Complex Adaptive Systems

Presenter:

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Researchers often refer to the following as “Complex Adaptive Systems”

- Immune systems;
- Multi-cellular organisms;
- Insect colonies;
- Ecologies;
- Decentralized market economies;
- Robot “herds” (groups of robots interacting with each other in an environment).

But what does this really mean?
Rough Definition of a Complex System


- A *system* is any entity to be described.

- A *complex system* is a system that:
  - is composed of interacting units (components, primitive elements, constituents,…), and
  - exhibits *emergent* properties, i.e., properties arising from the interactions of the units that are not properties of the individual units themselves.
Which (if any) of the following systems would you classify as a complex system?

- A pencil?
- A thermostat?
- The Colorado River?
- A labor market (i.e., a job market)?
What about a *Complex Adaptive System*?

A range of possible definitions: A *complex adaptive system (CAS)* is a complex system that contains at least some units that are...

**DEF 1:** reactive, i.e., they have an internal structure that reacts systematically to different environmental conditions.

**DEF 2:** goal-directed, i.e., they are reactive, and at least some of their reactions are directed towards achievement of goals.

**DEF 3:** planners, i.e., they are goal-directed and they attempt to exert some degree of control over their environment to facilitate achievement of these goals.
Definition of CAS… Continued

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