535.622 - Robot Motion Planning
Final Project

Department of Mechanical Engineering
Engineering for Professionals Program
Johns Hopkins University

Project Policy:

- All external references must be cited following the "IEEE Citation Reference."
- All code should be written in MATLAB unless written approval is provided from the course instructor.
- Use of code found online or from other sources is not permitted without written approval from the course instructor.
- Collaboration of any kind is not permitted without written approval from the course instructor..
- The final project must be submitted via email to your instructor prior to **11:59 PM on the final day of the course. Late submissions will not be accepted.**
- The final project report must consist of:
  - A working copy of all functions required for the final project (excluding internal/embedded MATLAB functions),
  - A script to run and visualize the results of each method explored,
  - A final report (PDF or MS Word format), and
  - A signed cover letter (see below).

Name: ______________________________

Date: ______________________________

Sign below prior to handing in your completed project. This sheet should be scanned and turned in as part of the final project packet. Signing indicates that you have adhered to all aspects of the project policy stated above.

Signature: ______________________________

- All methods implemented in this project should be capable of accepting the following input arguments (where applicable):
  - A - a 2xN array containing x and y coordinates of the robot's vertices relative to a body fixed reference frame located at $[0, 0]$.
  - B - a 1xM cell array whose elements represent individual obstacles within a world frame located at $[0, 0]$.
    * $B\{i\}$ - a 2xK array containing x and y coordinates of the ith obstacle's vertices relative to a world frame located at $[0, 0]$.
  - q_{init} - a 3x1 array containing the initial position and orientation of the robot.
  - q_{goal} - a 3x1 array containing the goal position and orientation of the robot.

- Generated/output trajectories should discretized to accurately illustrate the movement of the robot in both position and orientation. It is recommended that the output q_{path} linking q_{init} to q_{goal} have the following format:
  - q_{path} - 3xN array containing points (position and orientation) along the path such that:
    * $q_{path}(:, 1) = q_{init}$
    * $q_{path}(:, end) = q_{goal}$
    * q_{path} =[ ] indicates no path linking q_{init} to q_{goal} exists

Three distinct path planning methods (your choice) should be implemented and will be scored as follows:

1. **Method I**
   (a) (15 points) Implement a path planning method adhering to the constraints described above.
   (b) (5 points) Incorporate some element or elements of this method outside of those implemented as part of the homework assignments. These can include variations on planning methods, alternate planning methods, different (applicable) weighting functions, etc.
   (c) (10 points) Document your method in one page or less. Include all relevant citations, pseudocode and equations where applicable, and a figure (or figures) of the results. If you are including methods not covered as part of the homework, clearly explain them in this part.
2. **Method II**
   (a) (15 points) Implement a path planning method adhering to the constraints described above.
   (b) (5 points) Incorporate some element or elements of this method outside of those implemented as part of the homework assignments. These can include variations on planning methods, alternate planning methods, different (applicable) weighting functions, etc.
   (c) (10 points) Document your method in one page or less. Include all relevant citations, pseudocode and equations where applicable, and a figure (or figures) of the results. If you are including methods not covered as part of the homework, clearly explain them in this part.
3. **Method III**
   (a) (15 points) Implement a path planning method adhering to the constraints described above.
   (b) (5 points) Incorporate some element or elements of this method outside of those implemented as part of the homework assignments. These can include variations on planning methods, alternate planning methods, different (applicable) weighting functions, etc.
   (c) (10 points) Include/incorporate a planning that utilizes both position and orientation to circumvent obstacles.
   (d) (5 points) Include/incorporate a planning that utilizes kinematic driving constraints of a two-wheeled, differential drive vehicle. This method should account for both position and orientation to circumvent obstacles.
   (e) (10 points) Document your method in one page or less. Include all relevant citations, pseudocode and equations where applicable, and a figure (or figures) of the results. If you are including methods not covered as part of the homework, clearly explain them in this part.

**This project will be scored out of a total of 100 points with a total of 105 points available.*