CBCS SCHEME

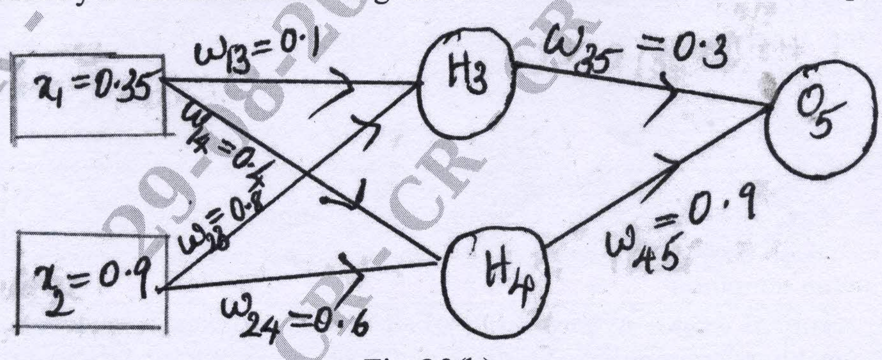
USN | | | | | | | | | |

BCS405C

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024
Optimization Techniques

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Explain the understanding of Jacobian in the context of data science.	05	L2	CO1
	b.	Calculate the gradient of a matrix with respect to the matrix: $X = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$ $Y = \begin{bmatrix} \sin(x_0 + 2x_1) & 2x_1 + x_3 \\ 2x_0 + x_2 & \cos(2x_1 + x_3) \end{bmatrix}$	07	L2	CO1
	c.	Obtain 3rd Degree polynomial for the function $f(x, y) = e^x \sin y$ about the point $\left(1, \frac{\pi}{2}\right)$.	08	L2	CO1
		OR			
Q.2	a.	Calculate the gradient, given $u = \frac{yz}{x}$, $v = \frac{xz}{y}$, $w = \frac{xy}{z}$.	06	L2	CO1
	b.	Calculate gradient of a vector with respect to the matrix $X = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$, $Y = x_0 \sin(x_1^2 x_2),\ x_2 \cos(x_3^2 x_0)$	07	L2	CO1
	c.	Calculate the Third Degree polynomial for the function $f(x, y) = xe^y + 1$ near to the point (1, 0).	07	L2	CO1
		Module – 2			
Q.3	a.	Explain the term Back propagation.	06	L2	CO2
	b.	Assume that the Neurons have a sigmoid activation function. Perform a forward pass and a backward pass on the network. Assume that the actual output of y is 0.5 and the learning rate is 1. Perform another forward pass.  Fig.Q3(b)	14	L3	CO2
		OR			
Q.4	a.	Draw a computation graph of function $f(x) = \sqrt{x^2 + e^{x^2}} + \cos(x^2 + e^{x^2})$. Also find $\frac{2f}{2x}$ using Automatic differentiation.	05	L2	CO2

	b.	Assume that the hidden layer uses sigmoid activation function. Perform a forward pass and a backward pass and predict y. Assume that actual output y = 1 and learning rate is 0.9.	15	L3	CO2

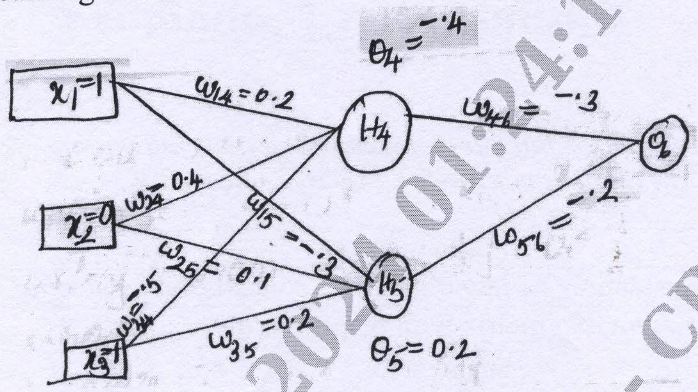


Fig.Q4(b)

Module – 3

Q.5	a.	Explain the terms local minima, Global minima and saddle points. Also explain the conditions for a point to be local Extrema with the help of Hessian matrix.	05	L2	CO3
	b.	Find the local Extrema for the function $f(x,y,z) = x^3 + y^3 + z^3 - 9xy - 9xz + 27x$	05	L3	CO3
	c.	By using 3 point interval search method, find maximum of $f(x) = x(3-x)^{5/3}$ over [0, 3]. Carry out 5 iterations.	10	L3	CO3

OR

Q.6	a.	Analyze local minima and local Maxima using first derivative method, for the function $f(x) = 2x^3 - 3x^2 - 12x + 5$.	05	L2	CO3
	b.	Minimize $f(x) = x^2$ over [–5, 15] using Fibonacce method, taking n = 7.	15	L3	CO3

Module – 4

Q.7	a.	Minimize $f(x_1,x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$, starting from $X_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ using steepest descent method.	12	L3	CO4
	b.	Explain the terms Gradient Descent, Mini Batch Gradient Descent and Stochastic Gradient Descent.	08	L2	CO4

OR

Q.8	a.	Minimize $f(x_1,x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from $X_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ using Newton's method.	06	L3	CO4
	b.	We have recorded weekly average price of a stock over 6 consecutive days. Y shows weekly average price of a stock and X shows number of days. Try to fit best possible function f to establish the relationship between number of days and conversion rates where y = f(x) = a + bx.	14	L3	CO4

x	1	2	3	4	5	6
y	10	14	18	22	25	33

The initial a and b are a = 4.9, b = 4.401. The learning rate is mentioned as 0.05. Perform three iterations. Also plot the prediction and the actual data in the graph.

Module – 5

Q.9	a.	Explain the terms: (i) Momentum based gradient descent (ii) RMS prop optimizer	10	L2	CO5
	b.	Calculate the 5 years of moving average for the given data: (see table below)	10	L3	CO5

Year	1977	1978	1979	1980	1981	1982
Production	14	17	22	28	26	18
Years	1983	1984	1985	1986	1987	1988
Production	29	24	25	29	30	23

OR

Q.10	a.	Explain convex and concave function. Also explain non-convex optimization.	10	L2	CO5
	b.	Explain the terms : (i) Adagrad optimizer (ii) Adam optimizer	10	L2	CO5

* * * * *