Applications of ML in Industries

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A Brief Introduction to ML

- Paradigms,
- Knowledge Representation,
- Data Acquisition, Data Pre-Processing,
- Feature Extraction and Processing
- Feature Ranking and Selection, Feature Reduction,
- Model Learning,
- Evaluation and Deployment

Paradigms

- Classical to Modern AI
- Classical AI :

  Symbolic

  Rule Based

  Difficult to learn by itself

  mainly Heuristic based approach

  Reasoning based

  Expert systems

  Knowledge Representation

Modern AI

- Ability to learn by itself
- Data driven based
- Neural Network based
- **Fuzzy logic based**
- Neuro Fuzzy based
- Genetic algorithms based
- Optimization based
- Overall soft computing based

Knowledge Representation

- Predicate logic
- Propositional logic
- Semantic Net
- Conceptual Dependency
- Frames

Data Acquisition, Preprocessing,Feature Extraction

- ML demands two primary things : Data and model .
- During data acquisition features are to be maintained/selected adequately.
- With proper features, model can be trained properly.
- data gathered .
- When data available it has to be prepared with the help of preprocessing : Preprocessing involves multiple transformation operations such as filtering, sampling, scaling, reducing, editing columns, finding missing values etc.

Model : Training and Tuning

- First figure out type of analysis. Classification analysis (spam vs non-spam), a clustering analysis (automatic classification), or a regression analysis (for prediction and forecasting). compare the results of multiple models to know which one is the most efficient for your dataset. The logic here is to:

1. Select a model with default value
2. Train the model
3. Score the model
4. Evaluate the model (to figure out which model is the most efficient)
5. Sweep the model (to figure out the best configuration for your model)
6. Evaluate the model
7. Save the trained model (to be used in production)

ML in Banking and Securities: Major Areas of Banking with Potential AI intervention

- Anti Money Laundering(AML)
- Chatbot
- Fraud Detection
- Algorithmic trading and digitization: Executed by institutional traders and large Brokers.

Widely used ML Algorithm in banking and security

- Supervised ML algorithm
- Unsupervised ML algorithm
- Reinforcement ML algorithm

Domains

- Fraud and risk management
- Customer services
- Financial trading and securities
- Credit assessment
- Portfolio management

Content Based Image Retrieval System

- ML algorithm/Soft Computing based approach to reduce semantic gap.

Role of ML : Challenges of banking sector and securities

- Fraud and Risk Management : ML based solutions and predictive analytics are assisting in examination of real time transaction to identify suspicious and fraudulent operations.
- Customer Services : ML powered AI applications helps analyzing customer behavior and requirements.
- Financial trading and securities : AI based applications are assisting banks in effectively handling foreign exchange transaction and liquidity management.
- Credit assessment : ML based applications along with big data analytics are viable solution to assess the credit worthiness of the customer in case of loan disbursement.
- Portfolio management :AI and ML based technological ecosystems are helping banks in real time, smarter decisions to ensure appropriate investment plans.

Widely used ML algorithm in banking and security

- Supervised ML algorithms
- Unsupervised ML algorithms
- Reinforcement algorithms

Portfolio Management System

- Portfolio : It can be defined as financial assets like stocks, bonds, shares,mutual funds, debt instruments etc.
- In order to maintain the risk in various asset pools of investment, a portfolio is planned.

Management : In order to achieve its pre described objectives with well defined policies, a management can be defined as a firm which coordinates the activities of that firm/enterprise.

Objectives of Portfolio Management

- Security of Principal Investment
- Consistency of Returns
- Capital Growth
- Marketability
- Liquidity
- Diversification of Portfolio
- Favorable Tax Status.

Deep Learning For Customer Services

- Chatbots : The ability of chatbots is used as effective self service solution that interacts with the customer service representative and resolve their queries.
- ML allows chatbots to analyze and know when to utilize answers,collect customer details and turn over the interaction to the individual customer support agents.
- ML helps chatbots to know when to utilize unique answers, when to collect required user information and when to send a discussion to a person agent.

Recurrent Neural Network

- The main problem with feed forward neural network is it only focuses on the current value/context.
- This value is not retained in the next time stamp.
- Sometimes in the real world situation we have to retain the previous value and based on the previous and current input/context we have to decide the output.
- For example, in case of sentences what will be the next word, that can be decided with the help of the context of the previous words.

Recurrent Neural Network Contd.

- Hence in language modelling we require long term temporal dependencies to decide the next word in the sentences.
- RNN model helps in such type of situation. Long term temporal dependencies can not be achieved with feed forward neural network.
- A simple model of recurrent neural network uses tanh or sigmoid as an activation function.
- Recurrent neural network also suffers from vanishing gradient and exploding gradient problem during the training process

RNN contd.

- When training a deep neural network with gradient based learning and backpropagation, we find the partial derivatives by traversing the network from the the final layer to the initial layer.
- Using the chain rule, layers that are deeper into the network go through continuous matrix multiplications in order to compute their derivatives.

RNN Contd.

- In a network of *n* hidden layers, *n* derivatives will be multiplied together.
- If the derivatives are large then the gradient will increase exponentially as we propagate down the model until they eventually explode, and this is what we call the problem of ***exploding gradient***.
- Alternatively, if the derivatives are small then the gradient will decrease exponentially as we propagate through the model until it eventually vanishes, and this is the ***vanishing gradient*** problem.

RNN Contd.

Chatbot : Deep learning approach

- The widely using deep learning model in chatbot is sequence to sequence model.
- Sentiment Analysis

Recurrent Neural Network

Long Short Term Memory(LSTM)

- The long term dependency problem can be solved with LSTM models.
- LSTM cells are operated with the help of real number parameter called gates.
- The input gate parameter helps to decide how much new input is required to change the memory state.
- The forget gate parameter helps to decide how much previous value to retain in-memory state.
- And the output gate parameter controls how strongly the current memory state is to pass into the next layer.

LSTM Architecture

Fraud Detection : Few Supervised Learning Algorithms.(IBM –Text Material)

- Random Forest :
- Support Vector Machines:
- K-Nearest Neighbors(KNN):

Random Forest :

- Random forest is an ensemble of decision trees, i.e. develops a group of decision trees to classify data objects.
- Advantages of Random Forest :

❖The algorithm is simple and exhibits higher operating speed.

❖It can be used with variety of data including credit and debit card numbers, dates,IP(Internet Protocol)addresses, Postal Index Numbers etc.

❖They are efficient predictors that can perform well even with datasets having considerable missing records.

Random Forest

- Disadvantages of Random Forest :

❖Prediction accuracy of random forest reduces considerably when training data contains more of normal transaction instances and very less proportion of fraud cases.

❖Overfitting problem – a case where a model considers noise and fluctuations in the training data set as learning instances.

Support Vector Machine(SVM)

- Algorithm works based on dividing given data set in to two distinct categories with well defined gap.
- Several hyper planes are made to identify which plane clearly divides the data set.
- Advantages of SVM :

❖SVM are more suitable to work with complex multidimensional systems.

❖The challenge of overfitting is avoided, which is generally experienced in case of random forest.

❖It is simple and yet effective in terms of accuracy but some time slower in its operation and demands high end computing ecosystem.

K-Nearest neighbor

- KNN algorithm works with an assumption that similar kind of objects/instances exist in close vicinity or distance or proximity.
- With the given data set, the algorithm compares the distance between current data and the newly available data instance to identify its neighborhood or proximity.
- Advantages of KNN:

❖Implementation of algorithm is easy.

❖It can be effectively used for classification, regression etc.

❖Drawback : Speed of the operation reduces significantly with increase number of data set to be compared to decide the close proximity.

Ensemble method

Ensemble contd.

- The goal of any machine learning problem is to find a single model that will best predict our wanted outcome. Rather than making one model and hoping this model is the best/most accurate predictor we can make, ensemble methods take a myriad of models into account, and average those models to produce one final model. It is important to note that Decision Trees are not the only form of ensemble methods, just the most popular and relevant in DataScience today.

Case Study : Sentiment Analysis for student’s feedback using ML

- The study focuses on symbolic analysis for online reviews from participants.
- Identify the feeling present in text documents based on polrity- positive, negative and neutral using the approach of machine learning, Lexicon based and Hybrid.
- Classifiers are used to measure the performance and accuracy.

Machine Learning Techniques for Customer Sentiment Analysis

- Application of NLP
- Company should also have knowledge on the following aspects

❖What is the response the marketing campaign getting?

❖Which different age group respond?

❖What’s the difference in men and women responding? etc. etc.

Sentiment Analysis for student’s Feedback: Work Flow

Steps :

- Student’s feedback : Awesome lecture, good delivery, boring
- Preprocessing : Tokenization, Stop word removal, POS tagging
- Feature Extraction :
- Classification : Random forest
- Evaluation : Model evaluation
- Accuracy, precision, visualization etc.

Sentiment Analysis for student's feedback using ML

Machine Learning Based Sentiment Analysis

- Machine learning based approaches of sentiment analysis learn a predictive model using the provided training dataset and evaluate the performance of the learned model on the test dataset.
- It can be further classified into supervised learning and unsupervised learning methods.

Lexicon based Method :

- Lexicon based approach of sentiment analysis makes use of a sentiment lexicon to determine the polarity of a given textual content.
- A lexicon or dictionary represents a list of words with associated sentiment polarity. The lexicon can be constructed either manually or automatically.
- Hu and Liu [7]utilized an online lexical resource WordNet to predict the semantic orientation of an opinion word.
- Taboada et al. [8]proposed another lexicon-based approach that determines the polarity of a word by using the dictionaries constructed.

Hybrid Approach :

- Combination of Lexicon based and Machine Learning based approach
- An opinion lexicon was used to label training dataset with sentiment polarities. The labeled dataset was then used to train a binary classifier to predict sentiment polarity on the evaluation dataset.

Reference

- “Learning sentiment from students’ feedback for real-time interventions in classrooms”, Nabeela Altrabsheh, Mihaela Cocea, and Sanaz Fallahkhair

Credit Default Prediction

- https://www.kaggle.com/uciml/default-of-credit-card-clients-dataset

Machine Translation in a Nutshell

- Machine translation(MT) as its name implies translate text written in one language to text written in other language.

Vacuous Triangle

Linguistic Aspects of MT system

- Lexical transfer is like a dictionary where we can get the meaning of words.
- Morphology means the structure of the word, for example, goes is recognized as inflected third person singular number present form of the verb go.
- Syntax is the grammar of the language and semantics is the meaning

of the word/sentence and so on.

MT Contd.: MT steps…..

- **Preprocessing :** Process the text by removing punctuation,
- Converting text to lower and/or true casing etc.
- Pre processing could be tokenization, padding etc.
- Tokenization is the process where we break the entire phrase, sentence into small units called words or tokens.
- Padding is done in translation task to find end of sentence.
- Padding is context/task dependent i.e. padding may have different purpose for different NLP application.
- To make all the sequence word size of equal length wherever any word size is smaller than the fixed maximum size, padding is used to make that equal to that fixed maximum size.

MT Contd…..

- **Modeling:** There are three important steps involved in modeling. They are building a model, then train the model and finally testing the model.
- **Prediction:** We have to translate English to Other language using our model and then have to compare this translation with ground truth and finally can evaluate on the basis of different automatic metric.
- **Iteration:** Iterating on the model by different hyper parameter adjustments and also on different architectures the model will be tried to find better accuracy in terms of translation.

MT Contd. : Statistical MT System

- In this approach machine learns from the data automatically with the help of statistics.
- It is actually on the basis of machine learning approach where it tries to map a proper function for source to target language.
- Unlike machine learning, the function in SMT is non deterministic.
- In machine learning, classification is actually considered as mapping from many to one.
- But in SMT we can map from one source language to multiple possible representation of target language i.e. one to many and hence, considered non-deterministic

MT Contd…..

- It is conditional probability distribution P(Y|X) where Y is the target language representation given X as source language.
- We can say given a source language X what is the maximum probability of target language Y i.e. maximizing the probability of P(Y|X) in statistical machine translation.
- This is data driven approach and hence requires corpus of source and target language examples

MT System contd.: Drawback Phrase based SMT

- The main drawback of Phrase based statistical machine translation is it does not consider the context.
- Only language model of statistical machine translation considers context.
- There are mainly two important objectives of any machine translation, adequacy and fluency.
- Adequacy refers to the measure of portion of translated text with respect to input text.
- Fluency is the measure of grammatically correctness of translated text with respect to the input text.

MT Contd....SMT Architecture.

MT Contd…..: Hybrid MT model

- **Hybrid Translation Model:** Hybrid model combines rule based and statistical machine translation engine to generate high performance and improved translation quality.

MT Contd…..: NMT

- Neural Machine Translation(NMT) Neural Machine translation uses the concept of Artificial Neural Network. Recently NMT exploits the concept of deep learning to translate source to target language.
- NMT directly targets the conditional probability P(x|y) to model it for translating a source sentence $x_{1,\ldots\ldots}x_n$ to target sentence $y_{1,\ldots\ldots}y_{n..}$ then finally decoder decodes one target word at a time from the entire source language. It is done by decomposing the conditional probability

MT Contd….: NMT

- The NMT do not require any domain specific knowledge and linguistic features for source and target language.
- Also NMT systems jointly train its encoder and decoder model unlike phrase based SMT systems where different components are trained and tuned separately to get optimal performance.
- Unlike SMT model where special hand crafted features are linearly combined for translation, NMT model automatically learns from distributed representation of data in non linear transfer function under trained network .

MT Contd…: NMT

- The first thing that is Neural language model with feed forward network is how to represent words in neural network nodes.
- All nodes in the neural networks carry real numbered values.
- Even we can’t simply use token ids because neural network will assume that for token 12133 is similar to token 12134 but practically these numbers are completely arbitrary in nature.
- The solution : each word with high dimensional vector and representing one dimension per word in the vocabulary and the value 1 for the dimension that matches with the word, and assigning 0 for the rest. This type of vector representation is called one hot vector.
- For example:
- Cat=(0,0,0,0,0,1,0,0,0……..)

MT Contd….: NMT

- These are very large vectors for the huge vocabulary size.
- To pool evidence, there is another layer exists in between input layer and hidden layer.
- In this layer, in low dimensional space each context word is represented. This is known as word embedding.

MT Contd……NMT

MT Contd…..

- The above diagram(Fig.) represents the feed forward neural language model.
- Context words W1, W2, W3,W4 are represented as one hot vector , then it is projected into continuous space with the help of word embedding using weight matrix C for all words.
- The predicted word w5 is computed with the help of hidden layer and the output predicted word is also one hot vector

MT Contd…..: NMT

- **Encoder Decoder based Neural Machine Translation:**

NMT contd…..Methodology

- Starting with the baseline model of Statistical Machine Translation for which Moses will be used. For NMT we will use Sockeye which is mainly based on MAXNET, Sequence to sequence NMT using Pytorch, Open NMT etc.
- First we will require bilingual parallel corpora. In our case we need English and Hindi corpus. We may require to preprocess our corpus if needed. Next we have to train the Neural network model with the help of linguistic syntax of the corresponding language.
- For example, in English the syntactic structure of the sentence is subject verb object(SVO). But in Bangla it is Subject object verb(SOV).
- Typical steps to be followed are as under:
- Step 1: Train the SMT/Neural network model using selected bilingual corpora.

MT Contd…..: NMT Methodology

- Step 2: Validate the different MT models with validation data set and tuning different hyperparameters.
- Step 3: Test the model with test data.
- Step 4 : Evaluate the result with automatic evaluators like BLEU, METEOR,NIST etc. and finally with the help of human evaluator best model will be proposed in terms of adequacy and fluency.

NMT Contd…..: Methodology

Machine Learning in Health Care

- Identifying diseases and diagnosis
- Drug discovery and manufacturing
- Medical Imaging diagnosis
- Clinical trial and research
- Outbreak prediction etc. etc.

Identifying diseases and diagnosis

- IBM Watson genomics is a best instance of how to rapidly diagnose genome based cancer cell replication.
- BERG(AI powered biotech company) the biopharmaceutical organization uses AI in fields such as oncology to produce innovative medicine. It uses the power of AI ,coupled with patient biology and thereby accelerate clinical identification and subsequently treating the disease. Hence a faster discovery and development of treatment.
- Medical imaging diagnosis: The ground breaking technology called computer vision was responsible for both machine learning and deep learning.
- Outbreak prediction: ProMED mail a web based monitoring system that tracks the occurrence of infectious disease and offers outbreak alerts in live time.

Role of ML in drug discovery

- The drug development and production pipelines are large, complicated and rely on many considerations.
- ML methods have plentiful , high quality data resources that can improve discovery and judgment making.
- Examples : Target verification, clinical trial analysis of pathology data etc.
- Various classifiers like SVM, Decision tree, ensemble methods, naïve bayse classifiers,KNN,ANN etc. help in this context

Medical Image Analysis

- AI imaging tools can screen chest X-rays for signs of tuberculosis, often achieving a level of accuracy comparable to humans. This capability could be deployed through an app available to providers in low-resource areas , reducing the need for a trained radiologist on site.
- Electronic Health Record(HER) providers are now using AI to create more intuitive interfaces and automate some of the routine processes that consume so much of users time. Electronic Health Record data can help to identify infection patterns and highlight patients at risk before they begin to show symptoms.
- Voice recognition and dictation are helping to improve the clinical documentation process , but NLP tools are helpful.

Segmentation and Detection

- Digital Pathology (DP) is the process by which histology (study of tissues/cells)slides are digitized to produce high resolution images.
- These digitized slides afford the possibility of applying image analysis techniques to DP for applications in detection, segmentation and classification.
- A segmentation task is defined as the requirement of delineating an accurate boundary for histologic primitives(i.e., nuclei etc…)so that precise morphological features can be extracted.
- Detection tasks are different from segmentation tasks in that the goal is to typically to simply identify the center of the primitive of interest and not explicitly extract the primitive contour or boundary.

Segmentation and Detection

- Identifying individual tissue based primitives and trying to identify primitive specific feature/patches to make predictions regarding tissue class, an alternative strategy is to directly learn the set of features representatives of the tissue class via DL.
- The DL classifiers could be trained to self discover the disease pattern within each class.

Medical Image Analysis

U-Net Architecture:

- U-Net is a convolutional NN architecture.
- U-Net is used for Image segmentation.
- It uses multiple channel feature maps.
- It is mainly used for image segmentation and also to process biomedical images.
- In biomedical images it not only distinguish whether there is a disease but also to find out area of abnormality.
- U-net network is strong enough and could do good prediction with small data sets.

U-Net Architecture

Framework for AI/ML based Computational Histopathology(Microscopic examination of tissue) Analysis .

- Data Acquisition and Preparation : Annotation by pathologists –region of interest , cell marking

- AI/ML processing : Trained with the patches and features are classified with ML based classifiers such as SVM, random forest etc. or DL based classifiers.
- Results and Visualizations of output : Validation and testing of individual models (Performance measures- Accuracy, precision,recall,F1-Score etc.)

Explainable AI

Explainable AI

- We are entering a new age of AI applications …….
- ML is the core technology
- ML models are opaque, non intuitive, and difficult for people to understand

End users can probably get the answers of the following:

Why did you do that ?

Why not something else??

When did you succeed???

When do you fail????

When can I trust you ????? And many more…….??????????????

ML in Insurance and Retail Industries.

- Data: Identifying unmet needs…
- Decisioning: Using customer behavior to trigger effective campaigns.
- Predictive model for insurance underwriting :
- Insurance underwriting is the process of evaluating a company’s risk in insuring a home,car,or an individual’s health or life.
- It determines whether it would be profitable for an insurance company to take a chance on providing insurance coverage to an individual or business.
- Life Insurance underwriting is all about risk.
- Risk level of a person is directly proportional to the premium he/she will pay.
- If person is less risky than the average to insure , he will pay less and if his risk level is higher than the average he will pay more.

Insurance Underwriting

- Underwriter uses software and finally approves or rejects the risk of issuing a policy…..

Loan underwriting rules:

- During underwriting, the lender gauges the credit worthiness of the borrower and assesses whether the applicant meets the loan eligibility criteria or not.
- Credit Score:
- Income:
- Current debt and liabilities :
- Value of the Collateral(The term collateral refers to an asset that a lender accepts as security for a loan):
- Property appraisal :

Regression and Correlation, Clustering and Classification algorithms are widely used.

- Both bivariate regression and correlation can be used to evaluate the strength of a relationship between two variables.
- Regression is generally used to predict future values based on the past values by fitting a set of points to a curve.
- Correlation used to examine the degree to which the values for two variables behave similarly.

Association Rule /Market Basket/ Buying Pattern/Retail Store

- The purchasing of one product when another product is purchased represents an association rule.
- Association rules are frequently used by retail stores to assist in marketing, advertisement, floor placement and inventory control.
- Association rules are directly applicable to retail business.
- Association rules are used to show the relationship between data items.

Sample data to illustrate Association Rules:

• Transactions	Items
T1	Bread, Jelly, PeanutButter
T2	Bread, PeanutButter
T3	Bread, milk, PeanutButter
T4	Beer, Bread
T5	Beer, Milk

Retail Market/ Market Basket Model

- The support (s) for an association rule X → Y is the percentage of transactions in the database that contain X U Y.
- Confidence/Strength (α) for an association rule X → Y is the ratio of the number of transactions that contain XUY to the number of transactions that contain X
- For Example : bread → Peanutbutter , support=60%, Confidence=75%
- Peanut butter → Bread , Support=60%, Confidence=100%
- Beer → Bread , Support =20%, confidence=50%
- Peanutbutter → Jelly , Support=20%, confidence=33.3 %

Association Rule Mining : Basic Algorithms

- Apriori Algorithms : Apriori algorithm is the most well known association rule algorithm and is used in most commercial products…
- ANY SUBSET OF A LARGE ITEM SET MUST BE LARGE.
- Sampling Algorithms :
- Partitioning Algorithms :
- Parallel and Distribution Algorithms…..

Rule based fraud detection vs ML based fraud detection

- Rule-Based fraud detection:

- ❑Catching obvious fraudulent scenarios
- ❑Requires much manual work to enumerate all possible detection rules
- ❑Multiple verification steps may become threat to user experience.
- ❑Long term processing

ML based fraud detection

- ❑Finding hidden and implicit correlations in data
- ❑Possible fraud scenario detection happens automatically
- ❑Reduction in the number of verification measures
- ❑Real time processing

Applications of ML and artificial intelligence in transportation

- The ML travel programs were implemented in a variety of forms. Among them for instance:
- Use machine learning techniques in strategic choice-making and management.
- AI technologies are also discussed with a view to improving public transport.
- Connected and autonomous cars are the next promising AI technology in transport, which tries to increase efficiency by limiting the amount of road disaster.

Applications of machine learning in transport

- AI technique can be viewed as an intelligent remedy for these complicated systems that traditional methods cannot be used to manage.
- A lot of AI methods are also used in transportation such as ANNs.
- Few applications of machine learning in transport are:

❑Incident detection.

❑ Predictive models.

Incident detection

- There have been many efforts to classify the date, location, and extent of an accident and assist traffic management in reducing congestion.
- Using statistical techniques such as the , event detection algorithms were first introduced.
- Algorithms have been developed for neural network approaches.
- An element-oriented model of a recurring time-lag system (TLRN-Time lag recurrent system) neural network has been developed.

Application of AI in aviation and public transportation

- Aviation : To control the flight trip more efficiently, AI has been acknowledged.
- The safety of the aircraft was measured by testing the engine on board utilizing the Probabilistic Neural Network (PNN)
- Bus Service : ANNs is easy to use by forecasting bus arrival times to reduce the waiting time for passengers. Bus Arrival, departure etc.
- An Automatic Vehicle Location (AVL) system aimed at improving the performance of public transport activities, retaining operational controls and enhancing the overall quality of public transport services

Full Syllabus-End Term Examination:

- **Unit 1: A Brief Introduction to Machine Learning**
- Paradigms, Knowledge Representation, Data Acquisition, Data Pre-Processing, Feature Extraction and Processing Feature Ranking and Selection, Feature Reduction, Model Learning, Evaluation and Deployment
- MT Translation System and its evaluation: Statistical to Neural , BLEU
- **Unit 2: Machine Learning in Banking and Securities**
- **Unit 3: Machine Learning in Communication, Media and Entertainment**
- **Unit 4: Machine Learning in Healthcare and Life Sciences**
- **Unit 5: Machine Learning in Education**
- **Unit 5: Machine Learning in Insurance**
- **Unit 6:Machine Learning in Transportation and Logistics**

Welcome to:

Machines Learning in Banking and Securities

Unit objectives

After completing this unit, you should be able to:

- Learn about machine learning in banking sectors, challenges in banking sector and fraud detection system in banking sector
- Understand manage customer data and algorithms in banking and security
- Gain knowledge on deep learning technology for personalized marketing
- Learn about applications of machine learning classifiers in credit risk analysis
- Understand the importance of machine learning in portfolio management systems
- Learn about algorithmic trading and stages for implementing applications of ai in marketing
- Deep learning approach for sentiment analysis of customers and customer services
- Understand cyber security in banking sector and loan underwriting and sentiment/news analysis
- Understand current challenges and opportunities in implementing machine learning technologies in banking and security domain

Couse description

- Purpose: Machine learning in banking and securities.
- Audience: 4th sem engineering students.
- Perquisite: Probability, Python basics, statistics, linear algebra.
- Course objectives: To introduce participants to understand the importance machine learning applications to address the problems and challenges in machine learning and securities.

Why machine learning in banking sector

- After financial crisis around the world, there has been a significant transformation in the banking services across the globe with intervention of Artificial Intelligence (AI) applications.

- With appropriate and robust machine learning algorithms, there is a lot of potential to address the key issues in the banking sector, leading to digital transformation and enhanced services.

- Major areas of banking with potential AI intervention include Anti Money Laundering(AML), Chabot's, fraud detection, algorithmic trading, and digitization.

Use of AI in banking and finance

- Efficient resource management, improvement in performance of operations and smart decision making are few of the promising advantages of machine learning technologies in the banking and finance sector.

- Fraud detection, automated customer support and services, banking security are few of the important use cases of ML in banking sector.

Challenges in banking sectors and securities

- Fraud detection.
- Though competitions.
- Risk modelling.
- Customer data management.
- Decreased customer experience and loyalty.
- Personalized marketing.

Fraud detection (1 of 2)

- One of the foremost requirements in banking sector is to provide enough security to the customers and employees in terms of operations and financial transactions.

- Ml techniques can help banks to detect fraud and can restrict account activities based on authentication and validation.

- Fraud detection includes the following initial steps:
  - Preliminary data testing and data sampling for model estimation.
  - Creating/estimating the appropriate model.
  - Deployment of the model and testing.

Fraud detection (2 of 2)

Figure: Fraud detection

Source: Factly

Tough competition in banking industry

- Indian banking services has evolved with many “pro-customer” applications leading to competition among major retail banks.

- User friendly online banking applications like Paytm, Phone pay, Google pay are redefining the banking services, especially in terms of its geographically limitless reachability.

- Personalized banking experience is another most important aspect of the afore mentioned applications.

Risk modeling and investment banks

- The foremost priorities for any investment banks is managing financial risks.

- With effective risk modelling, it becomes easier for banks to evaluate and strengthen the capabilities of companies in creating financial capital, sustain or restructure corporate operations, facilitate acquisitions and mergers whenever appropriate.

Customer data management

- Financial organizations have a challenging task of documenting and monitoring humongous amount of customer data.
- It is essential to establish cross data set linkages to develop unique insight of customer needs.
- Data science can help banks extract relevant information about their customer behavior, whereas appropriate ML algorithms can keep track of customer preferences.
- One such example for customer data management is “segmenting the customers”. It refers to clustering of customers based on their unique behavior.

Decreased customer experience and loyalty

- Ever increasing customer focused services provided by companies like phone pay, google pay etc., is redefining the customer experience.

- Now a day, customers expect totally hustle free and easy banking services and it is more likely that banks can lose customers if they can not provide quality services to its customers.

- Banks can make use of efficient emotion recognition algorithms to deeply analyze the customer feelings and sentiments.

Personalized marketing

- The key aspect that leads to success in marketing is, the extent to which customers receives offers that best suits their needs and preferences.

- In the banking sector, the financial products should be highly customized to the customers' needs and in addition, secured as well.

- As the customers are exposed to such personized banking experiences, there will be ever increasing expectation for improvement in the quality of services.

Role of machine learning: Challenges of banking sector and securities

Domain	Implications of ML based solutions
Fraud and Risk management	ML based solutions and predictive analytics are assisting in examination of real-time transactions to identify suspicious and fraudulent operations. Risk analysis experts are being guided by ML algorithms with appropriate recommendations to predict risk in the earlier stages of any banking operations.
Customer Services	With existing customer data along with ML powered AI applications are leading to effective personalized customer services by documenting and analyzing customer behavior and requirements. ML algorithms based cognitive machines are replacing humans in analyzing and responding to customer queries.
Financial trading and securities	ML based validation mechanisms are bridging the security and functional gap between front end trades and back end operations. AI based applications are assisting banks in effectively handling foreign exchange transactions and liquidity management operations.
Credit assessment	ML based applications along with big data analytics are viable solution to assess the credit worthiness of the customer in case of loan disbursement operations.
Portfolio management	AI and ML based technological ecosystems are helping banks in making real time, smarter decisions to ensure appropriate investment plans for their customers.

Widely used machine learning algorithm in banking and security

- Supervised machine learning algorithms.
- Unsupervised machine learning algorithms.
- Reinforcement algorithms.

Figure: Machine learning algorithms in Banking and security

Source: Altexsoft

Fraud prevention and detection systems

- The most used algorithms in fraud prevention and detection systems are:
  - Bayesian algorithms.
  - K-Nearest neighbor.
  - Support Vector machines (SVM).
  - Bagging ensemble classifier based on decision tree.

Rule based and machine learning based approach in fraud detection

Rule-Based fraud detection	ML-Based fraud detection
Catching obvious fraudulent scenarios	Finding hidden and implicit correlations in data
Requires much manual work to enumerate all possible detection rules	Possible fraud scenario detection happens automatically
Multiple verification steps may become threat to user experience.	Reduction in the number of verification measures
Long term processing	Real time processing

Anomaly detection: Ways to expose suspicious transactions in banks

- The main feature of this approach is classification of all data objects into two major groups:
  - Normal distribution.
  - Outliers.

Figure: Ways to expose suspicious transactions in banks

Source: https://zindi.africa/blog/introduction-to-anomaly-detection-using-machine-learning-with-a-case-study

Advanced fraud detection systems

- One of the major limitations of the primitive fraud detection approaches is that they are limited to identification of anomalies.

- The two commonly used ML techniques to develop anti-fraud mechanisms are:
  - Supervised ML algorithms.
  - Unsupervised ML algorithms.
  - Deep neural network algorithms.

Risk management systems

SL NO	Objectives of Portfolio Management	Key Features/ Objectives
1.	Security of Principal Investment	• To ensure safety investment and risk minimization • Along with keeping the investment unharmful, portfolio management also contribute in increase of its purchasing power over a period. • Only after ensuring safe investment, other factors like growth, income etc., are considered
2.	Consistency of returns	• In order to ensure stable return on investment by reinvesting the earned profit in good portfolios. • It helps the customers/ firms to obtain consistent returns.
3.	Capital growth	• Portfolio management helps the firms by increase in the rate of return by reinvesting securely or purchasing the profitable growth securities. • It takes care of any loss in purchasing power because of other economic factors, in order to appreciate values and to safeguard investors.
4.	Marketability	• In order to ensure flexibility in investment portfolio. • These portfolios consist of investment which concentrates only on the portfolios that can be marketed and traded. • Shifting from one investment to other will be a problem if the portfolio contains large number of inactive and unlisted shares. • It suggests investing only in secured stock exchanges.
5.	Liquidity	• It facilitates investors to make best use of available opportunities in future. • Based on the investor's requirement, it always ensure a enough fund availability in short notice
6.	Diversification of Portfolio	• To effectively manage the financial investment made by customer it is necessary to diversify the investment by considering benefits available across the industries.
7.	Favorable Tax status	• In order to minimize the tax burden and to increase the return in investors fund, the portfolio should assess by considering the applicable taxes.

Case study: Application of machine learning to financial risk management

- Summary: Machine learning affects all industry fields, like how banking companies and other sectors tackle stricter enforcement and threat mitigation criteria.

- This programmer path teaches you what to implement machine learning for a strategic threat system on IBM z/OS to assess the value of consumer debt. utilizing an API, you can know how to view the information, allowing you to integrate the information into company programs.

- Flow :

Credit risk analysis using machine learning classifier

- Promising business activity in banking industry is providing loan to the customers.
- Crediting risk analysis is evolving in the field of financial risk management.
- Based on the available database of customers many techniques were used in credit risk analysis in order to evaluate future credit risk that may occur.
- ML techniques can be used to analyze and evaluate the credit risk datasets.
  - Bayesian classifier.
  - Naive–Bayes classifier.
  - K-nearest neighbors.
  - K-means.
  - Multilayer perceptron.
  - Support vector machine.

Investment prediction systems

- The wealth management organizations are evolving with the potential AI based solutions for their investment decisions based on the historical data.

- The applications of collection of huge data about the assets are being recorded for digital assets or distributed industrial asset by making the assets ready for digitalization through AI.

Portfolio management systems

- Portfolio: It can be defined as financial assets like stocks, bonds, shares, mutual funds, cash equivalents, debt instruments etc., In order to maintain the risk in various asset pools of investment, a portfolio is planned.

- Management: In order to achieve its pre described objectives with well-defined policies, a management can be defined as a firm which coordinates the activities of that firm/enterprise.

No.	Investor's Portfolio	Investment	Percentage	Security	Returns
1.	Government Bonds	$ 25,000	25 %	High	Low
2.	Bank's Fixed Deposits	$ 15,000	15 %	High	Average
3.	Shares	$ 35,000	35 %	Low	High
4.	Mutual Funds	$ 25,000	25 %	Average	Average

- Note: This is just an example and may be taken as a slandered for the portfolio management.

Objectives of portfolio management

Figure: Objectives of portfolio management

Source: Image credits © moon rodriguez

Algorithmic trading

- Algorithm trading enables to produce profit at a very high intensity which is difficult by individual buyers.
- Algebraic equation is an example of algorithm, with prescribed rules of algebra.
- Complex formulas along with mathematical models and human inaccuracy will be used by algorithmic model in order to sell or buy the financial securities.
- The use of high-frequency algorithmic trading technology, enables algorithmic traders to make 10000 trades in fraction of time.

Deep learning for customer services

- Customer service center, are ready to adopt technologies like ML for their operations and these techniques is part of industries in upcoming days.

- In order to provide efficient customer service, it is always more flexible if we gather the data from their insights.

- Effective machine learning systems are implemented in environments where a lot of information is stored, as is important when the ultimate objective is to make an informed judgment.

Chatbot-deep learning approach

Figure: Chatbot-deep learning approach

Source: https://research.googleblog.com/2015/11/computer-respond-to-this-email.html

AI powered marketing systems

Figure: Stages for implementing applications of AI in marketing

Source: Smart insights © March 2018 the financial brand

Deep learning in cyber security

- Today cyber security uses smart technology such as machine learning and natural language analysis that can enable security analysts make smarter, quicker judgments.
- For the hackers banking sector is the hub where they can grab those important information of the customer.
- Security and its team are facing challenges to handle, interpret and prevent these type of mischievous events.
- Having a robust cyber security is an important requirement to maintain strong customer trust and credibility.

Types of cyber–attacks in banks

Denial of Services (DoS)	Phishing	Malware	Watering Hole	Zero-day exploits
Denial-of-service (DoS) attacks inundate systems with traffic to consume resources and bandwidth and make them unable to perform.	Phishing typically uses email that appears to be from a trusted or reputable source. Unsuspecting users open the email and take further actions like providing protected information or downloading malware.	Malware is malicious software. It's the chief weapon of a cyber-attack and includes viruses, worms, Trojans, ransomware, adware, spyware bots, bugs and rootkits. It installs when a user clicks a link or takes an action. When inside, malware can block access to data and programs, steal information and make systems inoperable.	In recent years' financial companies are most affected by watering hole, it is the most implemented cyber-attack. It mainly effects the IT system through online searches to figure out the behavioral pattern of employees to identify the website they frequently visit.	Zero-day exploits introduce malware through vulnerabilities unknown to the maker or user of software or systems. It is "zero-day" because developers have had zero-time to address or patch the vulnerability.[2]

Deep learning methods used in cyber security

- Deep learning is a machine learning approach that integrates natural systems in various levels to incrementally educate from information.

- The improvements in the deep learning technologies has increased the possibilities of utilizing machine learning approaches to address the problems in various domains.

- Deep learning has been applied towards number of use cases related to cyber security like identifying, malware detection, malware classification, android malware detection, phishing and spam detection.

- List of deep learning methods used in cyber security:
  - Deep belief networks.
  - Convolution neural networks (CNN).
  - Restricted Boltzmann machine.
  - Recurrent neural networks.

Deep learning v/s restricted Boltzmann machines

Deep Auto encoder	Restricted Boltzmann Machines
It is a type of unmonitored neural network that takes a vector reference and tries to fit the response to the same variable.	It is a two-layer, bipartite, undirected graphical models that from the building blocks of DBNs.
These are flexible due to their controlled learning of condensed data encryption.	RBM's are unsupervised as Deep auto encoders and can be trained one layer at a moment.
These will reduce the computational resources to build an effective model by training one layer at a time.	In this type of network there is no interlayer connections but every nodes are fully connected as shown in Figure 4.
When the hidden layer has lower dimensionality than the feedback and production layer, the network is used to encrypt the information.	Restricted Boltzmann machines are deterministic, i.e. rather than definite values they give possibilities.
To gradually compress the information multi layers of auto encoders can be trained in series this is called stacked auto encoder	The design is conditioned by taking and supplying binary source information through the cycle. Then, the reconstruction of the source information is fed back through the design. The program's power will then be measured also utilized to adjust the scales. This method continues until the convergence of the system.
Sparse auto encoder comprises in the feedback and production surface of more secret points than there where only the secret level part is enabled at a given period.	Deep neural network can be created by stacking auto-encoders and RBMs, these are referred as stacked RBMs.

Convolution Neural Networks (CNNs)

Figure: Convolution neural networks

Source: Smart insights © March 2018 the financial brand

Recurrent neural networks

Figure: Recurrent neural networks

Source: Smart insights © March 2018 the financial brand

Machine learning techniques: Loan underwriting & sentiment/news analysis

Challenges	Potential Solutions
Verification of discrepancies in the document **Variety of document formats to checked for its accuracy. If performed manually, increase the likelihood of errors and mistakes. Also, it is time consuming**	ML based Natural language processing, along with image analysis leads to effective digitization of the entire process reducing potential errors and reducing the time.
Issues in the credit analysis: Documenting and analyzing past financial transactions is a tedious task if performed manually.	AI based metrics for credit analysis may lead to unbiased and validated credit-worthiness. This involves deployment of appropriate ML algorithm to process the credit history of the customer along with data analytics.
Assessment of debt-to-income ratio: Manual assessment of borrower's overall debt to income along with evaluation of their ability to repay the loan is cumbersome task.	ML enabled applications to evaluate debt-to-income ratio can be authentic source of evidence to make appropriate decision.

Sentiment or news analysis

Figure: Flow of sentiment analysis application in the financial world.

Source: Semantic-Based Sentiment analysis in financial news, Vol-862

Current challenges and opportunities: Banking and security domain

- Challenge: Lack of skills and data.
- Opportunity: More usable AI is coming.
- Challenge: Adoption.
- Opportunity: Professionals recognize the wider value.
- Opportunity: AI can simplify transparency and explain ability.

Checkpoint (1 of 2)

Multiple choice questions:

1. Which of the following model is supervised learning model?
   a) Clustering
   b) Packing
   c) Regression
   d) Dimensionality reduction

2. Which of the following is a mathematical system which can be indicated by specific acyclic chart, it is also referred as a belief network?
   a) Deep neural network
   b) Bayesian classifier
   c) Naïve Bayes classifier
   d) Decision tree

3. Which of the following type of cyber attacks inundate systems with traffic to consume resources and bandwidth and make them unable to perform?
   a) Denial Of Services (dos)
   b) Phishing
   c) Watering hole
   d) None of the above

Checkpoint solutions (2 of 2)

Multiple choice questions:

1. Which of the following model is supervised learning model?
   a) Clustering
   b) Packing
   c) Regression
   d) Dimensionality reduction

2. Which of the following is a mathematical system which can be indicated by specific acyclic chart, it is also referred as a belief network?
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3. Which of the following type of cyber attacks inundate systems with traffic to consume resources and bandwidth and make them unable to perform?
   a) Denial Of Services (dos)
   b) Phishing
   c) Watering hole
   d) None of the above

Checkpoint (1 of 2)

Fill in the blanks:

1. _____ is a set of activities undertaken to prevent money or property from being obtained through false pretences.
2. _____ learning algorithms are task driven and the learning is based on a general rule of data classification.
3. Euclidean distance can be calculated as ----------.
4. ---------(also known as opinion mining or emotion AI) is a sub-field of NLP that tries to identify and extract opinions within a given text across blogs, reviews, social media, forums, news etc.,

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. Fraud detection is a set of activities undertaken to prevent money or property from being obtained through false pretences.
2. Supervised learning algorithms are task driven and the learning is based on a general rule of data classification.
3. Euclidean distance can be calculated as **$(x, x_i) = \sqrt{(\text{sum } (x_i - x_{ij})^2)}$.**
4. **Sentimental analysis** (also known as opinion mining or emotion AI) is a sub-field of NLP that tries to identify and extract opinions within a given text across blogs, reviews, social media, forums, news etc.,

Question bank

Two mark questions:

1. List the challenges in banking sector and securities.
2. What is fraud detection in banking sector?
3. What is risk modelling in banking sector?
4. List the widely used machine learning algorithms in banking sector.

Four mark questions:

1. Describe applications of machine learning in customer data management in banking sector.
2. Explain with an example the applications of machine learning algorithms in personalized marketing.
3. What is risk management in banking sector and how it can be addressed?
4. Explain working principal of sentiment analysis (API).

Eight mark questions:

1. Explain with an example the efficient fraud detection in banking sector.
2. Write a short note on role of machine learning in addressing the challenges of banking sector and securities.

Unit summary

Having completed this unit, you should be able to:

- Learn about machine learning in banking sectors, challenges in banking sector and fraud detection system in banking sector
- Understand manage customer data and algorithms in banking and security
- Gain knowledge on deep learning technology for personalized marketing
- Learn about applications of machine learning classifiers in credit risk analysis
- Understand the importance of machine learning in portfolio management systems
- Learn about algorithmic trading and stages for implementing applications of ai in marketing
- Deep learning approach for sentiment analysis of customers and customer services
- Understand cyber security in banking sector and loan underwriting and sentiment/news analysis
- Understand current challenges and opportunities in implementing machine learning technologies in banking and security domain

Welcome to:

Machine Learning in Communication, Media and Entertainment

IBM
Business
IT Infrastructure
Oil & Gas Informatics
Think
Technology
Smarter
Programmes
Open Source
Innovate
Analytics
Mainframe
Retail Informatics
Mentor
LMS
Planet
SME
segment
Cloud Computing & Virtualization
Telecom Informatics
Software
buzz
Internet
Architect
LAN
Network
Objectives
installation
consulting
news
visuals
deploying
Prerequisites
Exercises
feedback
Media
Administrator
Labs
Books
eLearning
Intelligence
advanced
repository
intermediate
inform
build
publish
audience
role
copy
documentation
consolidated
audience
Technical Training
curriculum
intranet
internet
questions
education
students
faculty
Retail Informatics
platform
login
goal
exam
resource
skill set
global
tracking
meeting
energy
connection
benefit
demand
processors
integration
overview
fee
response
expand
node
legal
tutorial
activated
schedule
AIX
Catalog
mediate
lecture
update
password
comunication
graduate
university
participate
logical
share
benefits
compact
excellent
source
success
LPAR
workshop
antivirus
content
FTP
read
features
contents
component
marketing
research
insights
pad
templates
engineer
https://www.u
purchase
feeds
news
update
addition
answer
workloads
store
graphics
course
instances
measured
value
reserved
active
upload
debate
animation
admin
catalog
technical
www
finish
agenda
professor
exam
server
password
ATTEST
URL
knowledge
memory
expansion
transform
portal
attend
unity
read
configuring
educate
consolidated
URL
neutral
specialist
average
product
copy
workloads
store
faculty
measured
value
reserved
active
students
questions
education
finish
agenda
professor
exam
Prerequisites
Cloud Computing & Virtualization
deploying
demand
processors
integration
overview
fee
response
expand
node
legal
tutorial
activated
schedule
AIX
Catalog
repository
intermediate
comunication
password
graduate
university
update
lecture
Intelligence
Smarter
Programmes
Architect
LAN
Network
Objectives
installation
Open Source
Innovate
consulting
news
visuals
SME
segment
eLearning
Books
Labs
meeting
energy
connection
benefit
demand
processors
integration
overview
fee
response
expand
node
legal
tutorial
activated
schedule
AIX
Catalog
mediate
lecture
update
password
comunication
graduate
university
participate
logical
share
benefits
compact
excellent
source
success
installation
Internet
Architect
LAN
Network
Objectives
Smarter
Programmes
Intelligence
advanced
repository
intermediate
comunication
password
graduate
Catalog
mediate
lecture
update
LPAR
workshop
antivirus
content
FTP
read
features
contents
component
marketing
research
insights
pad
templates
engineer
https://www.u
purchase
feeds
news
update
addition
answer
workloads
store
graphics
course
instances
measured
value
reserved
active
upload
debate
animation
admin
catalog
technical
www
finish
agenda
professor
exam
server
password
ATTEST
URL
knowledge
memory
expansion
transform
portal
attend
unity
read
configuring
educate
consolidated
URL
neutral
specialist
average
product
copy
workloads
store
faculty
measured
value
reserved
active
students
questions
education
finish
agenda
professor
exam
Prerequisites
Cloud Computing & Virtualization
deploying

Unit objectives

After completing this unit, you should be able to understand:

- Understand the purpose of using machine learning in communication, media and entertainment
- learn about the usage of machine learning in media and entertainment industry
- Learn about analyse the customer sentiment using machine learning models
- Understand need of real-time analytics in communication, media, entertainment industries
- Gain knowledge on deep learning for social media analytics
- Learn about different types of recommendation engines
- Understand the Restricted Boltzmann Machines (RBM) for collaborative filtering
- Gain knowledge on collaborative deep learning for recommender systems

Machine learning in communication, media and entertainment

- Identification and conviction of media content helps the customers to communicate easily with new media and materials from various sources successfully with the help of machine learning and data science techniques.

- AL and ML are the main technologies in the telecommunication industry that assist the firms to generate better income, build more trust from the customer end and have good customer relationships.

Usage of machine learning in media and entertainment Industry

- The contributions of analytics in the entertainment space are:
  - Helps us to understand consumer insights/psychology.
  - Tracking the customer's digital footprint to schedule ad campaigns accordingly.
  - Enhancing the product based on customer feedback.
  - To creating content based past available data.

- The following are the ways by which data science and machine learning are changing the entertainment and media industry:
  - Prediction of audience behaviour.
  - Analysing customer sentiment
  - Personalization of content

Machine learning techniques for customer sentiment analysis

- The concept of applying natural language processing and text analysis techniques to recognize and draw out subjective information from a piece of text is called sentiment analysis.

- Majority of the part, the feelings or opinions of a person are subjective and not actual facts.

- Another name given to sentiment Analysis is opinion mining, which is an area within Natural Language Processing (NLP) which builds up systems that can recognize and withdraw opinions within text.

World embedding's

- Word embedding is the collective name for a set of language modelling and feature learning techniques in Natural Language Processing (NLP) where words or phrases from the vocabulary are mapped to vectors of real numbers.

- Conceptually it involves a mathematical embedding from a space with many dimensions per word to a continuous vector space with a much lower dimension.

- Methods to generate this mapping include neural networks, dimensionality reduction on the word co-occurrence matrix, probabilistic models, explainable knowledge base method, and explicit representation in terms of the context in which words appear.

Sentiment analysis with long short term memory networks

- LSTM networks are a type of RNN that uses special units in addition to standard units.
- LSTM units include a 'memory cell' that can maintain information in memory for long periods of time.
- A set of gates is used to control when information enters the memory, when it's output, and when it's forgotten. This architecture lets them learn longer-term dependencies.

Figure: Recurrent neural network

Source: https://www.math.vu.nl/~sbhulai/papers/paper-miedema.pdf

real-time analytics in communication, media and entertainment industries

- Real time analytic is used in analysis of data as soon as the data become available.
- As soon as the data enters the system the customers were able to draw conclusions.
- Social sites like Facebook, Twitter and Instagram were used to advertise their products and services to brand it across the globe, media customers and entertainment customers had intensively high competition.

Real time analytics and social media

- The areas in which social media analytics make a big impact are as follows:
  - Innovation.
  - Marketing.
  - Sales.
  - Costumer services.
  - Competitive ontelligent.

Deep learning for social media analytics

- Social media analytics is the practice of gathering data from social media websites and analysing that data using social media analytics tools to make business decisions.

- The most common use of social media analytics is to mine customer sentiment to support marketing and customer service activities.

- The content generated by the user are composed by interactive web 2.0 internet-based applications such as:
  - Texts.
  - Posts.
  - Comments.
  - Videos.

- All the data is generated through online communications.

Recommendations engines

- The recommender system technology recommend users and help setting up in the environment for things like:
  - Products.
  - Movies.
  - Events.
  - Articles.

- Types of recommendation engines:
  - Collaborative filtering.
  - Content based filtering.
  - Hybrid recommendation systems.

Collaborative filtering

- This filtering technique is based on the resemblances of the users and its built on collecting and analyzing information of user's activities such as their:
  - Behaviors.
  - Choices.

- This predicts what the user may like or prefer.

- Types of collaborative filtering:
  - Memory based collaborative filtering.
  - Content based collaborative filtering.

Memory based collaborative filtering (1 of 2)

- Advantages of memory based collaborative filtering are:
  - Easier implementation in any condition.
  - Easier update of database can be done so as the new arrival data can easily be picked up.
  - Large sized data can be processed.
  - Feedback is provided to explain the working process of the recommender system by providing evidence such as listing the characteristics or illustration which made a product to appear in the suggestion site.

- Limitations of memory based collaborative filtering techniques are:
  - If active users have anything in contact with the individual who classified the product to be suggested, then the predictions made by the memory-based CF techniques were inaccurate and unreliable.
  - It makes prediction slow as it uses entire database each time.

Memory based collaborative filtering (2 of 2)

- Equation 1:

$$W_{u,v} = \frac{\sum_{i \in I}(r_{u,i} - \overline{r_u})(r_{v,i} - \overline{r_v})}{\sqrt{\sum_{i \in I}(r_{u,i} - \overline{r_u})^2}\sqrt{\sum_{i \in I}(r_{v,i} - \overline{r_v})^2}}$$

- Equation 2:

$$W_{i,j} = \frac{\sum_{u \in U}(r_{u,j} - \overline{r_i})(r_{u,j} - \overline{r_j})}{\sqrt{\sum_{u \in U}(r_{u,j} - \overline{r_i})^2}\sqrt{\sum_{u \in U}(r_{u,j} - \overline{r_j})^2}},$$

- Equation 3:

$$W_{i,j} = \cos(\vec{i}, \vec{j}) = \frac{\vec{i} \cdot \vec{j}}{\|\vec{i}\| * \|\vec{j}\|}$$

Model based collaborative filtering

- **Advantages:**
  - Over fittings can be avoided easily and the dataset is scalable.
  - Improvement in prediction performance.

- **The limitations of model-based CF algorithms are:**
  - Due to inflexibility it becomes hard to attach information to model based systems for users who do not rate.
  - Since it’s not able to generate reasonable recommendations it suffers from sparsity problems.

Content based filtering

- The profile of the user's choices and description of an item are the inputs for content-based filtering.
- The user profile is created to understand the sort of product an individual likes, keywords are also used to describe the item.
- If we like a product, we have the tendency to like a similar item and that's the principle behind content-based filtering.

Hybrid recommendation systems

- Hybrid methods can be implemented by independently creating and creating and integrating content based and collective predictions or in addition, by applying a cooperative approach to a content on the basis of capability and vice versa, or by integrating methods into a single model.

- The various ways of implementation of hybrid approaches are:
  - Implement content-based and collaborative methods separately and accumulate their observation.
  - Some of collaborative aspects are comprised into the content based approach.
  - Some content based features are integrated into collaborative approach.
  - General consolidate model is constructed which is integration of both collaborative and content based characteristics.
  - The problems faced in recommendation systems such as cold start and sparsity is resolved in hybrid recommender technique.

Summary of recommendation systems

Figure: Summary of recommendation systems

Source: https://www.math.vu.nl/~sbhulai/papers/paper-miedema.pdf

Deep learning techniques on recommender systems

- Building recommender systems for collaborative and content-based approaches, deep learning has been suggested.

- Restricted Boltzmann Machines (RBM) for collaborative filtering:
  - The special version of Boltzmann Machine (BM) consists of layer hidden components and a layer of visible components with no hidden-hidden or visible-visible contacts is the Restricted Boltzmann Machine (RBM).

- Collaborative deep learning for recommender systems:
  - Collaborative deep learning for recommender systems was introduced to address the cold start problems and it utilizes review texts and ratings.

- Bayesian Stack De-Noise Auto Encoder (SDAE) and Collaborative Topic Regression (CTR) is integrated to collaborative deep learning.

Checkpoint (1 of 2)

Multiple choice questions:

1. Word embedding is the collective name for a set of language modelling and feature learning techniques in Natural Language Processing (NLP) where words or phrases from the vocabulary are mapped to vectors of real numbers.
   a) Vector
   b) Scalar
   c) Letter embedding
   d) Word embedding

2. Which analytics is used in analysis of data as soon as the data become available?
   a) Full time analytics
   b) Real time analytics
   c) Time analytics
   d) Media analytics

3. Which of the following is a type of recommendation engine?
   a) Content based filtering
   b) Sentence based filtering
   c) Word based filtering
   d) Collective based filtering

Checkpoint solutions (2 of 2)

Multiple choice questions:

1. Word embedding is the collective name for a set of language modelling and feature learning techniques in natural language processing (NLP) where words or phrases from the vocabulary are mapped to vectors of real numbers.
   a) Vector
   b) Scalar
   c) Letter embedding
   d) Word embedding

2. Which analytics is used in analysis of data as soon as the data become available?
   a) Full time analytics
   b) Real time analytics
   c) Time analytics
   d) Media analytics

3. Which of the following is a type of recommendation engine?
   a) Content based filtering
   b) Sentence based filtering
   c) Word based filtering
   d) Collective based filtering

Checkpoint (2 of 2)

Fill in the blanks:

1. ---------- is a sub-field of NLP that tries to identify and extract opinions within a given text across blogs, reviews, social media, forums, news etc.,
2. ---------- is the collective name for a set of language modelling and feature learning techniques in natural language processing where words or phrases from the vocabulary are mapped to vectors of real numbers.
3. ---------- is used in analysis of data as soon as the data become available.
4. ---------- technique is based on the resemblances of the users and its built on collecting and analyzing information of user's activities such as their behaviors or choices.

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. **Sentiment analysis** is a sub-field of NLP that tries to identify and extract opinions within a given text across blogs, reviews, social media, forums, news etc.,
2. **Word embedding** is the collective name for a set of language modelling and feature learning techniques in natural language processing where words or phrases from the vocabulary are mapped to vectors of real numbers.
3. **Real time analytic** is used in analysis of data as soon as the data become available.
4. **Collaborative filtering** technique is based on the resemblances of the users and its built on collecting and analyzing information of user's activities such as their behaviors or choices.

Question bank

Two mark questions:

1. Define word embedding's.
2. What is real-time analytics?
3. What is social media analytics?
4. What is sentiment analysis?

Four mark questions:

1. Explain the basics of sentiment analysis.
2. List the usage of machine learning in media and entertainment industry.
3. Explain the deep learning techniques on recommender systems.
4. Explain hybrid recommendation systems.

Eight mark questions:

1. Write a short notes on sentiment analysis with long short-term memory networks.
2. Need of real-time analytics in communication, media and entertainment industries.

Unit summary

Having completed this unit, you should be able to:

- Understand the purpose of using machine learning in communication, media and entertainment
- learn about the usage of machine learning in media and entertainment industry
- Learn about analyse the customer sentiment using machine learning models
- Understand need of real-time analytics in communication, media, entertainment industries
- Gain knowledge on deep learning for social media analytics
- Learn about different types of recommendation engines
- Understand the Restricted Boltzmann Machines (RBM) for collaborative filtering
- Gain knowledge on collaborative deep learning for recommender systems

Welcome to:

Machine Learning in Healthcare and Life Science

IBM
Business
IT Infrastructure
Oil & Gas Informatics
Think
Technology
Smarter
Programmes
Open Source
Innovate
Analytics
Mainframe
Mentor
Retail Informatics
LMS
Planet
SME
segment
Cloud Computing & Virtualization
Prerequisites
Telecom Informatics
Internet
Architect
LAN
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Objectives
installation
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Labs
Books
meeting
resource
Exercises
feedback
buzz
Software
publish
role
audience
documentation
inform
build
Technical Training
curriculum
intranet
internet
Media
team
Administrator
partition
platform
www
goal
exam
questions
education
students
login
faculty
course
store
server
Intelligence
advanced
repository
intermediate
comunication
password
mediate
update
lecture
content
antivirus
FTP
LPAR
workshop
marketing
component
contents
features
read
insights
research
Catalog
graduate
university
participate
logical
share
benefits
compact
excellent
source
success
schedule
legal
tutorial
activated
AIX
energy
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response
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node
demand
processors
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overview
integration
professor
agenda
finish
admin
global
tracking
skill set
catalog
debate
animation
upload
ATTEST
password
URL
reserved
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configuring
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average
product
copy
Prerequisites
exam
goal
www
platform
Exercises
feedback
Mainframe
Analytics
Retail Informatics
Mentor
faculty
server
store
audience
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Mainframe
LMS
Planet
SME
segment
Cloud Computing & Virtualization
Prerequisites

Unit objectives

After completing this unit, you should be able to:

- Learn about applications of machine learning in health care
- Gain knowledge on the role of machine learning in drug discovery
- Learn about machine learning approaches in drug discovery
- Understand the applications of machine learning in medical image analysis
- Learn about compare the architectures of different types of deep learning models
- Gain knowledge on the applications of machine learning in genetics and genomics
- Understand the ML applications in breast cancer diagnosis and prognosis

Applications of machine learning in health and life sciences

- Artificial Intelligence (AI), machine learning, and deep learning are storming the healthcare industry.
- The most promising fields of application are automated diagnosis.
- Almost all major healthcare firms have already begun to use the technology.

The most important applications of machine learning in healthcare

- Identifying diseases and diagnosis.
- Drug discovery and manufacturing.
- Medical imaging diagnosis.
- Personalized medicine.
- Machine learning based behavioural modification.
- Smart health records.
- Clinical trial and research.
- Crowd-sourced data collection.
- Better radiotherapy.
- Outbreak prediction.

Role of machine learning in drug discovery

- The drug development and production pipelines are large, complicated and rely on many considerations.

- Machine Learning (ML) methods have plentiful, high-quality data resources that can improve discovery and judgment-making.

- Examples include:
  - Target verification.
  - Prognostic biomarker recognition.
  - Clinical trial analysis of electronic pathology data.

- Applications varied from context to technique, with some methods making detailed forecasts and observations.

Machine learning approaches in drug discovery (1 of 6)

Figure: Support vector machines

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Machine learning approaches in drug discovery (2 of 6)

- Decision Tree (DT): DT includes a collection of regulations that include the process by which chemical characteristics and/or identifier attributes are correlated with interest behaviour or properties.

- Often known as nodes are the root and leaves.

- That leaf module is allocated a location estate, while a non-leaf module (core or inner node) is allocated to a genomic descriptive term the is an exam situation with departments divided into different classes of character.

Machine learning approaches in drug discovery (3 of 6)

Figure: Ensemble methods

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Machine learning approaches in drug discovery (4 of 6)

- Naïve Bayesian classifier: In chemo informatics, Naive Bayesian classifiers are commonly utilized to estimate biochemical rather than physicochemical characteristics alongside or compared to other classifiers.

- P(A/B) – $P\left(\frac{B}{A}\right)P(A)/P(B)$

Figure: Drug discovery

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Machine learning approaches in drug discovery (5 of 6)

Figure: k-Nearest neighbours

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Machine learning approaches in drug discovery (6 of 6)

Figure: Artificial neural networks

Source: https://towardsdatascience.com/applied-deep-learning-part-1-artificial-neural-networks-d7834f67a4f6

Medical image analysis

- The medical care industry is completely distinct from other sectors.
- It is a high preferential business and individuals allow the largest degree of care and facilities, regardless of cost.
- Limitations of human interpretation.

Why deep learning for medical image analysis

- Accurate diagnosis of disease.
- Improvements in image processing algorithms.
- Current training approaches are not reliable because of the wide variation between patient and medical outcomes.
- Deep learning now has a considerable potential.

Neural network and deep learning architecture

Figure:Neural network and deep learning architecture

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Comparisons between architecture of different types of deep learning models

- Deep Neural Network (DNN).
- Convolution Neural Network (CNN)
- Recurrent Neural Network (RNN).
- Deep Boltzmann Machine (DBM).
- Deep Belief Network (DBN).
- Deep Auto-encoder (DA).

Machine learning in genetics and genomics

- Genetics is a scientific study of the effects genes have on an organism, which are units of inheritance.
- Genes contain information in the DNA molecule, a sequence of chemicals called bases.
- Genomics All the genes taken together by an organism, and all the sequences and details found in it, are called the genome.

Genomics and AI background

- The ability to decode DNA allows scientists to "read" the biological code that directs a human organism's behaviours.
- The genome is also an organism's inherited number of genes.
- Genomics is closely associated with the medicine of accuracy.

Two category of genomics

- Genome sequencing (particularly as it applies to precision medicine).
- Direct-to-consumer genomics.

How to use deep learning effectively

- Data from genomics is often highly unbalanced.
- Effective implementation of profound learning, like all other aspects of machine learning, also involves domain knowledge.

Interpreting deep learning models

- There should be no ambiguity between the experimental methods addressed here and explanatory frameworks seeking to establish connections between cause and effect.

Figure: Interpreting deep learning models

Source: https://www.iris.unina.it/retrieve/handle/11588/593395/28708/Lavecchia.pdf

Predictive medicine: Prognosis and diagnostics accuracy

- Predictive medicine is a medicine area where the threat of infection is forecast and protective steps are applied to either fully avoid the infection or substantially reduce its effects on the person.

- The aim of preventive medication is to foresee the probability of potential illness.

Predictive medicine: Examples

- Carrier testing: Carrier testing is done to classify individuals with one version of a gene defect that, if contained in both versions, induces a genetic illness.
- Diagnostic testing: Diagnostic research is done to help diagnose and classify a particular illness.
- New-born screening: Shortly after birth, infants testing is carried out to recognize genetic illness that can be handled late in life.
- Prenatal testing: Prenatal screening is used to track fetal or embryo illnesses before conception.

ML applications in breast cancer diagnosis and prognosis

- Artificial Neural Networks (ANNs).
- Support Vector Machine (SVM).
- Decision Tree (DT).
- K Nearest Neighbours (KNN;x).

Checkpoint (1 of 2)

Multiple choice questions:

1. Which of the following is a supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.
   a) Support vector machines
   b) Decision tree
   c) Assembler model
   d) Gradient decent
2. The medical model that separates people into different groups with medical decisions, practices, interventions and/or products being tailored to the individual patient based on their predicted response or risk of disease.
   a) Personalized medicine
   b) Social medicine
   c) General medicine
   d) Analytic medicine
3. In which of the following algorithms a non-parametric method is used for classification and regression. Where in both the cases the input consists of the k closest training examples in the feature space.
   a) K –nearest neighbours
   b) Decision tree
   c) ANN
   d) Naïve Bayesian classifier

Checkpoint solutions (1 of 2)

Multiple choice questions:

1. Which of the following is a supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.
   - **a) Support vector machines**
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   - d) Gradient decent
2. The medical model that separates people into different groups with medical decisions, practices, interventions and/or products being tailored to the individual patient based on their predicted response or risk of disease.
   - **a) Personalized medicine**
   - b) Social medicine
   - c) General medicine
   - d) Analytic medicine
3. In which of the following algorithms a non-parametric method is used for classification and regression. Where in both the cases the input consists of the k closest training examples in the feature space.
   - **a) K–nearest neighbours**
   - b) Decision tree
   - c) ANN
   - d) Naïve Bayesian classifier

Checkpoint (2 of 2)

Fill in the blanks:

1. Sequence learning is the study of machine learning algorithms designed for _____ data.
2. Ways to deal with sequence labeling in memory less models are _____ and _____.
3. Neural networks are complex _____ with many parameters.
4. The network that involves backward links from output to the input and hidden layers is called _____.

True or False

1. Hidden Markov models is a memory full model. True/False
2. Neural networks mimic the way the human brain works. True/False
3. In neural networks the nodes could be in excited state or non-excited state. True/False

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. Sequence learning is the study of machine learning algorithms designed for **sequential** data.
2. Ways to deal with sequence labeling in memory less models are **autoregressive models** and **feed-forward neural nets**
3. Neural networks are complex **linear functions** with many parameters.
4. The network that involves backward links from output to the input and hidden layers is called **recurrent neural network.**

True or False

1. Hidden Markov models is a memory full model.**True**
2. Neural networks mimic the way the human brain works. **False**
3. In neural networks the nodes could be in excited state or non-excited state. **True**

Question bank

Two mark questions:

1. List the applications of machine learning in health and life science.
2. What is medical image diagnosis?
3. What is genetics and genomics?
4. What is drug discovery?

Four mark questions:

1. Explain the difference between business intelligence and business.
2. Machine learning approaches for medical image diagnosis.
3. Why deep learning for medical image analysis?
4. What are the pros and corns of deferent types of deep learning models?

Eight mark questions:

1. Describe the machine learning approaches in drug discovery.
2. Explain the role of machine learning in genetics and genomics.

Unit summary

Having completing this unit, you should be able to:

- Learn about applications of machine learning in health care
- Gain knowledge on the role of machine learning in drug discovery
- Learn about machine learning approaches in drug discovery
- Understand the applications of machine learning in medical image analysis
- Learn about compare the architectures of different types of deep learning models
- Gain knowledge on the applications of machine learning in genetics and genomics
- Understand the ML applications in breast cancer diagnosis and prognosis

Welcome to:

Machines Learning in Education

Unit objectives

After completing this unit, you should be able to:

- Learn about application of machine learning in educational technology
- Understand the advantages of machine learning in education
- Gain knowledge on the role of machine learning in learning analytics
- Understand the use of machine learning algorithms for personalized adoptive learning
- Learn how machine can help in assessment
- Understand the sentimental analysis for student’s feedback using machine learning approach
- Gain knowledge on suitable algorithms for recommendation system in education
- Understand the application of machine learning in predicting student's performance

Machine learning in education

- Advantages of machine learning in education.
  - Customized and customized learning.
  - Analytics of content.
  - Grading.
  - Simplification of tedious tasks.
  - Students’ progress.

Advantages of machine learning in education

- Customized learning:
  - Machine learning is sufficiently versatile to accommodate all learners irrespective of educational level.
  - Machine learning helps the beginner to step on only after they have really understood the preceding material by using algorithms to learn how information is being interpreted by the individual.
- Analytics of content:
  - The computers are used to evaluate the data used by teachers to teach and to evaluate whether the material value satisfies the criteria necessary.
- Grading:
  - Computer technology models were utilized to shorten individual grading period.
- Simplification of tedious jobs:
  - ML techniques can minimize the time of teacher's time in routine and tedious tasks such as attending classes and gathering homework assignments in the traditional method of training.
- Shorten progress:
  - Educators can supervise each learner on a private stage by utilizing computers and independently assess their development in learning.
  - In addition, computers can supply learners with different teaching patterns to assist educators identify the finest methods to teach learners.

Learning analytics

- Learning analytics is about developing methods to assist the teaching method by utilizing academic information sets.

- Learning Analytics (LA) is a multidisciplinary area that includes:
  - Machine training.
  - Technology.
  - Data collection.
  - Analysis.
  - Simulation.

- Learning Analytics (LA) is defined as measuring, gathering, evaluating and reporting learner information and their contexts to understand and enhance teaching and the atmosphere in which it exists.

- Teaching effort describes LA as using information and designs to anticipate student's advancement and success and capacity to intervene on that knowledge (as stated in siemens, 2010).

Academic analytics

- Goldstein and Katz (2005) coined the word Academic Analytics (AA).
- Since the late 1990s, early AA services have introduced analytical approaches to satisfy the requirements of academic organization.

Action research

- Action research is a technique that has grown extremely famous and excellently-developed in teaching.
- This makes educators assess and analyse their jobs themselves.
- The aim of studies on academic intervention is to improve instructional practice and performance assurance.
- Students and teachers periodically discuss research questions that arise on the basis of a particular teaching situation, while intervention and reflection correlate.

Educational data mining

- In recent times, Educational Data Mining (EDM) has appeared as a separate research area.
- Educational Data Mining (EDM) describes a research field concerned with the application of data mining, machine learning and statistics to information generated from educational settings.
- At a high level, the field seeks to develop and improve methods for exploring this data, which often has multiple levels of meaningful hierarchy, in order to discover new insights about how people learn in the context of such settings.
- In doing so, EDM has contributed to theories of learning investigated by researchers in educational psychology and the learning sciences.
- The field is closely tied to that of learning analytics, and the two have been compared and contrasted.

Recommender system

- Recommender systems generally collect information on the actions or interests of the consumer in order to draw conclusions on the selection of products that may most likely be of interest to them.

- Technically, recommendation methods are categorized into the following forms on the basis of how they are recommended:
  - Content based recommendation.
  - Collaborative filtering.
  - Hybrid approaches.

Personalized adoptive learning

- Personalized Adaptive Learning (PAL):
  - It is a data driven assessment and remediation platform transforming learning outcomes through deep machine learning.
  - It empowers teachers with actionable intelligence.
  - It helps teachers stop guessing and make data driven decisions.
  - PAL helps in removing trending misconceptions and gaps.

Learning analytics process

Figure: Learning analytics process

Source: case study:https://www.academia.edu/39641945/IRJET-_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Reference model for learning analytics

- **The four dimensions of the proposed LA reference model:**
  - What? What type of data is the process gathering, storing and using for analysis?
  - Who? Who is the focus of the analysis?
  - How? How does the collected data interpret the system?
  - Why? Why is the system analysing the information gathered?

Data environment: What?

- LA methods use diverse academic data sources.
- LA is a data-driven approach.
- User-generated content, facilitated by ubiquitous technologies of production and cheap tools of creativity, has led to a vast amount of data produced by learners across several learning environments and systems.

Stakeholders: Who?

- LA may be applied to various participants like:
  - Learners.
  - Educators.
  - (Smart) lecturers/advisors.
  - Academic institutions (administrators and faculty decision makers).
  - Academics.
  - Program developers with specific la exercise context.
  - Goals and expectations.

- Students may be involved in how technology can enhance their skills and enable them develop their ideal educational experiences.

Methods: How?

- To find fascinating trends found in educational data sets, LA uses various strategies like:
  - Statistics.
  - Information visualization.
  - Data mining.
  - Social Network Analysis (SNA).

Case study: Sentimental analysis for student's feedback using ML (1 of 3)

- This study focuses primarily on symbolic analysis for online reviews from participants.
- Here we identify the feeling present in text documents based on polarity–positive, negative and neutral using the approach of machine learning and lexicon.
- We used the random forest classifiers and also obtained the highest accuracy of 90 percent for performance assessment and accuracy.

Case study: Sentimental analysis for student's feedback using ML (2 of 3)

Figure: Workflow diagram

Source: case study:https://www.academia.edu/39641945/IRJET-_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Case study: Sentimental analysis for student's feedback using ML (3 of 3)

- Results

Figure: Overall results

Figure: Negative feedback results

Figure: Positive feedback result

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Recommender systems in education

Figure: Functional models for proposed systems

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Domain model (1 of 2)

Figure: Course Organization

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

- Table: Metadata for course components.

Component	Metadata
Course	name, author, version, grading policy, prerequisites, attainment goal
Concept	name, attainment goal, attainment level, prerequisite
Topic	name, attainment goal, attainment level, prerequisite
Learning Object (LO)	name, author, creation date, version, last modified, attainment level, keyword, prerequisite, level of interactivity, instruction method, difficulty level

Domain model (2 of 2)

Figure: Test model

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Questions	Type	Difficulty	Knowledge Level
Q1	True/False	Easy	Basic
Q2	MultipleChoice	Medium	Basic
Q3	check boxes	Hard	Basic
Q4	One answer	Easy	Advanced
Q5	True/False	Medium	Advanced
Q6	check boxes	Hard	Advanced

Figure: Description of object X learning test (LOX)

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Learner model

Figure: Learning ontology mode

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Students classification algorithm

Figure: Schematic algorithm for student classification based on decision trees

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Recommendation model

- Equation 1: $RatingLO = \sum(L) + \sum(O)$

- Equation 2: $$w(x,y): \frac{\sum_j^m R_{x,j} \times R_{y,j}}{\sqrt{\sum_j^m R_{x,j}{}^2}\sqrt{\sum_j^m R_{y,j}{}^2}}$$

- Equation 3: $$P_{x,j} = \bar{R}_x + \frac{\sum_{y=1}^n w(x,y)(R_{y,j} - \bar{R}_y)}{\sum_{y=1}^n |w(x,y)|}$$

Case study: Application of ML in predicting students performance

Figure: Methodology proposed

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Proposed methodology

Figure: Methodology proposed

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Data description

- The data source used for this study consists of 335 student's educational documents.

- The overall quantity of cumulative documents of the grade of pupils was 6358, which applies to all the topics taken by this class of pupils.

Figure: Subjects by area of knowledge

Source: case study:https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Sample data sets

Academic Period	Subject Name	PG 1	PG 2	PG 3	FG	Area	Situation
2016-1	General Physics	8.0	4.5	6.3	6.2	Mathematics and Physics	Pass
2017-1	Communication Theory	6.0	5.6	5.3	5.7	Infrastructure	Fail
2017-1	Digital electronics	4.4	8.1	6.9	6.4	Electronics	Pass

Visualization

Figure: Visualization

Source: case study:
https://www.academia.edu/39641945/IRJET_Sentimental_Analysis_for_Students_Feedback_using_Machine_Learning_Approach

Selection of machine learning technique

- In this scenario, we used methods of information prospecting and artificial intelligence to offer real a precise method of predicting historical grade datasets.

- One of the most popular problems is forecasting student educational success and, at the current time, a challenging activity in instructional data collection.

Checkpoint (1 of 2)

Multiple choice questions:

1. Which of the following is a type of recommender system?
   a) Content based
   b) Picture based
   c) Image based
   d) Dimension based

2. Conventional CF-based methods use which of the following as the sole source of information for learning to make recommendation.
   a) Reviews and ratings given by the used
   b) Images captured
   c) Computer vision
   d) Real time data

3. Which of the following techniques are used to extract useful knowledge from raw data?
   a) Data mining
   b) Data execution
   c) Data extraction
   d) Educational data mining

Checkpoint solutions (1 of 2)

Multiple choice questions:

1. Which of the following is a type of recommender system?
   - **a) Content based**
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   - c) Image based
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   - d) Real time data

3. Which of the following techniques are used to extract useful knowledge from raw data?
   - **a) Data mining**
   - b) Data execution
   - c) Data extraction
   - d) Educational data mining

Checkpoint (2 of 2)

Fill in the blanks:

1. _____ is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.
2. _____ is emerging as a research area with a suite of computational and psychological methods and research approaches for understanding how students learn.
3. _____ is an educational approach that aims to customize learning for each student's strengths, needs, skills and interests.
4. _____ are an important class of machine learning algorithms that offer "relevant" suggestions to users.

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. **Learning analytics** is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.
2. **Educational data mining** is emerging as a research area with a suite of computational and psychological methods and research approaches for understanding how students learn.
3. **Personalized learning** is an educational approach that aims to customize learning for each student's strengths, needs, skills and interests.
4. **Recommender systems** are an important class of machine learning algorithms that offer "relevant" suggestions to users.

Question bank

Two mark questions:

1. What is learning analytics?
2. What is academic analytics?
3. What is education data mining?
4. What is recommendation system?

Four mark questions:

1. Describe learning analytics process.
2. Write a note on social network analysis.
3. How recommendation system can be used in recommendation system?
4. Describe the importance of educational data mining.

Eight mark questions:

1. Write a short notes on personalized adaptive learning.
2. Explain how sentimental analysis can be used for analysing students feedback.

Unit summary

Having completed this unit, you should be able to:

- Learn about application of machine learning in educational technology
- Understand the advantages of machine learning in education
- Gain knowledge on the role of machine learning in learning analytics
- Understand the use of machine learning algorithms for personalized adoptive learning
- Learn how machine can help in assessment
- Understand the sentimental analysis for student’s feedback using machine learning approach
- Gain knowledge on suitable algorithms for recommendation system in education
- Understand the application of machine learning in predicting student's performance

Welcome to:

Applications of Machine learning in Retail Industry and Supply Chain

Unit objectives

After completing this unit, you should be able to:

- Understand inventory management
- Gain knowledge on the machine learning use cases in inventory management
- Understand the benefits of predictive analytics to retailers in terms of intelligent inventory management
- Learn about the applications of inventory management with machine learning
- Understand the machine learning techniques for analyzing buying patterns
- Gain knowledge on make use of machine learning algorithms for retail analytics
- Understand the demand forecasting methods

Introduction

- The retail industry's use of data for competitive advantage is not new it has taken on a leading role in fostering digital and in-store consumer analytics.
- Deep learning approaches are currently in the process of transforming the retail industry.
- As artificial neural networks are becoming increasingly efficient, and as Graphics Processing Units (GPUs) are becoming more and more powerful, so is their retail influence.
- For retailers, data is clearly efficient, but it's all about putting it to function in the right areas and incorporating predictive capabilities.

Inventory management

- Inventory refers to the goods stored for use in the future.
- The distributor keeps track of the stored items and ensures that there is an inventory shortage to prevent "out of stock“.
- A system is called the management of inventory.

Few use case examples

- Use autonomous front-end sales robots to help customers find products, as well as back-end stock audits.

- Use of Internet-of-Things (IoT) to provide linked supply chain sensors and equipment capable of sending warnings regarding possible issues before they become complicated that would interfere with the action of goods.

- Use predictive analytics technology to help assess the availability of supply chain and weather-based demand.

Benefits of predictive analytics to retailers

- Filling customer needs faster by running comprehensive simulations that allow for evaluating the consequences of lateness or missed deadlines before they become a problem.
- Shrinkage reduction and stock maximization.
- Classification methods can be used to estimate the probability of a late order and how many days it will take.

Applications of inventory management with machine learning

- Robots: Seeing to customer satisfaction.
- IOT: Prevention first.
- Predictive analytics: Weathering demand.
- Analysing buying patterns.
- Analysing traffic patterns.

Robots-seeing to customer satisfaction

- The advanced commercial machines not only support buyers.
- Generate actual-time data through the use of device vision and machine learning to search stock and seek for brand and cost differences trends.
- The 5 multilingual commercial robot functions help buyers locate the items they are searching for by a viewable device interface, enhanced speech recognition and laser-based sensors that help them navigate the shop.

IOT: Prevention first

- Connectivity refers to their state beyond the position of items.
- Connected distribution equipment monitors will pass warnings regarding possible problems before the problem arise which would interrupt product motion.
- An Industrial IoT Accenture 2016 study concluded that strategic resources can preserve up to 12% on planned corrections and 30% on servicing, thus decreasing interruption from up to 70%.
- In 2014, Intel's the first full-united IoT production pilot ensured in saving of $9 million in only one plant.

Predictive analytics: Weathering demand

Figure: Weathering demand

Source: IBM Weathering demand.com

Analysing buying patterns

- One important area where retailers benefit from machine learning is to evaluate purchasing trends and patterns to recognize and plan for customized virtual bend-selling and upselling incentives.

- presenting consumers the most appropriate goods depending on their actions at the time.

- With AI and artificial intelligence technologies, it's simple to look how powerful tools they are for distributors:
  - Reading and hearing to information.
  - Knowing and growing from it.
  - Quickly and reliably.
  - Suggesting the better move without specific programming.

Analysing traffic patterns

- The use of deep learning to forecast patterns in retail foot traffic is that another important area of technology being developed by retailers.
- Through integrating video and audio from real-time traffic with digital fingerprinting from shopper's smartphones, sensors can detect in-store foot traffic.
- Significant progress has been made thanks to innovations such as deep learning, retail foot traffic monitoring and analysis.
- Some vendor solutions conduct a profound learning process that allows us to predict congestion.

Assortment planning

- The aim of assortment planning is to make the right product picks and order the right quantities to meet market demand.
- The business changes once a fashion season is finished.
- The excess inventory is often sold at heavily discounted prices at this point.
- The first step in the preparation of the collection is to understand the basics.
- Second, retailers also try to make their scheduling easier.
- We would combine stores with similar characteristics instead of planning for each store.

Why assort management is important

- Eliminate guess work.
- Feed the right stores.
- Get better information.

Eliminate guess work

- The main principle of proper planning for the assortment is to focus the decisions on information rather than guesses.

- This approach makes you nearer to the real variety of units for a particular style that you need to purchase.

Feed the right stores

- Overall sales has something to do with what customers want, it is just an indication of a place's traffic attracting ability.
- Each contact point of the customer is different.
- To get the best order amounts for each product based on what your customers need, you need to use assortment scheduling.
- Using product scheduling to customize the orders often increases customer experience, because consumers are more probable to find in-store what we need.

Get better information

- Increasing the preparation of assortments means improving the performance and amount of useful data that can affect the assortments tremendously.
- Proper variety planning puts things together so that before they go to visual merchandising, you can see assortments in one place.
- This is important before it's too late to catch issues.

Assortment planning to drive supply chain

- An end-to-end supply chain will work to schedule the:
  - Production.
  - Inventory.
  - Sales.
  - Margins necessary.

- It is possible for manufacturers to use market trend data and retailer requirements to modify their inventory levels.

Retail analytics

- The retail industry's that challenge is that the database and modelling resources that once served them well are no longer up to the task with ever larger data sets.
- Many players in the retail space use recommendation engines that apply scale-based deep learning.
- The inclination at that slow pace is to consider what is available as opposed to what is required.
- This capitulation is a failure treatment. To draw on insights found in their consumer analytics, the modern retailer needs to process large amounts of retail information in real time.
- For example, assume a consumer moves with a basket of goods in a store and the individual items contain RFIDs. Using a request, the retailer can make additional purchasing recommendations based on the composition of the basket as the consumer heads for checkout.

Domestic forecasting

- Demand forecasting is one of supply chains main concern. This aimed at maximizing inventory, reducing costs and rising customer loyalty, revenue and income.
- When competition among retailers on the market is growing day by day, companies concentrate on more anticipating analytical methods to lower their expenses and improve their profitability and profits.
- When consumers are unable to find the products they are looking for in the store, they can move to another competitor or buy replacement goods.
- It is very important to have an efficient supply predictive analytics and supply tracking program for successful operations planning in view of rivalry and monetary restrictions in the wholesale sector.
- Conventional techniques of predicting are predicated on methods to regression predicting.
- DL approaches have produced better predictions and outcomes in many research studies than conventional machine learning algorithms.

Case study: Forecasting seasonal footwear demand using ML

- Overview of retail fashion industry.
- The clothing sector has changed tremendously over the last several centuries, particularly since the advent of e-commerce. Customer's flavour has been the main factor of clothing materials supply.
- The ongoing change in the behaviour of customers has resulted in smaller life cycles of goods and more unpredictable demand.
- Clothing companies need to create overriding methods that can be modified to the continuous improvements in the sector with all these challenges.
- Such methods include advertising as a tool to create supply and electronic capacity as enablers of growth, such as e-commerce and mobile apps.
- It is also important to establish deferral techniques by conducting components or semi-finished products in allocation facilities or warehouses to offer flexibility and give the business additional time to see stronger transmissions on the market.

Demand forecasting methods

- Market forecasts are highly complex in the garment and shoes sector leading to:
  - Unpredictable market.
  - High variability.
  - Stock-keeping Unit Intensity (SKU).
  - Temporary and trend products.
  - Brief life cycles and lack of cultural data.

- Current predicting techniques typically only take a single variable or at most a few factors into consideration, so that portion of the variability in the predicting system remains unknown while trends can be uncovered.

Predictor variables in demand forecasting

- Many prevalent sorts of details utilized in supply predicting is POS information or onshore records.

- which is commonly utilized in conventional regression predicting and advanced machine learning techniques.

- For instance, in creating a Demand Signal Registry (DSR) for a quickly-operating material product company (FMCG), Rashad and Spraggon (2013) observed that the main significant factors in influencing production from the many factors analysed are:
  - Year.
  - Month.
  - Weekday.
  - Holidays.

Traditional techniques v/s machine learning techniques

	Traditional Forecasting	Machine Learning Forecasting
Number of predictor variables	Single or a few	Unlimited
Data source	Mainly demand history	Multiple
Algorithms	A number of single-dimension algorithms	An array of integrated algorithms
Manual data manipulation and cleansing need	High	Low
Data requirements	Low	High
Technology requirements	Low	High

Figure: Traditional techniques v/s machine learning techniques

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Methodology

Figure: Methodology

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Machine learning techniques used

- Supervised learning techniques.
- Unsupervised learning techniques.
- Scope and granularity of data.

Supervised learning techniques

- Guided training presents a program with document which has specified performance parameter.

- The program "learns" how to measure this quality for new documents where the performance is uncertain.

- The concept of controlled teaching method utilized is given here:
  - Reversion and category trees.
  - Random forests.
  - Neural networks.
  - K-Nearest Neighbour (k-NN).

Unsupervised learning techniques

- Instead of predicting an output value, unsupervised learning attempts to learn patterns in information.

- The meaning of each unattended teaching method used as follows is defined:
  - K-Means clustering.
  - Stochastic Neighbour Embedding (t-SNE).

Scope and granularity of data

- Two forms of content are gathered by the organization: Sell-in information (batch) and sold from data (POS).

- The collected POS content included:
  - Brand characteristics.
  - Schedule characteristics.
  - Shop attributes.
  - Cost and advancement characteristics.
  - Sales units from 115 retail outlet stores at the regular type location level.

- Although the purpose of this venture is on supporting the determination of each design to purchase from the supplier throughout the year, the content are consolidated to the point at this choice. i.e. at the monthly price, throughout all stores.

List of attributes from the aggregated data by month at the style level

Variable category	Variable	Description
Meta Data	Style	Unique style number of each product
Meta Data	Style Description	Description of the style
Calendar	Year	Fiscal year
Calendar	Month	Fiscal month
Product Attributes	Color	Color code
Product Attributes	Basic Material	Type of upper material
Product Attributes	Gender	Gender or age group description
Product Attributes	Category	Product family
Product Attributes	Sub-Category	Classic vs modern
Product Attributes	Retail Outlet Sub-Department	Basic vs. seasonal
Product Attributes	Cut	Ankle height
Product Attributes	Pillar	Product sub-brand
Product Attributes	Product Class	Product main feature
Price and Promotion	Price Status	Full-price vs mark-down
Price and Promotion	Manufacturer's Suggested Retail Price (MSRP)	Ticket price
Price and Promotion	Average Unit Retail (AUR)	Actual selling price
Sales Units	Retail Sales Units (Target variable)	Retail sales units

Feature selection and engineering

- In preparation for constructing the template, many features have been updated or removed. Under the colour classification.
- There are many different findings, some of which are very similar.
- Component and class are identical to one-to one connection attributes, i.e. They are entirely associated with one another.
- Since seasonal models are launched with limited lifecycles at various periods of the year.
- Their prices are assumed to rely on the development characteristics in relation to the schedule characteristics.
- Revenue are not only linked to the schedule month in which the sale takes place, but also to the month in which the item is released.

List of attributes for feature selection

Variable Category	Variable	Description
Meta Data	Style	Unique style number of each product
Meta Data	Style Description	Description of the style
Calendar	Year	Fiscal year
Calendar	Month	Fiscal month
Product Attributes	Color Group	Color code
Product Attributes	Basic Material	Type of material
Product Attributes	Gender	Gender or age group description
Product Attributes	Category	Product family
Product Attributes	Sub-Category	Classic vs. modern
Product Attributes	Cut	Ankle height
Product Attributes	Product Class	Product main feature
Price and Promotion	Manufacturer's Suggested Retail Price (MSRP)	Ticket price
Price and Promotion	Average Unit Retail (AUR)	Actual selling price
Lifecycle	Lifecycle	The total number of months in the lifecycle of a style
Lifecycle	Lifecycle Month	The number of months since product launch
Lifecycle	Lifecycle Start Month	The month at which the lifecycle started
Store	Store Count	Number of stores selling a style
Sales Units	Retail Sales Units (Target variable)	Retail sales units

Dataset partitioning

- Table: Overview of datasets generated for the general model.

Dataset	Months of sales	Number of Styles	Number of records
Training	36	578	1796
Validation	18	195	560

- Table: Overview of datasets generated for the three-step model.

Dataset	Months of sales	Number of Styles	Number of records
Training	35	539	1558
Validation	19	201	591
Testing	3	58	155

Model building

- General model.
- Three-step model.

Three step model

Process Name	Variable Name	Variable Category
Clustering	Lifecycle	Lifecycle
	MSRP	Price and Promotion
	Average AUR	Price and Promotion
	Average Store Count	Store
	Retail Sales Units	Sales Units
Classification	Lifecycle	Lifecycle
	MSRP	Price and Promotion
	AUR	Price and Promotion
	Store Count	Store
	Fiscal Year	Calendar
	Fiscal Month	Calendar
	Lifecycle Month	Calendar
	Lifecycle Start Month	Calendar
	Color Group	Product
	Basic Material	Product
	Gender	Product
	Category	Product
	Cut	Product
	Cluster Number	Cluster

K-means clustering

- After arranging the data and reducing the information dimension to just two elements.
- we operated the grouping method k-means to segment the information files into group scope.
- Classification:
  - At the end of the segmentation process, group details are allocated to the documents of both testing and verification sets.
  - The class engines were the classification characteristics as well as the statistical qualities.

Three steps followed in classification

Figure: the three sub-steps followed in classification

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Three sub-steps in prediction

Figure: The three sub-steps followed in prediction

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Performance measurement

- For our predictive models, we used two performance metrics: predictive accuracy and bias. To measure predictive precision, we utilized:
  - Weighted Mean Absolute Percentage Error (WMAPE).
  - Weighted Mean Percentage Error (WMPE).

- We eventually utilized equation 3 to determine the expected discrimination in a specific manner.

- Equation 1:

$$Absolute\ Forecast\ Error = |Forecasted\ Sale - Actual\ Sales|$$

- Equation 2:

$$Forecast\ Accuracy\ (WMAPE) = \frac{\sum_{i=1}^{n} |Forecasted\ Sales - Actual\ Sales|}{\sum_{i=1}^{n} Actual\ Sales}$$

- Equation 3:

$$Forecast\ Bias\ (WMPE) = \frac{\sum_{i=1}^{n} Forecasted\ Sales - Actual\ Sales}{\sum_{i=1}^{n} Actual\ Sales}$$

Results

- General model: The template with 12 parameters culminated in the smallest failure as shown in figure depending on the effects of reciprocal function removal.

Importance Rank	Attribute	Attribute Category
1	Store Count	Store
2	Month	Calendar
3	Lifecycle Month	Lifecycle
4	Gender	Product
5	AUR	Price and Promotion
6	Year	Calendar
7	Basic Material	Product
8	MSRP	Price and Promotion
9	Color Group	Product
10	Lifecycle	Lifecycle
11	Cut Description	Product
12	Product Class Description	Product

Figure: List of Attributes selected for model building

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Results

Figure: Cross validation error by number of attributes

Source: https://docplayer.net/102535491-Forecasting-seasonal-footwear-demand-using-machine-learning.html

Three step model

- The stages followed in the three-step model:
  - Clustering.
  - Classification.
  - Prediction.

Clustering and classification

- We used the profile score to access the variety of groups that matched our tests.
- The silhouette points in data groups are a type of perception and accuracy checking.
- Table: The silhouette score for different k number of clusters.

Number of Clusters	Silhouette Score
2	0.378
3	0.422
4	0.481
5	0.469
6	0.487
7	0.489
8	0.463
9	0.441
10	0.427

Prediction

- Testing the forecasting formulas on both verification and trial sets resulted in quite distinct quality algorithms tests.
- Both datasets, the predictability of the ensemble approaches was much smaller.
- Overall, relative to the validation sample, the test group had slightly better predictive reliability and worse predictive bias.

Machine learning for supply chain management

- Operational inefficiencies in supply chain management can often lead to potential reductions in sales, rising costs, and poor customer service–ultimately reducing profits.

- There are many uncertainties in the order-to-cash cycle, a key process in supply chain management.
  - Insufficient stock to meet demand.
  - Distribution of shortages and technical difficulties n enormous order backlog.
  - Request variance n stakeholder contact gaps.
  - Variation of stock quality levels.
  - Varied consumer performance indicators end.
  - Distribution of non-ordered goods.

Recommended architecture for machine learning models

- Creating models to recognize system gaps and predict the probability of return orders and shipment delays needs case-specific information such as:
  - Customer profile and demographics.
  - Order and shipping data.
  - Brand acceptance.
- Introduce and equip the data analytics platform with machine learning and visualization capabilities capable of embedding massive out-of-the-box data volumes.
- Identify the root cause of return orders by combining different data sources such as pricing, shipping and order booking.
- Predict whether shipments are likely to be delivered on time using data relating to invoice, transport and shipment.

Machine learning models use case

- An example can explain the effect of using an OTC ML approach.
- The optimized the data model for a marine shipping business after collecting data on chemical products orders for one year, and examined two specific business scenarios.
- The organization collected relevant data to identify problems with late deliveries and trained the ML model to determine the leading cause in the categories of 'defects', resulting in returned products.
- Predictive model can help businesses to identify pre-emptively which orders are likely to be returned, act proactively, and accelerate the delivery of orders.

Checkpoint (1 of 2)

Multiple choice questions:

1. What is the purpose of performing cross validation?
   a) To assess the predictive performance of the model
   b) To judge how the trained model performs outside the sample on test data
   c) Both a and b
   d) None of the above

2. Why is second order differencing in the time series needed?
   a) To remove stationary
   b) To find the maxima or minima at the local point
   c) Both a and b
   d) None of the above

3. When performing regression or classification, which of the following is the correct way to process data?
   a) Normalize the data → PCA → training → answer
   b) PCA → normalize PCA output → training
   c) Normalize the data → PCA → normalize PCA output → training
   d) None of the above

Checkpoint solutions (1 of 2)

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   b) PCA → normalize PCA output → training
   c) Normalize the data → PCA → normalize PCA output → training
   d) None of the above

Checkpoint (2 of 2)

Fill in the blanks:

1. _____ is a systematic approach to sourcing, storing, and selling inventory—both raw materials (components) and finished goods (products).
2. _____ encompasses a variety of statistical techniques from data mining, predictive modelling, and machine learning, that analyse current and historical facts to make predictions about future or otherwise unknown events.
3. _____ is a process whereby products are selected and planned to maximize sales and profit for a specified period of time.
4. _____ is a field of predictive analytics which tries to understand and predict customer demand to optimize supply decisions by corporate supply chain and business management.

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. **Inventory management** is a systematic approach to sourcing, storing, and selling inventory—both raw materials (components) and finished goods (products).
2. **Predictive analytics** encompasses a variety of statistical techniques from data mining, predictive modelling, and machine learning, that analyse current and historical facts to make predictions about future or otherwise unknown events.
3. **Assortment planning** is a process whereby products are selected and planned to maximize sales and profit for a specified period of time.
4. **Demand forecasting** is a field of predictive analytics which tries to understand and predict customer demand to optimize supply decisions by corporate supply chain and business management.

Question bank

Two mark questions:

1. What is inventory management?
2. What is demand forecasting in retail industry?
3. Define retail analytics.
4. Define K-Means clustering.

Four mark questions:

1. Explain some use cases of inventory management.
2. With an example explain the applications of machine learning in retail analytics.
3. Write importance of machine learning in supply chain management.
4. Explain the benefits of predictive analytics to retailers in terms of intelligent inventory management.

Eight mark questions:

1. Briefly explain the applications of machine learning in inventory management.
2. Explain with an example applications of machine learning in inventory management and retail analytics.

Unit summary

Having completed this unit, you should be able to:

- Understand inventory management
- Gain knowledge on the machine learning use cases in inventory management
- Understand the benefits of predictive analytics to retailers in terms of intelligent inventory management
- Learn about the applications of inventory management with machine learning
- Understand the machine learning techniques for analysing buying patterns
- Gain knowledge on make use of machine learning algorithms for retail analytics
- Understand the demand forecasting methods

Welcome to:

Machine Learning in Transportation and Logistics

Unit objectives

After completing this unit, you should be able to:

- Learn about applications of machine learning and artificial intelligence in transportation
- Understand the application of AI in aviation and public transportation
- Gain knowledge on artificial intelligence use cases in logistics
- Learn about ml powered customer services in logistics and transportation
- Understand the limitations of AI techniques in transportation

Introduction

- Artificial Intelligence (AI) has an extremely key role in the logistics field.
- Artificial intelligence comes with computing methods that help pick large amounts of data from the logistics and supply chain.
- The system-based architecture of the sector creates a powerful foundation for AI implementation and optimizing in logistics, reinforcing the biological elements of tightly organized global supply chains.
- AI extends beyond product ubiquity and into commercial ventures focused on consumers.
- Nevertheless, as many logistics companies around the world are adopting technological change, from conventional resource management systems to developed analytics, enhanced hardware and software automation and robotics, and digital technology.
- AI gives organizations the opportunity to automate network coherence with level of productivity that individual thought cannot accomplish.

Applications of ML and artificial intelligence in transportation

- The ML travel programs were implemented in a variety of forms. Among them, for instance:
  - Use machine learning techniques in strategic choice-making and management.
  - AI technologies are also discussed with a view to improving public transport.
  - Connected and autonomous cars are the next promising AI technology in transport, which tries to increase efficiency by limiting the amount of road disaster.

Applications of machine learning in transport

- AI technique can be viewed as an intelligent remedy for these complicated systems that traditional methods cannot be used to manage.
- A lot of ai methods are also used in transportation such as ANNs.
- Many travel problems lead to an issue of segmentation concerning custom methodologies to make mathematical data analysis easy to solve.
- The aim of organizing is to define the needs of the society and agree on the good method to satisfy this supply while taking advantage of transport's cultural, ecological and financial effects.
- Few applications of machine learning in transport are:
  - Incident detection.
  - Predictive models.

Incident detection

- There have been many efforts to classify the date, location, and extent of an accident and assist traffic management in reducing congestion.
- Using statistical techniques such as the California algorithm, event detection algorithms were first introduced.
- Algorithms have been developed for neural network approaches.
- To detect an incident on an autobahn, a neural network detection algorithm has been tested.

Predictive models (1 of 2)

- Smart Transport Services (STS) progressive growth has enhanced the need to incorporate sophisticated traffic data prediction methods.
- Sophisticated passenger intelligence structures, sophisticated traffic control systems, sophisticated public transport systems and business automobile services, play a key role in the reliability of ITS components historical data.
- An element-oriented model of a recurring time-lag system (TLRN) neural network has been developed.
- In the past, research has concentrated on short-term stream forecasting through the use of simple feed forward computer program.

Predictive models (2 of 2)

Figure: Three phases approach to develop advanced predictive model

Source: Ernst & Young

Application of AI in aviation and public transportation

- Aviation.
- Shared mobility.
- Buses.
- Intelligent urban mobility.
- Autonomous vehicle.

Aviation

- To control the flight trip more efficiently, AI has been acknowledged.
- A program called (PLADS) was developed in to retrieve and modify evidence to back up virtual system and SA optimization structures from high density aviation papers.
- The safety of the aircraft was measured by testing the engine on board utilizing the Probabilistic Neural Network (PNN).

Shared mobility

- ICT-enabled platforms for exchanges of goods and services drawing on non-market logics such as:
  - Sharing.
  - Lending.
  - Gifting.
  - Swapping.
  - Market logic.
    - Renting.
    - Selling.

- The evolving digital revolution has a strong interest in building innovation structures to create current distributed transportation solutions to establish a reliable transport network.

- For instance, by recommending user location based on travel background of the user, the uber provided customized rider experience.

Buses

- ANNs is easy to use by forecasting bus arrival times to reduce the waiting time for passengers.
- Usage of buses was also applied to automatic bus layout. With a strong dual-mode architecture.
- The innovative on-production bus services that run with flexible schedules and routes are another example in the AI developments in demand sensitive public transportation.
- These services are intended to provide taxi’s door-to-door convenience at a fraction of their cost along with the bus model's efficiency.
- An Automatic Vehicle Location (AVL) system aimed at improving the performance of public transport activities, retaining operational controls and enhancing the overall quality of public transport services.

Intelligent urban mobility

- The upcoming sight of smart social flexibility is strategic, real-time information-based decision-making and network management through efficient use of infrastructure.

- The world has recently been at the cusp of creating Autonomous Vehicles (AVs), i.e. vehicles that can travel without a human driver's assistance and guidance.

Autonomous vehicles

- Autonomous Vehicles (AV) depend on AI operating system based on deep learning.

- This method works by educating the car how to ride while retaining stable journey times, speed limits, and regulation etc., AVs are expected to have a significant shift in the way transport structures are worked worldwide and their effect on road protection and congestion has been projected to some degree along with their ability to change transport conduct.

- An international investigation into another dimension of what renders the smart intellectual cars more attractive to travellers was as follows:
  - Self-healing: Cars can detect and correct the fault on their own.
  - Self-socialization: The ability of a vehicle to communicate in natural language with the local environment, other vehicles and people. Self-learning: The car uses its own habits, drivers, passengers, and the world around it.
  - Self driving: The vehicle's ability to drive itself in a regulated setting that is fundamentally limited.
  - Self-configuration: Increasing flexibility requires electronic data to define the vehicle's desired experience and customization.
  - Self-integration: The ability to link to other transport systems such as any other intelligent transport network.

Autonomous transportation

Figure: Autonomous transportation

Source: Ernst & Young

Artificial intelligence use cases in logistics

- Back office AI.
- Cognitive customs.
- Predictive logistics.
- Predictive risk management.

Back office AI

- AI offers major time saving, cost reduction, and reliability and reliability by intelligent optimization.

- Cognitive automation relates to the usage of a mix of AI and programmed system technology (RPA) for good company system optimization.

Figure: Back office AI

Source: Ernst & Young

Cognitive customs

Figure: Comparison of existing RPA-assisted back office processes and future processes

Source: Ernst & Young

Predictive logistics

- This section will identify possibilities for global prediction at the network level as well as opportunities for process-specific prediction.

- This approach may categorize the top variables that affect shipping delays, including seasonal factors such as day of exit or administrative factors such as on-time performance of airlines.

- AI can recognise both the rise in numerical participation in a subject and the importance of that interest in its current state from the linguistic knowledge of unorganized text.

- The AI classifier reflects a datatype mirroring the measured average existing trade development and world trade in the next two months.

Predictive risk management (1 of 2)

- Predictive risk management is critical to maintaining the stability of the distribution store.
- Managing the allocation of resources from thousands of foreign suppliers for distribution store executives in many sectors, namely automobile, communications, engineering and industrial fields, is a regular part of the business.
- For efficient distribution providers to stock, collect and supply, intellectual path automation is critical.
- Procurement companies and specialists usually have solid, clear and implicit awareness and functional features of the group in the last-mile delivery.
- Smart robotic sorting is efficient heavy-speed mail processing, packing and even partially disassembled delivery one of the most critical operations for modern parcel and express operators.

Predictive risk management (2 of 2)

Figure: IBM Watson visual recognition enables maintenance with AI visual inspection

Source: Ernst & Young

Seeing thinking and speaking logistics operations

Figure: Seeing speaking & thinking logistics operations

Source: Ernst & Young

ML powered customer experience

- AI will help logistics companies eliminate all of these consumer touch points through consumer satisfaction and acquisition.
- Speakers will improve and customize the user service of logistics companies.
- The discovery of ai technologies would allow logistics companies to proactively manage their consumer connections.
- Involuntary logistics takes AI-powered distribution customer experience to the next level, bringing products to customers until they even order or realize they need them.
- Involuntary operations seeks to harness ai's ability to interpret and forecast large quantities of information such as browsing habits, purchase background, and social norms, as well as completely irrelevant forms of data such as weather data, social networking activity, and news reports to determine what customers will buy.

Limitations of AI techniques in transpiration

- Approaches to transportation (AI) have been restricted to specific ITS implementations such as statistical analysis and future flexibility predictions.
- it is necessary to realize AI's full capacity to build applications that can run as standalone systems.
- To obtain high accuracy, it is important to develop climate and incident sensitive algorithms and prediction schemes.
- The AI will enhance the efficiency of virtual computation in the development of such algorithms and increase the standardization of spatial and temporal information coverage requirements.

Computation complexity of AI algorithms

- An essential part of AI techniques is the development and evaluation of formulas.
- It takes less time to run the algorithm to be efficient for a large number of sample data.
- The quantity of source information rises in a basic example of the algorithm, the list of procedures increases at a steady level.
- While the number of operations and calculations in polynomial time (X2), additive time (2X) and polynomial time (X!) is described in complicated algorithm scenarios.
- AI addresses issues for motorists and road users such as traffic flow and effective transport planning.

Checkpoint (1 of 2)

Multiple choice questions:

1. Which of the following is an example of feature extraction?
   a) Constructing bag of words vector from an email
   b) Applying PCA projects to a large high dimensional data
   c) Removing stop words in sentences
   d) All the above

2. Which of the following is true about naïve Bayes?
   a) Assumes that all the features in a datasets are equally important
   b) Assumes that all the features in the datasets are equally important
   c) Both a and b
   d) None of the above

3. Which of the flowing techniques can be used for normalization in text mining?
   a) Stemming
   b) Lemmatization
   c) Stop word removal
   d) Both a and b

Checkpoint solutions (1 of 2)

Multiple choice questions:

1. Which of the following is an example of feature extraction?
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   c) Both a and b
   d) None of the above

3. Which of the flowing techniques can be used for normalization in text mining?
   a) Stemming
   b) Lemmatization
   c) Stop word removal
   d) Both a and b

Checkpoint (2 of 2)

Fill in the blanks:

1. ---------- process involves both the collection and analysis of traffic data.
2. ---------- modelling uses statistics to predict outcomes. Most often the event one wants to predict is in the future, but predictive modelling can be applied to any type of unknown event, regardless of when it occurred.
3. ---------- is the process of performing risk management activities on hypothetical hazards, risk events, and/or consequences.
4. ---------- refers to the shared used of a vehicle, bicycle, or other transportation mode. It is a transportation strategy that allows users to access transportation services on an as-needed basis.

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. **Incident detection** process involves both the collection and analysis of traffic data.
2. **Predictive** modelling uses statistics to predict outcomes. Most often the event one wants to predict is in the future, but predictive modelling can be applied to any type of unknown event, regardless of when it occurred.
3. **Predictive risk management** is the process of performing risk management activities on hypothetical hazards, risk events, and/or consequences.
4. **Shared mobility** refers to the shared used of a vehicle, bicycle, or other transportation mode. It is a transportation strategy that allows users to access transportation services on an as-needed basis.

Question bank

Two mark questions:

1. List the applications of machine learning in transport.
2. What is incident detection?
3. What is predictive modelling?
4. Define predictive risk management.

Four mark questions:

1. Explain the applications of AI in aviation and public transport.
2. How machine learning can be used for autonomous transportation.
3. What is risk management in banking sector and how it can be addressed.
4. List the limitations of ai techniques in transportation.

Eight mark questions:

1. Explain how machine learning can be applied in logistics.
2. Short not on applications of AI in aviation and public transportation.

Unit summary

Having completed this unit, you should be able to:

- Learn about applications of machine learning and artificial intelligence in transportation
- Understand the application of AI in aviation and public transportation
- Gain knowledge on artificial intelligence use cases in logistics
- Learn about ml powered customer services in logistics and transportation
- Understand the limitations of AI techniques in transportation