MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. (Industrial Automation and Robotics)
End Sem Examination

SUBJECT: Machine Learning [MTE 5054]
Date: 2/6/2023

Time: 3 Hour Exam time: 9:30AM-12:30PM **MAX. MARKS: 50**

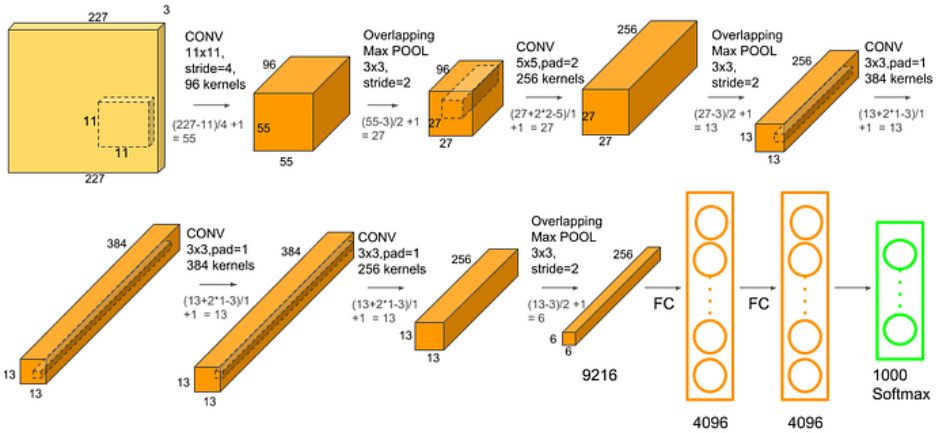
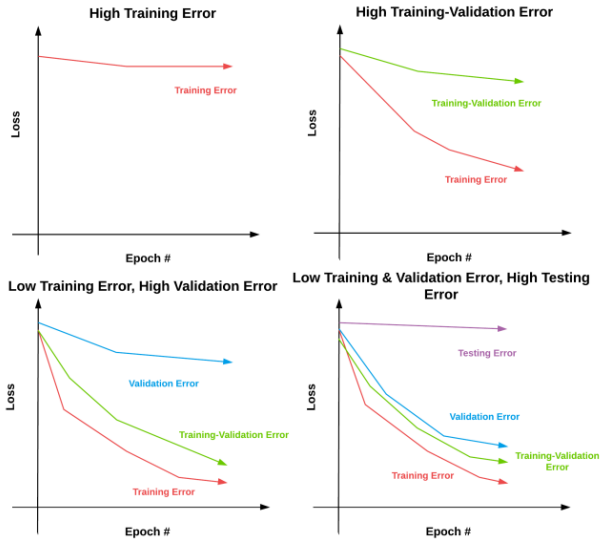
Instructions to Candidates:

- Answer ALL the questions.
- Missing data may be suitably assumed and justified.

Q. No	Question	M	CO	PO	LO	BL
1QA	Consider the dataset (shown in Table 1QA) containing outlook, temperature, humidity, and windy feature of a place used for training the Naïve Bayes algorithm. Outlook / Temperature / Humidity / Windy / Play sunny / hot / high / false / NO sunny / hot / high / true / NO overcast / hot / high / false / YES rainy / mild / high / false / YES rainy / cool / normal / false / YES rainy / cool / normal / true / NO overcast / cool / normal / true / YES sunny / mild / high / false / NO sunny / cool / normal / false / YES rainy / mild / normal / false / YES sunny / mild / normal / true / YES overcast / mild / high / true / YES overcast / hot / normal / false / YES rainy / mild / high / true / NO Table 1QA: dataset Predict the probability of playing when the weather conditions are outlook of rainy, temperature of hot, humidity of normal, and windy true using the Naïve Bayes algorithm.	5	1	4	1	3
1QB	Consider the classification of flower dataset for predicting the color based on 2 features, i.e, brightness, and saturation with class as colors red or blue as shown in the Table 1QB. Classify the color with brightness of 50 and saturation of 80 using KNN classifier. Choose the best K value for prediction. Justify the selection of K value for given dataset. **Brightness** / **Saturation** / **Class** 40 / 20 / Red 50 / 50 / Blue 60 / 90 / Blue 10 / 25 / Red 70 / 70 / Blue 60 / 10 / Red 25 / 80 / Blue Table 1QB: flower dataset for color prediction	5	1	4	2	4

2QA	Assume that you are working in the factory that produces wind turbines. Consider a set of features such as temperature, wind, energy, etc. You are asked to test the system whether it is faulty or not. Model the anomaly detection algorithm by fitting Gaussian distribution for the given data and how the threshold parameter is selected for the optimal result.	5	2	4	1	3
2QB	A new virus is affecting the population. People who have the virus will normally have specific symptoms such as a cough and the loss of the sense of taste and/or smell. It is estimated that 1 in 5 of people who suffer these symptoms have the virus and 1 in 2000 people without these symptoms have the virus. A test for the virus has the following accuracy using SVM classifier. For people with symptoms, the true positive rate is 90% and the false positive rate is 5%. For people without symptoms, the true positive rate is 80% and the false positive rate is 1%. Construct the confusion matrix, discuss accuracy, F1 score, precision and recall of given classifier.	5	2	4	2	3
3QA	You are asked to collect the dataset of people performing yoga for classification of yoga poses. What are the ethical concerns that you need to pay attention to before you start your project (provide 5 points).	5	3	4	2	3
3QB	You work as a lead data scientist for a bio-sciences company and under your supervision you have a junior Machine Learning engineer. You asked them to develop a model for recognizing 10 different classes of bacteria from 28x28 RGB images. The ML engineer came back to you with their proposed architecture, shown in Fig 3QB. Is there anything wrong with it? Provide the reasoning behind your answer. Fig 3QB: sample pytorch code for classification of images	5	3	4	2	4

```
class MyNet(torch.nn.Module):
    def __init__(self, num_inputs, C1, C2, num_outputs):
        super(MyNet, self).__init__()
        self.num_inputs = num_inputs
        self.num_outputs = num_outputs
        if C1 != C2:
            self.expand_channels = nn.Conv2d(C1, C2, 1)
        self.relu = nn.ReLU()
        self.stem = nn.Conv2d(num_inputs, C1, kernel_size = 5, padding = 2)
        self.bn1 = nn.BatchNorm2d(C1)
        self.conv1 = nn.Conv2d(C1, C1, kernel_size = 5, padding = 2)
        self.sigmoid = nn.Sigmoid()
        self.bn2 = nn.BatchNorm2d(C1)
        self.conv2 = nn.Conv2d(C1, C2, kernel_size = 5, padding = 2)
        self.conv_last = nn.Conv2d(C2, C2, kernel_size = 3, stride = 4)
        self.fl = nn.Flatten()
        self.lin = nn.Linear(784, num_outputs)
    def forward(self, x):
        x = self.stem(x)
        identity = x
        x = self.bn1(x)
        x = self.relu(x)
        x = self.conv1(x)
        x = self.bn2(x)
        x = self.relu(x)
        x = self.conv2(x)
        if self.expand_channels is not None:
            identity = self.expand_channels(identity)
        x = identity
        x = self.relu(x)
        out = self.conv_last(x)
        out = self.fl(out)
        out = self.lin(out)
        return out
```

4QA	The layers of AlexNet architecture is depicted in the Fig 4QA.  Fig 4QA. AlexNet Architecture Analyze the significance of the layer and justify the size of each layer with mathematical computation.	5	4	4	2	4
4QB	A custom CNN architecture is tried with different dataset. Justify the reasons for each loss curve in each graph provided in the Fig 4QB.  Fig 4QB. loss vs epochs	5	4	4	2	5
5QA	You work as a Deep Learning engineer in an self-driving car company and you're given a labelled dataset of 100 images of cars belonging to 10 different categories. You must use the dataset to train a model that will achieve at least 90% accuracy in recognizing the correct car model. Moreover, your model must be as lightweight as possible meaning that it should contain as few parameters as possible. Your advisor suggests to use the pretrained architecture. Describe your strategy (i.e. training process) to classify the car category that meets the given requirements.	5	4	4	2	5
5QB	Assume that you have images of dimension 128x128x3. These images are processed by a small network consisting of 2 convolutional layers, 1 average pooling layer and 1 linear layer as follows: For the frst convolutional layer, the spatial dimensions of the convolutional kernel are 7x7, there are 256 kernels, the stride is equal to 1 and no padding is used. The image is then processed by a convolutional layer with kernel size 5x5, stride 2, and no padding, and then max pooling of size 2x2 with the stride os 2 is applied. Finally this tensor is flattened and passed to a linear layer to classify 10 classes. Assume that all layers do not have bias terms. What is the total number of parameters in the network? Provide all the details of your calculation for every steps.	5	4	4	2	4