

BLOB

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MACHINE LEARNING

DEPARTMENT OF
COMPUTER SCIENCE
AND ENGINEERING

MEA Engineering College,
Perinthalmanna



Department of Computer Science & Engineering

Vision

The Computer Science and Engineering department is committed to provide an educational environment in order to develop professionals with strong technical skills and aptitude towards the research and entrepreneurship.

Mission

- To impart quality education to the aspiring students for improving their level of confidence to solve various engineering problems.
- To deliver a perfect blend of technical and soft skills for creating competent computer engineers with professional and ethical values.
- To cultivate an environment of intellectual growth in pursuit of academic and research activities.



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Editorial

It gives me immense pleasure to announce that the Department of Computer Science and Engineering brings out its 3rd edition of the Department Magazine "BLOB".

I congratulate the department for launching the magazine to share the required knowledge on Machine learning among faculty and students. Readers of this magazine will come to know about the latest innovations and current trends in machine learning.

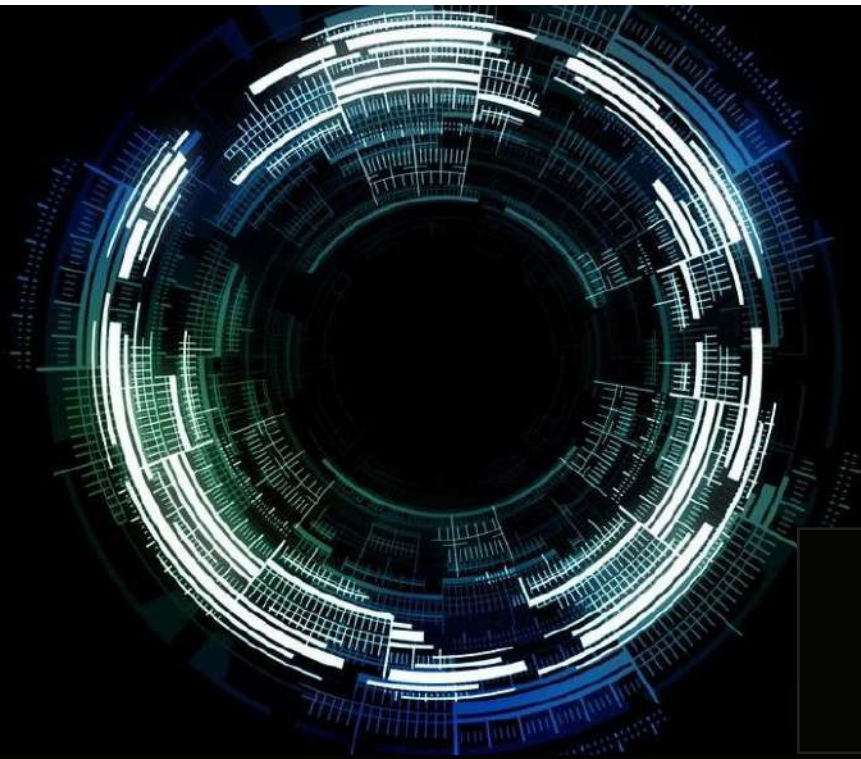
"Data truly empowers the whole thing that we do", Machine learning is the field of study that combines domain expertise, programming skills with the knowledge of mathematics and statistics. Data science practitioners apply machine learning algorithms to numbers, text, images, video, audio, and more to produce Artificial Intelligence (AI) systems to perform tasks that ordinarily require human intelligence.

Let me remind each one of you that there is no substitute for hard work. Remember, hard work and hard work after hard work and your life will be changed forever. I wish you good luck to achieve more in the coming years. Remember 'Success is a journey and not a destination'.

"We're here
to put a
dent in the
universe.
Otherwise
why else
even be
here?"
– Steve Jobs



Dr. Raji C G
Chief Editor



Support Vector Machine



Thanseeha C
MEA19CS094

Introduction

The Support Vector Machine (SVM) is a strong and extensively used machine learning method that is mostly used for classification and regression analysis. It is a supervised learning method that builds a model using the data set given to it. SVM algorithms work by locating a hyperplane that best separates data points into different classes. This technique is unusual in that it can handle non-linear data and high-dimensional data sets with a

large number of characteristics. SVM is widely utilized in a variety of applications, including text classification, picture recognition, and bioinformatics. SVM algorithms are popular due to their ability to handle complex data, high accuracy, and versatility. SVM works by determining the best hyperplane, also known as the decision boundary, that divides the data points into classes. This border is determined by maximizing the margin between the nearest data points in each class, referred to as support vectors. These support vectors define the boundary between the classes and determine the placement of the hyperplane. The algorithm then applies these support vectors to fresh data points to produce predictions. Another critical feature of SVM is its capacity to handle non-linear data. This is accomplished by utilizing kernel functions. The kernel function converts the input data into a higher-dimensional space, allowing the formation of a non-linear decision boundary. SVM can handle complex data that cannot be divided by a linear boundary as a result of this. SVM can also handle imbalanced data sets, in which one class has much more data points than the other. This is performed through the use of cost functions, which can be changed to give the underrepresented class more weight. Overall, SVM is a versatile and powerful machine learning method that is widely used in a wide range of industries. Because of its capacity to handle complex and non-linear data, as well as its high accuracy and versatility, it is an appealing option for many data analysis challenges.

Working of SVM

SVM is a strong machine learning technique that is used for classification and regression

analysis. SVM operation entails multiple processes, beginning with data preparation, in which the data set is pre-processed, normalized, and divided into a training set and a testing set. SVM can handle non-linear data by using kernel functions to transform the input data into a higher dimensional space. The technique then uses an optimization algorithm to choose the best hyperplane for classifying the data based on the support vectors. The SVM model can then be used to make predictions on new data points by determining which side of the hyperplane they fall on. Finally, the SVM model is validated by calculating metrics such as accuracy, precision, recall, and F1 score based on its performance on the testing set. SVM is a common solution for many data analysis problems due to its ability to handle complex and non-linear data, as well as its high accuracy and versatility.

Another advantage of SVM is its capacity to handle unequal data sets, in which one class may have much more data points than the other. This is accomplished by employing cost functions that can be changed to provide more weight to the underrepresented class. SVM is also resistant to overfitting, making it an excellent choice for tiny data sets. Furthermore, SVM algorithms have been shown to have strong generalization ability, which means they may be used to predict new data that is comparable to the training data. Overall, SVM is a well-known machine learning method that has been widely used in a wide range of industries, including text classification, picture recognition, and bioinformatics. Its adaptability and capacity to handle complicated data, as well as its

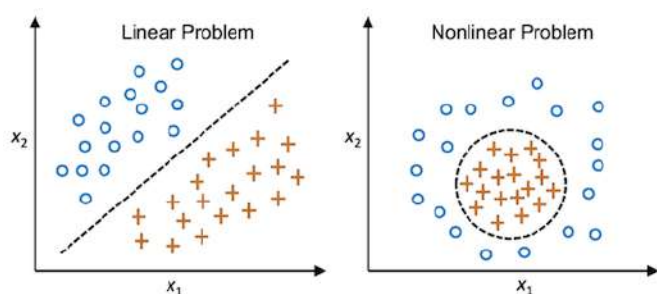
excellent accuracy and robustness, making it an appealing solution for a wide range of data analysis challenges. The use of SVM is increasing as more industries seek to harness the potential of machine learning to make data-driven decisions.

Types of SVM

Support Vector Machine (SVM) algorithms fall into two categories:

Linear SVM: A straight line or hyperplane can be used to divide the data in linear classification issues using linear SVM. Although simple and quick, linear SVM algorithms may not be able to handle complex, non-linear data

Non-Linear SVM: In non-linear classification issues where the data cannot be divided by a straight line or hyperplane, non-linear SVM is utilised. In order to create a non-linear decision boundary, non-linear SVM algorithms translate the input data into a higher dimensional space using kernel functions. Although slower and more complicated than linear SVM algorithms, non-linear SVM algorithms are better able to handle complex data.

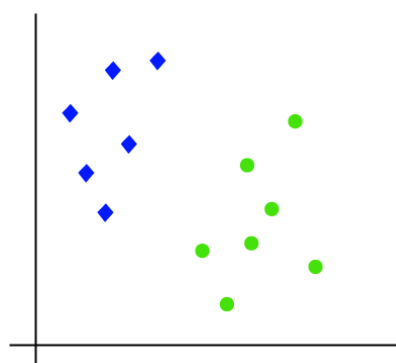


In addition to these two main types, there are several variations of SVM algorithms, including C-Support Vector Classification (C-SVC), Nu-Support Vector Classification (Nu-

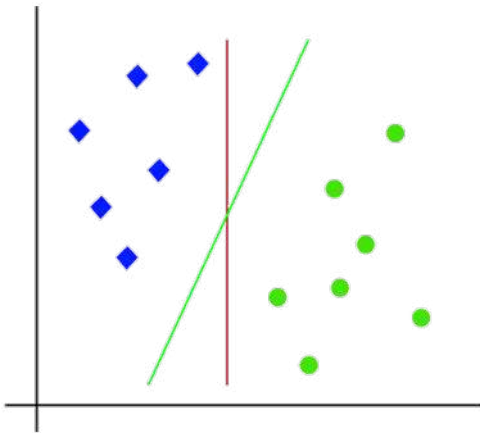
SVC), and Epsilon-Support Vector Regression (Epsilon-SVR). Each of these variations has its own unique strengths and weaknesses, making them better suited for different types of problems. Depending on the data's characteristics and the classification challenge, an appropriate SVM type must be chosen. Although fast and straightforward, linear SVM algorithms may struggle with complex, non-linear data. Although slower and more complicated, non-linear SVM algorithms are better able to handle complex data.

How does SVM works?

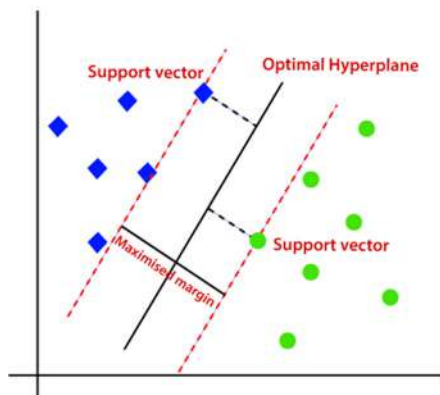
An example will help you understand how the SVM algorithm works. Assume we have a dataset with two tags (green and blue) and two features (x_1 and x_2). We require a classifier that can distinguish between green and blue coordinate pairs (x_1, x_2). Consider the following image:



Because it is a two-dimensional space, we can easily distinguish these two classes by using a straight line. However, numerous lines can exist to distinguish these types. Consider the following image:



As a result, the SVM method aids in the discovery of the optimal line or decision boundary; this best border or region is referred to as a hyperplane. The SVM method determines the nearest point of the lines from both classes. These are known as support vectors. The distance between the vectors and the hyperplane is defined as the margin. The goal of SVM is to maximise this margin. The hyperplane with the biggest margin is the optimum one.



Application of SVM

- 1. Text Classification:** SVM is frequently used for text classification applications, including sentiment analysis and spam detection. The system can categorise text into several categories and handle high dimensional data, such as text data.
- 2. Image Recognition:** SVM is also utilised for tasks involving image identification, such as face and object recognition. The algorithm is a perfect answer for issues with image recognition because it can handle massive amounts of data.
- 3. Bioinformatics:** SVM is used in bioinformatics for tasks like categorising proteins and analysing gene expression. The system can classify genes into several groups and handle complex data, such as genomic data.
- 4. Financial Markets:** SVM is used in the financial markets for tasks such as stock market prediction and risk management. The algorithm can handle large amounts of data, such as stock market data, and can be used to make predictions about future stock prices.
- 5. Medical Diagnosis:** SVM is used in medical diagnosis for tasks such as disease diagnosis and drug discovery. The algorithm can handle complex data, such as medical data, and can be used to classify patients into different categories.
- 6. Handwriting Recognition:** SVM is used in handwriting recognition tasks, such as recognizing handwritten characters and digits. The algorithm can handle complex data, such as handwritten data, and can be used to classify handwriting into different categories.
- 7. Fraud Detection:** SVM is used in fraud detection tasks, such as detecting fraudulent credit card transactions and insurance claims. The algorithm can handle large amounts of data, such as financial data, and can be used to classify transactions into different categories.

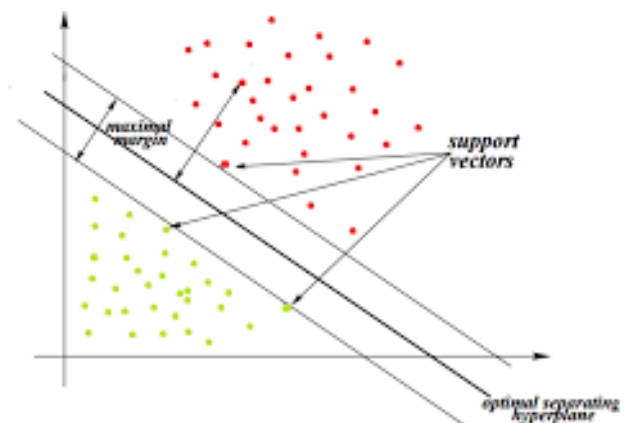
8. **Customer Segmentation:** SVM is used in customer segmentation tasks, such as dividing customers into different groups based on their spending patterns. The algorithm can handle high dimensional data, such as customer data, and can be used to classify customers into different categories.
9. **Weather Forecasting:** SVM is used in weather forecasting tasks, such as predicting future weather patterns. The algorithm can handle large amounts of data, such as weather data, and can be used to make predictions about future weather conditions.
10. **Stock Trading:** SVM is used in stock trading tasks, such as predicting future stock prices and optimizing stock portfolios. The algorithm can handle large amounts of data, such as stock market data, and can be used to make predictions about future stock prices.

Conclusion

As a strong machine learning technique, Support Vector Machine (SVM) is frequently employed for a variety of data analysis applications. The technique is noted for its great accuracy and capability to handle complicated and high dimensional data. It operates by locating an ideal hyperplane that divides the data into their respective classes. Text classification, picture identification, bioinformatics, financial markets, medical diagnosis, handwriting recognition, fraud detection, customer segmentation, weather forecasting, and stock trading are just a few of the many industries where SVM is used. By converting the input data into a higher dimensional space using kernel functions, the

SVM algorithm can handle non-linear data and employs an optimization algorithm to determine the best hyperplane. The method is a perfect answer for many data analysis issues since it can forecast new data points based on which side of the hyperplane they land on.

In conclusion, SVM is a flexible and effective machine learning technique that is frequently utilised for a range of data analysis jobs. It is the perfect solution for a variety of data analysis issues due to its excellent accuracy and capacity for handling complex and high dimensional data.



Products related to SVM

- **Python's scikit-learn library:** This is a popular open-source library that provides implementation of SVM and many other machine learning algorithms. It is widely used by data scientists and machine learning engineers for various data analysis tasks.
- **MATLAB:** This is a proprietary software that provides implementation of SVM and many other machine learning algorithms. It is widely used by researchers and

engineers for various data analysis tasks.

- **Weka:** This is an open-source software that provides implementation of SVM and many other machine learning algorithms. It is widely used by researchers and students for various data analysis tasks.
- **KNIME:** This is a proprietary software that implements SVM and a variety of other machine learning techniques. It is commonly utilised for numerous data analysis activities by data scientists and machine learning experts.
- **RapidMiner:** This is a proprietary software that provides implementation of SVM and many other machine learning algorithms. It is widely used by data scientists and machine learning engineers for various data analysis tasks.





Supervised vs Unsupervised Learning Algorithms



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INTRODUCTION

The science of teaching facts and information to computers without specifically programming them to learn and behave like humans is known as machine learning. Machine learning algorithms are trained using training data. They can accurately forecast and judge based on past data when new data is obtained. Both supervised and unsupervised learning are used in

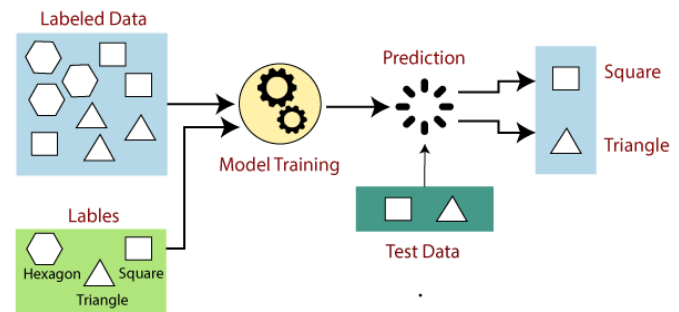
machine learning techniques. Using labeled datasets, supervised learning is a sort of machine learning. In order to enable computers to precisely identify data or forecast outcomes, these datasets are used to “train” or “supervise” the algorithms. The use of named inputs and outputs allows the model to test its precision and improve over time. Unsupervised learning uses machine learning techniques to analyze and group unlabeled data sets. These algorithms analyze data without the aid of humans to discover hidden patterns (thus the term “unsupervised”). These techniques, though, are used with various datasets and situations. A comparative chart and descriptions of both teaching strategies are provided below.

Supervised Machine Learning

Machines are trained using labeled training data in supervised learning, which then uses the labeled training data to predict the output. The right output has already been labeled on some of the input data. In supervised learning, the machines are given training data that serves as a supervisor, teaching them how to anticipate outcomes accurately. It employs the same principle as instruction provided by a teacher for a pupil. Supervised learning is the process of providing accurate input data and output data to the machine learning model. Discovering a mapping function that will map the input variable(x) to the output variable is the aim of a supervised learning algorithm (y). Supervised learning has applications in the real world such as risk

assessment, image categorization, fraud detection, spam filtering, etc.

You can better comprehend how supervised learning operates by using the example and illustration that follow.



Assume we have a dataset with a variety of forms, such as squares, rectangles, triangles, and polygons. The model must now be trained for each shape as the initial phase.

1. If the given shape has four sides, and all the sides are equal, then it will be labeled as a Square.
2. If the given shape has three sides, then it will be labeled as a triangle.
3. If the given shape has six equal sides then it will be labeled as hexagon.

After training, we use the test set to put our model to the test, and the model’s objective is to recognise the shape. The system has already been trained on several forms, and when it encounters a new one, it classifies it based on a number of sides and forecasts the outcome.

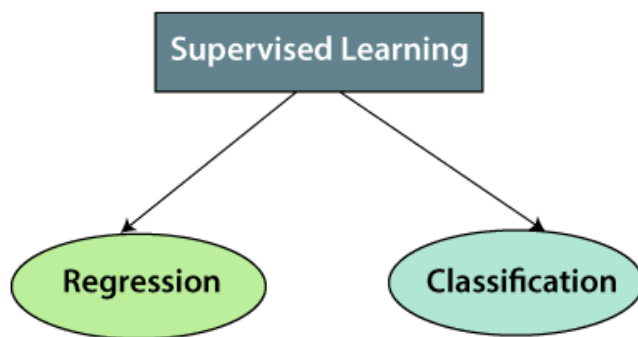
Steps involved in Supervised Learning:

1. Identify the type of training dataset first.

2. Assemble the tagged training data.
3. Divide the training dataset into three parts: training, test, and validation.
4. Determine the training dataset's input characteristics, which should contain enoughw information for the model to accurately predict the output.
5. Choose an appropriate method for the model, such as a support vector machine or a decision tree.
6. Use the training dataset to run the algorithm. Validation sets, which are a subset of training datasets, are sometimes required as control parameters.
7. Evaluate the model's accuracy by delivering the test set. If the model correctly predicts the outcome, our model is accurate.

Types of supervised Machine learning Algorithms

Supervised learning can be further divided into two types of problems:



1. Regression

If there is a relationship between the input and output variables, regression procedures are applied.

It's used to predict continuous variables

like weather forecasting, market trends, and so on.

Some popular supervised learning regression algorithms are listed below:

- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression

2. Classification

When the output variable is categorical, meaning there are two classes, such as Yes-No, Male-Female, True-False, and so on, classification methods are utilized.

Advantages of Supervised learning

Supervised learning is a machine learning technique where an algorithm is trained on a labeled dataset. This technique has several advantages that make it a popular choice among machine learning practitioners. Firstly, supervised learning algorithms can learn to predict the target output based on a set of inputs, making them suitable for a wide range of applications such as image recognition, speech recognition, and sentiment analysis. Secondly, supervised learning algorithms can be trained with large amounts of data, allowing them to learn complex relationships between inputs and outputs. Thirdly, the algorithm's accuracy can be easily evaluated using metrics such as accuracy, precision, recall, and F1-score, allowing for quick and efficient optimization. Finally, the algorithms can be used to make predictions on new unseen data, making it an ideal choice for real-world applications. In summary,

the advantages of supervised learning include its ability to learn from labeled data, handle complex relationships, be evaluated easily, and make predictions on new data.

Disadvantages of supervised learning

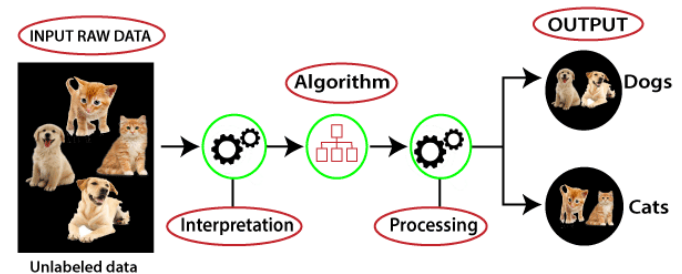
Supervised learning is a widely used machine learning technique for solving regression and classification problems. However, it is not without its disadvantages. Firstly, it requires a large amount of labeled data for the model to be trained on. This can be a limitation in cases where collecting labeled data is time-consuming, costly, or even impossible. Secondly, the model's performance is dependent on the quality of the labeled data. If the labeled data is biased or inconsistent, the model's predictions will also be biased. Thirdly, the model is only capable of making predictions based on the patterns it has learned from the training data. It cannot handle new and unseen data well, which is referred to as overfitting. Lastly, supervised learning algorithms may be computationally expensive and time-consuming, especially when the data size is large or the model is complex.

Unsupervised Machine Learning

Unsupervised learning is a type of machine learning that does not require labeled data or a predefined set of categories for training. Instead, the algorithm is left to its own devices to find patterns and relationships within the data. This approach is commonly used for clustering, dimensionality reduction, and anomaly detection. In clustering, the algorithm

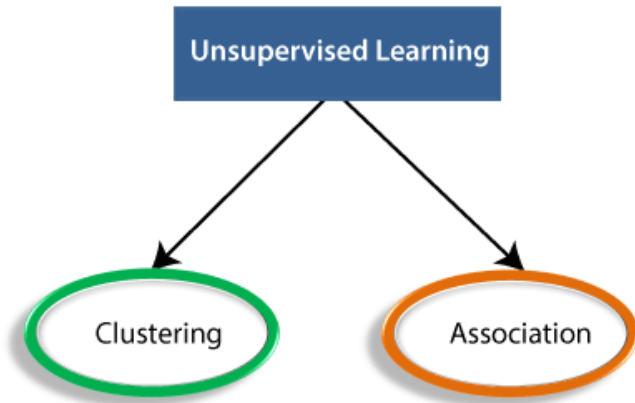
groups similar data points together and assigns them to a cluster. Dimensionality reduction is used to reduce the complexity of the data by identifying and removing redundant features. Anomaly detection is used to identify unusual data points that deviate significantly from the general pattern of the data. Unsupervised learning can be a powerful tool for uncovering hidden insights in large and complex data sets, but it also presents a number of challenges, such as ensuring the quality of the results and avoiding overfitting.

The following figure depicts how unsupervised learning works:



We used unlabeled input data, which means it wasn't categorized and didn't have any associated outputs. To train the machine learning model, this unlabeled input data is now supplied to it. It will first analyze the raw data in order to uncover hidden patterns, and then use appropriate algorithms such as k-means clustering, Decision tree, and so on. After applying the appropriate method, the algorithm splits the data objects into groups based on their similarities and differences.

Types of Unsupervised Learning Algorithm



Clustering : A way of organizing things into clusters so that those with the most similarities stay in one group while those with less or no similarities stay in another. Cluster analysis identifies commonalities between data objects and classifies them according to their presence or absence.

Association: An association rule is an unsupervised learning strategy for discovering associations between variables in a large database. It identifies the group of items that appear in the dataset together. The association rule improves the effectiveness of marketing strategies. People who purchase X (for example, bread) are more likely to purchase Y (butter/jam). Market Basket Analysis is a good example of an association rule.

Below is the list of some popular unsupervised learning algorithms:

- K-means clustering
- KNN (k-nearest neighbors)
- Hierarchical clustering
- Anomaly detection

- Neural Networks

Advantages of Unsupervised Learning

Unsupervised learning is a type of machine learning algorithm that does not require labeled data to train the model. This method of learning has several advantages over supervised learning. Firstly, unsupervised learning does not require a large amount of labeled data, making it suitable for situations where labeling data is difficult or impossible. Secondly, unsupervised learning algorithms can identify patterns and relationships in data that may be difficult for human experts to detect. This makes it particularly useful for exploratory data analysis and dimensionality reduction. Additionally, unsupervised learning algorithms can handle complex and high-dimensional data with ease, allowing for a more complete understanding of the data. Finally, unsupervised learning can be used to generate new and useful information, such as clustering similar data points or identifying anomalies in data. Overall, unsupervised learning is a valuable tool for machine learning practitioners and data scientists, providing a range of benefits that can enhance the understanding of complex data.

Disadvantages of Unsupervised Learning

Unsupervised learning, despite its potential benefits, also has several disadvantages that need to be considered. Firstly, unsupervised learning algorithms are not as effective as supervised learning algorithms in tasks that require high

accuracy, such as image recognition or speech recognition. Secondly, unsupervised learning algorithms can be less interpretable than supervised learning algorithms, making it difficult to understand why a particular result was produced. Thirdly, unsupervised learning algorithms are more computationally intensive, requiring large amounts of data and processing power, which can be a challenge for smaller organizations or businesses. Lastly, unsupervised learning algorithms are more prone to overfitting, where the model becomes too complex and fails to generalize to new data, leading to poor performance in real-world situations. In conclusion, while unsupervised learning algorithms offer valuable insights into data, they should be used with caution and in conjunction with other techniques, such as supervised learning, to achieve the best results.

Goals

The goals of supervised and unsupervised learning are different, reflecting their distinct approaches to solving problems. The goal of supervised learning is to develop a model that can accurately predict the outputs for new data, based on the relationship between inputs and outputs in the training data. Supervised learning algorithms use a labeled data set to learn from and make predictions based on the patterns learned from the labeled data. The algorithm tries to find the best mapping between inputs and outputs that accurately reflects the underlying relationship between them. The goal of unsupervised learning is to

find patterns or structures in the data that are not explicitly labeled. Unsupervised learning algorithms work by exploring the data and discovering relationships and groupings within the data without any prior knowledge of the output. This technique can be used to identify patterns and clusters in large, complex data sets, as well as to identify anomalies or outliers.

In conclusion, while supervised learning aims to make predictions based on labeled data, unsupervised learning aims to discover relationships and structures within the data without prior knowledge of the outputs. Both techniques have important applications in various fields and are used to solve different types of problems.

Applications

Supervised learning and unsupervised learning are two major branches of machine learning that have different approaches to learning from data. Supervised learning is a learning technique that involves using labeled data to make predictions about new data. In this technique, the algorithm is trained on a labeled dataset, where the relationship between inputs and outputs is known, to learn a mapping function that can be used to make predictions about new data. This technique is often used for classification problems, where the goal is to assign a label to a new data point based on its features, and regression problems, where the goal is to predict a continuous output based on input features.

Unsupervised learning, on the other

hand, is a learning technique that involves finding patterns in data without any prior knowledge of the relationship between inputs and outputs. This technique is used to find structure in data, and it is often used in tasks such as clustering, where the goal is to group similar data points together, and dimensionality reduction, where the goal is to reduce the number of features in a dataset while preserving its structure. Unsupervised learning is also commonly used for anomaly detection, where the goal is to identify data points that are different from the rest of the data.

In conclusion, both supervised and unsupervised learning have their own strengths and weaknesses, and the choice of technique depends on the problem being solved and the nature of the data. Supervised learning is more effective for tasks that require high accuracy, such as image recognition and speech recognition, while unsupervised learning is more effective for tasks that require finding patterns in data, such as customer segmentation and recommendation

systems. Both techniques are widely used and play an important role in the field of machine learning.

Conclusion

Using unsupervised learning techniques, you can handle increasingly challenging tasks. Unsupervised learning has a number of benefits, including speeding up problem-solving and allowing learners to analyse and identify all incoming data. Data that is not labeled is significantly simpler to receive from a computer than data that is labeled and necessitates user interaction. Unsupervised learning in its many forms promotes the implementation of fresh concepts, creativity, and the development of novel experiences. Using labeled data, supervised learning models can be an effective tool for automating categorizing activities and making predictions for the future. Configuring your machine learning algorithms, however, requires human knowledge and expertise to prevent overfitting data models.





Healthcare and ML



Shahul P
MEA19CS087

Do you understand the meaning of machine learning in healthcare and why its importance is being emphasised so much? The use of machine learning in healthcare is increasing, and it is helping patients and doctors by solving practical challenges and creating a more unified system for enhancing work processes. The most typical applications of machine learning in healthcare are to automate clinical decision support, medical

billing, and the creation of clinical care recommendations.

Introduction

Doctors have a critical role in ensuring that their patients receive proper care as well as limiting rising healthcare expenditures. They must strike a balance between acting as a gatekeeper for the insurance companies and representing the case as an attorney. The goal of assigning the gatekeeper role to primary care doctors was to reduce healthcare expenditures by allowing for fewer testing and referrals. Still, that is not enough, and it may be necessary to reconsider the character of the particular care doctor in terms of patient referrals. The coordinator role may be preferable than the gatekeeper role. Primary care providers have increased the number of patients seen in a given length of time to compensate for their lower income and defensive diagnostic testing has increased. These doctors don't spend enough time looking through the chart or talking to the patient, so they order more tests to lower their liability risks. Care expenditures for these activities will also change. The physician is placed between these two personalities, creating a conflict of interest.

A subset of artificial intelligence known as machine learning (ML) uses algorithms to search through enormous data sets for patterns, learn from them, and carry out tasks without being instructed on how to do so. The widespread availability of strong hardware and cloud computing has led to a wider acceptance of machine learning in several sectors of human life, ranging

from social media recommendations to factory process automation. And its popularity will only increase. Healthcare is another industry that evolves with the times. Machine learning algorithms in healthcare have a lot of potential because of the volume of data gathered for each patient. It's no surprise, then, that there are a number of effective machine learning applications in healthcare right now.

Applications

With the growing number of machine learning applications in healthcare, we can see a future where data, analysis, and innovation work together to aid countless people without even understanding it. Soon, ML-based applications embedded with real-time patient data available from numerous healthcare systems in multiple countries will be commonplace, enhancing the efficiency of previously unavailable treatment alternatives.

Major applications of ML in healthcare are;

- One of the most important uses of machine learning in healthcare is the detection and diagnosis of diseases and conditions that are otherwise difficult to identify.
- Maintaining current health records is a time-consuming task, and while technology has aided the data input process, the truth is that the majority of the activities still take a long time to complete. Machine learning's primary role in healthcare is to simplify processes in order to save time, effort, and money.

- Machine learning's main clinical uses are in the early stages of medication development.
- Radiology is one of the most sought-after applications of machine learning in healthcare.
- Personalized Medicine.
- Artificial neural networks assist in the gathering of this data and the prediction of everything from malaria outbreaks to severe chronic infectious diseases.
- Prescription errors can also be detected and evaluated using machine learning. The intelligence can examine the patient's medical records in conjunction with the prescribed medications to identify and remedy any pharmaceutical errors.

While machine learning offers a lot of potential in healthcare, it also has several drawbacks, such as healthcare data quality, developing physician-friendly products, and assembling a large team of data experts. There are also certain ethical issues to consider, such as patient safety and accountability.

Products Related

Without any human intelligence, numerous data science models can give precise and efficient solutions in the healthcare industry in little to no time. Machine learning models benefit the health-care sector in a variety of ways, including establishing accurate and efficient suggestions and eliminating the manual responsibilities of healthcare workers, allowing them to focus on

research and improve their performance in emergency situations. The healthcare sector currently uses machine learning extensively, but this technology has much more potential. A subset of artificial intelligence known as machine learning (ML) uses algorithms to search through enormous data sets for patterns, learn from them, and carry out tasks without being instructed on how to do so.. Some of the major equipments used by ML in healthcare are;

SPECT/CT

A sophisticated and thoroughly integrated diagnostic approach is SPECT/CT. It broadens nuclear medicine's application to routine surgery planning, orthopaedics, cutting-edge cardiology, and many other fields.

One of the most cutting-edge cancer therapies is the Novalis Tx radiosurgery system, which uses a LINAC accelerator. A radiation therapy technique known as radiosurgery uses an energy beam that is precisely tailored to follow the contours of the tumour. Wherever it is needed, energy is given.

High Dose Rate (HDR) Brachytherapy

Using radioactive plaques, needles, or small "seeds" constructed of radionuclides, high-dose rate (HDR) brachytherapy involves inserting a shielded source of high-energy radiation directly within the tumour. These radioactive materials are applied to the tumor's surface, implanted into the tumour, or injected into a bodily cavity containing the tumour.

EEG (Electroencephalography)

The electroencephalogram (EEG) is a method of determining the frequency of brain waves. It's a simple test that shows how the brain functions throughout time. Small electrodes are inserted on your scalp during an EEG test.

Motorized Thrombectomy System

The Motorized Thrombectomy System contains a catheter for insertion into a patient's vascular system, with the tip of the catheter positioned in the region of a blood clot to be removed. The blood clot is removed from the patient via the catheter using a suction source.

Conclusion

The highest score is given to machine learning's amazing abilities to organise and categorise health data, as well as to speed up clinicians' clinical judgements and any forecasts that can save lives or simplify operations (e.g., the prevention

of hypoxemia during surgery). Isn't that already a lot? Without a question, the most valuable resource is human life. Currently, machine learning in healthcare offers technologies that directly support the development of better medical diagnostics and treatments in the future. Machine learning is beginning to realise its potential in the healthcare industry, from better patient care and administrative procedures to more efficient medicine research and development. Future years are expected to see a rise in the adoption of machine learning and other AI technologies. Rather than completely replacing clinicians' work, these technologies are more likely to enhance and supplement it. Improved care quality and a more effective, cost-effective healthcare system could be the long-term results, and all of these things would be advantageous for patients, providers, insurers, regulators, and legislators.





Power of TensorFlow



Mohammed Marwan VK
LMEA20CS089

Introduction

TensorFlow is a software library or framework created by Google for swiftly putting machine learning and deep learning principles into practise. In order to make many mathematical problems easy to calculate, it combines computational algebra and optimization techniques.

TensorFlow2.0's standardized SavedModel file format enables models to run on a

variety of runtimes, including browsers, Node.js, smartphones, and embedded devices.

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Let's now analyze the following crucial TensorFlow features:

- It has a capability that designs, optimizes, and computes mathematical statements using multidimensional arrays known as tensors.
- Programming supports deep neural networks and machine learning techniques.
- With a wide range of data sets, it provides a highly scalable compute capabilities.
- TensorFlow uses GPU processing to automate management.
- Additionally, it has a unique feature that optimizes the same data and memory.

What is TensorFlow

TensorFlow is an open-source machine learning framework developed by the Google Brain Team that enables

businesses of all sizes and types to build intelligent web applications with AI and machine learning capabilities.

To put it another way, TensorFlow is a free neural network you can use to build apps that are customised to your specific business needs and automate operations. It lets developers to employ artificial intelligence to build and distribute tailored apps, improving user experience and boosting productivity.

C++, Python, CUDA, as well as other languages like Swift, can all be used to create TensorFlow programmes. The open-source platform can be used to conduct research and develop commercial products that provide users analytical abilities similar to those of humans.

TensorFlow: How Does it Work

The robust Python front-end framework provides programmers with an abstraction of programming, sheltering users from pointless technical details.

TensorFlow is now available to businesses across all sectors and geographies thanks to this.

The platform was developed to spread AI and machine learning throughout the world and help most businesses run more efficiently.

These technologies operate in a manner that is similar to how the human brain operates.

Similar to the human brain, an AI framework interprets inputs like light, music, colour, touch, and scent to create special connections.

1. First, creating the app model.
2. Giving it pertinent input data.
3. Teaching the model how to carry out particular tasks.
4. Model testing (preferably using dummy data).
5. Putting the application model into use.

Applications of TensorFlow in AI and ML

In 2021, there will be a sizable market for machine learning and artificial intelligence services.

If these technologies are used effectively, nearly every sector of every industry might gain.

Here are a few of the most significant applications of TensorFlow in various fields.

Providing Personalized Employee Support Using Conversational AI

Consistent employee assistance is necessary for employee engagement.

Conversational AI into your service desk enables you to provide personalized responses to issues raised by your team.

AI chatbots that scan the company knowledge base, understand the context of the questions asked, and offer responses that are specific to the individual in question can be used to achieve this.

Fraud Detection

A comprehensive and automated fraud

detection system is clearly needed, especially in the banking and financial sectors.

You may use an AI and ML framework for pattern recognition to find even the smallest irregularities in daily transactions that the human eye would otherwise miss.

Major TensorFlow Use Cases

Image Recognition

Using the image recognition method in TensorFlow, an application (or a model) may identify particular objects, faces, colours, and forms in data.

It can be used by architects to generate virtual models, medical experts to interpret scans, and financial institutions to do digital KYC on their clients.

Text-based Applications

The framework of TensorFlow can be used to benefit text-based applications, especially when using the language identification technique.

Users can comprehend the sentiment behind comments made by customers or workers by using sentiment analysis in CRM systems and employee help desks.

It can be used by online news outlets to condense an article and create a captivating headline.

Legal firms can also employ language detection to remove jargon from documents so that clients can understand them.

Voice or Sound Detection

The TensorFlow framework can be applied to sound-driven applications to provide voice search, sentiment analysis (instead of text as stated above), engine problem detection (for the automotive and aviation industries), and a number of other uses where the system must assess the input of a sound.

Increase Business Agility with TensorFlow

Fission Labs can assist you in developing scalable and tailored applications by utilising the framework's features if you want to use TensorFlow to make the most of AI and ML technologies in your business. We'll see to it that your machine picks up the necessary skills and develops into a valuable worker!

The only thing left to do is arrange a free consultation with one of our experts.

TensorFlow In Brief

Fission Labs can assist you in developing scalable and tailored applications by utilising the framework's features if you want to use TensorFlow to make the most of AI and ML technologies in your business.

We'll see to it that your machine picks up the necessary skills and develops into a valuable worker!

The only thing left to do is arrange a free consultation with one of our experts.

Applications of Machine Learning and Deep Learning

In this section, we will learn about the different applications of Machine Learning and Deep Learning.

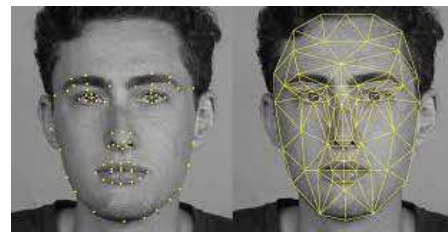
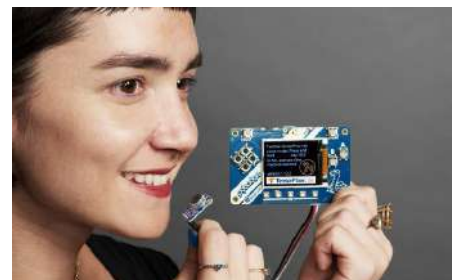
- Computer vision which is used for

facial recognition and attendance marks through fingerprints or vehicle identification through number plate.

- Information Retrieval from search engines like text search for image search.
- Automated email marketing with specified target identification.
- Medical diagnosis of cancer tumors or anomaly identification of any chronic disease.
- Natural language processing for applications like photo tagging. The best example to explain this scenario is used in Facebook.
- Online Advertising.



Products Related



Object detection

TensorFlow Lite for Microcontrollers Kit
Building a Facial Recognition

Future Scope

Future Trends

- With the increasing trend of using data science and machine learning in the industry, it will become important for each organization to inculcate machine learning in their businesses.
- Deep learning is gaining more importance than machine learning. Deep learning is proving to be one of the best techniques in state-of-art performance.

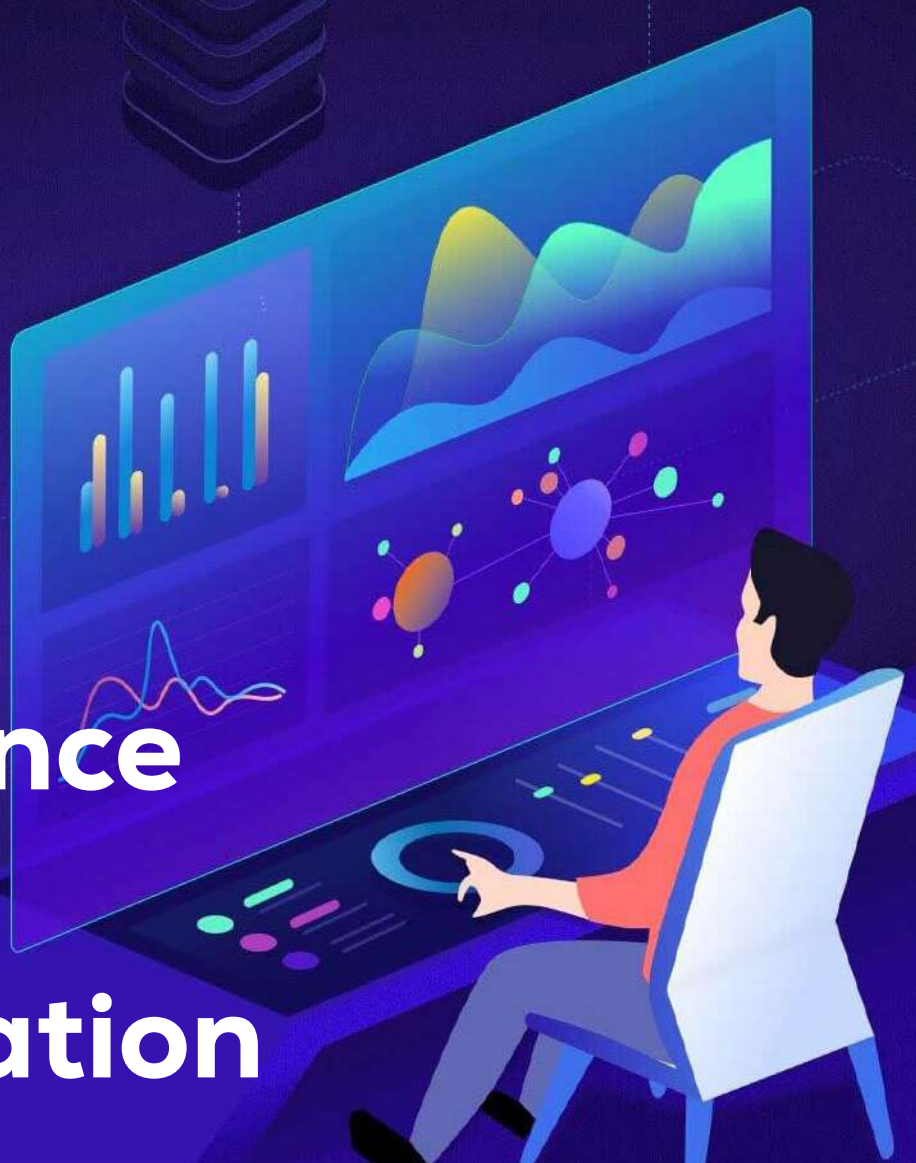
- Machine learning and deep learning will prove beneficial in research and academics.

Conclusion

The overview of machine learning and deep learning in this article included examples, differences, and a focus on emerging trends. Machine learning algorithms are widely used in AI applications, primarily to promote self-service, improve agent productivity, and more reliably execute workflows. For many companies and industry titans, machine learning and deep learning algorithms present an exciting opportunity.



Importance of Data Visualization



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Introduction

Data visualization is the graphical depiction of data and information. Understanding how humans gather and process data is the foundation of data visualization science. Data visualization is a simple and effective approach to convey information to a broad audience using visual data. It has the ability to swiftly absorb information, increase insights, and make quicker decisions.

Data visualization's major purpose is to make it easier to spot patterns, trends, and outliers in massive data sets. As data and information visualization has its roots in statistics, it is usually considered a subset of descriptive statistics.

Data visualization is part of the larger Data Presentation Architecture (DPA) discipline, which strives to efficiently identify, find, modify, prepare, and transmit data. It's also the study of how to use visual representations of abstract data to help people remember things. "Research in human-computer interaction, computer science, graphics, visual design, psychology, and business approaches" gave rise to the discipline of data and information visualization.

Data scientists are no longer required because data is more accessible and intelligible. It has enhanced capacity to move rapidly on insights and, as a result, achieve achievement with more speed and fewer errors.

Technology Used In Data Visualization

1. Chart

A chart is the most straightforward approach to depict the evolution of one or more data sets.

From bar and line charts that demonstrate the relationship between parts over time to pie charts that display the elements or proportions between the elements of a single whole, charts come in many shapes and sizes.

2. Plots

Plots allow you to display the relationship

between two or more data sets and the plot's parameters by distributing them over a 2D or even 3D space.

Plots differ as well.

Some of the most popular visualizations include scatter and bubble charts.

Analysts often utilize more complicated box plots to visualize the links between enormous amounts of data when working with big data.

3. Maps

Maps are widely used for data visualization in a variety of industries.

They enable items to be located on relevant objects and places, such as geographical maps, architectural blueprints, and website layouts.

Heat maps, dot distribution maps, and cartograms are some of the most popular map visualizations.

4. Diagrams and matrices

Diagrams are commonly used to show complicated data relationships and links, as well as to combine different forms of data into a single visual representation. They can have a hierarchical, multidimensional, or tree-like structure.

Matrix is an advanced data visualization tool for determining the link between numerous data sets that are constantly changing (streaming).

Application Of Data Visualization

Data visualization can be applied to a variety of industries. And thus can help the industries to a great extent in maintaining the data and information. The following industries benefit from data visualization:

1. Healthcare Industries

A display that visualizes a patient's medical history could help a current or new doctor better understand a patient's health. In the event of an emergency, it may provide speedier care facilities based on sickness. Data visualization can help you uncover trends without having to trawl through hundreds of pages of data. It generates matrices that facilitate analysis, resulting in a quicker reaction time.

2. Business Intelligence

When compared to local options, cloud connection can provide the cost-effective "heavy lifting" of processor-intensive analytics, allowing users to see bigger volumes of data from numerous sources to help speed up decision-making.

Additional integrated tools, such as those targeted toward business intelligence (BI), assist provide a unified view of an organization's whole data system because such systems might be diverse, consisting of various components, and use their own data storage and interfaces for access to stored data.

3. Military

Dynamic Data Visualization assists in gaining a better understanding of geography and climate, resulting in a more effective strategy. Military equipment and tools are expensive; analyzing current inventory and making purchases as needed is straightforward with bar and pie charts.

4. Finance Industries

Data visualization tools are becoming a demand for financial sectors for exploring/explaining data of linked consumers, understanding consumer behavior, having a clear flow of information, the efficiency of decision making, and so on. Data visualization helps associated organizations and enterprises create patterns, which aids in better investment planning. Data visualization emphasizes the most recent trends for better business possibilities.

5. Data Science

Visualizations are typically created by data scientists for their own use or to present information to a limited group of people. To produce the visual representations, visualization libraries for the given programming languages and tools are utilized.

6. Marketing

Data visualization is a boon in marketing analytics. Various patterns and trends analysis, such as sales analysis, market research analysis, customer analysis, defect analysis, cost analysis, and forecasting, may be analyzed using graphics and reports.

By visually engaging your audience, visual aids can help them grasp your core point.

7. Education

Users can use easy, interactive dashboards to visually engage with data, answer questions quickly, make more accurate, data-informed decisions, and share their findings with others.

The capacity to track students' progress throughout the semester, allowing advisers to reach out to failing students swiftly.

Besides these industries data visualization has various applications in other industries too which include food delivery apps, E-commerce, Real estate business and so on.

Conclusion

Data visualization is one of the processes in the data science process, according to which data must be represented after it has been collected, processed, and modeled in order to draw conclusions. Almost every profession requires data visualization. When a data scientist is developing advanced predictive analytics or machine learning (ML) algorithms, it's critical to display the outputs in order to track results and confirm that models are working as expected.

This is because sophisticated algorithm visuals are often easier to understand than numerical results. With recent technological developments, data can now be obtained using an infinite range of tactics that brings us in touch with advanced analytical configurations.

Products Related

Tools related to data visualization are:

1. Tableau
2. QlikView
3. Microsoft Power BI
4. Datawrapper

5. Plotly
6. Sisense
7. Excel
8. Zoho analytics

Future Scope

By generating infographics that can be turned into important insights, the future of Big Data visualization dramatically boosts and improves productivity.

The complexity of displaying data might get more difficult as the amount of data available on multiple platforms grows. These new platforms show how data visualization is rapidly evolving to satisfy ever-increasing operational and data needs.

Data visualization's major aspect is extracting knowledge from data, which can be enhanced by utilizing emerging technologies.

Data on demand and data storing into databases with a clear purpose will be the focus of data visualization in the future. Data visualization departments will emerge, with resources for pre-processing, character identification, and post-processing on visual data. For tech organizations, focusing on these tasks would boost the importance of machine learning and artificial intelligence.

This will have an impact on their competency, development, and investment plans.

ML in Autonomous Vehicles



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Introduction

An autonomous vehicle uses various in-vehicle technologies and sensors, such as adaptive cruise control, active steering (steer by wire), anti-lock braking systems (brake by wire), GPS navigation technology, lasers, and radar, to drive itself from a starting point to a predetermined destination in “autopilot” mode.

How do Autonomous vehicles work?

Sensors, actuators, complicated algorithms, machine learning systems, and powerful processors are used to run software in autonomous vehicles.

Based on a number of sensors located throughout the vehicle, autonomous automobiles develop and maintain a map of their surroundings.

Radar sensors track the movement of adjacent cars.

Traffic signals are detected by video cameras, which also read road signs, monitor other vehicles, and look for pedestrians.

Lidar (light detection and ranging) sensors estimate distances, detect road boundaries, and recognise lane markers by bouncing light pulses off the car's surroundings.

When parking, ultrasonic sensors in the wheels detect curbs and other vehicles. After that, sophisticated software evaluates all of the sensory data, draws a path, and sends commands to the car's actuators, which control acceleration and steering.

Challenges with autonomous cars

Lidar and Radar

Lidar is expensive and is still trying to strike the right balance between range and resolution. If multiple autonomous cars were to drive on the same road, would their lidar signals interfere with one another? And if multiple radio frequencies

are available, will the frequency range be enough to support mass production of autonomous cars?

Weather Conditions

What happens when an autonomous car drives in heavy precipitation? If there's a layer of snow on the road, lane dividers disappear. How will the cameras and sensors track lane markings if the markings are obscured by water, oil, ice, or debris?

Accident Liability

Who is liable for accidents caused by an autonomous car? The manufacturer? The human passenger? The latest blueprints suggest that a fully autonomous Level 5 car will not have a dashboard or a steering wheel, so a human passenger would not even have the option to take control of the vehicle in an emergency.

Benefits of autonomous cars

The scenarios for convenience and quality-of-life improvements are limitless. The elderly and the physically disabled would have independence.

The real promise of autonomous cars is the potential for dramatically lowering CO2 emissions. In a recent study, experts identified three trends that, if adopted concurrently, would unleash the full potential of autonomous cars: vehicle automation, vehicle electrification, and ridesharing. By 2050, these "three revolutions in urban transportation" could:

- Reduce traffic congestion (30% fewer

- vehicles on the road)
- Cut transportation costs by 40% (in terms of vehicles, fuel, and infrastructure)
- Improve walkability and livability
- Free up parking lots for other uses (schools, parks, community centers)
- Reduce urban CO2 emissions by 80% worldwide.

The Role of Machine Learning in Autonomous Vehicles

Detection and classification of objects

Machine learning is being deployed for the higher levels of driver assistance, such as the perception and understanding of the world around the vehicle. This chiefly involves the use of camera-based systems to detect and classify objects, but there are also developments in LiDAR and radar as well.

One of the biggest issues for autonomous driving is that objects are wrongly classified. The data gathered by the vehicle's different sensors is collected and then interpreted by the vehicle's system. But with just a few pixels of difference in an image produced by a camera system, a vehicle might incorrectly perceive a stop sign as something more innocuous, like a speed limit sign. If the system similarly mistook a pedestrian for a lamp post, then it would not anticipate that it might move.

Through improved and more generalized training of the ML models, the systems can improve perception and identify objects with greater accuracy. Training

the system—by giving it more varied inputs on the key parameters on which it makes its decisions—helps to better validate the data and ensure that what it's being trained on is representative of true distribution in real life. In this way, there isn't a heavy dependence on a single parameter, or a key set of particulars, which might otherwise make a system draw a certain conclusion.

If a system is given data that's 90% about red cars, then there's a risk that it will come to identify all red objects as being red cars. This "overfitting" in one area can skew the data and therefore skew the output; thus, varied training is vital.

Driver monitoring

Neural networks can recognize patterns, so they can be used within vehicles to monitor the driver. For example, facial recognition can be employed to identify the driver and verify if he or she has certain rights, e.g., permission to start the car, which could help prevent unauthorized use and theft.

This might mean automatically adjusting the air conditioning to correspond to the number and location of the passengers. In the short term, vehicles will need a degree of supervision and attention from someone designated as the "driver." It's here that recognition of facial expressions will be key to enhancing safety. Systems can be used to learn and detect signs of fatigue or insufficient attention, and warn the occupants, perhaps even going so far as to slow or stop the vehicle.

Vehicle Powertrains

Vehicle powertrains typically generate a time series of data points. Machine learning can be applied to this data to improve motor control and battery management.

With ML, a vehicle isn't limited to boundary conditions that are factory-set and permanently fixed. Instead, the system can adapt over time to the aging of the vehicle and respond to changes as they happen. ML allows for boundary conditions to be adjusted as the vehicle system ages, as the powertrain changes, and as the vehicle is gradually broken in. With flexibility of boundary conditions, the vehicle is able to achieve more optimal operation.

The system can adjust over time, changing its operating parameters. Or, if the system has sufficient computing capacity, it could adapt in real time to the changing environment. The system can learn to detect anomalies and provide timely notification that maintenance is required, or give warnings of imminent motor-control failure.

Functional Safety and Device Reliability

Machine learning has a part to play in ensuring that a vehicle remains in good operating order by avoiding system failures that might cause accidents.

ML can be applied to the data captured by on-board devices. Data on variables such as motor temperature, battery charge, oil pressure, and coolant levels

is delivered to the system, where it's analyzed and produces a picture of the motor's performance and overall health of the vehicle. Indicators showing a potential fault can then alert the system and its owner—that the vehicle should be repaired or proactively maintained.

Similarly, ML can be applied to data derived from the devices in a vehicle, ensuring that their failure does not cause an accident. Devices such as the sensor systems—cameras, LiDAR, and radar—need to be optimally maintained; otherwise, a safe journey couldn't be assured.

Detecting Attacks and Anomalies

It's possible that the autonomous classification system within a vehicle could be maliciously attacked. Such an offensive attack may deliberately make the vehicle misinterpret an object and classify it incorrectly. This sort of attack would need to be detected and overcome. An offensive attack could impose the wrong classification on a vehicle, as in the case of a stop sign being perceived as a speed-limit sign. ML can be used to detect these kinds of adversarial attacks and manufacturers are beginning to develop defensive approaches to circumvent them.

It's by delivering robust systems around the ML model that such attacks can be defended. Once again, training is important here. The aim is to create a more generalized way for the ADAS to make its decision. Employing training to avoid overfitting avoids a heavy dependence on

one key particular—or a set of them. So, because the system has a greater breadth of knowledge, the input that's been maliciously manipulated will not cause it to wrongly change the outcome or the perception.

Conclusion

To summarize, the technology underlying semi- and fully autonomous vehicles is well-developed and poised for commercial deployment. Major automotive companies and software developers have made considerable progress in navigation, collision avoidance, and street mapping.

Leading brand

Waymo, by most measures, is still the leader of the world's autonomous vehicle effort. Development of its technology began at Google more than a decade ago, and the company hit a historic milestone last year when it started its completely driverless taxi program in Arizona.

Future and Autonomous vehicles

Over the past decade, the pursuit of self-driving cars has excited public

imagination and inspired unprecedented collaboration between carmakers and tech innovators. So how much closer are we to integrating autonomous vehicles (AVs) into our transportation systems? Forecasts predict that one in 10 vehicles will be fully automated globally by 2030, but until difficult challenges can be fully resolved, the industry can only speculate. In reality, many pieces of a very complicated puzzle need to fall into place before autonomous vehicles become a normal sight on the roads.

Ambitious real-world testing and intriguing vehicle projects continue to build hype around AVs, but many automakers now acknowledge that developing the technology is more complex than they originally thought. Still, optimism for AI-powered self-driving technology (enabled by 5G) is growing, as advancements in partially-autonomous cars offer a more realistic vision of what the next decade may look like. With the potential to transform everything from our mobility behaviors to how future smart cities are designed.





Reinforcement Learning



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Introduction

Reinforcement learning is demonstrated by the way a robotic dog learns to move his arms. Reinforcement learning is a machine learning method in which an intelligent agent (computer programme) interacts with its environment and learns how to act within it.

It is about taking appropriate action in order to optimize reward in a specific

situation.

Various software and machines use it to determine the best possible actions or path to take in a given situation.

Examples of Reinforcement Learning

- **Robotics**

Robots with pre-programmed behavior are useful in structured environments with repetitive tasks, such as an assembly line in an automobile manufacturing plant.

- **Self-driving cars**

In an uncertain environment, an autonomous driving system must execute various perception and planning tasks.

Vehicle path planning and motion prediction are two examples of tasks where RL is useful.

- **AlphaGo**

It learns by playing thousands of games with professional players, much like a human player. The latest RL-based Go agent can learn by playing against itself, which gives it an advantage over human players.

Applications Of Reinforcement Learning In Machine Learning

1. Reinforcement Learning in Marketing, Advertising, and Business

Technology can be crucial in money-related industries. For example, RL models of corporations can examine customer preferences and aid in better product advertising.

We understand that business demands careful planning.

For a product or firm to make money, the processes must be carefully planned. RL assists in the development of effective tactics by analyzing many options and attempting to enhance the profit margin on each result.

2. Reinforcement Learning in Gaming

Gaming is a burgeoning sector that is catching up with technological advancements. The games are becoming increasingly realistic and detailed.

PSXLE, or PlayStation Reinforcement Learning Environment, is an environment that focuses on customizing emulators to provide better gaming environments.

3. Recommendation systems with Reinforcement Learning

RL is currently widely used in recommendation systems such as news, music apps, and web-series apps such as Netflix. These apps function according to the preferences of the user. Companies with advanced recommendation systems, such as these, exist. They take into account a variety of factors, including user preferences, popular shows, and genres.

4. Reinforcement Learning in Science

Interest in AI and machine learning research has grown in recent times. Reinforcement learning is useful in a variety of scientific domains.

Understanding chemical reactions is aided by reinforcement learning. We can strive for cleaner reactions that produce better results. Any molecule or atom can have a variety of reaction combinations. Machine learning can help us analyze their bonding habits.

Future Prospects For Reinforcement Learning

Many of the following tasks will be performed in the future using reinforcement learning:

- intelligently trade stocks and options (as Apteo does)
- advanced self-driving automobiles
- intelligent traffic signals
- self-sufficient robots
- factory that is completely automated
- intelligent prosthetic limbs.

Products Related To Learning Reinforcement

- **RLgraph**
RLgraph is a reinforcement learning framework that allows researchers and practitioners to quickly prototype, define, and execute reinforcement learning algorithms.
- **TayPO**
TayPO, or Taylor expansion Policy Optimisation, is a policy optimisation framework that generalizes methods such as TRPO and improves the performance of several cutting-edge distributed algorithms.
- **Tensorforce**

Tensorforce is a deep reinforcement learning framework that is open source. The framework focuses on modularised flexible library design and simple usability for applications in research and practice.

- **SLM-Lab**
SLM Lab is a software framework for researching reproducible reinforcement learning (RL). SLM Lab's reinforcement learning algorithms are built around three base classes: algorithms, deep networks, and memory.
- **Surreal**
Surreal is an open-source, scalable framework that supports cutting-edge distributed reinforcement learning algorithms. It is also known as Scalable Robotic Reinforcement Learning Algorithms.

Elements In Reinforcement Learning

1. Policy:

A policy is a set of rules that govern how an agent behaves at any given time. It connects environmental perceptions to actions taken as a result of those perceptions. Because it is the only thing that can define the agent's behavior, the policy is the most important component of the RL.

2. The Reward Signal:

The reward signal determines the purpose of reinforcement learning. The environment gives a reward signal to the learning agent in each state. These

bonuses are determined by the agent's positive and negative activities.

3. Value Function:

The value function indicates how good the situation and action are and how much reward an agent can expect. A value function specifies the desired future state and action. The value function is dependent on the reward because there could be no value if there was no reward. The goal of estimating values is to reap more benefits.

4. Model:

The model, which mimics the behavior of the environment, is the final component of reinforcement

learning. The model allows one to make predictions about how the environment will behave. For example, given a state and an action, a model can predict the next state and reward.

Conclusion

Despite all of the recent advances in the field, there is still a long way to go. We need the efforts of dedicated researchers, engineers, and data scientists to achieve the same level of success in RL as we have in deep learning. We're still several breakthroughs away from using RL in practise, but with smart people researching its capabilities every day, we're making progress.



Convolutional Neural Network



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Introduction

In recent years, deep learning has attracted a lot of interest. Since the astounding results were given on the ImageNet Large Scale Visual Recognition Competition (ILSVRC) in 2012, the convolutional neural network (CNN), a family of artificial neural networks, has emerged as the method of choice for computer vision problems. In a number of fields, including medical science, CNN has achieved success. Deep

learning can be used to identify lymph node metastases, categorize skin lesions, and screen for diabetic retinopathy, according to research by Gulshan et al., Esteva et al., and Ehteshami Bejnordi et al.

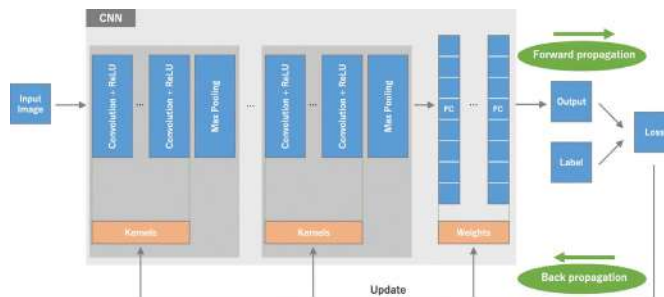
Naturally, the promise of CNN has attracted the attention of radiology professionals, and a number of research in areas such as lesion identification, classification, segmentation, image reconstruction, and natural language processing have already been published. Not just researchers but clinical radiologists as well can benefit from understanding how to employ CNN in radiology and medical imaging as deep learning may soon influence their practice.

What is CNN?

The CNN deep learning model was created to automatically and flexibly learn spatial hierarchies of characteristics from low- to high-level patterns in data having a grid pattern, such as pictures. CNN was inspired by the organization of animal visual cortex. Convolution, pooling, and fully linked layers are the three different types of layers (or “building blocks”) that make up CNNs. Convolution and pooling, the first two layers, extract features, while a fully connected layer, the third layer, transfers the obtained features to outputs like categorization. Convolution, a particular kind of linear operation, is one of a number of mathematical procedures that make up CNN.

CNNs are particularly effective for image processing since a feature can exist

anywhere in the image. Pixel values are retained in a two-dimensional (2D) grid, i.e. An array of integers and a small grid of parameters called a kernel, an optimizable feature extractor, is applied at each picture point. As one layer feeds its output into the next layer, extracted features can become increasingly sophisticated in a hierarchical and progressive manner. Through the use of optimization methods like backpropagation and gradient descent, among others, training is the act of optimizing parameters like kernels to reduce the discrepancy between outputs and ground truth labels.



The convolutional neural network’s architecture and training process (CNN). A CNN is made up of convolution layers, pooling layers (such max pooling), and fully connected (FC) layers. Learnable parameters, such as kernels and weights, are updated using the gradient descent optimization process utilising transfer learning. The performance of a model with particular kernels and weights is calculated using a loss function on a training dataset. One kind of corrected linear unit is the rectified linear unit (ReLU).



are so significant and trying with strategies to lessen their consequences. It is believed that the information in these natural history collections can lead to deeper social and scientific discoveries, although doing so would require qualified human resources, including academics who can physically visit these archives. To undertake more in-depth research on this topic, more personnel is needed.

Conclusion

Convolutional Neural Nets are a popular deep learning method for visual identification problems today. Like other deep learning algorithms, CNN is very dependent on the quantity and calibre of training data. In image identification tasks, CNNs can do better than humans if given a well-prepared dataset. However, despite human ability to adapt for glare and noise, they are still susceptible to

visual distortions. In order to enable CNNs to assess novel things that are significantly dissimilar from what they were trained on, researchers are working to incorporate features like active attention and online memory into the CNN theory. This results in a more intelligent artificial visual recognition system since it more closely matches the mammalian visual system.

Products Related

- Google lens
- Social media
- Health care

Future Scope

A futuristic and largely untapped discipline, image recognition has a wide range of useful applications in industry, science, and medicine. This discipline has a lot of room for growth and application in brand-new domains including space exploration, signal image processing, computer vision, etc. Many operations, like processing bank checks, can be automated using picture recognition.



Deep Neural Networks



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Introduction

An Artificial Neural Network (ANN) having numerous layers in between the input and output layers is referred to as a deep neural network. Although there are various kinds of neural networks, they all share the same building blocks: neurons, synapses, weights, biases, and functions. In computer vision, deep neural networks (DNNs) have found exceptional success. However, their increased computational

complexity significantly outweighs their enhanced performance, making it difficult for many resource-constrained devices, such as mobile phones and Internet of Things (IoT) devices, to use them. Therefore, in order to enable a wide range of edge AI applications, approaches and techniques that can remove the efficiency bottleneck while maintaining the high accuracy of DNNs are highly sought after. In this chapter, effective deep learning techniques are briefly discussed. We begin by introducing a well-liked model.

What is a deep neural network?

An artificial neural network (ANN) with several layers of network architecture search (NAS), automated pruning, and quantization is referred to as a deep neural network. A neural network is made up of numerous nodes, which are connected components. These are the tiniest components of the neural network and function as the brain's neurons. A neuron initiates a process when it receives a signal. Depending on the input received, the signal is transferred from one neuron to another. A sophisticated network emerges that gains knowledge via feedback. Layers are used to group the nodes. Processing the many layers between the input and output layers completes a task. The deeper the network, and hence the term "deep learning," the more layers there are to be processed. Light is shed through CAP (Credit Assignment Path).

Difference between neural network and deep neural network

Compared to the neural network, the deep neural network is more complex and innovative. Deep learning algorithms are able to analyse data, forecast outcomes, think creatively, and detect noises and voice commands. They behave like the brain of a person. Neural networks only produce one outcome. It might be a deed, a word, or a fix. Deep Neural Networks, on the other hand, offer solutions by solving issues worldwide using the information provided.

A neural network requires a certain algorithm and data input, whereas Deep Neural Networks can solve issues with any quantity of data.

DEEP NEURAL NETWORK TYPES

1. Multi-Layer Perceptrons (MLP)
2. Convolutional Neural Networks (CNN)
3. Recurrent Neural Networks (RNN)

1. Multi layer perceptions(MLP)

A class of feedforward artificial neural network is called a multilayer perceptron (MLP) (ANN). The most fundamental deep neural network, which consists of a number of fully linked layers, is an MLP model. Modern deep learning architectures need a lot of computer resources, but MLP machine learning techniques can get around this.

Each additional layer is composed of a group of nonlinear functions that represent the weighted sum of all the outputs from the preceding layer.

2. Convolutional Neural Networks (CNN)

Another type of deep neural network is a convolutional neural network (CNN, or ConvNet). The most typical application of CNNs is in computer vision. The AI system learns to automatically extract the properties of these inputs to finish a specified goal, such as picture classification, face identification, or image semantic segmentation, given a sequence of real-world images or videos and using CNN.

In contrast to fully linked layers in MLPs, convolution operations are used by one or more convolution layers in CNN models to extract the simple characteristics from input. Each layer consists of a collection of nonlinear functions that compute weighted sums of spatially close-by subsets of the outputs from the preceding layer at various positions.

3. Recurrent Neural Networks (RNN)

Another type of deep neural network is a convolutional neural network (CNN, or ConvNet). The most typical application of CNNs is in computer vision. CNN is used to train an AI system to recognise objects in a set of real-world photos or videos. Recurrent neural networks are another kind of artificial neural network that make use of sequential data feeding (RNN). RNNs have been created in order to address the time-series issue of sequential input data.

The RNN's input consists of both the current input and the previous samples. The connections between the nodes

along a temporal sequence result in a directed graph. The computation-related data from earlier samples are also stored in each neuron's internal memory, which is a feature of an RNN.

Future of neural networks

Integration

If neural nets could be combined with a complementing technology, such as symbolic functions, their flaws may be readily made up for. Finding a way for various systems to cooperate in order to generate a single outcome would be challenging, but engineers are already working on it.

Sheer complexity

Everything has the capacity to increase in complexity and power. With advances in technology, CPUs and GPUs can become more affordable and/or quicker, allowing for the creation of larger, more effective algorithms. We can create neural networks that can process more data or do so more quickly, allowing them to discover patterns from 1,000 samples rather than 10,000. Unfortunately, there might be a ceiling on how far we can go in these fields; nevertheless, since we haven't hit it yet, we'll probably work towards it in the near future.

Applications

Neural networks might (and probably will) expand horizontally, being used in more varied applications, as opposed to only developing vertically in terms of faster processing power and greater

sheer complexity. Neural networks have the potential to help hundreds of businesses function more effectively, reach new markets, create new products, or increase consumer safety—yet they are grossly neglected. Increased engineering and marketing innovation, broader acceptability, and availability could lead to more applications for neural networks.

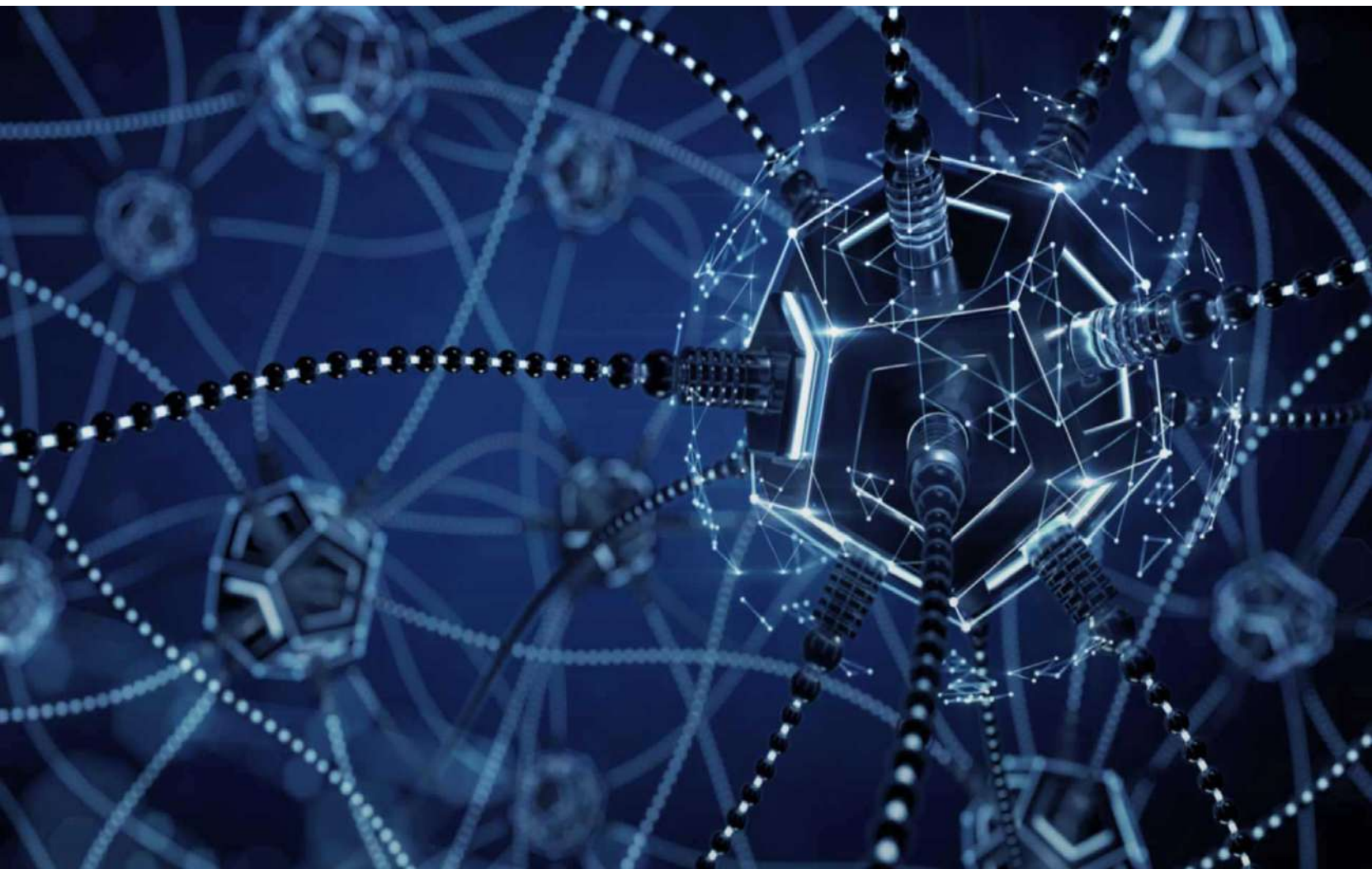
Conclusion

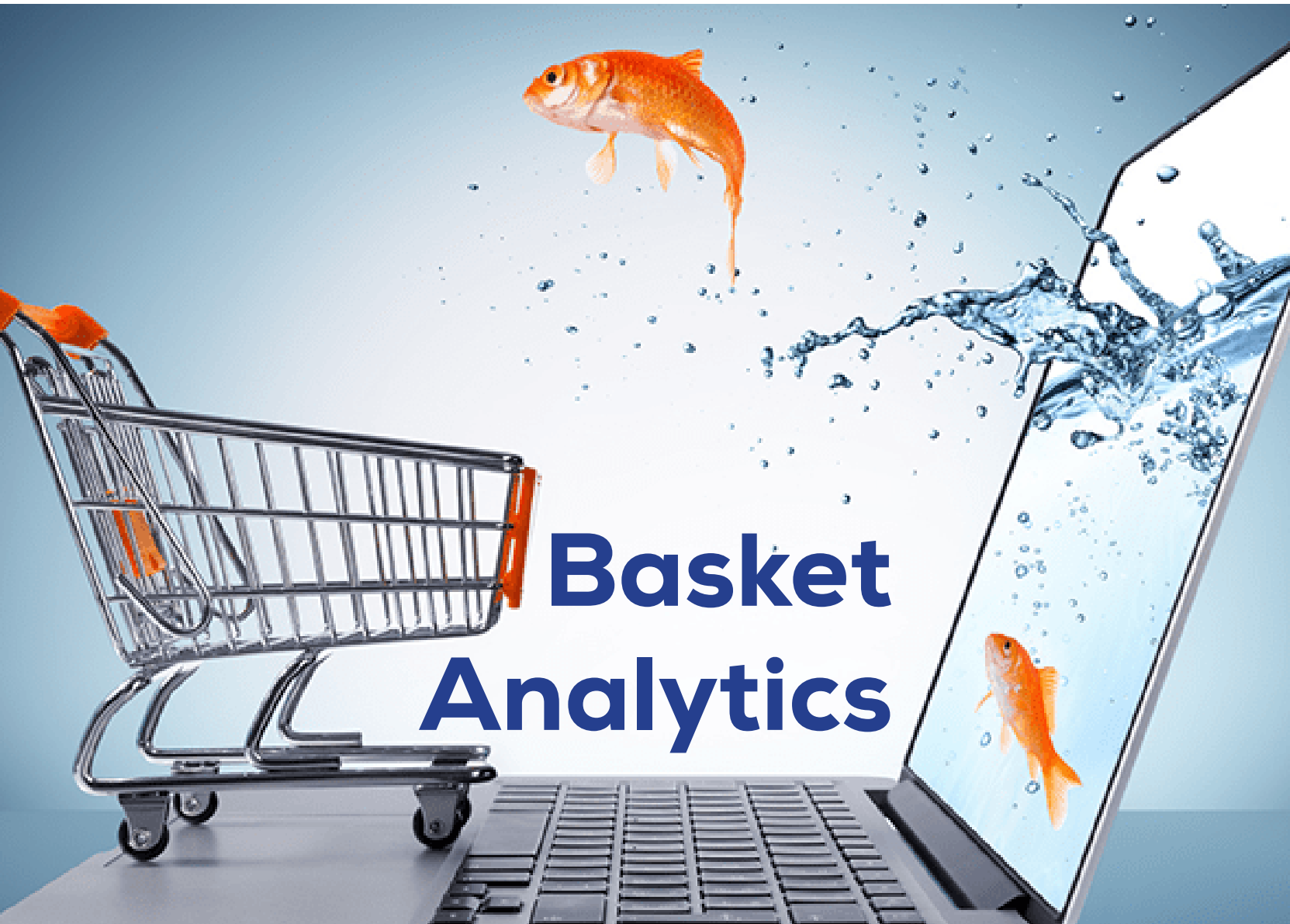
An extensive topic is neural networks. Many data scientists only use neural network methods as their primary focus. We only practiced the foundational topics in this session. Neural networks

employ considerably more sophisticated methods. In Addition to back propagation, there are other algorithms.

In particular, neural networks are effective at solving various types of problems, like image recognition. The neural network techniques involve a lot of calculations. They call for extremely effective computing devices. R takes a long time to process large datasets. We must test out several alternatives and packaging.

There is a lot of fascinating research being done right now on neural networks.





Basket Analytics



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MEA20CS012

Introduction

Machine Learning is now assisting the retail industry in a variety of ways. Machine learning (ML) has various applications in the retail industry, from projecting sales performance to identifying purchasers, as you may expect. One of the top machine learning applications in the retail industry is “Market Basket Analysis”. We can discover which products are usually purchased jointly by customers

by studying their previous purchasing history.

The most accurate Market Analysis definition is – a data mining technique that is used to uncover purchase patterns in any retail setting. The goal of Market Basket Analysis is to understand consumer behavior by identifying relationships between the items that people buy. For example, people who buy green tea are also likely to buy honey. So Market Basket Analysis would quantitatively establish that there is a relationship between Green Tea and Honey. The same goes for bread, butter, and jam.

Technology Used

Market basket analysis is performed using the Apriori algorithm, a data mining method. Using support, confidence, and lift indicators, this apriori algorithm discovers itemsets that are commonly purchased. We established support and confidence thresholds based on our requirements. If the support and confidence values of itemsets cross pre-threshold values, we know they're connected.

Types Of Market Basket Analysis

There are two type of market basket analysis:

1. Predictive market basket:

This type analysis evaluates things purchased in order to determine cross-sell opportunities.

2. Differential market basket analysis:

This type takes into account data from

several stores as well as purchases from various client groups at various times of the day, month, or year. If a rule holds true in one dimension (such as store, time period, or client group) but not in others, analysts can figure out what caused the exception. These revelations may lead to new product offers that increase sales.

Application Of Basket Analysis

Market basket research is used in a variety of retail areas to increase sales and revenue by detecting client demands and making buy recommendations.

a) Cross-selling:-

Cross-selling is a sales tactic in which a vendor recommends a similar product to a buyer after he has purchased one. A merchant can persuade a customer to spend more money by suggesting that he buy more products that are similar to the one he already owns. When someone buys milk from a store, the seller may offer or suggest that he also buy coffee or tea. So, given the product that the consumer has previously purchased, the vendor proposes a complementary product.

b) Product placement:-

It refers to combining complementary (pen and paper) and replacement goods (tea and coffee) so that the client can address the commodities and purchase both of them. When a merchant groups several items together, there's a strong chance that a client will buy them all. The retailer can use market basket analysis

to determine which items a customer can buy together.

c) Affinity Promotion:-

Affinity marketing is a type of marketing that creates promotional events around related products. Affinity promotion using market basket analysis is a good technique to prepare and analyze survey results.

d) Fraud Detection:-

Market basket analysis is also applied to fraud detection. It may be possible to identify purchase behavior that can associate with fraud on the basis of market basket analysis data that contain credit card usage. Hence market basket analysis is also useful in fraud detection.

Advantages Of Basket Analysis

- Increases customer engagement
- Boosting sales and increasing RoI
- Improving customer experience
- Optimize marketing strategies and campaigns
- Help to understand customers better
- Identifies customer behavior and pattern

Conclusion

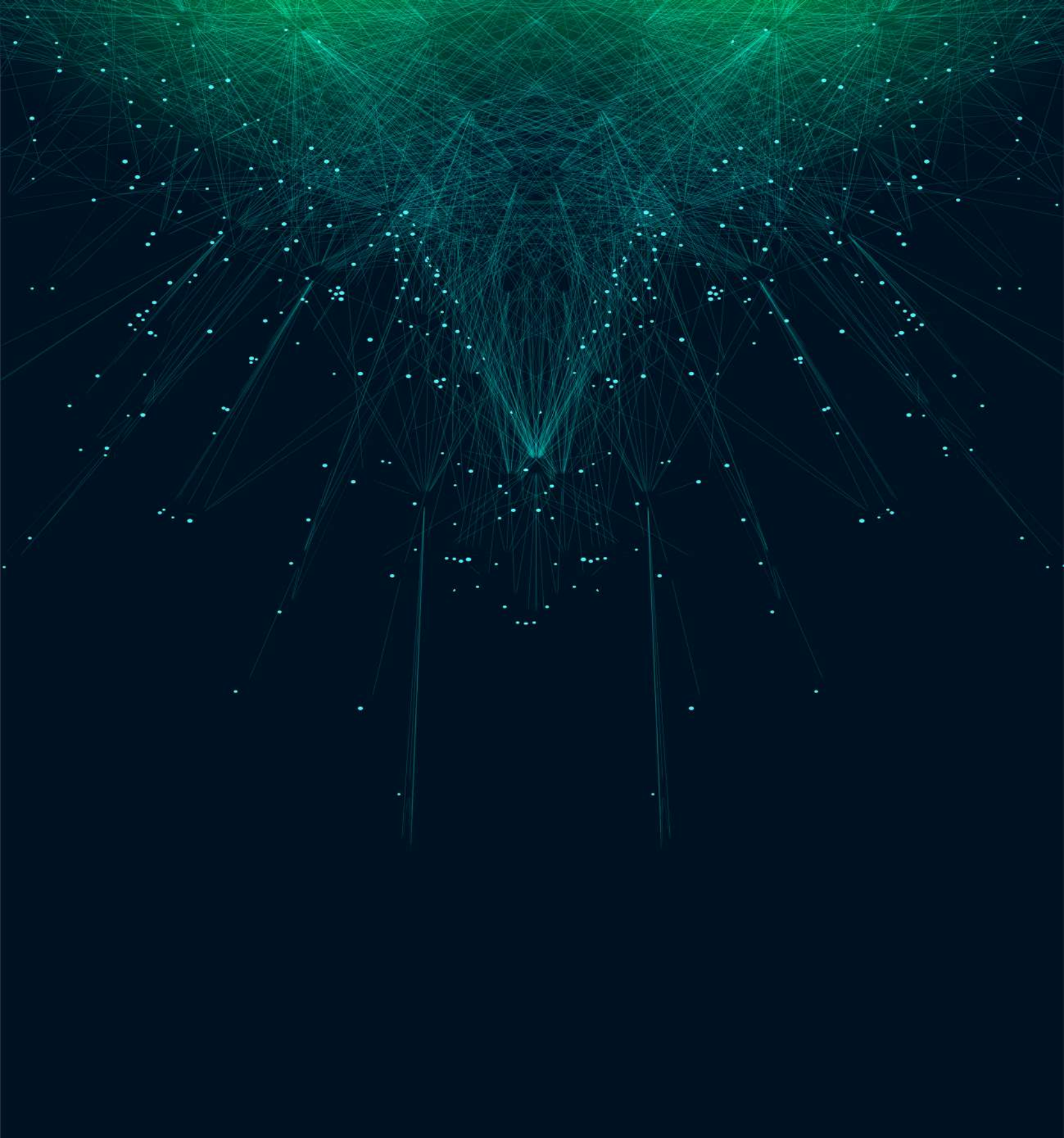
An idealistic automatic market basket analysis system is one that has the proper kind of analysis system that works behind the scenes to assist the company in enhancing their market. The exhibition of various internet technologies and unique algorithms is capable of giving solutions to the problem of client purchasing habits analysis in this research work. At first, frequent item sets are mined using association rule mining approaches using Probabilistic Graphical Model techniques. Following that, the key will be generated using the RSA technique, and the private key will be selected using the Enhanced Support Vector Machine (ESVM) classifier. Future efforts will include the implementation of certain features that the work requires. Future works will include certain characteristics that the current work was unable to explore by employing a more dependable algorithm in the system, allowing the system to operate more quickly and efficiently. Efforts to improve search techniques can also help to increase market share and profitability.



“ The advance of technology is based on making it fit in so that you don’t really even notice it, so it’s part of everyday life. ”

- Bill Gates





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