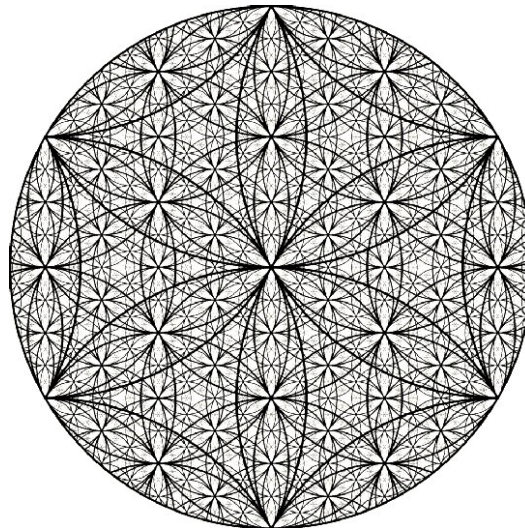
Using a fractal circle coding scheme to create LC art

Initialization: Draw a circle of arbitrary radius and center position. Arbitrarily select a point on the first circle and use it as the center of a second circle with equal radius. The first two circles are defined as legal circles

Rule 1. Wherever two legal circles of equal radius touch or intersect, draw another legal circle of equal radius with the intersection point as its center.

Rule 2. Within every legal circle with center point p and radius r , draw another legal circle whose center point is also p but whose radius is $r/2$.

Legal Circle



Using a fractal circle scheme to create LC art

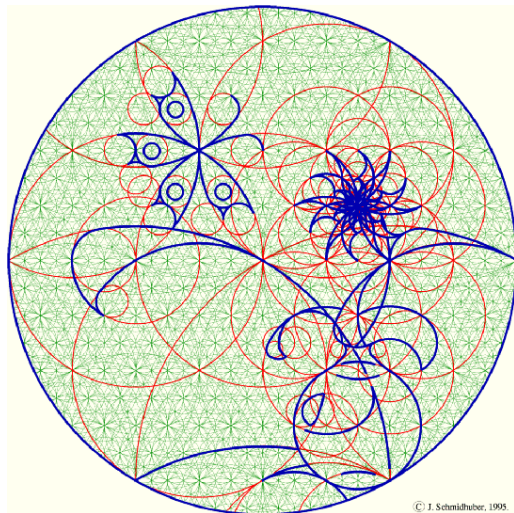
- A legal drawing is defined by (a) legal arcs or (b) legal areas.
- Rules for legal arcs and areas are:

Rule 3. *Each legal arc must be a segment of a legal circle.*

Rule 4. *At both endpoints of a legal arc, some legal circles must touch or intersect.*

Rule 5. *The arc width of a legal arc must be equal to the radius of some legal circle.*

Rule 6. *A legal area is an area whose border is a closed chain of legal arcs. Legal areas may be shaded using a small set of grey levels.*



Legal Drawing

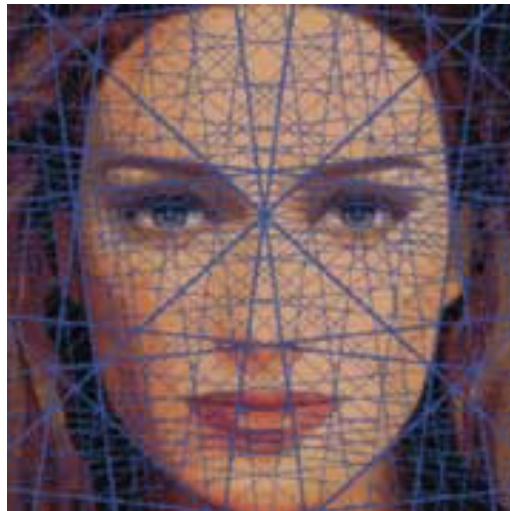


The probability of a face being beautiful

- Given C (*coding algorithm*), the best way of selecting a drawing s from a set or class S of possible drawings satisfying certain specifications may be to maximize $P(s | C)$, the conditional probability of s , given C .

$$P(s | C) = P(C | s) P(s) / P(C) \quad \text{or} \quad -\log P(s | C) = -\log P(C | s) + \log P(C) - \log P(s)$$

- The information required to compute C from s is minimized for a beautiful face
- The probability that a given face will appear beautiful is related to the coding scheme necessary to interpret a face 's'



An informal description of the compression progress drive

Principle 1 *Generate curiosity reward for the controller in response to improvements of the predictor or history compressor*

- Algorithmic Framework

1. Store everything
2. Improve Subjective Compressibility
3. Reward intrinsic curiosity
4. Reinforced Learning to maximize intrinsic curiosity reward

Reward for compression progress

- At any time t ($1 \leq t < T$), given some compressor program p able to compress history $h(\leq t)$, let $C(p, h(\leq t))$ denote p 's compression performance on $h(\leq t)$. An appropriate performance measure would be

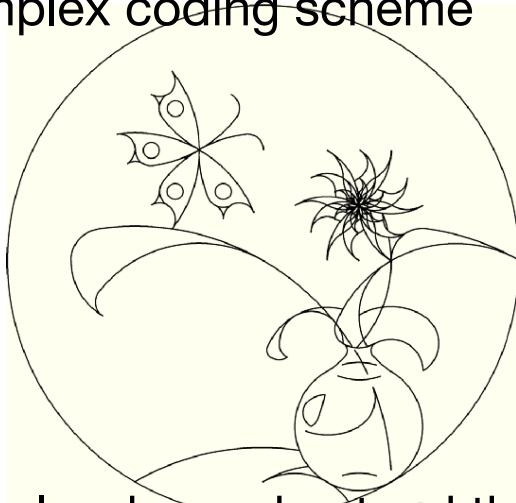
$$Cl(p, h(\leq t)) = l(p)$$

- Measurement of compressor (p) performance

$$r_{int}(t+1) = f[C(p(t+1), h(\leq t+1)), C(p(t), h(\leq t+1))]$$

Beauty as a by-product of a self-rewarding compression progress drive

- The butterfly and vase with flower image can be constructed through a simple algorithm based on a fractal circle coding scheme
- The visual data is more compressible than a similar drawing based on a more complex coding scheme



- People who understand the simplicity of the algorithm tend to appreciate the image more.
- The observers reward is generated by the realization of this compressibility

Implementations of compression progress drive in AI

- Simple algorithmic principle based on notions of data compression progress informally represent fundamental aspects of subjective beauty
- Similarly, Science and Art can be regarded as by-products of the desire to create and discover more data that is compressible in hitherto unknown ways
- Implementing this system in artificial intelligence would improve their learning?

References

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