CBCS SCHEME

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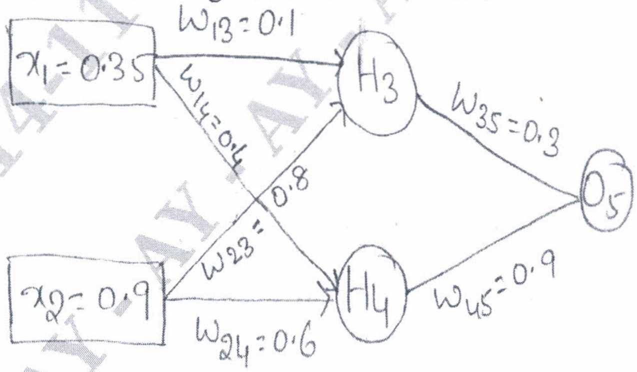
BCS405C

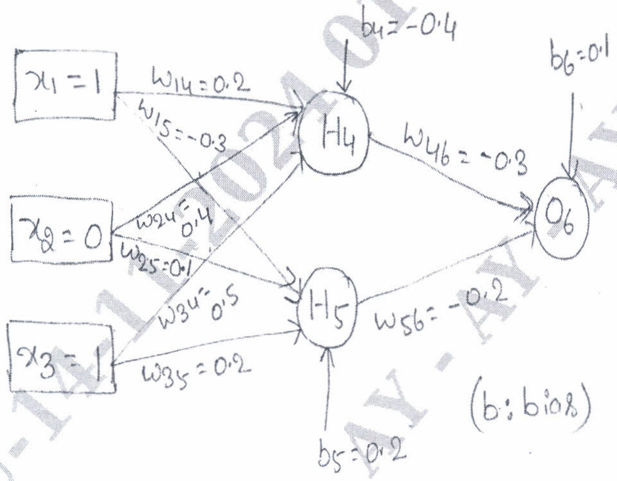
Fourth Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

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
Q.1	a.	If $f(x_1,x_2)=e^{x_1x_2^2}$, where $x_1 = t\cos t$, $x_2 = t\sin t$. Find $\frac{df}{dt}$.	6	L2	CO1
	b.	Obtain the Gradient of vector $f=\begin{bmatrix} e^{x_0x_1} & e^{x_2x_3}\end{bmatrix}$ with respect to the matrix $x=\begin{bmatrix} x_0 & x_1 \\ x_2 & x_3\end{bmatrix}$	6	L2	CO1
	c.	Find the Taylor's series expansion of the function $f(x_1,x_2)=x_1^2x_2+5x_1e^{x_2}$ about the point a = 1, b = 0 upto second degree.	8	L2	CO1
		OR			
Q.2	a.	If x, $y \in R^2$ and $y_1=-2x_1+x_2$, $y_2=x_1+x_2$. Show that the Jacobian determinant $\|\det J\|=3$	6	L2	CO1
	b.	Discuss the gradient of a vector with respect to matrix.	6	L2	CO1
	c.	Obtain Taylor's series expansion of $f(x,y)=x^2y+3y-2$ in terms of (x-1) and (y+2) upto second degree.	8	L2	CO1
		Module – 2			
Q.3	a.	If $f=x^2(x+y)$ where $C=x^2$ and $S=x+y$, (i) Draw a computational graph (ii) Find $\frac{\delta f}{\delta x}$ and $\frac{\delta f}{\delta y}$ at the point x = 2 and y = 3, using chain rule. (iii) Construct computational graph in forward modes to show the results of (ii)	8	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 learning rate is 1. Perform another forward pass.  Fig. Q3 (b)	12	L3	CO2

		OR			
Q.4	**a.**	Construct a computational graph of the function, $f(x)=\sqrt{x^2+e^x}+\cos(x^2+e^x)$. Also find $\frac{\delta f}{\delta x}$ using automatic differentiation.	8	L3	CO2
	b.	Assume that the neuron have a sigmoid activation function. Perform forward pass and backward pass on the network. Assume that the actual output of y is 1 and learning rate is 0.9. Perform another forward pass.  Fig. Q4 (b)	12	L3	CO2
		Module – 3			
Q.5	**a.**	Describe Local and Global optima. List the differences between local and global optima.	6	L2	CO3
	b.	Minimize $f(x)=x_1^2+x_2^2$, Subject to the condition $a_1x_1+a_2x_2=b$ using Lagrangian multipliers.	6	L3	CO3
	c.	Define Hessian matrix, using the Hessian matrix classify the relative extrema for the function, $f(x_1,x_2,x_3)=x_1+2x_3+x_2x_3-x_1^2-x_2^2-x_3^2$	8	L3	CO3
		OR			
Q.6	**a.**	Write 3-point interval search algorithm and also use it to find maximum of $f(x)=x(5\pi-x)$ on [0, 20] with $\varepsilon=0.1$	10	L2	CO3
	b.	Minimize $f(x)=x(x-1.5)$ over [0, 1] with the interval of uncertainty 0.25 of the interval of uncertainty using Fibonacci method.	10	L3	CO3
		Module – 4			
Q.7	**a.**	Write the Stochastic Gradient Descent algorithm.	6	L2	CO4
	b.	Find the extrema of the function $f(x)=5\sin(2x)-2x^2-4x$, with initial guess of -2, and $\varepsilon=10^{-4}$ by Newton Raphson method.	8	L3	CO4
	c.	Write the differences between Stochastic Gradient Descent and Mini Batch Gradient Descent methods.	6	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 the point $x_0=\begin{bmatrix}0\\0\end{bmatrix}$ using steepest gradient descent method.	10	L3	CO4

	b.	Use Newton Raphson method to approximate the maximum of $f(x) = 2\sin x - \frac{x^2}{10}$ with initial guess of 2.5, $\varepsilon = 10^{-4}$	10	L3	CO4
Module – 5					
Q.9	a.	Write a note on Stochastic gradient descent with momentum.	6	L2	CO5
	b.	What is the best optimization algorithm for machine learning? Explain.	6	L3	CO5
	c.	Describe the saddle point problem in machine learning.	8	L2	CO5
OR					
Q.10	a.	Write any 3 differences between convex optimization and non convex optimization.	6	L2	CO5
	b.	Explain Adagrad optimization strategy.	7	L2	CO5
	c.	Briefly explain the advantages of RMS prop over Adagrad.	7	L2	CO5

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