Embodiment

- Very divisive issue (different paradigms have different requirements)

- Cognitivist:
  - there is no need for embodiment
    (cf. physical symbol system hypothesis)

  - Cognitivism exhibits a form of mind-body dualism
    [Thelen & Smith 94, Thelen 95]

  - Symbolic knowledge can be programmed in directly

  - Embodiment may be useful, but it's not necessary

Embodiment

- Emergent:
  - Must be embodied (by definition)

  - Embedded in their environment

  - Situated historical developmental context

  - Three complementary processes
    - Self-organization
    - Structural coupling
    - Development

  - Without physical embodied exploration, a cognitive system has no basis for development

  - Embodiment is a key component of system dynamics

Embodiment

- Are there different forms of embodiment?

- What's an action?

- Does it have to be forcible?

- Is speech an act (or action)?

- Does action require mobility?

- Is a computer triggering a switch embodied?

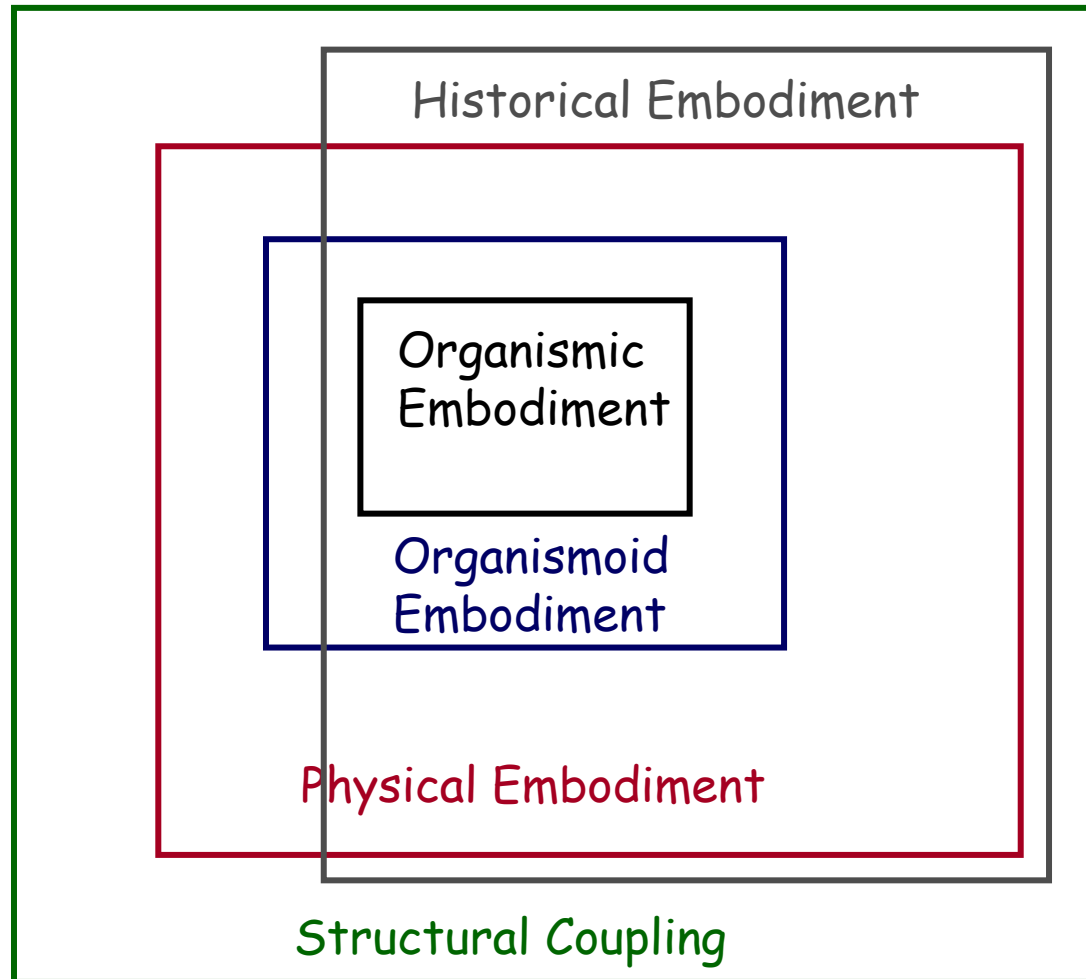# Embodiment

Instantiation
Realization
Embedded
Situated
Embodied
In context

Different or the same?

Embodiment

Historical Embodiment

Organismic Embodiment

Organismoid Embodiment

Physical Embodiment

Structural Coupling

From: T. Ziemke, 'What's this thing called embodiment?', 2003

Embodiment

- Structural coupling
  - System can be perturbed by the environment
  - System can perturb the environment

- Historical embodiment
  - History of structural coupling

- Physical embodiment
  - Forcible action (excluded software agents)

- Organismoid embodiment
  - Organism-like bodily form (e.g. humanoid robots)

- Organismic embodiment
  - Autopoietic living systems

Embodiment

- Structural Coupling

  - The system-environment perturbations must be
    - rich enough to drive the ontogenic development
    - But not destructive of the self-organization

  - No guarantee that the resultant cognitive behaviour will be consistent with human preconceptions

  - Shared epistemology (knowledge) requires shared experiences

The problem of disparate embodiment & interaction histories

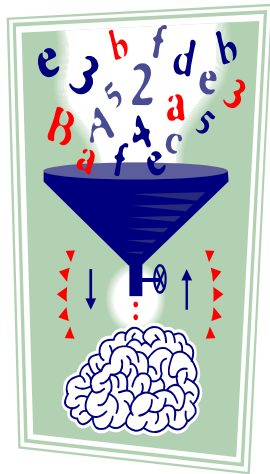# The problem of disparate embodiment & interaction histories

Embodiment

- Hollnagel uses the term 'cognition in context' (for embodied or situated cognition)

- 'Cognition without context' … cognitivist approaches

- 5 characteristics of situated cognition

  1. Cognition is not confined to a single individual … can be distributed across multiple natural and artificial systems

  1. Cognitive activity is not confined to instantaneous responses/action … it's part of a stream of activity

  2. Social cognitive systems are embedded in an environment that constrains their activities and provides resources

  3. Activities are not static but evolve and undergo transitions

  4. Almost all activity is aided by something/someone outside the cognitive entity (e.g. a tool)
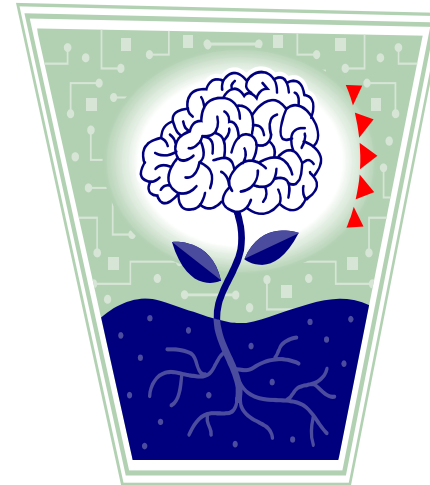
Embodiment
Cognitivist vs. Emergent

<u>Functionalist</u>:
Mechanisms are independent of the instantiation

<u>Dualist:</u>
Distinction between mind and body

[Freeman and Nunez]

Embodiment plays a constitutive role in the process of cognition

Not just a vehicle for instantiation