# EN.530.663: Robot Motion Planning
# Homework 7

### Jin Seob Kim, Ph.D.
### Senior Lecturer, ME Dept., LCSR, JHU

### due: 03/31/2021, Wednesday midnight to Gradescope

*This is exclusively used for Spring 2021 EN.530.663 RMP students, and is not to be posted, shared, or otherwise distributed.*

## Problems

1. Write a Matlab function code for ClosestPointOnTriangleToPoint. Or, you can write ClosestPointOn-TriangleToOrigin 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 ClosestPointOnTriangle-ToOrigin, 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_HW7.zip". For example, "JinSeobKim_HW7.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.