Deep Learning

Assignment- Week 0

TYPE OF QUESTION: MCQ/MSQ

Number of questions: 11 **Total mark: 11 X 1 = 11**

QUESTION 1:

Find $\frac{df}{dx}$ where $f = e^x \sin x$?

a. $\mathrm{e}^x \sin x$
b. $\mathrm{e}^x(\sin x + \cos x)$
c. $\mathrm{e}^x \cos x$
d. $\mathrm{e}^x(\sin x\ cosx)$

Correct Answer:b

Detailed Solution:

Since this is a product of 2 functions we may apply the product rule which states that the derivative of a product of 2 functions is the first function times the derivative of the second, plus the second function times the derivative of the first. Thus,

$$\frac{df}{dx} = \mathrm{e}^x(\sin x + \cos x)$$

QUESTION 2:

Find $\frac{df_1}{dx} \cdot \frac{df_2}{dx}$where $f_1 = \log_e x^2 , f_2 = \frac{4}{\sqrt{x}}$?

a. $-4x^{-\frac{5}{2}}$
b. $-x^{-\frac{5}{2}}$
c. $-4x^{-1/2}$
d. $-2x^{-3/2}$

Correct Answer: a

Detailed Solution:

$$\frac{df_1}{dx} = \frac{1}{x^2} \cdot 2x = \frac{2}{x}, \qquad \frac{df_2}{dx} = \frac{-4}{2} x^{-\frac{3}{2}} = -2x^{-3/2}$$

$$\frac{df_1}{dx} \cdot \frac{df_2}{dx} = \frac{2}{x} \cdot (-2x^{-\frac{3}{2}}) = -4x^{-5/2}$$

QUESTION 3:

Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?

a. $1/2$
b. $2/5$
c. $8/15$
d. $9/20$

Correct Answer:d

Detailed Solution:

Here, S = {1, 2, 3, 4, ..., 19, 20}.

Let E = event of getting a multiple of 3 or 5 = {3, 6 , 9, 12, 15, 18, 5, 10, 20}.

$\therefore$ P(E) = $\frac{n(E)}{n(S)} = \frac{9}{20}$.

QUESTION 4:

What is the probability of getting a sum 9 from two throws of a dice?

a. $1/6$
b. $1/8$
c. $1/9$
d. $1/12$

Correct Answer: c

Detailed Solution:

In two throws of a dice, n(S) = (6 x 6) = 36.

Let E = event of getting a sum ={(3, 6), (4, 5), (5, 4), (6, 3)}.

$\therefore \; P(E) = \frac{n(E)}{n(S)} = \frac{4}{36}. \quad = 1/9$

QUESTION 5:

Consideranxn symmetric matrix “A” with real entries. What can you say about its eigenvectors and eigen values?

a. There exists a set of n eigenvectors, one for each real eigenvalue, that are mutually orthogonal.
b. There exists a set of n eigenvectors, one for each real eigenvalue, that are not mutually orthogonal
c. There exists a set of n eigenvectors, one for each complex eigenvalue, that are mutually orthogonal
d. There exists a set of n eigenvectors, one for each complex eigenvalue, that are not mutually orthogonal

Correct Answer:a

Detailed Solution:

If A is symmetric and v, w are eigenvectors with different eigenvalues then$\langle v,w \rangle = 0$. Also, if A_{nxn} is real and symmetric then A has nreal eigenvalues.

The above two are properties of anxnsymmetric matrix with real entries.

QUESTION 6:

Find $\frac{d\sigma}{dx}$, where $\sigma(x) = \frac{1}{1+e^{-x}}$

a. $\frac{d\sigma}{dx} = 1 - \sigma(x)$
b. $\frac{d\sigma}{dx} = 1 + \sigma(x)$
c. $\frac{d\sigma}{dx} = \sigma(x)(1 - \sigma(x))$
d. $\frac{d\sigma}{dx} = \sigma(x)(1 + \sigma(x))$

Correct Answer: c

Detailed Solution:

$$\sigma(x) = \frac{1}{1 + e^{-x}}$$

$$\frac{d\sigma}{dx} = (1 + e^{-x})^{-2} * \ e^{-x}$$

$$\frac{d\sigma}{dx} = \frac{e^{-x}}{(1 + e^{-x})^2} = \frac{1 + e^{-x} - 1}{(1 + e^{-x})^2} = \frac{1}{1 + e^{-x}} - \frac{1}{(1 + e^{-x})^2} = \frac{1}{1 + e^{-x}}\left(1 - \frac{1}{1 + e^{-x}}\right)$$

$$\frac{d\sigma}{dx} = \sigma(x)(1 - \sigma(x))$$

QUESTION 7:

Consider a vector $x \in \mathbb{R}^n$ and a matrix $A \in \mathbb{R}^{n\times n}$. The product $x^T Ax$ can be written as:

a. $\sum_{i=1}^{n}\sum_{j=1}^{n} x_i A_{ji}\, x_j$
b. $\sum_{i=1}^{n}\sum_{j=1}^{n} {x_i}^2 A_{ji}$
c. $\sum_{i=1}^{n}\sum_{j=1}^{n} {x_j}^2 A_{ji}$
d. None of the above.

Correct Answer: a

Detailed Solution:

The options are self-explanatory.

QUESTION 8:

Given a vector$v = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ \vdots \\ v_n \end{bmatrix} \in \mathbb{R}^n$, find its L2 norm.

a. $\|\mathrm{v}\|_2 = \sum_{i=1}^{n} |v_i|$
b. $\|\mathrm{v}\|_2 = \sqrt{\sum_{i=1}^{n} v_i^2}$
c. $\|\mathrm{v}\|_2 = \max(v_i)$
d. $\|\mathrm{v}\|_2 = \max({v_i}^2)$

Correct Answer: b

Detailed Solution:

L2 norm of a vector is defined as the square root of the sum of squares of the vector components.

QUESTION 9:

Given the following matrix $A = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, what is the relationship between the eigenvalues of the matrix A.?

a. Equal and Opposite sign
b. Equal and same sign
c. Complex conjugate
d. No relationship.

Correct Answer: c

Detailed Solution:

The options are self-explanatory.

QUESTION 10:

Choose the correct equation for finding the output of a discrete time convolution? Where $y[n]$ is the convolution output, and $h[n]$, $x[n]$ are the two input.

a. $y[n] = \sum_{k=0}^{\infty} x[k]h[n-k]$
b. $y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$
c. $y[n] = \sum_{k=0}^{\infty} x[k]h[n]$
d. $y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n+k]$

Correct Answer: b

Detailed Solution:

We compute the discrete time convolution by the following method.

i. First we take the time reversal version of one of the input signal, let's consider the input signal is $h[k]$, and the time reversal version is $h[-k]$
ii. Then to compute the output response at any time step n, i.e.$y[n]$, we shift the time reversed version of the input signal to that time step, i.e. $h[n-k]$ and compute the sum of product $x[k] * h[n-k]$ for all possible values of k

So, $y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$

QUESTION 11:

A single card is drawn from a standard deck of playing cards. What is the probability of that a queen is drawn from the deck of cards provided that the card is a face card?

(Hints: face cards are the cards having a face i.e. Jack, Queen, King)

a. 3/13
b. 1/3
c. 4/13
d. 1/52

Correct Answer: b

Detailed Solution:

The probability that the card drawn is a queen = 4/52, since there are 4 queens in a standard deck of 52 cards. If the event is "this card is a queen" the prior probability P (queen)= 4/52=1/13.

The posterior probability P (queen|face) can be calculated using Bayes theorem:

$P\ (queen\ |face)\ =\ P\ (face|\ queen)/P\ (face) * \ P\ (queen).$

Since every queen is also a face card, P (face|queen) = 1.

The probability of a face card is P (face) = (3/13). [Since there are 3 face cards in each suit (Jack, Queen, and King)].

Using Bayes theorem gives P (queen|face) =$^1/_{(^3/_{13})} \times {^1/_{13}} = {^{13}/_3} \times {^1/_{13}} = {^1/_3}$.

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