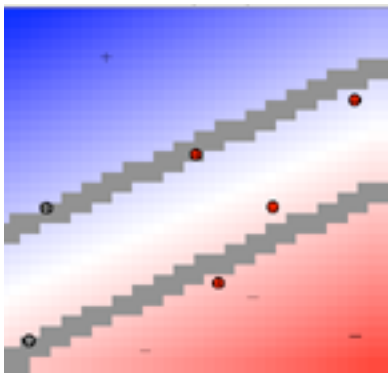
Final Exam 2002 Problem 6: Support Vector Machines (14 Points)

Part A: (2 Points)

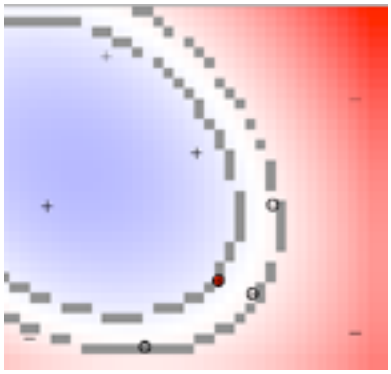
The following diagrams represent graphs of support vector machines trained to separate pluses (+) from minuses (-) for the same data set. The origin is at the lower left corner in all diagrams. Which represents the best classifier for the training data? ***See the separate color sheet for a clearer view of these diagrams.***

Indicate your choice here: ☐

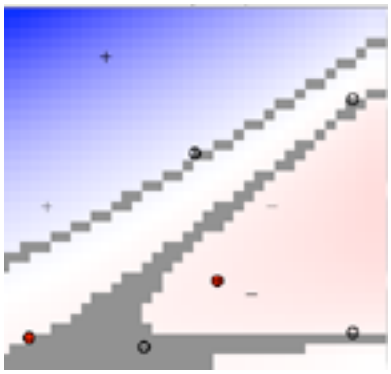
A.



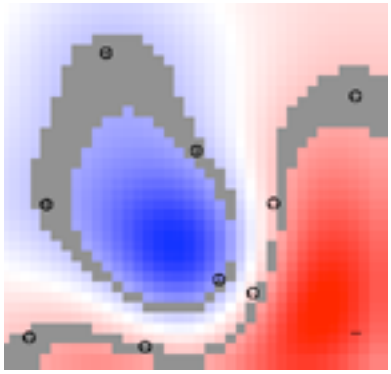
B.



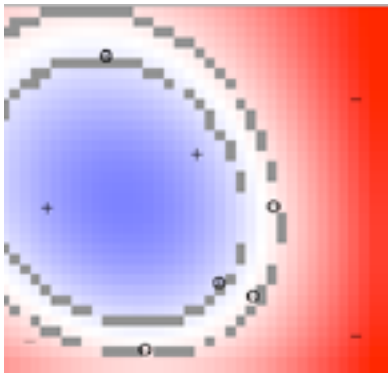
C.



D.



E.



Part B: (5 Points)

Match the diagrams in Part 1 with the following kernels:

Radial basis function, sigma .08 ☐

Radial basis function, sigma .5 ☐

Radial basis function, sigma 2.0 ☐

Linear ☐

Second order polynomial ☐

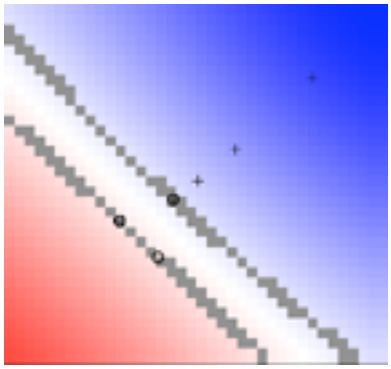
Part C: (3 Points)

Order the following diagrams from ***smallest*** support vector weights to ***largest*** support vector weights, assuming all diagrams are produced by the same mechanism using a linear kernel (that is, there is no transformation from the dot-product space).

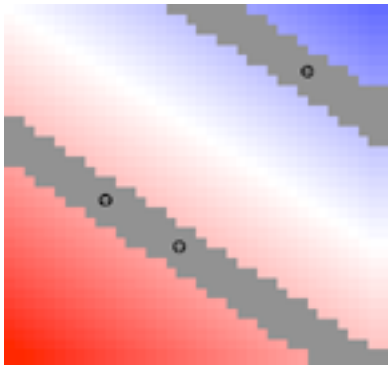
The origin is at the lower left corner in all diagrams. Support vector weights are also referred to as α_i values or LaGrangian multipliers. ***See the separate color sheet for a clearer view of these diagrams.***

Smallest ☐ ***Medium*** ☐ ***Largest*** ☐

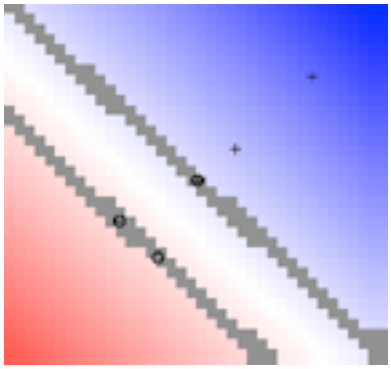
A.



B.



C.



Part D (4 Points)

Suppose a support vector machine for separating pluses from minuses finds a plus support vector at the point $\mathbf{x_1} = (1, 0)$, a minus support vector at $\mathbf{x_2} = (0, 1)$.

You are to determine values for the classification vector ***w*** and the threshold value *b*. Your expression for ***w*** may contain $\mathbf{x_1}$ and $\mathbf{x_2}$ because those are vectors with known components, but you are not to include any α_i or y_i. Hint: think about the values produced by the decision rule for the support vectors, $\mathbf{x_1}$ and $\mathbf{x_2}$.

w ☐

b ☐