COMPUTER INFO–GALLERY

VOLUME - 10

(2021-2022)

Students' Assignments as IT Encyclopedia

PREFACE

This book is intended to make the New-Comers (Students) of the Department of Computer Science (UG), who does not have the ideas regarding the basics of the Computer and its terminologies. It can also help the students from computer backdrop, to make a review regarding the IT terminologies and concepts. Already 9 Volumes has been launched during 2012-2021.

The thought of publishing this book arises as a sparkle to make the Student's Assignments, in an organized manner. I had an idea that, if the topics given to the students to prepare their Assignments are non-repetitive, then they may do the task without copying others' content. Then, I thought why it shouldn't be combined together in the form of a book, which will help other students also. That is how this book got emerged. This is the 10th Volume for the academic year 2021-2022 with some other useful contents to make the students very well equipped in the foundation level especially for the students who come into the area of Autonomous.

The copy of this book will be maintained in the Department Library and also the E-content of this book has been posted in our college website. I hereby deliver my heartfelt thanks to the most honourable Correspondent Sir, the respected Principal Sir, and the beloved HOD (CS) Prof. P.Ramesh Sir, who gave me the freedom, to conduct an activity of this kind. I sincerely thank our beloved faculty members who have given me a moral support. I also thank our dear students for their co-operation. I hereby assure that the Department of Computer Science (UG) will always find ways for the betterment of the Students.

Thanking You,

INFO-GALLERY IN-CHARGE

Dr.R.PUSHPALATHA

BEST WISHES

To all your present and future innovations for the betterment of our students and the Institution…

HOD **Principal** **Correspondent**

CONTENTS

Assignment Contributions

Class: I B.Sc (CS) - 'A'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	DHANASEKAR R	1	1
2	GOKULAPRIYAN T	2	3
3	HARINI M	3	5
4	SRI DHARSHINI B	4	7
5	SRI VARSHINI B	5	9

UNDER THE GUIDANCE OF: **Dr.K.PRABHA**

Class: I B.Sc (CS) - 'B'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	RANJANI S	6	11
2	REVANTH S	7	13
3	KARTHIKA S	8	15
4	DHARSHINI V	9	17
5	ABINAYAA K	10	19

UNDER THE GUIDANCE OF: **Mrs.S.VIDHYA**

Class: II B.Sc (CS) - 'A'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	SRINITHI N V	11	21
2	UDHAYANAVASHINI N	12	23
3	DHIVYAA D	13	25
4	MANOJ KUMAR D	14	27
5	ASHIK AHMED S	15	29

UNDER THE GUIDANCE OF: **Mrs.K.GOMATHY**

Class: II B.Sc (CS) – 'B'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	RAMANAMOORTHY K	16	31
2	BLESSON JABEZ DORSEE B	17	33
3	KISHORE G	18	35
4	AJITH J	19	37
5	HARI VARSHNI E	20	39

UNDER THE GUIDANCE OF: **Mr.D.GOPINATH**

Class: III B.Sc (CS) – 'A'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	MADHAN KUMAR M C	21	41
2	RENUKA A	22	43
3	BALAKRISHNAN D	23	45
4	SANDHYA K	24	47
5	VASAVI G	25	49

UNDER THE GUIDANCE OF: **Mrs.S.GOWTHAMI**

Class: III B.Sc (CS) - 'B'

S.NO	NAME	TOPIC. NO	PAGE. NO
1	HARI PRASATH M	26	51
2	KIRUTHIKA U	27	53
3	KAVIN KUMAR K	28	55
4	DHARSHANA S	29	57
5	ELAKKIYA G	30	59

UNDER THE GUIDANCE OF: **Mr.S.SIVARAJA**

Class:III B.Sc (CS) - 'C'

UNDER THE GUIDANCE OF: **Mrs.R.SAVEETHA**

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1. MACHINE LERNING

Introduction

Machine learning is a set of tools that, broadly speaking, allow us to "teach" computers how to perform tasks by providing examples of how they should be done. Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values. Image recognition is a well-known and widespread example of machine learning in the real world. However, writing rules to accurately distinguish which text is valid can actually be quite difficult to do well, resulting either in many missed spam messages, or, worse, many lost emails. Worse, the spammers will actively adjust the way they send spam in order to trick these strategies (e.g., writing). Writing effective rules-and keeping them up-to-date-quickly becomes an insurmountable task.

Fortunately, machine learning has provided a solution. Modern spam filters are "learned" from examples: we provide the learning algorithm with example emails which we have manually labelled as "ham" (valid email) or "spam" (unwanted email), and the algorithms learn to distinguish between them automatically.

Artificial intelligence

Learning is central to human knowledge and intelligence and, likewise, it is also essential for building intelligent machines. Years of effort in AI has shown that trying to build intelligent computers by programming all the rules cannot be done.

Types of machine learning

There are three types of machine learning algorithms: Supervised Learning, Unsupervised Learning and Reinforcement Learning.

Supervised learning

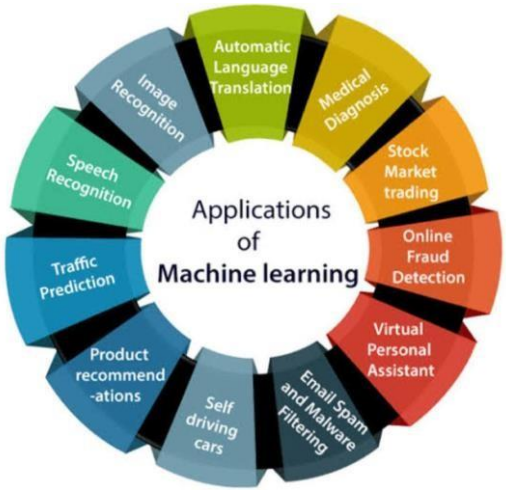
Supervised Learning, in which the training data is labeled with the correct answers, e.g., "spam" or "ham." The two most common types of supervised learning are classification (where the outputs are discrete labels, as in spam filtering) and regression (where the outputs are real-valued).

Unsupervised learning

Unsupervised learning, in which we are given a collection of unlabeled data, which we wish to analyze and discover patterns within. The two most important examples are dimension reduction and clustering.

Reinforcement learning

Reinforcement learning, in which an agent (e.g., a robot or controller) seeks to learn the optimal actions to take, based the outcomes of past actions.



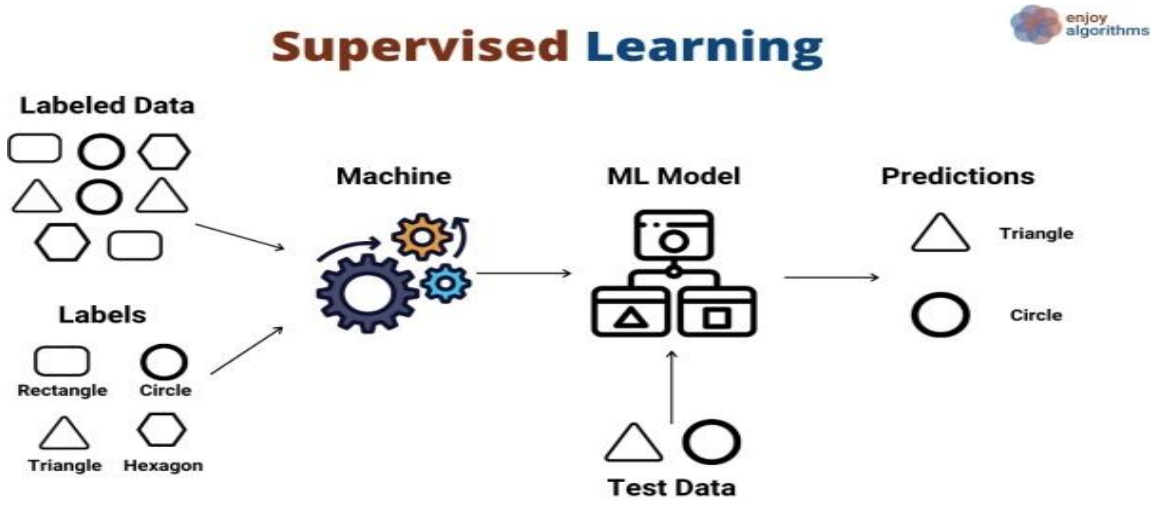
Conclusion

Finally, when it comes to the development of machine learning models of your own, you looked at the choices of various development languages, ides and platforms. The subject is vast, it means that there is width, but if you consider the depth, each topic can be learned in a few hours. Each topic is independent of each other. This is the best way to start studying machine learning. Practicing one topic at a time, very soon you would acquire the width that is eventually required of a machine learning expert.

2. SUPERVISED LEARNING

Introduction

Supervised learning is a process of providing input data as well as correct output data to the machine learning model. The aim of a supervised learning algorithm is to find a mapping function to map the input variable(x) with the output variable(y).



Supervised learning uses a training set to teach models to yield the desired output. This training dataset includes inputs and correct outputs, which allow the model to learn over time. The algorithm measures its accuracy through the loss function, adjusting until the error has been sufficiently minimized. Supervised learning helps organizations solve for a variety of real-world problems at scale, such as classifying spamina separate folder from your inbox.

Applications of supervised learning

Sentiment analysis: It is a natural language processing technique in which we analyze and categorize some meaning out of the given text data. For example, if we are analyzing tweets of people and want to predict whether a tweet is a query, complaint, suggestion, opinion or news, we will simply use sentiment analysis.

Recommendations: Every e-Commerce site or media, all of them use the recommendation system to recommend their products and new releases to their customers or users on the basis of their activities.

Spam filtration: Detecting spam emails is indeed a very helpful tool, this filtration techniques can easily detect any sort of virus, malware or even

Advantages

- Supervised learning allows collecting data and produces data output from previous experiences.
- Helps to optimize performance criteria with the help of experience.
- Supervised machine learning helps to solve various types of real-world computation problems.

Disadvantages

- Computation time is vast for supervised learning.
- Unwanted data downs efficiency.
- Pre-processing of data is no less than a big challenge.
- Always in need of updates.
- Anyone can over fit supervised algorithms easily.

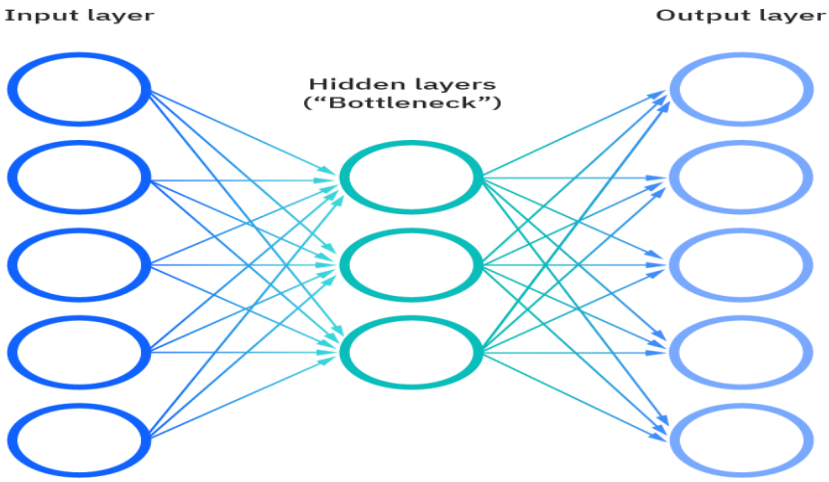
Best practices for Supervised Learning

- Before doing anything else, need to decide what kind of data is to be used as a training set.
- Need to decide the structure of the learned function and learning algorithm.
- Gather corresponding outputs either from human experts or from measurements.

3. UNSUPERVISED LEARNING

Definition

Unsupervised learning is a type of machine learning in which the algorithm is not provided with any pre-assigned labels or scores for the training data. As a result, unsupervised learning algorithm must first self-discover any naturally occurring patterns in that training datasets.



Function of unsupervised learning

Unsupervised learning is a type of machine learning algorithm used to draw inferences from datasets without human intervention, in contrast to supervised learning where labels are provided along with the data.

Types of unsupervised learning

- Clustering
- Association

Clustering

Clustering is an unsupervised machine learning task. It involves automatically discovering natural grouping in data. Unlike supervised learning, clustering algorithms only interpret the input data and find natural groups or clusters in feature space.

Association

Association rule learning is a type of unsupervised learning technique that checks for the dependency of one data item on another data item and maps accordingly so that it can be more profitable. It tries to find some interesting relations or associations among the variables of dataset.

Applications of unsupervised learning

The main applications of unsupervised learning include clustering, visualization, dimensionality reduction, finding association rules.

Challenges in unsupervised learning

Unsupervised learning has many benefits, some challenges can occur when it allows machine learning models to execute without any human intervention. Some of these challenges can include:

- Computational complexity due to a high volume of training data
- Longer training times
- Higher risk of in accurate results
- Human intervention to validate output variables
- Lack of transparency into the basis on which data was clustered.

Examples of unsupervised learning

- K-means clustering.
- KNN (k-nearest neighbours)
- Hierarchical clustering.
- Anomaly detection.
- Neural Networks.
- Principle Component Analysis.

4. ARTIFICIAL NEURAL NETWORK

Introduction

An Artificial Neural Network (ANN) is a computer system inspired by biological neural networks for creating artificial brains based on the collection of connected units called artificial neurons. It is designed to analyse and process information as humans. Artificial Neural Network has self-learning capabilities to produce better results as more data is available.

Artificial Neural Network

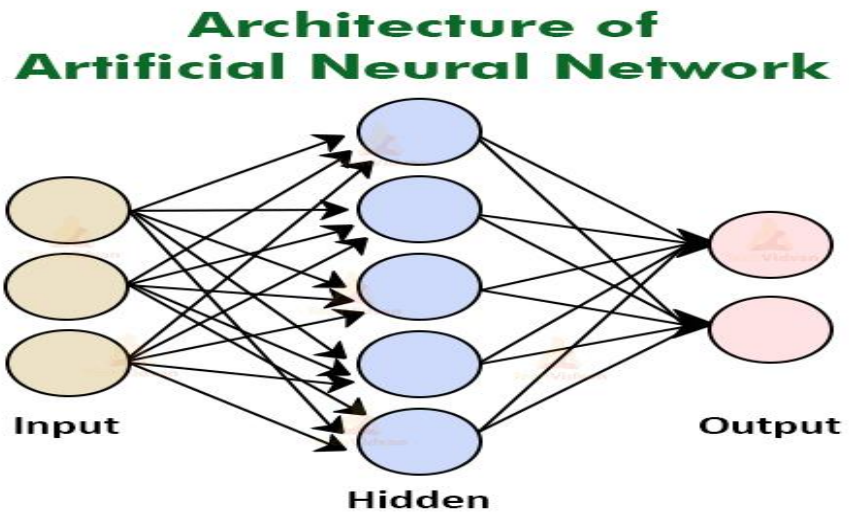
A neural network will take the input data and push them into an ensemble of layers. The network needs to evaluate its performance with a loss function. The loss function gives to the network an idea of the path it needs to take before it masters the knowledge. The network needs to improve its knowledge with the help of an optimizer. Neural Networks find great application in data mining used in sectors it can also be used for data classification in a large amount of data after carefully training.

Principle objects

An Artificial Neural Network is composed of four principle objects:

- Layers: All the learning occurs in the layers, there are three layers they are input, hidden, output.
- Feature and label: Input data to the network (features) and output from the network (labels).
- Loss function: Metric used to estimate the performance of the learning phase.
- Optimizer: Improve the learning by updating the knowledge in the network.

Layers in ANN



Input layer: The activity of the input units represents the raw information that can feed into the network.

Hidden layer: To determine the activity of each hidden unit. The activities of the input units and the weights on the connections between the input and the hidden units. There may be one are more hidden layers.

Output layer: The behavior of the output units depends on the activity of the hidden units and the weights between the hidden and the output unit

Benefits of ANN

Problems in ANN are represented by attribute value pairs. They are used for problems having the target function, the output may be discrete valued, real valued or a vector of several real or discrete valued attributes. It is used where the fast evaluation of the learned target function required. It can bear long training times depending on factors such as the number of weights in the network and the settings of various learning algorithm parameters.

Conclusion

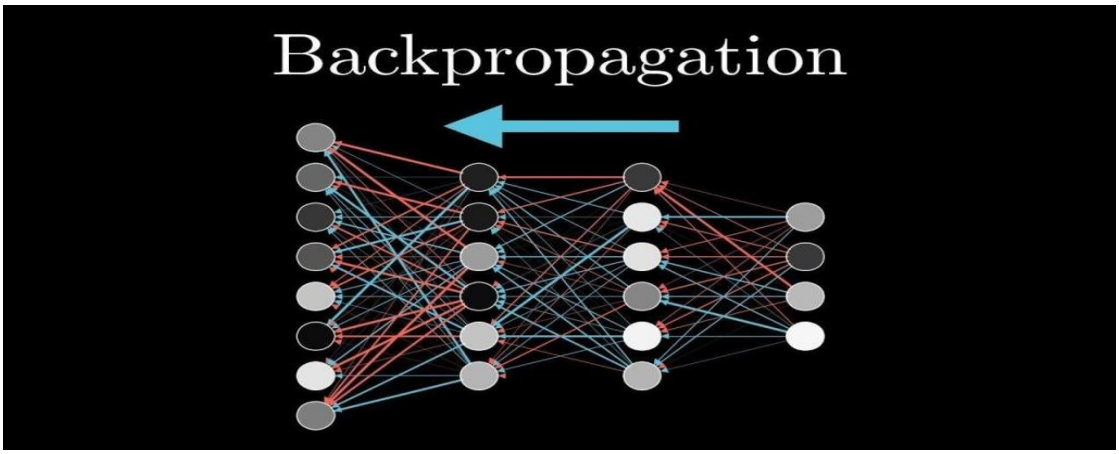
Artificial neural networks are considered as simple mathematical models to enhance existing data analysis technologies. Although it is not comparable with the power of human brain, still it is the basic building block of the artificial intelligence. ANN is used in economics, forensics and for pattern recognitions.

5. BACKPROPAGATION

Introduction

Backpropagation is the essence of neural network training. It is the method of fine-tuning the weights of a neural network based on the error rate obtained in the previous epoch (i.e., iteration). Proper tuning of the weights allows you to reduce error rates and make the model reliable by increasing its generalization. Back propagation in neural network is a short form for “backward propagation of errors.”

Backpropagation



Backpropagation is a standard method of training artificial neural networks. This method helps calculate the gradient of a loss function with respect to all the weights in the network. Backpropagation (backward propagation) is an important mathematical tool for improving the accuracy of predictions in data mining and machine learning.

The Backpropagation algorithm in neural network computes the gradient of the loss function for a single weight by the chain rule. It efficiently computes one layer at a time, unlike a native direct computation. It computes the gradient, but it does not define how the gradient is used. It generalizes the computation in the delta rule.

Types of backpropagation

There are two types of propagation networks, they are:

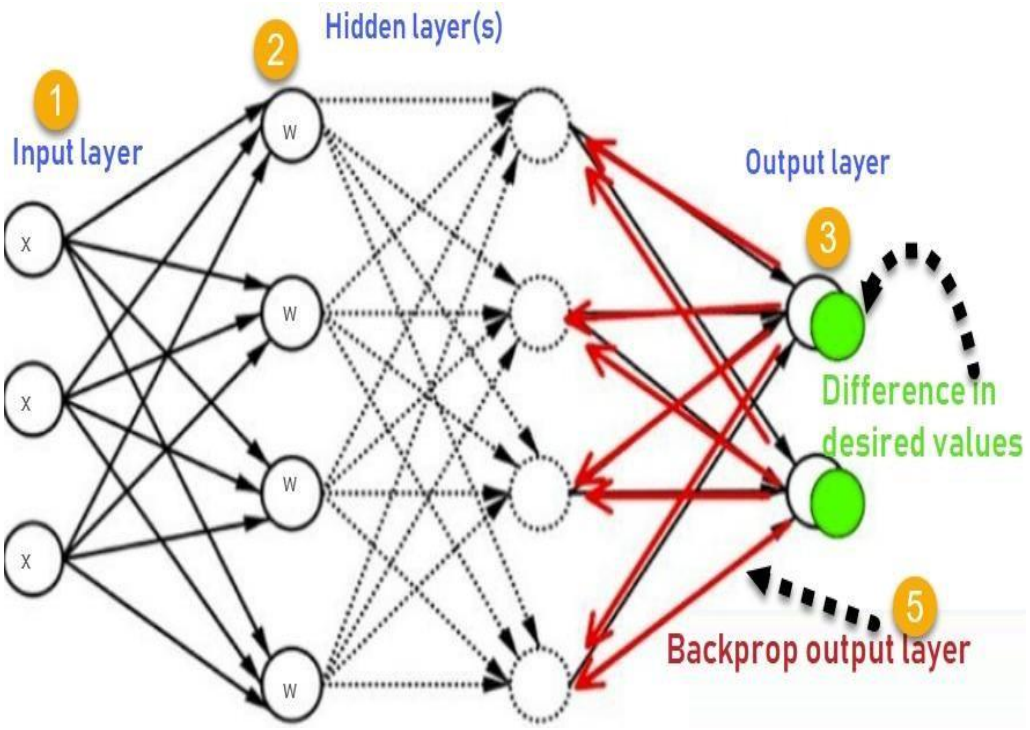
- Static Backpropagation
- Recurrent Backpropagation

Static Backpropagation

Static Backpropagation is one kind of propagation networks which produces a mapping of static input for static output. It is useful to solve static classification issue like optical character recognition.

Recurrent Backpropagation

Recurrent Backpropagation in data mining is fed forward until a fixed value is achieved. After that the error is computed and propagated backward. The main difference between both of these methods is that the mapping is rapid in Static propagation while it is non static in recurrent Backpropagation.



6. DEEP LEARNING

Introduction

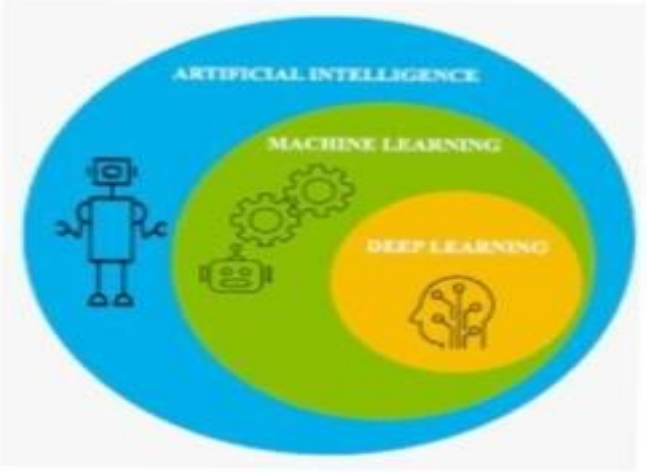
Deep learning is a type of machine learning and artificial intelligence (AI) that imitates the way humans gain certain types of knowledge. Deep learning is an important element of data science, which includes statistics and predictive modeling. It is extremely beneficial to data scientists who are tasked with collecting, analyzing and interpreting large amounts of data: deep learning makes this process faster and easier. Deep learning can be thought of as a way to automate predictive analytics.

Deep Learning Methods

Various methods can be used to create strong deep learning models. These techniques include learning rate decay. The learning rate is a Hyper parameter, a factor that defines the system or set conditions for its operation prior to the learning process that controls how much change the model experiences in response to the estimated error every time the model weights are altered. Learning rates that are too high may result in unstable training processes or the learning of a suboptimal set of weights.

Deep Learning Neural Works

Training from scratch method requires a developer to collect a large labeled data set and configure a network architecture that can learn the features and model. This technique is especially useful for new applications, as well as applications with a large number of output categories.

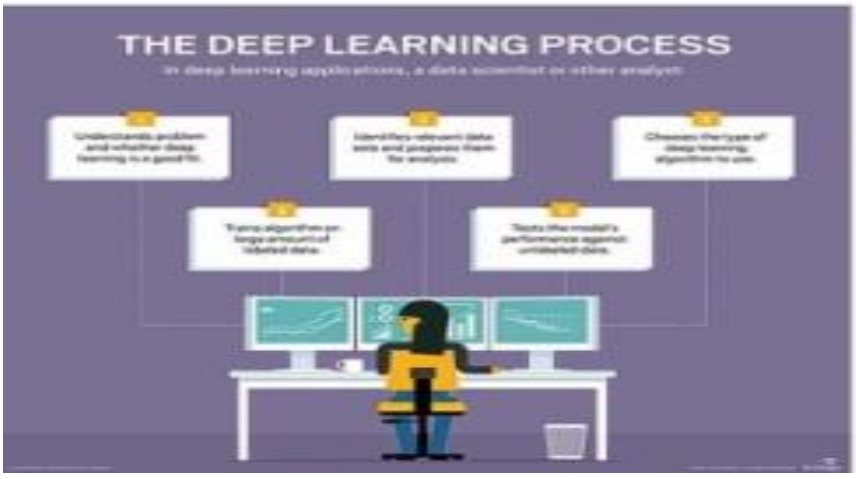


A type of advanced machine learning algorithm, known as an artificial neural network, under pins most deep learning models. As a result, deep learning may sometimes be referred to as deep neural learning or deep neural networking. Neural networks come in several different forms, including recurrent neural networks, convolution neural networks, artificial neural networks and feed forward neural networks and each has benefits for specific use cases. Neural networks involve a trial-and-error process, so they need massive amounts of data on which to train. It's no coincidence neural networks became popular only after most enterprises embraced big data analytics and accumulated large stores of data. Because the model's first few iterations involve somewhat educated guesses on the contents of an image or parts of speech, the data used during the training stage must be labeled so the model can see if its guess was accurate. This means, though many enterprises that use bigdata have large amounts of data. Unstructured data is less helpful.

Deep Learning Examples

Specific fields in which deep learning is currently being used include the following:

- Customer experience(CX) - Deep learning models are already being used for chatbots. And, as it continues to mature, deep learning is expected to be implemented in various businesses to improve CX and increase customer satisfaction.
- Text generation - Machines are being taught the grammar and style of a piece of text and are then using this model to automatically create a completely new text matching the proper spelling, grammar and style of the original text.



7. VISUAL ART PROCESSING

Processing of Visual Art

Processing is a free, open-source coding language for visual art developed by Ben Fry and Casey Reas, former classmates at the MIT Media Lab launched in 2001 as processing, the project encompasses a programming environment designed for artists' use, and a community of practitioners.

Processing is for artists, designers, visualization creators, hobbyists, or anyone else looking to create images, animation, and interactive pieces for art, education, science, or business.

Visual Art

The visual arts are art forms such as painting, drawing, printmaking, sculpture, ceramics, photography, video, filmmaking, design, crafts and architecture. Many artistic disciplines such as performing arts, conceptual art, and textile arts also involve aspects of visual arts as well as arts of other types. Also included within the visual arts are the applied arts such as industrial design, graphic design, fashion design, interior design and decorative art.

The Church at Auvers, an oil painting by Vincent van Gogh (1890). These are the arts that meet the eye and evoke an emotion through an expression of skill and imagination. They include the most ancient forms, such as painting and drawing, and the arts that were born thanks to the development of technology, like sculpture, printmaking, photography, and installation art, the latter a combination of multiple creative expressions.

"Visual Arts" is a modern but imprecise umbrella term for a broad category of art which includes a number of artistic disciplines from various sub-categories.

Types of Visual Arts

Fine Arts

All fine art belongs to the general category of visual arts. These include activities such as: Drawing, Painting, Printmaking and Sculpture, along with associated activities like Graphic art, Manuscript Illumination, Book Illustration, Calligraphy and Architecture.

Contemporary Arts

The visual arts also include a number of modern art forms, such as: Assemblage, Collage, Mixed-media, Conceptual Art, Installation, Happenings and Performance art, along with film-based disciplines such as Photography, Video Art and Animation, or any combination thereof. This group of activities also includes high tech disciplines like computer graphics and giclee prints. Another modern visual art, is the new environmental or Land art, which also includes transitory forms like ice/snow sculpture, and graffiti art.

Decorative Arts & Crafts

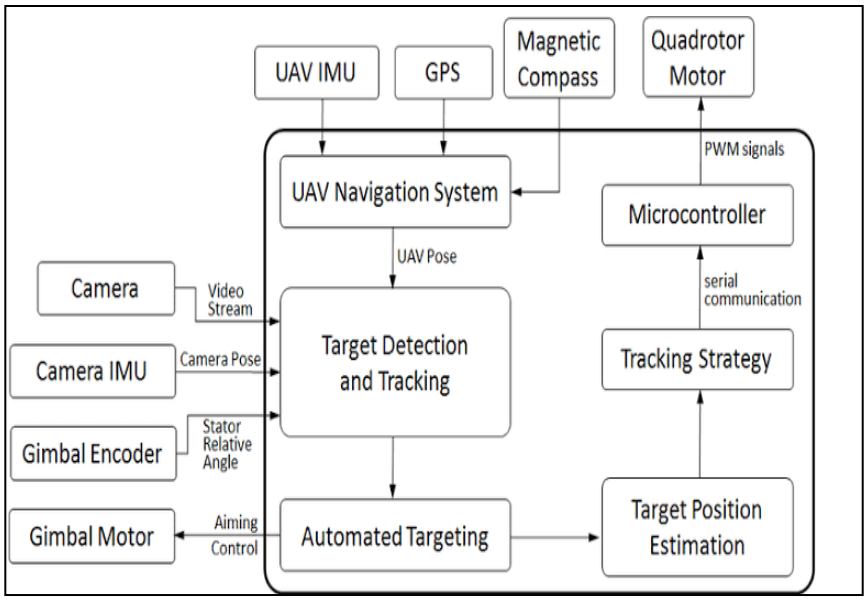
The general category of visual arts encompasses a number of decorative art disciplines and crafts, including: ceramics and studio pottery, mosaic art mobiles, tapestry, glass art (including stained glass), and others.

8. VISUAL TRACKING SYSTEM

Introduction

Visual tracking, also called object tracking, is the process that detects, extracts, identifies and locates the target in a sequence of images or a video. It is a fundamental computer vision task with a wide range of real-world applications, including traffic flow monitoring, medical diagnostic, visual surveillance and human-computer interaction. It refers to the automatic estimation of the trajectory of an arbitrary target object, usually specified by a bounding box in the first frame, as it moves around in subsequent video frames.

Methods of Visual Tracking



Visual tracking methods can be divided into two categories according to the observation model: generative method and discriminative method. The generative model to describe the apparent characteristics, and minimizes there construction error to search the object, such as PCA. Discriminative method can be used to distinguish between the object and the background, its performance is more robust, and gradually becomes the main method in tracking. Discriminative method is also referred to as Tracking-by-Detection, and deep learning belongs to this category.

Deep Learning Based Trackers

Deep learning improves the performance in computer vision by a huge margin. And in image classification, object detection, object localization, scene classification, almost all the best algorithms are based on deep learning. Although the application of deep learning in visual tracking is relatively late, many novel trackers were proposed by researchers with superior accuracy and performance than traditional un-deep-learning trackers over the past four years.

System Overview

The real-time tracking system functionality can be split into three basic phases : 1) image acquisition and camera motion estimation 2) Object motion detection and localization 3)Camera control. Data acquisition is performed by a wide-angel CCD camera mounted on a fixed pan/tilt gimbals unit. Feature matching between two successive frames is used to estimate camera motion. Moving object is detected and localized by the following sequence of operations: 1) Threshold frame difference 2) Morphological opening 3) Size filtering 4) Clustering. When the moving object is localized, commands are sent to the pan/tilt gimbals in order to perform a smooth pursuit.

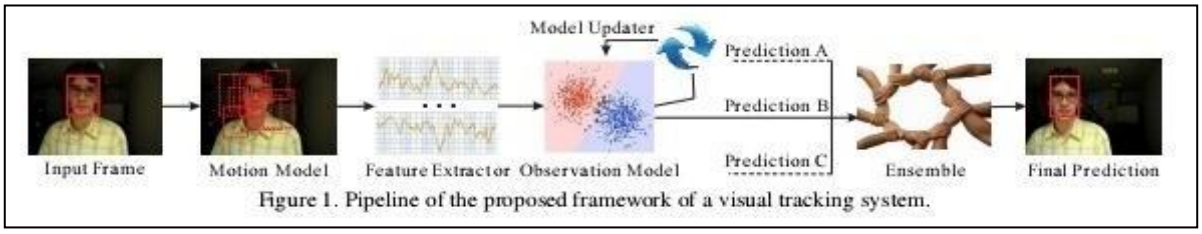


Figure 1. Pipeline of the proposed framework of a visual tracking system.

Conclusion

Visual tracking with deep learning starts late and develops slowly, it is eye-catching in terms of the accuracy and overall performance. But it is still not so performance. But it is still not so perfect, like drifting, and not real-time, etc. Many of the current important and outstanding deep learning based visual tracking algorithms have been presented and analyzed. These trackers are future extended and may provide more room for further improvement in accuracy and performance.

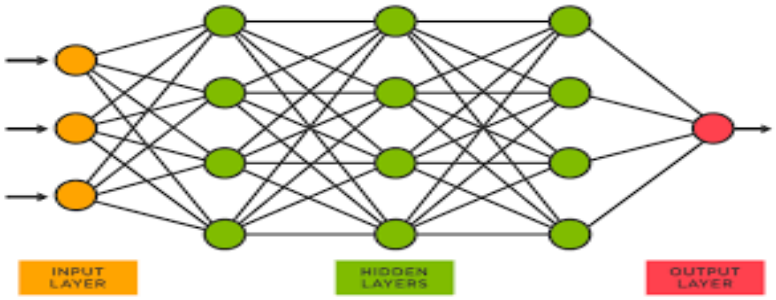
9. DIGIT RECOGNITION SYSTEM

Introduction

Scientists believe that the most intelligent device is the Human Brain. There is no computer which can beat the level of efficiency of human. These brain inefficiencies of the computer has lead to evolution of "Artificial Neural Network". They differ from conventional systems in the sense that rather than being programmed these systems learn to recognize pattern.

Neural Network

Artificial neural networks, usually called neural networks (NNS), are interconnected systems composed of many simple processing elements(neurons) operating in parallel whose function is determined by network structure, connection strengths, the Processing performed at computing elements or nodes.



Training Dataset

Training of the network is done by a dataset named MNIST dataset. MNIST dataset has a training set of 60,000 examples, and a test set 10,000 examples. All the images in the dataset are 28x28 pixels.

Convolutions

Convolutions is a simple mathematical operation between two matrices in which one is multiplied to the other elements wise and sum of all these multiplications is calculated. Convolutions are performed for various reasons. Convolutions provide better feature extractions. They a lot of computation compared to ANNs. Less numbers of parameters are created than those in pure

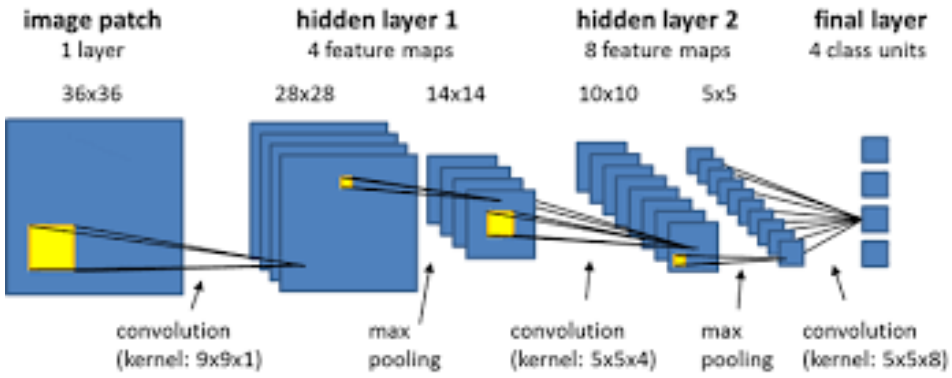
fully connected layers. Due to less number of required parameters, lesser fully connected layers are needed.

Pre-processing of images

Pre processing of images is done using a python library called OpenCV. It has certain functions which can be implemented to make necessary changes in the image before passing them to network. Gauusian Blur is a function for smoothening a image. In Adaptive - Threshold, the algorithm calculate thresholds for a small region of images. So we get different thresholds for different regions of the same image and it gives us better results for images with varying illumination. Dilation is done to make the digits bigger. Dilation is very useful in cases where digits have holes as noises in them. Erosion is done to make the digits smaller or thinner. This reduces the noise as thin noises get vanished after erosion.

Segmentation

Segmentation of the images is done by the concept contours in OpenCV. Contours can be explained as simply curve joining all the continuous points, having same colour or intensity. The contours are a useful tool for shape analysis and object detection and recognition.



Conclusion

The handwritten digit recognition using convolution neural network has proved to be of fairly good efficiency. It works better than any other algorithm, including artificial neural networks.

10. WAVEGLOW

Introduction

As voice interactions with machines become increasingly useful, efficiently synthesizing high quality speech becomes increasingly important. Small changes in voice quality or latency have large impacts on customer experience and customer preferences. However, high quality, real-time speech synthesis remains a challenging task. Speech synthesis requires generating very high dimensional samples with strong long term dependencies.

WaveGlow

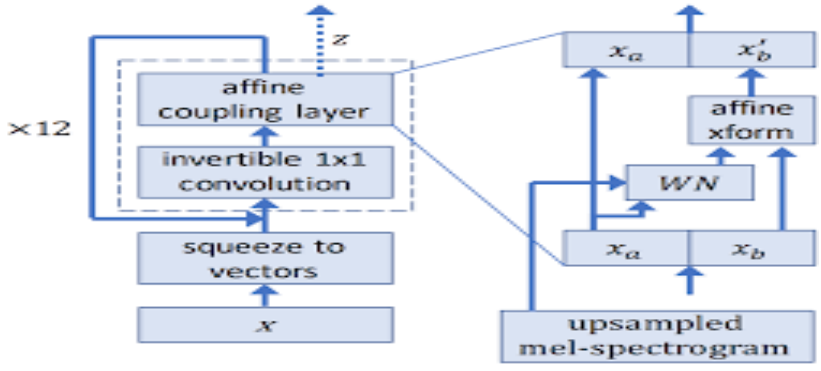
WaveGlow is a flow-based model that consumes the mel spectrograms to generate speech. WaveGlow is a flow-based generative model that generates audio by sampling from a distribution. Specifically samples are taken from a zero mean spherical Gaussian with the same number of dimensions as our desired output, and those samples are put through a series of layers that transforms the simple distribution to one which has the desired distribution.

Mel-spectrograms

Mel spectrogram is a spectrogram that is converted to a Mel scale. A spectrogram is a visualization of the frequency spectrum of a signal, where the frequency spectrum of a signal is the frequency range that is contained by the signal.

Affine Coupling Layer

Invertible neural networks are typically constructed using coupling layers. In our case, we use an affine coupling layer. Half of the channels serve as inputs, which then produce multiplicative and additive terms that are used to scale and translate the remaining channels:



Early outputs

Rather than having all channels go through all the layers, we found it useful to output 2 of the channels to the loss function after every 4 coupling layers. After going through all the layers of the network, the final vectors are concatenated with all of the previously output channels to make the final z. Outputting some dimensions early makes it easier for the network to add information at multiple time scales, and helps gradients propagate to earlier layers, much like skip connections.

Inference

Once the network is trained, doing inference is simply a matter of randomly sampling z values from a Gaussian and running them through the network.

Experiments

We use the mel spectrogram of the original audio as the input to the WaveNet and WaveGlow networks. For WaveGlow, we use mel spectrograms with 80 bins using librosamel filter defaults, i.e. each bin is normalized by the filter length and the scale is the same as HTK. The parameters of the mel spectrograms are FFT size 1024, hop size 256, and window size 1024.

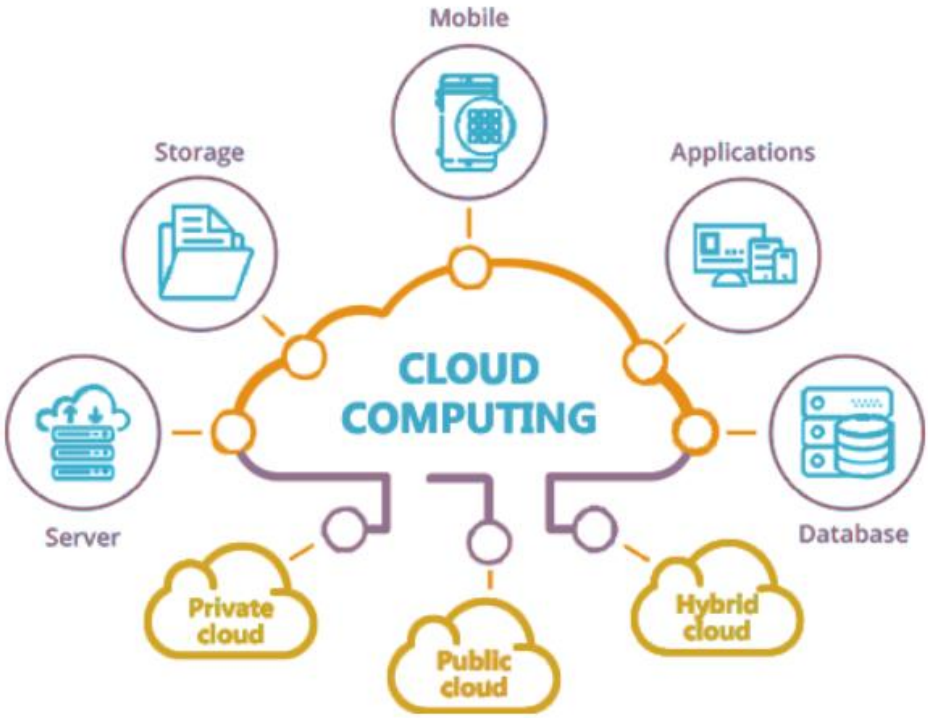
Speed of inference comparison

Our implementation of Griffin-Lim can synthesize speech at 507 kHz for 60 iterations of the algorithm. Note that GriffinLim requires the full spectrogram rather than the reduced mel spectrogram like the other vocoders in this comparison. The inference implementation of the WaveNet we compare against synthesizes speech at 0.11 kHz, significantly slower than the real time.

11. CLOUD COMPUTING

Introduction

Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each location being a data center. Cloud computing relies on sharing of resources to achieve coherence and economies of scale, typically using a "pay-as-you-go" model which can help in reducing capital expenses but may also lead to unexpected operating expenses for unaware users.

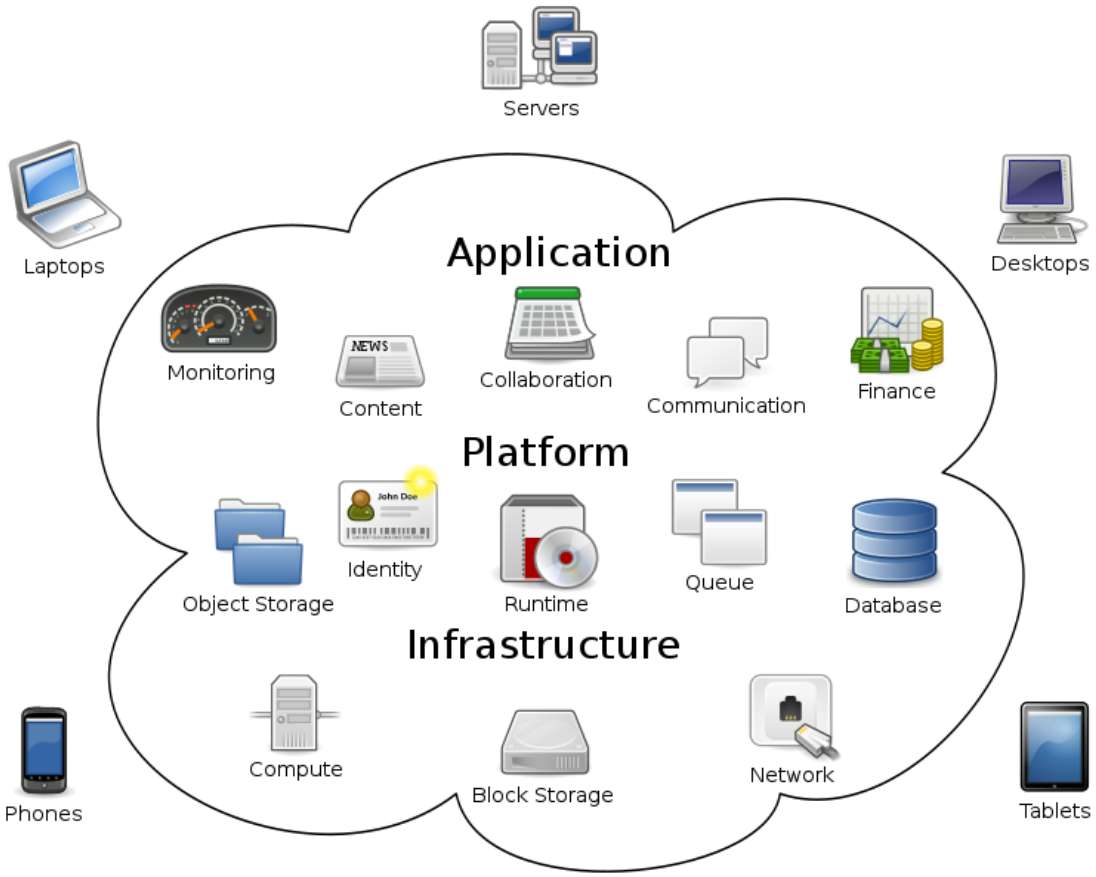


Value Preposition

Advocates of public and hybrid clouds note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and that it enables IT, teams, to more rapidly adjust resources to meet fluctuating and unpredictable demand, providing the burst computing capability: high computing power at certain periods of peak demand.

Cloud Architecture

The systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over a loose coupling mechanism such as a messaging queue. Elastic provision implies intelligence in the use of tight or loose coupling as applied to mechanisms such as these and others.



Cloud Engineering

Cloud engineering is the application of engineering disciplines of cloud computing. It brings a systematic approach to the high-level concerns of commercialization, standardization and governance in conceiving, developing, operating and maintaining cloud computing systems. It is a multidisciplinary method encompassing contributions from diverse areas such as systems, software, web, performance, information technology, engineering, security, platform, risk, and quality engineering.

12. CLOUD CRYPTOGRAPHY

Introduction

Cloud Cryptography is an encryption that protects data stored within the cloud. In return, it allows those who have the cryptographic keys to access the server with ease and safety. The whole idea behind this measure is authentication.

Types of Cloud Cryptography

- Secret Key Cryptography.
- Public Key Cryptography.
- Hash Functions.

Secret or Symmetric Cryptography

In symmetric cryptography a secret key (or "private key") is a piece of information or a framework that is used to decrypt and encrypt messages.

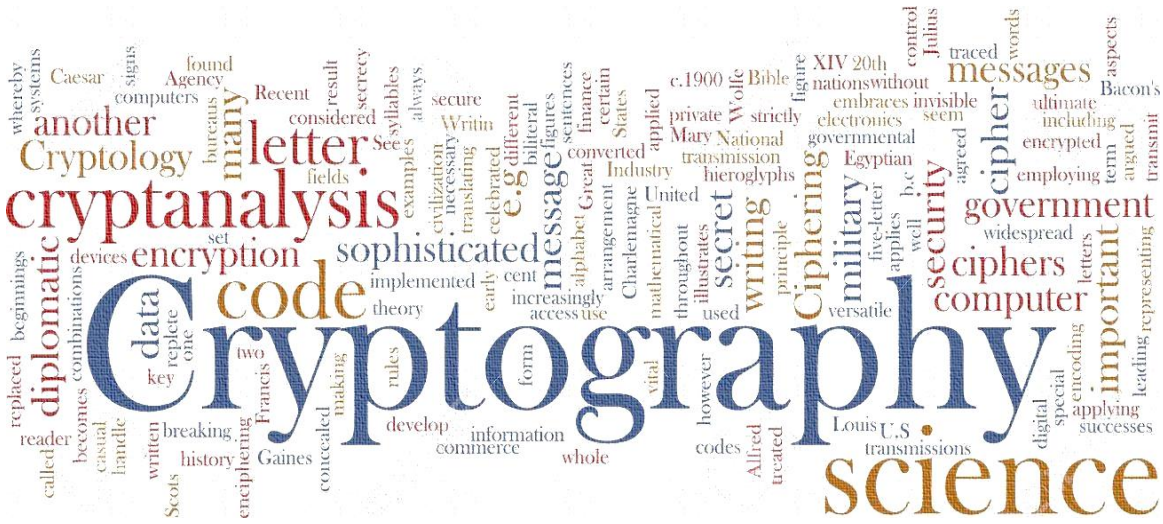
Each party to a conversation that is intended to be private possesses a common secret key. Using the key one party sends the other a message transformed from its original (plaintext) into its encrypted form (ciphertext) and the other party reverses this process to reveal the original, and the process repeats.

Public or Asymmetric Cryptography

Public-key cryptography, or asymmetric cryptography, is a cryptographic system that uses pairs of keys. Each pair consists of a public key (which may be known to others) and a private key (which may not be known by anyone except the owner). The generation of such key pairs depends on cryptographic algorithms which are based on mathematical problems termed one-way functions.

Hash Functions

Hashing is using a special cryptographic function to transform one set of data into another of fixed length by using a mathematical process with passwords, anytime you create an account that requires a password, the password is run through a hash function and then stored in the digest.



Advantages of Cloud Cryptography

- The data remains private for the users. This reduces cybercrime from hackers.
- The encryption prevents the data from being vulnerable when the data is being brought over from one computer to another,
- Organization receives notifications immediately if an unauthorized person tries to make modifications. The users who have cryptographic keys are granted access.
- Receivers of the data have the ability to identify if the data received is corrupted, permitting an immediate response and solution to the attack.

13. GREEN CLOUD COMPUTING

Introduction

'Green Cloud Computing', the word green with cloud computing denotes that this is environment-friendly. The concept is to reduce energy consumption and reduce the waste disposed to the environment. Green Cloud is "the study and practice of designing, manufacturing, using and disposing of computers, servers and associated subsystems. Key issues are energy efficiency in computing and promoting environmentally friendly computer technologies. The cloud computing concept has made work possible without having a physical server. The IT industry was used in campuses to connect servers in the server rooms. Cloud computing completely eradicated physical servers from organizations and gave the flexibility to work remotely.

Objectives of Green Cloud Computing

- To minimize the use of hazardous IT/computing products.
- To make the computing process more eco-friendly.
- To make the computing process energy efficiency.
- Reducing travel requirements.
- Recycling of computing wastage product.
- Purchasing and using green energy.
- Save money due to reduced utility cost.
- Reducing the use of papers.
- Designing good algorithms for better computer's efficiency.

Approaches to Green Cloud Computing

- Green Use – Reducing the power usage of computers and its periphery subsystems and using them in an eco-friendly manner. Also adopting virtualization reducing the need of energy.
- Green Disposal – Recycling and reusing existing equipment, properly disposing the wasted IT/computing materials, electronic equipment etc.
- Green Design – Designing energy efficient as well as effective systems which have a minimal impact on the green environment.

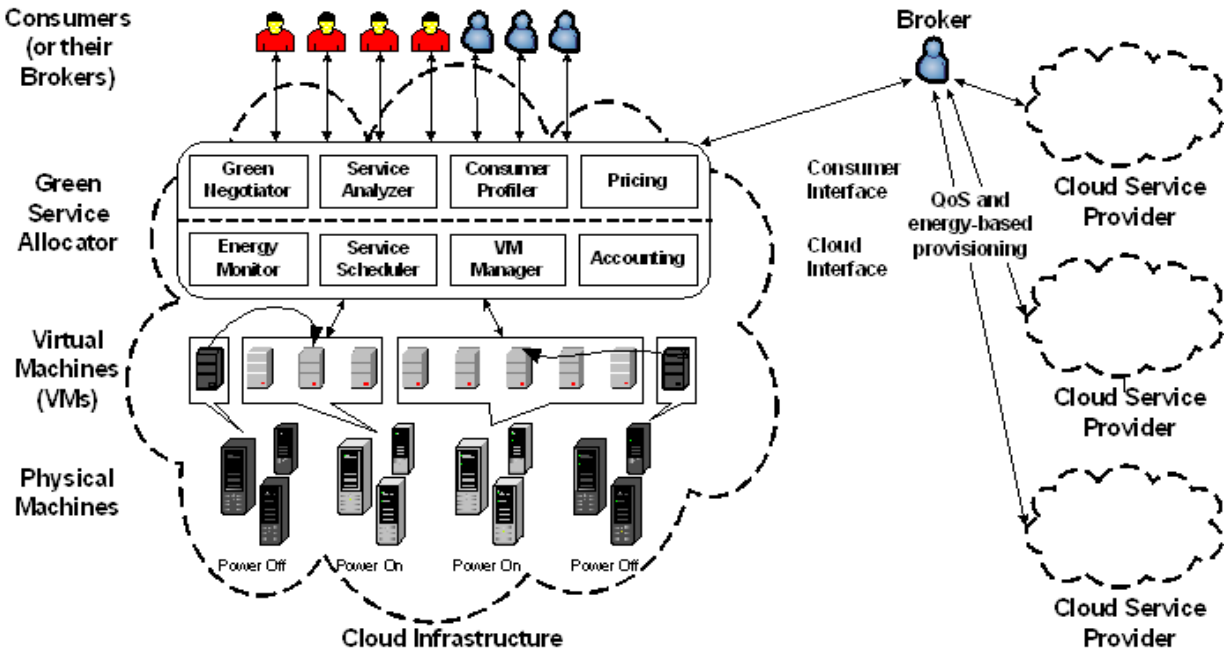
- Green manufacturing – Manufacturing Biodegradable materials, also manufacturing long usable, recyclable products and reducing wastage during manufacturing process.

Advantages of Green Cloud Computing

- Conserving energy by Green Cloud Computing.
- Remote working reduces the Carbon Footprint in the environment.
- Going Paperless with Green Computing and Cloud Computing.
- Reduction in E-waste generation.

Disadvantages of Green Cloud Computing

- Implementation Cost is High.
- Green Computers may be considered Underpowered.



Applications in Green Cloud Computing

- Management of energy in Data Centers.
- Green Wireless Network.
- Green Parallel Computing with Big Data Network.
- Green computing with an algorithm.

14. EDGE COMPUTING

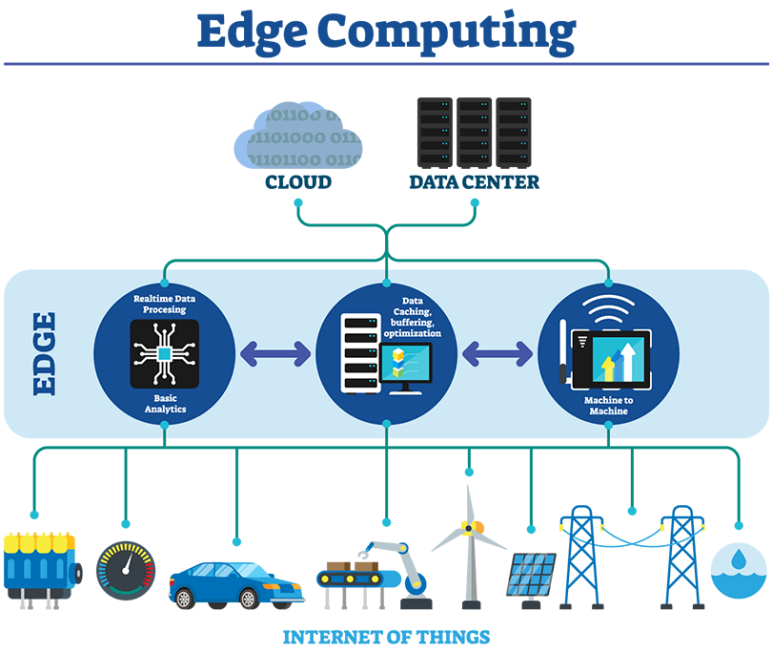
Definition

Edge computing is a distributed computing paradigm that brings computation and data storage closer to the sources of data. This is expected to improve response times and save bandwidth. "A common misconception is that edge and Internet of Things are synonymous. Edge Computing is a topology- and location-sensitive form of distributed computing, while Internet of Things is a use case instantiation of edge computing."

Privacy and Security

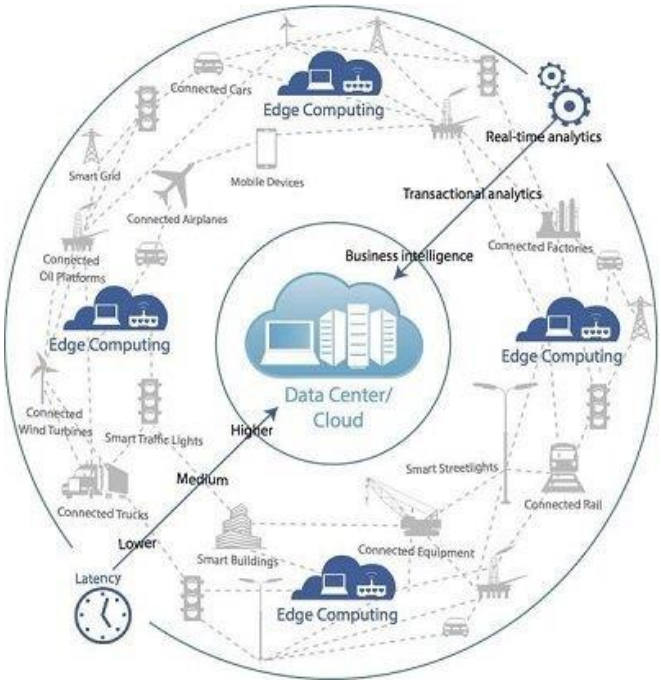
The distributed nature of this paradigm introduces a shift in security schemes used in cloud computing. In edge computing, data may travel between different distributed nodes connected through the Internet and thus requires special encryption mechanisms independent of the cloud. Edge nodes may also be resource-constrained devices, limiting the choice in terms of security methods.

A shift from centralized top-down infrastructure to a decentralized trust model is required. By keeping and processing data at the edge, it is possible to increase privacy by minimizing the transmission of sensitive information to the cloud. The ownership of collected data shifts from service providers to end-users.



Speed

Edge computing brings analytical computational resources close to the end users and therefore can increase the responsiveness and throughput of applications. A well-designed edge platform would significantly outperform a traditional cloud-based system. Some applications rely on short response times, making edge computing a significantly more feasible option than cloud computing.



Applications

- Edge application services reduce the volumes of data that must be moved, the consequent traffic, and the distance that data must travel.
- It provides lower latency and reduces transmission costs. Computation offloading for real-time applications, such as facial recognition algorithms, showed considerable improvements in response times.
- Resource-rich machines called cloudlets near mobile users, which offer services typically found in the cloud, provided improvements in execution time when some of the tasks are offloaded to the edge node.
- Another use of the architecture is cloud gaming, where some aspects of a game could run in the cloud, while the rendered video is transferred to lightweight clients running on devices such as mobile phones, VR glasses, etc. This type of streaming is also known as pixel streaming.

15. CLOUD SECURITY

Definition

Cloud Security is the protection of data stored online via cloud computing platforms from theft, leakage, and deletion. Methods of providing cloud security include firewalls, penetration testing, obfuscation, tokenization, virtual private networks (VPN), and avoiding public internet connections. Cloud Security is a form of cyber security.

Cloud Security Controls

Cloud Security architecture is effective only if the correct defensive implementations are in place. An efficient cloud security architecture should recognize the issues that will arise with security management. The security management addresses these issues with security controls. While there are many types of controls behind cloud security architecture, they can usually be found in one of the following categories:

- Deterrent controls
- Preventive controls
- Detective controls
- Corrective controls

Dimensions of Cloud Security

It is generally recommended that information security controls be selected and implemented according and in proportion to the risks, typically by assessing the threats, vulnerabilities and impacts. Cloud Access Security Brokers (CASBs) are software that sits between cloud users and cloud applications to provide visibility into cloud application usage, data protection and governance to monitor all activity and enforce security policies.

Data Security

There are numerous security threats associated with cloud data services. This includes traditional threats and non-traditional threats. Traditional security threats include the ones in which military is the referent object. While Non-traditional security threats include other domains of security like economy, politics, human rights, trade etc.

Security and Privacy

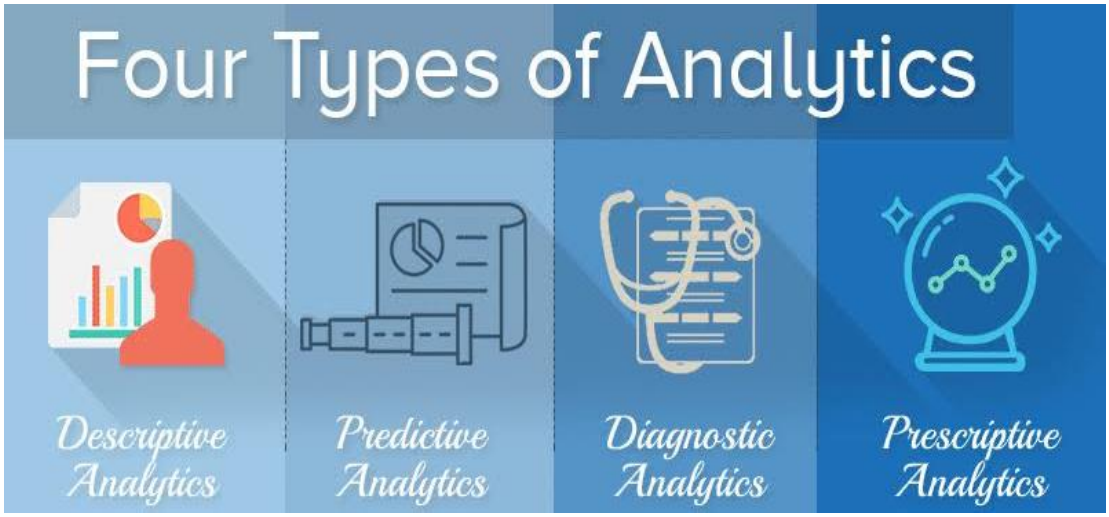
Cloud security consists of a set of policies, controls, procedures and technologies that work together to protect cloud-based systems, data, and infrastructure. These security measures are configured to protect cloud data, support regulatory compliance and protect customers' privacy as well as setting authentication rules for individual users and devices.

16. DATA ANALYTICS

Data Analytics is the science of analyzing raw data to make conclusions about that information. Many of the techniques and processes of data analytics have been automated into mechanical processes and algorithms that work over raw data for human consumption. Data analytics is important because it helps businesses optimize their performances. Implementing it into the business model means companies can help reduce costs by identifying more efficient ways of doing business and by storing large amounts of data. A company can also use data analytics to make better business decisions and help analyze customer trends and satisfaction.

Data Analysis Steps

- The first step is to determine the data requirements or how the data is grouped. Data may be separated by age, demographic, income, or gender. Data values may be numerical or be divided by category.
- The second step in data analytics is the process of collecting it. This can be done through a variety of sources such as computers, online sources, cameras, environmental sources, or through personnel.
- Once the data is collected, it must be organized so it can be analyzed. This may take place on a spreadsheet or other form of software that can take statistical data.
- The data is then cleaned up before analysis. This means it is scrubbed and checked to ensure there is no duplication or error, and that it is not incomplete. This step helps correct any errors before it goes on to a data analyst to be analyzed.



Types of Data Analytics

Data analytics is broken down into four basic types.

- Descriptive analytics: This describes what has happened over a given period of time. Have the number of views gone up? Are sales stronger this month than last?
- Diagnostic analytics: This focuses more on why something happened. This involves more diverse data inputs and a bit of hypothesizing. Did the weather affect beer sales? Did that latest marketing campaign impact sales?
- Predictive analytics: This moves to what is likely going to happen in the near term. What happened to sales the last time we had a hot summer? How many weather models predict a hot summer this year?
- Prescriptive analytics: This suggests a course of action. If the likelihood of a hot summer is measured as an average of these five weather models is above 58%, we should add an evening shift to the brewery and rent an additional tank to increase output.

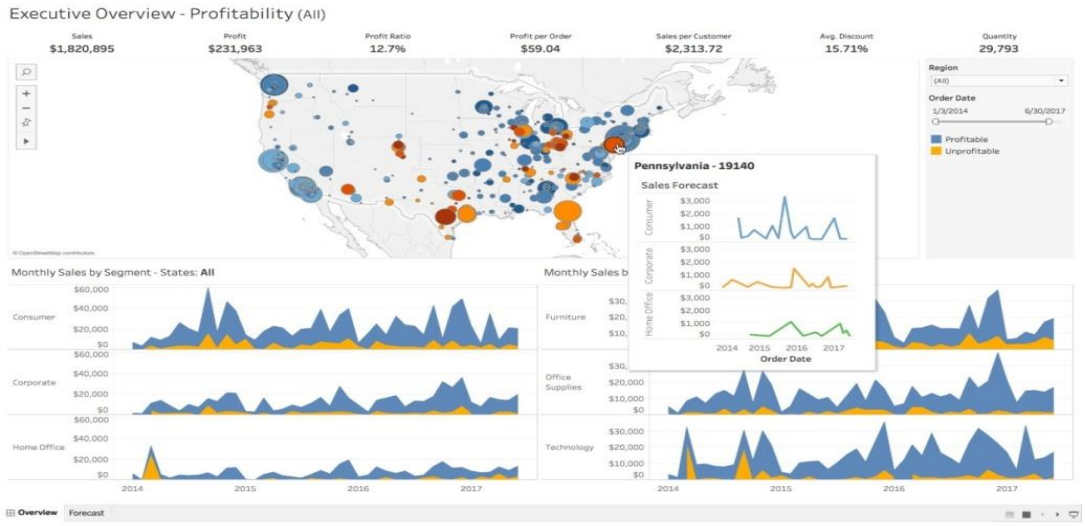
Who Is Using Data Analytics?

Data analytics has been adopted by several sectors, such as the travel and hospitality industry, where turnarounds can be quick. Healthcare is another sector that combines the use of high volumes of structured and unstructured data and data analytics can help in making quick decisions.

17. TABLEAU

Tableau is the rapidly growing visualization tool used for different business applications. It is high in demand software due to its easy access to use. It is widely used in Business Intelligence (BI) processes. Tableau is crafted in such a way that all kinds of charts, plots, and graphs with different designs can be positioned simultaneously for visualization.

If we talk about the data type and structure and their access in tableau, it can work on any kind of data type either data is structured, unstructured datasets with the accessing of any sort of programming language as R, Python, SAS, etc.



A person with a non-technical background can easily work on Tableau as it doesn't require any technical or programming knowledge. Researchers described Tableau as a "highly interactive and intuitive visual-based exploration experience for business users to easily access, prepare and analyze their data without the need for coding".

Tableau has plenty of easily accessible functions that can create highly simplified graphs or charts for any set of complex data. A business analyst can investigate any pattern, insight, flow, or trends from visually available data and hence predict or conclude for any business problem.

Working of Tableau

- Tableau can extract data from a database like pdf, excel, text documents, R, Hadoop, Python, or SAS to cloud databases like Flipkart, Google sheet, Netflix, Amazon.

- The data is dragged off to the data engine of Tableau, also called the Tableau desktop. Here, the business analyst works on data, generates a dashboard, and shares it with the user, where the user reads this on the screen called Tableau Reader.
- Data is published with various supported features like collaboration, models of security, automation, distribution, etc.
- In the end, the user will be able to download a visualized data file on emails, desktop, or mobile. (Understand the basics and types of Data Visualization in Business Analytics).

Pros of Tableau

- RemarkableVisualization Capabilities
- Ease of use
- High performance
- Multiple data source connections
- Thriving community and forum
- Mobile Friendliness

Cons of Tableau

- High cost
- Inflexible pricing
- Poor after-sales support
- Security issues
- Poor BI capabilities
- Poor versioning
- Embedment issues

18. QLIK SENSE

Introduction

Qlik Sense is part of the Qlik Active Intelligence Platform powered by Qlik Cloud. Qlik Sense uses AI to help users to understand and use data more effectively, minimizing cognitive bias, amplifying discovery, and elevating data literacy. The difference between Qlik's two main products: QlikView and Qlik Sense are

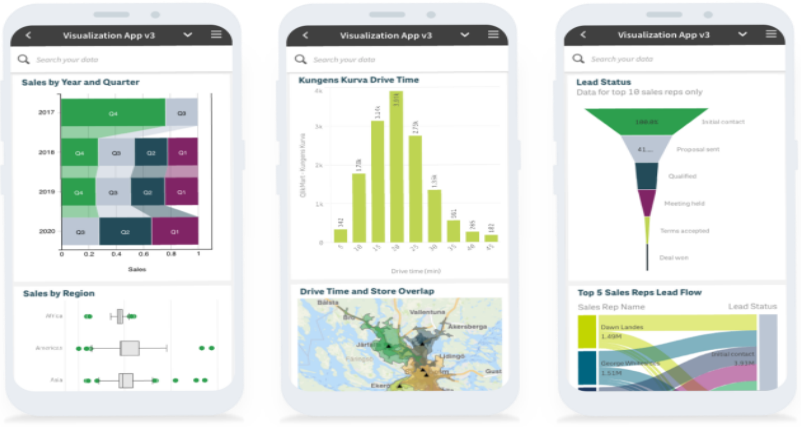
- QlikView set the benchmark for smart data visualisation that looks great
- Qlik Sense is an intuitive self-service data visualisation and discovery application.

Qlik Sense

Qlik Sense Desktop is a Windows application that allows users to create visualizations, charts, interactive dashboards and analytics apps for local and offline usage. Qlik Sense is a self-service data discovery tool for creating your own visualisations and applications. Qlik Sense is available on Qlik cloud, a cloud platform for the enterprise and beyond, supporting organizations of all sizes with unmatched performance. Qlik Sense's build and use approach makes it easy for you to create visualisations to extend the analytical capabilities and add extra value.

Benefits of Qlik Sense

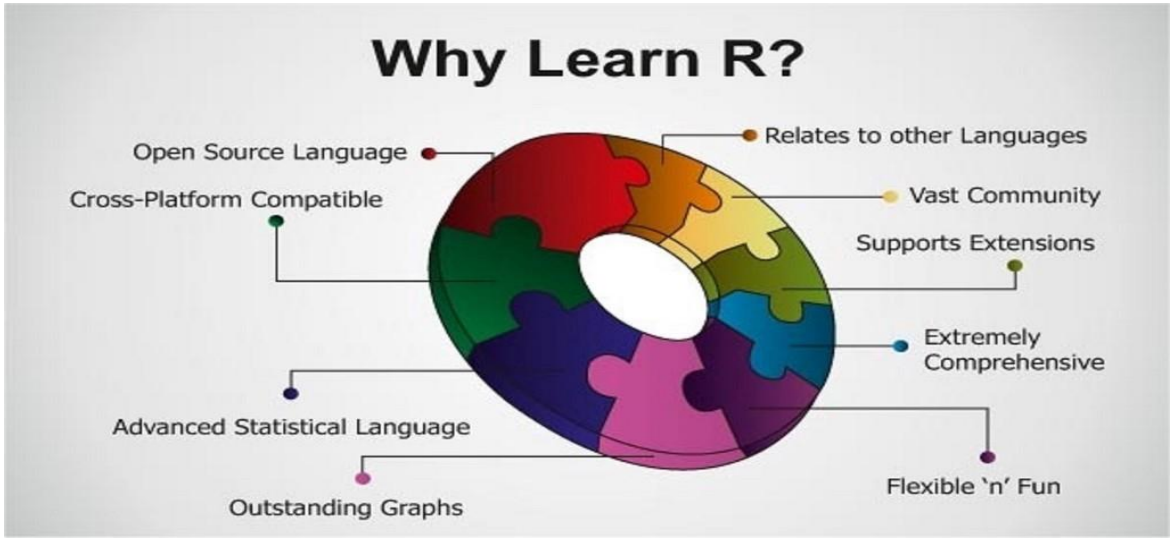
- Data integration and linking is made easy due to the associative model.
- It provides a suitable platform for the enterprise ecosystem.
- Smart analytics as there are options for system guided analytics like the Insight Advisor. Also geographical and advanced calculations can be applied to the data to give data new contexts and analyzing it from a different point of views.
- Qlik Sense is compatible with all sorts of devices like desktop, tablets, laptops, mobile phones. This makes creating and analyzing the applications much more eased up.
- The centralized hub acts as a platform for collaboration and sharing information, data, reports, applications with other users.
- For an individual as well as team users, the self-service creation is very beneficial especially for non-technical users in creating apps, spreadsheets, visualizations and BI solutions with the help of machine-guided analytics.
- Custom application development is possible by the virtue of embedded analytics having open standard APIs and development tools.
- The software provides flexible and robust security provisions.
- The multi-cloud architecture has made this software one of the best as it leads to efficient functioning in the areas like data security, scalability, processing ensuring optimum performance of the tool



19. R LANGUAGE

R is a programming language and software environment for statistical analysis, graphics representation and reporting. R was created by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, and is currently developed by the R Development Core Team.

The core of R is an interpreted computer language which allows branching and looping as well as modular programming using functions. R allows integration with the procedures written in the C, C++, .Net, Python or FORTRAN languages for efficiency.

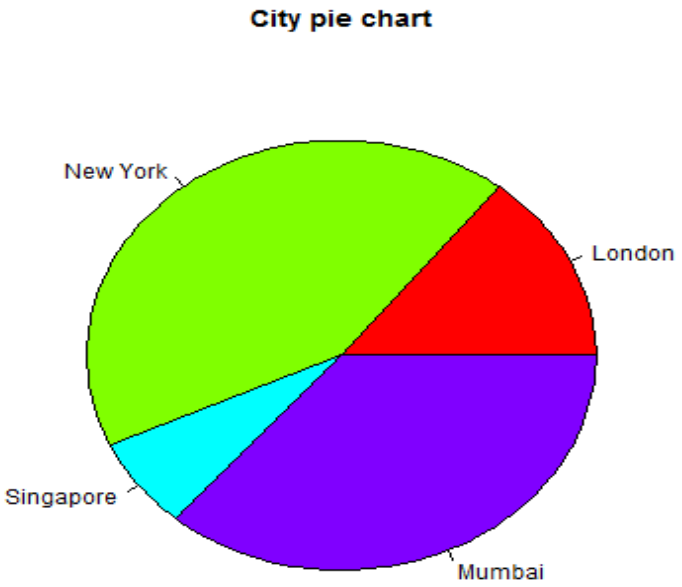


R is freely available under the GNU General Public License, and pre-compiled binary versions are provided for various operating systems like Linux, Windows and Mac.R is free software distributed under a GNU-style copy left, and an official part of the GNU project called **GNU S**.

Evolution of R

R made its first appearance in 1993.

- A large group of individuals has contributed to R by sending code and bug reports.
- Since mid-1997 there has been a core group (the "R Core Team") who can modify the R source code archive.



Features of R

R is a programming language and software environment for statistical analysis, graphics representation and reporting. The following are the important features of R language,

- R is a well-developed, simple and effective programming language which includes conditionals, loops; user defined recursive functions and input and output facilities.
- R has an effective data handling and storage facility,
- R provides a suite of operators for calculations on arrays, lists, vectors and matrices.
- R provides a large, coherent and integrated collection of tools for data analysis.
- R provides graphical facilities for data analysis and display either directly at the computer or printing at the papers.

R is world's most widely used statistics programming language. It's the # 1 choice of data scientists and supported by a vibrant and talented community of contributors. R is taught in universities and deployed in mission critical business applications.

20. HADOOP

Hadoop is an open-source software framework developed by the Apache Software Foundation. It uses programming models to process large data sets. Hadoop is written in Java, and it's built on Hadoop clusters. It provides a software framework for distributed storage and processing of big data using the Map Reduce programming model.

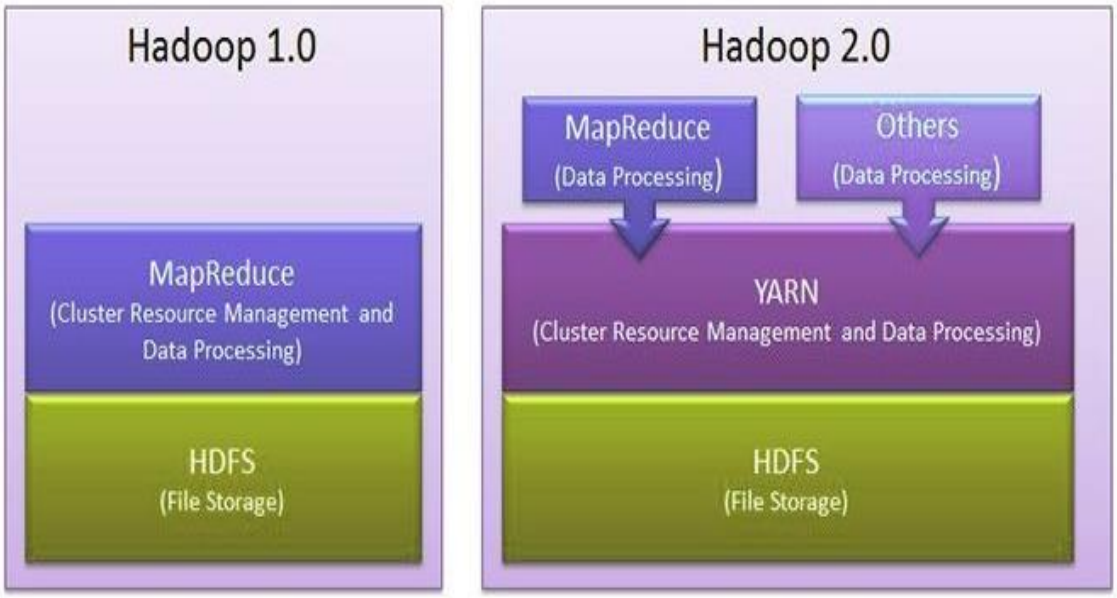
The core of Apache Hadoop consists of a storage part, known as Hadoop Distributed File System (HDFS), and a processing part which is a Map Reduce programming mode. Hadoop splits files into large blocks and distributes them across nodes in a cluster. It then transfers packaged code into nodes to process the data in parallel.

This approach takes advantage of data locality, where nodes manipulate the data they have access to. This allows the dataset to be processed faster and more efficiently than it would be in a more conventional supercomputer architecture that relies on a parallel file system where computation and data are distributed via high-speed networking.

Modules of Apache Hadoop Framework

- Hadoop Common – contains libraries and utilities needed by other Hadoop modules.

- Hadoop Distributed File System (HDFS) – a distributed file-system that stores data on commodity machines, providing very high aggregate bandwidth across the cluster.
- Hadoop YARN – (Introduced in 2012) a platform responsible for managing computing resources in clusters and using them for scheduling users' applications.
- Hadoop Map Reduce – an implementation of the Map Reduce programming model for large-scale data processing.
- Hadoop Ozone – (Introduced in 2020) An object store for Hadoop.

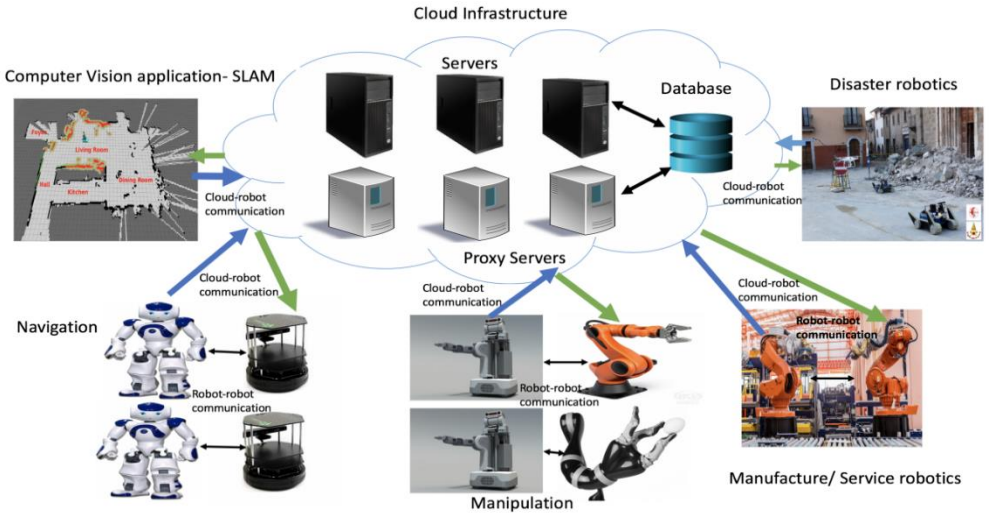


Difference between Hadoop 1 and Hadoop 2

The biggest difference between Hadoop 1 and Hadoop 2 is the addition of YARN (Yet another Resource Negotiator), which replaced the Map Reduce engine in the first version of Hadoop. YARN strives to allocate resources to various applications effectively. It runs two demons, which take care of two different tasks: the resource manager, which does job tracking and resource allocation to applications, the application master, which monitors progress of the execution.

21. CLOUD ROBOTICS

Cloud robotics is a field of robotics that attempts to invoke cloud technologies such as cloud computing, cloud storage, and other Internet technologies centred on the benefits of converged infrastructure and shared services for robotics. Humans can also delegate tasks to robots remotely through networks. Cloud computing technologies enable robot systems to be endowed with powerful capability whilst reducing costs through cloud technologies.



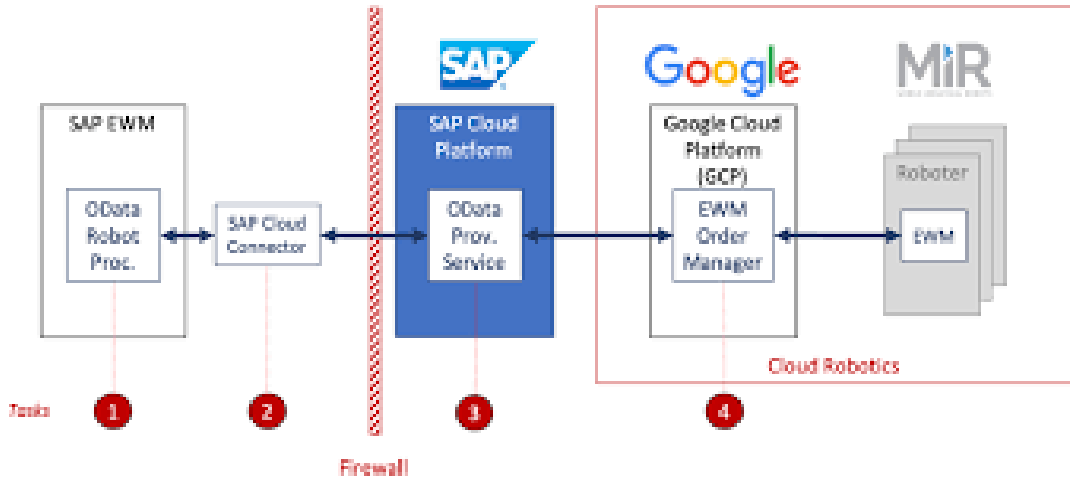
Cloud-based is a term that refers to applications, services or resources made available to users on demand via the Internet from a cloud computing provider's servers.

Robot developers are no longer limited by the amount of processing power and software they can cram on board their robots. One of the primary advantages of cloud robotics is the extra computing power it provides for expanded robot capabilities.

Applications

- Autonomous mobile robots- Google's self-driving cars are cloud robots. It combines with streaming data from GPS, cameras, and 3D sensors to monitor.

- Cloud medical robots – A medical cloud (also called a healthcare cluster) consists of various services such as a disease archive, electronic medical records, a patient health management system.



- Assistive robots - A domestic robot can be employed for healthcare and life monitoring for elderly people.
- Industrial robots - As highlighted by the German government's Industry 4.0 Plan, "Industry is on the threshold of the fourth industrial revolution.

Risks in Cloud Robotics

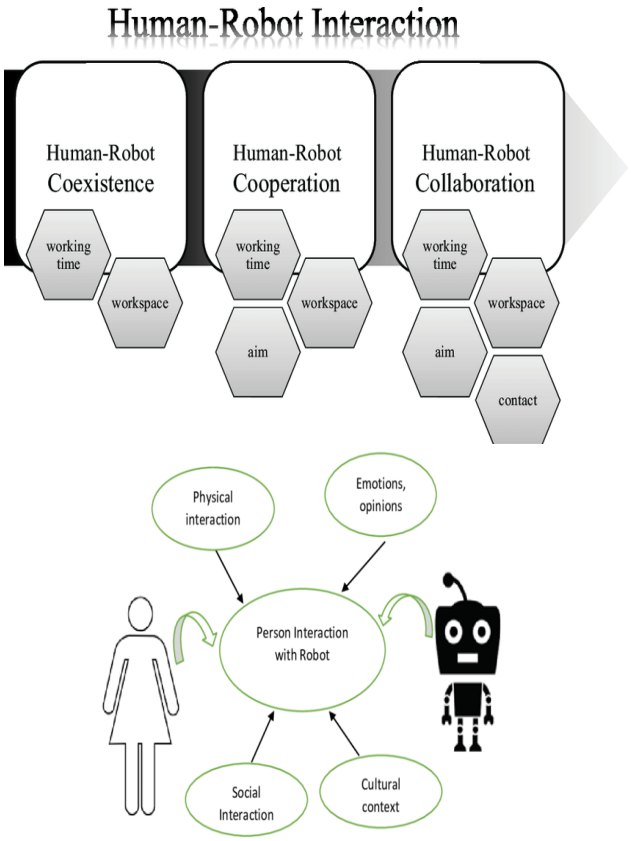
- Environmental security - The concentration of computing resources and users in a cloud computing environment also represents a concentration of security threats.
- Data privacy and security and Ethical problems - Hosting confidential data with cloud service providers involves the transfer of a considerable amount of an organisation's control.

Cloud Robotics Initiatives

- The DAvinCi Project showed the advantages of cloud computing by parallelizing a SLAM algorithm using a Hadoop cluster.
- Rosbridge focuses on bridging communication between a robot and single ROS environment in the cloud. Available open-source via ROS.org.
- The Cloud-Based Robot Grasping project uses Google's Object Recognition Engine to recognize and grasp common household objects.

22. HUMAN-ROBOT INTERACTION

Human-Robot Interaction (HRI) is a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans. Communication between a human and a robot may take several forms, but these forms are largely influenced by whether the human and the robot are in close proximity to each other or not.



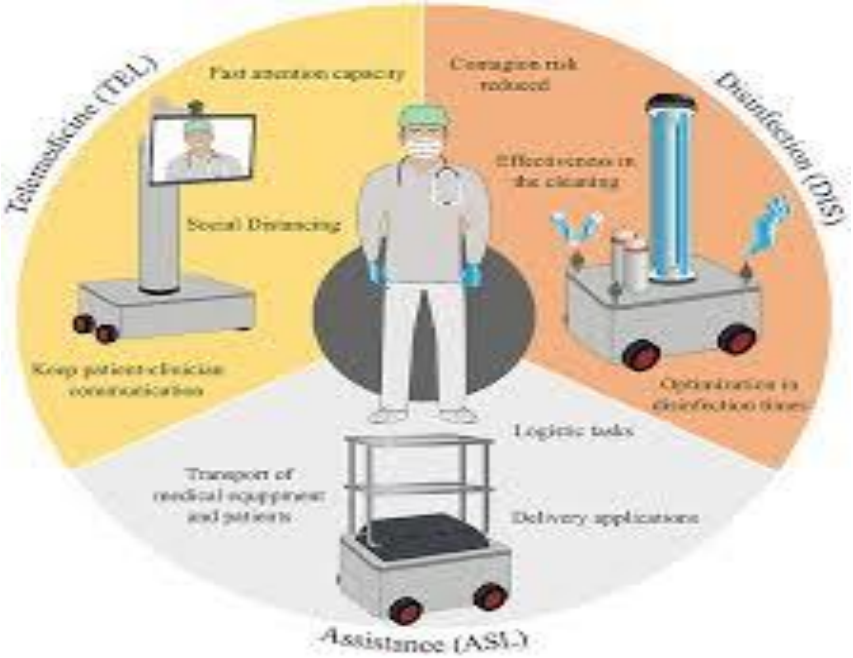
Components

The components of a robot are the body/frame, control system, manipulators, and drive train. Body/frame: The body or frame can be of any shape and size.

Application

Human-robot interaction (HRI) applications could be industrial, medical, agricultural, servical, and educational. HRI can be found in industrial applications in picking and placing in the production lines, welding processes, parts assembly, and painting. Assistive robotics is one from the highest profile areas in HRI. For people with the physical and the mental challenges, the robots can provide the opportunity of interaction and therapy. In addition, HRI can be widely applied in hospitals. HRI is very important for facing the new (COVID-19) pandemic. In agriculture, the cooperation between human and the robot

helps with many tasks including harvesting, seeding, fertilizing, spraying, weed detection and hauling.



Risks

There are seven sources of hazards that are associated with human interaction with robots and machines. They are human errors, control errors, unauthorized access, mechanical failures, environmental sources, power systems, and improper installation.

23. VISION-BASED ROBOT CONTROL

Visual Serving is known as Vision-Based robot control and abbreviated VS, is a technique which uses feedback information extracted from a vision sensor (visual feedback) to control the motion of a robot. Visual servoing is the method of controlling a robot's motion using real-time feedback from vision sensors to execute tasks. The robot is instructed to move in order to align its current task progress metrics with the desired task metrics and gradually reduce the error between the two.

Visual Servoing control techniques are broadly classified into the following types:

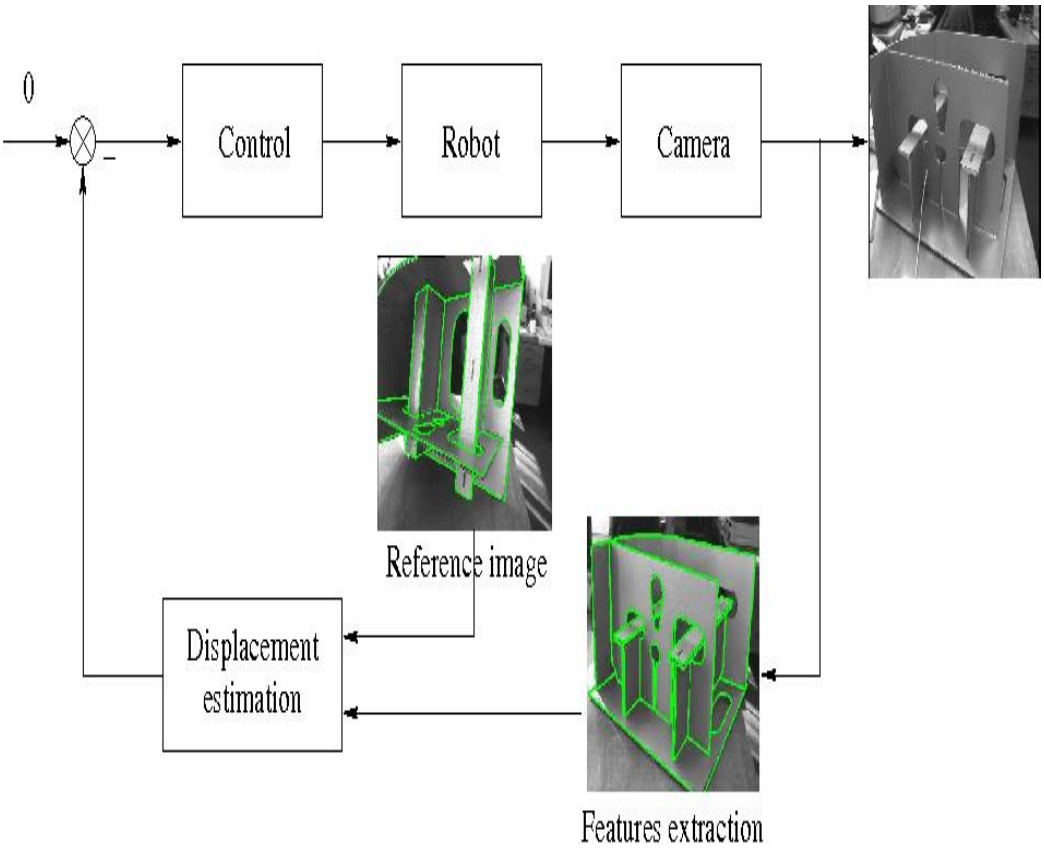
- Image-based (IBVS)
- Position/pose-based (PBVS)
- Hybrid approach

IBVS was proposed by Weiss and Sanderson. The control law is based on the error between current and desired features on the image plane, and does not involve any estimate of the pose of the target.

IBVS has difficulties with motions very large rotations, which has come to be called camera retreat.

Hybrid approaches use some combination of the 2D and 3D servoing. There have been a few different approaches to hybrid servoing

- 2-1/2-D Servoing
- Motion partition-based
- Partitioned DOF Based



Advantages

- Automates manual steps and processes
- One camera can replace multiple sensors
- Speeds production and increases throughput
- Greatly reduces programming effort to guide robot
- Increases flexibility of the robot
- Recipe-driven production reduces changeover times
- Allows for less precise positioning of parts
- Less expensive and more precise robots can be used
- Eliminates expensive fixtures
- Allows a robot to perform multiple tasks

24. MOBILE CONTROLLED ROBOT

Mobile Control Robot – Cell phone operated Land rover. It is one of the simple robotics projects using micro controller. In the Cell phone Robot project, we need two mobile phones. The "mobile controlled robot" is controlled by a mobile phone that makes a call to another mobile phone attached to the robot. This tone is called "Dual Tone Multiple-Frequency" (DTMF) tone. The robot perceives this DTMF tone with the help of the phone stacked on the robot. The received tone is processed by the micro controller with the help of a decoder IC.

The micro controller then transmits the signal to the motor driver ICs to operate the motors. Since this robot is controlled by dialling a call so we can also call it as DTMF controlled robot.

Construction

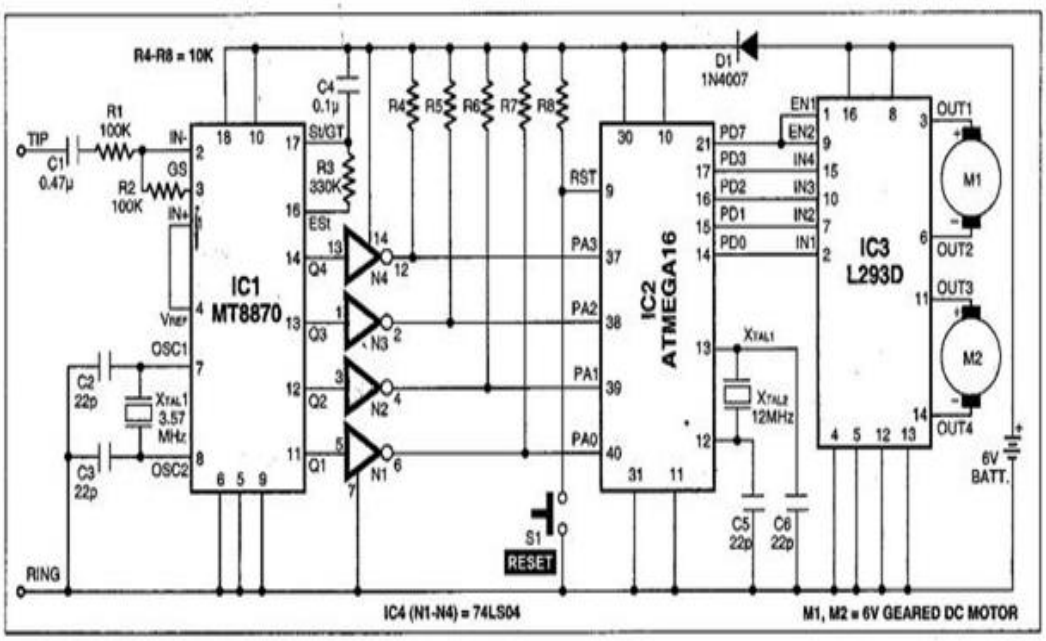
Hardware Required

- 12V, 1A DC Adapter-1 piece
- DTMF Decoder-1 piece
- AVR Micro controller Board-1 piece
- DC Motor Driver-1 piece
- AVR USB Programmer-1 piece
- Ear Phone with Connector-1 piece
- 1 to 1 Connector-15 piece
- 10 to 10 FRC Female Connector-3 piece
- Robot-1 piece

Software Required

- BASCOM-AVR Integrated Development Environment (IDE)
- AVRDUDE-GUI
- WinAVR-2010
- USBasp Driver

Circuit Diagram



Applications and Advantages

- "Cell phone-controlled robot "can be used in the borders for disposing hidden land mines.
- The robot can be used for reconnaissance or surveillance.
- The robot can be used anywhere there is the service provider tower of the connection provided that is mounted on the robot.
- The robot is small so can be used for spying.

25. INDUSTRIAL ROBOT

Industrial robots

An industrial robot is a robot system used for manufacturing .Industrial robots are automated, programmable and capable of movement on three or more axes. Typical applications of robots include welding, painting, assembly, disassembly, pick and place for printed circuit boards, packaging and labeling, palletizing, product inspection, and testing; all accomplished with high endurance, speed, and precision. They can assist in material handling.

Articulated robots

Articulated robots are the most common industrial robots. They look like a human arm, which is why they are also called robotic arm or manipulator arm. Articulations with several degrees of freedom allow the articulated arms a wide range of movements.

Cartesian coordinate robots

Cartesian robots, also called rectilinear, gantry robots, and x-y-z robots have three prismatic joints for the movement of the tool and three rotary joints for its orientation in space. To be able to move and orient the effect or organ in all directions, such a robot needs 6 axes (or degrees of freedom).In a 2-dimensional environment, three axes are sufficient, two for displacement and one for orientation.

Cylindrical coordinate robots

The cylindrical coordinate robots are characterized by their rotary joint at the base and at least one prismatic joint connecting its links. They can move vertically and horizontally by sliding.

Spherical coordinate robots

Spherical coordinate robots only have rotary joints. They are one of the first robots to have been used in industrial applications .They are commonly used for machine tending indie-casting, plastic injection and extrusion ,and for welding.

SCARA robots

SCARA is an acronym for Selective Compliance Assembly Robot Arm. SCARA robots are recognized by their two parallel joints which provide movement in the X-Y plane. Rotating shafts are positioned vertically at the effectors. SCARA robots are used for jobs that require precise lateral movements. They are ideal for assembly applications.

Delta robots

Delta robots are also referred to as parallel link robots. They consist of parallel links connected to a common base. Delta robots are particularly useful for direct control tasks and high maneuvering operations (such as quick pick-and place tasks). Delta robot stake advantage of four bar or parallelogram link age systems.

Serial manipulators

Serial manipulators are the most common industrial robots and they are designed as a series of links connected by motor-actuated joints that extend from a base to an end effecter. SCARA, Stanford manipulators are typical example soft his category.

Parallel architecture

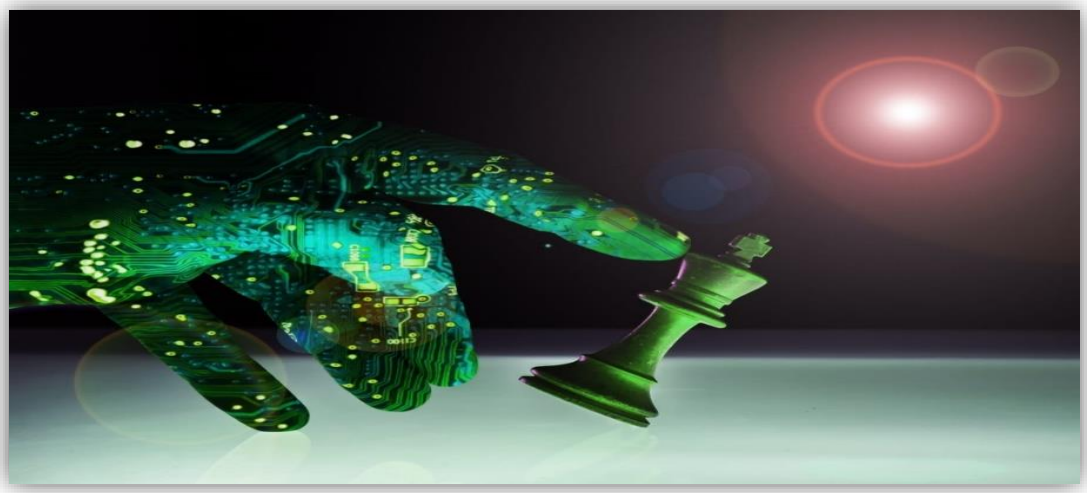
A parallel manipulator is designed so that each chain is usually short, simple and can thus be rigid against unwanted movement, compared to a serial manipulator.

26. ARTIFICIAL NARROW INTELLIGENCE

Introduction

Artificial Narrow Intelligence (ANI or narrow AI) refers to a computer's ability to perform a single task extremely well, such as crawling a webpage or playing chess.Artificial general intelligence (AGI) is when a computer program can perform any intellectual task that a human could.

Benefits of Using ANI



- Chatbots make use of ANI to effectively and accurately answer repetitive queries without getting frustrated and bored as people would. That makes it easier for customers to get the answers they want in real-time.
- An organization’s success also relies on employee productivity. And since ANI systems can process data quicker than humans, they can be crucial in improving productivity and efficiency.ANI applications can be programmed to crawl web pages and databases to come up with results within seconds. An example would be assistants like Siri. When you ask it where the nearest bank is in your area, it will crawl the Web and come up with a list. Again, ANI systems can do more than that.
- They can be programmed to provide you with the same list but give more relevant information by stating exactly how far each location is from where the user is at, what modes of transportation are available, and even a map.ANI systems are able to process data and complete tasks at a significantly quicker pace than any human being can, which has enabled us to improve our overall productivity, efficiency and quality of life.

Different Types of Narrow AI

Narrow AI has two possibilities, either it can be reactive or can have a limited amount of memory.

Reactive AI: It is the basic version, having no memory or data storage capabilities. It emulates the human mind's behavior and responds to different interpretations without any prior experience.

Limited Memory AI: It is more advanced, having great memory and data storage capabilities enabling machines to interpret precisely using statistical data. Most of the AI is the Limited Memory AI, enabling machines to use a large amount of data especially in the domains of Deep Learning to give results with utmost accuracy.

Types of AI

- Limited Memory — Artificial Narrow Intelligence (ANI)
- Reactive Machines — Artificial Super Intelligence (ASI)
- Theory of Mind — Artificial General Intelligence (AGI)
- Self-Aware

27. VIRTUAL REALITY

Virtual Reality (VR) is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality include entertainment (e.g. video games), education (e.g. medical or military training) and business (e.g. virtual meetings). Other distinct types of VR-style technology include augmented reality and mixed reality, sometimes referred to as extended reality or XR.

History

The exact origins of virtual reality are disputed, partly because of how difficult it has been to formulate a definition for the concept of an alternative existence. The development of perspective in Renaissance Europe created convincing depictions of spaces that did not exist, in what has been referred to as the "multiplying of artificial worlds. Other elements of virtual reality appeared as early as the 1860s. Antonin Artaud took the view that illusion was not distinct from reality, advocating that spectators at a play should suspend disbelief and regard the drama on stage as reality. The first references to the more modern concept of virtual reality came from science fiction.

Etymology

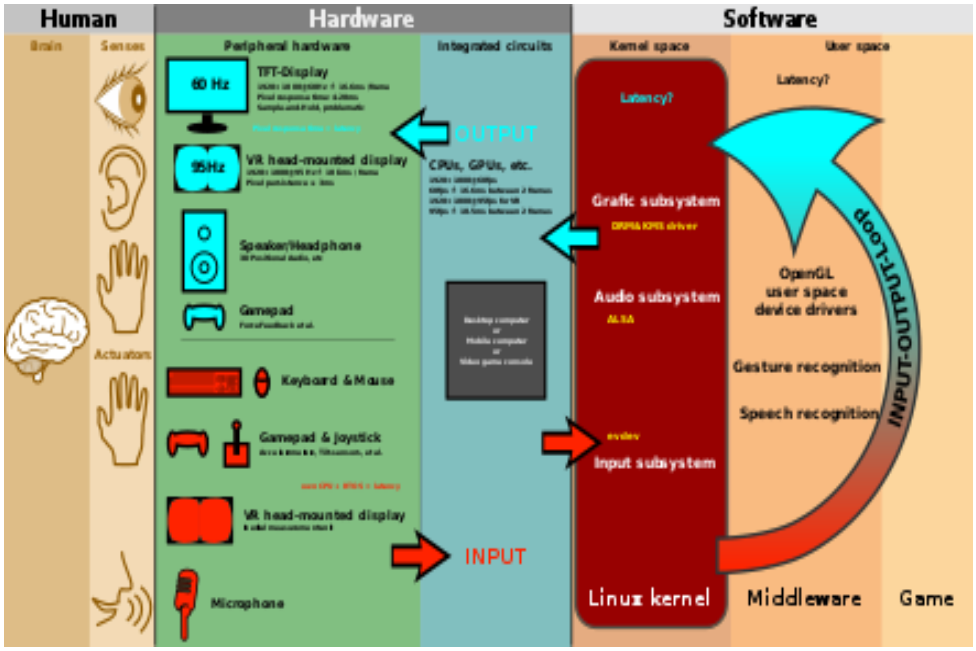
Virtual" has had the meaning of "being something in essence or effect, though not actually or in fact" since the mid-1400s. The term "virtual" has been used in the computer sense of "not physically existing but made to appear by software" since 1959.In 1938, French avant-garde playwright Antonin Artaud described the

illusory nature of characters and objects in the theatre as "la reality virtually" in a collection of essays, Le Theatre et son double.

Software

The Virtual Reality Modelling Language (VRML), first introduced in 1994, was intended for the development of "virtual worlds" without dependency on headsets.[58] The Web3D consortium was subsequently founded in 1997 for the development of industry standards for web-based 3D graphics. The consortiums subsequently developed X3D from the VRML framework as an archival, open-source standard for web-based distribution of VR content. WebVR is an experimental JavaScript application programming interface (API) that provides support for various virtual reality devices, such as the HTC Vive, Oculus Rift, Google Cardboard or OSVR, in a web browser

Hardware



Modern virtual reality headset displays are based on technology developed for Smartphone's including: gyroscopes and motion sensors for tracking head, body, and hand positions; small HD screens for stereoscopic displays; and small, lightweight and fast computer processors. These components led to relative affordability for independent VR developers, and lead to the 2012 Oculus Rift Kick starter offering the first independently developed VR headset.

28. AUGMENTED REALITY

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment).This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment.

Hardware

Hardware components for augmented reality are: a processor, display, sensors and input devices. Modern mobile computing devices like smart phones and tablet computers contain these elements, which often include a camera and micro electro mechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid state compass, making them suitable AR platforms. There are two technologies used in augmented reality: diffractive waveguides and reflective waveguides.

Projection mapping

Projection mapping augments real-world objects and scenes, without the use of special displays such as monitors, head-mounted displays or hand-held devices. Projection mapping makes use of digital projectors to display graphical information onto physical objects. The key difference in projection mapping is that the display is separated from the users of the system.

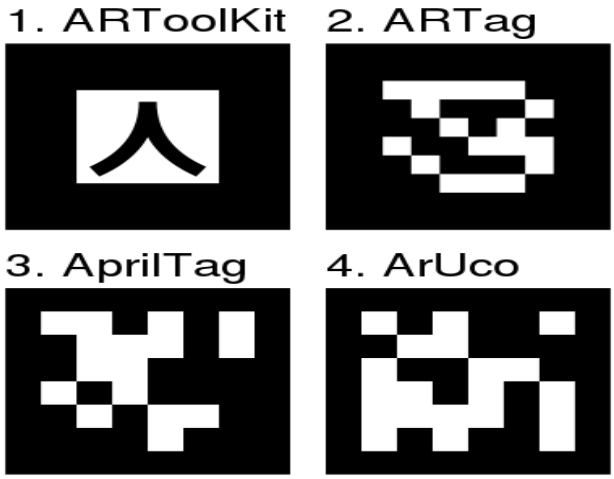
Tracking

Modern mobile augmented-reality systems use one or more of the following motion tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, Radio-Frequency Identification (RFID). These technologies offer varying levels of accuracy and precision. The most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.

Networking

Mobile augmented reality applications are gaining popularity because of the wide adoption of mobile and especially wearable devices. However, they often rely on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is often desired. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there are a plethora of real-time multimedia transport protocols, there is a need for support from network infrastructure as well.

Software and algorithms



A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent of camera, and camera images. That process is called image registration, and uses different methods of computer vision, mostly related to video tracking. Inherited from visual odometry.

29. ARTIFICIAL GENERAL INTELLIGENCE

Artificial General Intelligence (AGI) is the hypothetical ability of an intelligent agent to understand or learn any intellectual task that a human being can. It is a primary goal of some artificial intelligence research and a common topic in science fiction and futures studies. AGI can also be referred to as strong AI full AI or general intelligent action although academic sources reserve the term "strong AI" for computer programs that experience sentience or consciousness. In contrast to strong AI, weak AI or "narrow AI" is not intended to have general cognitive abilities; rather, weak AI is any program that is designed to solve exactly one problem.

Intelligent traits

However, there is wide agreement among artificial intelligence researchers that intelligence is required to do the following reason, use strategy, solve puzzles, and make judgments under uncertainty; represent knowledge, including commonsense knowledge; plan; learn; communicate in natural language; and integrate all these skills towards common goals. Other important capabilities include the ability to sense (e.g. see) and the ability to act (e.g. move and manipulate objects) in this world where intelligent behaviour is to be observed. This would include an ability to detect and respond to hazard. Many interdisciplinary approaches to intelligence (e.g. cognitive science, computational intelligence and decision making) tend to emphasise the need to consider additional traits such as imagination (taken as the ability to form mental images and concepts that were not programmed in) and autonomy.

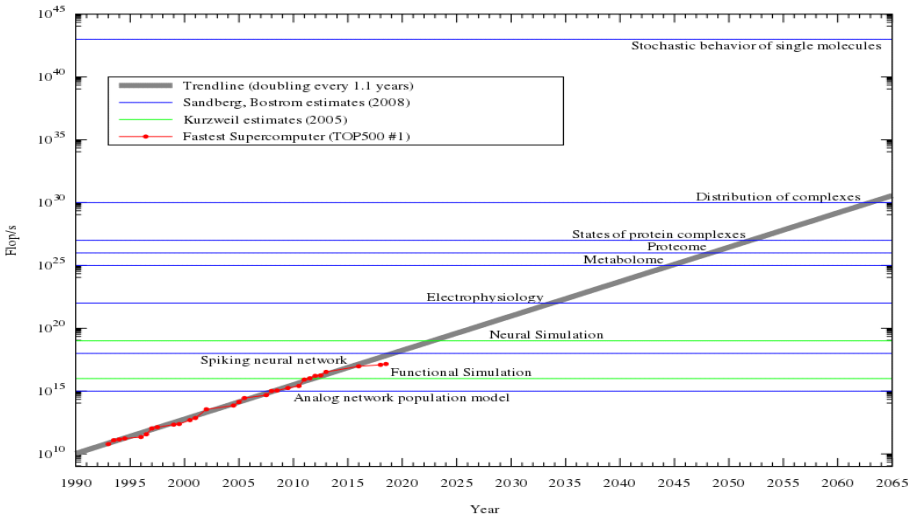
AI-complete problems

There are many individual problems that may require general intelligence, if machines are to solve the problems as well as people do. For example, even specific straightforward tasks, like machine translation, require that a machine

read and write in both languages (NLP), follow the author's argument (reason), know what is being talked about (knowledge), and faithfully reproduce the author's original intent (social intelligence). All of these problems need to be solved simultaneously in order to reach human-level machine performance.

Early estimates

Estimates of how much processing power is needed to emulate a human brain at various levels (from Ray Kurzweil, and Anders Sandberg and Nick Bostrom), along with the fastest supercomputer from TOP500 mapped by year. Note the logarithmic scale and exponential trend line, which assumes the computational capacity doubles every 1.1 years. Kurzweil believes that mind uploading will be possible at neural simulation, while the Sandberg, Bostrom report is less certain about where consciousness arises.



Current research

There are some research projects that are investigating brain simulation using more sophisticated neural models, implemented on conventional computing architectures. The Artificial Intelligence System project implemented non-real time simulations of a "brain" (with 1011 neurons) in 2005. It took 50 days on a cluster of 27 processors to simulate 1 second of a model. The Blue Brain project used one of the fastest supercomputer architectures in the world, IBM's Blue Gene platform, to create a real time simulation of a single rat neocortical column consisting of approximately 10,000 neurons and 108 synapses in 2006.

30. ARTIFICIAL SUPER INTELLIGENCE

Artificial Super Intelligence (ASI) is the hypothetical Al, i.e., we have not been able to achieve it but we know what will happen if we achieve it. So basically, it is the imaginary Al which not only interprets or understands human-behavior and intelligence, but ASI is where machines will become self-aware/self-vigilant enough to surpass the capacity of human intelligence and behavioral ability. With Super intelligence, machines can think of the possible abstractions/interpretations which are simply impossible for humans to think. This is because the human brain has a limit to the thinking ability which is constrained to some billion neurons.

Feasibility of artificial superintelligence

If research into strong Al produced sufficiently intelligent software, it would be able to reprogram and improve itself - a feature called "recursive self-improvement". It would then be even better at improving itself, and could continue doing so in a rapidly increasing cycle, leading to a super intelligence. This scenario is known as an intelligence explosion. Such intelligence would not have the limitations of human intellect, and may be able to invent or discover almost anything. Computer components already greatly surpass human performance in speed. Thus, the simplest example of a super intelligence may be an emulated human mind run on much faster hardware than the brain. A human - like reasoned that could think millions of times faster than current humans would have a dominant advantage in most reasoning tasks, particularly ones that require haste or long strings of actions.

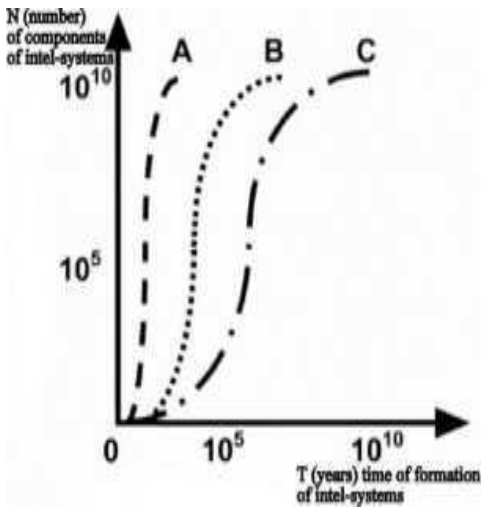
Design considerations

Instead of implementing humanity's coherent extrapolated volition, one could try to build an Al with the goal of doing what is morally right, relying on the Al's superior cognitive capacities to figure out just which actions fit that description. We can call this proposal "moral rightness" (MR). MR would also appear to have some disadvantages. It relies on the notion of "morally right," a

notoriously difficult concept, one with which philosophers have grappled since antiquity without yet attaining consensus as to its analysis. Responding to Bostrom, Santos-Lang raised concern that developers may attempt to start with a single kind of super intelligence.

Evolution of links between components of intelligence system

The number of human contacts is difficult to calculate, but the "Dunbar's number" 150 stable human connections with other people is fixed in science, the assumed cognitive limit of the number of people with whom it is possible to maintain stable social relations, according to other authors - the range of 100290. Structures responsible for social interaction have been identified in the brain. With the appearance of Homo sapiens -50-300 thousand years ago, the relevance of cooperation, its evolution in the human population, increased quantitatively.



Potential threat to humanity

This presents the Al control problem: how to build an intelligent agent that will aid its creators, while avoiding inadvertently building a super intelligence that will harm its creators. The danger of not designing control right "the first time," is that a super intelligence may be able to seize power over its environment and prevent humans from shutting it down. Since a super intelligent Al will likely have the ability to not fear death and instead consider it an avoidable situation which can be predicted and avoided by simply disabling the power button.

31. BLOCKCHAIN

Introduction

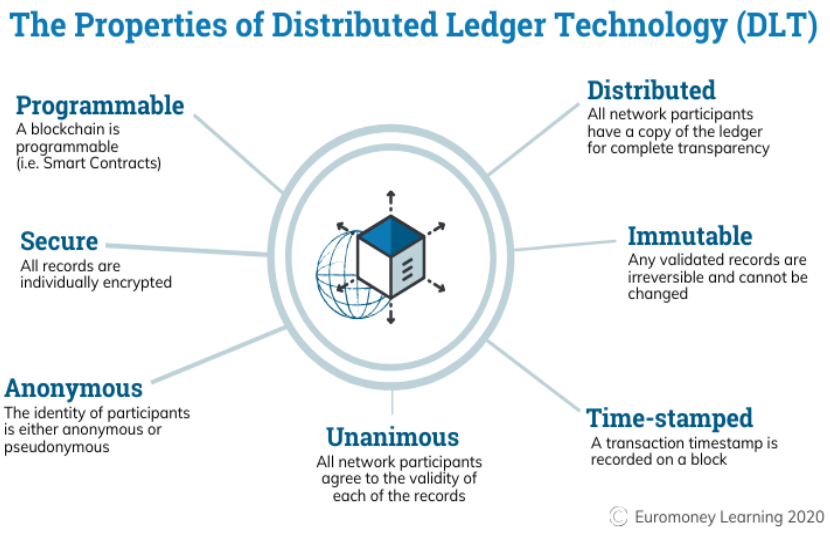
A blockchain is a growing list of records, called blocks, that are linked together using cryptography. Blockchains are typically managed by a peer-to-peer network for use as a publicly distributed ledger, where nodes collectively adhere to a protocol to communicate and validate new blocks. Although blockchain records are not unalterable as forks are possible, blockchains may be considered secure by design and exemplify a distributed computing system with high Byzantine fault tolerance.

Structure

A blockchain is a decentralized, distributed, and oftentimes public, digital ledger consisting of records called blocks that is used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks

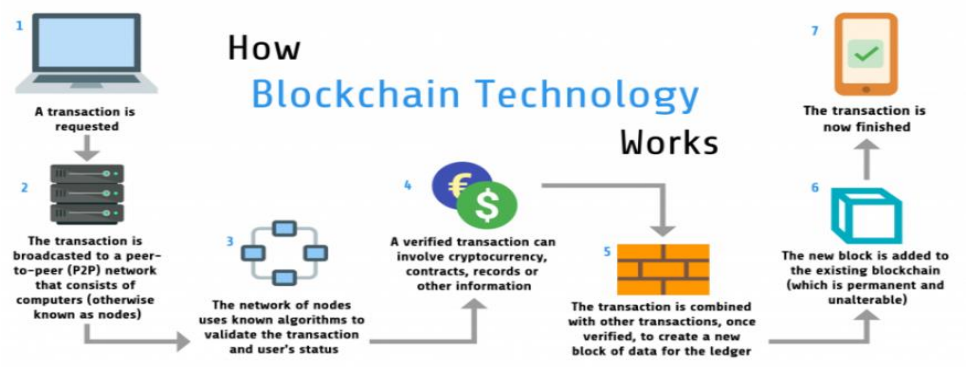
Logically, a blockchain can be seen as consisting of several layers:

- Infrastructure (hardware)
- Networking (node discovery, information propagation and Verification)
- Consensus (proof of work, proof of stake)
- Data (blocks, transactions)
- Application (smart contracts/decentralized applications, if applicable)



Uses

Blockchain technology can be integrated into multiple areas. The primary use of blockchain, as a distributed ledger for cryptocurrencies such as bitcoin; there were also a few other operational products which had matured from proof of concept by late 2016.



Types

Currently, there are four types of blockchain networks,
(i) Public blockchains, (ii) Private blockchains, (iii)Consortium blockchains and (iv)Hybrid blockchains.

Public Blockchains

A public blockchain has absolutely no access restrictions. Anyone with an Internet connection can send transactions to it as well as become a validator.

Private Blockchain

A private blockchain is permission. One cannot join it unless invited by the network administrators. Participant and validate access is restricted.

Hybrid Blockchain

A hybrid blockchain has a combination of centralized and decentralized features. The exact workings of the chain can vary based on which portions of centralization decentralization are used.

Sidechains

A sidechain is a designation for a blockchain ledger that runs in parallel to a primary blockchain. Entries from the primary blockchain can be linked to and from the sidechain.

32. INTERNET OF THINGS

The Internet of Things (IoT) describes physical objects (or groups of such objects), that are embedded with sensors, processing ability, software, and other technologies, and that connect and exchange data with other devices and systems over the Internet or other communications networks.

History

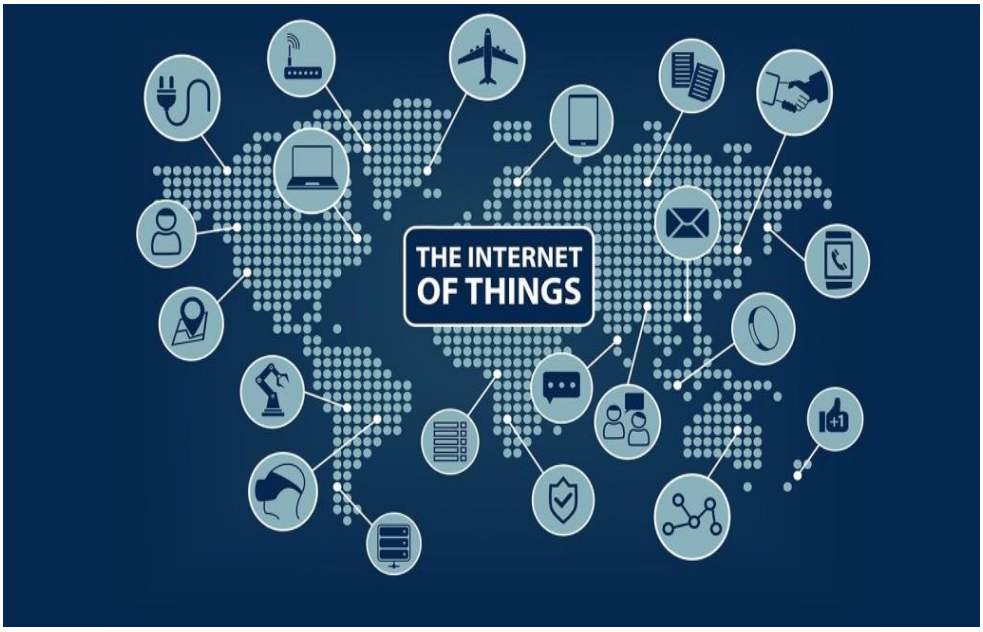
The main concept of a network of smart devices was discussed as early as 1982, with a modified Coca-Cola vending machine at Carnegie Mellon University becoming the first ARPANET-connected appliance, able to report its inventory and whether newly loaded drinks were cold or not. Mark Weiser's 1991 paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom produced the contemporary vision of the IOT. In 1994, Reza Raji described the concept in IEEE Spectrum as "small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories". Between 1993 and 1997, several companies proposed solutions like Microsoft's at Work or Novell's NEST.

Trends and Characteristics

The IoT's major significant trend in recent years is the explosive growth of devices connected and controlled by the Internet. The wide range of applications for IoT technology mean that the specifics can be very different from one device to the next but there are basic characteristics shared by most. The IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions. The number of IoT devices increased 31% year-over-year to 8.4 billion in the year 2017 and it is estimated that there will be 30 billion devices by 2020. The global market value of the IoT is projected to reach $7.1 trillion by 2020.

Politics and Civic Engagement

Some scholars and activists argue that the IoT can be used to create new models of civic engagement if device networks can be open to user control and inter-operable platforms. Philip N. Howard, a professor and author, writes that political life in both democracies and authoritarian regimes will be shaped by the way the IoT will be used for civic engagement. For that to happen, he argues that any connected device should be able to divulge a list of the "ultimate beneficiaries" of its sensor data and that individual citizens should be able to add new organizations to the beneficiary list.



Government regulations on IoT

One of the key drivers of the IoT is data. The success of the idea of connecting devices to make them more efficient is dependent upon access to and storage & processing of data. For this purpose, companies working on the IoT collect data from multiple sources and store it in their cloud network for further processing. This leaves the door wide open for privacy and security dangers and single point vulnerability of multiple systems. The other issues pertain to consumer choice and ownership of data and how it is used. Though still in their infancy, regulations and governance regarding these issues of privacy, security, and data ownership continue to develop. IoT regulation depends on the country. Some examples of legislation that is relevant to privacy and data collection are: the US Privacy Act of 1974, OECD Guidelines on the Protection of Privacy and Trans border Flows of Personal Data of 1980, and the EU Directive 95/46/EC of 1995.

33. 5G WIRELESS TECHNOLOGY

Introduction

In telecommunications, 5G is the fifth generation technology standard for broadband cellular networks, which cellular phone companies began deploying worldwide in 2019, and is the planned successor to the 4G networks which provide connectivity to most current cell phones. 5G networks are predicted to have more than 1.7 billion subscribers worldwide by 2025, according to the GSM Association. Like its predecessors, 5G networks are cellular networks, in which the service area is divided into small geographical areas called **cells**. All 5G wireless devices in a cell are connected to the Internet and telephone network by radio waves through a local antenna in the cell. The main advantage of the new networks is that they will have greater bandwidth, giving higher download speeds, eventually up to 10 gigabits per second (Gbps).

Speed & Connection

The increased speed is achieved partly by using additional higher-frequency radio waves in addition to the low- and medium-band frequencies used in previous cellular networks. However, higher-frequency radio waves have a shorter useful physical range, requiring smaller geographic cells. For wide service, 5G networks operate on up to three frequency bands – low, medium, and high.

A 5G network will be composed of networks consisting of up to three different types of cells, each requiring specific antenna designs as well as providing a different tradeoff of download speed to distance and service area. 5G

cell phones and wireless devices connect to the network through the highest-speed antenna within range at their location.

Implementation

5G can be implemented in low-band, mid-band or high-band millimeter-wave 24 GHz up to 54 GHz. Low-band 5G uses a similar frequency range to 4G cell phones, 600–900 MHz, giving download speeds a little higher than 4G: 30–250 megabits per second (Mbps). Low-band cell towers have a range and coverage area similar to 4G towers. Mid-band 5G uses microwaves of 2.3–4.7 GHz, allowing speeds of 100–900 Mbps, with each cell tower providing service up to several kilo meters in radius. This level of service is the most widely deployed, and was deployed in many metropolitan areas in 2020. Some regions are not implementing the low band, making this the minimum service level. High-band 5G uses frequencies of 24–47 GHz, near the bottom of the millimeter wave band, although higher frequencies may be used in the future.

The industry consortium setting standards for 5G is the 3rd Generation Partnership Project (3GPP). It defines any system using 5G NR (5G New Radio) software as "5G", a definition that came into general use by late 2018. Minimum standards are set by the International Telecommunication Union (ITU).Rollout of 5G technology has led to debate over its security and relationship with Chinese vendors. It has also been the subject of health concerns and misinformation, including discredited conspiracy theories linking it to the COVID-19 pandemic.

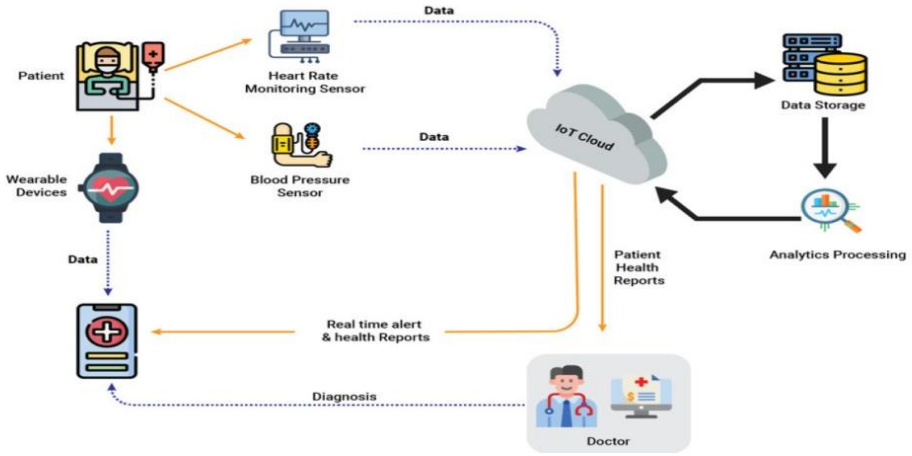
34. MEDICAL INTERNET OF THINGS

Introduction

IoT enables healthcare professionals to be more watchful and connect with the patients proactively. IoT devices tagged with sensors are used for tracking real time location of medical equipment like wheelchairs, defibrillators, nebulizers, oxygen pumps and other monitoring equipment.

For healthcare, it means changing the very definition of "data analytics" to something much broader, richer, and deeper. While healthcare organizations currently base most of their clinical and financial analytics on traditional data sources like EHR documentation, claims data, and lab results, others are starting to integrate behavioural data from shoppers' credit cards or sleep data from fitness trackers and smart phone check-ins on social media, adding a new dimension of object-based activity to their data pools. Remote monitoring from internet-connected prescription bottles, Bluetooth-connected scales, or blood glucose monitors harness the ubiquitous power of Wi-Fi to bring rich data on basic, everyday patient behaviours to providers.

As connected medical devices continue their march towards integration and providers establish more robust data analytics infrastructure that can harness patient-generated data of all shapes and sizes, the Internet of Things will grow slowly, quietly, and inescapably around us, allowing providers to generate actionable insights on a scale and level of sophistication never possible before.



Healthcare Technology for Improved Insights and Outcomes. Globally, healthcare systems are facing a massive rise in chronic conditions and experiencing increased pressure on costs. Everyone in the healthcare delivery chain—from pharmaceutical companies to clinicians to physicians and patients—

is looking for ways to deliver a more efficient healthcare system and better patient outcomes.

Innovations

Innovations in healthcare technology can help transform healthcare from reactive to proactive. Arm provides cost-effective, foundational technology for secure, low-power, high-performance electronic devices across healthcare to help improve patient outcomes and people's lives. Healthcare today is primarily based on face-to-face doctor-patient interactions, with the burden resting heavily on the patient. Patients with chronic diseases must monitor their own vitals and look for abnormalities that might trigger a call to a physician, or worse yet, an emergency visit costing the healthcare system tens of thousands of dollars.

Now device manufacturers can develop small, battery-powered monitors, smart patches, and even inhalers that incorporate machine learning within the device; this innovation allows healthcare diagnosis, delivery, or monitoring to take place remotely. Whether an off-the-shelf device or a custom System-on-Chip (SoC), Arm and our global ecosystem of partners provide everything required, including robust processing power in a small footprint, for devices that are transforming lives.

35. INTERNET OF THINGS SECURITY

What is Internet of Things Security?

Internet of Things Security refers to the methods of protection used to secure internet-connected or network-based devices. The term IoT is incredibly broad, and with the technology continuing to evolve, the term has only become bordered. IoT security is the family of techniques, strategies and tools used to protect these devices from becoming compromised. Ironically, it is the connectivity inherent to IoT that makes these increasingly vulnerable to cyber attacks.

Iot security issues

The more ways for devices to be able to connect to each other, the more ways threat actors can intercept them. Protocols like HTTP (Hypertext Transfer Protocol) and API are just a few of the channels that IoT devices rely on that hackers can intercept. Below are a few of the IoT security challenges that continue to threaten the financial safety of both individuals and organizations. They are Remote exposure, lack of industry foresight, resource constraints.

IoT security during the design phase of the IoT security issues discussed, most can be overcome by better preparation, particularly during the research and development process at the start of any consumer-, enterprise- or industrial-based IoT device development. Enabling security by default is critical, as well as providing the most recent operating systems and using secure hardware.

PKI and digital certificates

PKI (Public Key Infrastructure) is an excellent way to secure the client-server connections between multiple networked devices. Using a two-key asymmetric cryptosystem, PKI is able to facilitate the encrypt transactions.

Network security

Networks provide a huge opportunity for threat actors to remotely control others' IoT devices. Because networks involve both digital and physical components, on-premises IoT security should address both types of access points.

API security

APIs (Application Programming Interface) are the backbone of most sophisticated websites. They allow travel agencies, for example, to aggregate flight information from multiple airlines into one location. Unfortunately, hackers can compromise these channels of communication, making API security necessary for protecting the integrity of data being sent from IoT devices to back-end systems and ensuring only authorized devices, developers and apps communicate with APIs.