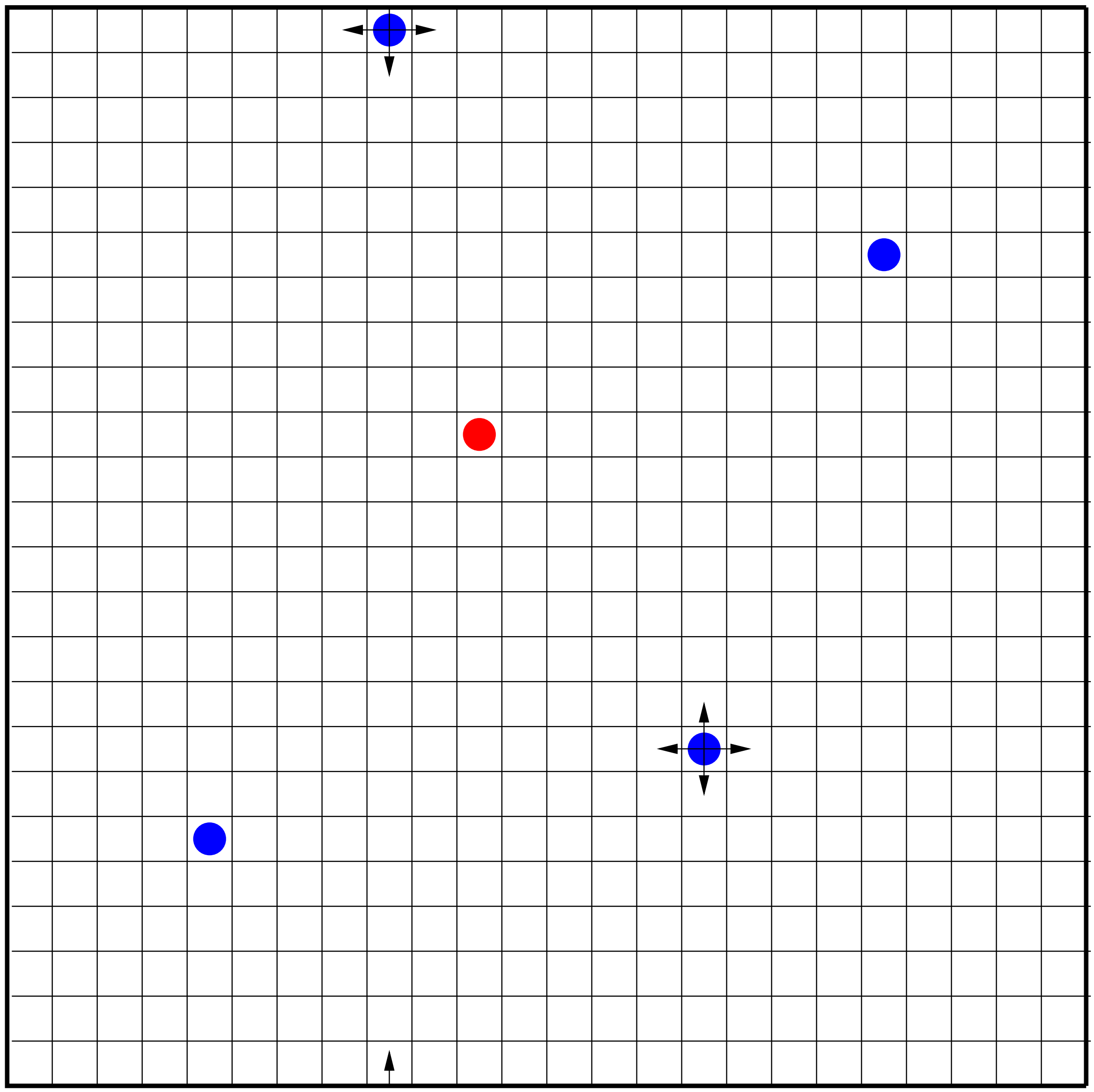
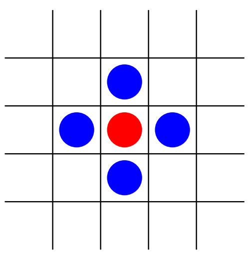
The Predator-Prey ("Pursuit") Domain



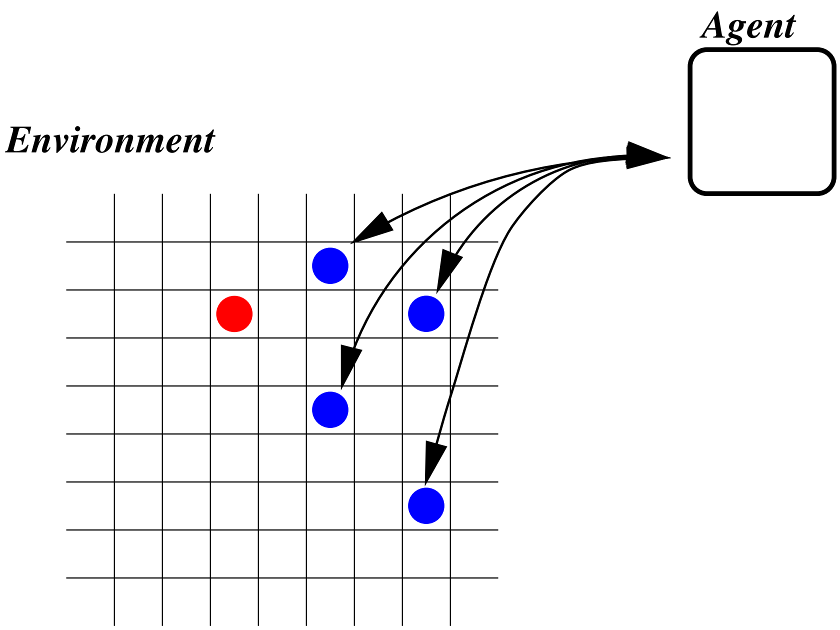
Orthogonal Game in a Toroidal World

Capture



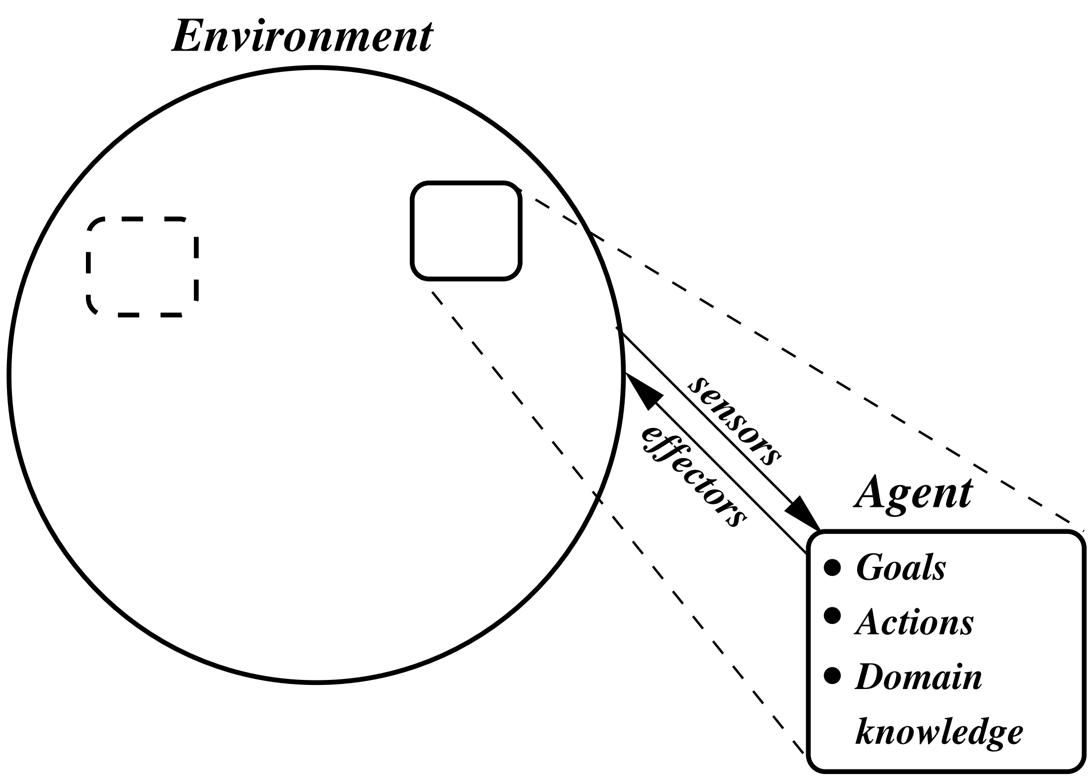
- *Predators see each other*
- *Predators can communicate*
- *Prey moves randomly*
- *Prey stays put 10% of time*
- *Simultaneous movements*

Single Agent Pursuit



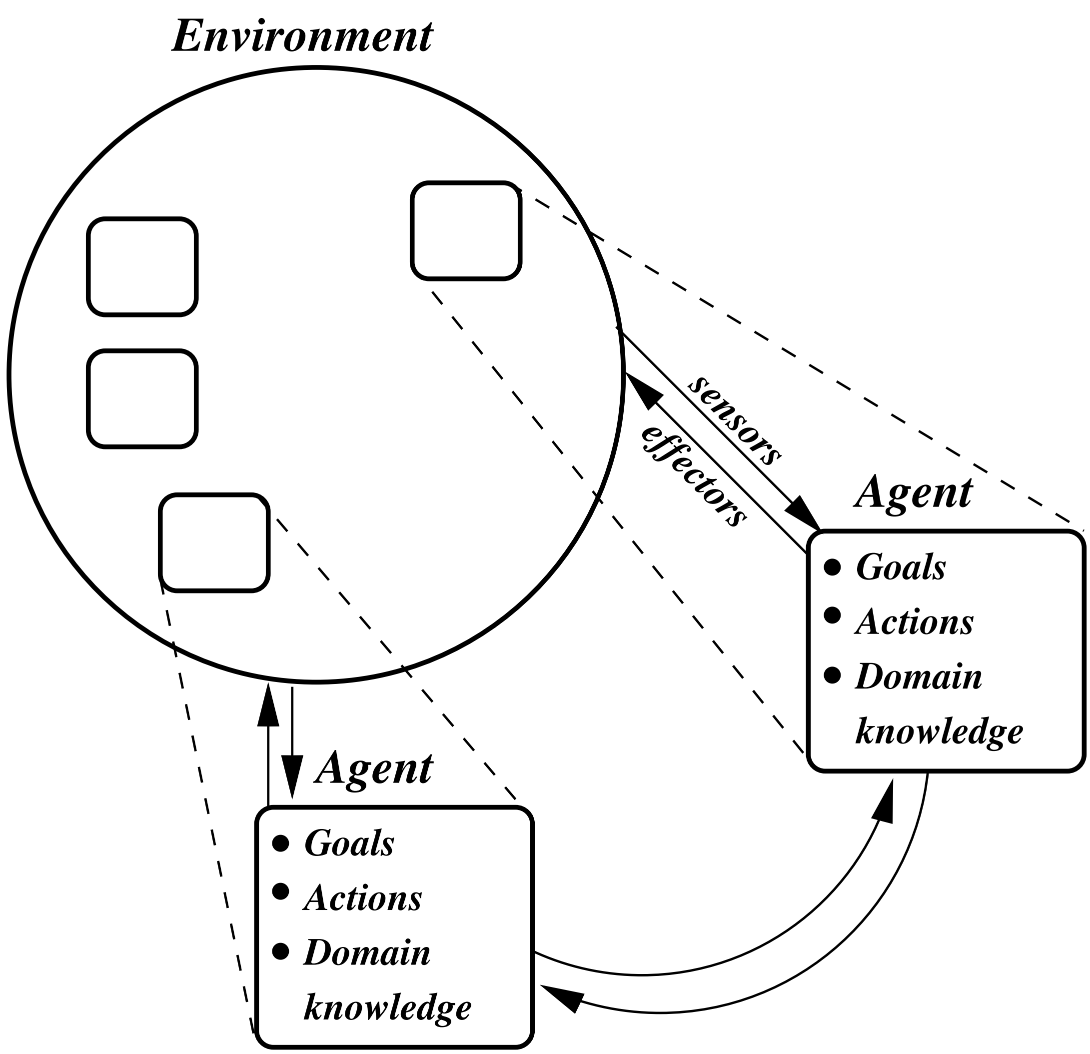
- One agent controls all predators.
- Prey is considered part of the environment.

Single Agent Systems



- Agent models itself, the environment, and their interactions.
- If other agents exist, they're considered environment.

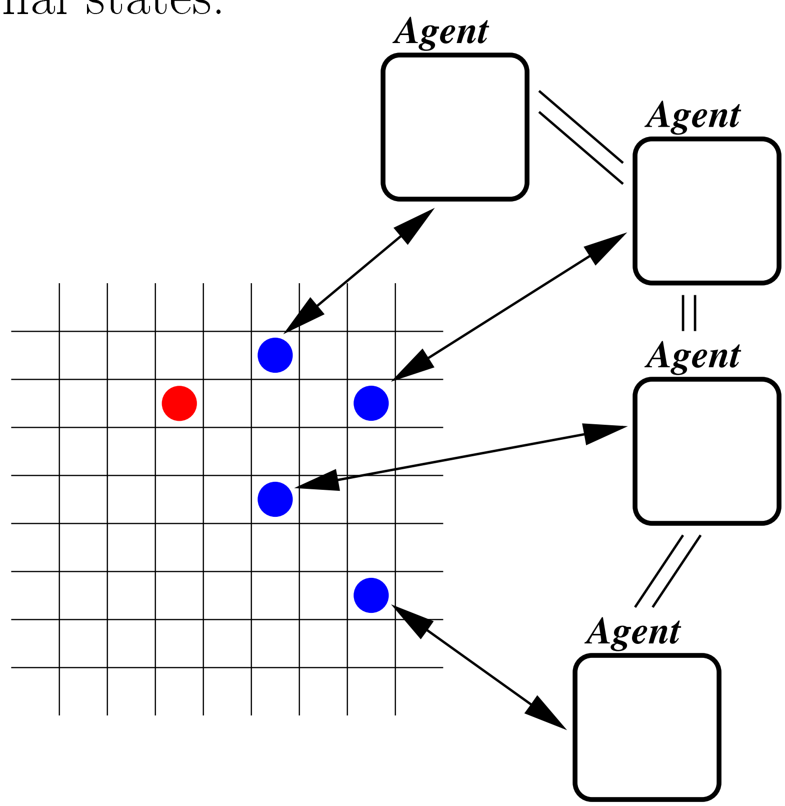
Multiagent Systems



- Agents model each others' goals and actions.
- Possible direct interaction.
- Dimensions: degree of agent **heterogeneity**; degree of **collaboration**; **communication** capabilities.

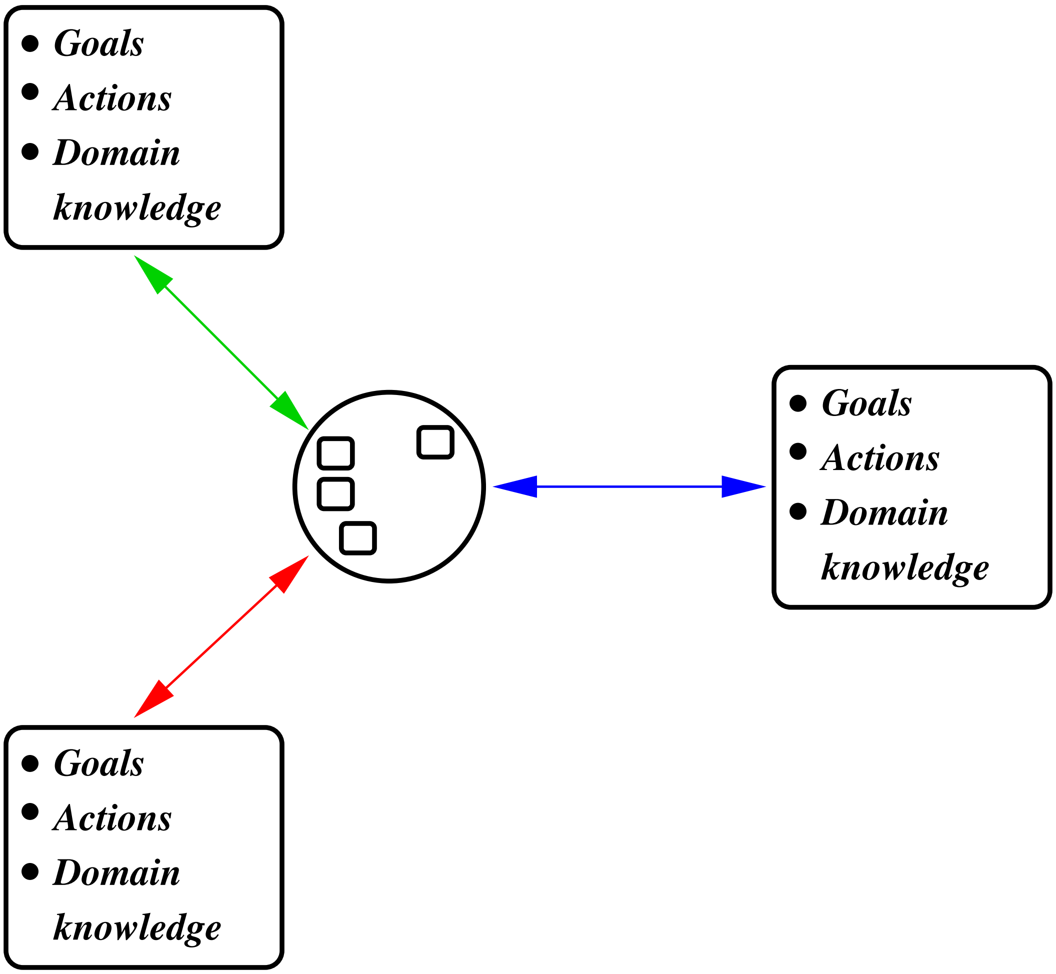
Homogeneous Multiagent Pursuit

- One **identical** agent per predator.
- Possibly limited information about other agents' internal states.



- Each agent to closest capture position. *Stephens and Merx*
- Predict other agents' moves using **Recursive Modeling**. *Vidal and Durfee*
- **Game theory**: each agent maximizing own utility leads to coordination. *Levy*
- Claim that game is easily solved with greedy decisions (diagonal, hexagonal games): attract to prey, repel other predators. *Korf*

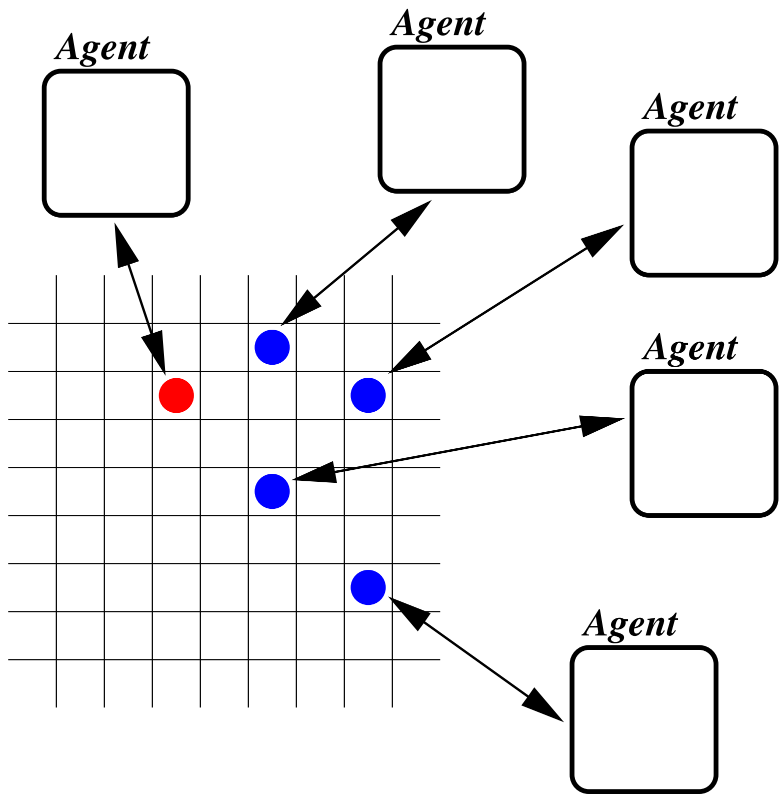
Homogeneous Agents



- Only sensors and effectors differ.
- Necessary condition.
- For now assume no direct interaction.

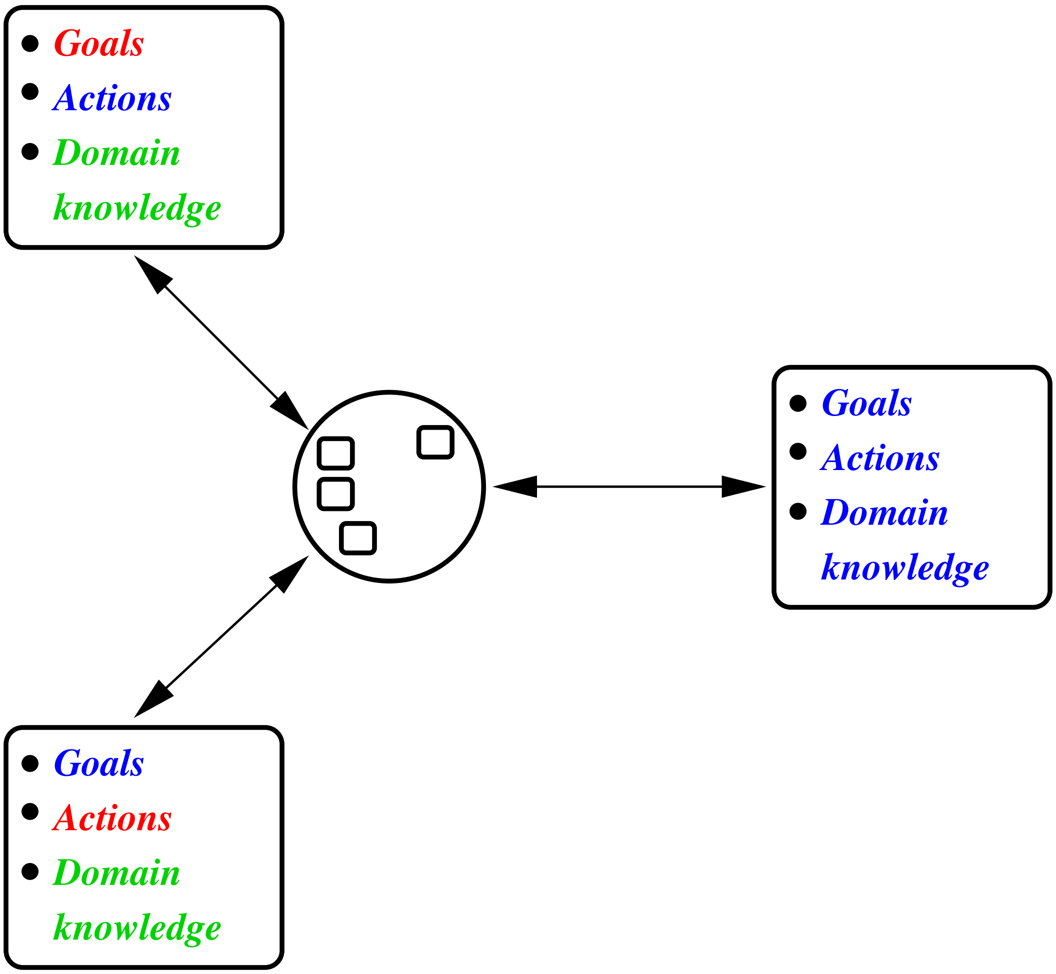
Heterogeneous Multiagent Pursuit

- Prey also modeled as an agent.
- Goals and actions differ among agents.



- Evolve teams of predators: implicit communication. *Haynes and Sen*
- Model others by set of default rules, then store negative cases and update behaviors (no co-occupation). *Haynes and Sen*
- **Evolve prey behaviors** (linear always succeeds?). *Haynes and Sen*

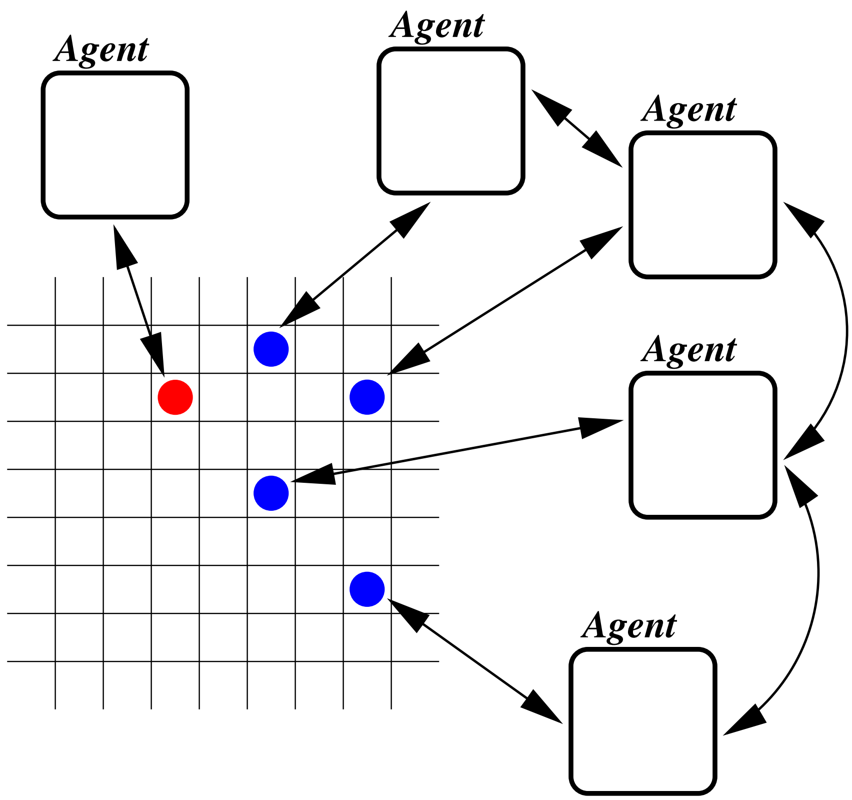
Heterogeneous Agents



- Goals, actions, and/or domain knowledge may differ.
- Still assume no direct interaction.

Communicating Multiagent Pursuit

- Predators can communicate.

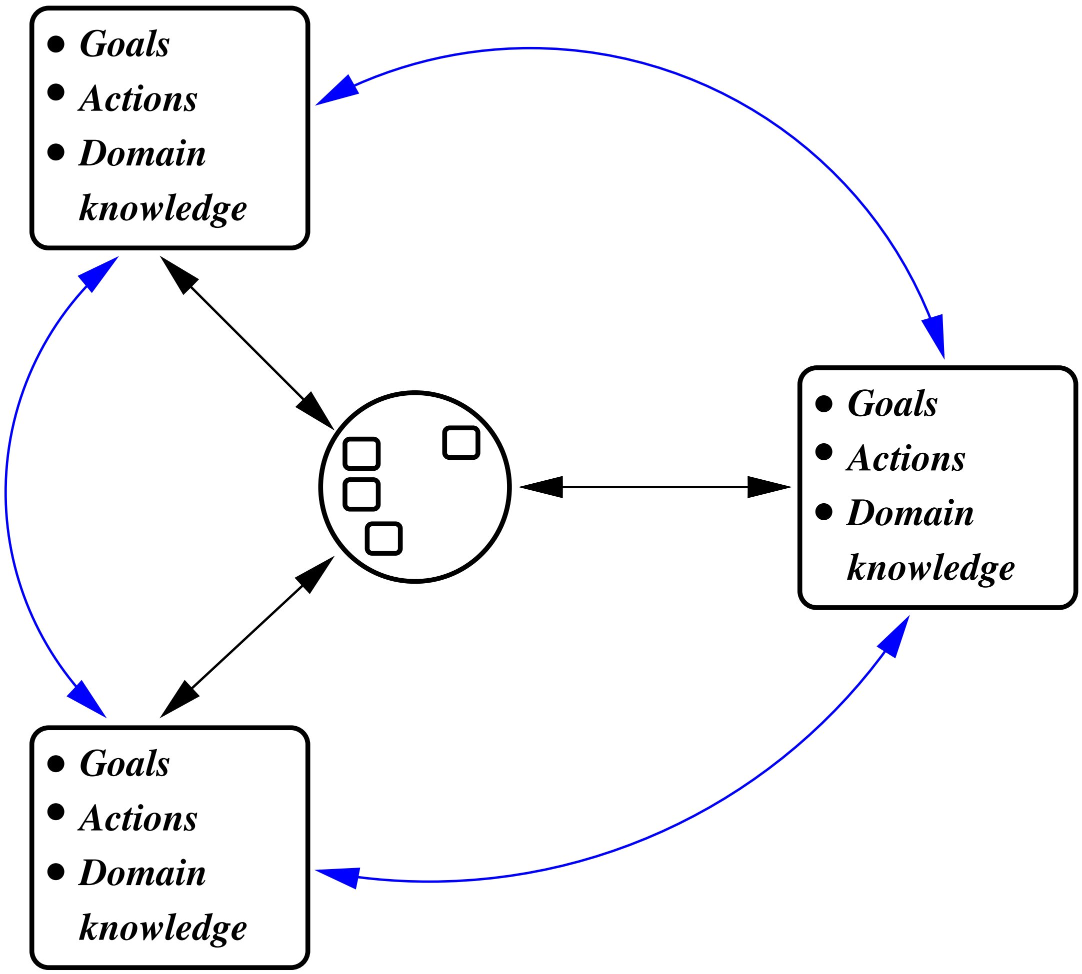


- Predators use Q-learning and share either sensation, episodes, or policies (predators, scouts, limited view). Share sensation for joint task. *Tan*
- Choose capture position to approach one at a time: farthest first. *Stephens and Merx*
- One agent controls all. *Stephens and Merx*

- Exchange data; exchange data and goals; or give up control: tradeoff between communication costs and better decisions. *Benda et al.*
- Start autonomously, then communicate, then negotiate, then control. Cost increases as freedom decreases. *Osawa*

In the extreme, we get back to the single agent scenario

Communicating Agents



- Information can be transmitted directly among agents.
- Blackboard or point-to-point communication.