Seminar 4 – Agents and Multi-Agent Systems

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Agents:

An agent is anything that can make decisions. It carries out tasks and actions and delivers an outcome with the best consideration possible. An AI system contains an agent and its environment. An agent interacts with their environment using sensors, cameras, and other external factors. An intelligent agent is an autonomous entity which act upon an environment using sensors and actuators for achieving goals. An intelligent agent may learn from the environment to achieve their goals. A thermostat is an example of an intelligent agent [2].

Diagram, line chart

Description automatically generated

An agent and their environment [1].

Multi-Agent Systems:

As you might expect, a multi-agent system is a system that contains multiple agents. These agents can interact and communicate [4]. Multi-Agent Systems (MAS) are useful as often they can out preform single agents as an MAS is capable of more difficult and more advanced tasks.

Question:

1. What are the different types of agents?

* Simple Reflex Agents
* Model-Based Reflex Agents
* Goal-Based Agents
* Utility-Based Agents
* Learning Agent

1. What is some example of Agents?

* A software agent has Keystrokes, file contents, received network packages which act as sensors and displays on the screen, files, sent network packets acting as actuators.
* A Human agent has eyes, ears, and other organs which act as sensors and hands, legs, mouth, and other body parts acting as actuators.
* A Robotic agent has Cameras and infrared range finders which act as sensors and various motors acting as actuators.

1. How does an Agent interact with their environment?

* **Perception:** This refers to when an agent passively interacts with their environment. By this, I mean that the agent may interact with the environment but not change it. An example of this could be an infrared camera. The agent may use this to scan the surrounding area but will not change anything by doing so.
* **Action:** This is when an agent actively interacts with their surroundings by changing and reacting to it. A simple example is if the agent has a robotic arm that can move something. They will then change the environment and then react accordingly [3].

1. What are the advantages of a Multi-Agent approach?

* An MAS distributes computational resources and capabilities across a network of interconnected agents. Whereas a centralized system may be plagued by resource limitations, performance bottlenecks, or critical failures, an MAS is decentralized and thus does not suffer from the "single point of failure" problem associated with centralized systems.
* An MAS allows for the interconnection and interoperation of multiple existing legacy systems. By building an agent wrapper around such systems, they can be inporporated into an agent society.
* An MAS models problems in terms of autonomous interacting component-agents, which is proving to be a more natural way of representing task allocation, team planning, user preferences, open environments, and so on.
* An MAS efficiently retrieves, filters, and globally coordinates information from sources that are spatially distributed.
* An MAS provides solutions in situations where expertise is spatially and temporally distributed.
* An MAS enhances overall system performance, specifically along the dimensions of computational efficiency, reliability, extensibility, robustness, maintainability, responsiveness, flexibility, and reuse [5].

1. What are the characteristics of an Intelligent agent?

* Adaptation based on experience
* Real time problem solving
* Analysis of error or success rates
* The use of memory-based storage and retrieval [6].

References:

[1] <https://www.geeksforgeeks.org/agents-artificial-intelligence/>

[2] <https://www.javatpoint.com/agents-in-ai>

[3] <https://www.educba.com/agents-in-artificial-intelligence/>

[4] <https://mitpress.mit.edu/books/multiagent-systems-second-edition>

[5] <https://www.cs.cmu.edu/~softagents/multi.html>

[6] <https://searchenterpriseai.techtarget.com/definition/agent-intelligent-agent#:~:text=Common%20characteristics%20of%20intelligent%20agents,memory%2Dbased%20storage%20and%20retrieval>.