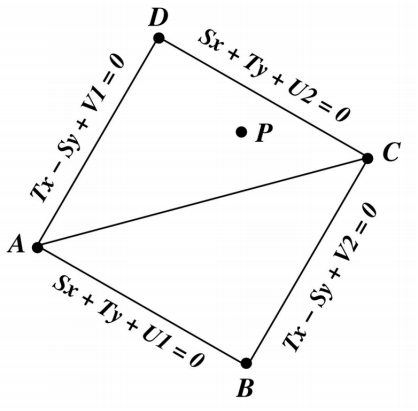
PDS Lab - Section 9

Assignment 2

January 20th, 2020

Consider a square in the two-dimensional plane. Let us call the vertices of the square A, B, C and D. Write a program to do the following tasks. All coordinates are assumed to be floating-point values. Special cases need to be handled (see below).



1. The square is specified by its diagonal AC. The user supplies the x- and y-coordinates (floating-point values) of A and C.

2. Compute the other two vertices B and D of the square. Call any of the two vertices other than A and C as B, and the other gets the name D. This computation requires the perpendicular bisector of AC. Proceed as in the Tutorial Problem. Now, you have to additionally handle the case that AC is a horizontal line segment. Alternatively, you may use simple trigonometric techniques to deduce the co-ordinates of the vertices B and D. Print all the four corners of the square.

3. Express the equations of the four sides of the square as shown in the figure above. More precisely, compute the values of S, T, $U1$, $U2$, $V1$ and $V2$. Notice that the sides may be parallel to the x- or y-axis. For a vertical line, take $T = 0$. For a non-vertical line, take $T = 1$ (in this case, compute m and l such that $-mx + y - l = 0$). Print the equations of the four sides.

4. Read the coordinates of a point $P = (h, k)$ from the user. Your task is to find out whether P lies inside the square (as shown in the figure), or outside the square, or on the boundary of the square. In order to do so, evaluate the left hand sides of the equations of the four sides at (h, k). That is, compute $Sh + Tk + U1$, $Th - Sk + V2$, and so on. The signs of these four quantities determine the location of P. For example, if $Sh + Tk + U1$ and $Sh + Tk + U2$ are non-zero and have opposite signs, then P lies between the two lines AB and CD. Similarly, if $Th - Sk + V1$ and $Th - Sk + V2$ are non-zero and have opposite signs, then P lies between the lines AD and BC. If both the conditions are satisfied, then P is inside the square. Find out the conditions for the other two possibilities.

Sample Output:

```
Ax = 1
Ay = 3
Cx = 5
Cy = 3
The four corners of the square are:
A = (1.000000,3.000000)
B = (3.000000,5.000000)
C = (5.000000,3.000000)
D = (3.000000,1.000000)
The four sides of the square are:
AB: -1.000000 x + 1.000000 y - 2.000000 = 0
BC: 1.000000 x + 1.000000 y - 8.000000 = 0
CD: -1.000000 x + 1.000000 y + 2.000000 = 0
DA: 1.000000 x + 1.000000 y - 4.000000 = 0
Enter the coordinates of P:
h = 0
k = 0
+++ P lies outside the square
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