Distributed Artificial Intelligence
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Contents

1 Motivation

Where can DAI be applied?

- Smart Factory: How can processes be designed to coordinate and communicate with each other (in Webservices, IoT)?
- Autonomous Control: Switch from hierarchical, centralized structure to distributed, decentralized control of processes (Package delivery).

2 Agents and agent interaction

An agent is the basic building block fo an AI system.

Properties of an intelligent agent

A weak notion of Agency

- Autonomy: makes own decisions, env influences the decisions
- Reactivity: perceives env and adapts behaviour
- Pro-activity: has goals, takes initiative to achieve them
- Social ability: interaction (eg exchange info, ask for help,...)

Agent interactions with the environment

Perception (Sensors) $\rightarrow$ Decision $\rightarrow$ Action (Effectors). Reactive Agents (Decide according to inputs from env and try to match conditions). Environment $E = e_0, e_1, ...$ is a set of env states. Agent actions $Ac = a, a', ...$ is a set of all actions that changes the Environment state . Ac_i is the set of actions the Agent i can perform. Agent Function Ag $Ag : E \rightarrow Ac$.

- R
- R^{Ac}
- R^{E}

Refined Ag = <see, action, next> Perception, Internal state transition, Action

- see: filter env to perception
- next: current state and perception to new state
- action: map internal state to actions

Communication between Agents

When agents have common goals or intentions they should interact, eg transport service.

Message Passing

Speech-Act Theory (augment communication with info about how to interpret messages):

- Speaker: Wants hearer to believe in info. Chooses language. Forms message.
- Hearer: Perceives message (w/ disturbance). Analyses possible meanings. Interprets and chooses a meaning. Decides to belive the info or rejects

Three parts of a Speech-Act:

- Locutionary act: meaningful words
- Illocutionary act: intention
- Perlocutionary act: effect of the intention

Classification:

- Representatives: notification
- Directives: request, order
- Commissives: promise
- Expressives:
- Declarations: directly changes the env

3 Coordination mechanisms and mechanism design

4 Deliberative agents and knowledge representaion

5 Norms, trust and reputation into control intelligent distributed systems

6 Distributed reinforcement learning