

# Emergence

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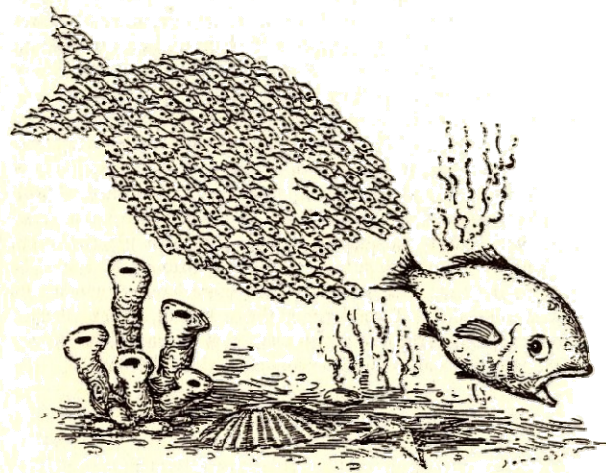




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The diagram illustrates the emergence of a spiral structure. It starts with a single green arrow pointing right. This evolves into a group of three arrows, then a group of five, and finally a complex structure of multiple parallel arrows that curve inward to form a spiral. Below this main diagram are two smaller versions of the same process. To the right is a photograph of several black puppies sitting in a circle on a tiled floor.

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### Examples

The diagram shows a traffic jam on a road, with cars represented by small rectangles. To the right is a photograph of a curved road with red lights along its edge.

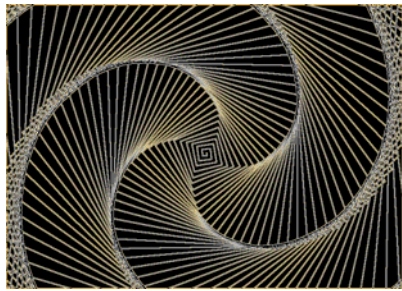
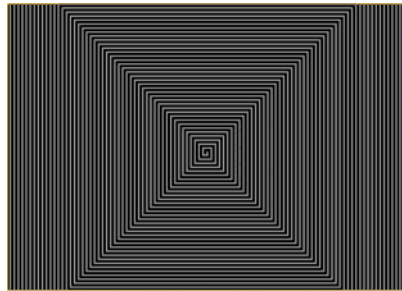
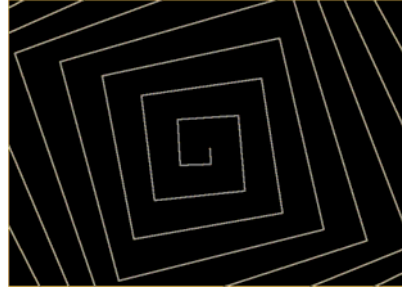
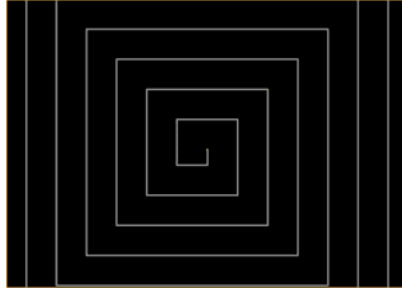
Spirales old

**spiraes**

**marienbad**

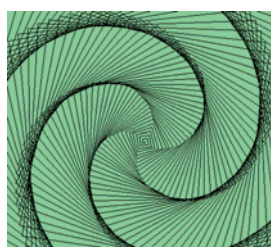
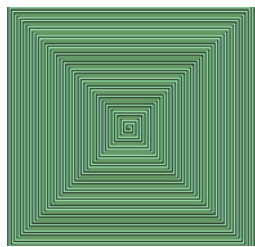
example	emerging object	component	new property
spiral	4 arms spiral	straight segments	rounded
traffic jam	vehicle gathering	car	moving back
temperature	group of molecules	molecule	hot
H <sub>2</sub> S	molecule	atoms	smell
particule	quantic particle	plane wave	localization
word	english word	phonem	reference
<b>run for 20</b>	complex rule	elementary rule	generality

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Emergence as complexity drop

$$E = C_{exp} - C_{obs}$$

Kolmogorov complexity

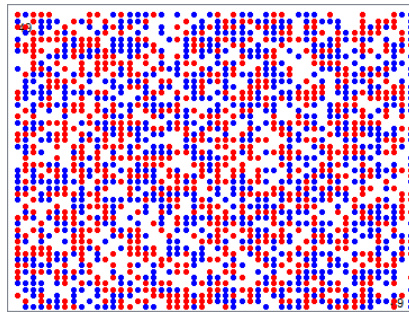
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## Emergence as complexity drop

$$E = C_{exp} - C_{obs}$$

Kolmogorov complexity



Thomas Schelling (1971)

## Emergence as complexity drop

$$E = C_{exp} - C_{obs}$$

Kolmogorov complexity



$$C_{exp}(s) = N \times C(a_i)$$

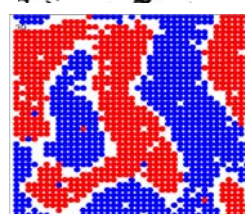
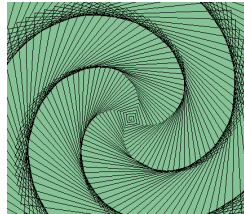
$$C_{obs} = C(s) + N \times C(a_i/s)$$

The whole is more than the sum of its parts

The whole is *less* than the sum of its parts

## Emergence as complexity drop

$$E = C_{exp} - C_{obs}$$



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