

Intelligent Interaction Pearl 2020-2021
Sample exam questions

Evaluation of performance

Assume we have trained a classifier on a training set, to recognize samples from class C1 and C2, and evaluated it on an independent test set. The following confusion matrix summarizes the results. Your task is to calculate different performance measures from the confusion matrix.

		Predicted class	
		C1	C2
True (ground truth)	C1	300	75
	C2	25	200

1. *What is the Accuracy?*
2. *What is the Precision for class C1?*
3. *What is the Recall for class C1?*
4. *What is the Precision for class C2?*
5. *What is the Recall for class C2?*

Recognition

A robot that navigates in a garden is equipped with a camera system to see what is in front of it. The robot is programmed to recognize roses, iris and violets, pick them up and store in different places. The term 'recognition' applies to this process (of recognizing different types of flower) but this term is rather general. Another, more specific term can be used here. From the following list, choose the term which best describes this type of pattern recognition.

- a) Classification
- b) Verification
- c) Clustering
- d) Identification
- e) Detection
- f) Authorization/Authentication

Model validation

You have trained a classification model and you observe that on your training data, you achieve a very low error (~1%). When you test your model on an independent test set, you achieve a test error of 25%. What do you infer from these results?

- a) The model overfitted the training data
- b) The model has good generalization
- c) The classifier is good: 75% on new data in a great result
- d) The error on the training set is very low: the classifier is robust

Discriminant functions

What is a discriminant function?

- a) a function that discriminate data samples from a data set
- b) a function that models the distribution of the samples in a given class, and computes a score for new samples to belong to that class
- c) a function that computes the Prior probability of a class
- d) a classifier that predicts the class of new samples
- e) a function that models the probability distribution of new data

Discriminant function (computation) and classification

Let us have two classes, that contains data samples that can be modeled by a one-dimensional Normal distribution.

We computed the mean and variance of the samples in the two classes, and their values are:

Class 1: mean $m_1 = -4$, variance $s_1^2 = 10$

Class 2: mean $m_2 = 5$, variance $s_2^2 = 10$

The two distributions have same prior probability $P(\text{Class 1}) = P(\text{Class 2}) = 0.5$.

- a) Compute the value of the decision criterion x^* .
- b) In which class do you classify the sample $x_1 = 0.9$?
- c) In which class do you classify the sample $x_2 = 0$?
- d) In which class do you classify the sample $x_3 = 3$?
- e) In which class do you classify the sample $x_4 = -2$?

Probability estimation – binary events

Assume that you have a rigged dice: out of six faces, it has one 1, one 2, one 3, two 4, and one 5. You roll the dice four times.

- a) What is the probability of obtaining exactly two 4?
- b) What is the probability of obtaining exactly four 2?

Probability estimation – Bayes

You are standing in the box of the accused, on trial for murder. You want to scream your innocence from the rooftops!

You happen to live in the city where the crime was committed, but so do 100,000 people --- any of them could be the murderer!

Still, the evidence against you is overwhelming: DNA was found at the scene of the crime, and it was tested to match your DNA. This is the only evidence against you, but an expert witness is called to testify, and she testifies that the test is extremely reliable. The true positive rate of the test is 1 (that is, if the DNA really matches, the test always reports a match), and the false positive rate of a DNA test is one in 1,000,000 (that is, if the DNA is not actually a match, the test will still report a match once every 1,000,000 tests).

From the jury's perspective, what is the (approximate) probability that you are the murderer?

- a. $999,999 / 1,000,000$
- b. $1 / 100,000$
- c. ~ 0.91
- d. ~ 0.85
- e. 0
- f. ~ 0.99