Consider 3 weight vectors with 3 dimensions:

$w_1 = <1.0, -2.0, 0.5>$

$w_2 = <0.1, -0.2, 0.05>$

$w_3 = <100.0, -200.0, 50.0>$

On a training dataset, they give the following errors:

$L(\mathbf{w_1}) = 10.0$

$L(\mathbf{w_2}) = 100.0$

$L(\mathbf{w_3}) = 8.0$

1. Calculate the L2 norm of each weight vector.

$||\mathbf{w_1}|| = ?$

$||\mathbf{w_2}|| = ?$

$||\mathbf{w_3}|| = ?$

Assume you apply L2 regularization, where you minimize the combined function:

$L(\mathbf{w}) + \lambda R(\mathbf{w})$, where $R(\mathbf{w}) = \|\mathbf{w}\|$.

(Note: more often, the *squared* L2 norm is used for L2 regularization, but here let's use the L2 norm without squaring it).

2. For each of the 3 weight vectors, and each of the following values of λ, calculate the value of the function, $L(\mathbf{w}) + \lambda R(\mathbf{w})$.

	λ=0.001	λ=0.1	λ=100.0
$\mathbf{w}_1$	?	?	?
$\mathbf{w}_2$	?	?	?
$\mathbf{w}_3$	?	?	?

3. Based on your answer to Question 2, for each value of λ, say which weight vector is optimal.

For each one, say whether you think it is overfitting, underfitting, or neither. (There is no single best answer here.)

λ=.001: ?

λ=0.1: ?

λ=100: ?

3. Assume you are using an SVM. Calculate the margin for each weight vector.

Margin with $\mathbf{w_1}$: ?

Margin with $\mathbf{w_2}$: ?

Margin with $\mathbf{w_3}$: ?

5. Discuss how adjusting λ adjusts the tradeoff of bias and variance.