Model Question Paper-I with effect from 2022(CBCS Scheme)

USN | | | | | | | | | | |

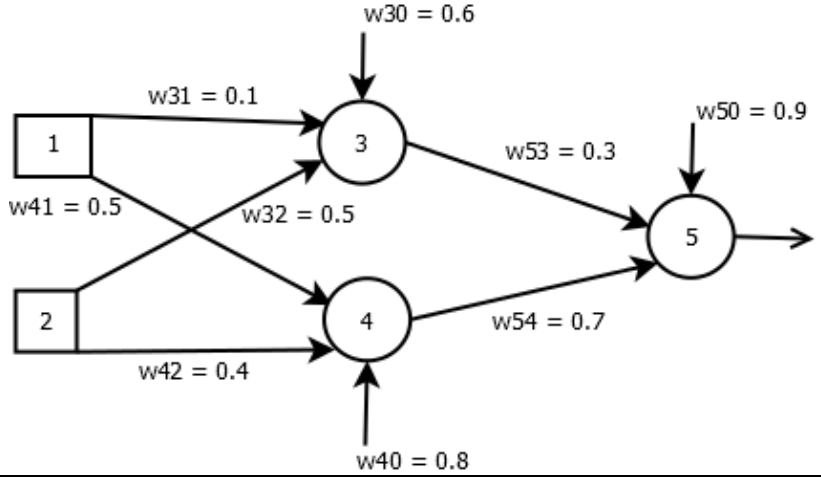
Fourth Semester B.E Degree Examination

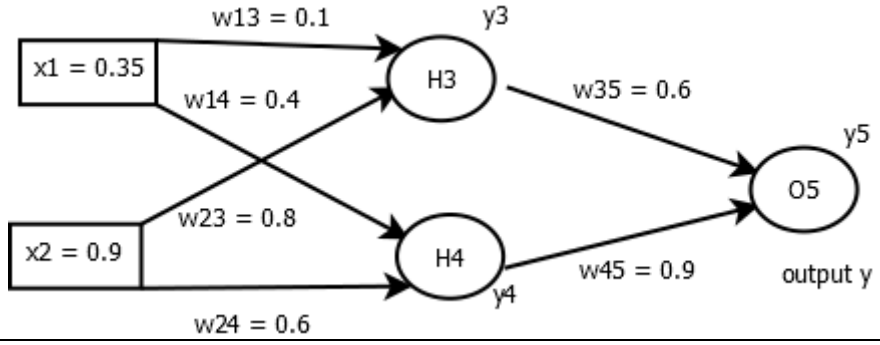
OPTIMIZATION TECHNIQUES (BCS405C)

TIME:03Hours **Max.Marks:100**

Note:

1. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**
2. VTU Formula Hand Book is Permitted
3. M: Marks, L: RBT levels, C: Course outcomes.

		Module - 1	M	L	C
Q.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 $\frac{df}{dt}$.	7	L2	CO1
	b	Obtain the gradient of scalar $\phi = 4x_0 + 2x_1 - 3x_2 + x_4$ with respect to the matrix $\vec{x} = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$.	6	L2	CO1
	c	Obtain the power series expansion of $f(x, y) = x^2y + 3y - 2$ in terms of $(x-1)$ and $(y+2)$ up to second degree.	7	L3	CO1
		OR			
Q.2	a	Discuss the gradient of vectors with respect to matrices.	7	L2	CO1
	b	If $\vec{x}, \vec{y} \in \mathbb{R}^2$ and $y_1 = -2x_1 + x_2$, $y_2 = x_1 + x_2$. Show that the Jacobian determinant $\lvert\det \boldsymbol{J}\rvert = 3$.	6	L3	CO1
	c	Find the second order Taylor's series approximation of the function $f(x_1, x_2) = x_1^2x_2 + 5x_1e^{x_2}$ about the point $a = 1$, $b = 0$.	7	L3	CO1
		Module – 2			
Q.3	a	Draw a computation graph of the function: $f(x) = \sqrt{x^2 + e^{x^2}} + \cos(x^2 + e^{x^2})$. Also find $\frac{\partial f}{\partial x}$ using automatic differentiation.	8	L3	CO2
	b	Obtain the gradient of quadratic cost.	6	L3	CO2
	c	Find the output at neuron 5, if input vector [0.7, 0.3] using the activation function ReLU. 	6	L3	CO2

		OR			
Q.4	**a**	Let $f(x_1, x_2) = \log(x_1) + x_1x_2 - \sin(x_2)$. (i) Draw a computational graph of $f(x_1, x_2)$. (ii) Evaluate f at $(x_1, x_2) = (2, 5)$ by forward trace.	**8**	**L3**	**CO2**
	b	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 0.5 and learning rate is 1. Perform another forward pass. 	**12**	**L3**	**CO2**
		Module – 3			
Q.5	**a**	Describe Local and Global optima. List out the differences between Local and Global optima.	**5**	**L2**	**CO3**
	b	Define Hessian matrix. Using the Hessian matrix, classify the relative extreme for the function $f(x, y) = \frac{1}{3}x^3 + xy^2 - 8xy + 3$	**7**	**L3**	**CO3**
	c	Explain the algorithm of sequential search. Using the sequential search, for an array of size 7 with elements 13, 9, 21, 15, 39, 19, and 27 that starts with 0 and ends with size minus one, 6 locate the position of number 39.	**8**	**L3**	**CO3**
		OR			
Q.6	**a**	Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from $X_0 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$	**7**	**L3**	**CO3**
	b	Write the algorithm for Fibonacci search method.	**6**	**L2**	**CO3**
	c	Using 3-point interval search method, find $Max\ f(x) = x(5\pi - x)$ on $[0,20]$ with $\varepsilon = 0.1$	**7**	**L3**	**CO3**
		Module – 4			
Q.7	**a**	Use steepest Descent method for f(x, y) = $x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $x_1 = (0, 0)$	**7**	**L3**	**CO4**
	b	Explain how the Gradient Descent Algorithm works?	**6**	**L2**	**CO4**
	c	Find the Linear Regression Coefficients using Gradient Descent Method.	**7**	**L2**	**CO4**
		OR			
Q.8	**a**	Use the NR method to find the smallest and the second smallest positive roots of the equation tan x = 4x correct to 4 decimal places.	**7**	**L3**	**CO4**
	b	Write the differences between Stochastic Gradient Descent and Mini Batch Gradient Descent methods.	**6**	**L2**	**CO4**
	c	Write the Stochastic Gradient Descent Algorithm.	**7**	**L2**	**CO4**
		Module – 5			

Q.9	**a**	Explain in brief 1. Adagrad optimization strategy 2. 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**	**L2**	**CO5**
OR					
Q.10	**a**	Write a short notes on 1.Stochastic gradient descent with momentum 2.ADAM	**10**	**L2**	**CO5**
	b	What is the best optimization algorithm for machine learning	**5**	**L2**	**CO5**
	c	Briefly explain the advantages of RMSprop over Adagrad	**5**	**L2**	**CO5**

Model Question Paper-II with effect from 2022(CBCS Scheme)

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Fourth Semester B.E Degree Examination

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		Module - 1	M	L	C
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	b	Obtain the gradient of matrix $\vec{f} = \begin{bmatrix} \sin(x_0 + 2x_1) & 2x_1 + x_3 \\ 2x_0 + x_2 & \cos(2x_2 + x_3) \end{bmatrix}$ with respect to the matrix $\vec{x} = \begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$.	7	L3	CO1
	c	Obtain the partial derivatives for (i) $f(x, y) = (x + 2y^3)^2$ (ii) $f(x, y) = x^2y + xy^3$	6	L3	CO1
		OR			
Q.2	a	Discuss (i) Gradient of a matrix with respect to a vector. (ii) Gradient of a matrix with respect to a matrix.	10	L2	CO1
	b	Find the Taylor's series expansion of the function $f(x, y) = x^2 + 2xy + y^3$ at $(x_0, y_0) = (1, 2)$ up to third degree.	10	L3	CO1
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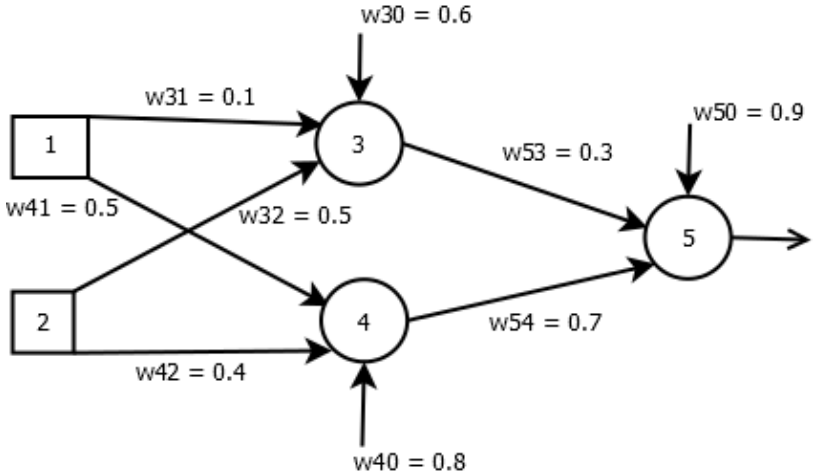
	c	Find the output at neuron 5, if input vector [0.7, 0.3] using the activation function ReLU. 	6	L3	CO2

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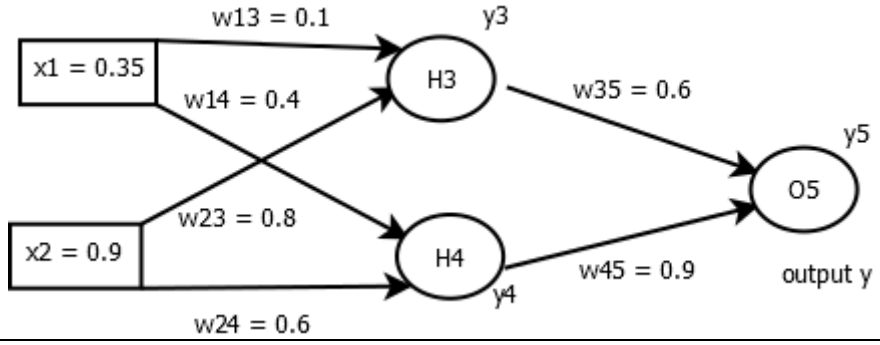
	b	Assume that the neuron have a sigmoid activation function, perform a forward pass and a backward pass on the network. Assume that the actual output of y is 0.5 and learning rate is 1. Perform another forward pass. 	**12**	**L3**	**CO2**
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