Multiagent Systems

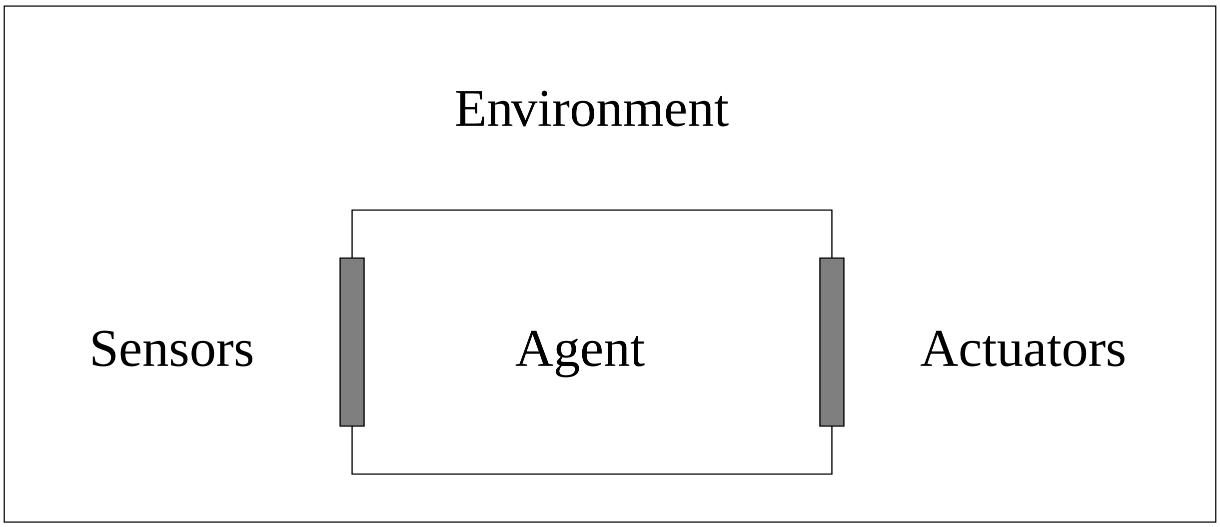
Objects:

- well-defined interfaces
- clear tasks and well-defined specifications
- a priori integration into environment; relation defined at specification time
- “passive”

Agents:

- ill-defined (embodied) interfaces: sensors and actuators need AI techniques to be exploited
- loosely defined interests and goals
- need to balance these with respect to environmental conditions
- its relation to environment is more volatile and temporary
- “active”

Embedding of Agent



1. selecting information

2. processing information

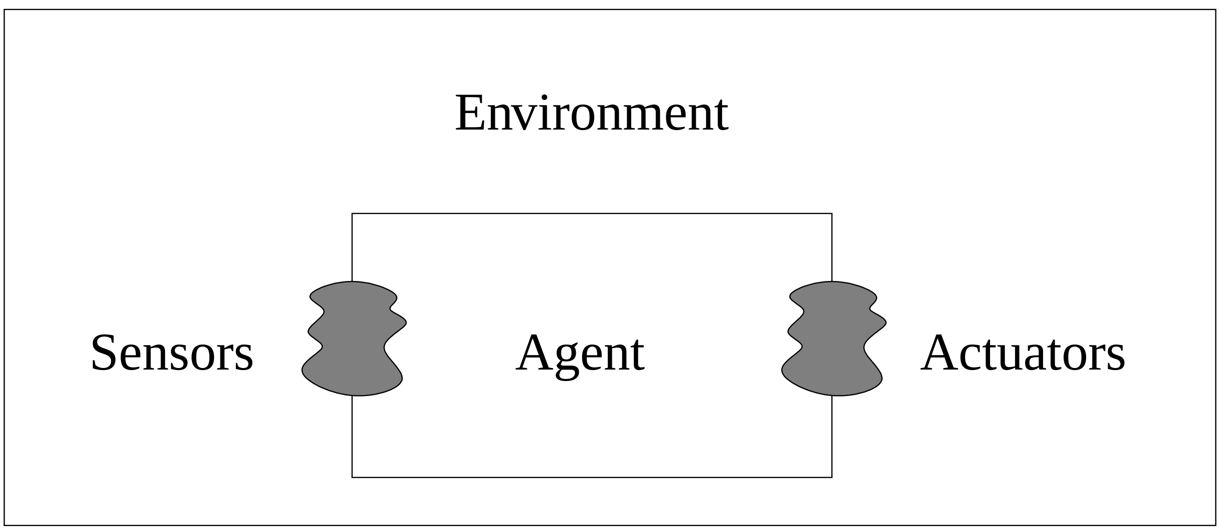
3. imprinting information

Agent Interface and Embodiment

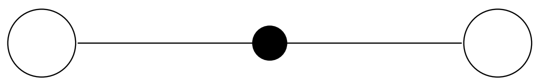
- agent interfaces different from regular interfaces
- sensor input is different from classical information
- choice of information important
- actions may evoke informative system states: actuator-induced sensoric information:
  - bats
  - pit vipers
  - electric fish
- metamorphosis of sensoric substrate

“Dirty” Interfaces

Remark: interfaces of embodied agents typically not clean



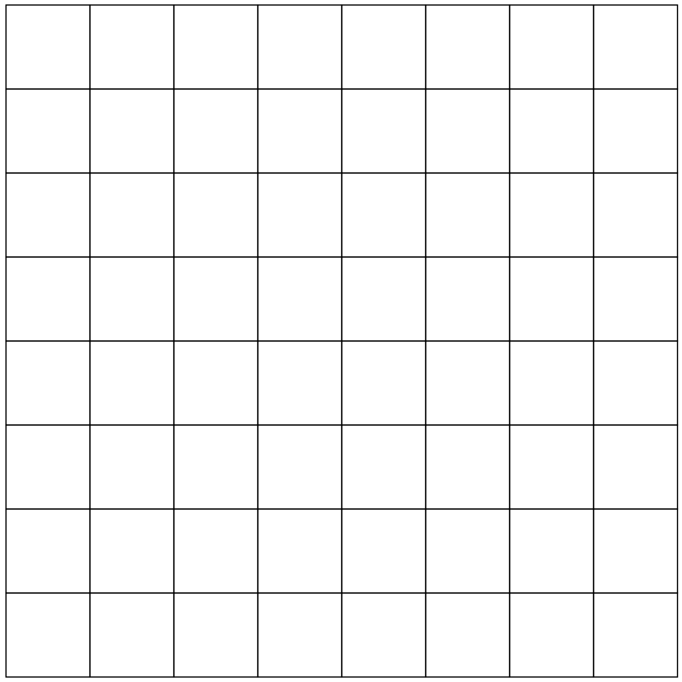
State-Action View



- state changed by actions

- but agents see only part of the state

Simple Example



Task: shortest path to goal

Observation: classes of strategies

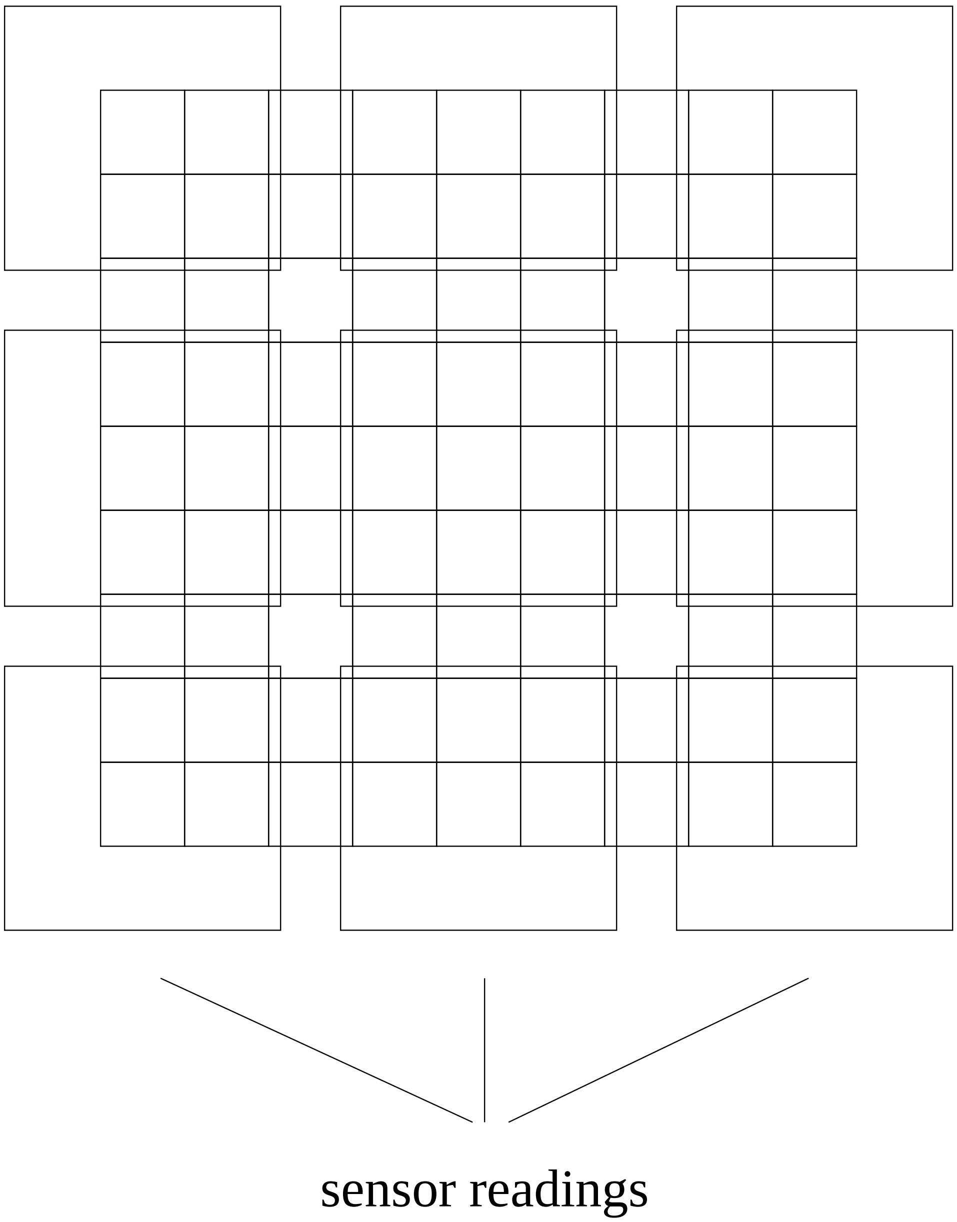
Approach: cluster into state groups

Note:

- extremely simple principle
- classification into states according to available action choices

Completeness: if sensors able to distinguish those, complete sensoric information

Maze State Classes



Bottom Line: Embodiment and Agent Interface

Embodiment:

- defines how these data are being obtained
- defines form of data

Sensors: can preselect this information by clever "design" (evolution)

Actuators:

- can change world state to agent's advantage
- can provide sensors with information

Multiagent Ant Scenario

Queen:

- slow movement
- procreation

Ant:

- fast movement
- feeding

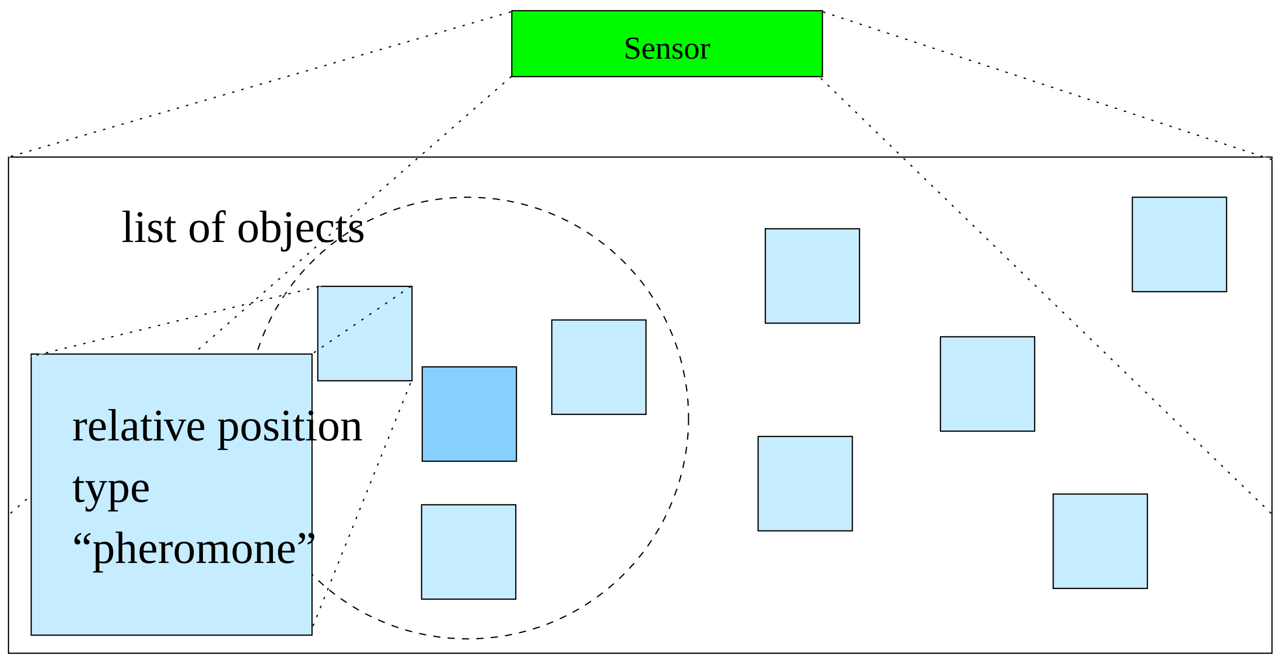
Movement: Braitenberg vehicle-like movement

Populations: agents from different populations are enemies

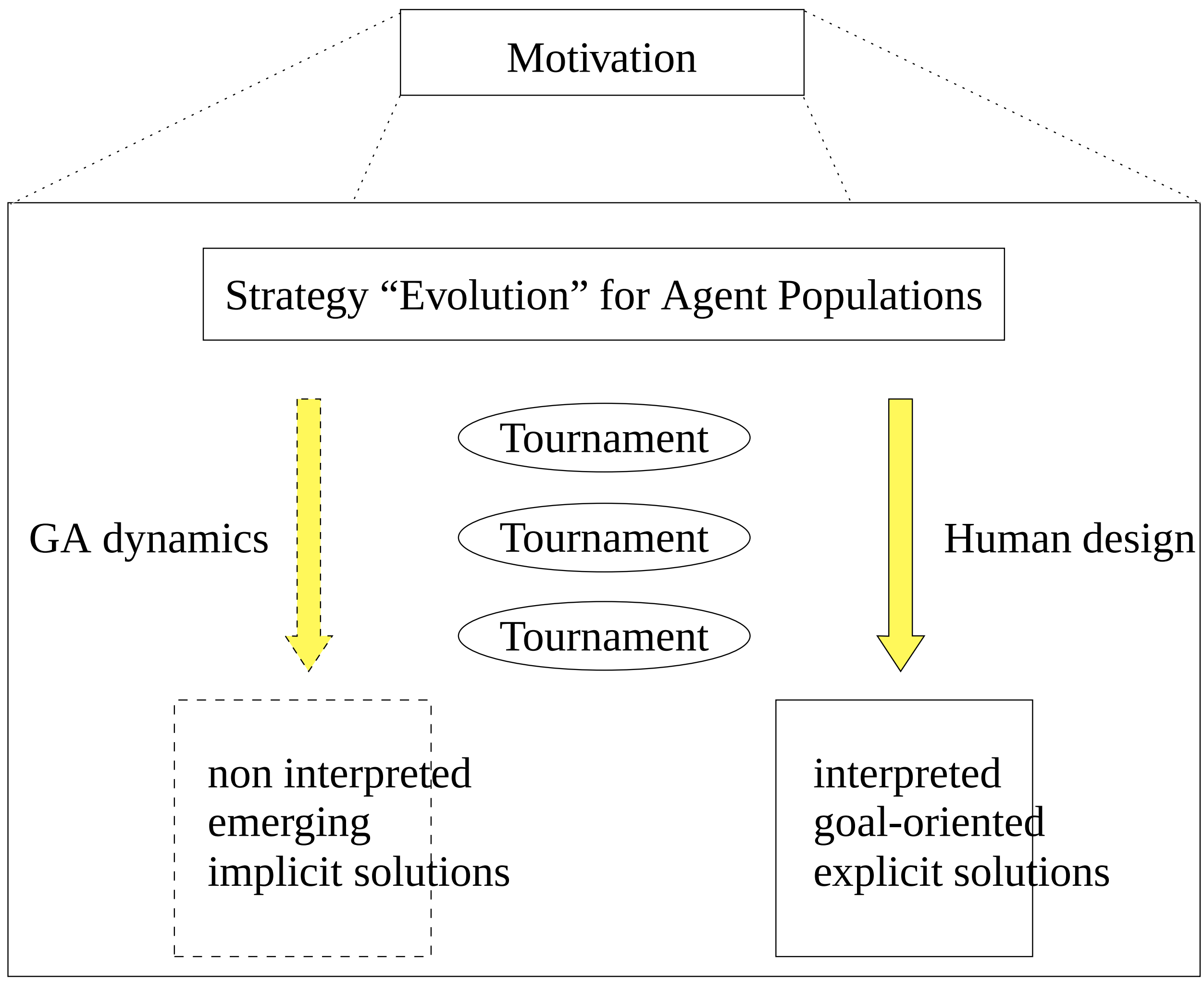
Life Energy balance:

- constant drop ("metabolism")
- increased by feeding
- enemy collisions reduce energy
- death below energy threshold

Multiagent Ant Scenario



Procedure



Goal: strategy design by iterative population development

Fundamental Tasks

Ants have to:

1. find food
2. feed themselves
3. provide logistics to feed queen
4. explore the world
5. identify areas with competing agents
6. identify areas with food
7. protect and defend queen
8. attack other teams if strong enough

Queen has to:

1. uphold balance between procreation and safe energy level

Strategies

Strategies

Population
size
resources ⟺ threat
queen relocation

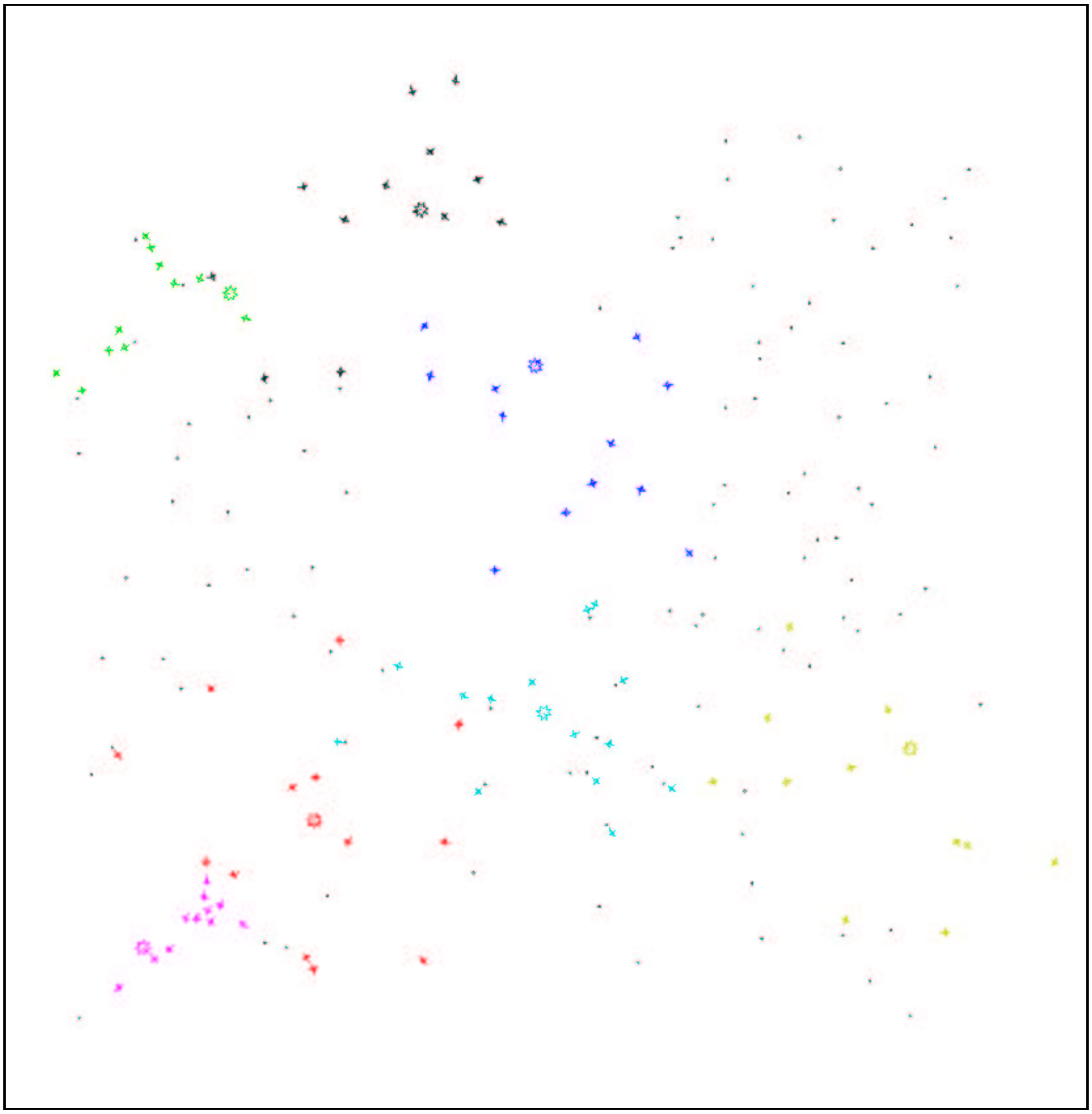
Navigation
local ⟺ global
sensor fusion
communication

Foraging
food density mapping
undirected search

Logistics
agent coordination
food transport

Conflict
queen defense ⟺ food logistics
enemy queen attacks ⟺ “vengeance” responses
distress calls
“scorched earth” tactics

Ant Colony Scenario



Scenario:

- competition between different ant colonies
- feeding, transporting food, signaling and fighting

http://www.informatik.uni-mainz.de/˜polani/XRaptor/XRaptor.html

Results

Tournament results

- – high initial aggressiveness ⇔ early resource waste
- – pure pacifistic strategy
- – small population with high queen energy
- \+ defensive start and increasing aggressiveness