

Emergence

what are emergent structures?

ant colonies
flocks of birds
neighborhoods
economies

"from the bottom-up"

Emergent properties?

- arise from interaction of "lower-level" entities, none of which show it.

E.g. - The volume of a gas, or its pressure or temperature, which are not properties of any individual molecule, though they depend on the properties of those individual molecules.

- stable pattern induced by local interaction of agents.

emergent properties are *self-organizing*

- display systematic group behavior different, and not necessarily predictable from the behavior of individuals in the group.

not everything is self-organizing

ant colonies

flocks of birds

neighborhoods

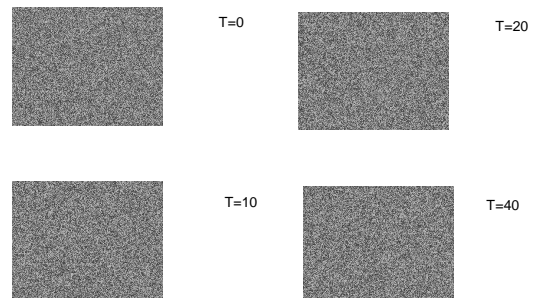
economies

self-organizing?

self-organizing systems

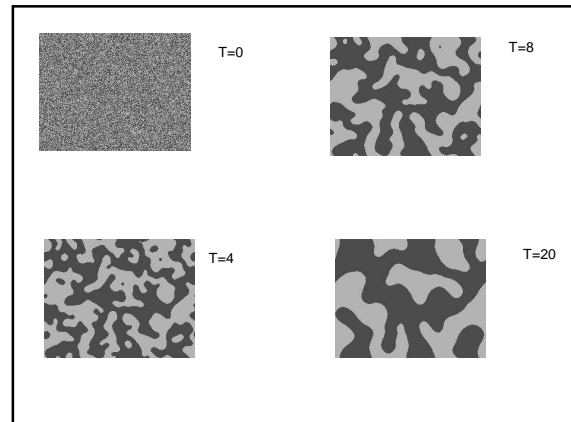
Non-Linear Voter Model

- 2 colors, two political parties
- each cell polls its immediate neighbor
- if all neighbors are of its current opinion, cell retains opinion.
- else flips a coin.



Majority Voting Model

- 2 colors for the two parties.
- each cell polls neighbors and switches to whichever opinion the majority



What good are these models?

- How real?
- What can expect from them?

understand the dynamics better

distinguish correlations from causes

U and me

Universality

Self-organizing criticality (SOC)

Fractal
scale-free
everywhere

bibliography

Wolfram, Stephen. *Cellular Automata and Complexity: Collected Papers*. Reading, Mass.: Addison-Wesley 1994

Barabasi, Albert-Laszlo. *Linked: The New Science of Networks* 2002

Bak, P. *How Nature Works*, Springer-Verlag, New York, 1996.

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For images I used:

<http://www.cscs.umich.edu/~crshalizi/Self-organization/soup-done/nlvm/>