

2021-10-25 - Pearls of Computer Science Core - Intelligent Interaction

Course: B-CS Pearls of Computer Science Module - 202001021/
202001022 – TEST 7

Welcome to the digital exam for Pearl 110 Intelligent Interaction

- You may use 1 A4 sheet (both sides) with your own notes for this test
- If you want scrap paper, ask the examination staff, you are not allowed your own scrap paper.
- Programmable or graphical calculators, laptops, mobile phones, books etc. are not allowed. Put those in your bag now (with the sound switched off)!
- You are allowed only one sheet of paper as 'cheat sheet'.
- Each question in this digital exam allows you to open the built-in scientific calculator of Remindo.

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.

What does the 'learning' in Machine Learning consist of? Select the correct answer:

- a.** The value of the parameters of a model are determined by means of an automatic mathematical optimization process, using training samples
- b.** The training samples are labeled in order to train a classifier
- c.** A machine scans the data acquired by sensors to find patterns of interest
- d.** The classifier chooses the type of discriminant functions to model the data samples
- e.** A machine understand the surrounding environment by means of sensors and takes actions accordingly
- f.** Intelligent algorithms process the data acquired by the sensors and provide predictions

2 We are at a funfair and want to play to a ‘target shooting’ game. The guy at the stand tells us the rules:

- we can choose either ‘Gun A’ or ‘Gun B’ to shoot
- if we choose ‘Gun A’, we win if we hit the target exactly 3 times out of 5 attempts
- if we choose ‘Gun B’, we win if we hit the target exactly 4 times out of 6 attempts

We have observed that ‘Gun A’ fails to shoot 2 out of 6 times, while ‘Gun B’ fails to shoot 1 out of 6 times.

We are very good shooters, meaning that when we shoot (i.e. the gun does not fail), we are certain to get the target (note that we do not make mistakes on purpose).

We are asked to choose the gun to play the game with.

5 pt. **a.** What is the probability that we hit the target exactly 3 times out of 5 attempts using Gun A? (Approximate to the second decimal digit)

- a.** 0.01
- b.** 0.08
- c.** 0.40
- d.** 0.33
- e.** 0.60

5 pt. **b.** What is the probability that we hit the target exactly 4 times out of 6 attempts using Gun B? (Approximate to the second decimal digit)

- a.** 0.25
- b.** 0.20
- c.** 0.08
- d.** 0.12
- e.** 0.35

2 pt. **c.** Given the probability computed above, which gun should we choose to play with?

- a.** Gun B
- b.** Gun A

- 3 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	18	25
	C_2	35	72

- 1 pt. a. What is the accuracy?
- a. 0.7
 - b. 0.56
 - c. 0.6
 - d. 0.8
 - e. 0.65
- 2 pt. b. What is the precision for the class C_1 ?
- a. 0.42
 - b. 0.34
 - c. 0.74
 - d. 0.88
 - e. 0.67
- 2 pt. c. What is the recall for the class C_1 ?
- a. 0.67
 - b. 0.42
 - c. 0.88
 - d. 0.34
 - e. 0.74

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

- a.** 0.34
- b.** 0.88
- c.** 0.42
- d.** 0.74
- e.** 0.67

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

- a.** 0.34
- b.** 0.88
- c.** 0.67
- d.** 0.42
- e.** 0.74

4 Select the correct statement about discriminant functions.

8 pt.

- a.** A discriminant function is equivalent to a probability density function.
- b.** A classifier computes the value of discriminant functions for each feature of the input samples.
- c.** Only monotonically increasing functions can be discriminant functions.
- d.** A discriminant function models the distribution of the samples in one class and is used to compute a score for new samples to belong to that class.
- e.** A discriminant function separates the feature space in two or more regions.

5 A self-driving car uses cameras to perceive the surrounding environment. The car is equipped with an AI system that analyses the acquired images and recognizes objects in the field of view as obstacles, which have to be avoided

8 pt.

The term 'recognition' applies to this process (of recognizing the objects in the field of view as obstacles) 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. Falsification
- b. Supervised learning
- c. Classification
- d. Verification
- e. Identification
- f. Detection
- g. Unsupervised learning
- h. Authorization/Authentication

6 All the kids of a neighborhood cannot go to school because they are sick. We know that 90% of them have the flu and the remaining 10% have the measles. The doctor that came to visit them knows that in 95% of measles cases, one of the symptoms is a skin rash. They also know that flu can have a skin rash as symptom in 8% of the cases.

4 pt. **a.** A kid has rash, what is the probability that it is caused by measles? Approximate the answer to the second decimal digit.

a. 0.27

b. 0.57

c. 0.43

d. 0.08

e. 0.95

f. 0.90

4 pt. **b.** A kid has rash, what is the probability that it is caused by the flu? Approximate the answer to the second decimal digit.

a. 0.43

b. 0.57

c. 0.27

d. 0.90

e. 0.08

f. 0.95

2 pt. **c.** Does the doctor diagnose the flu or measles?

a. measles

b. flu

7 Let us consider two classes that can be modeled as two one-dimensional Normal distributions with mean $m_1 = -6$ and $m_2 = 4$, with standard deviations $s_1 = s_2 = \sqrt{5}$. The two distributions prior probability are $P(C_1) = 0.75$ and $P(C_2) = 0.25$. Compute the value of the decision criterion x^* .

9 pt. a. What is the value of the decision criterion x^* ? (Approximate it to the 2nd decimal digit)

a. 0.55

b. 0

c. -0.45

d. 1

e. -1

f. 0.45

2 pt. b. How do you classify the point $x_1 = 0.3$?

a. C_1

b. C_2

2 pt. c. How do you classify the point $x_2 = -0.6$?

a. C_2

b. C_1

2 pt. d. How do you classify the point $x_2 = -2$?

a. C_1

b. C_2

8 In a bag we have 3 cubes. Each cube has six sides, colored using different colors. In particular they have the following structure:

- Cube1: 3 red sides, 2 yellow sides, 1 green side
- Cube2: 3 yellow sides, 3 green sides
- Cube3: 2 red sides, 2 yellow sides, 2 green sides

We pick a cube from the bag and show one of its sides to the people. The outcome is a 'red side'.

4 pt. **a.** What is the probability that we picked Cube1?

- a.** 0.1
- b.** 0.33
- c.** 0.6
- d.** 0.4
- e.** 0
- f.** 0.2

4 pt. **b.** What is the probability that we picked Cube2?

- a.** 0.1
- b.** 0.33
- c.** 0.2
- d.** 0
- e.** 0.6
- f.** 0.4

4 pt. **c.** What is the probability that we picked Cube3?

- a.** 0.33
- b.** 0.2
- c.** 0
- d.** 0.4
- e.** 0.1
- f.** 0.6

- 3 pt. **d.** What is the most likely cube that we have picked?
- a.** Cube3
 - b.** Cube1
 - c.** Cube2

9

8 pt.

One of the concerns around Artificial Intelligence and Machine Learning is the problem of the fairness of decisions. Select the correct statement about fairness of AI systems:

- a.** AI systems are used by big-tech companies to make large profit and they do not take decisions that respect ethical principles
- b.** Decisions should be taken by AI systems independently of sensitive features (e.g. ethnicity, religion, skin color, etc.)
- c.** Decisions of AI systems should be explainable according to human-like reasoning
- d.** AI system should use the data according to the law
- e.** The decisions of AI systems are taken by computing rigorous mathematical models
- f.** The data sets used for training are skewed and this reflects in the decisions taken by AI systems

10 Consider that you have an unfair dice. Its faces are: one 1, two 2, two 3, and one 4. You roll the dice four times.

3 pt. **a.** What is the probability of obtaining exactly four 4 out of the four rolls? Approximate your solution to the 3rd decimal digit.

- a. 0.001
- b. 0
- c. 0.148
- d. 0.296
- e. 0.245
- f. 0.05

3 pt. **b.** What is the probability of obtaining exactly two 2 out of the four rolls? Approximate your solution to the 3rd decimal digit.

- a. 0.05
- b. 0.296
- c. 0.148
- d. 0.245
- e. 0.001
- f. 0

1 pt. **c.** What is the probability of obtaining exactly one 6 out of the four rolls? Approximate your solution to the 3rd decimal digit.

- a. 0.148
- b. 0.245
- c. 0.001
- d. 0.05
- e. 0.296
- f. 0