Collaborative Discussion 1: Agent Based Systems

Discussion Topic: Agent Based Systems

Discuss what has led to the rise of agent-based systems and the benefits that this approach can offer to organisations. Discussion should include at least three references.

Learning Outcomes

- An understanding of the motivations for, and appropriate use of, agent-based computing.
- An understanding of the main agent models in use today and their grounding in artificial intelligence research.

Initial Post.

by Anastasia Rizzo - Tuesday, 9 May 2023, 6:30 PM

Number of replies: 2

Agent-based systems have gained immense popularity in various fields, including space exploration, ocean research, and medicine. These systems comprise autonomous agents that can interact with their environment, make decisions, and perform tasks without human intervention. The emergence of agent-based systems is attributed to their ability to enhance efficiency, accuracy, and safety in complex and dynamic environments (Wilensky & Rand, 2015). In this Collaborative Discussion, the reasons behind the rise of agent-based systems and the benefits that this approach can offer to organisations will be explored.

The first example of agent-based systems that will be considered is their application in space exploration. NASA's Autonomous Flight Safety System (AFSS) is an agent-based system that monitors and controls the trajectory of space rockets during ascent. The system employs agents to autonomously detect and respond to potential hazards in real-time. The use of agent-based systems in space rockets offers several benefits, including improved reliability, efficiency, and safety. With autonomous agents responsible for monitoring and controlling rocket trajectories, the risk of human error is reduced, resulting in improved launch accuracy and precision. Moreover, these systems

can help organisations optimise rocket performance and reduce launch costs, leading to more successful and cost-effective space missions overall (Bull & Lanzi, 2007).

The second example will be examined is the REMUS AUV, an agent-based system used in ocean research. The REMUS AUV operates autonomously and adaptively with a combination of sensors, computer vision, and machine learning algorithms. The use of agent-based systems like the REMUS AUV has several advantages in the underwater world. They can collect data on underwater environments and ecosystems with various sensors and instruments, allowing scientists to gain a comprehensive understanding of the marine environment. Agent-based systems can adapt their behaviour to respond to changing environmental conditions, enabling efficient and cost-effective data collection without human intervention. The flexibility and adaptability of these systems make them an invaluable tool for ocean study (Woods Hole Oceanographic Institution, 2023).

The third example will be explored is the Virtual Cell (VCell), an agent-based software platform used in medicine and biology. VCell enables scientists to develop computational models of biological systems, such as cells and tissues, and simulate their behaviour with great accuracy. The main advantage of using VCell and other agent-based systems in medicine and biology is the ability to simulate complex biological processes that would be difficult or impossible to study experimentally. This allows researchers to test hypotheses and explore different scenarios in a controlled environment, leading to the development of new treatments and therapies for diseases, optimization of drug dosages, and identification of potential side effects before they occur in clinical trials. Furthermore, agent-based systems can help to personalise healthcare, as researchers can create simulations tailored to individual patients based on their genetic and other biological data (vcell.org, 2023).

In conclusion, agent-based systems have emerged as a powerful and versatile approach to solving complex problems across a range of domains, from space exploration to ocean research and medicine. The ability of these systems to autonomously adapt and learn from their environment, as well as simulate and predict complex behaviours, offers significant benefits to organisations seeking to improve efficiency, safety, and cost-effectiveness (O’Sullivan et al., 2012). As technology continues to evolve, we can expect to see even more advanced agent-based systems emerge, opening up new opportunities for innovation and discovery in fields ranging from healthcare to transportation and beyond.

References:

Bull, J.B. & Lanzi, R.J. (2007). An Autonomous Flight Safety System. Available from: https://ntrs.nasa.gov/citations/20080044860 [Accessed 8 May 2023].

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Peer Response: Three pitches of salt for the balance

by Vasilisa Lukashevich - Friday, 12 May 2023, 12:44 PM

Given that critical thinking is a vital skill for students to learn and implement, I intend to supplement every demonstration of outstanding agent-based system examples with a critical perspective to highlight the potential limitations of AI implementation in each of the above areas.

The main problem for applying AI in NASA's Autonomous Flight Safety System is the need to ensure that the system operates reliably and safely. Firstly, as Yampolskiy asserts (2019), the field of AI Safety is relatively young. Secondly, to make AI algorithms highly robust and resilient to unexpected events or anomalies during spaceflight, extensive testing and validation are required under a wide range of conditions and scenarios. As anyone who has experimented with Machine Learning algorithms may say, most of them exhibit high accuracy only after undergoing multiple rounds of training. Hence, in real unpredictable situations, AI may not be the optimal decision.

One of the principal issue with AI models being applied in ocean research, particularly in the context of Unmanned Maritime Vehicles (UMVs) technology like REMUS, is the lack of standardization and interoperability between different AI models. Numerous scholars are attempting to address and solve this problem. Moreover, as mentioned by Costanzi

et al. (2020), the underwater domain presents considerable challenges that cannot be resolved with the solutions developed for terrestrial networks.

A crucial issue with AI models in VCell projects is the challenge of accurately capturing the complexity of biological systems, because these systems are highly dynamic and can exhibit emergent behaviors that are difficult to predict or explain. Liu et al. (2022) proposed hybrid modelling for biological systems. The group of researchers pointed out that mainstream modeling work has focused on fragments of biological systems, such as individual signaling networks, gene regulatory networks, metabolic networks, etc., which does not provide a complete view of the whole system. To obtain a holistic understanding of cellular behavior, scholars aim to integrate the fragments into a more comprehensive model that represents the system's behavior as an ensemble.

References:

Yampolskiy, R. (2019) Unpredictability of AI. arXiv preprint arXiv:1905.13053. Available from: https://arxiv.org/abs/1905.13053 [Accessed 12 May 2023].

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Liu, F., Heiner, M. & Gilbert, D. (2022) Hybrid modelling of biological systems: current progress and future prospects. Briefings in Bioinformatics, 23(3), p.bbac081.