

GATE 2025 15th Feb 25 S1

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Test Time	9:30 AM - 12:30 PM
Subject	DA Data Science and Artificial Intelligence

Section : General Aptitude

Q.1 Weight of a person can be expressed as a function of their age. The function usually varies from person to person. Suppose this function is identical for two brothers, and it monotonically increases till the age of 50 years and then it monotonically decreases. Let a_1 and a_2 (in years) denote the ages of the brothers and $a_1 < a_2$.

Which one of the following statements is correct about their age on the day when they attain the same weight?

Options A. $a_1 < 50 < a_2$

B. $a_1 < a_2 < 50$

C. $50 < a_1 < a_2$

D. Either $a_1 = 50$ or $a_2 = 50$

Question Type : MCQ

Question ID : 142276868

Status : Answered

Chosen Option : A

Q.2 We _____ tennis in the lawn when it suddenly started to rain.

Select the most appropriate option to complete the above sentence.

Options A. could be playing

B. would have been playing

C. had been playing

D. have been playing

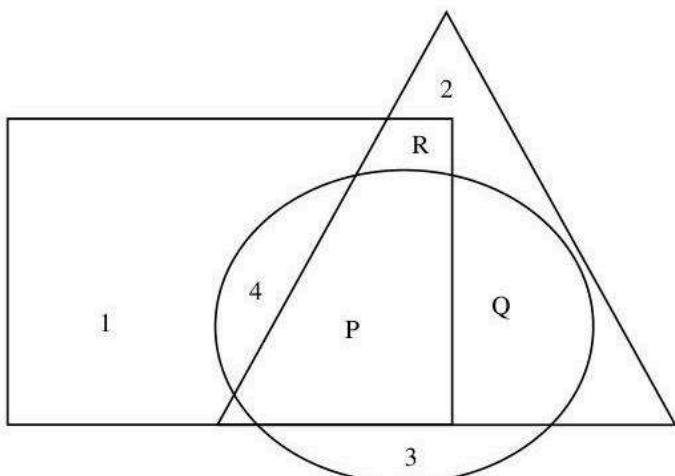
Question Type : MCQ

Question ID : 142276863

Status : Answered

Chosen Option : C

- Q.3** In the given figure, the numbers associated with the rectangle, triangle, and ellipse are 1, 2, and 3, respectively. Which one among the given options is the most appropriate combination of P, Q, and R ?



Options A. $P = 6; Q = 5; R = 3$

B. $P = 5; Q = 3; R = 6$

C. $P = 5; Q = 6; R = 3$

D. $P = 3; Q = 6; R = 6$

Question Type : MCQ

Question ID : 142276865

Status : Answered

Chosen Option : A

- Q.4** A 4×4 digital image has pixel intensities (U) as shown in the figure. The number of pixels with $U \leq 4$ is:

0	1	0	2
4	7	3	3
5	5	4	4
6	7	3	2

Options A. 8

B. 11

C. 3

D. 9

Question Type : MCQ

Question ID : 142276864

Status : Answered

Chosen Option : B

Q.5 Courage : Bravery :: Yearning : _____

Select the most appropriate option to complete the analogy.

Options

- A. Glaring
- B. Yelling
- C. Yawning
- D. Longing

Question Type : MCQ

Question ID : 142276862

Status : Answered

Chosen Option : A

Q.6 Column-I has statements made by Shanthala; and, Column-II has responses given by Kanishk.

Column-I		Column-II	
P.	This house is in a mess.	1.	Alright, I won't bring it up during our conversations.
Q.	I am not happy with the marks given to me.	2.	Well, you can easily look it up.
R.	Politics is a subject I avoid talking about.	3.	No problem, let me clear it up for you.
S.	I don't know what this word means.	4.	Don't worry, I will take it up with your teacher.

Identify the option that has the correct match between Column-I and Column-II.

Options

- A. P – 3; Q – 4; R – 1; S – 2
- B. P – 4; Q – 1; R – 2; S – 3
- C. P – 2; Q – 3; R – 1; S – 4
- D. P – 1; Q – 2; R – 4; S – 3

Question Type : MCQ

Question ID : 142276867

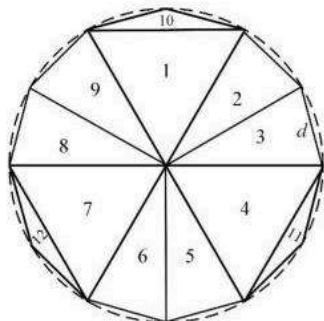
Status : Answered

Chosen Option : A

- Q.7** A regular dodecagon (12-sided regular polygon) is inscribed in a circle of radius r cm as shown in the figure. The side of the dodecagon is d cm. All the triangles (numbered 1 to 12) in the figure are used to form squares of side r cm and each numbered triangle is used only once to form a square.

The number of squares that can be formed and the number of triangles required to form each square, respectively, are:

Note: The figure shown is representative.



- Options**
- A. 3; 4
 - B. 4; 3
 - C. 3; 3
 - D. 3; 2

Question Type : MCQ
 Question ID : 142276869
 Status : Answered
 Chosen Option : D

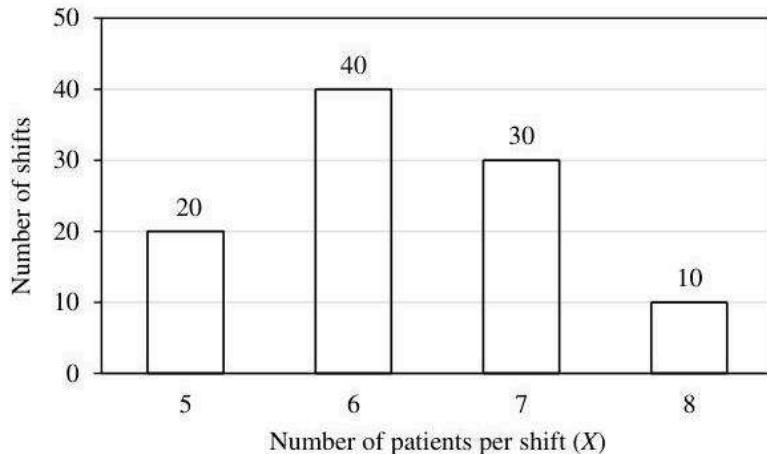
- Q.8** A rectangle has a length L and a width W, where $L > W$. If the width, W, is increased by 10%, which one of the following statements is correct for all values of L and W?

- Options**
- A. The rectangle becomes a square.
 - B. Perimeter increases by 10%.
 - C. Length of the diagonals increases by 10%.
 - D. Area increases by 10%.

Question Type : MCQ
 Question ID : 142276866
 Status : Answered
 Chosen Option : C

- Q.9** The number of patients per shift (X) consulting Dr. Gita in her past 100 shifts is shown in the figure. If the amount she earns is ₹ $1000(X - 0.2)$, what is the average amount (in ₹) she has earned per shift in the past 100 shifts?

Note: The figure shown is representative.



Options

- A. 6,100
- B. 6,300
- C. 6,500
- D. 6,000

Question Type : MCQ

Question ID : 142276871

Status : Answered

Chosen Option : B

Q.10

If a real variable x satisfies $3^{x^2} = 27 \times 9^x$, then the value of $\frac{2^{x^2}}{(2^x)^2}$ is:

Options

- A. 2^3
- B. 2^{15}
- C. 2^{-1}
- D. 2^0

Question Type : MCQ

Question ID : 142276870

Status : Answered

Chosen Option : A

Section : DA Data Science and Artificial Intelligence

- Q.1** Let C_1 and C_2 be two sets of objects. Let $D(x, y)$ be a measure of dissimilarity between two objects x and y . Consider the following definitions of dissimilarity between C_1 and C_2 .

$$\text{DIS-1}(C_1, C_2) = \max_{x \in C_1, y \in C_2} D(x, y)$$

$$\text{DIS-2}(C_1, C_2) = \min_{x \in C_1, y \in C_2} D(x, y)$$

Which of the following statements is/are correct?

- Options**
- A. Complete Linkage Clustering uses **DIS-2**
 - B. Single Linkage Clustering uses **DIS-2**
 - C. Single Linkage Clustering uses **DIS-1**
 - D. Complete Linkage Clustering uses **DIS-1**

Question Type : **MSQ**

Question ID : **142276891**

Status : **Answered**

Chosen Option : **B,D**

- Q.2** Let X be a continuous random variable whose cumulative distribution function (CDF)

$F_X(x)$, for some t , is given as follows:

$$F_X(x) = \begin{cases} 0 & x \leq t \\ \frac{x-t}{4-t} & t \leq x \leq 4 \\ 1 & x \geq 4 \end{cases}$$

If the median of X is 3, then what is the value of t ?

- Options**
- A. 1
 - B. 0
 - C. 2
 - D. -1

Question Type : **MCQ**

Question ID : **142276880**

Status : **Answered**

Chosen Option : **B**

- Q.3** For which of the following inputs does binary search take time $O(\log n)$ in the worst case?

- Options**
- A. An array of n integers in any order
 - B. A linked list of n integers in increasing order
 - C. A linked list of n integers in any order
 - D. An array of n integers in increasing order

Question Type : **MSQ**

Question ID : **142276888**

Status : **Answered**

Chosen Option : **A,C**

Q.4 $\lim_{t \rightarrow +\infty} \sqrt{t^2 + t} - t = \underline{\hspace{2cm}}$

(Round off to one decimal place)

Give 0.5
n
Ans
wer :

Question Type : NAT
Question ID : 142276893
Status : Answered

Q.5 Consider the following three relations:

Car (model, year, serial, color)

Make (maker, model)

Own (owner, serial)

A tuple in Car represents a specific car of a given model, made in a given year, with a serial number and a color. A tuple in Make specifies that a maker company makes cars of a certain model. A tuple in Own specifies that an owner owns the car with a given serial number. Keys are underlined; (owner, serial) together form key for Own. (\bowtie denotes natural join)

$\pi_{\text{owner}}(\text{Own} \bowtie (\sigma_{\text{color}=\text{"red"}}(\text{Car} \bowtie (\sigma_{\text{maker}=\text{"ABC"}} \text{Make}))))$

Which one of the following options describes what the above expression computes?

- Options**
- A. All red cars made by ABC
 - B. All owners of a red car made by ABC
 - C.
 - All owners of more than one car, where at least one car is red and made by ABC
 - D.
 - All owners of a red car, a car made by ABC, or a red car made by ABC

Question Type : MCQ
Question ID : 142276878
Status : Answered
Chosen Option : D

Q.6 Consider two functions $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow (1, \infty)$. Both functions are differentiable at a point c . Which of the following functions is/are ALWAYS differentiable at c ? The symbol \cdot denotes product and the symbol \circ denotes composition of functions.

- Options**
- A. $f \circ g + g \circ f$
 - B. $f \cdot g$
 - C. $f \pm g$
 - D. $\frac{f}{g}$

Question Type : MSQ
Question ID : 142276885
Status : Answered
Chosen Option : A,C

- Q.7** Given data $\{(-1, 1), (2, -5), (3, 5)\}$ of the form (x, y) , we fit a model $y = wx$ using linear least-squares regression. The optimal value of w is _____
(Round off to three decimal places)

Give **1.666**

n
Ans
wer :

Question Type : **NAT**
Question ID : **142276895**
Status : **Answered**

- Q.8** Let $f(x) = \frac{e^x - e^{-x}}{2}$, $x \in \mathbb{R}$. Let $f^{(k)}(a)$ denote the k^{th} derivative of f evaluated at a . What is the value of $f^{(10)}(0)$? (Note: ! denotes factorial)

Options A. 0

B. $\frac{2}{10!}$

C. 1

D. $\frac{1}{10!}$

Question Type : **MCQ**
Question ID : **142276875**
Status : **Answered**
Chosen Option : **C**

- Q.9** Consider a hash table of size 10 with indices $\{0, 1, \dots, 9\}$, with the hash function

$$h(x) = 3x \pmod{10},$$

where linear probing is used to handle collisions. The hash table is initially empty and then the following sequence of keys is inserted into the hash table: 1, 4, 5, 6, 14, 15. The indices where the keys 14 and 15 are stored are, respectively

Options A. 4 and 5

B. 4 and 6

C. 2 and 5

D. 2 and 6

Question Type : **MCQ**
Question ID : **142276879**
Status : **Not Answered**
Chosen Option : --

Q.10 There are three boxes containing white balls and black balls.

Box-1 contains 2 black and 1 white balls.

Box-2 contains 1 black and 2 white balls.

Box-3 contains 3 black and 3 white balls.

In a random experiment, one of these boxes is selected, where the probability of choosing Box-1 is $\frac{1}{2}$, Box-2 is $\frac{1}{6}$, and Box-3 is $\frac{1}{3}$. A ball is drawn at random from the selected box. Given that the ball drawn is white, the probability that it is drawn from Box-2 is _____

(Round off to two decimal places)

Give 0.22

n

Ans

wer :

Question Type : NAT

Question ID : 142276892

Status : Answered

Q.11 Let $X = aZ + b$, where Z is a standard normal random variable, and a, b are two unknown constants. It is given that

$$E[X] = 1, \quad E[(X - E[X])Z] = -2, \quad E[(X - E[X])^2] = 4,$$

where $E[X]$ denotes the expectation of random variable X . The values of a, b are:

Options A. $a = 1, b = 1$

B. $a = 2, b = -1$

C. $a = -2, b = -1$

D. $a = -2, b = 1$

Question Type : MCQ

Question ID : 142276881

Status : Answered

Chosen Option : B

Q.12 Which of the following statements is/are correct?

Options A. Linearly independent vectors in \mathbb{R}^n are orthonormal

B. Orthonormal vectors \mathbb{R}^n are linearly independent

C. \mathbb{R}^n does not have a unique set of orthonormal basis vectors

D. \mathbb{R}^n has a unique set of orthonormal basis vectors

Question Type : MSQ

Question ID : 142276886

Status : Answered

Chosen Option : A,B,D

Q.13 If a relational decomposition is not dependency-preserving, which one of the following relational operators will be executed more frequently in order to maintain the dependencies?

- Options**
- A. Selection
 - B. Join
 - C. Projection
 - D. Set union

Question Type : MCQ
 Question ID : 142276877
 Status : Answered
 Chosen Option : B

Q.14 The number of additions and multiplications involved in performing Gaussian elimination on any $n \times n$ upper triangular matrix is of the order

- Options**
- A. $O(n^2)$
 - B. $O(n^3)$
 - C. $O(n)$
 - D. $O(n^4)$

Question Type : MCQ
 Question ID : 142276873
 Status : Not Answered
 Chosen Option : --

Q.15 The naive Bayes classifier is used to solve a two-class classification problem with class-labels y_1, y_2 . Suppose the prior probabilities are $P(y_1) = \frac{1}{3}$ and $P(y_2) = \frac{2}{3}$. Assuming a discrete feature space with

$$P(x|y_1) = \frac{3}{4} \quad \text{and} \quad P(x|y_2) = \frac{1}{4}$$

for a specific feature vector x . The probability of misclassifying x is _____.
 (Round off to two decimal places)

Give **0.25**

n
 Ans
 wer :

Question Type : NAT
 Question ID : 142276896
 Status : Answered

Q.16 Let p and q be any two propositions. Consider the following propositional statements.

$$S_1 : p \rightarrow q, \quad S_2 : \neg p \wedge q, \quad S_3 : \neg p \vee q, \quad S_4 : \neg p \vee \neg q,$$

where \wedge denotes conjunction (AND operation), \vee denotes disjunction (OR operation), and \neg denotes negation (NOT operation). Which one of the following options is correct?

(Note: \equiv denotes logical equivalence)

Options A. $S_2 \equiv S_3$

B. $S_1 \equiv S_3$

C. $S_1 \equiv S_4$

D. $S_2 \equiv S_4$

Question Type : **MCQ**

Question ID : **142276876**

Status : **Not Answered**

Chosen Option : --

Q.17 Which of the following statements is/are correct in a Bayesian network?

Options A. Rejection sampling is an approximate inference algorithm

B. Gibbs sampling is an exact inference algorithm

C. Variable elimination is an approximate inference algorithm

D.

Variable elimination is used to determine conditional probabilities

Question Type : **MSQ**

Question ID : **142276887**

Status : **Answered**

Chosen Option : **B,C**

Q.18 Let $A = I_n + xx^\top$, where I_n is the $n \times n$ identity matrix and $x \in \mathbb{R}^n$, $x^\top x = 1$. Which

of the following options is/are correct?

Options A. Rank of A is n

B. A is invertible

C. 0 is an eigenvalue of A

D. A^{-1} has a negative eigenvalue

Question Type : **MSQ**

Question ID : **142276889**

Status : **Answered**

Chosen Option : **A,C**

- Q.19** The sum of the elements in each row of $A \in \mathbb{R}^{n \times n}$ is 1. If $B = A^3 - 2A^2 + A$, which one of the following statements is correct (for $x \in \mathbb{R}^n$)?

- Options**
- A. The equation $Bx = 0$ has a unique solution
 - B. The equation $Bx = 0$ has infinitely many solutions
 - C. The equation $Bx = 0$ has no solution
 - D. The equation $Bx = 0$ has exactly two solutions

Question Type : MCQ
Question ID : 142276874
Status : Not Answered
Chosen Option : --

- Q.20** Suppose X and Y are random variables. The conditional expectation of X given Y is denoted by $E[X|Y]$. Then $E[E[X|Y]]$ equals

- Options**
- A. $E[X]$
 - B. $E[Y]$
 - C. $\frac{E[X]}{E[Y]}$
 - D. $E[X|Y]$

Question Type : MCQ
Question ID : 142276872
Status : Answered
Chosen Option : B

Q.21 Consider designing a linear classifier

$$y = \text{sign}(f(x; w, b)), \quad f(x; w, b) = w^\top x + b$$

on a dataset $D = \{(x_1, y_1), (x_2, y_2), \dots, (x_N, y_N)\}$, $x_i \in \mathbb{R}^d$, $y_i \in \{+1, -1\}$, $i = 1, 2, \dots, N$. Recall that the sign function outputs +1 if the argument is positive, and -1 if the argument is non-positive. The parameters w and b are updated as per the following training algorithm:

$$w_{\text{new}} = w_{\text{old}} + y_n x_n, \quad b_{\text{new}} = b_{\text{old}} + y_n$$

whenever $\text{sign}(f(x_n; w_{\text{old}}, b_{\text{old}})) \neq y_n$. In other words, whenever the classifier wrongly predicts a sample (x_n, y_n) from the dataset, w_{old} gets updated to w_{new} , and likewise b_{old} gets updated to b_{new} . Consider the case $(x_n, +1)$, $f(x_n; w_{\text{old}}, b_{\text{old}}) < 0$. Then

- Options**
- A. $f(x_n; w_{\text{new}}, b_{\text{new}}) = f(x_n; w_{\text{old}}, b_{\text{old}})$
 - B. $f(x_n; w_{\text{new}}, b_{\text{new}}) < f(x_n; w_{\text{old}}, b_{\text{old}})$
 - C. $f(x_n; w_{\text{new}}, b_{\text{new}}) > f(x_n; w_{\text{old}}, b_{\text{old}})$
 - D. $y_n f(x_n; w_{\text{old}}, b_{\text{old}}) > 1$

Question Type : **MCQ**
 Question ID : **142276883**
 Status : **Not Answered**
 Chosen Option : --

Q.22 Suppose that insertion sort is applied to the array $[1, 3, 5, 7, 9, 11, x, 15, 13]$ and it takes exactly two swaps to sort the array. Select all possible values of x .

- Options**
- A. 16
 - B. 12
 - C. 14
 - D. 10

Question Type : **MSQ**
 Question ID : **142276890**
 Status : **Answered**
 Chosen Option : **B,C**

Q.23 On a relation named **Loan** of a bank:

Loan		
loan_number	branch_name	amount
L11	Banjara Hills	90000
L14	Kondapur	50000
L15	SR Nagar	40000
L22	SR Nagar	25000
L23	Balanagar	80000
L25	Kondapur	70000
L19	SR Nagar	65000

the following SQL query is executed.

```
SELECT L1.loan_number
FROM Loan L1
WHERE L1.amount > (SELECT MAX (L2.amount)
                     FROM Loan L2
                     WHERE L2.branch_name = 'SR Nagar');
```

The number of rows returned by the query is _____ (Answer in integer)

Give 3

n
Ans
wer :

Question Type : **NAT**
 Question ID : **142276894**
 Status : **Answered**

Q.24 Consider the following Python declarations of two lists.

A=[1, 2, 3]

B=[4, 5, 6]

Which one of the following statements results in A= [1, 2, 3, 4, 5, 6]?

- Options**
- A. A.append(B)
 - B. A.update(B)
 - C. A.extend(B)
 - D. A.insert(B)

Question Type : **MCQ**
 Question ID : **142276884**
 Status : **Not Answered**
 Chosen Option : --

- Q.25** It is given that $P(X \geq 2) = 0.25$ for an exponentially distributed random variable X with $E[X] = \frac{1}{\lambda}$, where $E[X]$ denotes the expectation of X . What is the value of λ ?
(ln denotes natural logarithm)

Options

- A. $\ln 4$
- B. $\ln 0.25$
- C. $\ln 3$
- D. $\ln 2$

Question Type : **MCQ**
 Question ID : **142276882**
 Status : **Not Answered**
 Chosen Option : --

- Q.26** Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be such that $|f(x) - f(y)| \leq (x - y)^2$ for all $x, y \in \mathbb{R}$. Then
 $f(1) - f(0) = \text{_____}$ (Answer in integer)

Give --
 n
 Ans
 wer :

Question Type : **NAT**
 Question ID : **142276920**
 Status : **Not Answered**

- Q.27** Consider designing a linear binary classifier $f(x) = \text{sign}(w^\top x + b)$, $x \in \mathbb{R}^2$ on the following training data:

$$\text{Class-1: } \left\{ \begin{pmatrix} 2 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 2 \end{pmatrix}, \begin{pmatrix} 2 \\ 2 \end{pmatrix} \right\}, \text{ Class-2: } \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix} \right\}$$

Hard-margin support vector machine (SVM) formulation is solved to obtain w and b .

Which of the following options is/are correct?

Options

- A. Training accuracy is 98%
- B. $w = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$ and $b = 1$
- C. The number of support vectors is 3
- D. The margin is $\sqrt{2}$

Question Type : **MSQ**
 Question ID : **142276914**
 Status : **Answered**
 Chosen Option : **A,C**

Q.28 Consider the following two relations, named *Customer* and *Person*, in a database:

```

Person (
    aadhaar CHAR(12) PRIMARY KEY,
    name VARCHAR(32));

Customer (
    name VARCHAR(32),
    email VARCHAR(32) PRIMARY KEY,
    phone CHAR(10),
    aadhaar CHAR(12),
    FOREIGN KEY (aadhaar) REFERENCES Person(aadhaar));

```

Which of the following statements is/are correct?

- Options**
- A. aadhaar is a candidate key in the Customer relation
 - B. aadhaar can be NULL in the Person relation
 - C. phone can be NULL in the Customer relation
 - D. aadhaar is a candidate key in the Person relation

Question Type : **MSQ**
 Question ID : **142276917**
 Status : **Answered**
 Chosen Option : **A,D**

Q.29 Let $A \in \mathbb{R}^{n \times n}$ be such that $A^3 = A$. Which one of the following statements is ALWAYS correct?

- Options**
- A. The sum of the diagonal elements of A is 1
 - B. A is invertible
 - C. Determinant of A is 0
 - D. A and A^2 have the same rank

Question Type : **MCQ**
 Question ID : **142276898**
 Status : **Not Answered**
 Chosen Option : --

Q.30 Consider the following tables, **Loan** and **Borrower**, of a bank.

Loan		
loan_num	branch_name	amount
L11	Banjara Hills	90000
L14	Kondapur	50000
L15	SR Nagar	40000
L22	SR Nagar	25000
L23	Balanagar	80000
L25	Kondapur	70000
L19	SR Nagar	65000

Borrower	
customer_name	loan_num
Anand	L11
Karteek	L11
Karteek	L14
Ankita	L15
Gopal	L19
Karteek	L22
Karteek	L23
Sunil	L23
Sunil	L25

Query: $\pi_{\text{branch_name}, \text{customer_name}}(\text{Loan} \bowtie \text{Borrower}) \div \pi_{\text{branch_name}}(\text{Loan})$

where \bowtie denotes natural join.

The number of tuples returned by the above relational algebra query is _____

(Answer in integer)

Give 16

n

Ans
wer :

Question Type : NAT
Question ID : 142276923
Status : Answered

Q.31 A random experiment consists of throwing 100 fair dice, each die having six faces numbered 1 to 6. An event A represents the set of all outcomes where at least one of the dice shows a 1. Then, $P(A) =$

Options

A. $\left(\frac{5}{6}\right)^{100}$

B. 1

c. $1 - \left(\frac{5}{6}\right)^{100}$

D. 0

Question Type : MCQ
Question ID : 142276906
Status : Not Answered
Chosen Option : --

Q.32 For $x \in \mathbb{R}$, the floor function is denoted by $f(x) = \lfloor x \rfloor$ and defined as follows

$$\lfloor x \rfloor = k, \quad k \leq x < k + 1,$$

where k is an integer. Let $Y = \lfloor X \rfloor$, where X is an exponentially distributed random variable with mean $\frac{1}{\ln 10}$, where \ln denotes natural logarithm. For any positive integer ℓ , one can write the probability of the event $Y = \ell$ as follows

$$P(Y = \ell) = q^\ell(1 - q)$$

The value of q is

- Options
- A. 0.5
 - B. 0.01
 - C. 0.434
 - D. 0.1

Question Type : MCQ

Question ID : 142276902

Status : Not Answered

Chosen Option : --

Q.33 Let $\{x_1, x_2, \dots, x_n\}$ be a set of linearly independent vectors in \mathbb{R}^n . Let the (i, j) -th element of matrix $A \in \mathbb{R}^{n \times n}$ be given by $A_{ij} = x_i^\top x_j$, $1 \leq i, j \leq n$. Which one of the following statements is correct?

- Options
- A. $z^\top A z = 0$ for some non-zero $z \in \mathbb{R}^n$
 - B. A is invertible
 - C. 0 is a singular value of A
 - D. Determinant of A is 0

Question Type : MCQ

Question ID : 142276899

Status : Not Answered

Chosen Option : --

- Q.34** Consider a fact table in an OLAP application: $\text{Facts}(\text{D1}, \text{D2}, \text{val})$, where D1 and D2 are its dimension attributes and val is a dependent attribute. Suppose attribute D1 takes 3 values and D2 takes 2 values, and all combinations of these values are present in the table Facts . How many tuples are there in the result of the following query?

```
SELECT D1, D2, sum(val)
FROM Facts
GROUP BY CUBE (D1, D2);
```

Options A. 12

- B. 6
- C. 1
- D. 9

Question Type : MCQ
 Question ID : 142276907
 Status : Not Answered
 Chosen Option : --

- Q.35** Consider a two-class problem in \mathbb{R}^d with class labels *red* and *green*. Let μ_{red} and μ_{green} be the means of the two classes. Given test sample $x \in \mathbb{R}^d$, a classifier calculates the squared Euclidean distance (denoted by $\|\cdot\|^2$) between x and the means of the two classes and assigns the class label that the sample x is closest to. That is, the classifier computes

$$f(x) = \|\mu_{\text{red}} - x\|^2 - \|\mu_{\text{green}} - x\|^2$$

and assigns the label *red* to x if $f(x) < 0$, and *green* otherwise. Which of the following statements is/are correct?

Options A.

- The sample $x = 0$ is assigned the label *green* if $\|\mu_{\text{red}}\| < \|\mu_{\text{green}}\|$
- B. f is a quadratic polynomial in x
- C.
- $f(x) = w^\top x + b$, where w and b are functions of μ_{red} and μ_{green}
- D. f is a linear function of x

Question Type : MSQ
 Question ID : 142276916
 Status : Answered
 Chosen Option : B,D

Q.36 A bag contains 5 white balls and 10 black balls. In a random experiment, n balls are drawn from the bag one at a time with replacement. Let S_n denote the total number of black balls drawn in the experiment.

The expectation of S_{100} denoted by $E[S_{100}] = \underline{\hspace{2cm}}$
(Round off to one decimal place)

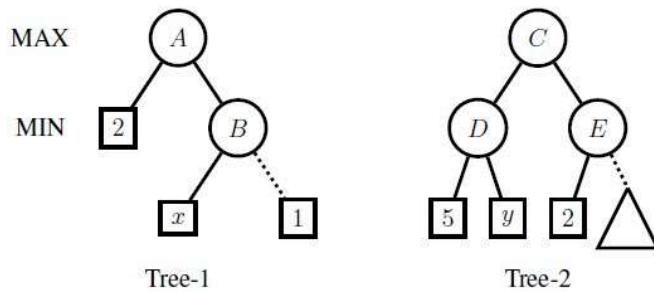
Give 2.8

n

Answer :

Question Type : NAT
Question ID : 142276922
Status : Answered

Q.37 Consider game trees Tree-1 and Tree-2 as shown. The first level is a MAX agent and the second level is a MIN agent. The value in the square node is the output of the utility function.



For what ranges of x and y , the right child of node B and the right child of node E will be pruned by alpha-beta pruning algorithm?

- Options
- A. $x \in (-\infty, 2]$ and $y \in [2, \infty)$
 - B. $x \in (-\infty, 2]$ and $y \in (-\infty, 5]$
 - C. $x \in [1, \infty)$ and $y \in (-\infty, 5]$
 - D. $x \in [1, \infty)$ and $y \in (-\infty, 2]$

Question Type : MCQ
Question ID : 142276904
Status : Not Answered
Chosen Option : --

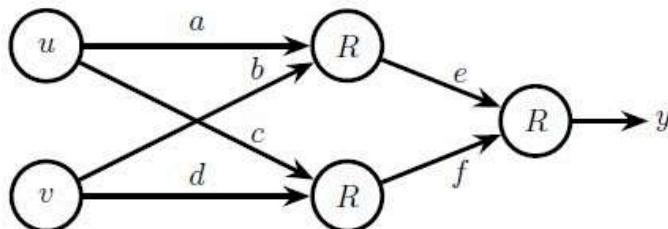
Q.38 Consider the neural network shown in the figure with

inputs: u, v

weights: a, b, c, d, e, f

output: y

R denotes the ReLU function, $R(x) = \max(0, x)$.



Given $u = 2, v = 3,$

$a = 1, b = 1, c = 1, d = -1, e = 4, f = -1,$

which one of the following is correct?

Options

- A. $\frac{\partial y}{\partial a} = 1, \frac{\partial y}{\partial f} = 0$
- B. $\frac{\partial y}{\partial a} = 2, \frac{\partial y}{\partial f} = -1$
- C. $\frac{\partial y}{\partial a} = 1, \frac{\partial y}{\partial f} = -1$
- D. $\frac{\partial y}{\partial a} = 8, \frac{\partial y}{\partial f} = 0$

Question Type : MCQ

Question ID : 142276903

Status : Not Answered

Chosen Option : --

Q.39 Let $D = \{x^{(1)}, \dots, x^{(n)}\}$ be a dataset of n observations where each $x^{(i)} \in \mathbb{R}^{100}$. It

is given that $\sum_{i=1}^n x^{(i)} = 0$. The covariance matrix computed from D has eigenvalues $\lambda_i = 100^{2-i}$, $1 \leq i \leq 100$. Let $u \in \mathbb{R}^{100}$ be the direction of maximum variance with $u^\top u = 1$.

The value of

$$\frac{1}{n} \sum_{i=1}^n (u^\top x^{(i)})^2 = \underline{\hspace{2cm}}$$

(Answer in integer)

Give 1

n

Ans

wer :

Question Type : NAT

Question ID : 142276921

Status : Answered

- Q.40** Consider a coin-toss experiment where the probability of head showing up is p . In the i^{th} coin toss, let $X_i = 1$ if head appears, and $X_i = 0$ if tail appears. Consider

$$\hat{p} = \frac{1}{n} \sum_{i=1}^n X_i$$

where n is the total number of independent coin tosses.

Which of the following statements is/are correct?

Options A. $E[\hat{p}] = \frac{p}{n}$

B. $E[\hat{p}] = p$

C. Variance of \hat{p} does not depend on n

D. As n increases, variance of \hat{p} decreases

Question Type : **MSQ**

Question ID : **142276915**

Status : **Answered**

Chosen Option : **A,D**

- Q.41** Let $Y = Z^2$, $Z = \frac{X - \mu}{\sigma}$, where X is a normal random variable with mean μ and variance σ^2 . The variance of Y is

Options A. 4

B. 1

C. 3

D. 2

Question Type : **MCQ**

Question ID : **142276897**

Status : **Not Answered**

Chosen Option : --

- Q.42** Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a twice-differentiable function and suppose its second derivative satisfies $f''(x) > 0$ for all $x \in \mathbb{R}$. Which of the following statements is/are ALWAYS correct?

Options A. f has a local minima

B. f has at most one local minimum

C.

There does not exist x and y , $x \neq y$, such that $f'(x) = f'(y) = 0$

D. f has at most one global minimum

Question Type : **MSQ**

Question ID : **142276912**

Status : **Answered**

Chosen Option : **A,C**

Q.43 Consider the following pseudocode.

```
Create empty stack S  
Set x=0, flag=0, sum=0  
Push x onto S  
while (S is not empty){  
    if (flag equals 0){  
        Set x = x+1  
        Push x onto S}  
    if (x equals 8):  
        Set flag=1  
    if (flag equals 1){  
        x = Pop(S)  
        if (x is odd):  
            Pop(S)  
        Set sum = sum + x}  
    }  
Output sum
```

The value of sum output by a program executing the above pseudocode is _____

(Answer in integer)

Give 10

n

Ans

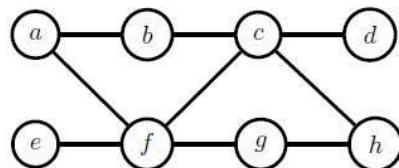
wer :

Question Type : NAT

Question ID : 142276925

Status : Answered

- Q.44** Let G be a simple, unweighted, and undirected graph. A subset of the vertices and edges of G are shown below.



It is given that $a - b - c - d$ is a shortest path between a and d ; $e - f - g - h$ is a shortest path between e and h ; $a - f - c - h$ is a shortest path between a and h . Which of the following is/are NOT the edges of G ?

- Options**
- A. (b, d)
 - B. (b, g)
 - C. (e, g)
 - D. (b, h)

Question Type : **MSQ**
 Question ID : **142276919**
 Status : **Answered**
 Chosen Option : **B,D**

- Q.45** Let x_1, x_2, x_3, x_4, x_5 be a system of orthonormal vectors in \mathbb{R}^{10} . Consider the matrix $A = x_1x_1^\top + \dots + x_5x_5^\top$. Which of the following statements is/are correct?

- Options**
- A. Determinant of A is 1
 - B. A is invertible
 - C. Singular values of A are either 0 or 1
 - D. Singular values of A are also its eigenvalues

Question Type : **MSQ**
 Question ID : **142276911**
 Status : **Answered**
 Chosen Option : **B,C,D**

- Q.46** An $n \times n$ matrix A with real entries satisfies the property: $\|Ax\|^2 = \|x\|^2$, for all $x \in \mathbb{R}^n$, where $\|\cdot\|$ denotes the Euclidean norm. Which of the following statements is/are ALWAYS correct?

- Options**
- A. A has full rank
 - B. $A = I$, where I denotes the identity matrix, is the only solution
 - C. A must be orthogonal
 - D. The eigenvalues of A are either $+1$ or -1

Question Type : **MSQ**
 Question ID : **142276913**
 Status : **Answered**
 Chosen Option : **B,D**

Q.47 Consider a directed graph $G = (V, E)$, where $V = \{0, 1, 2, \dots, 100\}$ and

$E = \{(i, j) : 0 < j - i \leq 2, \text{ for all } i, j \in V\}$. Suppose the adjacency list of each vertex is in *decreasing* order of vertex number, and depth-first search (DFS) is performed at vertex 0. The number of vertices that will be discovered after vertex 50 is

_____ (Answer in integer)

Give --

n

Ans
wer :

Question Type : NAT

Question ID : 142276926

Status : Not Answered

Q.48 Consider a database relation R with attributes ABCDEFG, and having the following functional dependencies:

$$A \rightarrow BCEF \quad E \rightarrow DG \quad BC \rightarrow A$$

Which of the following statements is/are correct?

Options A. A, BC are the candidate keys of R

B. A, BC, E are the candidate keys of R

C. A is the only candidate key of R

D. Relation R is not in Boyce-Codd Normal Form (BCNF)

Question Type : MSQ

Question ID : 142276918

Status : Answered

Chosen Option : B,D

Q.49 Consider the function $f(x) = \frac{x^3}{3} + \frac{7}{2}x^2 + 10x + \frac{133}{2}$, $x \in [-8, 0]$. Which of the following statements is/are correct?

Options A.

The minimum value of the derivative of f is attained at $x = -\frac{7}{2}$

B. The maximum value of f is attained at $x = -5$

C. The minimum value of f is attained at $x = -2$

D. The maximum value of f is $\frac{133}{2}$

Question Type : MSQ

Question ID : 142276910

Status : Answered

Chosen Option : A,D

Q.50 Consider the cumulative distribution function (CDF) of a random variable X :

$$F_X(x) = \begin{cases} 0 & x \leq -1 \\ \frac{1}{4}(x+1)^2 & -1 \leq x \leq 1 \\ 1 & x \geq 1 \end{cases}$$

The value of $P(X^2 \leq 0.25)$ is

- Options**
- A. 0.25
 - B. 0.5625
 - C. 0.625
 - D. 0.5

Question Type : MCQ
 Question ID : 142276900
 Status : Not Answered
 Chosen Option : --

Q.51 A random variable X is said to be distributed as $Bernoulli(\theta)$, denoted by $X \sim Bernoulli(\theta)$, if

$$P(X = 1) = \theta, \quad P(X = 0) = 1 - \theta$$

for $0 < \theta < 1$. Let $Y = \sum_{i=1}^{300} X_i$, where $X_i \sim Bernoulli(\theta)$, $i = 1, 2, \dots, 300$ be independent and identically distributed random variables with $\theta = 0.25$. The value of $P(60 \leq Y \leq 90)$, after approximation through Central Limit Theorem, is given by

$$\text{(Recall that } \phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-\frac{t^2}{2}} dt\text{)}$$

- Options**
- A. $\phi(3) - \phi(-3)$
 - B. $\phi(2) - \phi(-2)$
 - C. $\phi(1) - \phi(-1)$
 - D. $\phi(90) - \phi(60)$

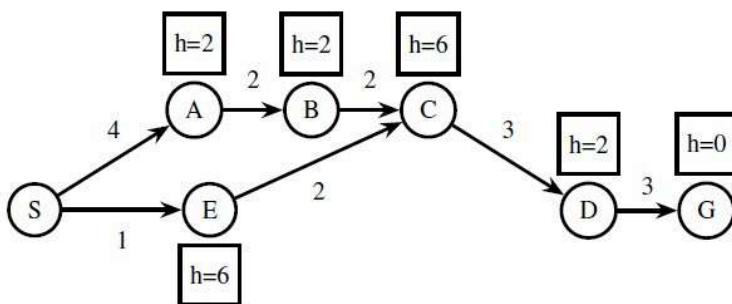
Question Type : MCQ
 Question ID : 142276901
 Status : Not Answered
 Chosen Option : --

Q.52 Which of the following statements is/are correct about the rectified linear unit (ReLU) activation function defined as $\text{ReLU}(x) = \max(x, 0)$, where $x \in \mathbb{R}$?

- Options**
- A. $\text{ReLU}(x) = \text{ReLU}(ax)$, for all $a \in \mathbb{R}$
 - B. ReLU is continuous everywhere
 - C. ReLU is differentiable everywhere
 - D. ReLU is not differentiable at $x = 0$

Question Type : MSQ
 Question ID : 142276909
 Status : Answered
 Chosen Option : A,D

- Q.53** The state graph shows the action cost along the edges and the heuristic function h associated with each state.



Suppose A^* algorithm is applied on this state graph using priority queue to store the frontier. In what sequence are the nodes expanded?

- Options**
- S,A,B,E,C,D,G
 - S,A,E,B,C,D,G
 - S,E,A,C,B,D,G
 - S,A,E,C,B,D,G

Question Type : MCQ
 Question ID : 142276905
 Status : Not Answered
 Chosen Option : --

- Q.54** Consider the following Python code snippet.

```

A={"this", "that"}
B={"that", "other"}
C={"other", "this"}

while "other" in C:
    if "this" in A:
        A, B, C=A-B, B-C, C-A
    if "that" in B:
        A, B, C=C|A, A|B, B|C
  
```

When the above program is executed, at the end, which of the following sets contains "this"?

- Options**
- Only B
 - Only A
 - Only C
 - A, C

Question Type : MCQ
 Question ID : 142276908
 Status : Answered
 Chosen Option : C

Q.55 Consider the following Python code snippet.

```
def f(a,b):  
    if (a==0):  
        return b  
    if (a%2==1):  
        return 2*f((a-1)/2,b)  
    return b+f(a-1,b)  
  
print(f(15,10))
```

The value printed by the code snippet is _____ (Answer in integer)

Give 10

n

Ans

wer :

Question Type : NAT

Question ID : 142276924

Status : Answered