Exercise 1: Morphology
Part A

-1 = background, 1 = object pixel

Original

-1	-1	1	1	1	1	1	-1	-1	1
-1	1	1	1	-1	1	1	1	-1	1
1	1	1	-1	1	-1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	-1	1	-1	-1	1	1	1	-1	1
1	-1	1	-1	-1	1	-1	-1	1	1
1	1	1	1	1	1	-1	1	1	1
-1	-1	1	1	1	-1	1	1	1	1
1	1	1	1	-1	1	1	1	-1	-1
1	1	1	1	1	1	1	1	-1	-1

Erosion - First Element

-1	1	-1
1	O	1

First Element

-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	1	-1	-1	-1	1	-1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1	-1
-1	1	1	-1	1	-1	1	1	1	-1
-1	-1	-1	-1	-1	-1	1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	-1	1	-1	-1	-1	1	1	-1
-1	-1	1	-1	-1	-1	1	-1	-1	-1
-1	1	1	1	-1	1	1	-1	-1	-1

Opening(Erosion -> Dilation) - First Element

-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	1	1	1	-1	1	1	1	-1	-1
1	1	1	-1	-1	-1	1	1	1	-1
1	1	1	1	1	1	1	1	1	1
-1	1	1	-1	1	1	1	1	1	-1
-1	-1	-1	-1	-1	-1	1	-1	-1	-1
-1	1	1	1	-1	-1	-1	1	1	1
-1	-1	1	1	1	-1	1	1	1	1
-1	1	1	1	-1	1	1	1	1	-1
1	1	1	1	1	1	1	1	-1	-1

Dilation - Second Element

O	1
1	1

Second Element

1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	-1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	-1	-1
1	1	1	1	1	1	1	1	-1	-1

Closing (dilation->erosion) - Second Element

1	1	1	1	1	1	1	1	1	-1
1	1	1	1	1	1	1	1	1	-1
1	1	1	1	1	1	1	1	1	-1
1	1	-1	-1	1	1	1	1	1	-1
1	1	-1	-1	1	1	1	1	1	-1
1	1	1	1	1	1	1	1	1	-1
1	1	1	1	1	1	1	1	1	-1
1	1	1	1	1	1	1	-1	-1	-1
1	1	1	1	1	1	1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Part B

Before Erosion

1	1	1	1	-1	-1	1	1	1
1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1
1	1	1	1	-1	-1	1	1	1

After Erosion

-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	1	1	1	-1	-1	1	1	-1
-1	1	1	1	-1	-1	1	1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1

Mask

-1	1	-1
1	O	1
-1	1	-1

Exercise 2: Hausdorff Distance
Part A

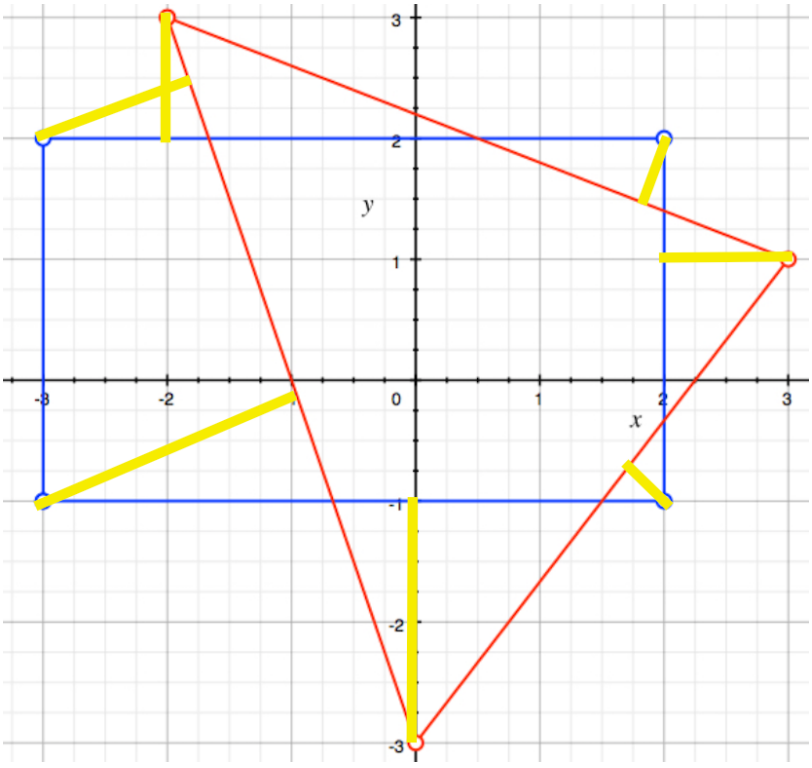
A(-2,3), B(3,1), and C(0,-3)
D(-3,2), E(2,2), F(2,-1), and G(-3, -1)
S1={A, B, C} and S2={D, E, F, G}

h(S1, S2) = max_s1(min_s2 (d(s1, s2)))
min (d(A, s2)): sqrt(1^2 + 1^2) = sqrt(2)
min (d(B, s2)): sqrt(1^2 + 1^2) = sqrt(2)
min(d(C, s2)): sqrt(2^2 + 2^2) = sqrt(8)
h(S1, S2) = max_s1(min(…)) = sqrt(8)

h(S2, S1) = max_s2(min_s1 (d(s1, s2)))
min (d(D, s1)): sqrt(2)
min (d(E, s1)): sqrt(2)
min(d(F, s1)): sqrt(1^2 + 2^2) = sqrt(5)
min(d(G, s1)): sqrt(3^2 + 2^2) = sqrt(13)
h(S2, S1) = max_s2(min(…)) = sqrt(13)

H(S1,S2) = max(h(S1,S2), h(S2,S1)) = **sqrt(13)**

Part B



h(S1, S2) = max_s1(min_s2 (d(s1, s2)))
min (d(A, s2_polygon))

min (d(B, s2_polygon))
min(d(C, s2_polygon))
h(S1, S2) = max_s1(min(…)) = d(C, S2_polygon) = 2

h(S2, S1) = max_s2(min_s1 (d(s1, s2)))
min (d(D, s1_polygon))
min (d(E, s1_polygon))
min(d(F, s1_polygon))
min(d(G, s1_polygon))
h(S2, S1) = max_s2(min(…)) = d(D, s1_polygon) = sqrt(2^2 + (3/4)^2) = sqrt(73)/4 ~ 2.13

H(S1,S2) = max(h(S1,S2), h(S2,S1)) = **sqrt(73)/4 ~ 2.13**

Exercise 3: Edge Detection

Todo