Generic characteristics of Complex Systems

part 2: Complexity Theory

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Theories

Natural sciences

- Dissipative structures
- chemistry-physics (Prigogine)
- Autocatalytic sets
- evolutionary biology (Kauffman)
- Autopoiesis (self-generation)
- biology/cognition (Maturana)
- Chaos theory

Social sciences

- Increasing returns
- economics (B. Arthur)

Generic characteristics of complex co-evolving systems

- **connectivity**
- **inter-dependence**
- **feedback**
- **emergence**

- **self-organisation**
- **space of possibilities**
- **co-evolution**
- **historicity & time**
- **far from equilibrium**

creation of new order

Self-organization

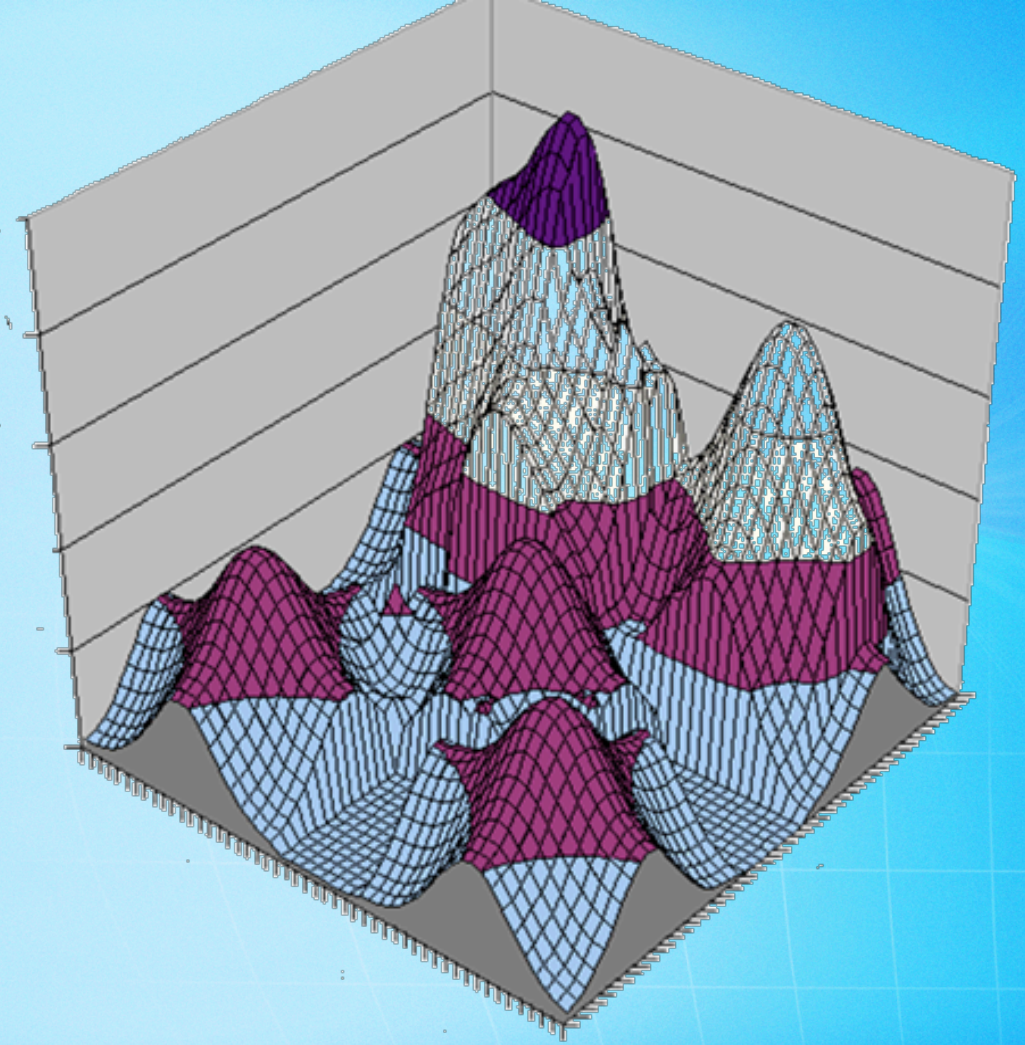
an example in biology: Birds flocking

Self-organization in a human context

- **Spontaneous** 'coming together'
- **Not directed** or designed by someone outside the group
- The group decides *what* needs to be done, *how, when* …
- Can be a source of innovation
- Self-organization ≠ self-management

Exploration of the space of possibilities

Exploration of new options, different ways of working and relating



Exploration of the space of possibilities

The search for a single **'optimum'** strategy is neither possible nor desirable, in a changing or turbulent environment

Multiple micro-strategies

Essential for innovation

Co-evolution - An example in biology

Bumblebees and the flowers they pollinate have co-evolved so that both have become dependent on each other for survival

Co-evolution in a Social Ecosystem

- Co-evolution takes place within ***a social ecosystem***
- If influence and change are entirely in one direction: '***adaptation to***' a changing environment
- Short-term adaptation may result in ***long-term co-evolution***

Co-evolution in a Social Ecosystem

- **Reciprocal influence which changes the behaviour of the interacting entities**

  (individuals, organisations, industries, economies, etc.)

Far-from-equilibrium

- Original work on dissipative by *Ilya Prigogine, with Nicolis* and *Stengers*
- Nobel Prize for reinterpreting the Second Law of Thermodynamics

  - (increase in entropy & irreversibility)

Point of bifurcation when system is pushed far-from-equilibrium

Summary of characteristics

When a system is pushed far-from-equilibrium the following characteristics come into play to create new order:

- Self-organisation
- Exploration of possible solutions at the critical point
- Co-evolution
- Emergence of new structure
- Coherence
- *Precise* behaviour can neither be predicted nor controlled

Summary of characteristics

Creation of new order:

= *difference between*:

'just' complicated and

complex systems

Thank you for your attention!

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