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University Examinations 2024/2025

SECOND YEAR FIRST SEMESTER FOR THE DEGREE OF BACHELOR OF SCIENCE IN DATA SCIENCE, BACHELLOR OF SCIENCE IN COMPUTER SCIENCE, BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY,

CCS 3400: NEURAL NETWORKS

DATE: JANUARY 2025 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **ONE** (Compulsory) and any other **TWO** questions*

QUESTION ONE (30 MARKS)

a) Differentiate between:

i. Weight and bias (2 marks)

ii. Learning rate and hyperparameter (2 marks)

iii. supervised learning and reinforcement learning (2 marks)

iv. Training loss and validation loss " (2 marks)

b) Discuss briefly why model regularization is important (2 marks)

c) Suppose we train a neural network classifier in a supervised fashion and notice that it suffers from overfitting. What are some of the common ways to reduce overfitting in neural networks (4 marks)?

d) Illustrate and explain any two Nonlinear Activation Functions types (4 marks)

e) List and explain any two cost functions for regression problems. (2 marks)

f) Write short explanations on the following:

i. YOLO (2 marks)

ii. Dropout (2 marks)

iii. Ensemble method concept (2 marks)

iv. Lang Chain (2 marks)

v. Prompt engineering (2 marks)

QUESTION TWO (20 MARKS)

a) State the challenges faced while implementing the algorithms of machine learning. (3 marks)

b) Study the following Confusion Matrix.

i. Fill in the missing sections (3 marks)

ii. Explain your answer (3 marks)

		Predicted Class	
		Positive	**Negative**
Actual Class	**Positive**		
	Negative	False Positive (FP)	

c) Compare and contrast:

i. "training, validation and test" datasets (3 marks)

ii. Epoch, batch and sample size (3 marks)

d) Enumerate the layers of CNN stating their functions (5 marks)

QUESTION THREE (20 MARKS)

a) Using an example, demonstrate the concept of "Backpropagation" (2 marks)

b) Discus the difference between: (6 marks)

i. transfer learning and fine-tuning

ii.RNN and Convolutional neural networks

iii.Large Language Model and Generative AI

c) Illustrate the following activation functions. (4 marks)

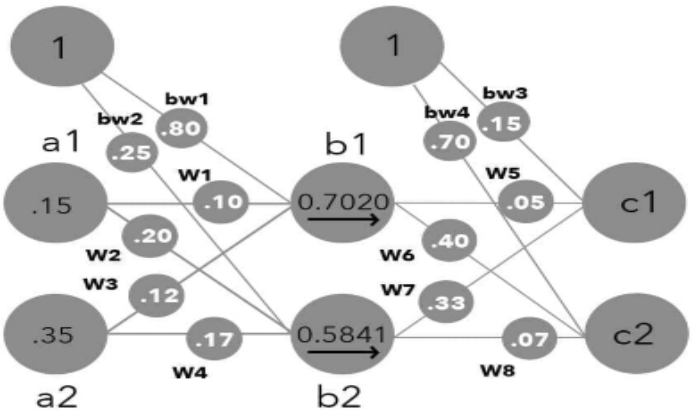
i.Tanh

ii.ReLU

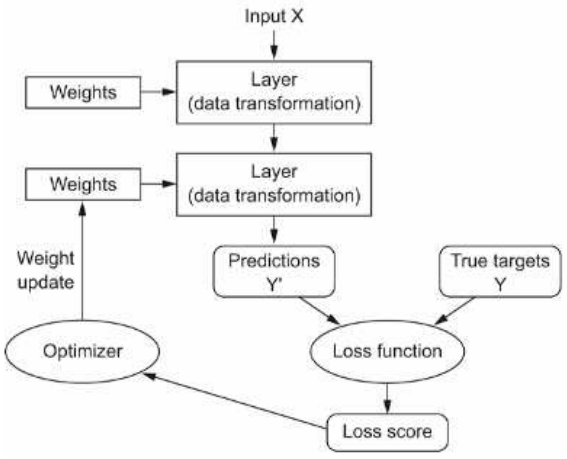
iii.Sigmoid

iv.Softmax

d) Moving from Layer B to C(neural network illustrated below), calculate the output of nodes C1 and C2. Show your working. (4 marks)



e) Interpret the diagram below: (4 marks)



QUESTION FOUR (20 MARKS)

a) Discuss briefly the following concept:
   i. momentum (2 marks)
   ii. regularization (2 marks)
   iii. Learning rate (2 marks)
   iv. Epoch (2 marks)
   v. Dropout (2 marks)

b) List and describe briefly any two Multi-Class Classification Loss Functions (4 marks)

c) Describe the overall sequence of steps followed to train a neural network using gradient descent and backpropagation. (6 marks)

QUESTION FIVE (20 MARKS)

a) Compare and contrast the concepts of:
   i. supervised, unsupervised and reinforcement learning (3 marks)
   ii. A darn, Adagrad, RMS Prop (3 marks)

b) Discuss in detail the Transfer Learning approach in Deep Learning (4 marks)

c) Interpret the following cost function formula: (4 marks)

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(t_i - z_i)^2$$

d) Explain the importance of the following: (6 marks)
   i. Local minima
   ii. bias
   iii. Cross-entropy
   iv. L1/L2
   v. RELU
   vi. Maxpooling