Name : Enrolment No. :	UPES

UPES

End Semester Examination, May 2023

Course : ANN & Its Applications	Semester : 2^{nd}
Program :MTech	Time : 3 hour
Course Code : AI7005P	Max. Marks : 100
Instructions : Attempt all Sections	

SECTION-A

(5Q $\times$ 4M = 20 Marks)

S. No.		Marks	CO
Q.1	Consider a kernel $h = \begin{bmatrix} 0.2 & 0.2 \\ 0.2 & -0.2 \end{bmatrix}$, Is this kernel symmetric or non-symmetric? How are symmetric and non-symmetric kernels different?	4	CO3
Q.2	What are vanishing gradient and exploding gradient problems in neural networks? Explain with respect to delta rule.	4	CO1
Q.3	State the equations of continous and discrete 2D correlation and convolution. State how correlation is different from convolution based on your equations.	4	CO1
Q.4	We have an impulse image matrix I, which looks like $I = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ for a 3x3 image, and $I = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$ for a 5x5 image matrix. Carry out correlation and convolution of the above image with 3x3 kernel $h = \begin{bmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{bmatrix}$. State the results of correlation and convolution and point out how they are different.	4	CO2
Q.5	What is the Stochastic Gradient Descent (SGD) algorithm? What is one epoch ? What is batch size?	4	CO2

SECTION-B (4Q $\times$ 10M = 40 Marks)			
S. No.		Marks	CO
Q.6	(a) What are error/objective functions? What is their role in Neural networks? State three error functions you are familer with. (b) Give the formulas for your error functions.	10 (7) (3)	CO4, CO6
Q.7	What is a convolution neuron in an artificial neural network? What is the receptive field of a convolution kernal? State the receptive field of a kernal of size $k \times k$. What is 1×1 convolution? State the resulting feature map size if 32, 1×1 convolution kernel is applied to a feature map of size $64 \times 64 \times 64$.	10	CO5
Q.8	(a) State two 3×3 kernals which will compute the derivative of an image in x and y directions. (b) For an image $I = \begin{bmatrix} 10 & 10 & 11 & 11 & 12 & 12 \\ 10 & 11 & 11 & 12 & 8 & 5 \\ 10 & 11 & 8 & 3 & 2 & 2 \\ 10 & 8 & 3 & 2 & 2 & 3 \\ 10 & 4 & 2 & 2 & 2 & 3 \\ 8 & 3 & 2 & 2 & 2 & 2 \end{bmatrix}$ compute I_x and I_y using your kernals stated above.	10 (2) (8)	CO5
Q.9	For the neural network stated below. Compute and state the number of trainable parameters in each layer and hence total number of parameters?	10	CO 6

```
def create_generator():
    generator=Sequential()
    generator.add(Dense(units=256,input_dim=100))
    generator.add(LeakyReLU(0.2))

    generator.add(Dense(units=512))
    generator.add(LeakyReLU(0.2))

    generator.add(Dense(units=1024))
    generator.add(LeakyReLU(0.2))

    generator.add(Dense(units=3072, activation='tanh'))

    generator.compile(loss='binary_crossentropy', optimizer=adam_optimizer())
    return generator
g=create_generator()
```

(2Q $\times$ 20M = 40 Marks)			
S. No.		Marks	CO
Q.10	**Principal Component Analysis (PCA)** (a) Let $X = N \times 4$ be a data matrix. Give your interpretation of the numbers of data samples in the matrix and the length of the feature vectors for each data samples. (2) (b) What is data covariance matrix, give an expression for it. What will be the size of the data covariance matrix for the above data matrix? (4) (c) Carry out principal component analysis for data whose covariance matrix is $\begin{bmatrix} 6 & 10 & 6 \\ 0 & 8 & 12 \\ 0 & 0 & 2 \end{bmatrix}$ How many principal components and eigen-values are there for this matrix? Cleary state the PCs and their correponding variances. (10) (d) State four uses of PCA. (4)	20	CO4
Q.11	**Radial Basis Functions** We have a problem of multivariate non-linear regression. There are 100 input features for the problem and we need to predict the output variable. We have to construct a RBF network for this problem. (a) What will be the number of nodes in the input and output layers? (2) (b) Let there be 150 neurons in the hidden layers. Construct human understandable computational graph representation of this RBF network. (4) (c) Compute the total number of trainable parameters for this RBF. Please do show the intermediate steps for your computation for each layer. (4) (d) What will be your choice of activation functions in the hidden and output layers of your RBF? Give reasons for your choice. (5) (e) A Gaussian function is defined as $G(\|\mathbf{x} - \mathbf{t_i}\| = exp(-\|\mathbf{x} - \mathbf{t_i}\|^2)), i = 1, 2$ where the centers $\mathbf{t_1}$ and $\mathbf{t_2}$ are $\mathbf{t_1} = [1, 0]^T$ and $\mathbf{t_2} = [0, 1]^T$ Compute the values of the function G for $x = \begin{bmatrix} 0, & 0 \\ 1, & 0 \\ 0, & 1 \\ 1, & 1 \end{bmatrix}^T$ (5)	20	CO3