Exercise: Generalization

Links:

- Task1: Multiple choice
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Task1: Multiple choice

Question 1.1

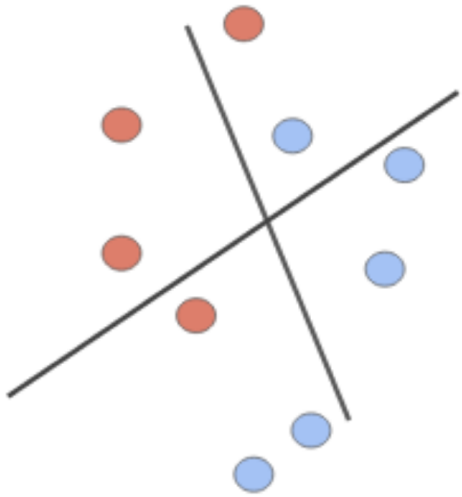
What does this represent?

Options:

1. A model
2. An example
3. A hypothesis
4. In-sample

Question 1.2

What is an effect of choosing the best (in-smaple) from two hypothesis?



Options:

1. Out-of-sampe error decrease
2. Lower probability of generalization
3. In-sample error increase
4. Higher probability of generalization

Question 1.3

Which statement is true?

$$\hat{y} = sign(ax^3 + bx + c)$$
$$\hat{y} = sign(ax + c)$$

Options:

1. $ax^3 + bx + c$ have a larger hypothesis space
2. $ax^3 + bx + c$ have a smaller hypothesis space
3. Their hypothesis space is of the same size

Question 1.4

Which statement is true?

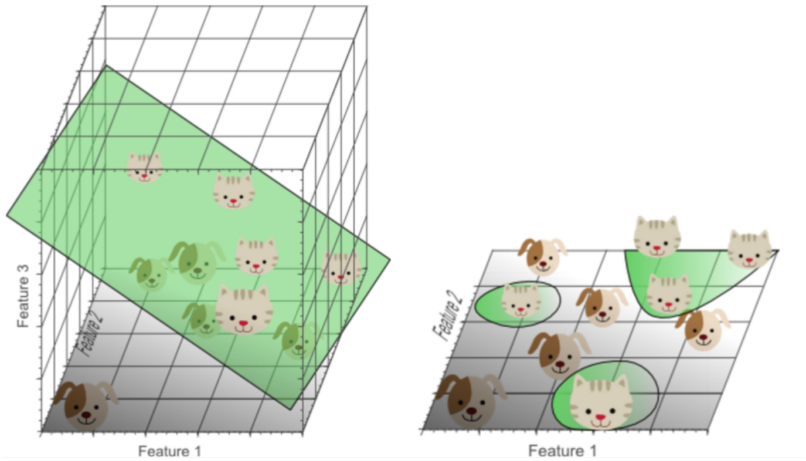
$$\hat{y} = sign(ax^2 + c)$$
$$\hat{y} = sign(ax + c)$$

Options:

1. $ax^2 + c$ have a larger hypothesis space
2. $ax^2 + c$ have a smaller hypothesis space
3. Their hypothesis space is of the same size

Question 1.5

What is the VC dimension of a linear classifier in 3D (plane)



Options:

1. $d_{VC} = 3$
2. $d_{VC} = 4$
3. $d_{VC} = 7$
4. $d_{VC} = 8$

Question 1.6

What is the VC dimension of a n dimensional linear classifier?

Options:

1. $n + 1$
2. $n^2 + 1$
3. $n^2 - (n-1)^2 - 1$

Question 1.7

What is true about the VC dimension of a model?

Options:

1. A model with high VC dimension is more likely to underfit
2. More training examples will give a lower VC dimension
3. A higher VC dimension give a better classifier
4. A model with high VC dimension is more likely to overfit

Question 1.8

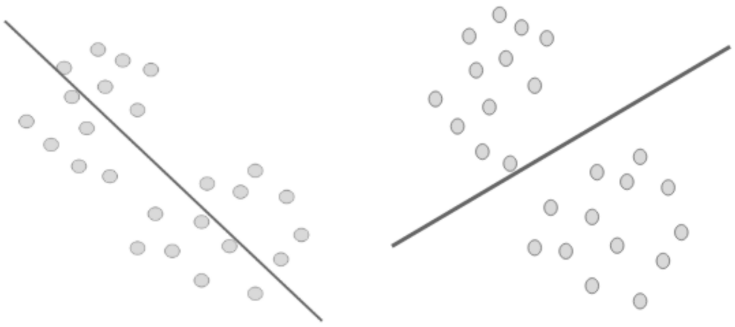
Will using the K-Nearest Neighbors classifier with k=1 imply:

Options:

1. Most likely to overfit
2. Most likely to underfit
3. Depends on the data

Question 1.9

Given an unknown class distribution, which line is probably the best classification boundary?

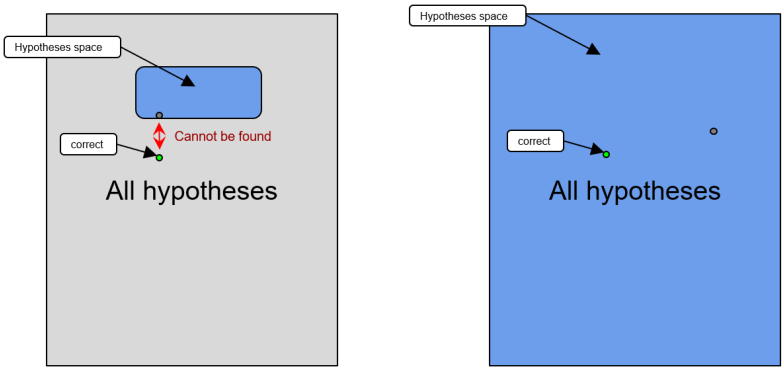


Options:

1. The left line
2. The right line
3. They are both equally good

Question 1.10

What effect does adding a regularization term has on the hypothesis space?



Options:

1. No effect
2. Decreasing the hypothesis space
3. Increasing the hypothesis space

Task2: Questions

Give short answers to the following questions.

Question 2.1

Early stopping is often used to prevent (limit) overfitting. Is the out-of-sample error estimate from the validation set a good estimate?

Answer:

The labelled data available is often spilt into a training set, a validation set and a test set. We use the validation set to find the best model by tuning parameters such as network architecture, learning rate, regularization coefficient, etc. Early stopping is an option for reducing overfitting. At the end, we choose the model with the lowest validation loss (error) as our model. This model is found by iteratively testing multiple hypotheses, and will be a too optimistic estimate of the true out-of-sample error. A better estimate would be to use the error from the test set.

Question 2.2

How can we improve the out-of-sample error when we have a small dataset only?

Answer:

We have a couple of options:

- Increase the size of the dataset by augmenting the data.
- Reduce the hypothesis space by including a regularization term in the cost function.
- Make it harder for the network to memorize the input data by using dropout.
- Use parts of a pre-trained network which are trained on a large dataset. The pre-trained network should have many general features and have been trained on a harder task.

