# EN.530.663: Robot Motion Planning
# Homework 8

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Out: 03/29/2024;
Due: 04/05/2024, midnight ET

*This is exclusively used for Spring 2024 EN.530.663 RMP students, and is not to be posted, shared, or otherwise distributed.*

**1** Write a Matlab function code for ClosestPointOnTriangleToPoint. Or, you can write ClosestPointOnTriangleToOrigin function, which means the point is the origin in the latter function. The specification of the code is the following:

- The input includes:
  - A $2 \times 3$ array that contains the coordinates of the vertices of the triangle.
  - If you consider a general point (other than the origin), then a $2 \times 1$ array for the point is required for ClosestPointOnTriangleToPoint. If you are to write ClosestPointOnTriangleToOrigin, then you don't need this as input.
- The output includes:
  - A $2 \times 1$ array that contains the coordinates of the closest point (this is the default output).
  - Optionally, type of the Voronoi region, and other outputs as you feel necessary for using this function in Problem 2.

Specifically,

- Implement:
  **function** [closest_pt, ... ] = ClosestPointOnTriangleToPoint(vertices, pt)
  - vertices: a $2 \times 3$ array of the coordinates of the triangle vertices.
  - pt: a $2 \times 1$ array of the coordinate of the point.
  - closest pt: a $2 \times 1$ array of the coordinate of the closest point. Please make it the **first output** of your function.
  - You can add other outputs if necessary
- Or you can implement:
  **function** [closest_pt, ... ] = ClosestPointOnTriangleToOrigin(vertices)

**2** Write a Matlab function code for the GJK algorithm, GJKalg_2D. The specification of the code is the following:

- The input includes:
  - Two convex polygons $A$ and $B$: specifically, each input is a $2 \times n_i$ array ($n_i$ being the number of vertices of the polygon $i$ ($i = A, B$)).
- The output includes:
  - Distance between $A$ and $B$

Specifically,

- implement:
  **function** [distance, ...] = GJKalg_2D(A, B)
  - A: a $2 \times n_A$ array of the coordinates of the vertices of polygon A
  - B: a $2 \times n_B$ array of the coordinates of the vertices of polygon B
  - distance: the distance between A and B

You can use the Minkowski difference $C = A \ominus B$ in your function code (as in the pseudocode in the GJK algorithm document), or use the suggestion in Section 1.3 in it. The function in Problem 1 should be used in Problem 2.
**Please also provide a script that you use to test both of your functions.** If your function fails our test cases, you can still get partial credits.

## Submission Guideline

- Submit all your Matlab codes in a single .zip file. Name your single zip file submission as "YourName_HW8.zip". For example, "JinSeobKim_HW8.zip" for a single zip file. Submission will be done through the Gradescope.

- Please make sure to include *all the necessary files*. If TAs try to run your function and it does not run, then your submission will have a significant points deduction.

- Make as much comments as possible so that the TAs can easily read your codes.