Vraj Patel (301384968)
Dhruv Patel (301385233)

MATH 301 (Game Theory) - Final Project Topic

Topic: The Use of Utility Theory in Artificial Intelligence

Basic Outline:

1. Introduction to Utility Theory
   - In artificial intelligence, utility functions are used to measure the preferences of an AI agent, enabling it to choose options that maximize its expected utility [1], [2].
2. Fundamental Concept of Utility Theory
   - Explanation of the utility function and its significance in decision-making [5].
3. Utility Theory in AI Applications
   - The AI system selects the action that offers the greatest expected utility as the best option. Some examples are **Self-Driving cars** and **Recommendation Systems**, and **Reinforcement Learning** [3], [4].
4. Mathematical Framework
   - One of the fundamental concepts in utility theory in artificial intelligence is the idea of Maximum Expected Utility (MEU).
   - We will discuss about Utility Theory Axioms - Orderability, Transitivity, Continuity, Substitutability, Monotonicity and Decomposability [5].
5. Practical Implementation
   - We will try to implement a small example, preferably with the means of coding in Python to demonstrate the use of Utility Theory in AI.

References

[1] M. Shakerinava and S. Ravanbakhsh, “Utility Theory for Sequential Decision Making,” Jun. 2022, Accessed: Nov. 17, 2023. [Online]. Available: https://ar5iv.labs.arxiv.org/html/2206.13637

[2] Q. Yang and R. Liu, “Understanding the Application of Utility Theory in Robotics and Artificial Intelligence: A Survey,” Jun. 2023, Accessed: Nov. 17, 2023. [Online]. Available: https://arxiv.org/pdf/2306.09445.pdf

[3] G. Bontempi, “Between Accurate Prediction and Poor Decision making: the AI/ML Gap (position paper),” Nov. 2022, Accessed: Nov. 17, 2023. [Online]. Available: https://ar5iv.labs.arxiv.org/html/2310.02029

[4] R. Tansuchat and O. Kosheleva, “How to Make Recommendation Systems fair: an Adequate utility-based Approach,” Asian Journal of Economics and Banking, vol. 6, no. 3, pp. 308–313, Apr. 2022, Accessed: Nov. 17, 2023. [Online]. Available: https://www.emerald.com/insight/content/doi/10.1108/AJEB-03-2022-0031/full/pdf

[5] S. Russel and P. Norvig, Artificial intelligence: a Modern approach., 3rd ed. Prentice Hall, 2020, pp. 610–644.