Report on
Guest Lecture on

Machine Learning and its Applications
Organized by
Department of Computer Science & Engineering
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Participants : II Year B.Tech – Computer Science & Engineering Students – MITS

Resource Person: Dr. Pradeep Kumar Roy, Assistant Professor, Dept. of CSE, IIIT Surat.

A Guest Lecture on "Machine Learning & its Applications" was organized by the Department of Computer Science & Engineering through Virtual mode (Online) for II B. Tech students.

The inauguration of the Guest Lecture was started at 10:00 A.M in Seminar Hall – B, the dignitaries were Dr.R. Kalpana, HoD-CSE, Dr. Pradeep Kumar Roy, Assistant Professor, Dept. of CSE, IIIT Surat, Mr. BSH. Shayeez Ahamed, Asst. Professor, Mrs. G. Vasundhara Devi, Asst. Professor.

The lecture was started with opening remarks by, Dr. R. Kalpana who thanked Management for this great initiation of creating an opportunity to invite the resource person of the institute and enabling them to interact with the students and enlightening them with the current developments in the corporate world.

Mrs. R. Usha has introduced about the speaker and invited him to share his valuable experiences to the students. The number of students participated in the lecture were around 115.

After inaugural session, the main session was started at 10:20 A.M, Dr. Pradeep Kumar Roy explained about Machine Learning & its Applications.

Machine Learning

Machine learning is concerned with algorithms which train a machine learning model to learn how to perform tasks using data rather than hand-coded rules. These tasks often involve classification (i.e. determining what's in a picture), prediction (i.e. which Netflix shows is this user most likely to watch), decision making (i.e. should this autonomous car turn), or data generation (i.e. human speech synthesis). Machine learning data most frequently takes the form of input-label pairs (x, y) where x is the input to a machine learning model and y is the label or expected output. x is typically a multi-dimensional vector. Each element of the input vector is called a feature. For example, for an image classification problem, x would be an image bitmap with RGB values and y the content of the image (i.e. "cat"). In a machine translation problem, x might be a sentence in English and y a sentence in Spanish.

Data is often split into three partitions: training data, validation/development data, and testing data. Training data is used to train the model, validation data is used to evaluate the performance of the model on previously unseen data for model tuning purposes, and testing data is used for a final performance evaluation with completely new data. In cases where there is not a lot of data, there is usually just a training/testing split, with validation performed via cross-validation on the training data.

Machine Learning Models

At a high level, a machine learning model can be thought of as a parameterized function $\hat{y} = f(x, \theta)$ where x is the input data, θ is a set of parameters that varies from model to model, and $\hat{y}$ is the predicted output. For example, in a simple line-fitting model, the parameters would be the slope and intercept of the line. In a neural network, the parameters are all the weights of the network. The goal of machine learning then is to find θ such that $f(x, \theta)$ outputs the desired result y. The problem is that θ is often high-dimensional and continuous, which makes exhaustive search hard. Instead, we iteratively calculate θ using optimization techniques to minimize the error between the predicted labels and the true labels.

Classic machine learning models include regression models, support vector machines, and Bayesian models. Choosing a model involves considering a number of trade-offs including running time, amount of data required, and performance of the model. In addition, models often make assumptions about the underlying structure of the data, which can impact the performance of the model if the assumptions are not accurate. For example, the naive Bayes classifier assumes that the input features are independent from each other.

Neural Networks

Neural networks are the sledgehammers of machine learning. They are immensely powerful, but also require a lot of computing power and training data. Neural networks only became feasible in the past few years because of the development of more powerful hardware and the rise of big data. Neural networks are inspired by the firing mechanism of biological neurons in which a neuron only fires after the combination of its inputs reaches some threshold. However, where neurons in a brain are arranged chaotically with connections all over the place, neurons in a neural network are typically arranged in a sequence of layers, where all the neurons in a layer are connected to all the neurons in the next layer. This arrangement is known as a feed-forward network or a fully-connected network. The “firing” of a neuron is calculated by taking a weighted sum over the inputs to the neuron and then applying a nonlinear function to the weighted sum.

Other arrangement of neural networks exists for different applications. Image processing tasks often involve a convolutional network, in which activations are calculated by sliding a n x n convolutional filter across the 2D image. This has the advantage of preserving spatial information, which is often a large part of image processing. Language processing tasks, such as machine translation and natural language understanding, use recurrent neural networks in which the network maintains an internal state that is updated as the network processes an input sequence. This allows the network to preserve temporal information, such as the ordering of words in a sentence.

Constraints of Machine Learning

Machine learning is well-suited for applications in which there is an abundance of representative data, the task has well-defined inputs and outputs, and there is a quantifiable way to determine the error of the model’s predictions. If any of these conditions are not met, the performance of the model will suffer.

Representative data means that the data the model is trained and evaluated on is similar to the data that it will be seeing out in the wild. For example, a speech recognition system trained on American English would likely struggle if faced with a heavy Scottish accent. An image classification system trained to recognize objects in photographs would perform very poorly on hand-drawn pictures. Gathering sufficient data is often one of the most time-consuming and expensive parts of machine learning, as a bad dataset will inevitably produce a bad model.

A well-defined task means that the structure of the inputs and outputs are known. For example, in an autonomous driving situation, the inputs are the sensor readings and the outputs are the controls of the vehicle. In an image localization problem, the inputs are images and the outputs are bounding boxes around objects of interest. In contrast, a task such as “Decide governmental policy.” is not well-defined, as the space of possible policies to enact is both vague and infinitely large. Another challenge in machine learning is the formalization of general problems into specific well-defined tasks.

Applications of Machine learning

Machine learning is a buzzword for today's technology, and it is growing very rapidly day by day. We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc. Below are some most trending real-world applications of Machine Learning.

1. Image Recognition:

Image recognition is one of the most common applications of machine learning. It is used to identify objects, persons, places, digital images, etc. The popular use case of image recognition and face detection is, Automatic friend tagging suggestion: Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning's face detection and recognition algorithm. It is based on the Facebook project named "Deep Face," which is responsible for face recognition and person identification in the picture.

2. Speech Recognition

While using Google, we get an option of "Search by voice," it comes under speech recognition, and it's a popular application of machine learning. Speech recognition is a process of converting voice instructions into text, and it is also known as "Speech to text", or "Computer speech recognition." At present, machine learning algorithms are widely used by various applications of speech recognition. Google assistant, Siri, Cortana, and Alexa are using speech recognition technology to follow the voice instructions.

3. Traffic prediction:

If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions. It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:

- Real Time location of the vehicle form Google Map app and sensors
- Average time has taken on past days at the same time.

Everyone who is using Google Map is helping this app to make it better. It takes information from the user and sends back to its database to improve the performance.

4. Product recommendations:

Machine learning is widely used by various e-commerce and entertainment companies such as Amazon, Netflix, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning. Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest. As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.

5. Self-driving cars:

One of the most exciting applications of machine learning is self-driving cars. Machine learning plays a significant role in self-driving cars. Tesla, the most popular car manufacturing company is working on self-driving car. It is using unsupervised learning method to train the car models to detect people and objects while driving.

6. Email Spam and Malware Filtering:

Whenever we receive a new email, it is filtered automatically as important, normal, and spam. We always receive an important mail in our inbox with the important symbol and spam emails in our spam box, and the technology behind this is Machine learning. Below are some spam filters used by Gmail:

- Content Filter
- Header filter
- General blacklists filter
- Rules-based filters
- Permission filters

Some machine learning algorithms such as Multi-Layer Perceptron, Decision tree, and Naïve Bayes classifier are used for email spam filtering and malware detection.

7. Virtual Personal Assistant:

We have various virtual personal assistants such as Google assistant, Alexa, Cortana, Siri. As the name suggests, they help us in finding the information using our voice instruction. These assistants can help us in various ways just by our voice instructions such as Play music, call someone, open an email, Scheduling an appointment, etc. These virtual assistants use machine learning algorithms as an important part. These assistants record our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.

8. Online Fraud Detection:

Machine learning is making our online transaction safe and secure by detecting fraud transaction. Whenever we perform some online transaction, there may be various ways that a fraudulent transaction can take place such as fake accounts, fake ids, and steal money in the middle of a transaction. So to detect this, Feed Forward Neural network helps us by checking whether it is a genuine transaction or a fraud transaction. For each genuine transaction, the output is converted into some hash values, and these values become the input for the next round. For each genuine transaction, there is a specific pattern which gets change for the fraud transaction hence, it detects it and makes our online transactions more secure.

9. Stock Market trading:

Machine learning is widely used in stock market trading. In the stock market, there is always a risk of up and downs in shares, so for this machine learning's long short term memory neural network is used for the prediction of stock market trends.

10. Medical Diagnosis:

In medical science, machine learning is used for diseases diagnoses. With this, medical technology is growing very fast and able to build 3D models that can predict the exact position of lesions in the brain. It helps in finding brain tumors and other brain-related diseases easily.

11. Automatic Language Translation:

Nowadays, if we visit a new place and we are not aware of the language then it is not a problem at all, as for this also machine learning helps us by converting the text into our known languages. Google's GNMT (Google Neural Machine Translation) provide this feature,

which is a Neural Machine Learning that translates the text into our familiar language, and it called as automatic translation. The technology behind the automatic translation is a sequence to sequence learning algorithm, which is used with image recognition and translates the text from one language to another language.

The session is completed at 11:30 A.M, and he clarified the queries of enthusiastic young minds with a great zeal during the interaction time.

Vote of Thanks: Mr. BSH. Shayeez Ahamed proposed a vote of thanks to Resource person, HOD, II B.Tech Students for attending the function. He extended his thanks to the Principal, and the Management for their support to conduct the Programme.