Task 3 (10 marks) - Autonomous Robot navigation:

For the final lab assessment, you will work in pairs to design, implement, and document software for autonomous navigation of a simulated mobile robot towards a target within a map of randomly generated obstacles. Your program will utilise the Python robotics library and basics of python programming covered in previous labs to achieve the following objectives:

a) Allow user input to initialise the robot's start coordinates, target coordinates, and number of obstacles in the map. In addition to any custom variables required.
b) Calculate and continue to update both the angle and distance between the robot and a randomly placed target within a 20m by 20m map.
c) Acquire and process the feedback from a simulated distance sensor to find out the coordinates of nearby randomly placed obstacles within the map.
d) Define the logic to implement appropriate manoeuvres to prevent collision with the obstacles until the robot reaches its target.
e) display a map showing the robot, random obstacles, target, and any additional useful outputs, in order to visualise the robot's locomotion towards its target.

The Python code will be submitted online via Moodle by 21/04/22 with a link to a personal GitHub repository that contains the code and documentation explaining its operation. The GitHub documentation should cover the following aspects:

a) Demonstrate collaboration and contribution of team members.
b) Definition of user inputs required to run the code and expected outputs.
c) Declare software versions and any dependencies required to run the code.
d) Explain the functionality of the code and the thought process behind its operating principle. Include a flowchart summarising the operating logic implemented in the code.
e) Discuss the results with supporting graphics from simulation.
f) Highlight areas for innovation achieved to improve the performance of autonomous navigation, as well as areas for further improvement.

The following marking scheme will be used to evaluate your submission:

<table>
<tr><th></th><th>Task Completion</th><th>Code quality</th><th>Documentation</th></tr>
<tr><td></td><td>out of 40%</td><td>out of 40%</td><td>out of 20%</td></tr>
<tr><td>0% to 40%</td><td>Tasks are not attempted or have major technical errors.</td><td>Unclear structure, missing function definitions and comments</td><td>Missing or mostly incomplete documentation</td></tr>
<tr><td>40% to 50%</td><td rowspan="2">Progress made with all tasks, but robot doesn't reach its target or collides with obstacles in some instances.</td><td rowspan="2">Appropriate use of variables and function definitions to maintain code efficiency and structure.</td><td>Completed documentation detailing functionality</td></tr>
<tr><td>50% to 60%</td><td>+ Correct and clear flowchart summarising code operation</td></tr>
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60% to **70%**	All tasks completed. Robot reaches target with no collision.	**+** Clear structure with supporting comments to aid readability.	+ Clear formatting with supporting media for a rich documentation
70% to **100%**	Demonstrating innovation to handle increased task complexity (e.g. multiple targets or more obstacles)	**+** Robust implementation. Task still completed with varying inputs (e.g. starting/target location).	+ Critical discussion highlighting areas for innovation and future work to address limitations

Best wishes