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 $a_i$ values or Lagrangian multipliers. See the separate color sheet for a clearer view of these diagrams.

<table>
<thead>
<tr>
<th>Smallest</th>
<th>Medium</th>
<th>Largest</th>
</tr>
</thead>
<tbody>
<tr>
<td>[image]</td>
<td>[image]</td>
<td>[image]</td>
</tr>
</tbody>
</table>

A. [image]  
B. [image]  
C. [image]

Part D (4 Points)

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

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

$w$

$w$

$b$

$b$