Unit 2

1)Applications of Deep Learning in Retail Industry

Stocking And Inventory Analysis:

The success of a retail lie in the productive and efficient stocking and inventory management with the automated approach.

The deep learning models used these days allow the retailers to use the data online and offline and help predict the inventory needs by disintegrating the factors on various divisions like day, week of the month and the activities happening in a shop.

This data acquired can help develop analytics and visualizations for the purchasing owner. The computer vision models, along with the deep learning models, are used to detect the store images from the camera installed and the number of items in the entire store.

***Predicting Customer Behavior*:**

The deep learning models also help analyses the customer data and predict purchasing and buying behaviors, enabling the retail companies to understand the customers' requirements by investigation the price panel of their past spending and purchases and help suggest the products they might be interested. In addition, the deep learning models help generate recommendations of products that the customers can buy as complementary to the main product they are interested in rather than purchasing an unrelated product. On top of this, we can present the customers with suggestions on healthcare products they can buy weekly, monthly or quarterly.

* Deep Learning enjoys a flourishing evolution with tremendous achievements in image dassification and object detection.

* the intention of product recognition is to facilitate the management of retail products and improve customers' shopping experience. At present barcode recognition is the most widely used technology not only in research but also in industries where automatic Identifications of commodities is used.

* As retail is evolving at an accelerated rate, enterprises are increasingly focusing on how to use artificial intelligence technology to reshape the retail industry's ecology and integrate online and offline experiences. Based on the study from Juniper research, the global spending by retailers on AI services will increase over 300% from $3.6 billion in 2019 to $12 billion in 2023.

Computer Vision methods in Retail Product recognition

*With computer vision's rapid growth, researchers have been drawn to product recognition using the technology. Product recognition is realized by extracting features on the image of the package.

the composition of product recomendation system is

* Image capture

* Image preprocessing

*Feature extraction

*Feature classification

* the output of recognition

Deep Learning

* Deep Learning is often regarded as subfield of machine learning. The vital objective of deep learning is to learn deep presentation

* In 2006, the methods of unsupervised pretraining and fine tuning to solve the Vanishing gradient problem.

* In 2007. a greedy layer wrise training strategy was provided to optimize the initial weights for deep networks.

Convolution Neural Networks.

* The success of deep learning in computer. vision profits from (CNN's) which are wisely inspired by the biological research of the cat's visual cortex.

they conceived the LeNet convolution neural. network model that had seven layers. After training on the dataset which contained 32*32 handwritten characteristics, this model had been sucessfully. applied to the digital identifications of check.

Deep Learning for Object detection

CNN's have been the major deep Learning technique for object detection. Therefore, all the deep learning model is based on Learning has made a research on CNN.

2)Deep learning in Energy

***Demand Response* :**

when huge variations in the energy demand occur, it proves to be very expensive for even the developed nations, although they can generate power through renewable energy sources, which is likely to result in two major issues. 1.The energy demand will be at its peak. 2.weather volatility. If it remains cloudy throughout the day, there may not be enough energy production, and a situation may arise, and it may not be possible to cope with the energy demand.

It is essential to analyze the weather data and the energy demand to mitigate issues. If these are done correctly, it helps overcome the problems of an energy. Shortage, and non-renewable sources can produce excess energy. To precisely match the energy demand and supply, the utility providers can utilize historical datasets to train the deep learning models with the datasets from the turbines and the solar panel, which can be used inefficiently to forecast the energy and the weather changes

***Predicting Customer Lifetime value* :**

one must keep an eye on customer lifetime value in the energy market. This enables the utility companies to know how much their customers will spend over their contract period. The deep learning models used in the utility sectors can provide more insight than predicting customer lifetime value. However, with consumer data, their consumption patterns, and purchasing histories, it is. Possible to predict the overall value of the consumers...

With the help of deep learning models, we can go one step ahead and suggest approaches to increase customer value. In turn, it helps in making highly -targeted offers to similar consumers.

* Reep Learning provides a methodology to predict extreme loads observed in energy grids. Forecasting energy loads and prices is challenging due to sharp peaks and troughs that arise from industry system constraints due to supply demand fluctuations. and

* Data driven energy pricing used to forecast hourly location marginal prices propose newal network to predict LMP's in the PJM's interconnection

*The PJM interconnection is a regional transmission organisation that exists to Ouate a competitive wholesale electricity market, coordinating numelous wholesale electricity market and producers and consumers.

*Prices in real time cost market are a at the function to produce electricity and system constraints, such as congestion in transmission lines.

*We predict the price at each load point using the historical prices, demand and weather observations.

*The as will relations between price and weather as price and the demand. We see that demand always accurate predictor for the price.

* Electricity load forecasting is essential for designing operational strategies for electric grids. In presence of renewable energy resources. short term forecasting increasingly important. ace

3)Usage of Deep Learning Techniques in Energy

4)Deep learning in Oil & Gas

Accurate Modelling

One of the remarkable works of deep learning models in the oil and Industry is how they are transforming the discovery processes.

The deep learning models involved helps the industry to analyse massive quantities of data, including the signals and the noise in the seismic data. Once all this information is collected and analysed, we can use the latest software to build precise geological models that allow the oil & gas operators to predict what lies under the surface before the actual drilling has been initialised. If this is implemented, it is assumed to decrease the overall wellheads by more than 10%.

Defect Detection

One of the major difficulties the oil and gas industries encounter is improper threading problems or flaws in the pipeline systems that can cause them a great deal. The defects found or discovered in the production lines can cause substantial losses to the operations and budget resources.

Deep Learning models can come to the fore and help validate the production quality and offer a clear analysis of the defects in the pipeline system. For example, the pattern recognition can

capture the videos from the camera and if an oil & gas personnel is not adequately dressed up, then ring an alarm bell. Also, the deep learning models can be used to check the health status of the oil and gas equipment, which prevents a great disaster with the outcomes related to health and safety.
Applications of Deep Learning in Oil and Gas Industry

Deep learning with dynamic landscape for energy production, Deep Learning provides powreful benefits across the entire value chain. Deep Learning oil and gas companies assess the value of specific reseniours, customize drilling and completion plans according to gealogy of the area, and asses the risk of individual well

Exploration and Production

* Forecasts total recoverable reserve volumes.

* Analyze exploration and reservoir data

*Model well spacing and field development plans

* Greate lifetime well production models and more effective production focecast

Midstream and refining *

Forecast long term commodity input and product market price.

* Provide capital planning and risk evaluvation better long term decisions.

Oil field services Equipment

* Optimize drilling and Completion equipment
Scheduling and fleet management.

* Manage and optimize supply chains.

5)Deep learning in Automobile

Self driven cars

A self -driving car is an autonomous vehicle that can capture everything around its environment and can self-drive by itself without any humans controlling or managing them. No human is necessary to operate the car at any point in time, nor is anybody in the car. The self-driving cars can travel anywhere a normal car travels and does everything a human inside the cars does.

Autonomous or self-driving cars can detect objects and make intelligent decisions using deep learning object detection and classification models. In addition, autonomous or self-driving vehicles can capture data from various sensors like the RADAR and the LIDAR. The data captured and processed can then be utilized and modelled using the DL models.

Passenger Experience

The safety of the passengers is taken care of by the deep learning systems these days. In addition, automotive operators use all kinds of enhancements for the satisfaction and overall experience of the passenger. For example, we have seen facial recognition and emotion detection systems capturing the vehicle's driver's mood and mental state.

Furthermore, the deep learning models and the natural language processing applications help the passengers with a better experience by playing the movies and music of their choice. Others can even order goods and services during on-road travelling.

*All of the automatic accident detection system. suffers from tradeoff between computational Overhead and detection accuracy. Recent advances in detection and classification methodologies have shown phenomenal improvements in accuracy but these system requires a huge number of computational resources making them unviable for deployment requiring the real time feedback.

* Deep Learning refers to a set of machine learning techniques that utilize neural networks with many hidden layers for task, set of automotive cases for deep learning are :

+ Visual Inspection in Manufacturing

* Social Media analytics Autonomasis driving

*Robot and smart machines Conversational user interfaces.

*Neural networks in particular deep learning networks with many hidden layers are to scale. Also, the application against the حمد more compute intensive than challenging model other models.

*To support manufacturing an the visual inspection. process during and to aid data collection, we build i-pad application.

6)Deep learning workflow

Steps in Deep learning in Implementation

Data Collection

Data is being generated at a tremendous volume, velocity and veracity these days. The data can take any format. It can be numeric, categorical or even free-text. Data collection is collecting data from various sources. To build a scalable machine learning or deep learning solutions, we need to collect data from these sources and store them to address the business problems.

Public Datasets

Public Datasets are Open datasets available for somebody to collect, access, modify and use. The Government and individual organisations have provided the open datasets for free access and usage. Below are some of the open and public datasets available for somebody to utilise

Existing Databases

The Existing Databases of an organization contain important structured data for information for collection and performing machine learning workloads or performing analytical insights on them. Example: The Customer master and the transactional data.

Data Preparation
Cleaning Data

Data Cleaning is the preparation of data for Machine Learning operations or analytics by eradicating incorrect and accurate data.

Data cleaning is not a simple work of arranging the data and removing the unwanted rows of data. Instead, it has some amount of muscle work. Nevertheless, data cleaning is considered one of the important steps in the data preparation cycle. It involves the below:

• Correcting the spelling and syntactical issues

Data Standardization

Rectifying mistakes such as null fields

• Finding the duplicates and fixing them

Handling Categorical Data & Text

There are different techniques for handling categorical data and converting them into numeric values; they are

1.Integer Encoding

2.One Hot-Ending

Another technique known as the learned embedding can handle the categorical values.

A categorical variable's value takes on the value of labels. For example, the variable "colour" has orange, white, and pink values. Often these types of string values will have an ordinal relationship with the categories like 1st, 2nd and the 3rd. Therefore, the machine and the deep learning model need numerical values for the dependent and independent variables.

Integer Encoding: The categorical label is returned as an integer.

• One Hot Encoding: The categorical label is returned as a binary vector.

• Learned Embedding: In this technique, the categories' distributed representation is learnt.

Model Engineering

Test Train Split

One of the important procedures in machine learning is dividing the input datasets into train, test and validation. The dataset has to be split into train, test and validation datasets; failing to do so, the model will evaluate the samples it was trained upon instead of the new samples the model has never seen to be evaluated would cause problems like the overfitting of the model.

• A training dataset is a dataset utilized for training the model.

• A validation dataset is a dataset utilized for the evaluation of the models during the training process.

• A test set is a dataset that is utilised to find the accuracy of the model's performance..

Model Training

Model Training Machine Learning operates on finding relationships between a label's features with many examples from our dataset to understand the relationship between the Label and its features. In other words, it memorizes the entire input dataset perfectly. This process is called Model Training.

Model Testing

Model Testing Model Testing refers to testing the model with the Test Dataset. The model is trained with Training Data for Learning the Patterns in the Dataset, validated against the Validation Dataset, and then tested with the data never seen. This process is referred to as
Model testing

Model Outcome

Model Outcome refers to model prediction results. The results/outcome of the model is stored in a file or any persistent storage as required.

Tune Hyperparameters

We need to tune different hyperparameters of the algorithm or the model for accurate predictions. However, because of the presence of more number of parameters, we do not know which parameter to tune. There is no answer for the right number of neurons, the number of layers in the network, or the best optimizers that suit the problem at hand. Hyperparameter tuning gives the best set of parameters to tune.

Neural Network is a Deep Learning technic to build a model according to training data to predict unseen data using many layers consisting of neurons. This is similar to other Machine Learning algorithms, except for the use of multiple layers. The use of multiple layers is what makes it Deep Learning.

Instead of directly building Machine Learning in 1 line, Neural Network requires users to build the architecture before compiling them into a model. Users will have to arrange how many layers and how many nodes or neurons to build. This is not found in other conventional Machine Learning algorithms.

Different datasets require different sets of hyperparameters to predict accurately. But, the large number of hyperparameters makes users difficult to decided which one to choose. There is no answer to how many layers are the most suitable, how many neurons are the best, or which optimizer suits the best for all datasets. Hyperparameter-tuning is important to find the possible best sets of hyperparameters to build the model from a specific dataset

The process to tune 2 things of Neural Network:
(1) the hyperparameters
(2) the layers.

I find it more difficult to find the latter tutorials than the former. The first one is the same as other conventional Machine Learning algorithms. The hyperparameters to tune are the number of neurons, activation function, optimizer, learning rate, batch size, and epochs. The second step is to tune the number of layers. This is what other conventional algorithms do not have. Different layers can affect the accuracy. Fewer layers may give an underfitting result while too many layers may make it overfitting.

Deploy Model

Model Deployment is the task of successfully putting the developed machine or the deep learning model into the production systems after training and testing. The models are usually deployed in several production environments. They can be connected to applications via the application programming interfaces or the APIs and finally accessed by the end customers. The model deployment usually comes after the training and the testing stage in a machine learning implementation lifecycle, but every model is developed with the deployment in mind.

The model learning models are typically developed in the development environment where they are trained and tested. However, several times, the models developed do not meet the business objectives; only some models move on to the next stage. Hence putting the model into the production environment needs meticulous planning and execution to meet the business outcomes.

7) Fundamentals of Deep Learning

When to use Deep Learning

Deep Learning finds its usage in almost all applications involving artificial intelligence and technology. Deep learning drives the applications with a neural network architecture that enables businesses worldwide to implement DL-based solutions as part of their Artificial Intelligence

strategy. From the chatbots deployed to handle customer service to image and object detection in the retail industry, deep learning is used to build complex AI applications.

The ability of deep learning models to handle the massive amount of data and solve complex problems , along with the pre-trained model available as open-source, makes deep learning suitable for many businesses. But with this ability, deep learning is not the only solution to all machine learning problems.

But when deep learning is used is one of the biggest questions to be answered. Every use case in the industry is unique and must meet its desired outcomes, goals, timeline, etc. Nevertheless, the business has some essential considerations before they employ the deep learning models in their solution-building methodologies.

8)Architecture of Deep Learning

A basic Deep Learning model called the artificial neural network comprises a network of neurons and layers that receive the input and process them within the layers. A neural network comprises different layers, input, hidden and output. The hidden and output layers do the computation and help solve the underlying problem through trial and error methods.

Input Layers:

The Input Layer receives the input from an external source. Every node in the artificial network is connected to the other node and has weights attached to it. Weights are attached to each of the nodes. The input layer does not involve any calculations, and the main goal of the nodes is to transmit the information received as input to the next layer, the hidden layer. The number of nodes in the input layer equals the number of features from the input.

Hidden Layer:

The hidden layers are sandwiched between the input and the output layers. The hidden layers' responsibility is to perform all the required computations. The number of nodes or neurons in the hidden layer is mysterious. Additional layers of hidden nodes are added to the network that effectively provides flexibility to the system. Though these different layers are practical and flexible to the system, they bring the complexity factor into the picture.

Output Layer:

The Output layer is the network's final layer, which is responsible for delivering the expected results. There is always one output layer that should be present in the system. The Output layer receives information from the layers ahead of it, performs computations, and produces results. The number of nodes or neurons in this layer is dependent on the problem type. For example, if the problem type is regression, then one node. If the problem type is classification, then the number of neurons or nodes equals the number of classes.