CS 5180 Project Proposal

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Team Members:

The team is formed with two members, Zhida Zhang who is pursuing a graduate degree in Master of Science in Robotics concentrating in mechanical engineering and Meishan Li who is also studying Robotics targeting computer science in graduate school. The team members will divide labor equally among the following tasks, topic researching, environment testing, algorithm development, advanced environment and algorithm development and final presentation preparation.

Project Topic:

The team considers working on the BipedalWalker-v2 environment from OpenAI organization which can be processed through Python as a framework under OpenAI.gym module. It is a classic bipedal robot walker with 2 joints for each leg, a total of 4 joints. The real-life example for this project would be a bipedal humanoid robot named Atlas developed by Boston Dynamics.

Brief Introduction:

The main problem of this project is that the robot to be trained to select correct actions to stand up and eventually start to walk in an environment with a slightly uneven horizontal terrain. This is a Markov-decision-process (MDP) because the robot needs to choose a suitable action at each step under the current policy. Moreover, the agent receives a positive reward with respect to the distance walked on the terrain. A total of 300+ reward will be received if it walked all the way till the end. However, the agent will get a reward of -100 if it tumbles. There is also some negative reward proportional to the torque applied on the joint. As a result, the agent needs to apply optimal action to learn to walk smoothly and efficiently to receive more points. According to OpenAI Gym BipedalWalker-v2, state consists of hull angle speed, angular velocity, horizontal speed, vertical speed, position of joints and joints angular speed, legs contact with ground, and 10 lidar rangefinder measurements. The team members will study and understand how these parameters change would affect the decision making of the agent.

Idea Outcome:

The ideal outcome of this project is to train the robot to start walking first, then train it to walk quickly and efficiently to the end. Lastly, if time permits, the team plans to train it to jump over obstacles and land.

Potential Algorithms:

The team has not decided which algorithm to use in our project. After some research, the team found the following algorithms might be useful for the project: Natural Evolution Strategies (NES) algorithm, Genetic algorithm, Augmented Random Search (ARS)

algorithm and advantage Actor Critic(A2C) algorithm and so on. In a few weeks, the team members will try to learn, test, and finally implement some of the algorithms to our project and try to get the best results.

Milestones:

According to the plan, the team will finish relevant research on the BipedalWalker-v2 by 11/16 and learn about potential algorithms (mentioned in Potential Algorithms part). The team members will find out how these algorithms work, test and compare them, and select the most effective algorithm for our project.

Week-by-Week Plan:

Week 1 11/1-11/7	Topic research, algorithm research
Week 2 11/8-11/14	Test Environment, learn and algorithms
Week 3 11/15-11/21	Compare and find out most effective algorithm, implement algorithms
Week 4 11/22-11/28	Test, Debug, compare results
Week 5 11/29-12/6	Develop advanced environment and algorithm (If possible)
Week 6 12/7	Final Presentation