Institute of Technical Education & Research, Siksha 'O' Anusandhan
(formerly SOA University or Siksha 'O' Anusandhan)

Centre for Artificial Intelligence and Machine Learning

Subject Code: CSE 2194 - Supervised Machine Learning

Last Date of Submission: 23/05/2024

Major Assignment

Support Vector Machine (SVM)

1. Discuss the capability of the Radial Kernel in the Support Vector Machine to manage infinite-dimensional datasets.
2. The Radial Basis Function (RBF) kernel is renowned for Weighted Nearest Neighbor. Provide an example using a dataset and demonstrate the significant impact of the closest value.
3. Contrast the Linear, Polynomial, and Radial Basis Function Kernels.
4. Distinguish between the Soft Margin and Maximal Margin Classifiers. Elaborate on the concept of the threshold for the support vector.

Decision Tree

1. Explain the principles of Entropy and Information Gain.
2. Given the training set displayed in Table 1, comprising three features (X, Y, Z) and two classes (I, II), calculate the entropy of the target attribute 'C' and determine the root node of the Decision Tree using Information Gain.

X	Y	Z	C
1	1	1	I
1	1	0	I
0	0	1	II
1	0	0	II

Table 1: Training Set

3. Utilizing the previously calculated Information Gain, construct the Decision Tree.
4. Calculate the Entropy for the following scenarios:

(a) A bucket containing 4 red balls and 2 black balls.

(b) A bucket containing 10 red balls and 4 blue balls.

Random Forest

1. Describe the concept of Ensemble Learning using a diagram and an illustrative example.

2. Define a Bootstrap Dataset and its application in Random Forest. Explain the operation of a Random Forest with the aid of a diagram and example.

Neural Network

1. Illustrate the structure of an artificial neuron and provide the mathematical equation for its computation.

2. Explain the role of an Activation Function and differentiate between Saturated and Non-saturated functions.

3. Conduct a critical analysis of the Confusion Matrix provided in Figure 1 and compute Accuracy, Precision, Recall, and F1 Score.

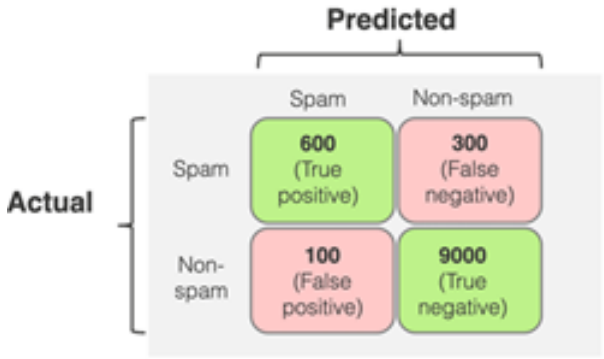

Figure 1: Confusion Matrix

4. Define a Neural Network and elucidate fundamental terms such as Input Layer, Hidden Layer, and Output Layer. Provide an example demonstrating its operation and outline key considerations in its design.

5. What are Convolutional Neural Networks (CNNs)? Describe them with equations and explain the functions of filters and input feature maps in the convolution operation.

6. Enumerate the most prominent types of Deep Neural Networks.

7. Create graphs and equations for:
    (a) Sigmoid
    (b) Hyperbolic Tangent
    (c) ReLU (Rectified Linear Unit)
    (d) Leaky ReLU
    (e) Exponential ReLU
8. Define a Confusion Matrix and elaborate on Accuracy, Precision, Recall, and F1 Score.
9. Explain with an example the concepts of Fully Connected Neural Network and Sparsely Connected Neural Network.
10. Explain the functionality of the Auto-Regressive Integrated Moving Average (ARIMA) model with an example.