COT 4521: Intro. to Computational Geometry (Fall 2020)

Worksheet 1

Ground Rules

This assignment is intended to be solved within your group. However, you must submit your own answers. For all questions we expect you to show yours work!

Submission

Upload your answers and associated work to canvas as a single scanned, typed, or photographed PDF document. Be sure that your submission is legible.

Assignment Instructions

1. For each of the following triangles, where $\{p_1, p_2, p_3\}$:

$$T_1 = \{\{2,3\},\{5,6\},\{3,5\}\}$$
$$T_2 = \{\{3,2\},\{1,6\},\{4,4\}\}$$
$$T_3 = \{\{1,3\},\{5,9\},\{3,6\}\}$$

   (a) Draw the triangles

   (b) Calculate the vectors: $\overrightarrow{A} = \overrightarrow{p_1p_2}; \overrightarrow{B} = \overrightarrow{p_1p_3}$

   (c) Calculate the angle between the following 2 vectors, $\angle \overrightarrow{A}\,\overrightarrow{B}$ using the:

   - difference between 2 angles approach
   - dot product approach
   - cross product approach

   (d) Determine the orientation (clockwise or counterclockwise) of the following triangles.

2. Perform the following linear interpolations:

$$A = 2; B = 5; \alpha = 0.4$$
$$A = \{1,6\}; B = \{4,4\}; \alpha = 0.7$$
$$A = \{5,6\}; B = \{5,9\}; \alpha = 0.2$$

3. Answer the following questions about complexity:

   - Does $2^{n+1} = O(2^n)$? If not, what does it equal?
   - Does $2^{2n} = O(2^n)$? If not, what does it equal?
   - Generally speaking, what is the complexity of an algorithm that runs a single loop through n data?
   - Generally speaking, what is the complexity of an algorithm with nested loops, each running through n data?
   - Generally speaking, what is the complexity of tree operations (insert, remove, search) on a binary search tree? On a self-balanced binary tree?