CS559: Machine Learning Name:

Review Session on SVM

First, you work on these questions by yourself.
Second, you discuss these questions with your peers in a group (2-3).
Third, reflect and revise your answers.

1. **Linear Classifiers and Perceptron**
    1. What is the general form of a linear classifier's decision boundary in $\mathbb{R}^d$?
    2. Perceptron classifier computes a nonlinear combination of features. (True of False)
    3. What is the main limitation of Perceptron?
    4. Why does the Perceptron algorithm potentially take longer to converge when classes are closer together?
2. **Vector Algebra and Geometric Concepts**
    1. What does the vector $\mathbf{w}$ represent with respect to a hyperplane?
    2. What is the signed distance from a point $\mathbf{x}$ to the hyperplane $\mathbf{w}^\top \mathbf{x} + b = 0$?
    3. Any points lying on the decision hyperplane satisfy $\mathbf{w}^\top \mathbf{x} + b = 1$. (True of False)
3. **Optimization and the Margin Maximization Problem**
    1. What does the constraint $y_i(\mathbf{w}^\top \mathbf{x}_i + b) \geq 1$ guarantee for all training points?
    2. What is the loss for SVM? is it a convex loss?
4. **Lagrange Multipliers and Dual Form**
    1. What is the purpose of introducing Lagrange multipliers in the SVM optimization?
    2. The dual form of the SVM problem contains explicit references to $\mathbf{w}$ and b. (True of False)
    3. What role do support vectors play in determining the final decision boundary?
5. **Non-separable Case and Slack Variables**
    1. What are slack variables ξ_i used for in SVMs?
    2. Larger γ values encourage smoother decision boundaries. (True of False)
6. **Nonlinear SVMs and the Kernel Trick**
    1. What is a kernel function in the context of SVMs?
    2. Give two common examples of valid kernel functions.