APPLICATION OF MACHINE LEARNING IN INDUSTRIES

ROLE OF MACHINE LEARNING AND AGENDA FOR THE LECTURE

- **Machines Learning in Banking and Securities**
- **Machine Learning in Communication, Media and Entertainment**
- **Machine Learning in Healthcare and Life Science**
- **Machines Learning in Education.**

Why machine learning in banking sector

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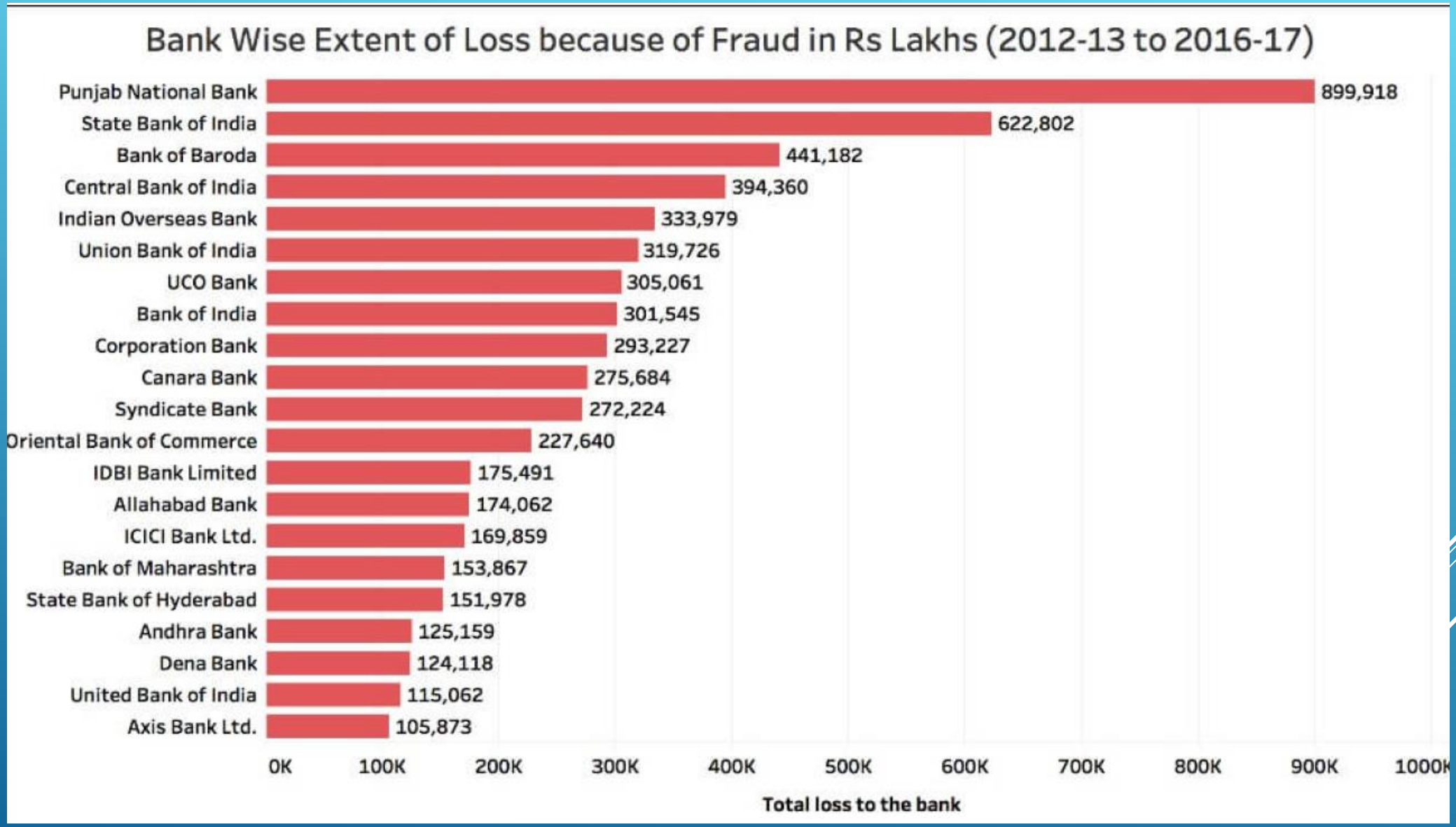
- After financial crisis around the world, there has been a significant transformation in the banking services across the globe with intervention of Artificial Intelligence (AI) applications.
- With appropriate and robust machine learning algorithms, there is a lot of potential to address the key issues 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.


Bank Wise Extent of Loss because of Fraud in Rs Lakhs (2012-13 to 2016-17)
Punjab National Bank 899,918
State Bank of India 622,802
Bank of Baroda 441,182
Central Bank of India 394,360
Indian Overseas Bank 333,979
Union Bank of India 319,726
UCO Bank 305,061
Bank of India 301,545
Corporation Bank 293,227
Canara Bank 275,684
Syndicate Bank 272,224
Oriental Bank of Commerce 227,640
IDBI Bank Limited 175,491
Allahabad Bank 174,062
ICICI Bank Ltd. 169,859
Bank of Maharashtra 153,867
State Bank of Hyderabad 151,978
Andhra Bank 125,159
Dena Bank 124,118
United Bank of India 115,062
Axis Bank Ltd. 105,873
0K 100K 200K 300K 400K 500K 600K 700K 800K 900K 1000K
Total loss to the bank

Tough competition in banking industry

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- 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.

Customer data management

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- 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.

Domain	Implication of ML based solution
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.

Fraud prevention and detection systems

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Rule based and machine learning based approach in fraud detection

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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

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- The way to expose suspicious transactions in banks.

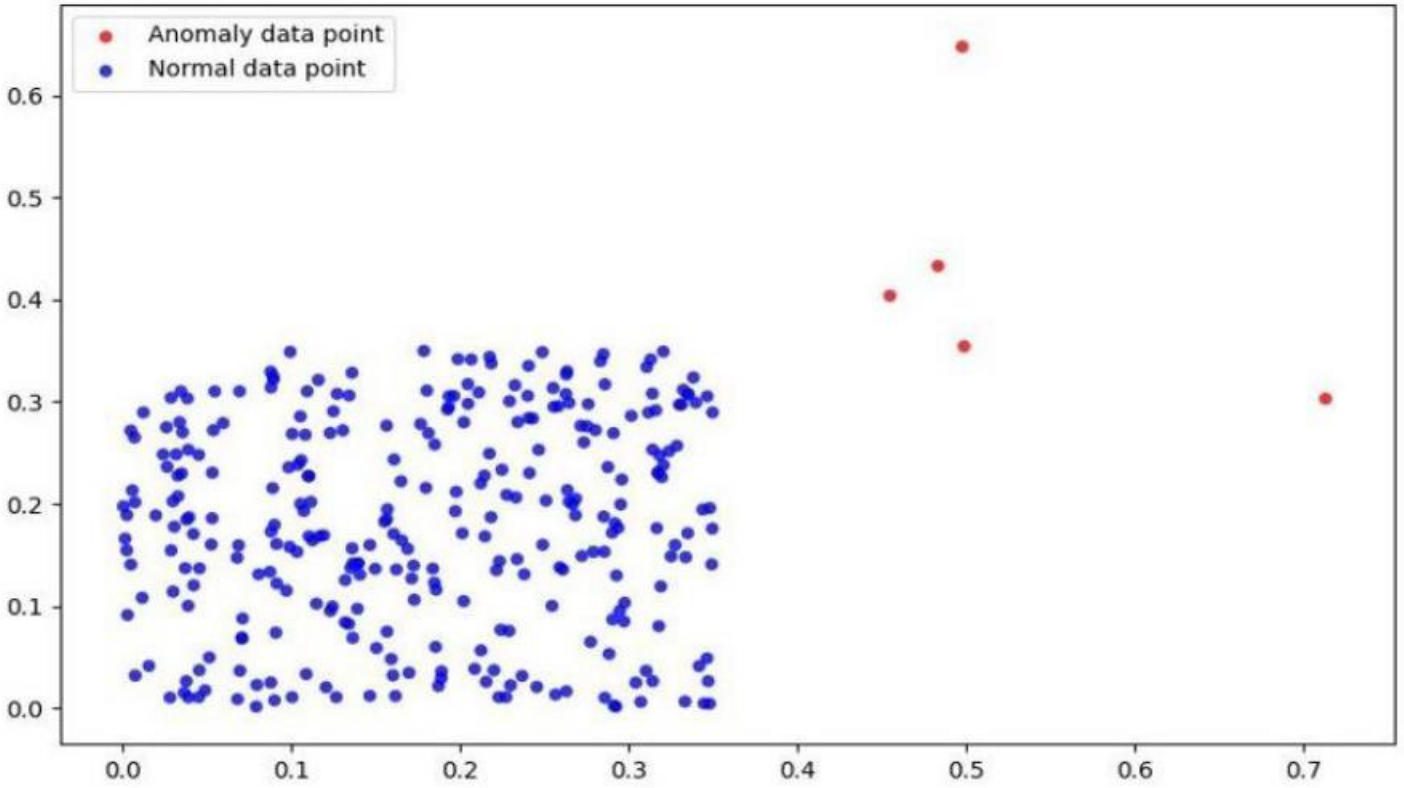

Figure: Ways to expose suspicious transactions in banks

Chatbot: Deep learning approach

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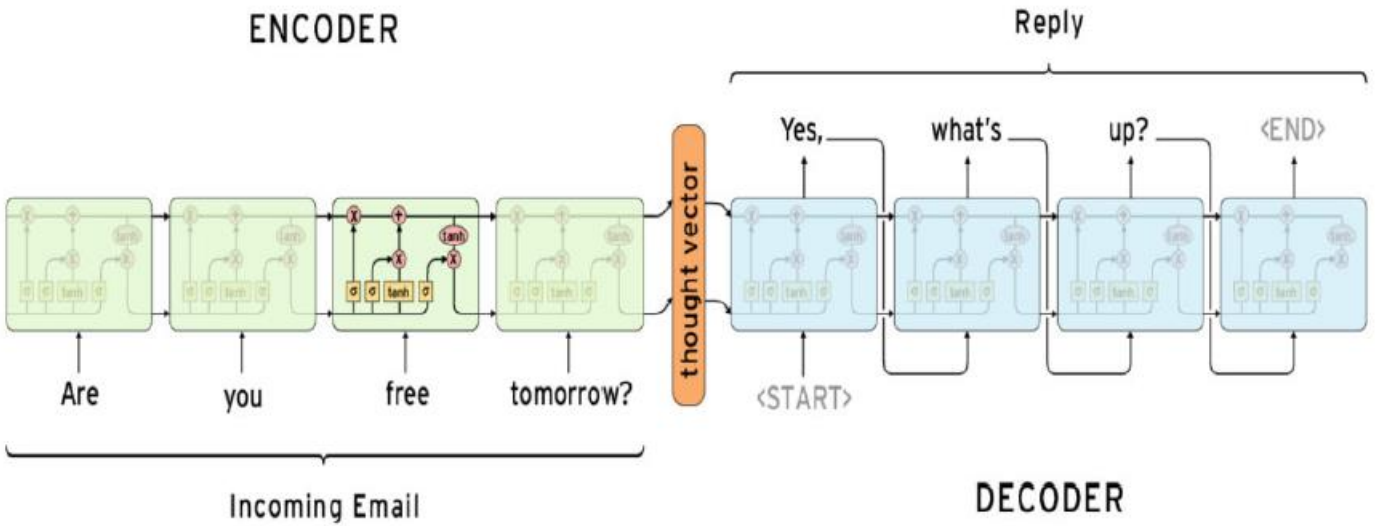

Figure: Chatbot: Deep learning approach

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

Deep learning in cyber security

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- 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

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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 method 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

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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.

Machine learning techniques: Loan underwriting & sentiment/news analysis

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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

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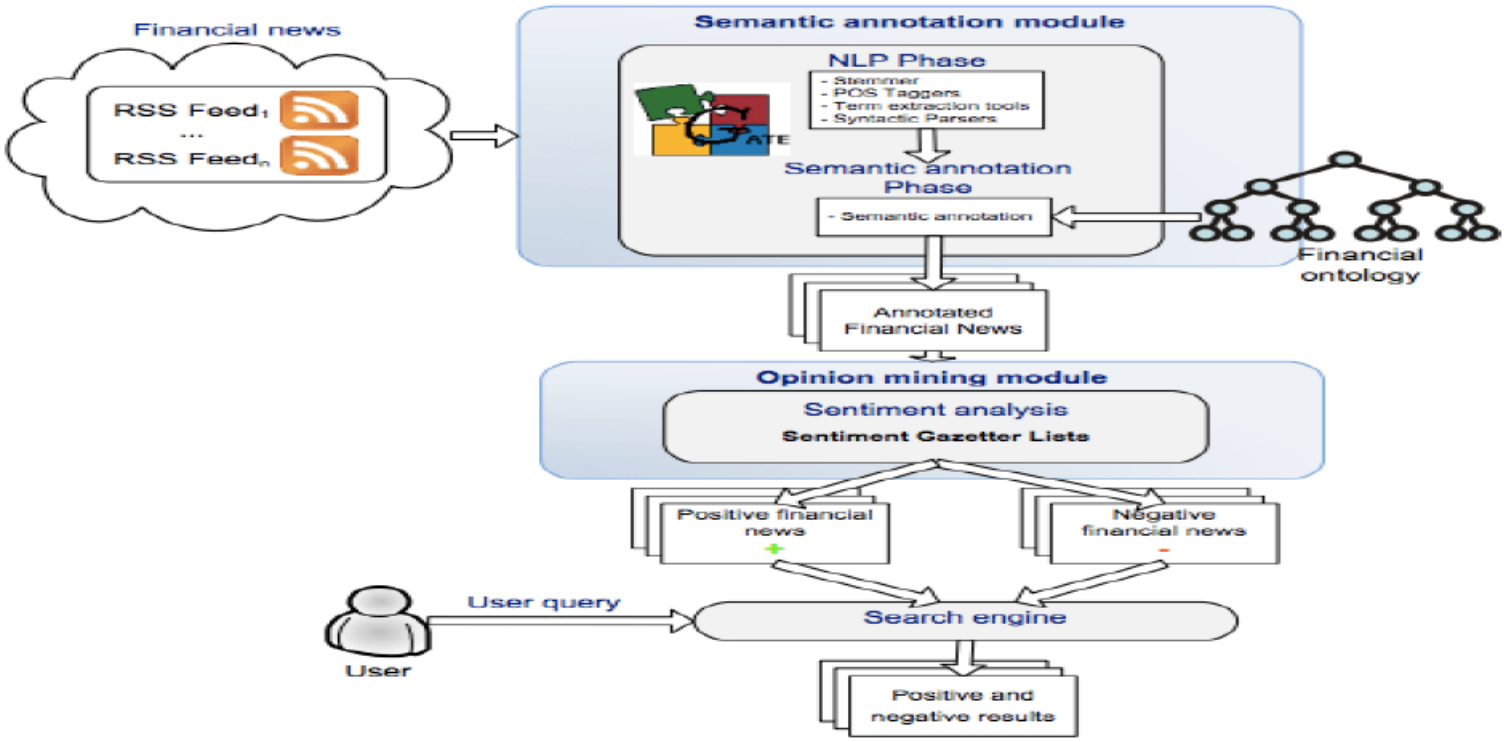

Figure: Flow of sentiment analysis application in the financial world.

Current challenges and opportunities: Banking and security domain

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- 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.

Machine Learning in Communication, Media and Entertainment

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.
- AI 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

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- 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

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- 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.

Sentiment analysis with long short term memory networks

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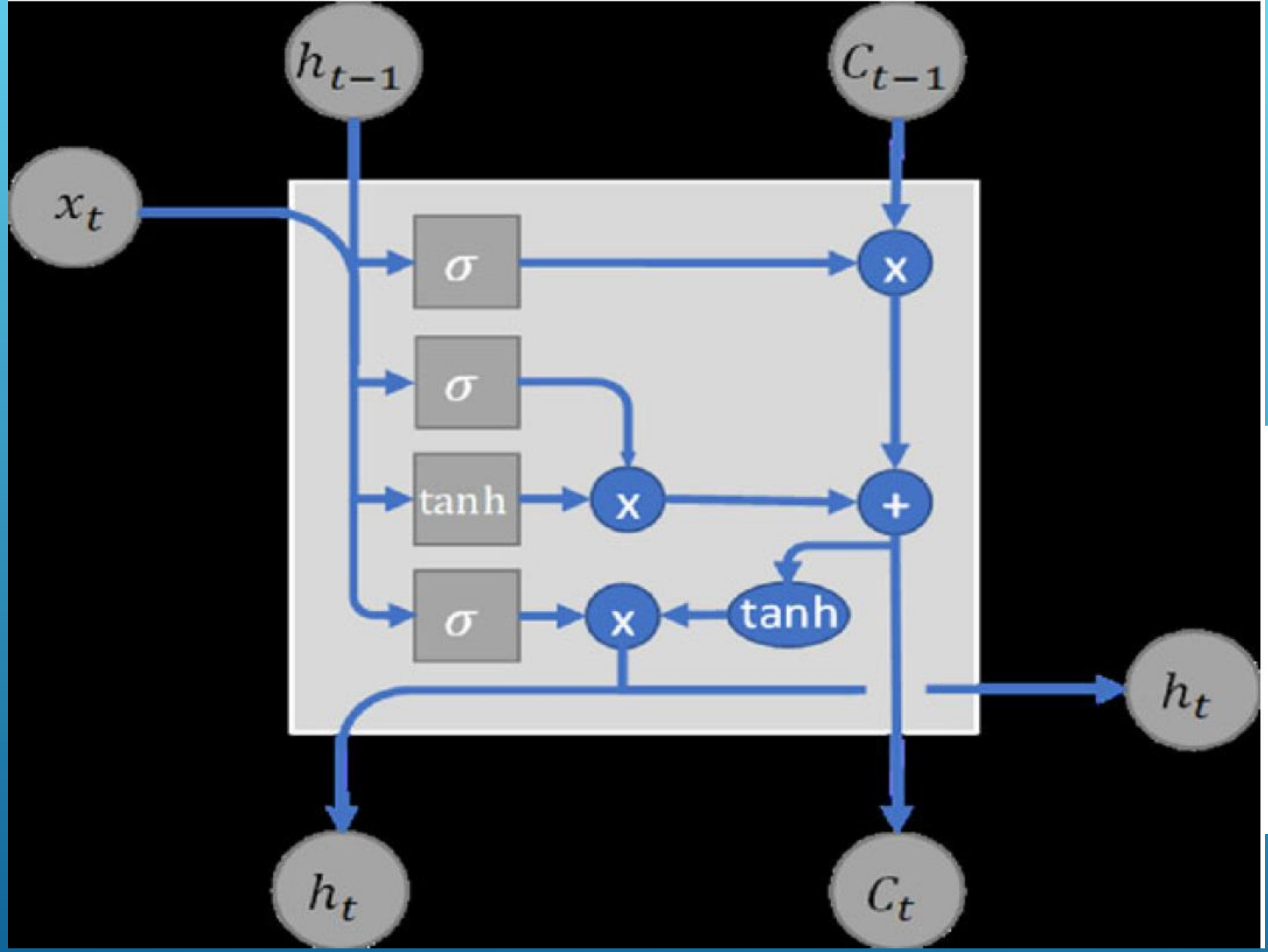
- LSTM networks are a type of RNN that uses special units in addition to standard units.
- LSTM units include a 'memory cell' that can maintain information in memory for long periods of time.
- A set of gates is used to control when information enters the memory, when it's output, and when it's forgotten.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



$$f_t = \sigma(W_f \times x_t + U_f \times h_{t-1} + b_f),$$

$$i_t = \sigma(W_i \times x_t + U_i \times h_{t-1} + b_i),$$

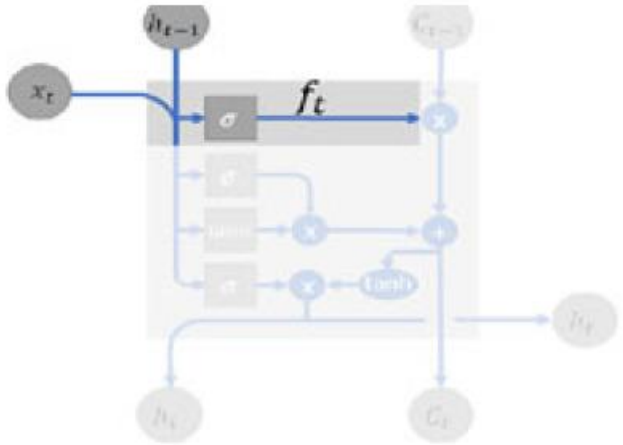
$$\tilde{C}_t = tanh(W_C \times x_t + U_C \times h_{t-1} + b_C),$$

$$C_t = i_t \times \tilde{C}_t + f_t \times C_{t-1},$$

$$o_t = \sigma(W_o \times x_t + U_o \times h_{t-1} + b_o),$$

$$h_t = o_t \times tanh(C_t).$$

A.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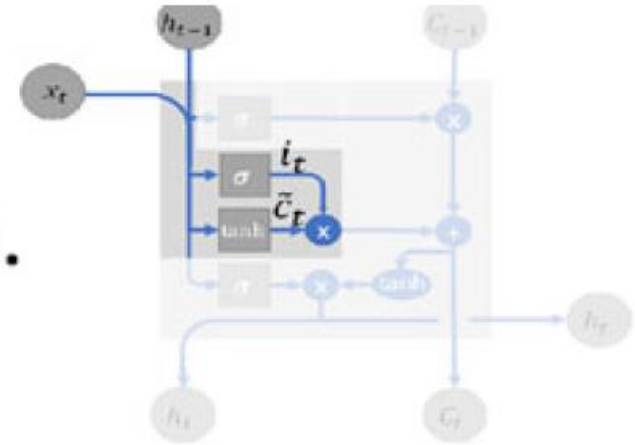
B.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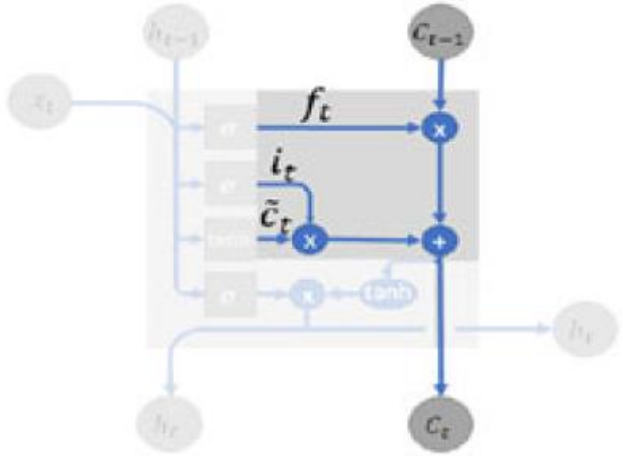
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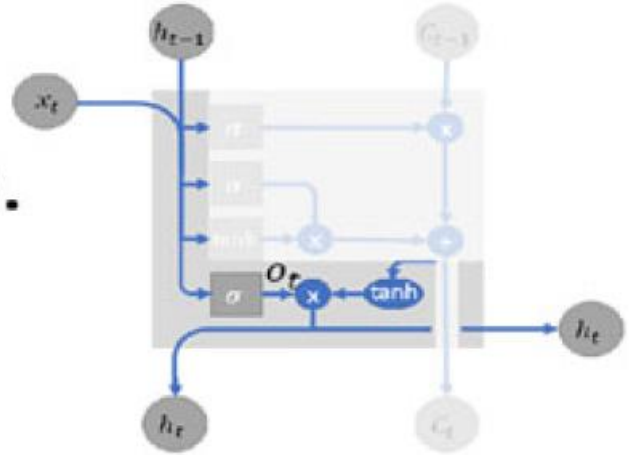
h_{t-1}
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Real-time analytics in communication, media and entertainment industries

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- 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.

Collaborative filtering

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- 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

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- 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

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- 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

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- 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

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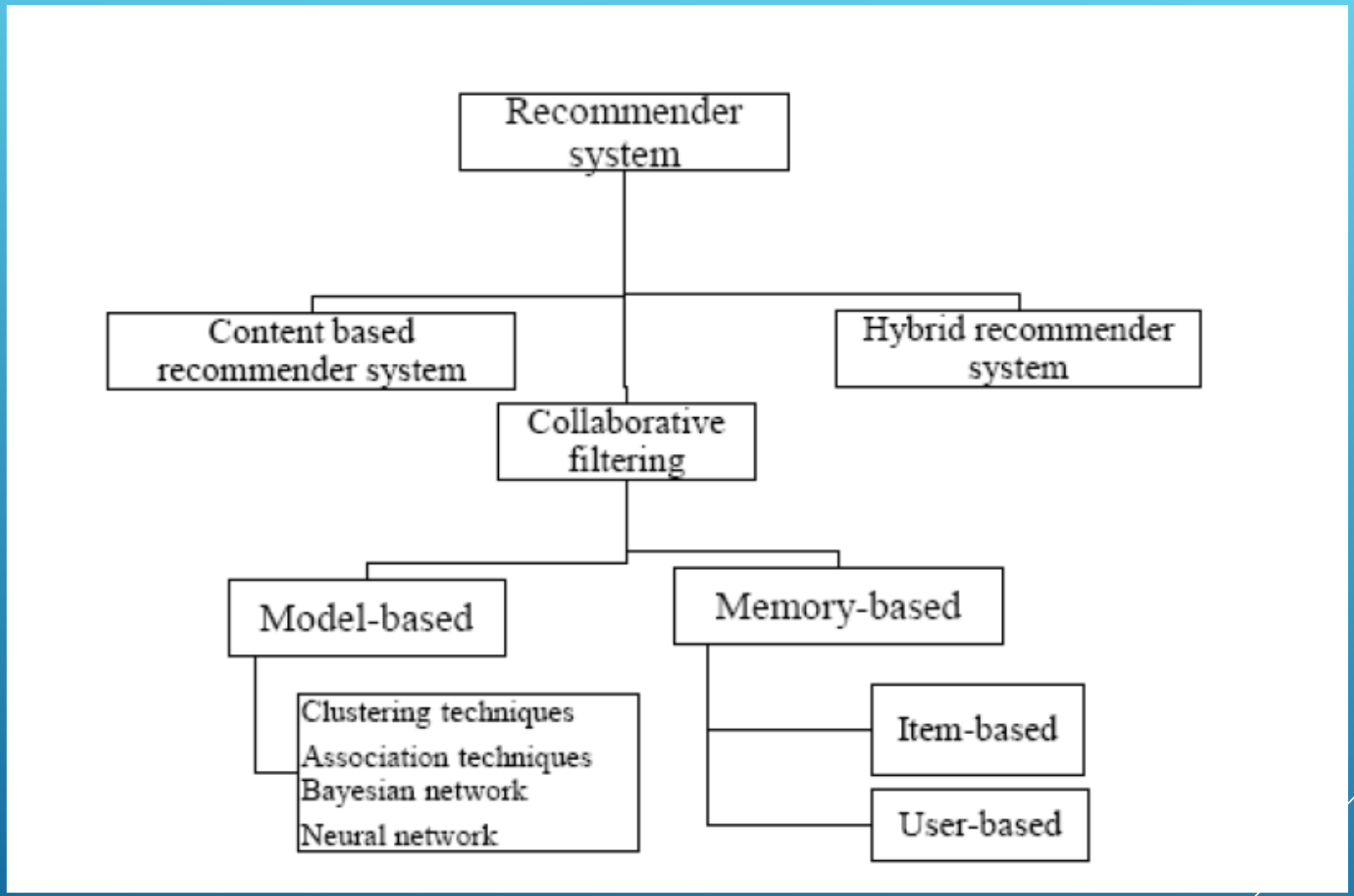
- Hybrid methods can be implemented by independently creating and creating and integrating content based and collective predictions or in addition, by applying a cooperative approach to a content on the basis of capability and vice versa, or by integrating methods into a single model.

- 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.


Recommender system
Content based recommender system
Collaborative filtering
Hybrid recommender system
Model-based
Memory-based
Clustering techniques
Association techniques
Bayesian network
Neural network
Item-based
User-based

Deep learning techniques on recommender systems

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- 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.

Machine Learning in Healthcare and Life Science

Applications of machine learning in health and life sciences

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- 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

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- 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.

Role of machine learning in drug discovery

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- 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.

Medical image analysis

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- 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

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- 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.

Comparisons between architecture of different types of deep learning models

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- 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

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- Genetics: It is a scientific study of the effects genes have on an organism, which are units of inheritance.
- Genes: It contains 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.

Interpreting deep learning models

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

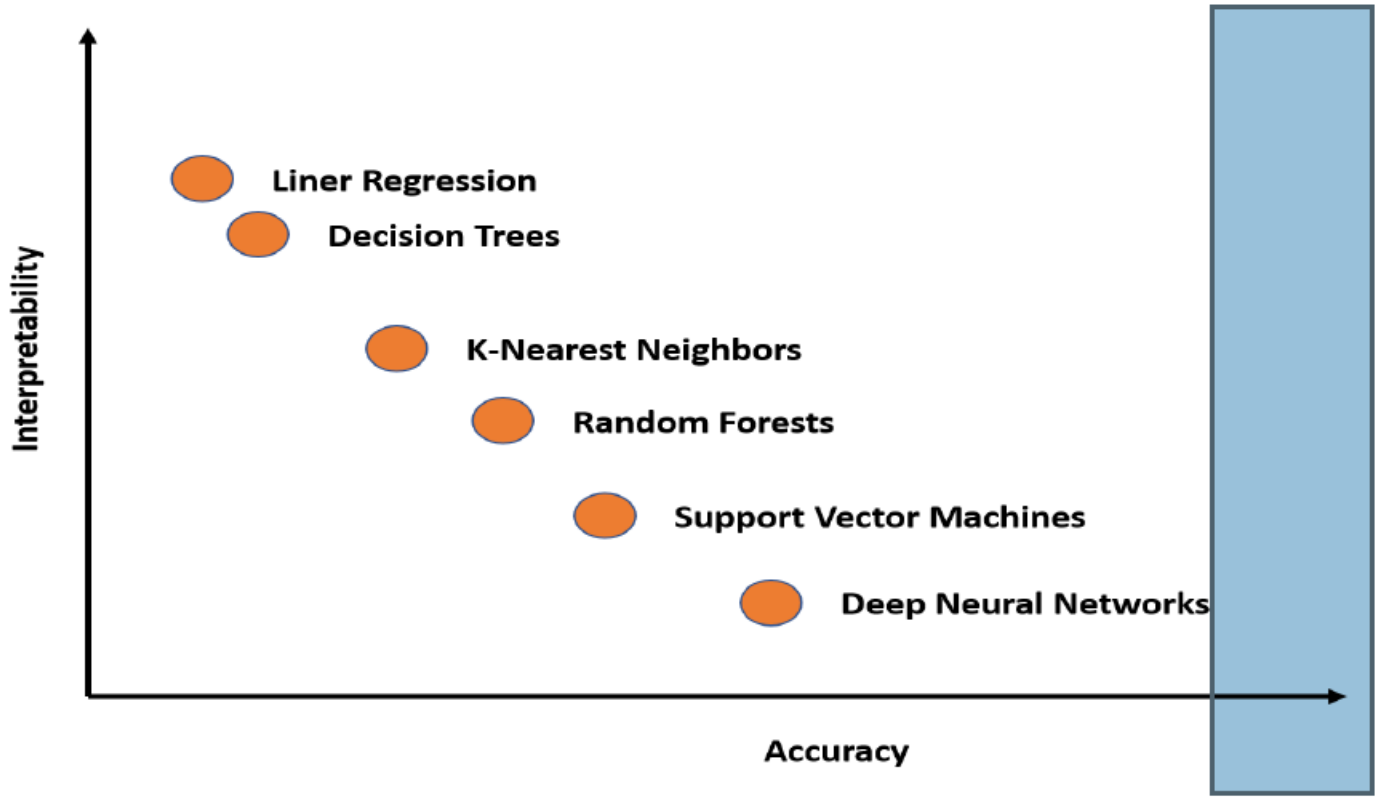

Figure: Interpreting deep learning models

Machines Learning in Education

Machine learning in education

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

Advantages of machine learning in education

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- 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

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- 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).

Action research

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- 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

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- 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

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- 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.

Stakeholders: Who?

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- 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 lab exercise context.
  - Goals and expectations.

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

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

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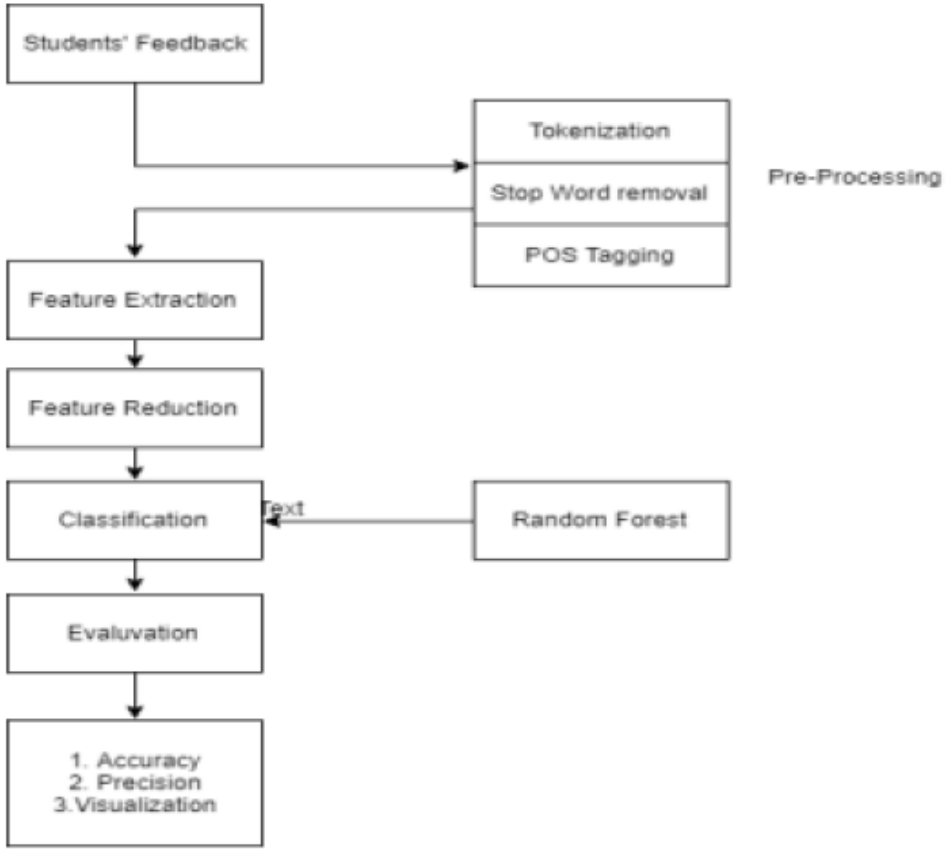

Figure: Workflow diagram

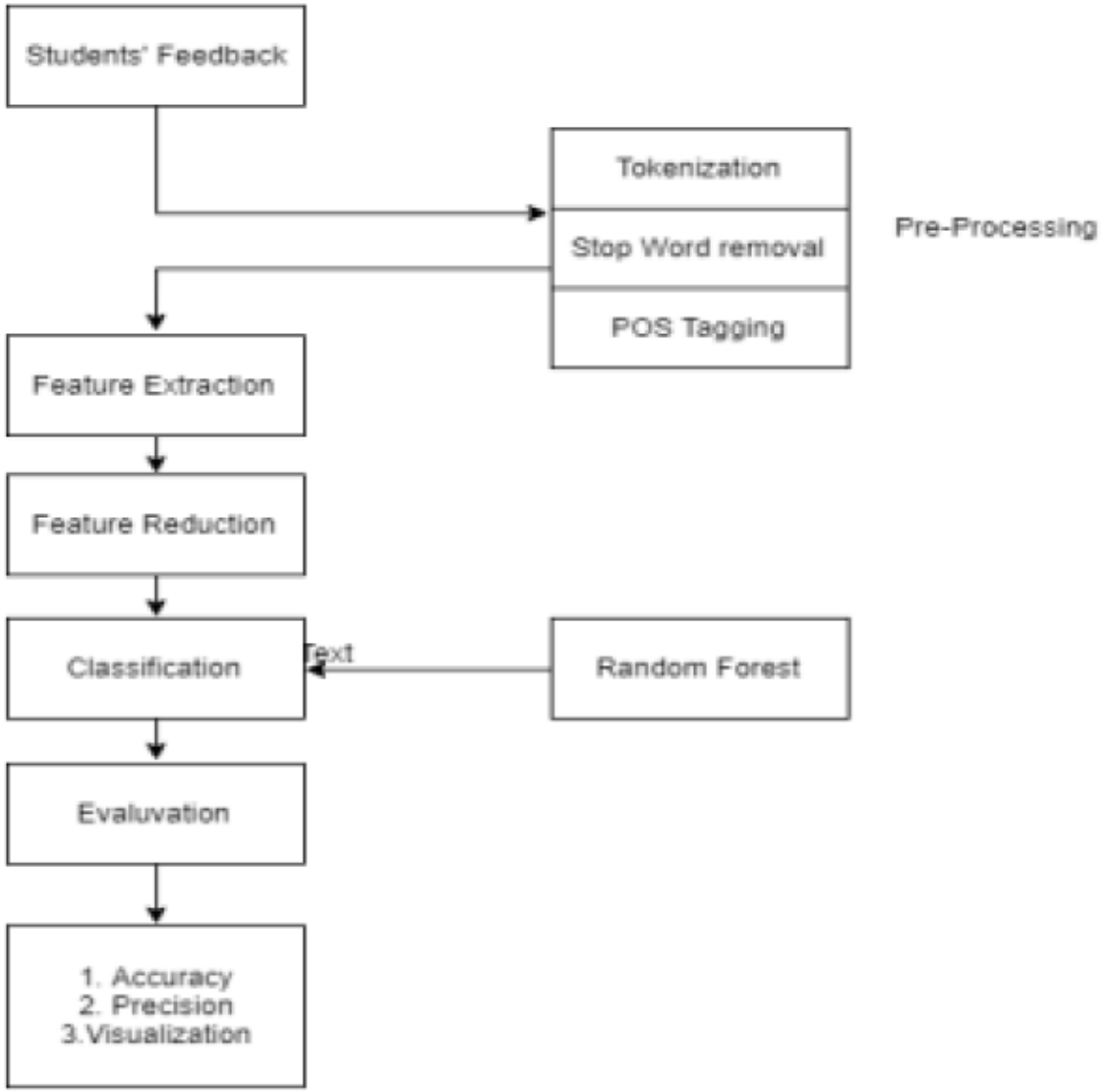

Figure: Work flow diagram

Students classification algorithm

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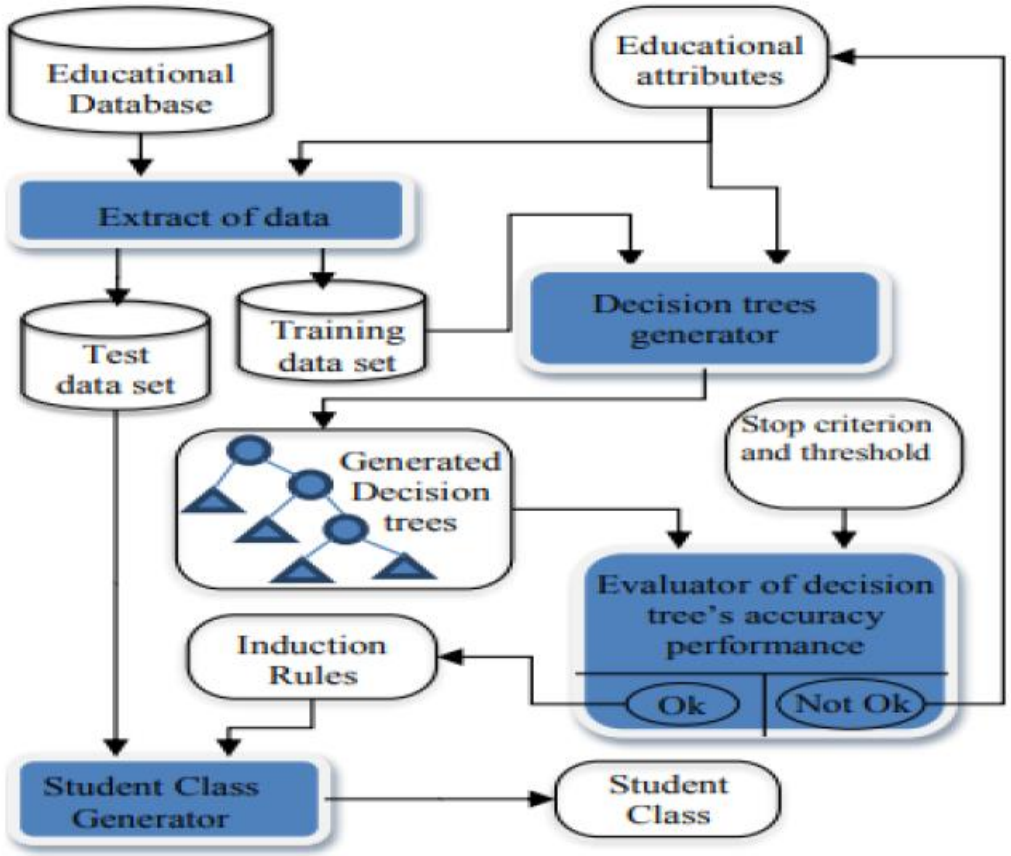

Figure: Schematic algorithm for student classification based on decision trees

Learning analytics process

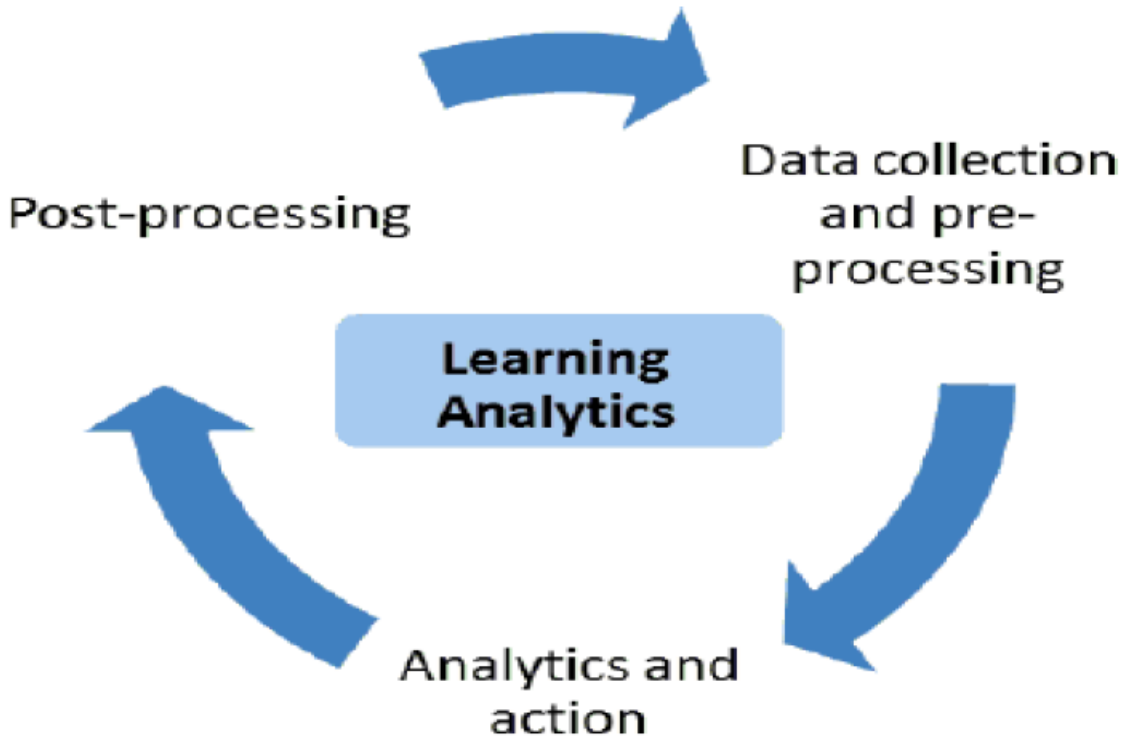

Figure: Learning analytics process

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

Methods: How?

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