

About

Self-Organisation Emergent Behaviour Self-Management

Giovanna Di Marzo Serugendo
University of Geneva, Switzerland

Self-Organisation

- Definitions
 - Swarms: coordination and regulation through environment without central control (stigmergy)
 - Self-org occurs results from behaviour inside the system
 - Thermodynamics: open systems decrease entropy when external pressure is applied (decrease of entropy)
 - Self-org is the result of pressure applied from the outside
 - Cells: self-maintenance of system of system through self-generation of system's components (autopoiesis)
- Essentially: *capacity to spontaneously produce a new organisation in case of environmental changes*

Emergent Behaviour

- Definition
 - Structure (pattern or function), not explicitly represented at a lower level, appears at a higher level
- Essentially
 - Observed pattern or function but it has no causal effect on the system itself (stones ordered by sea)
 - Observed function which has a causal effect on the system
 - This function can be desired or not!! (in both cases it has an effect)
- Not always needed or required or good for the system

When Self-Org meets Emergence

- Self-Org can be independent of Emergent behaviour
 - Self-Org can happen without emergent behaviour
 - If central control
 - Emergent Behaviour can happen without self-organisation
 - No (re-)organisation
- Self-Org + Emergent Behaviour when:
 - Dynamic Self-Organising Systems
 - Decentralised Control
 - Local Interactions

Self-Management

- Decentralised control
- Adaptation to changes (re-organisation?)
- Local knowledge of individual components
- Desired result: self-management
 - Then ... self-org + emergent behaviour
- Maybe more complex ...
- Three aspects:
 - Self-managing system itself
 - Any additional resource this system manages (self-managed system)
 - Interaction with human administrator
- Ex. Self-managing distributed operating system

Current Solutions for Self-Org/Emergence

- Reproducing natural self-org mechanisms
 - Biology or Social Behaviour (insects, humans, etc.)
 - Direct interactions / Reinforcement / Adaptive Agents / Cooperation / Middleware
- Strengths
 - Robust / Adaptive / Simple individual components
- Limits
 - Controlling emergent behaviour
 - Designing those systems
 - Implementing supporting infrastructures

Issues for Self-Management

- Software engineering of systems with both
 - Self-org and Emergent Behaviour
 - Needs: to define a global goal and to design local behaviour (making the global expected behaviour to happen)
- Control / Design of decentralised behaviour
 - Good properties have to emerge
 - Bad properties to be avoided!
 - Control and emergence are contradictory
 - Which kind of self-organisation do we need?

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Issues for Self-Management

- What about environment
 - Where is the border?
 - How to take into account the environment?
- 3 Aspects of Self-Managing(ed) Systems
 - Managing itself
 - Managing resources (environment?)
 - Human interaction with self-managing system (2 directions)
 - From Human to System (decomposition of high-level goal)
 - From System to Human (coherent global info produced by local decentralised info)

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