MULTI-AGENT RL

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MDP

agent

state $S_t$

reward $R_t$

action $A_t$

Environment

$S_{t+1}$

$R_{t+1}$
Multi-agent Reinforcement Learning (MARL)

Source: Nowe, Vrancx & De Hauwere 2012
Axes of MARL I

Centralized:

- One brain / algorithm deployed across many agents
Axes of MARL I

**Centralized:**
- One brain / algorithm deployed across many agents

**Decentralized:**
- All agents learn individually
- Communication limitations defined by environment
Axes of MARL II

Prescriptive:

- Suggests how agents should behave
Axes of MARL II

Prescriptive:
• Suggests how agents should behave

Descriptive:
• Forecast how agent will behave
Axes of MARL III

Cooperative: Agents cooperate to achieve a goal

• Shared team reward
Axe of MARL III

**Cooperative:** Agents cooperate to achieve a goal
- Shared team reward

**Competitive:** Agents compete against each other
- Zero-sum games
- Individual opposing rewards
Axes of MARL III

**Cooperative:** Agents cooperate to achieve a goal
- Shared team reward

**Competitive:** Agents compete against each other
- Zero-sum games
- Individual opposing rewards

**Neither:** Agents maximize their utility which may require cooperating and/or competing
- General-sum games
Axes of MARL IV

Numbers of agents:
- One (single-agent)
Axes of MARL IV

Numbers of agents:

- One (single-agent)
- Two (very common)
Axes of MARL IV

**Numbers of agents:**
- One (single-agent)
- Two (very common)
- Finite
Ages of MARL IV

**Numbers of agents:**
- One (single-agent)
- Two (very common)
- Finite
- Infinite
Transportation Problem
Thank you!