16-10-2020 - Pearls of Computer Science Core - Pearl 110 Intelligent Interaction

Course: B-CS-MOD01-1A-202001022 B-CS Pearls of Computer Science Core 202001022

Duration:	1 hour
Number of questions:	10
Generated on:	Oct 28, 2020

Contents: Pages:

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Number of questions: 10

You can score a total of 100 points for this exam, you need 55 points to pass the exam.

1
8 pt.

On recent mobile phones, a fingerprint scanner is used to recognize the user and unlock the device. The term 'recognition' applies to this process 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. Authorization/Authentication

b. Identification

c. Verification

d. Unsupervised learning

e. Falsification

f. Supervised learning

g. Detection

h. Classification

2
10 pt.

You have been accused of having robbed a security box worth a lot of money, and you are undergoing a trial for that. The robbery was done in a building where there were a total of 10000 people, and any of them could have done it. However, the evidence is against you as DNA traces that matched with your DNA have been found next to the security box.The results of the DNA test are used against you as evidence.
During trial, a biologist expert is called to testify, and he declares that the test has a true positive rate of 1, that is if there is a real DNA match (between the DNA collected and that of the accused person), the test is always correct. Anyway, the false positive rate is 1 out of 20000 tests (that is if there is not an actual DNA match, the test may still result as positive).
From the judge perspective, what is the (approximate) probability that you are the robber?

a. 1 / 3

b. 1 / 10000

c. 0.5

d. 19999 / 20000

e. 2 / 3

f. 1 / 20000

3
8 pt.

When we obtain training data for a certain classification task, we can represent the distribution of the data in different classes using discriminant functions. Why should we do that? What is the purpose of fitting the data with a discriminant function (e.g. a Gaussian function) that models its distribution?

a. It makes easier to make decisions on new samples

b. It allows to compute (estimate) a score for a new sample to belong to a certain class

c. It makes the model more mathematically sound

d. It allows to explain the decisions taken by a classifier

e. It allows to combine the classification results

f. It facilitates the computation of statistics

g. It allows to classify new samples

4
8 pt.

What are the steps of the typical workflow of a Machine Learning system? Order the blocks:

1	Pre-processing
2	Model training/Classification
3	Post-processing
4	Feature extraction
5	Sensing the world/Acquiring input data

5
8 pt.

AI systems are surrounded by discussions and concerns about their deployment in real-world, everyday tasks. One of these discussions is about the **fairness** of AI systems. What is the **fairness** of AI about?

a. Decisions should be taken by AI systems independently of sensitive features (e.g. religion, skin color, etc.)

b. AI systems are used by big-tech companies to make large profit and they do not take decisions that respect ethical principles

c. The data used for training are biased and this reflects in the decisions taken by AI systems

d. AI systems should not respect human decisions

e. AI system should use the data according to law

f. AI systems can take random decisions that can harm humans

6
8 pt.

You are assigned the task to design a classifier using the principles of the Bayes Decision Theory. In which case you can use the Naive Bayes approach to model the training data and estimate the class-conditional probabilities?

a. if the prior probability is equal for all the classes

b. when the decision boundary is linear

c. when modeling the data with a Normal distribution (Gaussian function)

d. if we assume that the prior probability of each class is lower than 0.5

e. if we assume that the posterior probability does not depend on the measured features

f. if we assume that the values of different features are independent from each other

7 Assume we have trained a classifier on a training set, to recognize samples from class C_1 and C_2, and evaluated 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		
		C_1	**C_2**	
True (ground truth)	**C_1**	40	10	
	C_2	15	35	

3 pt. **a.** What is the accuracy?

a. 0.7

b. 0.8

c. 0.75

d. 0.73

3 pt. **b.** What is the precision for the class C_1?

a. 0.73

b. 0.7

c. 0.78

d. 0.8

3 pt. **c.** What is the recall for the class C_1?

a. 0.73

b. 0.78

c. 0.7

d. 0.8

3 pt. **d.** What is the precision for the class C_2?

a. 0.78

b. 0.73

c. 0.8

d. 0.7

3 pt. **e.** What is the recall for the class C_2?

a. 0.78

b. 0.73

c. 0.8

d. 0.7

8 Let us consider two classes C_1 and C_2 that can be modeled as two one-dimensional Normal distributions with mean $m_1 = 1$ and $m_2 = -3$, and with standard deviations $\sigma_1 = \sigma_2 = \sqrt{2}$. The two distributions have same prior probability $P(C_1) = P(C_2) = 0.5$. We use the modeled distributions to design a classifier based on discriminant functions. Answer the following questions.

9 pt. **a.** What is the value of the decision criterion x*?

a. 1.5

b. 1

c. -0.5

d. 0

e. -1

3 pt. **b.** *How do you classify the point $x_1 = 0$?*

a. class C_1

b. class C_2

3 pt. **c.** *How do you classify the point $x_2 = -1.5$?*

a. class C_1

b. class C_2

9 In a bag we have 6 fair dice, of which one is a 6-sided dice, two are 8-sided dice, one is a 10-sided dice and two are 20-sided dice.
We pick a dice from the bag and roll it. The outcome of the experiment is 7.

3 pt. **a.** What is the probability that we picked the 6-sided dice?

a. 0.222

b. 0.555

c. 0.31

d. 0

3 pt. **b.** What is the probability that we picked the 8-sided dice?

a. 0.31

b. 0.555

c. 0.99

d. 0.222

3 pt. **c.** What is the probability that we picked the 10-sided dice?

a. 0.555

b. 0.222

c. 0.31

d. 0.99

3 pt. **d.** What is the probability that we picked the 20-sided dice?

a. 0.222

b. 0.99

c. 0.555

d. 0

3 pt. **e.** What is the most likely dice when we know that we have rolled a 7?

a. 6-sided

b. 20-sided

c. 8-sided

d. 10-sided

10
5 pt.

Given an unfair coin, for which the probability of tossing a tail is 0.7. What is the probability of obtaining exactly 7 tails out of 10 tosses?

a. 0.267

b. 1

c. 0.009

d. 0.333

e. 0.7

Thank you! This is the end of the Intelligent Interaction test (pearl 110).
Your answers have been saved and you will be notified about your grade after the exam team has checked your answers.

Please don't forget to fill in the evaluation form for this pearl!

Name:		Signature:	
Date:	/ /	Birth date:	/ /

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1 8 pt. A B C D E F G H

2 10 pt. A B C D E F

3 8 pt. A B C D E F G

4 8 pt. Answer:

5 8 pt. A B C D E F

6 8 pt. A B C D E F

7 15 pt.

a. A B C D

b. A B C D

c. A B C D

d. A B C D

e. A B C D

8 15 pt.

a. A ○ B ○ C ○ D ○ E ○

b. A ○ B ○

c. A ○ B ○

9 15 pt.

a. A ○ B ○ C ○ D ○

b. A ○ B ○ C ○ D ○

c. A ○ B ○ C ○ D ○

d. A ○ B ○ C ○ D ○

e. A ○ B ○ C ○ D ○

10 5 pt. A ○ B ○ C ○ D ○ E ○

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Correction model

1. A
8 pt.

2. E
10 pt.

3. B
8 pt.

4. What are the steps of the typical workflow of a Machine Learning system? Order the blocks:
8 pt.

5	Sensing the world/Acquiring input data
1	Pre-processing
4	Feature extraction
2	Model training/Classification
3	Post-processing

5. A
8 pt.

6. F
8 pt.

7. 15 pt.
a. 3 pt. C
b. 3 pt. A
c. 3 pt. D
d. 3 pt. A
e. 3 pt. D

8. 15 pt.
a. 9 pt. E
b. 3 pt. A
c. 3 pt. B

9. 15 pt.
a. 3 pt. D
b. 3 pt. B
c. 3 pt. B
d. 3 pt. A
e. 3 pt. C

10. A
5 pt.