Question Paper Preview

Notations :

1.Options shown in green color and with ✔ icon are correct.

2.Options shown in red color and with ✖ icon are incorrect.

Change Font Color :	No
Change Background Color :	No
Change Theme :	No
Help Button :	No
Show Reports :	No
Show Progress Bar :	No

MLF

Section Id :	640653124268
Number of Questions :	11
Section Marks :	40
Maximum Instruction Time :	0

Question Number : 1 Question Id : 6406531852138 Question Type : MCQ

Correct Marks : 0

Question Label : Multiple Choice Question

THIS IS QUESTION PAPER FOR THE SUBJECT "DIPLOMA LEVEL : MACHINE LEARNING FOUNDATIONS (COMPUTER BASED EXAM)"

ARE YOU SURE YOU HAVE TO WRITE EXAM FOR THIS SUBJECT?
CROSS CHECK YOUR HALL TICKET TO CONFIRM THE SUBJECTS TO BE WRITTEN.

(IF IT IS NOT THE CORRECT SUBJECT, PLS CHECK THE SECTION AT THE TOP FOR THE SUBJECTS REGISTERED BY YOU)

Options :

6406536003974. ✔ YES

6406536003975. ✖ NO

Question Number : 2 Question Id : 6406531852139 Question Type : MCQ
Correct Marks : 3
Question Label : Multiple Choice Question

Consider the function $f : \mathbb{R}^2 \to \mathbb{R}$ defined as $f(x, y) = x^2 + 2axy + 3y^2$. For what values of a is f convex?

Options :

6406536003976. ✔ $|a| \leq \sqrt{3}$

6406536003977. ✖ $|a| \leq 3$

6406536003978. ✖ $|a| \leq \frac{1}{3}$

6406536003979. ✖ $|a| \leq \frac{1}{\sqrt{3}}$

Question Number : 3 Question Id : 6406531852140 Question Type : MSQ
Correct Marks : 3 Max. Selectable Options : 0
Question Label : Multiple Select Question

Consider $A = \begin{bmatrix} 1 & i \\ -i & 1 \end{bmatrix}$

Which of the following is/are true?

Options :

6406536003980. ✔ A is Hermitian.

6406536003981. ✖ A is unitary.

6406536003982. ✔ A is positive semi-definite.

6406536003983. ✖ A is positive definite.

6406536003984. ✖ A is invertible.

Question Number : 4 Question Id : 6406531852141 Question Type : SA
Correct Marks : 3
Question Label : Short Answer Question

An ML team wants to predict whether an email is spam $(y = 1)$ or not $(y = 0)$ by using some classification models. Therefore, the team defines three binary features $x = [x_1, x_2, x_3]$ where,

- x_1 = Presence of suspicious keywords (1 = present, 0 = absent)
- x_2 = Whether the sender is unknown (1 = unknown, 0 = known)
- x_3 = Whether the email contains a link (1 = yes, 0 = no)

The team collects the following dataset from previously classified emails:

x	y
[1,0,1]	1
[0,1,0]	0
[1,1,0]	1
[0,0,1]	0

The model makes a prediction using the rule : $z = 0.3x_1 + 0.4x_2 - 0.7x_3$ and

$$u(z) = \begin{cases} 1, \text{ if } z \geq 0 \\ 0, \text{ otherwise} \end{cases}$$

Compute the average loss on this dataset. Enter your answer correct to one decimal place.
Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Range
Text Areas : PlainText
Possible Answers :
0.4 to 0.6

Question Number : 5 Question Id : 6406531852142 Question Type : SA
Correct Marks : 3
Question Label : Short Answer Question

Let X be a continuous random variable with the probability density function:

$$f_X(x) = \begin{cases} \frac{1}{2}(2-x), & 0 < x < 2, \\ 0, & \text{otherwise.} \end{cases}$$

What is the value of $E[3X]$?
Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
2

Question Number : 6 Question Id : 6406531852143 Question Type : SA
Correct Marks : 3
Question Label : Short Answer Question

A is a 5×5 matrix whose eigenvalues are $1, 2, 3, 4, 5$. Consider the set S as defined below:

$$S = \left\{ \frac{v^T A v}{v^T v} : \ v \text{ is an eigenvector of } A, v \in \mathbb{R}^5 \right\}$$

Find $\max(S) - \min(S)$.
Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
4

Question Number : 7 Question Id : 6406531852144 Question Type : SA

Correct Marks : 3

Question Label : Short Answer Question

Using the method of Lagrange multipliers, find a point on the circle centered at $(0,0)$ with radius $\sqrt{80}$ that is closest to the point $(1,2)$. If this distance is d^*, enter $(d^*)^2$ as your answer. Your answer should be an integer.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

45

Question Id : 6406531852145 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix Question Numbers : (8 to 10)

Question Label : Comprehension

A cafe records the time (in minutes) a customer waits for a freshly made sandwich. The waiting time X follows an exponential distribution with mean 5 minutes.

Based on the above data, answer the given subquestions.

Sub questions

Question Number : 8 Question Id : 6406531852146 Question Type : MCQ

Correct Marks : 3

Question Label : Multiple Choice Question

Find the waiting time k such that 95% of customers are served within k minutes.

Options :

6406536003989. ✖ $\frac{1}{5}(\ln 20)$

6406536003990. ✔ $5(\ln 20)$

6406536003991. ✖ $\frac{1}{5}(\ln 2)$

6406536003992. ✖ $5(\ln 2)$

Question Number : 9 Question Id : 6406531852147 Question Type : MCQ

Correct Marks : 2

Question Label : Multiple Choice Question

What is the probability that a randomly chosen customer waits between 10 and 15 minutes?

Options :

6406536003993. ✖ $e^{-3} - e^{-2}$

6406536003994. ✖ $1 - e^{-2}$

6406536003995. ✖ $1 - e^{-3}$

6406536003996. ✔ $e^{-2} - e^{-3}$

Question Number : 10 Question Id : 6406531852148 Question Type : SA
Correct Marks : 2
Question Label : Short Answer Question

Using Chebyshev's inequality, find an upper bound for $P(|\ X - \mu\ | \geq 8)$, where μ represents the mean of the random variable X. Enter your answer correct to two decimal places.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Range
Text Areas : PlainText
Possible Answers :
0.37 to 0.41

Question Id : 6406531852149 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix

Question Numbers : (11 to 13)

Question Label : Comprehension

Consider the following constrained optimization problem:

$$\begin{aligned} & \min \quad x^2 + y \\ \text{subject to} \quad & x^2 + y^2 \leqslant 2 \end{aligned}$$

Answer the sub-questions assuming that we take a very small step in the direction of interest.

Sub questions

Question Number : 11 Question Id : 6406531852150 Question Type : MSQ

Correct Marks : 2 Max. Selectable Options : 0

Question Label : Multiple Select Question

At the point $(1, 1)$, which of the following is/are descent directions for the objective function?

Options :

6406536003998. ✔ $(-2, 1)$

6406536003999. ✖ $(1, 1)$

6406536004000. ✔ $(1, -3)$

6406536004001. ✖ $(1, 2)$

Question Number : 12 Question Id : 6406531852151 Question Type : MSQ

Correct Marks : 2 Max. Selectable Options : 0

Question Label : Multiple Select Question

At the point $(1, 1)$, which of the following is/are feasible directions?

Options :

6406536004002. ✔ $(-2, 1)$

6406536004003. ✖ $(1, 1)$

6406536004004. ✔ $(1, -3)$

6406536004005. ✖ $(1, 2)$

Question Number : 13 Question Id : 6406531852152 Question Type : MCQ

Correct Marks : 1

Question Label : Multiple Choice Question

Is $(1,1)$ a potential candidate at which the problem could have a local minimum$^{?}$

Options :

6406536004006. ✖ Yes

6406536004007. ✔ No

Question Id : 6406531852153 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix

Question Numbers : (14 to 16)

Question Label : Comprehension

If $X \sim \text{Normal}(\mu, \Sigma)$ and $Y = AX$, where

$X = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix}, \mu = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \Sigma = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $A = \begin{pmatrix} 2 & 1 \\ 1 & 3 \end{pmatrix}$

Based on the above data, answer the given subquestions.

Sub questions

Question Number : 14 Question Id : 6406531852154 Question Type : MCQ

Correct Marks : 1

Question Label : Multiple Choice Question

What is the distribution of $2X_1$?

Options :

6406536004008. ✖ Normal$(2, 3)$

6406536004009. ✔ Normal$(0, 4)$

6406536004010. ✖ Normal$(0, 2)$

6406536004011. ✖ Normal$(2, 2)$

Question Number : 15 Question Id : 6406531852155 Question Type : MCQ

Correct Marks : 2

Question Label : Multiple Choice Question

What is the distribution of $W = X_1 + 2X_2$?

Options :

6406536004012. ✔ Normal$(0, 5)$

6406536004013. ✖ Normal$(0, 4)$

6406536004014. ✖ Normal$(0, 3)$

6406536004015. ✖ Insufficient information.

Question Number : 16 Question Id : 6406531852156 Question Type : MCQ

Correct Marks : 2

Question Label : Multiple Choice Question

Find the covariance matrix of Y.

Options :

6406536004016. ✔ $\begin{pmatrix} 5 & 5 \\ 5 & 10 \end{pmatrix}$

6406536004017. ✖ $\begin{pmatrix} 2 & 1 \\ 1 & 3 \end{pmatrix}$

6406536004018. ✖ $\begin{pmatrix} 3 & 1 \\ 1 & 2 \end{pmatrix}$

6406536004019. ✖ $\begin{pmatrix} 10 & 5 \\ 5 & 6 \end{pmatrix}$

Question Id : 6406531852157 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix

Question Numbers : (17 to 18)

Question Label : Comprehension

A company aims to minimize its production cost, represented by the following quadratic function: $f(x, y) = 3x^2 + 2xy + y^2$

The company applies the gradient descent algorithm to minimize this function, starting with an initial guess of $(x_0, y_0) = (1, 1)$ and using a step size (learning rate) of $\eta = \frac{1}{t+1}$, where $t = 0, 1, 2, \ldots$

Based on the above data, answer the given subquestions.

Sub questions

Question Number : 17 Question Id : 6406531852158 Question Type : MCQ

Correct Marks : 2

Question Label : Multiple Choice Question

Find the updated point (x_1, y_1) after the first iteration of the gradient descent algorithm.

Options :

6406536004020. ✖ $(7, 3)$

6406536004021. ✔ $(-7, -3)$

6406536004022. ✖ $(-7, -17)$

6406536004023. ✖ $(8, 4)$

Question Number : 18 Question Id : 6406531852159 Question Type : SA

Correct Marks : 3

Question Label : Short Answer Question

Compute the value of $f(x, y)$ after the second iteration, i.e., $f(x_2, y_2)$.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

1154