MORL: Initial Assessment

Jeremiah Greer

Introduction

Reinforcement Learning is one of the primary areas currently being explored in research related to Machine Learning, Neural Networks, and Deep Learning. Often this type of learning involves "learning" multiple tasks in order to reach the desired functionality, and these multiple tasks are generally defined as trying to optimize multiple objective functions at once. Modern methods for optimizing these multi-objective functions usually involve taking a linear combination of the reward terms, basically combining the functions into one via a linear combination. One area that so far has not been tested in these methods are Filter Methods, which are a method of optimizing multi-objective functions. We seek to design and test a filter method which can adequately train a network in Reinforcement Learning. By drawing upon our previous experience with Data Analytics and Machine Learning, we hope to extend our own understanding of these areas and contribute to them.

Experiences

The experiences I've gained in my curriculum will help to contribute to this project in many ways. CS 5152, Intelligent Data Analysis, has given me a wide breadth of knowledge and tools with which I may be able to analyze data, as well as an introduction into neural networks and machine learning as a whole. This knowledge will directly benefit me in my dive into Reinforcement Learning and Multi-Objective Optimization. In addition, CS 7001, an independent study which turned into a Deep Learning seminar, helped to work as a deep-dive into the areas of neural networks, allowing me to analyze modern open-source literature on these areas using the Deep Learning Book. This spurred off my own personal study on Coursera of Machine Learning and Neural Networks with Andrew Ng and Geoffrey Hinton, respectively. The knowledge I've gained from these experiences will prove to be invaluable in understanding future material and work.

My co-op experiences will also help to contribute to this learning. In particular, my time at the University of Cincinnati as a Student Researcher under Dr. Rozier contributes immensely to my current ability as a researcher and as a Data Scientist. In this co-op, I worked extensively in Python, gaining an intuitive grasp on what it's like to perform data analytics in the language. In addition, it improved my ability to self-educate and perform research, two areas which will prove to be critical in this project, as a large part of it is education and research to understand exactly what we need to do. I had another co-op at Kinetic Vision as a Software Developer, and in this co-op I primarily developed VR applications using Unity and C#, while also gaining some design skills to help improve the visual fidelity of my work. This co-op, while not specifically related to Machine Learning, did give me the skills necessary to bring my work up to an acceptable level to present to others as well as manage various projects. These two skills will assist me in my effort to get our project to a presentable state, as well as improving how we work on the project going forward, both as individuals and as a group. I don't seek to maintain leadership in the project, but I will be happy to help work to keep everything organized.

Motivation and Methodology

I look forward to this project primarily because I'm excited to get a chance at becoming familiar with modern Deep Learning concepts, tools, and datasets. I have a strong interest in machine learning and I believe that it will continue to be a fruitful area of the future. I'm also excited because this project particularly entails multi-objective learning, something which encompasses a lot of areas, including teaching robots to walk like humans. Replicating organic life behavior through simulations and robotics is immensely interesting to me, and I feel that this will help me to develop a reasonable understanding of this area as a result. In order to develop this understanding, I must first become fairly acquainted with these areas for the project. Doing so will help to prepare me for the actual project and enable me to structure it in such a way that is understandable to others and hopefully successful.

In researching the aforementioned areas, we hope to better understand the current state of research in these topics. We plan to accomplish this by discovering baseline tutorials for these concepts to gain a familiarity with the vocabulary and concepts, then read the current literature on these areas to get an idea of what the most current practices are. After getting ourselves up to speed, we will start working with the tools we'll need to use to gain familiarity with them, then begin discussing and testing

some possible designs for Filter Methods to use and how to best implement them. This will finally result in the visualization of the training of the dataset and a formalization of our process and results presented in a poster and potentially a publication. The project will be completed once we've achieved a consistent, stable result with which we can use as a solid test result. We will evaluate our results by comparing them with current modern methods utilizing different means of multi-objective optimization on the same dataset.