Question Number : 400 Question Id : 640653611320 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Which of the following statement is/are true in context of lighthouse?

Options :

6406532041579. ✖ “First contentful paint” for a webpage is the size of the smallest visible element on a webpage.

6406532041580. ✔ “First contentful paint” for a webpage is the time the browser takes to paint the first visible content on the webpage.

6406532041581. ✔ “Largest contentful paint” for a webpage is the time the browser takes to paint the largest visible content on the webpage.

6406532041582. ✖ “Largest contentfull paint” for a webpage is the size of the largest visible content on the webpage.

MLF

Section Id :	64065341318
Section Number :	15
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	18
Number of Questions to be attempted :	18
Section Marks :	50
Display Number Panel :	Yes
Section Negative Marks :	0
Group All Questions :	No
Enable Mark as Answered Mark for Review and	Yes

Clear Response :

Maximum Instruction Time : 0

Sub-Section Number : 1

Sub-Section Id : 64065388123

Question Shuffling Allowed : No

Is Section Default? : null

Question Number : 401 Question Id : 640653611330 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

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 :

6406532041619. ✔ YES

6406532041620. ✖ NO

Question Number : 402 Question Id : 640653611331 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 0

Question Label : Multiple Choice Question

Discrete random variables:

Distribution	PMF ($f_X(k)$)	CDF ($F_X(x)$)	$E[X]$	$\mathrm{Var}(X)$
Uniform(A) $A=\{a,a+1,\ldots,b\}$	$\frac{1}{n}, \quad x=k$ $n=b-a+1$ $k=a,a+1,\ldots,b$	$\begin{cases} 0 & x<0 \\ \frac{k-a+1}{n} & k\le x<k+1 \\ & k=a,a+1,\ldots,b-1,b \\ 1 & x\ge n \end{cases}$	$\frac{a+b}{2}$	$\frac{n^2-1}{12}$
Bernoulli(p)	$\begin{cases} p & x=1 \\ 1-p & x=0 \end{cases}$	$\begin{cases} 0 & x<0 \\ 1-p & 0\le x<1 \\ 1 & x\ge 1 \end{cases}$	p	$p(1-p)$
Binomial(n,p)	${}^nC_k p^k(1-p)^{n-k}$, $k=0,1,\ldots,n$	$\begin{cases} 0 & x<0 \\ \sum_{i=0}^{k} {}^nC_i p^i(1-p)^{n-i} & k\le x<k+1 \\ & k=0,1,\ldots,n \\ 1 & x\ge n \end{cases}$	np	$np(1-p)$
Geometric(p)	$(1-p)^{k-1}p$, $k=1,\ldots,\infty$	$\begin{cases} 0 & x<0 \\ 1-(1-p)^k & k\le x<k+1 \\ & k=1,\ldots,\infty \end{cases}$	$\frac{1}{p}$	$\frac{1-p}{p^2}$
Poisson(λ)	$\frac{e^{-\lambda}\lambda^k}{k!}$, $k=0,1,\ldots,\infty$	$\begin{cases} 0 & x<0 \\ e^{-\lambda}\sum_{i=0}^{k}\frac{\lambda^i}{i!} & k\le x<k+1 \\ & k=0,1,\ldots,\infty \end{cases}$	λ	λ

Continuous random variables:

Distribution	PDF ($f_X(k)$)	CDF ($F_X(x)$)	$E[X]$	$\text{Var}(X)$
Uniform$[a,b]$	$\frac{1}{b-a}$, $a \le x \le b$	$\begin{cases} 0 & x \le a \\ \frac{x-a}{b-a} & a < x < b \\ 1 & x \ge b \end{cases}$	$\frac{a+b}{2}$	$\frac{(b-a)^2}{12}$
Exp(λ)	$\lambda e^{-\lambda x}$, $x > 0$	$\begin{cases} 0 & x \le 0 \\ 1-e^{-\lambda x} & x > 0 \end{cases}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Normal(μ, σ^2)	$\frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$, $-\infty < x < \infty$	No closed form	μ	σ^2
Gamma(α, β)	$\frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}$, $x > 0$		$\frac{\alpha}{\beta}$	$\frac{\alpha}{\beta^2}$
Beta(α, β)	$\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}$ $0 < x < 1$		$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$

1. **Markov's inequality:** Let X be a discrete random variable taking non-negative values with a finite mean μ. Then,
$$P(X \ge c) \le \frac{\mu}{c}$$

2. **Chebyshev's inequality:** Let X be a discrete random variable with a finite mean μ and a finite variance σ^2. Then,
$$P(|\, X - \mu \,| \ge k\sigma) \le \frac{1}{k^2}$$

3. **Weak Law of Large numbers:** Let $X_1, X_2, \ldots, X_n \sim$ iid X with $E[X] = \mu, \text{Var}(X) = \sigma^2$.
Define sample mean $\overline{X} = \frac{X_1 + X_2 + \ldots + X_n}{n}$. Then,
$$P(|\overline{X} - \mu| > \delta) \le \frac{\sigma^2}{n\delta^2}$$

4. **Using CLT to approximate probability:** Let $X_1, X_2, \ldots, X_n \sim$ iid X with $E[X] = \mu, \text{Var}(X) = \sigma^2$.
Define $Y = X_1 + X_2 + \ldots + X_n$. Then,
$$\frac{Y - n\mu}{\sqrt{n}\sigma} \approx \text{Normal}(0,1).$$

5. **Likelihood of i.i.d. samples:** Likelihood of a sampling $x_1, x_2, \ldots, x_n$, denoted

$$L(x_1, \ldots, x_n) = \prod_{i=1}^{n} f_X(x_i; \theta_1, \theta_2, \ldots)$$

6. **Maximum likelihood (ML) estimation:**

$$\theta_1^*, \theta_2^*, \ldots = \arg \max_{\theta_1^*, \theta_2^*, \ldots} \prod_{i=1}^{n} f_X(x_i; \theta_1, \theta_2, \ldots)$$

Options :

6406532041621. ✔ Useful Data has been mentioned above.

6406532041622. ✖ This data attachment is just for a reference & not for an evaluation.

Sub-Section Number :	2
Sub-Section Id :	64065388124
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 403 Question Id : 640653611332 Question Type : SA Calculator : None

Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

For the data set $(x_i, y_i) = [(1,1), (2,3), (3,9), (4,15), (5,27)], i = 1$ to 5, consider the regression model $f(x) = x^2$. What is the mean squared loss of $f(x)$. (Enter 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 :

1.1 to 1.3

Question Number : 404 Question Id : 640653611335 Question Type : SA Calculator : None

Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

Let $A = \begin{bmatrix} 3 & -2 \\ 5 & -4 \end{bmatrix}$. Find the trace of A^{10}.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

1025

Question Number : 405 Question Id : 640653611348 Question Type : SA Calculator : None

Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Short Answer Question

The time (in hours) it takes for a computer system to reboot after a crash follows an exponential distribution, with a parameter λ. Last five observations are noted as 1, 2, 3, 1, 3. Find the maximum likelihood estimate for λ. Enter the answer correct to one decimal place.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

0.5

Sub-Section Number :	3
Sub-Section Id :	64065388125
Question Shuffling Allowed :	Yes

Is Section Default? : null

Question Number : 406 Question Id : 640653611339 Question Type : SA Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Short Answer Question

What will be the value of $f(x) = 4x^2 + 2$ with an initial guess of 2, after two iterations of gradient descent algorithm? Take step size as 0.1. Enter the answer correct to three decimal places.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

2.022 to 2.028

Sub-Section Number : 4

Sub-Section Id : 64065388126

Question Shuffling Allowed : Yes

Is Section Default? : null

Question Number : 407 Question Id : 640653611349 Question Type : SA Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4

Question Label : Short Answer Question

Suppose a firm produces X_i number of equipments on day i, where i : 1, 2, . . . , n. Each of the X_i's are independent and identically distributed with mean 4 and variance 9. Using CLT, find the approximate probability that the total number of equipments produced in 100 days is greater than 450. Enter the answer correct to three decimal places.

Hint: Use the following values of F_Z if required:

• F_Z (−1.66) = 0.04846

• F_Z (−3.2) = 0.00064

• F_Z (1.66) = 0.95154

• F_Z (3.2) = 0.99936

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

0.044 to 0.052

Sub-Section Number :	5
Sub-Section Id :	64065388127
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 408 Question Id : 640653611333 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

Find the linearization of $f(x, y) = e^{2y-x}$ at the point $(1, 2)$.

Options :

6406532041624. ✖ $-e^3x + e^3y - e^3$

6406532041625. ✖ $-2e^3 + e^3x + 2e^3y$

6406532041626. ✔ $-e^3x + 2e^3y + e^3$

6406532041627.

✖ $-e^3x + 2e^3y$

Sub-Section Number : 6

Sub-Section Id : 64065388128

Question Shuffling Allowed : Yes

Is Section Default? : null

Question Number : 409 Question Id : 640653611336 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Let *A* and *B* be two *n*×*n* complex Hermitian matrices. Then, which among the following are true?

Options :

6406532041633. ✔ $A + B$ is Hermitian.

6406532041634. ✖ AB is Hermitian.

6406532041635. ✖ $iA + (2 + i)B$ is Hermitian.

6406532041636. ✖ $A + iB$ is Hermitian.

Question Number : 410 Question Id : 640653611341 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Let $f : \mathbb{R}^d \longrightarrow \mathbb{R}$ and $g : \mathbb{R}^d \longrightarrow \mathbb{R}$ be two convex functions. Which of the following functions is/are convex?

Options :

6406532041651. ✔ $\max\{f, g\}$

6406532041652. ✖ $\min\{f, g\}$

6406532041653. ✖ $f \circ g$

6406532041654. ✖ $\alpha f + (1 - \alpha)g$, where $\alpha \in \mathbb{R}$

Question Number : 411 Question Id : 640653611342 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

A consumer wants to maximize his utility subject to some constraints. He consumes two goods g_1 and g_2 and the utility function is the sum of g_1 and g_2. His budget is Rs.100. The per unit price of goods g_1 and g_2 are Rs.3 and Rs.4 respectively. Chose the correct optimization problem.

Options :

6406532041655. ✔ $\text{maximize } g_1 + g_2 \text{ subject to } 3g_1 + 4g_2 \leq 100$

6406532041656. ✖ $\text{maximize } g_1 g_2 \text{ subject to } 3g_1 + 4g_2 \leq 100$

6406532041657. ✖ $\text{maximize } g_1 g_2 \text{ subject to } 3g_1 + 4g_2 \geq 100$

6406532041658. ✖ $\text{maximize } g_1 + g_2 \text{ subject to } 3g_1 + 4g_2 \geq 100$

Sub-Section Number : 7

Sub-Section Id : 64065388129

Question Shuffling Allowed : Yes

Is Section Default? : null

Question Number : 412 Question Id : 640653611343 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4

Question Label : Multiple Choice Question

Consider the following optimization problem involving the variable $\mathbf{x} \in \mathbb{R}^2$:

$$\begin{aligned} \min_{x} \quad & x_1^2 - 3x_2 \\ \text{sub. to} \quad & x_1 + x_2 \leq 5 \end{aligned}$$

What is the output of the following expression for $\mathbf{x}' = [3 \quad 4]^T$?

$$\max_{\lambda \geq 0} \quad L(\mathbf{x}', \lambda)$$

Here, $L(\mathbf{x}', \lambda)$ is the Lagrangian function for this optimization problem evaluated at $\mathbf{x}'$.

Options :

6406532041659. ✖ $(x_1')^2 - 3(x_2')$

6406532041660. ✔ ∞

6406532041661. ✖ $-\infty$

6406532041662. ✖ 0

Sub-Section Number : 8

Sub-Section Id : 64065388130

Question Shuffling Allowed : Yes

Is Section Default? : null

Question Number : 413 Question Id : 640653611334 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Suppose an $m \times n$ matrix A satisfies $A^T A = I$, then which among the following is true?

Options :

6406532041628. ✔ Columns of A are orthonormal.

6406532041629. ✖ $\text{Rank}(A) = m$

6406532041630. ✔ $P = AA^T$ is a projection matrix.

6406532041631. ✖ $P = AA^T$ is not a projection matrix.

Question Number : 414 Question Id : 640653611338 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Which among the following is true for PCA?

Options :

6406532041641. ✔ The first principal component represents the direction along which the variance of the dataset is maximized.

6406532041642. ✖ The first principal component represents the direction along which the variance of the dataset is minimized.

6406532041643. ✖ The first principal component is the eigenvector corresponding to the smallest

eigenvalue of the covariance matrix.

6406532041644. ✔ The first principal component is the eigenvector corresponding to the largest eigenvalue of the covariance matrix.

Question Number : 415 Question Id : 640653611340 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Which of the following statements regarding gradient descent is/are correct?

Options :

6406532041646. ✔ If the step size is chosen as 1, we may “not always” arrive as close to the optimal solution even after many number of iterations.

6406532041647. ✔ Solution obtained for optimization problem is the local minimum of its objective function.

6406532041648. ✖ Solution obtained for optimization problem is the global minimum of its objective function.

6406532041649. ✔ Gradient descent converges to the global optimum in the case of convex functions.

6406532041650. ✖ Gradient descent does not converge to the global optimum in the case of convex functions.

Question Number : 416 Question Id : 640653611344 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Suppose a fair coin is tossed twice. Let *A* denote the event that the first toss is a tail. Let *B* denote the event that the second toss is a tail. Let *C* denote the event that out of the first two tosses,

either both are heads or both are tails. Which among the following options are true? Select all that apply.

Options :

6406532041663. ✖ *A*, *B* and *C* are independent.

6406532041664. ✔ *A*, *B* and *C* are dependent.

6406532041665. ✔ *A*, *B* and *C* are pairwise independent.

6406532041666. ✔ *P(A) = P(B) = P(C)* = 1/2

Sub-Section Number :	9
Sub-Section Id :	64065388131
Question Shuffling Allowed :	Yes
Is Section Default? :	null

Question Number : 417 Question Id : 640653611337 Question Type : MSQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 4 Max. Selectable Options : 0

Question Label : Multiple Select Question

Let A be an $n \times d$ matrix with right-singular vectors $v_1, \ldots, v_r$, left-singular vectors $u_1, \ldots, u_r$, and corresponding singular values $\sigma_1, \sigma_2, \ldots, \sigma_r$. If $A = \sum_{i=1}^{r} \sigma_i u_i v_i^T$, select the correct options from the following:

Options :

6406532041637. ✔ Each of $\sigma_i u_i v_i^T$ is a rank one matrix.

6406532041638. ✖ Each of $\sigma_i u_i v_i^T$ is a matrix of rank r.

6406532041639. ✔ For $B = A^T A$, $B = \sum_{i=1}^{r} \sigma_i^2 v_i v_i^T$.

6406532041640. ✖

For $B = AA^T, B = \sum_{i=1}^{r} \sigma_i^2 v_i v_i^T$.

Sub-Section Number :	10
Sub-Section Id :	64065388132
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Id : 640653611345 Question Type : COMPREHENSION Sub Question Shuffling Allowed : No Group Comprehension Questions : No Question Pattern Type : NonMatrix Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Question Numbers : (418 to 419)

Question Label : Comprehension

Let X and Y have the following joint probability density function:

$$f_{XY}(x,y) = \begin{cases} 3/2, & x > 0, x^2 < y < 1 \\ 0, & \text{otherwise} \end{cases}$$

Based on the above data, answer the given subquestions.

Sub questions

Question Number : 418 Question Id : 640653611346 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Multiple Choice Question

Are *X* and *Y* independent?

Options :

6406532041667. ✖ Yes

6406532041668. ✔ No

Question Number : 419 Question Id : 640653611347 Question Type : SA Calculator : None

Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 2

Question Label : Short Answer Question

Find Pr($X > Y$). Enter the answer correct to two decimal places.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

0.25