# COMPUTER AND INFORMATION DEPARTMENT

**SDT 2143**

**ARTIFICIAL INTELLIGENCE**

**IN MODERN COMPUTING**

**LAB ACTIVITY :**

**INTRODUCTION TO NEURAL NETWORK**

**Multiple Choice Questions (20)**

1. What is the basic unit of a neural network?

   A. Neuron

   B. Pixel

   C. Layer

   D. Weight

2. Which part of a neural network adjusts during training?

   A. Input

   B. Output

   C. Weights

   D. Activation

3. What does backpropagation primarily optimize?

   A. Input data

   B. Activation function

   C. Loss function

   D. Parameter values

4. Which function introduces non-linearity in neural networks?

   A. Linear regression

   B. Activation function

   C. Cost function

   D. Gradient descent

5. What is the role of the loss function?

   A. To store weights

   B. To calculate error

   C. To activate neurons

   D. To normalize data

6. Which algorithm is used to minimize the loss function?

   A. Decision tree

   B. K-means

   C. Gradient descent

   D. Random forest

7. What does a neural network mimic?

   A. Human heart

   B. Human brain

   C. Human lungs

   D. Human eye

8. Which layer receives the raw input data?

   A. Output layer

   B. Hidden layer

   C. Input layer

   D. Activation layer

9. What is the output of a neuron called?

   A. Signal

   B. Activation

   C. Gradient

   D. Bias

10. Which of the following is NOT a common activation function?

    A. ReLU

    B. Sigmoid

    C. Tanh

    D. Linear regression


11. What is the purpose of the hidden layer?

    A. To store data

    B. To perform computations

    C. To display results

    D. To collect feedback


12. What does the term "epoch" refer to in training?

    A. One complete pass through the dataset

    B. One neuron activation

    C. One layer computation

    D. One weight update


13. Which concept helps neural networks generalize better?

    A. Overfitting

    B. Underfitting

    C. Regularization

    D. Memorization


14. What is the derivative of the loss function used for?

    A. To increase error

    B. To update weights

    C. To normalize data

    D. To activate neurons

15. Which layer produces the final prediction?

    A. Input layer

    B. Hidden layer

    C. Output layer

    D. Activation layer

16. What does "feedforward" refer to?

    A. Sending data backward

    B. Updating weights

    C. Passing input through the network

    D. Calculating gradients

17. What is the main drawback of deep networks?

    A. Too few parameters

    B. High interpretability

    C. Overfitting

    D. Low accuracy

18. Which of the following is a supervised learning task?

    A. Clustering

    B. Classification

    C. Dimensionality reduction

    D. Association rule mining

19. What is the role of bias in a neuron?

    A. To scale the output

    B. To shift the activation

    C. To reduce error

    D. To store weights

20. What does the acronym "ML" stand for?

   A. Machine Logic

   B. Machine Learning

   C. Model Layer

   D. Memory Loop

**Short Essay Questions**

Based on your understanding and in your own words,

1. Explain the concept of backpropagation and its role in training neural networks. (4 marks)

2. Describe how activation functions contribute to the learning capability of neural networks. (4 marks)

3. Discuss the similarities and differences between the human brain and artificial neural networks.

(4 marks)

4. How does gradient descent help in minimizing the loss function during training?

5. What are the challenges of training deep neural networks and how can they be mitigated?

**True/False Questions (HIGHLIGHT THE CORRECT ANSWERS)**

1. Neural networks are inspired by the human brain.  (TRUE / FALSE )

2. Backpropagation increases the error in the network.  (TRUE / FALSE )

3. The input layer is responsible for producing predictions.  (TRUE / FALSE )

4. Activation functions help introduce non-linearity.  (TRUE / FALSE )

5. Weights in a neural network remain constant during training.  (TRUE / FALSE )

6. Bias helps shift the activation function.  (TRUE / FALSE )

7. Feedforward is the process of sending data backward.  (TRUE / FALSE )

8. Gradient descent is used to update weights.  (TRUE / FALSE )

9. Overfitting occurs when a model performs well on training data but poorly on unseen data.

(TRUE / FALSE )

10. The loss function measures the accuracy of predictions.  (TRUE / FALSE )

11. Neural networks can only be used for image recognition.  (TRUE / FALSE )

12. The output layer provides the final result of the network.  (TRUE / FALSE )

13. Epoch refers to a single neuron activation.  (TRUE / FALSE )

14. Regularization helps prevent overfitting.  (TRUE / FALSE )

15. Deep learning is a subset of machine learning.  (TRUE / FALSE )

**Multiple Choice Questions**
1. A. Neuron
2. C. Weights
3. D. Parameter values
4. B. Activation function
5. B. To calculate error
6. C. Gradient descent
7. B. Human brain
8. C. Input layer
9. B. Activation
10. D. Linear regression
11. B. To perform computations
12. A. One complete pass through the dataset
13. C. Regularization
14. B. To update weights
15. C. Output layer
16. C. Passing input through the network
17. C. Overfitting
18. B. Classification
19. B. To shift the activation
20. B. Machine Learning

1. Backpropagation is the core algorithm for training neural networks. It works in two main steps: first, data is passed forward through the network to make a prediction and calculate the error (loss). Then, this error is propagated backward from the output layer to the input layer. During this backward pass, the algorithm calculates the gradient of the loss function with respect to each weight and bias in the network using the chain rule of calculus. These gradients indicate how much each parameter contributed to the final error, allowing an optimization algorithm like gradient descent to make precise adjustments to minimize the loss in the next iteration.

2. Activation functions are crucial because they introduce non-linearity into the network. Without them, a neural network would simply be a stack of linear transformations, no more powerful than a single linear model. Non-linear functions like Sigmoid, Tanh, and ReLU allow the network to learn and represent complex, real-world patterns and relationships beyond simple straight lines. They decide whether a neuron should be activate or not, enabling the network to build a complex mapping between inputs and outputs, which is essential for tasks like image recognition and language processing.

3.

| Aspect | Human Brain | Artificial Neural Networks |
|---|---|---|
| **Basic Unit & Structure** | Network of biological neurons. | Network of artificial neurons (nodes). |
| **Learning Mechanism** | Learns by strengthening synaptic connections. | Learns by adjusting numerical weights between nodes. |
| **Processing & Capability** | General, common-sense, and unsupervised learning. | Specialized, requires large data, excels at specific tasks. |
| **Efficiency & Operation** | Highly energy-efficient and parallel. | Computationally intensive and typically digital. |

4. **Gradient descent** minimizes the loss function by iteratively adjusting the model's parameters (weights and biases). It calculates the gradient (the slope) of the loss function at the current parameter values. Since the gradient points in the direction of the steepest ascent, gradient descent moves the parameters in the *opposite direction* (downhill) by a small step called the **learning rate**. This process is repeated, gradually descending the loss landscape until a (hopefully) minimum value is reached.

5. Challenges:
    a. Vanishing/Exploding Gradients: Gradients become extremely small or large as they are backpropagated through many layers, halting learning.
    b. Overfitting: The model memorizes the training data and fails to generalize to new data.
    c. Computational Cost: Deep networks require significant processing power and time to train.
    d. Mitigation:
    e. Using activation functions like ReLU and techniques like Batch Normalization to combat vanishing gradients.
    f. Applying Regularization methods (e.g., L1/L2, Dropout) to prevent overfitting.
    g. Using powerful hardware (GPUs/TPUs) and optimized libraries to handle computational demands.

True/False Questions
1. TRUE
2. FALSE
3. FALSE
4. TRUE
5. FALSE
6. TRUE
7. FALSE
8. TRUE
9. TRUE
10. FALSE
11. FALSE
12. TRUE
13. FALSE
14. TRUE
15. TRUE