CBCS SCHEME

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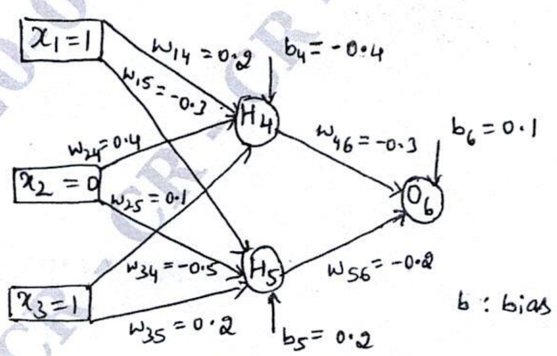
BCS405C

Fourth Semester B.E/B.Tech. Degree Examination, Dec.2024/Jan.2025

Optimization Technique

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
1	a.	Let $f(x_1, x_2) = e^{x_1 x_2^2}$ where $x_1 = t\cos t$ and $x_2 = t\sin t$. Find $\frac{df}{dt}$.	6	L2	CO1
	b.	Discuss the gradient of vector with respect to matrix and obtain the gradient of vector $f = [e^{x_0 x_1} \; e^{x_2 x_3}]$ with respect to the matrix $x = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$.	7	L2	CO1
	c.	Find the Taylor's series expansion of the function $f(x, y) = x^2y^2 + 2x^2y + 3xy^2$ in power of $(x + 2)$ and $(y - 1)$ upto a second degree terms.	7	L2	CO1
		OR			
2	a.	If $\vec{x}, \vec{y}$ and R^2 and $y_1 = -2x_1 + x_2$, $y_2 = x_1 + x_2$. Show that the Jacobian determinate $\lvert detJ \rvert = 3$.	6	L2	CO1
	b.	Obtain the gradient of matrix $f = \begin{bmatrix} \sin(x_0 + 2x_1) & 2x_1 + x_3 \\ 2x_0 + x_2 & \cos(2x_2 + x_3) \end{bmatrix}$ with respect to matrix $x = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$.	7	L2	CO1
	c.	Find the Taylor's series expansion of $f(x, y) = \sin(xy)$ in terms of $(x - 1)$ and $(y - \pi/2)$ upto second degree.	7	L2	CO1
		Module – 2			
3	a.	Assume that the neuron have a sigmoid activation function, perform a forward pass and a backward pass on the network. Assume that the actual output of y is 1 and learning rate is 0.9 perform another forward pass. (Refer Fig.Q3(a)).  Fig.Q3(a)	12	L3	CO2
	b.	Obtain the gradient of quadratic cost.	8	L2	CO2

		OR			
4	a.	If $f = x^2(x+y)$ where $C = x^2$ and $S = x + y$: i) Construct a computational graph ii) Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at the point x = 2 and y = 3 using chain rule ii) Construct computational graphs in forward mode to show the result of (ii).	12	L2	CO2
	b.	Obtain the gradient of mean squared error.	8	L2	CO2
		Module – 3			
5	a.	Describe local and global optima. List out the difference between local and global optima.	6	L2	CO3
	b.	Minimize $f(x) = 3x_1^2 + 4x_2^2 + 5x_3^2$ subject to the constrain $x_1 + x_2 + x_3 = 10$.	7	L3	CO3
	c.	Use Fibonacci search method to minimize $f(x) = x^2$ over [–5, 15] by taking n = 7.	7	L3	CO3
		OR			
6	a.	Define convex set. Explain separating hyper-plane of convex set.	6	L2	CO3
	b.	Using the Hessain matrix, matrix, classify the relative extreme for the function: $f(x_1, x_2, x_3) = x_1 + 2x_3 + x_2x_3 - x_1^2 - x_2^2 - x_3^2$.	7	L3	CO3
	c.	Use 3-point interval search method to find maximum $f(x) = x(5\pi - x)$ on [0, 20] with $\varepsilon = 0.1$.	7	L3	CO3
		Module – 4			
7	a.	Use Newton method for $f(x_1x_2) = x_1^2 + x_2^2 + 14x_1 + 14x_2 + 100$ starting form the point $x_1 = (0, 0)$.	7	L3	CO4
	b.	Explain how the gradient descent algorithm works.	6	L2	CO4
	c.	Write the difference between stochastic gradient descent and minim batch gradient descent method.	7	L2	CO4
		OR			
8	a.	Use steepest Descent method for $f[x_1\ x_2] = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $x_1 = (0, 0)$ [perform 3 iteration].	7	L3	CO4
	b.	Write the advantages and disadvantages algorithm for stochastic gradient descent algorithm.	7	L1	CO4
	c.	Write the mini batch gradient descent algorithm.	6	L2	CO4
		Module – 5			
9	a.	Explain in brief : i) Adagrad optimization strategy ii) RMSprop.	10	L2	CO5
	b.	What is the difference between convex optimization and non-convex optimization?	5	L2	CO5
	c.	Describe the saddle point problem in machine learning.	5	L3	CO5
		OR			
10	a.	Write short notes on : i) Stochastic gradient descent with momentum ii) ADAM.	10	L2	CO5
	b.	What is the best optimization algorithm for machine learning?	5	L3	CO5
	c.	Briefly explain the advantage of RMSprop over Adagrad.	5	L2	CO5

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