

PROJECT PROPOSAL

Team Members:

Our team consists of 2 members – **Jitesh Sonkusare and Neeraj Sahasrabudhe**. We have intentionally chosen not to have a clear division of labor. Instead, we prefer to collaborate closely throughout the project. This approach allows us to work together seamlessly, brainstorm ideas collectively, and address errors and challenges collaboratively as they arise. We believe that this collaborative spirit enhances our ability to adapt to changing project dynamics and fosters a creative and agile work environment, which is particularly well-suited to our project's needs.

Problem Statement in detail:

Warehouses play a crucial role in modern supply chains, and the ability of robots to navigate them optimally is vital for increasing productivity and reducing operational costs. Leveraging RL techniques to automate and improve warehouse navigation offers a promising avenue for innovation. The primary idea of the project is to deploy reinforcement learning algorithms for mobile robots deployed in a warehouse environment. We plan to define a custom environment of a warehouse in which a mobile robot would act as the agent. The robot in the simulated environment must collect the required materials from designated locations and deliver them to the goal. To complete this task, the agent must produce an optimal policy that minimizes time and distance.

What is the ideal outcome of the project? What do you expect to show?:

Automating warehouse operations through the utilization of various Reinforcement Learning (RL) techniques for optimizing a robot's pathfinding process, and subsequently, comparing this performance with conventional algorithms such as BFS and A* to determine the most efficient path

Algorithms

We plan to implement the following algorithms:

- 1) Monte Carlo Methods
- 2) Temporal Difference (TD) Learning
- 3) Q-Learning
- 4) Deep Q-Learning

What topics/libraries/platforms, if any, will you have to learn in order to undertake your project? Provide references where applicable

To complete this project, we would need to learn Goal-oriented RL, Deep RL, etc. As of now, we will be referring to this research paper but, in the future, we will need to refer more-

- 1) <https://www.mdpi.com/1424-8220/20/19/5493>
- 2) <https://arxiv.org/pdf/2202.10019.pdf>
- 3) <https://ai.plainenglish.io/reinforcement-learning-in-the-warehousing-industry-a5e7f1c28422>

Apart from this, we would also need to explore gym environments from OpenAI.

What domain(s) will you be working on? Is there a simulator available? If not, will you making a new one? If the latter, do you have the resources/data to do so?

We would be majorly working on domains of reinforcement learning and deep learning. We would be defining our custom environment using OpenAI Gym.

We have also identified a GitHub repo consisting of an implementation of a warehouse environment in OpenAI Gym: https://github.com/mickjigar/ip_gym_wh1

Project Timeline:

- 1) Week 1 - Reading research papers related to our project + start solving the problem statement using conventional algorithms like – BFS, A*, or Dijkstra, start working on RL algorithms side by side.
- 2) Week 2 – Try writing the env, agent for solving the problem using Deep RL.
- 3) Week 3 – Debug the errors that occurred in week 2 plus start working on env, and agent for other RL algorithms (yet to decide between Monte Carlo, TD learning or something new that we would come across during our project).
- 4) Week 4 – Debug any errors from week 2 and week 3 and prepare presentation slides.