

# CM2302 - Individual Project - 40 Credits

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Initial Plan

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## Simulating a Robot Swarm in a Factory Setting and evaluating effective path finding methods.

### 1. Project Description.

In recent years the model that supermarkets use to get business from their customers has changed drastically. This started with allowing customers to pick out their shopping orders online and then “pickers” working in supermarkets would collect the items off the shop floor and pack the customers shopping for them before loading these orders into delivery trucks to be delivered to the customer.

This was a massive change to traditional shopping and soon became incredibly popular. This left supermarket chains with both massive opportunities and challenges. The idea of having local pickers worked well at first due to having low initial setup costs and also low traffic, however as the number of customers that wanted to use the delivery service increased it became difficult to keep up with demand. Human pickers were collecting and packing items too slowly and also it was duplicating work for the supermarket as products were being loaded onto shelves and then picked up.

The solution for this was to move from a system that utilised human pickers navigating a human environment and instead move towards a robotic system that would allow much faster picking times and also reduce work duplication. What this meant was huge warehouse spaces designed primarily for robots to navigate were constructed.

The aim of this project is to produce a simulation of this robot swarm that would move across a simulated warehouse space and fill customer orders. This project will explore the effect that different path finding algorithms have on the performance of the robots to maximise efficiency gained using robot workers.

## 2. Project Aims and Objectives.

### Aim:

The aim for this project is to build a simulation of a robot swarm picking products for customer orders in a simulated warehouse. With a focus on showing how different path find algorithms can affect the overall performance of the swarm.

### Objectives:

1. Carry out research into existing algorithms used in multi agent path finding and also into the Mesa Library which is a python library built around multi agent based modelling.
2. To set up a simulated environment that can show the movement of robots around it. And can show details about the action the robot is carrying out, for example travelling, picking up an item or dropping off an item. It should also show what order a given robot is currently working on.
3. The robots will not only work on one order at a time they will work together as a swarm to fulfil customer orders in an efficient way.
4. Implement different path finding algorithms to find the one that works most efficiently for the simulation and allow the user to select between different options to show this change in efficiency.
5. Users viewing the simulation will be able to interact with the simulation, they will be able to add custom orders for the system to fulfil and track it's progress. They will be able to view information about a specific individual agent, what it's currently working on.

### 3. Work Plan.

Date	Tasks	Milestones
Week 1: 31st Jan - 4th Feb	<ul style="list-style-type: none"> <li>• Create initial plan for the project</li> <li>• Research into possible implementations</li> </ul>	<ul style="list-style-type: none"> <li>• Initial Plan</li> </ul>
Week 2: 7th Feb - 11th Feb	<ul style="list-style-type: none"> <li>• <b>Submit Initial Plan</b></li> <li>• More research into Mesa Library for python</li> <li>• Research into possible visualisations to use.</li> <li>• Review meeting on Wednesday the 9th of February</li> </ul>	<ul style="list-style-type: none"> <li>• Should have at this point a good understanding of how the simulation will be presented.</li> </ul>
Week 3: 14th Feb - 18th Feb	<ul style="list-style-type: none"> <li>• Start by creating a swarm with no object that moves within the visualisation.</li> <li>• Plan out attributes for the bots to have and how to define these in the library, I.E colour of the bot to show current task.</li> <li>• Decide on the types of products that would be picked, some robots should be designed to only be able to pick certain types of products.</li> </ul>	
Week 4: 21st Feb - 25th Feb	<ul style="list-style-type: none"> <li>• Work on a routine to generate custom orders for the simulation to fulfil.</li> <li>• Research and prototyping path finding algorithms for an individual bot.</li> <li>• Research into existing multi agent path finding algorithms and then implementing them with a small number of bots.</li> </ul>	
Week 5: 28th Feb - 4th March	<ul style="list-style-type: none"> <li>• Start to implement different path finding algorithms</li> </ul>	
Week 6: 7th March - 11th March	<ul style="list-style-type: none"> <li>• Continue to implement different path finding algorithms</li> <li>• Review meeting to discuss the implemented path finding approaches.</li> </ul>	
Week 7: 14th March - 18th March		

Week 8: 21st March - 25th March	<ul style="list-style-type: none"> <li>• Research a way of measuring performance for the different path finding techniques.</li> <li>• Setup a way for the user to choose which algorithm to use for the simulation.</li> </ul>	<ul style="list-style-type: none"> <li>• Should have tables and graphs showing relative performance of different path finding algorithms.</li> </ul>
Week 9: 28th March - 1st April	<ul style="list-style-type: none"> <li>• Setup the bots to being to fulfil customer orders</li> <li>• Add functionality for the user to be able to add in custom orders.</li> <li>• Review meeting to showcase the working visualisation and to discuss any insight my supervisor has into enhancing it.</li> </ul>	<ul style="list-style-type: none"> <li>• Working visualisation of the bots filling orders</li> </ul>
Week 10: 4th April - 8th April	<ul style="list-style-type: none"> <li>• Easter Break - Will plan to take this time as a break however if the project is taking longer then expected can use this flex time to continue working on the pathfinding implementation.</li> </ul>	
Week 11: 11th April - 15th April		
Week 12: 18th April - 22nd April		
Week 13: 25th April - 29th April	<ul style="list-style-type: none"> <li>• Analyse strengths and weakness of the project</li> <li>• Find areas where the project could be improved and either implement or consider why they were not implemented.</li> <li>• Using the parts of the report written during the course of the project finish a rough draft of the overall report</li> <li>• Get the report fully ready for submission</li> <li>• Review meeting to go over any areas of the report that I feel are weaker and get any final feedback notes from my supervisor.</li> </ul>	<ul style="list-style-type: none"> <li>• Fully written draft report</li> </ul>
Week 14: 2nd May - 6th May		
Week 15: 9th May - 13th May	<ul style="list-style-type: none"> <li>• Finalise Report</li> <li>• <b>Submit Final Report</b></li> </ul>	<ul style="list-style-type: none"> <li>• Final Report</li> </ul>