COMPUTER
INFO-GALLERY

VOLUME – 11
(2022-23)

CRYPTOGRAPHY

Students' Assignments as

IT Encyclopedia

PREFACE

This book is intended to make the New-Comers (Students) of the Department of Computer Science (UG), who do not have ideas regarding the basics of the Computer and its terminologies. It can also help the students from a computer backdrop, to make a review regarding IT terminologies and concepts. Already 10 Volumes have been launched during 2012-2022.

The thought of publishing this book arises as a sparkle to make the Student's Assignments, in 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 in the form of a book, which will help other students also. That is how this book got emerged. This is the 11th Volume for the academic year 2022-2023 with some other useful content to make the students very well equipped in the foundation level, especially for the students who come into the area of Autonomous.

A copy of this book will be maintained in the Department Library and also the E-content of this book has been posted on 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 moral support. I also thank our dear students for their co-operation. I hereby assure you 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

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

HOD   Principal   Correspondent

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2. Ms. D. DHIVYA - III B.Sc (CS) -'A'

1. OPERATING SYSTEM

An Operating System (OS) is an interface between a computer user and computer hardware. An operating system is software that performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

History of OS

❖ Operating systems were first developed in the late 1950s to manage tape storage

❖ The General Motors Research Lab implemented the first OS in the early 1950s for their IBM 701

❖ In the mid-1960s, operating systems started to use disks

❖ In the late 1960s, the first version of the Unix OS was developed

❖ The first OS built by Microsoft was DOS. It was built in 1981 by purchasing the 86-DOS software from a Seattle company

❖ The present-day popular OS Windows first came into existence in 1985 when a GUI was created and paired with MS-DOS.

Types of Operating Systems

Batch Operating System

Some computer processes are very lengthy and time-consuming. To speed up the same process, a job with similar types of needs is batched together and run as a group.

The user of a batch operating system never directly interacts with the computer. In this type of OS, every user prepares his or her job on an offline device like a punch card, and submits it to the computer operator.

Some most famous mobile operating systems are Android and iOS, but others include BlackBerry, Web, and watch OS. Allows you to hide details of hardware by creating an abstraction

Multi-Tasking/Time-Sharing Operating Systems

A time-sharing operating system enables people located at a different terminal(shell) to use a single computer system at the same time. The processor time (CPU) which is shared among multiple users is termed as time sharing.

Real-Time OS

A real-time operating system's time interval to process and respond to inputs is very small. Examples: Military Software Systems and Space Software Systems are the Real-time OS example.

Network Operating System

Network Operating System runs on a server. It provides the capability to serve to manage data, users, groups, security, application, and other networking functions.

Mobile OS

Mobile operating systems are those OS which are especially that are designed to power smartphones, tablets, and wearables devices.

Some most famous mobile operating systems are Android and iOS, but others include BlackBerry, Web, and watchOS.Allows you to hide details of hardware by creating an abstraction.

Advantages and Disadvantages of OS

❖ Offers an environment in which a user may execute programs/applications

❖ The operating system must make sure that the computer system is convenient to use

Disadvantages of OS

❖ If any issue occurs in OS, you may lose all the contents which have been stored in your system

❖ Operating system software is quite expensive for small size organizations which adds a burden on them. **Example:** Windows

2. WEBSITE CREATION

Web designing is the creation of websites and pages to reflect a company's brand and information and ensure a user-friendly experience. Appearance and design are incorporated as vital elements whether you're designing a website, or mobile app or maintaining content on a web page. You can learn web designing to create a site for your own business or become a professional web designer creating sites for clients.

What do Web Designers do?

Web design identifies the goals of a website or webpage and promotes accessibility for all potential users. This process involves organizing content and images across a series of pages and integrating applications and other interactive elements.

What are the Elements of Web Design?

The web design process allows designers to adjust to any preferences and provide effective solutions. There are many standard components of every web design, including:

- ❖ Layout
- ❖ Images
- ❖ Visual hierarchy
- ❖ Color scheme
- ❖ Typography
- ❖ Readability
- ❖ Navigation
- ❖ Content
- ❖ Mobile

What is the use of Web Design?

Web designing is used for many important tasks and goals, including:

Search Engine Optimization

Search engine optimization (SEO) is a method for improving the chances for a website to be found by search engines. Web design codes information in a way that search engines can read it. It can boost business because the site shows up on the top search result pages, helping people to find it.

Customer Satisfaction

A professional web design impacts clients' satisfaction positively as it provides them with the information, they are looking for quickly. It helps the company build a positive relationship with the visitors by ensuring the navigation on its website is easy to understand, predictable and consistent.

Mobile Responsiveness

Mobile responsiveness is the feature of a website that allows it to display on a mobile device and adapt its layout and proportions to be legible. Web design ensures sites are easy to view and navigate from mobile devices. When a website is well-designed and mobile-responsive, customers can reach the business with ease.

Consistent Branding

Branding refers to the promotion of a product with a unique design. Web design helps companies build or maintain a clear brand for their business. When a website expresses a business's brand consistently, it makes it easier to navigate and helps customers more clearly identify the visual elements of a brand as a specific company and its products or services.

Technical Efficiency

This term refers to how productive a website can be in making a comfortable experience on a website. Designers can achieve this with clean coding that allows for quick loading times, functioning links, and dynamic images and graphics. Web design services also fix those eventual glitches when they occur.

3. WEBSITE BUILDER

A Website Builder is a tool that allows you to build a website without coding experience. There are two different types of website builders: online and offline. An offline website builder is software that you download to create the website On your personal computer. Online website builders are web-based to create and edit your website directly on the company's server.

Website Builder Features

A Website builder makes many of the complicated aspects of running a website simple and intuitive. Here is a list of some of the most common features.

Drag-and-Drop Interface

Many Website builders allow you to drag and drop the components of a Web page to design it as if you are assembling a collage. This could be text, photos, video, or any other component on your web page. Each Website builder offers different flexibility for customization options. Some companies use themes that are harder to adjust, while others allow you to customize almost every aspect of the web page.

Pictures and Video Storage

Website builders make it easy to upload pictures and videos. With Square space, for example, you'll have access to an image gallery on your account. This way, you'll be able to edit and remove photos and videos from different pages, but still, store them and refer to them in the future. Storage Capability generally varies by subscription plan.

Hosting and Domains

When you're building a website, you need two components other than design: a website host and a domain name (the URL used to navigate to your site). Many Website builders offer all three services. If you already own a domain name but want to use a different website builder (for example you purchased your domain name through Go Daddy but want to use Wix for design), you'll have to migrate your domain to the new platform.

Mobile Compatibility

Because so many people browse the web, mobile compatibility is an important feature for any website. Many Website builders integrate these features automatically and allow you to view the mobile version of your website as you edit. Some can even reflexively adjust the elements on your site so that one design functions well on multiple platforms.

Third-Party Integrations

Website builders make it easy to integrate third-party applications like social media feeds or shopping carts. Lead capture forms are another commonly used integration, allowing potential customers/clients to provide their information and dump it directly into your preferred CRM or data repository.

Business Email

Most website builders come with the ability to create an email address with your domain name as the extension. Some always charge extra for these features while others offer one or two emails for free and charge for each additional email, so be sure to choose the best plan for your needs.

Do I Need a Website Builder?

If you want to create a website and you don't have experience coding, a website builder is the easiest way to do it. The other option is to build your website yourself, but this requires knowledge of coding or hiring a professional. The benefit of hiring someone is that you have complete control of how the website looks

4. WEB DESIGNING LANGUAGE

Web Designing Language

HTML is the most basic of all coding languages. If you're planning to develop a website or web app, HTML will provide you with a solid foundation for website development. Since most websites get built on top of HTML, developers can style your code to fit your specific needs by an experienced developer.

Best Web Designing Language

The First Language of Web Designing

- ❖ Web developers use this language to add interactive elements to their websites.
- ❖ User engagement is important to your business, and your web developer should be incorporating Java script elements in your design.
- ❖ If HTML is the base of web development language, JavaScript is the king of web development.

Web Design Overview

- ❖ The web design process starts with a visual concept, which you could sketch by hand or with software like Photoshop.
- ❖ Then, you use HTML to build the website. HTML and CSS are the codes for writing web pages.
- ❖ HTML handles the basic structure and 'bones' of your page, while CSS handles the style and appearance.

Responsive Design

It is a popular technique for making websites look good and function well on additional devices, like phones and tablets. It does this by setting different CSS rules for different browser widths.

5 Great Books for Learning Web Design the Right Way

- ❖ TML and CSS: Design and Build Websites
- ❖ Learning Web Design: A Beginner's Guide
- ❖ Designing with Web Standards
- ❖ Don't Make Me Think: A common sense approach to Web Usability
- ❖ CSS Mastery: Advanced Web Standards Solutions.

Subjects in Web Designing

- ❖ We can divide the web designing subjects into 2 categories which are Sketching and Design Fundamentals. Sketching includes topics like – Information System Design, Introduction to Graphic Design, LAB HTML & VBScript, and Web Designing using HTML codes.
- ❖ Whereas the Fundamentals include topics like – User interface Graphics, Script Language, Internet Programming with ASP, and Introduction to User Experience Design.

Scope of Web Designing

- ❖ Web designing or web development is a short-term professional job-oriented course.
- ❖ There are huge opportunities available for students who want to work in this field.
- ❖ Many private and public organizations hire web designer for their online work and website development.

5. PLATFORM FOR THE WEBPAGE CREATION

Building a website doesn't have to be a painful experience. With the right Website Builders or Content Management System, you won't have to look at a single line of code when you're creating your own website.

Whether it's a simple portfolio page, a digital store for your business, or even just a hobby food blog – as long as you know how to use text processors (i.e. Microsoft Words) or email, you'll have an awesome site up and running in no time.

The best part? A lot of these platforms are cheap! You can have a personalized domain name and reliable website provider for less than $10 per month. Platforms for the webpage creation are:

Zyro

Zyro is a new website-building tool that comes with a hosting plan attached. Functionality is basic but covers most key areas. This makes it idea for new website owners who may not have the technical skills needed to build their own site.

WordPress.org

WordPress.org is an open-source web application that provides a convenient way to create, publish, and manage content online. WordPress was mainly used as a blogging platform at first but as the software revolt; it is now widely used in building and maintaining websites.

According to a recent study, WordPress.org holds a stunning 64.9% share of the CMS market. Almost one out of every three websites on the planet are created and managed using the WordPress platform.

Weebly

Initially founded in 2002 by college buddies David, Dan, and Chris, Weebly began its journey as a site builder officially in 2007. The company has since powered more than 40 million sites around the world and is currently headquartered in San Francisco with offices in New York, Scottsdale, and Toronto.

With a combined annual traffic of more than 325 million unique visitors, the company is now backed by funding from major players such as Sequoia Capital and Tencent Holdings.

Shopify

Shopify is a leading name in the online shop builder community and that makes it naturally double up as a site builder. The company has over 800,000 actives Shopify stores and has made over $100 billion worth of sales at the time of writing.

BigCommerce

BigCommerce was founded back in 2009 and is currently headed by CEO Brent Bellm. Since its inception, the company has grown with over 500+ employees, serving over 120+ countries, and has established offices in Sydney, Australia, San Francisco, California, and in Austin, Texas.

BigCommerece is slightly off the usual profile of the standard website builder in the sense that it serves a very specific purpose. The site is designed to help build eCommerce stores and has eventually morphed into a complete all-rounder in terms of virtual commerce, right down to offering product retail packaging!

SiteJet

Targeting itself against CMS behemoth WordPress, SiteJet nevertheless has its unique skew – web designers, freelancers, and service providers. Starts at $11/mo, the site builder is easy to use and comes with a ton of features.

Wix

Wix is by far one of the site builders that has seen a meteoric rise in uptake over a relatively short period. Created by Avishai Abrahami, Nadav Abrahami, and Giora Kaplan in 2016, by 2017 the company laid bold claim to a stunning 100 million users. Over that short timeframe, it has introduced multiple upgrades from an HTML5 editor to its drag-and-drop and A.I. Web Editor.

With an impressive catalog of designs and themes, Wix's extremely flexible tools let you create websites that are "pixel-perfect" and professional.

6. IMAGE PROCESSING

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is atype of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.
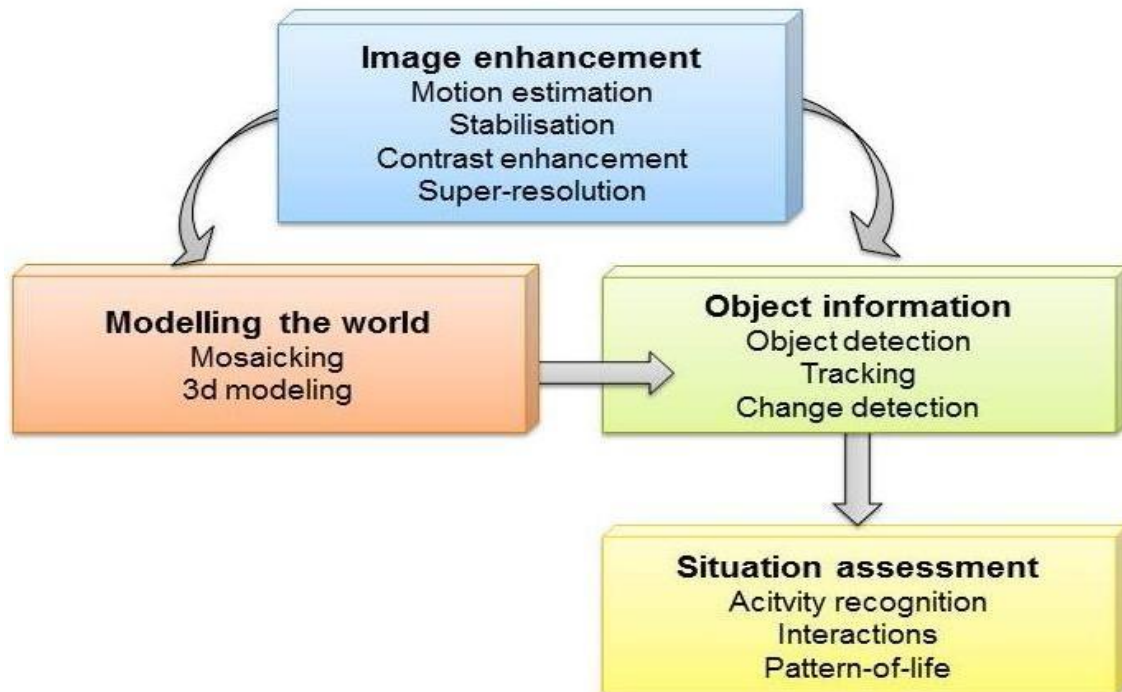
Function of Image Processing

In high resolution field, in addition to the usual preprocessing functions (offset, dark and flat corrections), the usefulness of image processing can be divided intotwo main functions:

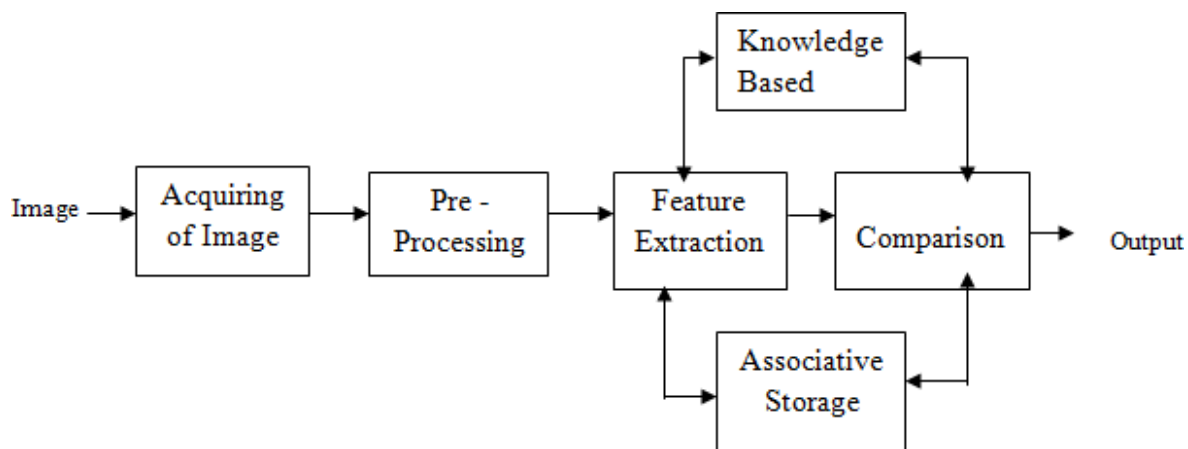- ❖ Increasing the contrast of planetary details
- ❖ Reducing the noise.

Image Processing Technique

Image processing is a method to perform operations on an image to extract information from it or enhance it. Digital image processing has a broad range of applications such as image restoration, medical imaging, remote sensing, image segmentation, etc. Every process requires a different technique.

In this process we will be covering the 6 image processing techniques for machine learning.

- ➢ Image Restoration
- ➢ Linear Filtering
- ➢ Independent Component Analysis
- ➢ Pixelation
- ➢ Template Matching
- ➢ Image Generation Technique (GAN)

7. IMAGE ENHANCEMENT

Introduction

Image enhancement is the procedure of improving the quality and information content of original data before processing. Image enhancement plays an important role in our day-to-day life. Some of the applications are listed below:

- Image sharpening and restoration
- Medical field
- Remote sensing
- Transmission and encoding
- Machine/Robot vision
- Color processing
- Pattern recognition
- Video processing.

Image Enhancement - Medical Field


Image Enhancement - Colour processing

Types of Image Enhancement

There are four types in Image Enhancement.

1. Point operation
2. Spatial operation
3. Transform operation.
4. Pseudo coloring.

Point Operation

Point operations are often used to change the grayscale range and distribution. The concept of point operation is to map every pixel onto a new image with a predefined transformation function.
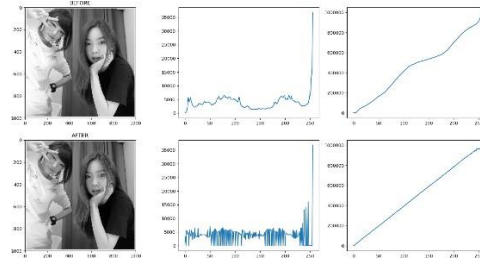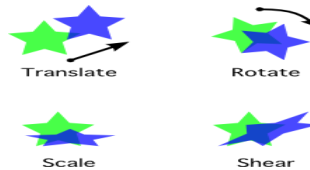
Spatial Operation

Spatial operations use geometry functions to take spatial data as input, analyze the data, then produce output data that is the derivative of the analysis performed on the input data.
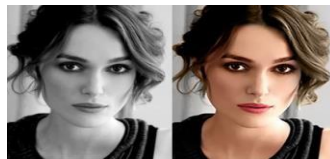
Transform Operation

An image transform can be applied to an image to convert it from one domain to another.

Pseudo Coloring

Pseudo Coloring is one of the attractive categories in image processing. It is used to make old black and white images or videos colorful.

Conclusion

The goal of image enhancement is to improve the usefulness of an image for a given task such as providing a more subjectively pleasing image for human viewing. In image enhancement, little or no attempt is made to estimate the actual image degradation process, and the techniques are often ad hoc.

8.IMAGE COMPRESSION

Introduction

Image compression is a type of data compression applied to digital images. io reduce their cost for storage or transmission. Algorithms may take advantage of visual perception and the statistical properties of image data to provide superior results compared with generic data Compression methods which
•are used for other digital law.

Types of Image Compression

There are two types of image compression.

1. Lossy compression.

2. Lossless compression.

Lossy Compression

Lossy compression reduces an image size permanently and particularly redundant data. Lossy compression can significantly reduce file size. but it can also reduce image quality to the point of distortion, especially if the image is overly compressed. However, quality can be maintained when compression is carefully applied. In Lossy compression. A file does not restore or rebuilt in its original form. Lossy compression is also termed as irreversible compression.

Lossless Compression

The other approach io image compression is referred io as lossless. This method applies compression without removing critical data or reducing image quality and results in a compressed image that can be restored to its original state with no degradation.

However. Lossless compression doesn't reduce the Size nearly as much as lossy compression, offering little advantage in terms of storage space, network bandwidth or download speeds.

Lossless compression is generally used in situations where image quality is more important than disk space or network performance, such as for product images or to showcase artwork.

Difference between Lossy Compression and Lossless Compression

In Lossy compression, A file does not restore or rebuilt in its original form. While in Lossless Compression. A file can he restored in its original form. Lossy compression reduces the size of data. But Lossless Compression does not reduce the size of data.

Conclusion

This assignment included several topics of image compression. Thus, image compression is a type of data compression applied to reduce the size of digital images.
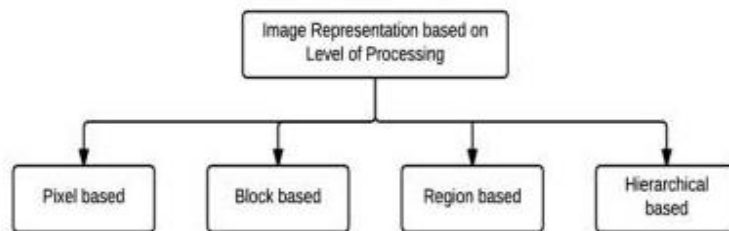
9. IMAGE REPRESENTATION TECHNIQUE

Image Representation

In computer science, we can represent an image in various forms. Most of the time, it refers to the way that brings information, such as color is coded digitally, and how the image is stored, i.e., how an image file is structured. Several open standards were recommended to create, manipulate, store, and exchange digital images. The rules described the format of image files, the algorithms of image encoding, the form of additional information often named as metadata.

## Image Representations Based on Levels of Processing

Based on the level of processing of images by a machine for different purposes, the image representation methods are grouped into four categories: Pixel based, Block based, Region based and Hierarchical based. Fig. 2. Classification based on level of processing.

Pixel Based Representation

Pixel representation is the simplest representation to define an image. In digital imaging, a pixel or picture element is a physical point in a raster image, or the smallest addressable element in an addressable display device. Each pixel contains only local information for each element. The number of elements in the

17
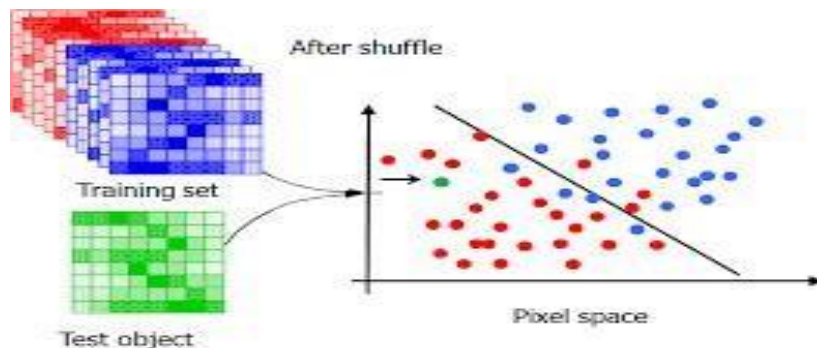
representation is normally big and is used for displaying the image and it has applications in medical imaging where each pixel has got its own importance
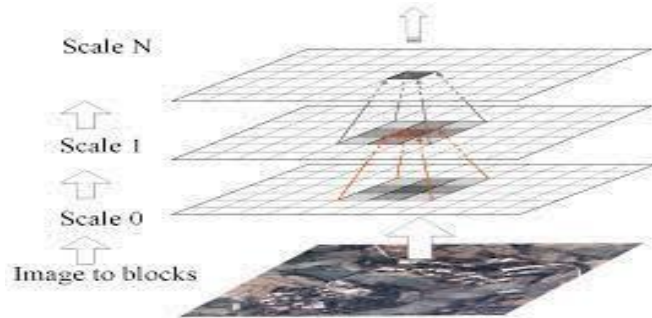
Block-Based Representations

Here, the image is divided in a set of (rectangular) array size. The number of elements is slightly smaller than with pixel-based, still only local information is stored which is same that of pixel-based representations. Block based representations can be done for both gray-scale and binary images. The representation is used in compression, segmentation, extracting different image features etc

Region Based Representations

Also known as super pixel representation. Here the regions are not rectangular and it is formed by grouping similar and connected pixels. The adjacency information between regions is represented usually as RAG(region-adjacency graph) or combinatorial map. The representation is used for object detection and segmentation, but different unions of multiple regions have to be considered .

Hierarchical Representations

The representation uses most likely unions of regions of region- based representations. The image representation can be done at different scales. Examples includes min-/max-tree, α - tree, quad tree, bin tree etc. Applications includes object detection, video segmentation, image segmentation and filtering, image simplification etc.
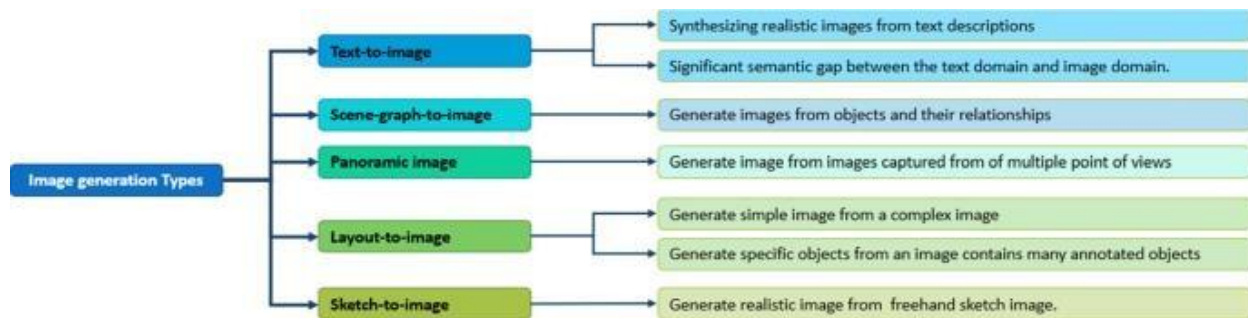
10.IMAGE GENERATION

Image Generation, also known as 'computer graphics (CG)' or 'computer graphics interactive (CGI)', is a collection of techniques or tricks designed to make the most realistic image possible with the available computer hardware as well as the budgets of time, funding and skillset. Image generation (synthesis) is the task of generating new images from an existing dataset.

Types of Image Generation

There are two types of image generation namely,
1. The content creation works
2. The consumption of the content.
These types can further be classified into the following namely,

GANs ("Generative Adversarial Networks")

GANs play a vital role in image generation. To generate anything basically with machine learning we have to use a generative algorithm and as of now, one generation is Generative Adversarial Networks (or GANs).
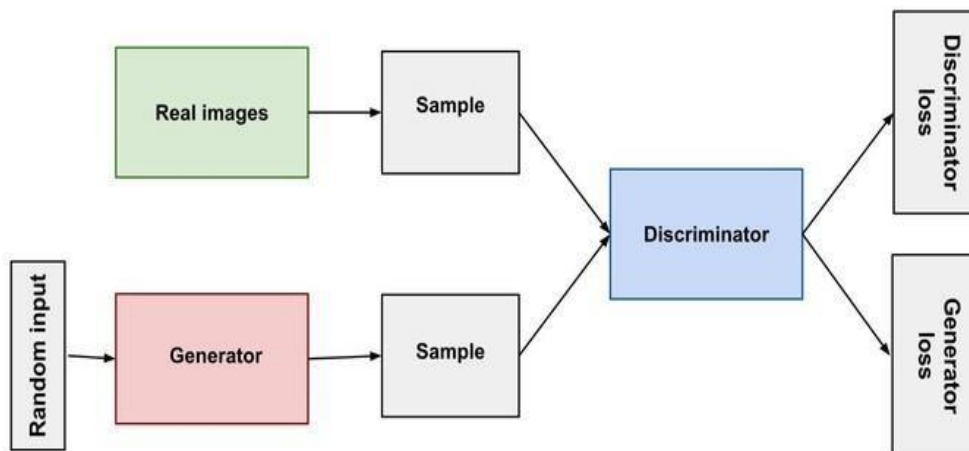
Role of GANs in Image Generation

Generative adversarial networks (GANs) are algorithmic architectures that use two neural networks pitting one against the other in order to generate new synthetic instances of data that can pass for real data. They are used widely in image generation, video generation and voice generation.

What is Synthetic Image Generation?

Synthetic Image generation is the creation of artificially generated images that look as realistic as real images. Synthetic image generation also uses GANs, For example:

Difference between Images Synthesis and Image Generation

Image synthesis is the process of artificially generating images that contain some particular desired content. The only difference between image synthesis and image generation is that image synthesis is focused on image generation, the focus is on the parts of the image generated.

Conclusion

This assignment included several topics of image generation by this, we know that image generation (synthesis) is the task of generating new images from existing data sets. GANs play a vital role in image generation. To generate anything basically with machine learning and GANs are a powerful model for image generation, which has been a fundamental basis for numerous computer vision tasks. In this assignment, we have described several pieces of information about image generation.

11. CRYPTOGRAPHY

Cryptography is a method of protecting information and communications through the use of codes so that only those for whom the information is intended can read and process it. Cryptography refers to secure information and communication techniques derived from mathematical concepts and a set of rule-based calculations called algorithms, to transform messages in ways that are hard to decipher. These deterministic algorithms are used for cryptographic key generation, digital signing, verification to protect data privacy, web browsing on the internet, and confidential communications such as credit card transactions and email.

Cryptography Techniques

Cryptography is closely related to the disciplines of cryptography and cryptanalysis. It includes techniques such as microdots, merging words with images, and other ways to hide information in storage or transit.

However, in today's computer-centric world, cryptography is most often associated with scrambling plain text (ordinary text, sometimes referred to as clear text) into chipper text (a process called encryption), then back again (known as decryption). Individuals who practice this field are known as cryptographers.

<u>Modern Cryptography concerns itself with the following four objectives:</u>

- ➢ Confidentiality**:** The information cannot be understood by anyone for whom it was unintended.

- ➢ Integrity: The information cannot be altered in storage or transit between the sender and intended receiver without the alteration being detected.

- ➢ Non-repudiation**:** The creator/sender of the information cannot deny at a later stage their intentions in the creation or transmission of the information.

- ➢ Authentication: The sender and receiver can confirm each other's identity and the origin/destination of the information.

Procedures and protocols that meet some or all of the above criteria are known as cryptosystems. Cryptosystems are often thought to refer only to mathematical procedures and computer programs; however, they also include the regulation of human behavior, such as choosing hard-to-guess passwords, logging off unused systems, and not discussing sensitive procedures with outsiders.

<u>Types of Cryptography</u>

- ➢ Symmetric Key Cryptography**:** It is an encryption system where the sender and receiver of a message use a single common key to encrypt and decrypt messages. The most popular symmetric key cryptography system is Data Encryption System (DES).

- ➢ Hash Functions**:** There is no usage of any key in this algorithm. A hash value with a fixed length is calculated as per the plain text which makes it impossible for the contents of plain text to be recovered. Many operating systems use hash functions to encrypt passwords.

- ➢ Asymmetric Key Cryptography**:** Under this system, a pair of keys is used to encrypt and decrypt information. A public key is used for encryption and a private key is used for decryption. The public keys and Private keys are different.

12. ENCRYPTION AND DECRYPTION

Encryption is the process by which a readable message is converted to an unreadable form to prevent unauthorized parties from reading it.

Decryption is the process of converting an encrypted message back to its original (readable) format. The original message is called the plaintext message. The encrypted message is called the cipher text message.

Digital encryption algorithms work by manipulating the digital content of a plaintext message mathematically, using an encryption algorithm and a digital key to produce a cipher text version of the message. The sender and recipient can communicate securely if the sender and recipient are the only ones who know the key.
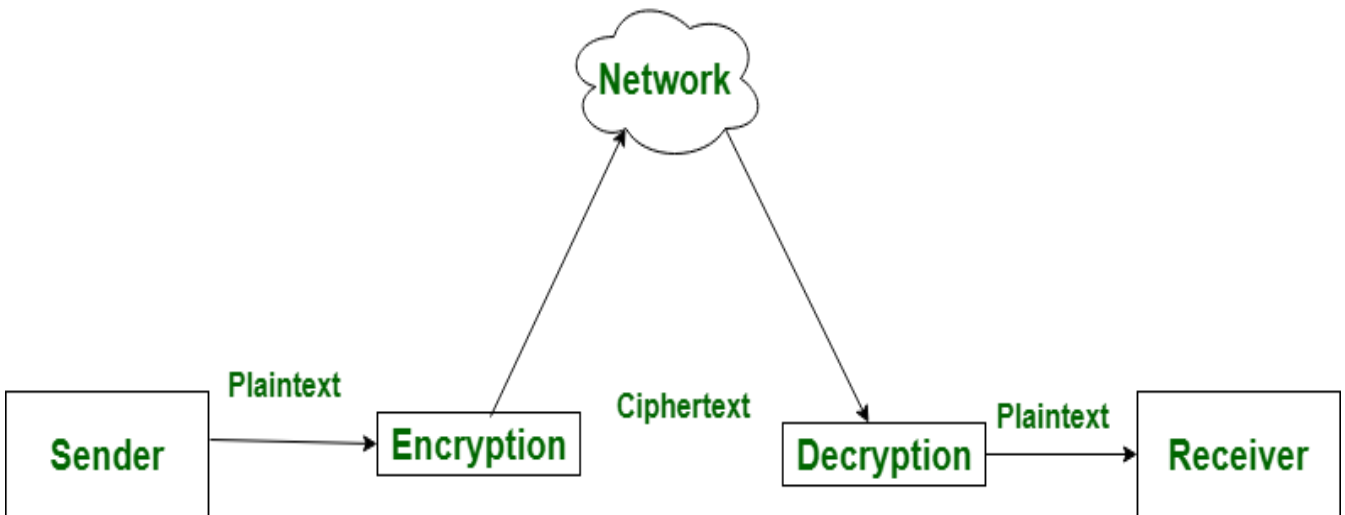
Shared Key and Public Key Encryption

SKIP uses a combination of shared key cryptography and public key cryptography to protect messages sent between hosts. SKIP hosts use shared traffic keys that change frequently to encrypt data sent from one host to another. To protect these shared traffic keys, SKIP hosts use the public key to calculate an implicitly shared secret, which they use to encrypt the shared traffic keys, keeping network communication secure.

Shared Key Encryption

Shared key encryption uses one key to encrypt and decrypt messages. For shared key cryptography to work, the sender and the recipient of a message must both have the same key, which they must keep secret from everybody else. The sender uses the shared key to encrypt a message, shown in the following figure, and then sends the cipher text message to the recipient.

SKIP Tunnels

A SKIP tunnel is a logical connection between your computer and another host that accepts encrypted messages on behalf of a remote host. Before your computer sends a message through a SKIP tunnel, it encrypts each packet and adds an IP header that specifies the security proxy as its destination.

The security proxy decrypts each packet and uses the IP header of the decrypted packet to route the packet to its actual destination.

Diffie-Hellman Key Exchange

The Diffie-Hellman key exchange algorithm, which is named after its inventors, solves the problem of securely distributing keys by removing the need to transmit secret keys.

When two hosts wish to use the Diffie-Hellman algorithm to exchange keys, they agree to use the same numerical values for the key basis (g) and modulus (p). Each host generates a large (512-, 1024-, or 2048-bit) random number (x) as a private key, and then uses this private key to generate a public key g^x mod p.

Once a user's private and public keys have been calculated, Sun Screen SKIP creates the user's public certificate. This certificate contains the public key value, the g and p values used to compute the public key and other information, such as the period for which the certificate is valid.

13. ETHICAL HACKING

Definition

Ethical hacking involves an authorized attempt to gain unauthorized access to a computer system, application, or data. Carrying out an ethical hack involves duplicating the strategies and actions of malicious attackers. This practice helps to identify security vulnerabilities which can then be resolved before a malicious attacker has the opportunity to exploit them.
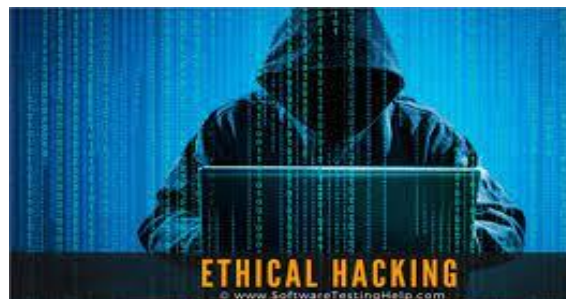
Key Concepts of Ethical Hacking

Stay Legal

Obtain proper approval before accessing and performing a security assessment.

Define the Scope

Determine the scope of the assessment so that the ethical hacker's work remains legal and within the organization's approved boundaries.

Report Vulnerabilities

Notify the organization of all vulnerabilities discovered during the assessment. Provide remediation advice for resolving these vulnerabilities.

Respect Data Sensitivity

Depending on the data sensitivity, ethical hackers may have to agree to a non-disclosure agreement, in addition to other terms and conditions required by the assessed organization.

Ethical Hackers are different from Malicious Hackers

Ethical hackers use their knowledge to secure and improve the technology of organizations. They provide an essential service to these organizations by looking for vulnerabilities that can lead to a security breach.

An ethical hacker reports the identified vulnerabilities to the organization. Additionally, they provide remediation advice. In many cases, with the organization's consent, the ethical hacker performs a re-test to ensure the vulnerabilities are fully resolved.

Malicious hackers intend to gain unauthorized access to a resource (the more sensitive the better) for financial gain or personal recognition. Some malicious hackers deface websites or crash backend servers for fun, reputation damage, or to cause financial loss. The methods used and vulnerabilities found remain unreported. They aren't concerned with improving the organizations' security posture.

Some of the most common vulnerabilities discovered by ethical hackers include:

- ❖ Injection attacks
- ❖ Broken authentication
- ❖ Security misconfigurations
- ❖ Use of components with known vulnerabilities
- ❖ Sensitive data exposure

Limitations of Ethical Hacking

- ❖ Limited scope: Ethical hackers cannot progress beyond a defined scope to make an attack successful. However, it's not unreasonable to discuss out-of-scope attack potential with the organization.
- ❖ Resource constraints: Malicious hackers don't have the time constraints that ethical hackers often face. Computing power and budget are additional constraints for ethical hackers.
- ❖ Restricted methods: Some organizations ask experts to avoid test cases
  that lead the servers to crash (e.g., Denial of Service (DoS) attacks).

14. NETWORK SECURITY

Network Security

According to the SANS Institute, network security is the process of taking preventative measures to protect the underlying networking infrastructure from unauthorized access, misuse, malfunction, modification, destruction, or improper disclosure. Implementing these measures allows computers, users, and programs to perform their permitted critical functions within a secure environment. Securing a network requires a complex combination of hardware devices, such as routers, firewalls, and anti-malware software applications. Government agencies and businesses employ highly skilled information security analysts to implement security plans and constantly monitor the efficacy of these plans.

Importance of Network Security

Network security is important for home networks as well as in the business world. Most homes with high-speed internet connections have one or more wireless routers, which could be exploited if not properly secured. A solid network security system helps reduce the risk of data loss, theft, and sabotage. Pc magazine offers simple steps you can take to make sure a home network is secure:

❖ Change your router admin username and password

❖ Change the network name

❖ Activate encryption

❖ Double up on firewalls

Types of Network Security Protections

- ❖ Firewall. Firewalls control incoming and outgoing traffic on networks, with predetermined security rules.

- ❖ Network Segmentation.

- ❖ Remote Access VPN.

- ❖ Email Security.

- ❖ Data Loss Prevention (DLP).

- ❖ Intrusion Prevention Systems (IPS).

- ❖ Sandboxing.

- ❖ Hyper-scale Network Security.

Types of Treats in Network Security

- ❖ Cybercriminals' principal goal is to monetize their attacks.

- ❖ Hacktivists crave publicity.

- ❖ Insiders.

- ❖ Physical threats.

- ❖ Terrorists.

- ❖ Espionage.

Benefits of Network Security

- ❖ Builds trust. Security for large systems translates to security for everyone.

- ❖ Mitigates risk.

- ❖ Protects proprietary information.

- ❖ Enables a more modern workplace.

- ❖ Access control.

- ❖ Antivirus and anti-malware software.

- ❖ Application security.

- ❖ Behavioral analytics.

15. CYBER SECURITY

Cyber Security

Cyber security is the practice of protecting critical systems and sensitive information from digital attacks. Also known as information technology (IT) security, cyber security measures are designed to combat threats against networked systems and applications, whether those threats originate from inside or outside of an organization. It seems that everything relies on computers and the internet now—communication (e.g., email, smart phones, tablets), entertainment (e.g., interactive video games, social media, apps), transportation (e.g., navigation systems), shopping (e.g., online shopping, credit cards), medicine (e.g., medical equipment, medical records), and the list goes on.

Importance of Cyber Security

➢ The costs of cyber security breaches are rising.

Privacy laws such as the GDPR (General Data Protection Regulation) and DPA (Data Protection Act) 2018 can mean significant fines for organizations that suffer cyber security breaches. There are also non-financial costs to be considered, like reputational damage.

➢ Cyber-attacks are increasingly sophisticated.

Cyber-attacks continue to grow in sophistication, with attackers using an ever-expanding variety of tactics. These include social engineering, malware, and ransom ware.

➢ Cyber security is a critical, board-level issue.

New regulations and reporting requirements make cyber security risk oversight a challenge. The board needs assurance from management that its cyber risk strategies will reduce the risk of attacks and limit financial and operational impacts.

➢ Cybercrime is a big business.

According to the hidden costs of cybercrime, a 2020 study carried out by McAfee and the CSIS (Centre for Strategic and International Studies), based on data collected by Vanson Bourne, the world economy loses more than $1 trillion (approximately £750 billion) each year. Political, ethical, and social incentives can also drive attackers.

<u>Types of Cyber Threats</u>

- ❖ Malware, such as ransomware, botnet software, RATs (remote access Trojans), rootkits and bootkits, spyware, Trojans, viruses, and worms.

- ❖ Backdoors, which allow remote access.

- ❖ Formjacking, which inserts malicious code into online forms.

- ❖ Cryptojacking, which installs illicit cryptocurrency mining software.

- ❖ DDoS (distributed denial-of-service) attacks, flood servers, systems, and networks with traffic to knock them offline.

- ❖ DNS (domain name system) poisoning attacks, which compromise the DNS to redirect traffic to malicious sites.

16. DATA MINING TECHNIQUES

Introduction

Data mining includes the utilization of refined data analysis tools to find previously unknown, valid patterns and relationships in huge data sets. These tools can incorporate statistical models, machine learning techniques, and mathematical algorithms, such as neural networks or decision trees. Thus, data mining incorporates analysis and prediction.
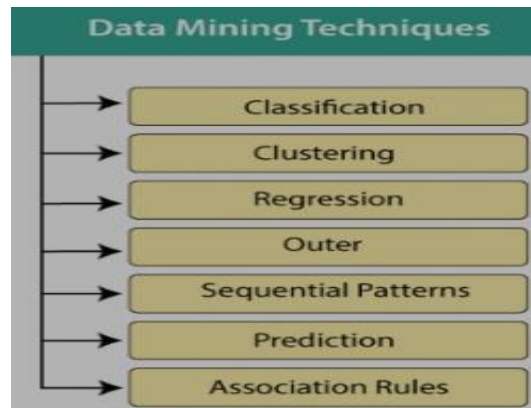
Classification

Classification is the processing of finding a set of models (or functions) that describe and distinguish data classes or concepts, to be able to use the model to predict the class of objects whose class label is unknown. The determined model depends on the investigation of a set of training data information (i.e. data objects whose class label is known). The derived model may be represented in various forms, such as classification (if – then) rules, decision trees, and neural networks.

Clustering

Clustering is a division of information into groups of connected objects. Describing the data by a few clusters mainly loses certain confine details, but accomplishes improvement. It models data by its clusters. Data modeling puts clustering from a historical point of view rooted in statistics, mathematics, and numerical analysis. From a machine learning point of view, clusters relate to hidden patterns, the search for clusters is unsupervised learning, and the subsequent framework represents a data concept. From a practical point of view, clustering plays an extraordinary job in data mining applications.

Regression

Regression analysis is the data mining process used to identify and analyze the relationship between variables because of the presence of the other factor.

It is used to define the probability of a specific variable. For example, we might use it to project certain costs, depending on other factors such as availability, consumer demand, and competition.

Outlier Detection

This type of data mining technique relates to the observation of data items in the data set, which do not match an expected pattern or expected behavior. This technique may be used in various domains like an intrusion, detection, fraud detection, etc. It is also known as Outlier Analysis or Outlier mining.

The outlier is a data point that diverges too much from the rest of the dataset. The majority of the real-world datasets have an outlier. Outlier plays a major role in data mining.

Sequential Patterns

Sequential pattern is a data mining technique specialized for evaluating sequential data to discover sequential patterns. It comprises finding interesting sub-sequences in a set of sequences, where the stake of a sequence can be measured in terms of different criteria like length, occurrence frequency, etc.

Prediction

Prediction used a combination of other data mining techniques such as trends, clustering, classification, etc. It Analyses past events or instances in the right sequence to predict a future event.

Association Rules

Association analysis is the finding of association rules showing attribute-value conditions that occur frequently together in a given set of data. One method of association-based classification, called associative classification, consists of two steps.

17. STAGES OF DATA MINING
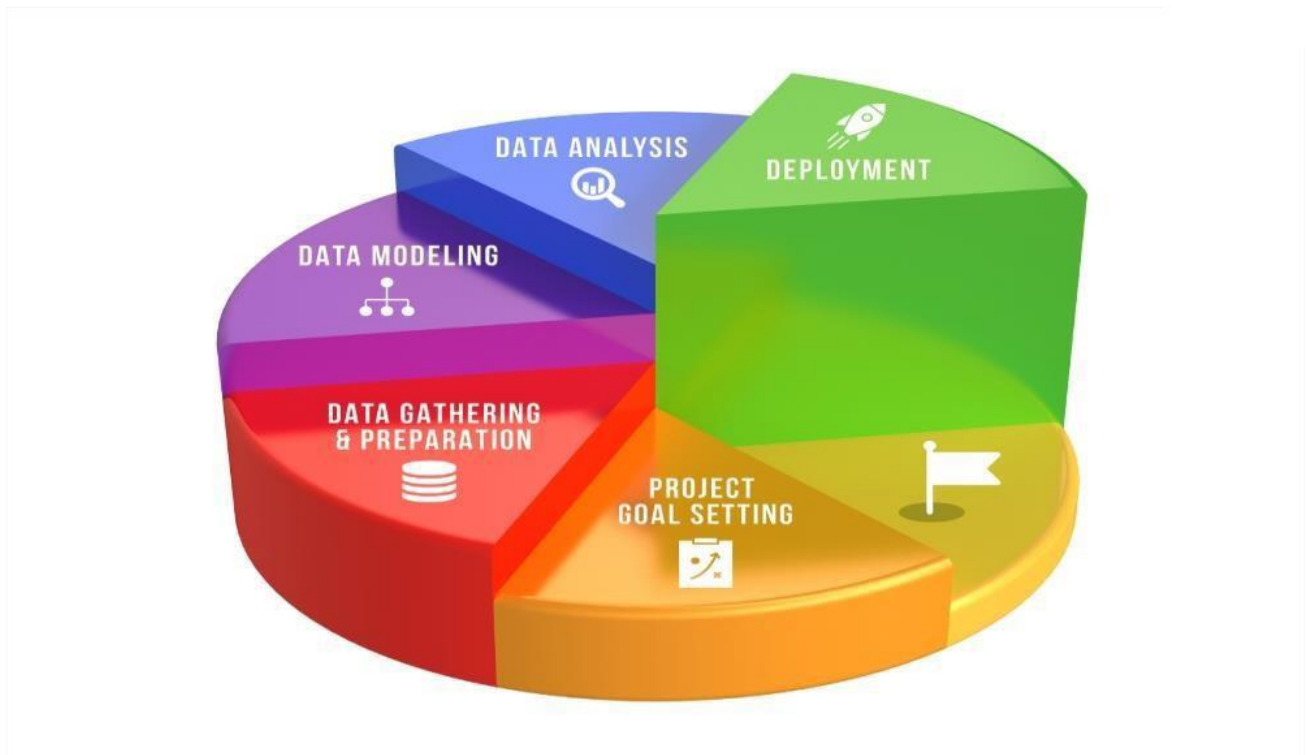
Project Goal Setting

For anything to succeed, it has to have a plan. Goal setting is the foundation of every successful data mining project. By aligning on their project objectives and timelines, business and data mining teams can have a smoother working relationship throughout the experience.

Goal setting allows teams to assign roles and make a clear plan to move forward. Expectation management is key to avoiding issues throughout the data mining process.

Data Gathering & Preparation

For every good kind of data, there is a mountain of bad data. From incomplete, and fraudulent to out-of-date, bad data is everywhere.

When not cleaned, it can ruin any campaign. The data gathering and preparation stage is all about making sure that the data is usable.

For larger, more established clients, there must be mitigation of security risk. Trust is a necessary element when dealing with sensitive information.

Data processing often uses modern database management systems (DBMS) to improve data mining speed.

It is also a primary precaution when dealing with data that is confidential to an organization.

Data Modeling

With the use of mathematical models and various data visualization tools, there are meaningful patterns discovered in the data. Through conceptual representations of how data objects and rules go hand in hand, they form a Database.

A Database can be conceptual, physical, or logical, depending on the Data Model applied. There are two types of Data Modeling Techniques: Entity-Relationship (ER) Model & Unified Modeling Language (UML).

Data Analysis

After the modeled data is analyzed, it is then extracted, transformed, and visualized. Data analysis helps bring together useful information to give insights or test hypotheses.

With a combination of business intelligence and analytics models, Data Analysis orders raw data in a way that is relevant to the project goals.

Deployment

In the last stage of Data Mining, relevant partners test the hypothesis. There are four different types of model deployment: data science tools, programming language, database, and SQL script or predictive model markup language.

Mined data provides a single source of truth that can guide business decisions moving forward with coordination between data scientists, IT teams, software developments, and business professionals work together to integrate the new models.
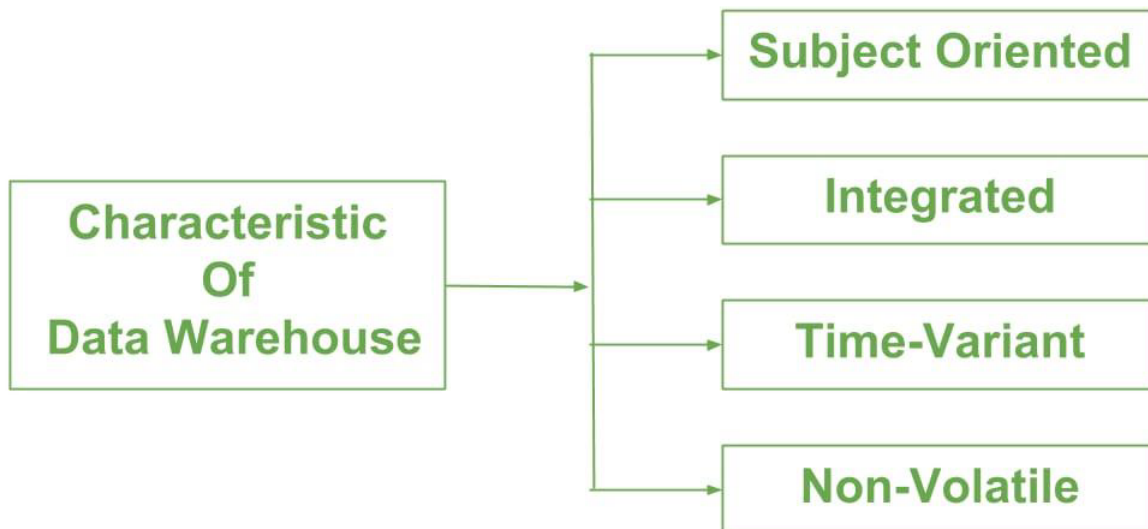
18. DATA WAREHOUSING

Definition

Data warehousing is the process of constructing and using a data warehouse. A data warehouse is constructed by integrating data from multiple heterogeneous sources that support analytical reporting structured and decision-making. Data warehousing involves data cleaning, data integration, and data consolidation.

Characteristics

The data warehouse can be controlled when the user has a shared way of explaining the trends that are introduced as specific subjects. Below are the major characteristics of a data warehouse:

Subject Oriented

A data warehouse is always subject-oriented as it delivers information about a theme instead of the organization's current operations. It can be achieved on a specific theme. That means the data warehousing process is proposed to handle a specific theme that is more defined. These themes can be sales, distribution, marketing, etc.

A data warehouse never puts emphasis only on current operations. Instead, it focuses on demonstration around a particular theme by eliminating data that is not required to make the decisions.
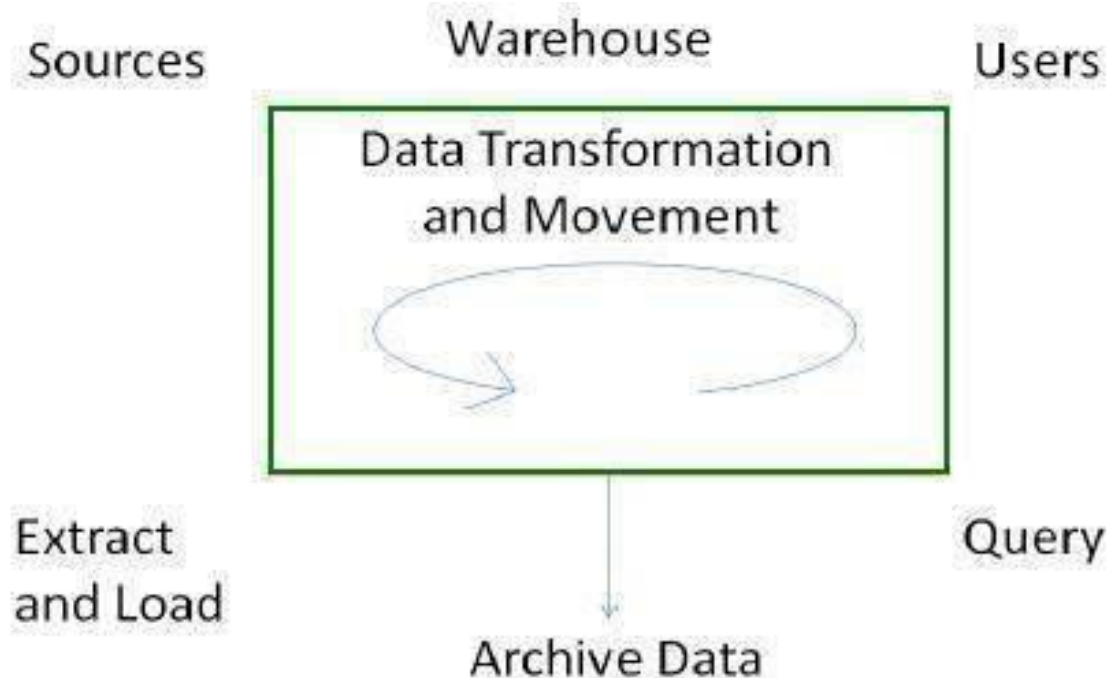
Integrated

It is somewhere the same as a subject orientation which is made in a reliable format. Integration means founding a shared entity to scale all similar data from the difference database.

Time Variant

The data residing in the data warehouse is predictable with a specific interval of time and delivers information from a historical perspective.

Non-Volatile

As the name defines the data residing in a data warehouse is permanent. It also means that data is not erased or deleted when new data is inserted. It includes the mammoth quantity of data that is inserted into modification between the selected quantity on logical business. It evaluates the analysis within the technologies of the warehouse.

19. DATA WRANGLING

Definition

Data wrangling is the process of cleaning and unifying messy and complex data sets for easy access and analysis. With the amount of data and data sources rapidly growing and expanding, it is getting increasingly essential for large amounts of available data to be organized for analysis.

Characteristics

Discovering

Discovery refers to the process of familiarizing yourself with data so you can conceptualize how you might use it. You can liken it to looking in your refrigerator before cooking a meal to see what ingredients you have at your disposal.

Structuring

Raw data is typically unusable in its raw state because it's either incomplete or misformatted for its intended application. Data structuring is the process of taking

raw data and transforming it to be more readily leveraged. The form your data takes will depend on the analytical model you use to interpret it.

Cleaning

Data cleaning is the process of removing inherent errors in data that might distort your analysis or render it less valuable. Cleaning can come in different forms, including deleting empty cells or rows, removing outliers, and standardizing inputs.

Enrichment

Once you understand your existing data and have transformed it into a more usable state, you must determine whether you have all of the data necessary for the project at hand. If not, you may choose to enrich or augment your data by incorporating values from other datasets.

Validating

Data validation refers to the process of verifying that your data is both consistent and of a high enough quality. During validation, you may discover issues you need to resolve or conclude that your data is ready to be analyzed. Validation is typically achieved through various automated processes and requires programming.

Publishing

Once your data has been validated, you can publish it. This involves making it available to others within your organization for analysis. The format you use to share the information—such as a written report or electronic file—will depend on your data and the organization's goals.

Conclusion

Data wrangling in machine learning is a huge necessity in recent times because of the huge amounts of data that get processed every day making user services more efficient. Without a strong infrastructure of data storage and investments in data-wrangling techniques, the business would suffer and hence data-wrangling proves its importance in the world of data science.

20. EMBEDDED SYSTEM DESIGN

Definition

An embedded system is a combination of a computer processor, computer memory, and input/output peripheral devices. An Embedded system can be an independent system or it can bean part of a large system.

An Embedded system is a microcontroller or microprocessor based which is designed to perform a specific task. For Example, a fire alarm is an embedded system; it will sense only smoke.
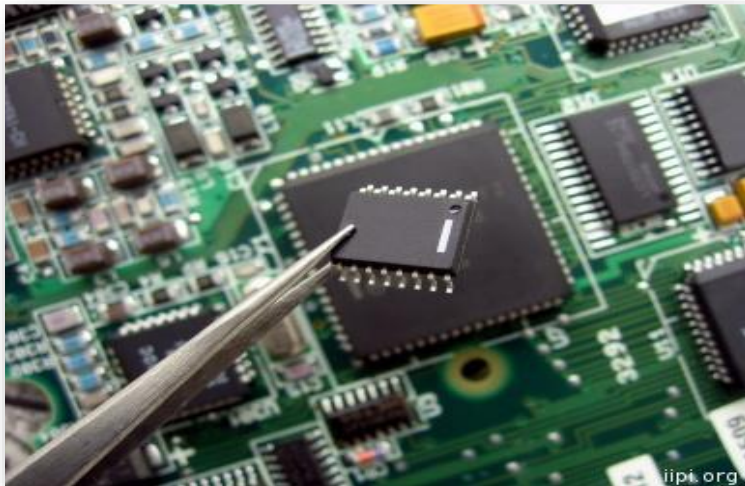
Types of Embedded System

Based on performance and functional requirements it is divided into four types:

- ❖ Real-time embedded system
- ❖ Stand-alone embedded system
- ❖ Network embedded system
- ❖ Mobile embedded system

Real-time Embedded System

Real-time embedded systems are those that incorporate a real-time operating system, ensuring that the device can respond to sensor input within the time Constrain specified by embedded software

Stand-alone Embedded System

Stand-alone embedded systems can work themselves they don't depend on a host system. It takes the input in digital or Analog form and Provides output.
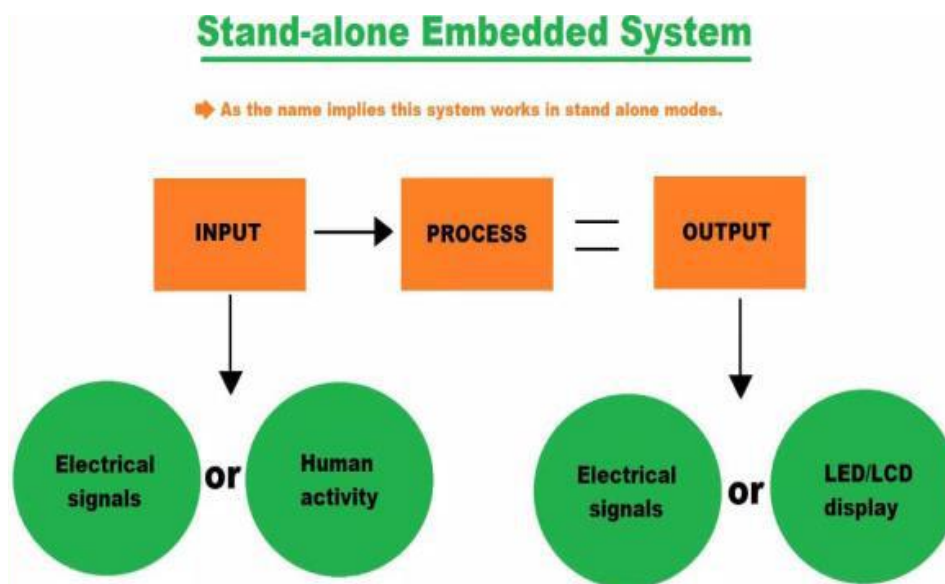
Network Embedded System

Network, or networked embedded system relay on wire or wireless networks and communication with web servers for output generation

Mobile Embedded System

A combination of hardware and software designed to perform a particular task this smartphone helps the user to interact with the embedded system located within the proximity of the smartphone.

21. BLOCKCHAIN TECHNOLOGY

The History Of Bitcoin

2008: Idea was published under the pseudonym, Satoshi Nakamoto.

2009: Start of the Bitcoin Network.

2010: First Cryptocurrency stock exchange is launched.

2011: One Bitcoin equals one USD.

2013: 1Bitcoin equals 100 USD.

2014: Microsoft accepts Bitcoin.

2017: 1 Bitcoin equals 10,000 USD.

Bitcoin and Blockchain

Bitcoin

Bitcoin is an application of block chain technology.

Blockchain

Blockchain is the underlying data structure, Which can be used for many things, including cryptocurrencies.
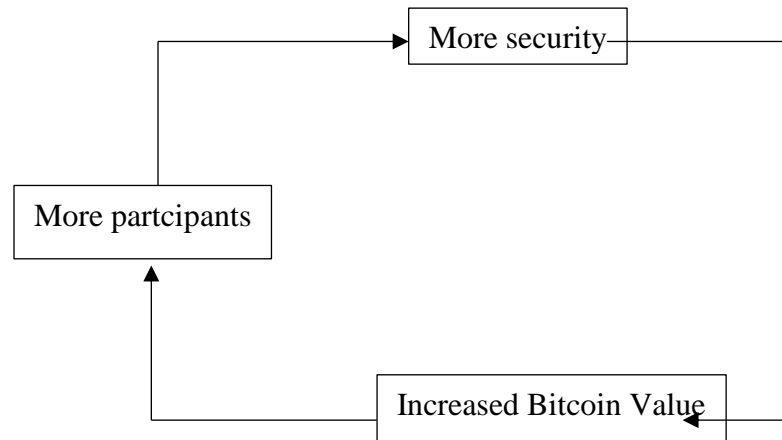
what is a Blockchain?

A blockchain is a growing list of data blocks that are linked together.

Block chain was introduced in the year 2008, introduced by Satoshi Nakamoto. In the early stage, the blockchain is used in bid coins. After the year passed the blockchain is used in the financial department and medical department and supply chain department.

Bitcoin Ecosystem

A public network in which anyone, including a malicious participant, can participate without restriction. Even though it is not organized by a central authority, it works!

```
            ┌──────────────┐
       ┌───▶│ More security │────┐
       │    └──────────────┘    │
┌──────────────┐                │
│ More partcipants │            │
└──────────────┘                │
       ▲                        ▼
       │    ┌────────────────────┐
       └────│ Increased Bitcoin Value │
            └────────────────────┘
```

Building Consensus

After a finite time, all participants agree on a single state.

### Creating Witnesses

If something is published on a public blockchain, all participants become witnesses. This is used, for example, by Originstamp to create a secure timestamp for documents.

Key Features

- ❖ Write-Only, immutable, transparent data storage.
- ❖ Decentralized, no need for intermediaries.
- ❖ Consistent state across all participants.
- ❖ Resistant against malicious participants.

22. COMPONENTS OF THE BLOCKCHAIN SYSTEM
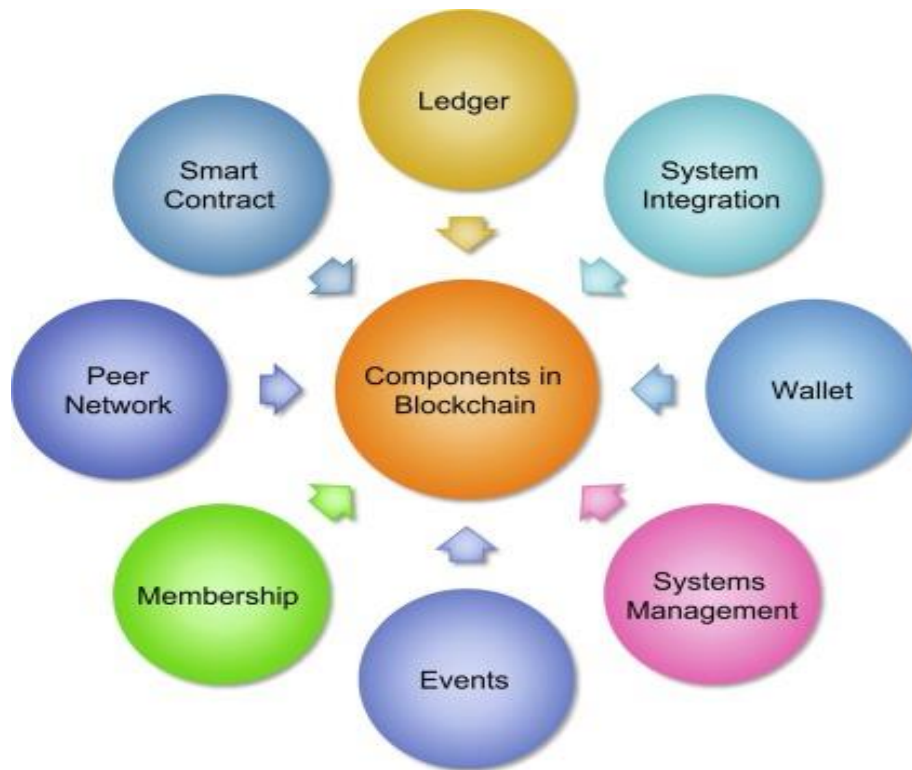
Several actors such as developers, users, architects, regulators, operators, membership services, etc.. are present in a blockchain that provides a solution to a blockchain-based business network.

Each actor and component present in a blockchain plays a major role to make the network more secure and reliable. In the functionality of blockchain components and concepts.

1. Ledger

A blockchain is a data structure that makes it possible to create a digital ledger of transactions and share it among a distributed network of computers.

2. System Integration

Blockchain for integration is a powerful technology that creates an immutable record of transactions that can be used to optimize business processes, enhance security, and maintain trust between stakeholders.

3. Wallet

Broadly speaking, a blockchain wallet is a digital wallet that allows users to store, manage, and trade their cryptocurrencies.

4. System Management

Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack or cheat the system.

5. Events

"Events" can be seen as present on a blockchain: each transaction can be seen as a kind of event: "The event of doing a certain transaction".

6. Membership

A blockchain network is a peer-to-peer network running a decentralized blockchain framework. Members are unique identities in the network.

7. Peer Network

Peer to peer network, commonly known as P2P is a decentralized network communications model that consists of a group of devices(nodes) that collectively store and share files where each node acts as an individual peer.

8. Smart Contract

Smart contracts defined. Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met.
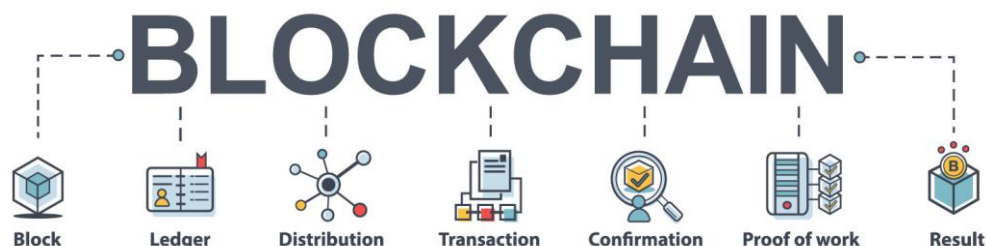
23. PROMINENT BLOCKCHAIN APPLICATIONS

Blockchain applications go far beyond cryptocurrency and bitcoin. With its ability to create more transparency and fairness while also saving businesses time and money, the technology is impacting a variety of sectors in ways that range from how contracts are enforced to making government work more efficiently.

We rounded up 34 examples of real-world blockchain use cases for this pragmatic yet revolutionary technology. It's far from an exhaustive list, but they're already changing how we do business.


13 Prominent Blockchain Applications to Know

- ❖ Secure sharing of medical data
- ❖ NFT marketplaces
- ❖ Music royalties tracking
- ❖ Cross-border payments
- ❖ Real-time IoT operating systems
- ❖ Personal identity security
- ❖ Anti-money laundering tracking system
- ❖ Supply chain and logistics monitoring
- ❖ Voting mechanism
- ❖ Advertising insights
- ❖ Original content creation

- Cryptocurrency exchange

- The real estate processing platform

Examples Of Blockchain

Bitcoin and Ethereum are popular examples of blockchains. Everyone is allowed to connect to the blockchain and transact on them.
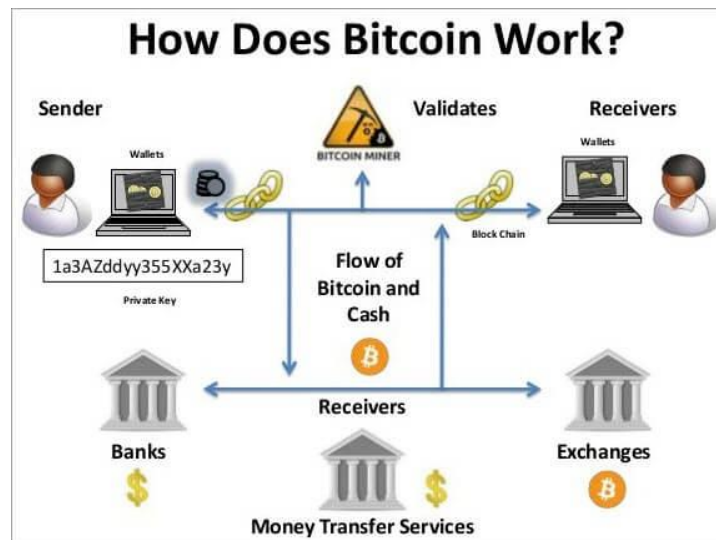
Each of these blockchains has a set of times assigned within which a block is to be added to the chain. For instance, the Bitcoin blockchain takes 10 minutes to verify a block and chain it with the previously verified blocks. This equals the transaction delay time. Ethereum and most of the modern blockchains have improved this and thus they take only seconds to verify a block and transactions in it.

For instance, Bitcoin started in 2009 and was rewarding users 50 BTC for verifying a single block in 10 minutes. This has reduced over the years to the current 6.75 BTC.

The reduction is because many people are joining the network and more cryptocurrency is in circulation to reduce the original set supply. This means it will take more time to release the rest of the fewer cryptocurrencies. Each blockchain has a limited supply or the number of coins that will be released to the public eventually, but this release happens in a timed manner over time.

24. LANGUAGES FOR BLOCKCHAIN DEVELOPMENT

Blockchain is synonymous with security as tampering with these blocks is next to impossible! And that makes this technology very popular in fields like banking, finance, etc. Blockchain was first made popular when it was used in the implementation of BitCoin. After all, people want their money to be as secure as possible! And so currently, Blockchain developers are highly in demand.

PYTHON

Python is fast becoming the most popular programming language in the world and if you are a new developer with experience in Python, then it might be the best Blockchain language for you. A problem with Python is that it is an interpreted language and that creates some problems for complex cryptographic operations in Blockchain.

However, Python is an object-oriented language that helps in managing many of its performance-related overheads. Another benefit of Python is that developers can prototype their ideas quickly with any long-winded coding required. Python also has huge open-source support which makes it ideal for Blockchain. There are many Python libraries, plugins, and other resources available online for almost every problem you can encounter in Blockchain development.

JAVA

Java provides stiff competition to C++ in popularity and usefulness. This is true in Blockchain technology as well! Java has an abundant Application Programming Interface (API) that includes many Java classes, packages, interfaces, etc. This is useful for constructing applications without necessarily knowing their inside implementations. Also, the one property of Java that is particularly useful in Blockchain is its portability. Java programs can be ported onto different platforms because of its WORA ("write once, run anywhere") functionality. These programs are not dependent on system-specific architecture as they use the universal JVM (Java Virtual Machine) for execution. This portability along with the other popular features of Java makes it perfect for Block chain.

VYPER

Vyper is a new Blockchain programming language that is derived from Python 3. So the Vyper syntax is also valid Python 3 syntax, even though Vyper does not have all of Python's features. Vyper is created as an alternative to Solidity. It is usually used for the Ethereum Virtual Machine (EVM), just like Solidity is. However, Vyper has different control structures than Solidity and it also handles security issues differently. Vyper has also done away with much of the OOPS functionalities in Solidity along with other features like infinite loops, modifiers, recursive calling, etc. This helps in avoiding the security issues that arise because of these features. So, if you want a Blockchain development language for writing smart contracts, check out Vyper!

C#

C# is syntactically similar to Java and C++ so it is ideal as a Blockchain programming language. While C# was initially created only as a Microsoft language, it is now quite popular and considered one of the best programming languages for blockchain. Open-source developers can easily create a highly portable code using C# that will run across all devices and multiple operating systems such as Windows, Linux, Mac, Android, etc. Also, since C# is an OOPs programming language, Blockchain developers can obtain maximum performance when developing their next blockchain.

25. BLOCKCHAIN PROTOCOL

With the internet, a broad range of protocols is widely used, such as HTTP, HTTPS, FTP, and SSH. Likewise, many protocols have been developed for this. The differences between protocols are significant, so various protocols will offer advantages and disadvantages that you will need to consider when creating an application. The bottom line is that if you want to get the most out of Blockchain technology, you have to understand how protocols impact network performance and the limitations that they can entail. When seeking to understand protocols, you should start by understanding some common terms that professionals use to describe how Block chains communicate.

Hyperledger

Hyper ledger is an open-source project that aims to create a suite of tools for enterprises to deploy technologies quickly and effectively. The protocol is commonly used in Block chain software solutions because it comes with libraries that help to speed up development. The Linux Foundation is a strong supporter of, and it has supplied significant expertise to accelerate the creation of the protocol. Hyper ledger is also highly compatible with Linux, so it is designed to work effectively on the same servers that are widely used in today's business world.

Multichain

Multi-chain was established to help for-profit corporations create private Block chains to facilitate more efficient transactions and to develop new applications for

the proof-of-work systems that Block chain technologies rely on. As a private company, Multi chain can offer an API that can be used by development services to streamline integration and accelerate deployment. What sets Multi chain apart from its competitors is how it is designed to work alongside fiat currencies and physical stores of value. In contrast, most cryptocurrency projects are centered on the ultimate replacement of physical money with digital mediums of exchange.

Enterprise Ethereum

Ethereum offers a version of its software that is designed for business use cases. The goal of Ethereum Enterprise is to increase the business use cases of software development. With Ethereum Enterprise, businesses can rapidly develop large-scale applications to exchange value. The major advantage of Ethereum Enterprise is that it allows businesses to create proprietary variants of Ethereum while still taking full advantage of the latest Ethereum code. Under ordinary circumstances, Ethereum's license makes it difficult to build proprietary variants of the software, but the enterprise version gives businesses an option for getting around this issue.

Corda

Corda is a competitor of Multichain that offers a protocol designed for enterprises. Most applications that have been developed with Corda have been in the finance and banking field. However, a wide range of custom Blockchain solutions can make use of Corda's technology. Corda is accredited by the R3 banking consortium, so it is a good choice for Blockchain development solutions in the finance industry.

Quorum

As with many of the leading protocols, Quorum aims to help businesses in the finance sector. Quorum is significant because it has strong backing from the financial community. For instance, J.P. Morgan Chase is a primary financial backer of the protocol, and it has received additional resources from other leading banks. However, Quorum has managed to remain an open-source project that can be utilized by anyone. Quorum is also strongly associated with Ethereum since the project started by modifying the Ethereum code.

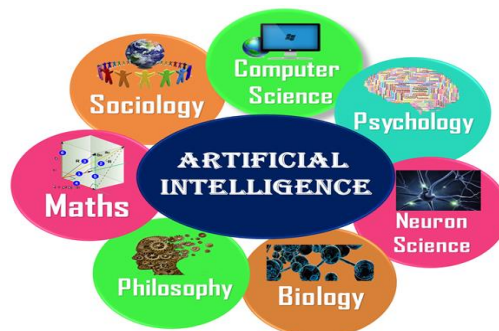# 26. BASIC CONCEPTS OF ARTIFICIAL INTELLIGENCE

Goals of Artificial Intelligence

Creativity and ideas never end as they are limitless. Likewise, there are a lot more things to create, improve, implement, and invent in the field of Artificial Intelligence. AI is far from reaching its saturation level of creating new things.
In short, here are the goals of Artificial Intelligence:
- ❖ Create machines that can replicate human intelligence
- ❖ Improve machine efficiency and accuracy
- ❖ Develop tools to help people solve real-world problems, e.g., robotics for people with disabilities, auto-driving cars to avoid accidents caused by human error, etc.

Artificial Intelligence is the intelligence that machines demonstrate. It allows us to create machines that can perform multiple tasks and solve real problems without error. AI can improve efficiency and productivity by automating repetitive tasks. Additionally, it can create an immersive and responsive experience and understand human emotions.

Advantages of Artificial Intelligence

High Accuracy with Fewer Errors: AI machines or systems are prone to fewer errors and high accuracy as it takes decisions as on pre-experience or information.

High-Speed: AI systems can be of very high-speed and fast-decision making, and because of that AI systems can beat a chess champion in the Chess game.

High Reliability: AI machines are highly reliable and can perform the same action multiple times with high accuracy.

Useful for Risky Areas: AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, and where employing a human can be risky.

Digital Assistant: AI can be very useful to provide digital assistance to the users such as AI technology is currently used by various E-commerce websites to show products as per customer requirements.

Useful as a Public Utility: AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purposes, Natural language processing to communicate with the human in human language, etc.
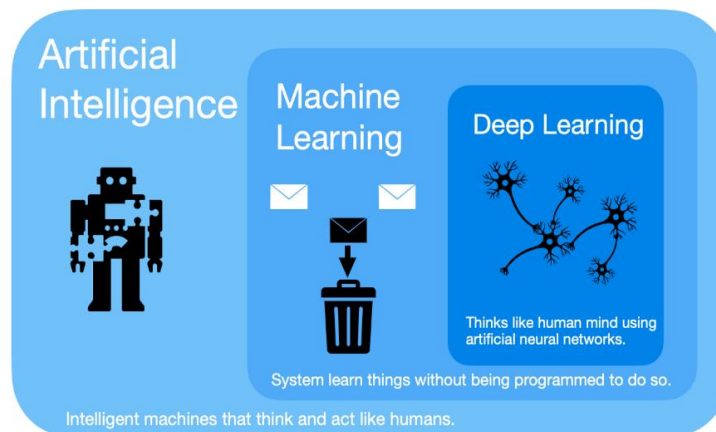
Disadvantages of Artificial Intelligence

High Cost: The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.

Can't think out of the box: Even though we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do the work for which they are trained, or programmed.

No Feelings and Emotions: AI machines can be an outstanding performer, but still it does not have the feeling so they cannot make any kind of emotional attachment to humans, and may sometime be harmful to users if the proper care is not taken.

Increase Dependency on Machines: With the increment of technology, people are getting more dependent on devices, and hence they are losing their mental capabilities.

No Original Creativity: Humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

27. KEY ELEMENTS OF ARTIFICIAL INTELLIGENCE

The Key Elements of AI include

❖ Natural language processing (NLP).

❖ Expert systems.

❖ Robotics.

❖ Intelligent agents.

❖ Computational intelligence.

Natural Language Processing (NLP)

Natural Language Processing (NLP) is a branch of Artificial Intelligence (AI) that enables machines to understand human language. Its goal is to build systems that can make sense of the text and automatically perform tasks like translation, spell check, or topic classification.

NLP primarily depends on machine learning algorithms for deriving meanings from words and sentences. NLP is one of the hottest and trendiest topics these days. Companies are investing an enormous amount of money in this as its outcomes are remarkable. One of the most familiar examples of NLP is Google Voice Search.

Expert Systems

In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if-then rules rather than through conventional procedural code.

An expert system is a computer program that uses artificial intelligence (AI) technologies to simulate the judgment and behavior of a human or an organization that has expertise and experience in a particular field.
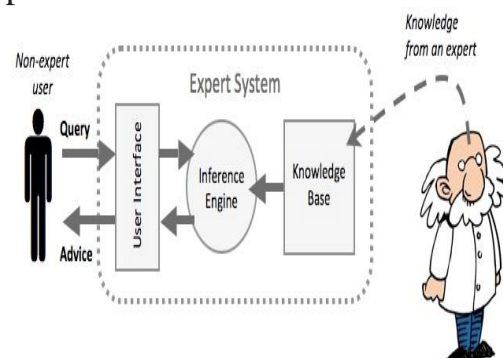
Robotics

Robotics and AI amplify human potential, increase productivity, and are moving from simple reasoning towards human-like cognitive abilities.AI can help a robot do a lot of tasks, from successfully navigating its surroundings, to identifying objects around the robot or assisting humans with various tasks such as bricklaying, installing drywall, or robotic-assisted surgeries. AI can help a robot do a lot of tasks, from successfully navigating its surroundings, to identifying objects around the robot or assisting humans with various tasks such as bricklaying, installing drywall, or robotic-assisted surgeries.

Intelligent Agents

An intelligent agent (IA) is an entity that makes a decision, that enables artificial intelligence to be put into action. It can also be described as a software entity that conducts operations in the place of users or programs after sensing the environment. It uses actuators to initiate action in that environment.

Agents can be grouped into five classes based on their degree of perceived intelligence and capability:

- Simple Reflex Agents.
- Model-Based Reflex Agents.
- Goal-Based Agents.
- Utility-Based Agents.
- Learning Agent.

## Computational Intelligence:

Computational Intelligence (CI) is the theory, design, application, and development of biologically and linguistically motivated computational paradigms. Traditionally the three main pillars of CI have been Neural Networks, Fuzzy Systems, and Evolutionary Computation.

Computational intelligence, also known as soft computing, is a form of computing modeled on the methods by which humans learn. As computers learn from processes based on logic and science, they become more intelligent.
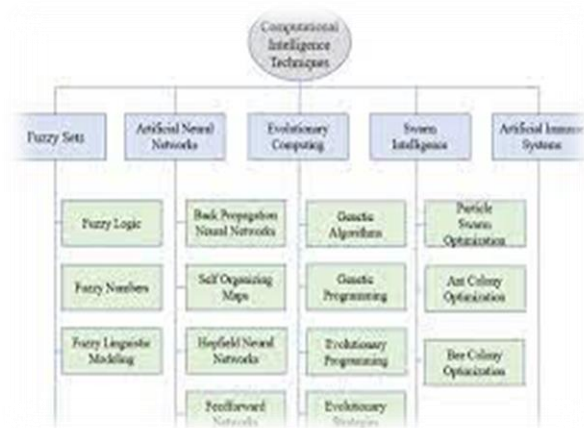
28. SUB-FIELDS OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence is having various subfields in its domain. All the Sub-Fields can be distinguished as per various techniques.
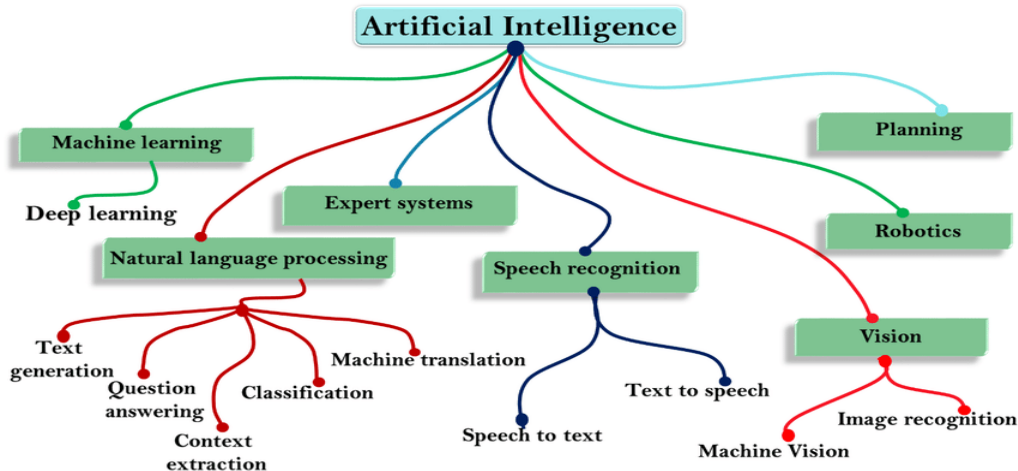
Machine Learning

❖ Machine Learning is based on the idea that machines can learn from past data, identify patterns, and make decisions using algorithms.

❖ Machine learning algorithms are designed in such a way that they can learn and improve their performance automatically.

❖ Machine learning helps in discovering patterns in data.

Natural Language Processing

❖ Natural language processing application enables a user to communicate with the system in their own words directly. such as English

❖ The Input and output of NLP applications can be in two forms:

1. Speech   2. Text

Deep Learning

❖ Deep learning is implemented through neural network architecture hence also called a **Deep Neural Network**.

❖ Deep learning is the primary technology behind self-driving cars, speech recognition, image recognition, automatic machine translation, etc.

❖ The main challenge for deep learning is that it requires lots of data with lots of computational power.

Expert System

❖ Expert systems emulate the decision-making ability of human experts. These systems are designed to solve complex problems through bodies of knowledge rather than conventional procedural code.

❖ One example of an expert system is a Suggestion for the spelling error while typing in the Google search box.

Robotics

❖ Robotics is a branch of artificial intelligence and engineering which is used for designing and manufacturing robots.

❖ Robots are programmed machines that can perform a series of actions automatically or semi-automatically.

❖ AI can be applied to robots to make intelligent robots that can perform the task with their intelligence.

Machine Vision

❖ Machine vision captures and analyses visual information using one or more video cameras, analog-to-digital conversations, and digital signal processing.

❖ Machine vision systems are programmed to perform narrowly defined tasks such as counting objects, reading serial numbers, etc.

❖ Computer systems do not see in the same way as human eyes can see, but it is also not bound by human limitations such as seeing through the wall.

❖ With the help of machine learning and machine vision, an AI agent can be able to see through walls.

Speech Recognition

❖ Speech recognition is a technology that enables a machine to understand spoken language and translate it into a machine-readable format. It can also be said for automatic Speech recognition and computer speech recognition. It is a way to talk with a computer and based on that command, a computer can perform a specific task

29. EXPERT SYSTEM IN AI (ARTIFICIAL INTELLIGENCE)

Expert System

An expert System is an interactive and reliable computer-based decision-making system that uses both facts and heuristics to solve complex decision-making problems. It is considered the highest level of human intelligence and expertise. The purpose of an expert system is to solve the most complex issues in a specific domain.

Expert Systems in Artificial Intelligence

The Expert System in AI can resolve many issues which generally would require a human expert. It is based on knowledge acquired from an expert. Artificial Intelligence and Expert Systems are capable of expressing and reasoning about some domain of knowledge.
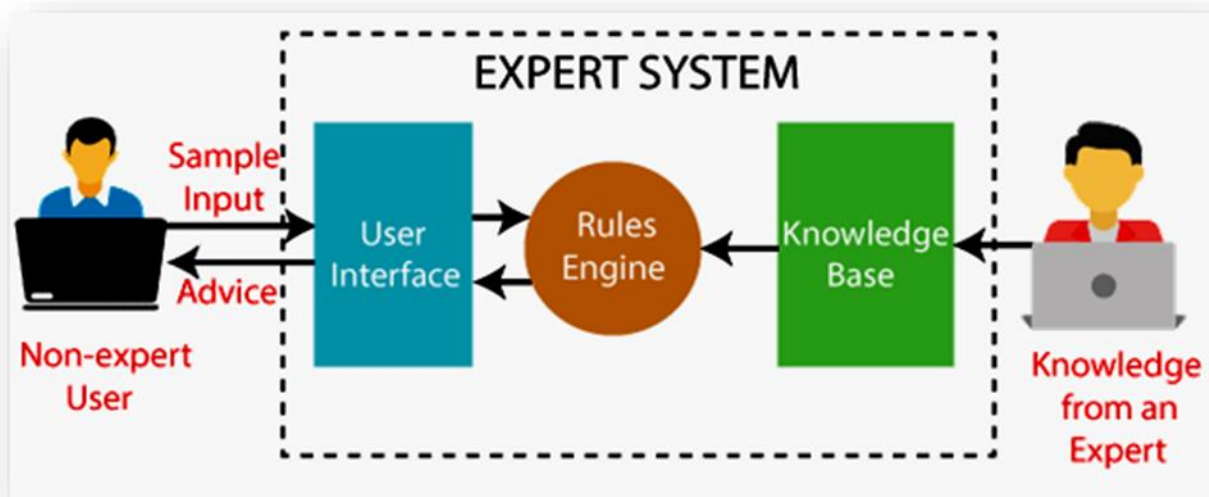
## Examples of Expert Systems

Following are the Expert System Examples:

❖ MYCIN: It was based on backward chaining and could identify various bacteria that could cause acute infections. It could also recommend
❖ DENDRAL: Expert system used for chemical analysis to predict molecular structure.

❖ PXDES: An Example of an Expert System used to predict the degree and type of lung cancer.
❖ CaDet: One of the best Expert System Examples that can identify cancer at its early stages.

Advantages of Expert System

It improves the decision quality

❖ Cuts the expense of consulting experts for problem-solving
❖ It provides fast and efficient solutions to problems in a narrow area of specialization.
❖ It can gather scarce expertise and use it efficiently.
❖ Offers consistent answers for the repetitive problem
❖ Maintains a significant level of information
❖ Helps you to get fast and accurate answers
❖ A proper explanation of decision making
❖ Ability to solve complex and challenging issues
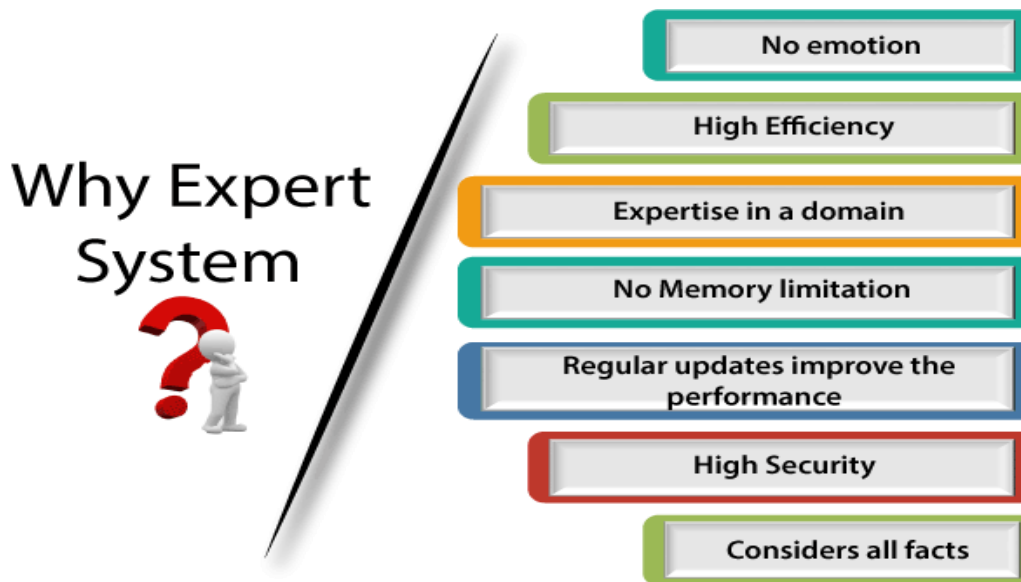
Artificial Intelligence Expert Systems can steadily work without getting emotional, tensed or fatigued.

30. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is machine-displayed intelligence that simulates human behavior or thinking and can be trained to solve specific problems. AI is a combination of Machine Learning techniques and Deep Learning. AI models that are trained using vast volumes of data can make intelligent decisions.

Application in E-Commerce Personalized Shopping

Artificial Intelligence technology is used to create recommendation engines through which you can engage better with your customers. These recommendations are made by their browsing history, preference, and interests.

Applications of Artificial Intelligence in Education

Although the education sector is the one most influenced by humans, Artificial Intelligence has slowly begun to seep its roots into the education sector as well.

Creating Smart Content

Digitization of content like video lectures, conferences, and textbook guides can be made using Artificial Intelligence. We can apply different interfaces like animations and learning content through customization for students from different grades.

Applications of Artificial Intelligence in Lifestyle

Autonomous Vehicles - Automobile manufacturing companies like Toyota, Audi, Volvo, and Tesla use machine learning to train computers to think and evolve like humans when it comes to driving in any environment and object detection to avoid accidents.

Facial Recognition - Our favorite devices like our phones, laptops, and PCs use facial recognition techniques by using face filters to detect and identify to provide secure access. Apart from personal usage, facial recognition is a widely used Artificial Intelligence application even in high security-related areas in several industries.

Applications of Artificial intelligence in Navigation

Based on research from MIT, GPS technology can provide users with accurate, timely, and detailed information to improve safety. The technology uses a combination of Convolutional Neural Networks and Graph Neural Networks, which makes lives easier for users by automatically detecting the number of lanes and road types behind obstructions on the roads. AI is heavily used by Uber and many logistics companies to improve operational efficiency, analyze road traffic, and optimize routes.

Applications of Artificial Intelligence in Robotics

Robotics is another field where artificial intelligence applications are commonly used. Robots powered by AI use real-time updates to sense obstacles in their path and pre-plan their journey instantly. It can be used for -Carrying goods in hospitals, factories, and warehouses, cleaning offices and large equipment, Inventory management

Applications of Artificial Intelligence in Healthcare

Artificial Intelligence finds diverse applications in the healthcare sector. AI applications are used in healthcare to build sophisticated machines that can detect diseases and identify cancer cells. Artificial Intelligence can help analyze chronic conditions with lab and other medical data to ensure early diagnosis. AI uses the combination of historical data and medical intelligence for the discovery of new drugs.

Applications of Artificial Intelligence in Agriculture

Artificial Intelligence is used to identify defects and nutrient deficiencies in the soil. This is done using computer vision, robotics, and machine learning applications, AI can analyze where weeds are growing. AI bots can help to harvest crops at a higher volume and faster pace than human laborers.

Applications of Artificial Intelligence in Social Media

Instagram, Facebook, Twitter - On Instagram, AI considers your likes and the accounts you follow to determine what posts you are shown on your explore tab.

31.BASICS OF DATA ANALYTICS

Data Analytics

Data analytics is a broad term that encompasses many diverse types of data analysis. Any type of information can be subjected to data analytics techniques to get insight that can be used to improve things. Data analytics techniques can reveal trends and metrics that would otherwise be lost in the mass of information. This information can then be used to optimize processes to increase the overall efficiency of a business or system.

Types of Analytics

At the core of any data refinement process sits what is commonly referred to as "analytics". But different people use the word "analytics" to imply different things. If you're in marketing and would like to understand data analytics, you should understand the different types of analytics.

Descriptive Analytics

Descriptive analytics is characterized by conventional business intelligence and visualizations such as the bar charts, pie charts, line graphs, or the generated narratives. A simple illustration of descriptive analytics can be assessing credit risk in a bank. Descriptive analytics is useful in providing insights into sales cycle such as categorizing customers based on their preferences.

Diagnostic Analytics

As the name suggests, diagnostic analytics is used to unearth or to determine why something happened. For example, if you're conducting a social media marketing campaign, you may be interested in assessing the number of likes, reviews, mentions, followers or fans. Diagnostic analytics can help you distill thousands of mentions into a single view so that you can make progress with your campaign.

Prescriptive Analytics:

While most data analytics provides general insights on the subject, prescriptive analytics gives you with a "laser-like" focus to answer precise questions. For instance, in the healthcare industry, you can use prescriptive analytics to manage the patient population by measuring the number of patients who are clinically obese. Prescriptive

analytics can allow you to add filters in obesity such as obesity with diabetes and cholesterol levels to find out areas where treatment should be focused.

Exploratory Analytics

Exploratory analytics is an analytical approach that primarily focuses on identifying general patterns in the raw data to identify outliers and features that might not have been anticipated using other analytical types. For you to use this approach, you have to understand where the outliers are occurring and how other environmental variables are related to making informed decisions.

Predictive Analytics

Predictive analytics is the use of data, machine learning techniques, and statistical algorithms to determine the likelihood of future results based on historical data. The primary goal of predictive analytics is to help you go beyond just what has happened and provide the best possible assessment of what is likely to happen in future.

Mechanistic Analytics

As the name suggests, mechanistic analytics allow big data scientists to understand clear alterations in procedures or even variables which can result in changing of variables. The results of mechanistic analytics are determined by equations in engineering and physical sciences. Also, they allow data scientists to determine the parameters if they know the equation.

Causal Analytics

Causal analytics allow big data scientists to figure out what is likely to happen if one component of the variable is changed. When you use this approach, you should rely on a number of random variables to determine what's likely to happen next even though you can use non-random studies to infer from causations. This approach to analytics is appropriate if you're dealing with large volumes of data.

Inferential Analytics

This approach to analytics takes different theories on the world into account to determine the certain aspects of the large population. When you use inferential analytics, you'll be required to take a smaller sample of information from the population and use that as a basis to infer parameters about the larger population.

32. VIRUS AND WORMS

Worms

Worms are similar to a virus but it does not modify the program. It replicates itself more and more to cause slow down the computer system. Worms can be controlled by remote. The main objective of worms is to eat the system resources.

A worm is a standalone malware computer program that replicates itself in order to spread to other computers. It often uses a computer network to spread itself, relying on security failures on the target computer to access it. It will use this machine as a host to scan and infect other computers.

When these new worm-invaded computers are controlled, the worm will continue to scan and infect other computers using these computers as hosts, and this behavior will continue. Computer worms use recursive methods to copy themselves without host programs and distribute themselves based on the law of exponential growth, thus controlling and infecting more and more computers in a short time. Worms almost always cause at least some harm to the network, even if only by consuming bandwidth, whereas viruses almost always corrupt or modify files on a targeted computer.

Virus

A virus typically attaches itself to a program, file, or the boot sector of the hard drive. Once the virus attaches itself to that file or program (aka, the host), they're infected. When the infected application or file runs in the computer, the virus activates and executes in the system. It continues to replicate and spread by attaching replicas of itself to other files and applications in the system.

A virus is a malicious executable code attached to another executable file that can be harmless or can modify or delete data. When the computer program runs attached with a virus it performs some action such as deleting a file from the computer system.

Viruses can't be controlled by remote. The ILOVEYOU virus spreads through email attachments. Viruses are named after human viruses that spread from person to person.

Difference Between Worms and Virus

Viruses are often attached or concealed in shared or downloaded files, both executable files. A program that runs script and non-executable files such as a Word document or an image file. When the host file is accepted or loaded by a target system, the virus remains dormant until the infected host file is activated. Only after the host file is activated, can the virus run, executing malicious code and replicating to infect other files on your system.

In contrast, worms don't require the activation of their host file. Once a worm has entered your system, usually via a network connection or as a downloaded file, it can then run, self-replicate and propagate without a triggering event. A worm makes multiple copies of itself which then spread across the network or through an internet connection. These copies will infect any inadequately protected computers and servers that connect via the network or internet to the originally infected device. Because each subsequent copy of a worm repeats this process of self-replication, execution and propagation, worm-based infections spread rapidly across computer networks and the internet at large.

How Does a Computer Virus Spread?

A virus spreads when the infected file or program migrates through networks, file collaboration apps, email attachments, and USB drives. Once a user opens the infected file or program, the vicious cycle repeats itself all over again.

Typically, the host program continues to function after the viral infection, but some viruses overwrite entire programs with copies of themselves, which corrupts and destroys the host program altogether. Viruses can also attack data: they can disrupt access, corrupt, and/or destroy your data.

How to Protect All Your Devices from Viruses and Worms?

Viruses, worms and malware most often exploit security vulnerabilities and bugs. For this reason, it is crucial to keep current with all OS and application updates and patches. Unfortunately, keeping current with updates and being vigilant simply are enough. There are many exploits and vectors that can get viruses and worms into a network or onto a computer or mobile device. It has also made threats against your safety an everyday concern.

33. PURPOSE OF DATA SCIENCE

Data Science

Data science is the field of applying advanced analytics techniques and scientific principles to extract valuable information from data for business decision-making, that data science generates help organizations increase operational efficiency, identify new business opportunities and improve marketing and sales programs, among other benefits. Ultimately, they can lead to competitive advantages over business rivals.

Data Science Tools

Data scientists rely on popular programming languages to conduct exploratory data analysis and statistical regression. These open source tools support pre-built statistical modeling, machine learning, and graphics capabilities.

R Studio - An opensource programming language and environment for developing statistical computing and graphics.

Python - It is a dynamic and flexible programming language. The Python includes numerous libraries, such as NumPy, Pandas, Matplotlib, for analyzing data quickly.

Data scientists also gain proficiency in using big data processing platforms, such as Apache Spark, the open-source framework Apache Hadoop, and NoSQL databases. They are also skilled with a wide range of data visualization tools, including simple graphics tools included with business presentation and spreadsheet applications, built-for-purpose commercial visualization tools like Tableau and IBM Cognos, and open-source tools like D3.js (a JavaScript library for creating interactive data visualizations) and RAW Graphs. For building machine learning models, data scientists frequently turn to several frameworks like PyTorch, TensorFlow, MXNet, and Spark MLib.

Data Science Applications

Fraud and Risk Detection - Over the years, financial organizations have learned to analyze the probabilities of risks and defaults through customer profiling, past expenditures, and other variables available through data.

Internet Search - All search engines, including Google, use data science algorithms to deliver the best result for searched queries within seconds.

Recommendation Systems - Internet giants as well as other businesses have fervidly made use of recommendation engines to promote their products based on users' previous search results and their interests.

Augmented Reality (AR) - Augmented reality promises an exciting future through Data Science. A VR headset, for example, contains algorithms, data, and computing knowledge to offer the best viewing experience.
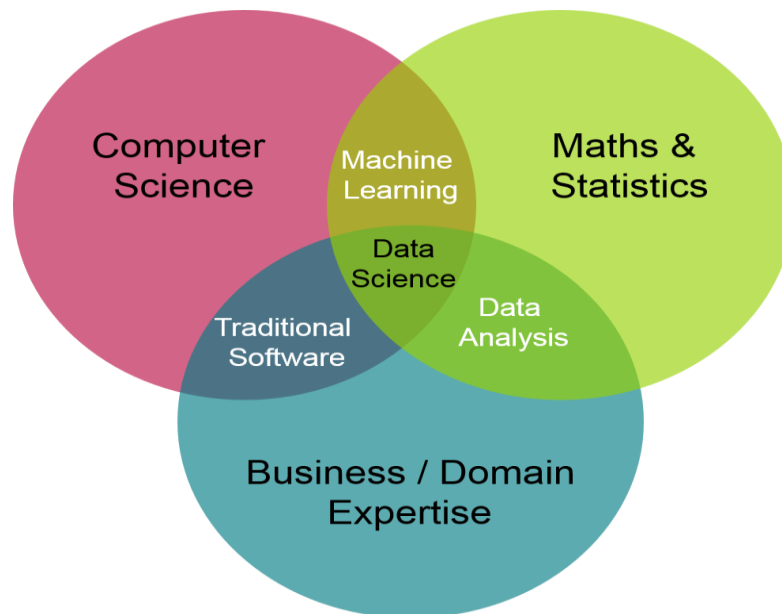
Figure.1 Data Science

Importance of Data Science

Data creates magic. Industries need data to help them make careful decisions. Data Science churns raw data into meaningful insights. Therefore, industries need data science. A Data Scientist is a wizard who knows how to create magic using data. A skilled Data Scientist will know how to dig out meaningful information with whatever data he comes across.

He helps the company in the right direction. The company requires strong data-driven decisions at which he's an expert. The Data Scientist is an expert in various underlying fields of Statistics and Computer Science. From the instances of data-centric companies, it is clear that each company uses data differently.

34. RASPBERRY PI- AN OVERVIEW

Raspberry Pi

Raspberry Pi is a small single board computer. By connecting peripherals like Keyboard, mouse, display to the Raspberry Pi, it will act as a mini personal computer. Raspberry Pi is popularly used for real time Image/Video Processing, IoT based applications and Robotics applications. Raspberry Pi is slower than laptop or desktop but is still a computer which can provide all the expected features or abilities, at low power consumption. Raspbian OS is official Operating System available for free to use. This OS is efficiently optimized to use with Raspberry Pi. Raspbian have GUI which includes tools for Browsing, Python programming, office, games, etc.

Raspberry Pi is more than computer as it provides access to the on-chip hardware i.e. GPIOs for developing an application. By accessing GPIO, we can connect devices like LED, motors, sensors and can control them too. It has ARM based Broadcom Processor SoC along with on-chip Graphics Processing Unit. The CPU speed of Raspberry Pi varies from 700 MHz to 1.2 GHz. Also, it has on-board SDRAM that ranges from 256 MB to 1 GB.

Uses of Raspberry Pi

There are so many things you can make with a Raspberry Pi and due to its extreme popularity, the number of third-party sensors, modules, and code libraries has grown to epic proportions. This has greatly expanded the possible applications for the Raspberry Pi. The applications really are endless, but here are some common ones: Web servers, Local network hubs for IoT, Sensor control, Robotics control, Industrial equipment control, Automated control systems, Data processing.

The Raspberry Pi OS

There are several different operating systems available for use on the Raspberry Pi, but the Raspberry Pi OS (formerly Raspbian) is the most popular. The Raspberry Pi OS is based on the Debian release of Linux.

Linux is great for critical applications because it focuses on security and stability instead of mainstream operating systems that focus on ease of use. Linux is also lightweight and less resource intensive than commercial operating systems.

Raspberry Pi 3 On-chip Hardware
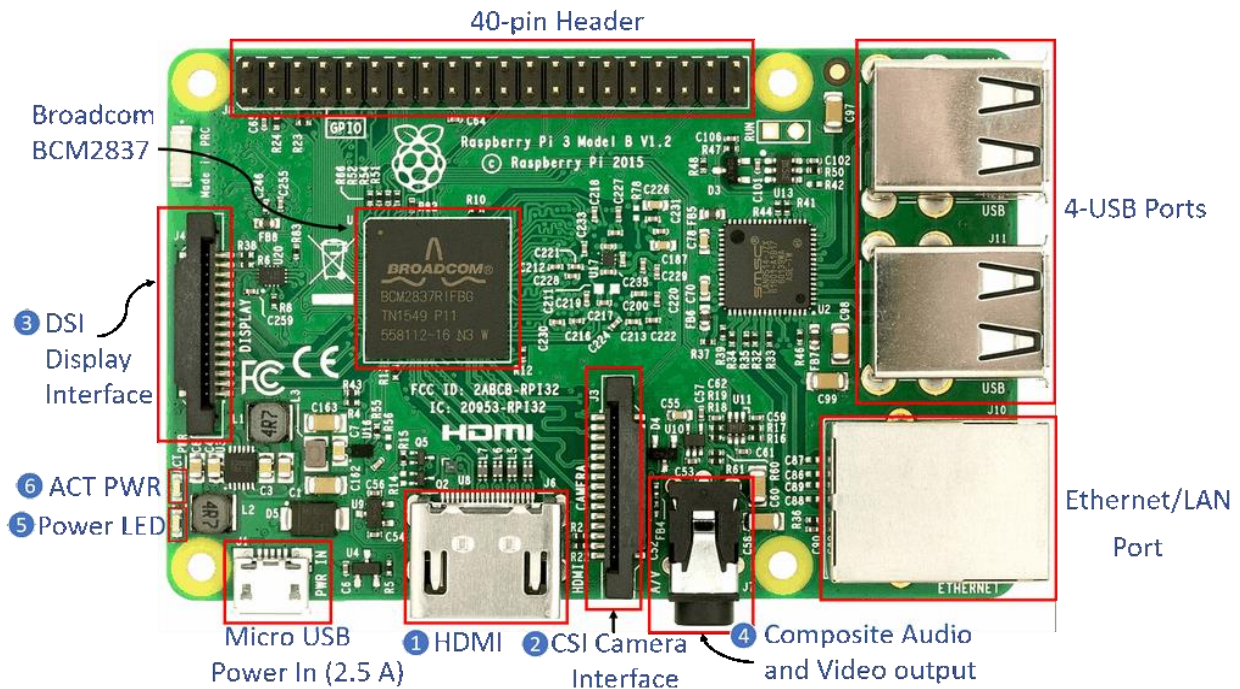
Some Hardware Components shown above are mention below:

HDMI (High-Definition Multimedia Interface): It is used for transmitting uncompressed video or digital audio data to the Computer Monitor, Digital TV, etc. Generally, this HDMI port helps to connect Raspberry Pi to the Digital television.

CSI Camera Interface: CSI (Camera Serial Interface) interface provides a connection in between Broadcom Processor and Pi camera. This interface provides electrical connections between two devices.

DSI Display Interface: DSI (Display Serial Interface) Display Interface is used for connecting LCD to the Raspberry Pi using 15-pin ribbon cable. DSI provides fast High-resolution display interface specifically used for sending video data directly from GPU to the LCD display.

Composite Video and Audio Output: The composite Video and Audio output port carries video along with audio signal to the Audio/Video systems.

Power LED: It is a RED colored LED which is used for Power indication. This LED will turn ON when Power is connected to the Raspberry Pi. It is connected directly and will start blinking whenever the supply voltage drops below 4.63V.

35. EMBEDDED C PROGRAM

Introduction to Embedded C Programming Language

Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems. The C Programming Language became so popular that it is used in a wide range of applications ranging from Embedded Systems to Super Computers. Embedded C Programming Language, which is widely used in the development of Embedded Systems, is an extension of C Program Language. The Embedded C Programming Language uses the same syntax and semantics of the C Programming Language like main function, declaration of data types, defining variables, loops, functions, statements, etc. The extension in Embedded C from standard C Programming Language include I/O Hardware Addressing, fixed point arithmetic operations, accessing address spaces, etc.

Factors for Selecting the Programming Language

Size: The memory that the program occupies is very important as Embedded Processors like Microcontrollers have a very limited amount of ROM (Program Memory).

Speed: The programs must be very fast i.e., they must run as fast as possible. The hardware should not be slowed down due to slow running software.

Portability: The same program can be compiled for different processors and Ease of Implementation, Ease of Maintenance, Readability.

Difference Between C and Embedded C

There is actually not much difference between C and Embedded C apart from few extensions and the operating environment. Both C and Embedded C are ISO Standards that have almost same syntax, data types, functions, etc.

Embedded C is basically an extension to the Standard C Programming Language with additional features like Addressing I/O, multiple memory addressing and fixed-point arithmetic, etc.

C Programming Language is generally used for developing desktop applications, whereas Embedded C is used in the development of Microcontroller based applications.

Different Components of an Embedded C Program

Comments

Comments are readable text that are written to help us (the reader) understand the code easily. They are ignored by the compiler and do not take up any memory in the final code (after compilation).

There are two ways you can write comments: one is the single line comments denoted by // and the other is multiline comments denoted by /*…*/.

Preprocessor Directive

A Preprocessor Directive in Embedded C is an indication to the compiler that it must look in to this file for symbols that are not defined in the program.

In C Programming Language (also in Embedded C), Preprocessor Directives are usually represented using # symbol like #include… or #define….

In Embedded C Programming, we usually use the preprocessor directive to indicate a header file specific to the microcontroller, which contains all the SFRs and the bits in those SFRs.

In case of 8051, Keil Compiler has the file "reg51.h", which must be written at the beginning of every Embedded C Program.

Global Variables: Global Variables, as the name suggests, are Global to the program i.e., they can be accessed anywhere in the program.

Local Variables: Local Variables, in contrast to Global Variables, are confined to their respective function.

Main Function: Every C or Embedded C Program has one main function, from where the execution of the program begins.

Data Types in Embedded C

Data Types in C Programming Language (or any programming language for that matter) help us declaring variables in the program. There are many data types in C Programming Language like signed int, unsigned int, signed char, unsigned char, float, double, etc. In addition to these there few more data types in Embedded C.

The following are the extra data types in Embedded C associated with the Keil's Cx51 Compiler: bit, sbit, sfr, sfr16.

We express our sincere Gratitude for all those who have helped us, for the successful launch of this book, which is one of the Best Practices of our Department....

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