CHAPTER 04

Emerging Trends

In this Chapter...

- Artificial Intelligence (AI)
- Big Data
- Internet of Things (IoT)
- Cloud Computing
- Grid Computing
- Blockchain Technology

Computers have been around for quite some time now. New technologies and initiatives emerge with each passing day. In order to understand the existing technologies and have a better view of the development around us, we must keep an eye on the emerging trends.

Many new technologies are introduced almost every day. Some of these do not succeed and fade away over time. Some of these new technologies prosper and persist over time, gaining attention from users.

Emerging trends are the state of the art technologies, which gain popularity and set a new trend among users. In this chapter, we will learn about some emerging trends that will make a huge impact on digital economy and interaction in digital societies.

Artificial Intelligence (AI)

Artificial Intelligence (AI) is an area of computer science that emphasises the creation of intelligent machines that work and react like humans.

The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

Knowledge engineering is a core part of AI research. Machines can often act and react like humans only if they have abundant information relating to the world.

Artificial intelligence must have access to objects, categories, properties and relations between all of them to implement knowledge engineering.

Types of Artificial Intelligence

Artificial intelligence can be categorised into two parts, which are as follows

(i) **Weak AI** It embodies a system designed to carry out one particular job. Weak AI systems include video games and personal assistants such as the chess and Amazon's Alexa, respectively.

(ii) **Strong AI** These systems are systems that carry on the tasks considered to be human like. Strong AI tend to be more complex and complicated systems. These kinds of systems can be found in applications like self-driving cars, in hospital operating rooms etc.

Applications of Artificial Intelligence

There are some applications of artificial intelligence, which are as follows

(i) **In Banking** A lot of banks have already adopted AI-based systems to provide customer support, detect anomalies and credit card frauds. AI solutions can be used to enhance security across a number of business sector, including retail and finance.

(ii) **In Gaming** Over the past few years, AI has become an integral part of the gaming industry. In fact, one of the biggest accomplishment of AI is in the gaming industry.

(iii) **In Healthcare** Companies are applying machine learning to make better and faster diagnoses than humans. One of the best known technologies is IBM's Watson. It understands natural language and can respond to questions asked it.

(iv) **In Business** Robotic process automation is being applied to highly repetitive tasks normally performed by humans. Machine learning algorithms are being integrated into analytics and CRM (Customer Relationship Management) platforms to uncover information on how to better serve customers.

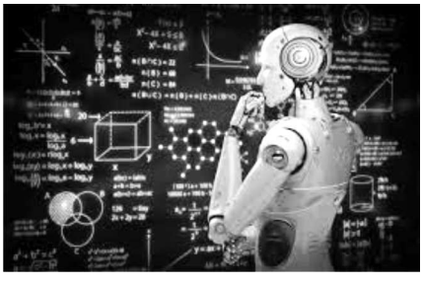
(v) **In Autonomous Vehicles** Just like humans, self driving cars need to have sensors to understand the world around them and a brain to collect, processes and choose specific actions based on information gathered. Autonomous vehicles are with advanced tool to gather information, including long range radar, cameras and LIDAR (Light Detection and Ranging).

(vi) **In Social Media** In social media platforms like facebook, AI is used for face verification wherein machine learning and deep learning concepts are used to detect facial features and tag your friends.

Machine Learning

Machine learning is a sub-system of artificial intelligence, wherein computers have the ability to learn from data using statistical techniques, without being explicitly programmed by a human being.

It comprises algorithms that use data to learn on their own and make predictions. These algorithms, called models, are first trained and tested using a training data and testing data, respectively. After successive trainings, once these models are able to give results to an acceptable level of accuracy, they are used to make predictions about new and unknown data.



Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, uncovering key insights within data mining projects. These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. As big data continues to expand and grow, the market demand for data scientists will increase, requiring them to assist in the identification of the most relevant business questions and subsequently the data to answer them.

Natural Language Processing (NLP)

The predictive typing feature of search engines that helps us by suggesting the next word in the sentence while typing keywords and the spell checking features are examples of Natural Language Processing (NLP). It deals with the interaction between human and computers using human spoken languages, such as Hindi, English, etc.

In fact, it is possible to search the web or operate or control our devices using our voice. All this has been possible by NLP. An NLP system can perform text-to-speech and speech-to-text conversion.

Some applications of Natural Language Processing are

- Sentiment Analysis
- Text Classification
- Chatbots & Virtual Assistants
- Text Extraction
- Machine Translation
- Text Summarization
- Market Intelligence
- Auto-Correct
- Intent Classificaion
- Urgency Detection
- Speech Recognition

Immersive Experiences

With the three dimensional (3D) videography, the joy of watching movies in theaters have reached to a new level video games are also being developed to provide immersive experiences to the player. Immersive experiences allow us to visualise, feel and react by stimulating over senses. It enhances our interaction and involvement, making them more realistic and engaging.

Immersive experiences have been used in the field of training, such as driving simulators, flight simulator and so on. Immersive experiences can be achieved using virtual reality and augmented reality.

1. Virtual Reality

Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds.

Virtual reality is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: Sight and Sound.

There are several applications of virtual reality technology in human lives, some of them are discussed below

(i) **In Gaming** Virtual technology's devices are used for virtual gaming experiences. Along with this, devices such as Wi-Fi Remote, PlayStation Move/Eye, Kinect are based on virtual reality which track and send input of the players to the game.

(ii) **In Healthcare** Healthcare is one of the applications where virtual reality could have the most significant impact. Health care professionals can now use virtual models to prepare them for working on a real body.

Virtual reality can also be used as a treatment for mental health issues.

(iii) **In Education** Virtual reality has been adopted in education too. It improves teaching and learning.

With virtual reality, a large group of students can interact with one another within a three-dimensional environment.

(iv) **In Engineering and Architecture** Virtual reality plays a major role in simulating three-dimensional models infrastructures, designs which can provide a real-life experience of the physical designs or infrastructures before hand. This helps in reducing considerable costs and expenses which can be incurred in a prototype.

(v) **In Entertainment** Virtual reality is being used in the entertainment industry to boost experiences with 360 films and increase emotional connection with them and/or the characters.

(vi) **In Business** Virtual reality has also been adopted in business. It is now being used for virtual tours of a business environment, training of new employees and this also gives new employees a 360 degree view of every product.

2. Augmented Reality

Augmented reality (AR) is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound or other sensory stimuli delivered *via* technology. It is a growing trend among companies involved in mobile computing and business applications in particular.

Augmented reality is a technology that extends the user's view of the real world with digital, virtual content. AR enhances, extends or teaches about the real world with in-context digital content.

The superimposition of computer generated perceptual information over the existing physical surroundings is called as Augmented Reality (AR). It adds components of the digital world to the physical world, along with the associated tactile and other sensory requirements, thereby making the environment interactive and digitally manipulable.

There are few applications of augmented reality, which are as follows

(i) **In Surgery** Augmented reality and the healthcare industry seem like the perfect match. Complicated medical procedures could be massively improved using AR technology surgery can be risky and even seasoned surgeons can make mistakes.

(ii) **In Engineering** Production and manufacturing have been disrupted by innovative technology.

Augmented Reality has provided another tool for the creation and maintenance of complicated and expensive machines, making it easier for engineers to carry out repairs.

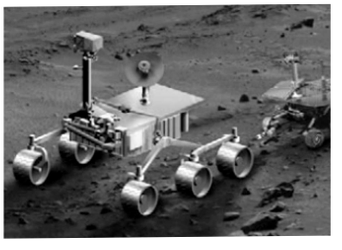
(iii) **In Military** Despite seeming like a relatively new application of Augmented reality, the first fully functioning. AR system was developed at the US Air Force Research Laboratory back in 1992.

Robotics

A robot is basically a machine capable of carrying out one or more tasks automatically with accuracy and precision. Unlike other machines, a robot is programmable, which means it can follow the instructions given through computer programs. Robots were initially conceptualised for doing repetitive industrial tasks that are boring or stressful for humans or were labour intensive.

Sensors are one of the prime components of a robot. Robot can be of many types, such as wheeled robots, legged robots, manipulators and humanoids. Robots that resemble humans are known as humanoids. Robots are being used in industries medical science, bionics, scientific research, military etc. Some examples are

- NASA's Mars Exploration Rover (MER) mission is a robotic space mission to study about a planet mars.



- Sophia is a humanoid that uses artificial intelligence, visual data processing, facial recognition and also imitates human gestures and facial expressions.

- A drone is an unmanned aircraft which can be remotely controlled or can fly autonomously through software controlled flight plans in their embedded systems. Drones are being used in many fields, such as journalism, filming and aerial photography, shipping or delivery at short distances, disaster management, search and rescue operations, healthcare, geographic mapping and structural safety inspections, agriculture, wildlife monitoring, besides law enforcement.

Generally, there are five types of robots

- Pre-programmed robots
- Humanoid robots
- Autonomous robots
- Tele-operated robots
- Augmenting robots

Advantages of Robots in the Workplace

The advantages of robots in the workplace are

- **Safety** Safety is the most obvious advantage of utilising robotics.
- **Speed** Robots don't get distracted or need to take breaks.
- **Consistency** Robots never need to divide their attention between a multitude of things.
- **Perfection** Being machines working on data , they produce perfect results.
- **Happier Employees** As these robots learn more about their environments and perform simple, repetitive tasks without the need for intervention, humans can focus on higher-level tasks, which leads to improved rates of employee satisfaction.
- **Job creation** When some of the rote elements of a job are eliminated, the higher-skilled parts of the job become more important. With automation, there will be a large net increase in jobs.
- **Productivity** Since they are electromechanical devices they work at faster rate than human beings and can work for longer durations.

Disadvantages of Robots in the Workplace

The disadvantages of robots in the workplace are

- They lead humans to lose their Jobs.
- They need constant power.
- They are restricted to their programming.
- They perform relatively few tasks.
- They have no emotions.
- They impact human interaction.
- They require expertise to set them up.

Big Data

The definition of big data is data that contains greater variety, arriving in increasing volumes and with more velocity.Put simply, big data is larger, more complex data sets, especially from new data sources. These data sets are so voluminous that traditional data processing software just cannot manage them.

Extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions.

Big data is the set of technologies created to store, analyse and manage this bulk data, a macro-tool created to identify patterns in the chaos of this explosion in information in order to design smart solutions. Today it is used in areas as diverse as medicine, agriculture, gambling and environmental protection.

Characterisitics of Big Data

Some characteristics of big data are as follows

(i) **Variety** Variety of big data refers to structured, unstructured and semi-structured data, i.e. gathered from multiple sources.

While in the past, data could only be collected from spreadsheets and databases, today data comes in an array of forms such as E-mails, PDFs, Photos, etc.

(ii) **Velocity** It essentially refers to the speed at which data is being created in real-time. In a broader prospect, it comprises the rate of change and linking of incoming data sets at varying speeds.

(iii) **Volume** Big data indicates huge volumes of data that is being generated on a daily basis from various sources like social media platforms, business processes, machines, networks, etc.

Applications of Big Data

There are some applications of big data are as follows

(i) **In Government** When government agencies are harnessing and applying analytics to their big data, they have improvised a lot in terms of managing utilities, running agencies, dealing with traffic congestion or preventing the crimes.

(ii) **In Healthcare** Big data had already started to create a huge difference in the healthcare sector.

With the help of predictive analytics, medical professionals can now able to provide personalised healthcare services to individual patient.

(iii) **In Banking** The banking sector relies on big data for fraud detection. Big data tools can efficiently detect fraudulent acts in real time such as misuse of credit/debit cards etc.

(iv) **In Manufacturing** Using big data manufacturing industry can improve product quality and output while minimizing waste.

Big Data Analytics

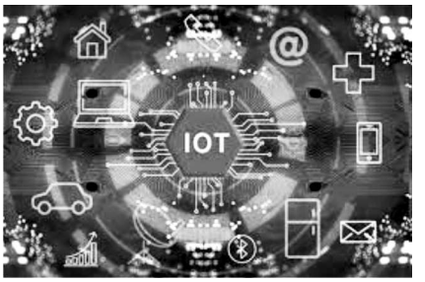
The term data analytics refers to the process of examining datasets to draw conclusions about the information they contain. Data analytic techniques enable you to take raw data and uncover patterns to extract valuable insights from it.

Data analytics is vital in analysing surveys, polls, public opinion, etc. *For example*, It helps segment audiences by different demographic groups and analyse attitudes and trends in each of them, producing more specific, accurate and actionable snapshots of public opinion.

There are four types of analytics, Descriptive, Diagnostic, Predictive and Prescriptive.

Internet of Things (IoT)

Internet of Things (IoT) is a network of physical objects or people called "things" that are embedded with software, electronics, network and sensors that allows these objects to collect and exchange data. The thing in IoT can also be a person with a diabetes monitor implant, an animal with tracking devices, etc.



The Internet of Things (IoT) refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention. The personal or business possibilities are endless. Businesses also are driven by a need for regulatory compliance.

In short, the Internet of Things (IoT) refers to the rapidly growing network of connected objects that are able to collect and exchange data in real time using embedded sensors. Cars, lights, refrigerators and more appliances can all be connected to the IoT.

For example, If a microwave oven, an air conditioner, door lock, CCTV camera or other such devices are enabled to connect to the Internet, we can access and remotely control them on-the-go using our smartphone.

Components of IoT

There are four fundamental components of IoT system, which are as follows

(i) **Sensors/Devices** These are key components that help you to collect live data from the surrounding environment. All this data may have various levels of complexities. It could be a simple temperature monitoring sensor or it may be in the form of the video feed. The display also changes to vertical or horizontal with respect to the way we hold our mobile. This is possible with the help of two sensors, namely accelerometer and gyroscope. The accelerometer sensor in the mobile phones detects the orientation of the phone. The gyroscope sensors track rotation or twist of your hand and add to the information supplied by the accelerometer.

(ii) **Connectivity** All the collected data is sent to a cloud infrastructure. The sensors should be connected to the cloud using various media of communication. These communication media include Mobile or Satellite networks, Bluetooth, Wi-Fi, WAN, etc.

(iii) **Data Processing** Once the data is collected and it gets to the cloud, the software performs processing on the gathered data. This process can be just checking the temperature, reading on devices like AC or heaters. However, it can sometimes also be very complex like identifying objects using computer vision on video.

(iv) **User Interface** The information made available to the end user in some ways. This can achieve by triggering alarms on their phones or notifying through text or E-mails. Also, a user sometimes might also have an interface through which they can actively check in on their IoT system.

Advantages of IoT

There are following advantages of IoT as follows

(i) **Technical Optimisation** IoT technology helps a lot in improving technologies and making them better.

(ii) **Reduce Waste** IoT offers real time information leading to effective decision-making and management of resources.

(iii) **Improved Customer Engagement** IoT allows you to improve customer experience by detecting problems and improving the process.

(iv) **Improved Data Collection** Traditional data collection has its limitations and its design for passive use.

Disadvantages of IoT

There are following disadvantages of IoT as follows

(i) **Security** As the IoT systems are interconnected and communicate over networks, the system offers little control despite any security measures. It can lead the various kinds of network attacks.

(ii) **Privacy** Even without the active participation of the user, IoT system provides substantial personal data in maximum detail.

(iii) **Complexity** The designing, developing, maintaining and enabling the large technology to IoT system is quite complicated.

Web of Things (WoT)

The Web of Things (WoT) is a computing concept that describes a future where everyday objects are fully integrated with the Web. Such smart devices would then be able to communicate with each other using existing web standards.

While IoT is about creating a network of objects, things, people, systems and applications, WoT tries to integrate them to the Web.However, the scope of IoT applications is broader and includes systems that are not accessible through the web.

The Web of Things (WoT) seeks to counter the fragmentation of the IoT by using and extending existing, standardised web technologies. By providing standardized metadata and other re-usable technological building blocks, W3C WoT enables easy integration across IoT platforms and application domains.

Smart City

A smart city uses Information and Communication Technology (ICT) to improve operational efficiency, share information with the public and provide a better quality of government service and citizen welfare. People are able to live and work within the city, using its resources.

In general, a smart city is a city that uses technology to provide services and solve city problems. A smart city does things like improve transportation and accessibility, improve social services, promote sustainability, and give its citizens a voice.

How Does a Smart City Work?

A smart city collects and analyses data from IoT sensors and video cameras. In essence, it senses the environment so that the city operator can decide how and when to take action. Some actions can be performed automatically.
For example, a public waste bin can contact the city for service when it is near capacity instead of waiting for a scheduled pickup.

Benefits of a Smart City

(i) **For City Agencies** Gain more citizen engagement and optimize operations through real-time data intelligence and intra-agency collaboration.

(ii) **For Citizens** Improve daily life through city service. Smart cities offer visibility into real time city data for improving mobility, connectivity and safety services.

(iii) **For Businesses** Drive new revenue stream and economic development by enhancing awareness of customer activity and behavior.

(iv) **For Development and Vendors** Fuel application development of city data. Help the city improve operational efficiences, engage citizens and boost economic viability.

Disadvantages of Smart City

- Lack of public awareness and social responsibility.
- Building and maintaining the infrastructure is costly and challenging.
- Demands 24×7 connectivity and power supply.
- Security issues in terms of public data.
- May lead a way towards social discrimination.

Cloud Computing

In the simplest terms, cloud computing means storing and accessing data and programs over the internet instead of your computer's hard drive.When you store data or run programs from the hard drive, that's called local storage and computing.

Cloud computing refers to remote access of hardware/software resources for access, configuration,manipulation. Cloud computing offers online data storage, infrastructure, and application. Applications such as Customer Relationship Management (CRM) , E-mail, web conferencing, execute on cloud.

Characteristics of Cloud Computing

The characteristics of cloud computing are as follows

(i) **On Demand Self Services** Computer services such as E-mail, applications, network or server service can be provided without requiring human interaction with each service provider.

(ii) **Broad Network Access Cloud** capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms such as mobile phones, laptops, PDAs, etc.

(iii) **Resource Pooling** The provider's computing resources are pooled together to serve multiple consumers using multiple-tenant model with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

(iv) **Rapid Elasticity** Cloud services can be rapidly and elastically provisioned, in some cases automatically, to quickly scale IN/OUT and rapidly released to quickly scale in.

(v) **Measured Service** Cloud computing resource usage can be measured, controlled and reported providing transparency for both the provider and consumer of the utilized service.

(vi) **Multi Tenacity** It refers to the need for policy-driven enforcement, segmentation, isolation, governance, service levels and chargeback/billing models for different consumer constituencies.

Types of Cloud Deployments

There are three types of cloud deployments categorized based on an organization's ability to manage and secure assets as follows

(i) **Public Cloud** It is managed by third party which provides cloud services over the Internet to public. They offer solutions for minimizing IT infrastructure costs and act as a good option for handling peak loads on the local infrastructure. A public cloud is meant to serve multiple users, not a single customer.

(ii) **Private Cloud** It is distributed system that works on a private infrastructure and providing the users with dynamic provisioning of computing resources.

(iii) **Hybrid Cloud** It is a heterogeneous distributed system resulted by combining facilities of public cloud and private cloud. For this reason, they are also called heterogeneous clouds.

Cloud Computing Services

The Most common and widely used cloud computing services are

(i) **Infrastructure as a Service (IaaS)** It is a cloud computing model where virtualized infrastructure is offered to and managed for business by external cloud providers. Some examples of the wide usage of IaaS are automated, policy-driven operations such as backup, recovery, etc.

(ii) **Software as a Service (SaaS)** It is a method for delivering software applications over the Internet as per the demand and on a subscription basis. Most common examples of SaaS are MicrosoftOffice 360,Oracle CRM, Marketo, etc.

(iii) **Platform as a Service (PaaS)** It refers to the supply on-demand environment for developing, testing, delivering and managing software applications. Some key players offering PaaS are Bluemix, CloudBees, Salesforce.com, etc.

Applications of Cloud Computing

The applications of cloud computing are limitless. With the right middleware, a cloud computing system could execute all the programs a normal computer could run. Potentially, everything from generic word processing software to customized computer programs designed for a specific company could work on a cloud computing system.

There are some applications of cloud computing, which are as follows

(i) Clients would be able to access their applications and data from anywhere at any time.

(ii) It could bring hardware costs down. You would not need a large hard drive because you'd store all your information on a remote computer.

(iii) Corporations that rely on computers have to make sure they have the right software in place to

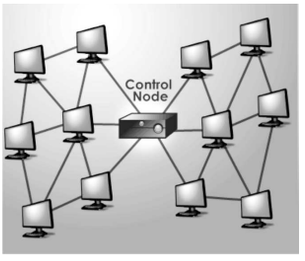
achieve goals. Cloud computing systems give these organisations company-wide access to computer applications. The companies do not have to buy a set of softwares or software licenses for every employee. Instead, the company could pay a metered fee to a cloud computing company.

(iv) Servers and digital storage devices take up space. Some companies rent physical space to store servers and databases because they do not have it available on site. Cloud computing gives these companies the option for storing data on someone else's hardware, removing the need for physical space on the front end.

(v) Corporations might save money on IT support. Streamlined hardware would, in theory, have fewer problems than a network of heterogeneous machines and operating systems.

Grid Computing

Grid computing is a distributed computing architecture. In grid computing, resources are used in collaborative pattern and users need do not to pay for use. Grid computing is a group of networked computers which work together as a virtual supercomputer to perform large tasks, such as analysing huge sets of data or weather modeling.



Unlike with parallel computing, grid computing projects typically have no time dependency associated with them.

For example, a corporation that allocates a set of computer nodes running in a cluster to jointly perform a given task is a simple example of grid computing in action.

There are three types of grid compating, which are as follows

(i) **Computational Grid** It acts as the resource of many computers in a network to a single problem at a time.

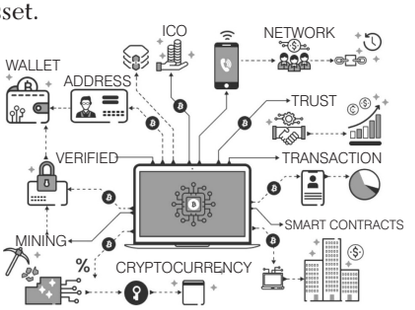
(ii) **Data Grid** It deals with the controlled sharing and management of distributed data of large amount.

(iii) **Collaborative Grid** It is the grid which solves collaborative problems.

Grid computing enables the virtualisation of distributed computing resources such as processing, network bandwidth, and storage capacity to create a single system image, granting users and applications seamless access to vast IT capabilities.

Blockchains Technology

Blockchain technology is most simply defined as a decentralised, distributed ledger that records the provenance of a digital asset.



Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack or cheat the system. A blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain.

Blockchain technology can be used to create a permanent, public, transparent ledger system for compiling data on sales, tracking digital use and payments to content creators, such as wireless users or musicians.

It is a chain of blocks which contain information.

How Blockchains Work?

When a new transaction or an edit to an existing transaction comes into a blockchain, generally a majority of the nodes within a blockchain implementation must execute algorithms to evaluate and verify the history of the individual blockchain block that is proposed.

If a majority of the nodes come to a consensus that the history and signature is valid, the new block of transactions is accepted into the ledger and a new block is added to the chain of transactions. If a majority does not concede to the addition or modification of the ledger entry, it is denied and not added to the chain.

This distributed consensus model is what allows blockchain to run as a distributed ledger without the need for some central, unifying authority saying that transactions are valid and which ones are not.

Advantages of Blockchain Technology

(i) It allows smart devices to speak to each other better and faster.

(ii) It allows the removal of intermediaries that are involved in record keeping and transfer of assets.

(iii) It provides durability, reliability and longevity with decentralized network.

(iv) The data that are entered in blockchain based systems are immutable which prevents against fraud through manipulating transactions and the history of data.

(v) It brings everyone to the highest degree of accountability.

Chapter Practice

PART 1
Objective Questions

• Multiple Choice Questions

1. Which of the following is not a emerging trend in technology?

(a) Sensors (b) Smart cities
(c) Blockchains (d) Fax machines

Ans. (*d*) Fax machines is not a recent technology and has been in use for quite a long time for sending documents using telephone network.

2. Which of the following is not a service in cloud computing?

(a) IaaS (b) SaaS
(c) PaaS (d) NaaS

Ans. (*d*) IaaS, SaaS , PaaS are all services available in cloud computing .

3. Which of the following is/are type(s) of grid computing?

(a) Data grid (b) Collaborative grid
(c) Both (a) and (b) (d) None of these

Ans. (*c*) There are three types of grid computing as
(i) Data grid
(ii) Collaborative grid
(iii) Computational grid

4. IaaS stands for

(a) Indian Administration Service
(b) Intenet as a Service
(c) Infrastructure as a Service
(d) Information as a Service

Ans. (*c*) IaaS stands for Infrastructure as a Service, a type of service in cloud computing.

5. Which of the following function(s) is/are possible by a robot?

(a) Helping in daily activities
(b) Helping in computation
(c) Helping in industries
(d) All of the above

Ans. (*d*) All the functions listed in the options are possible by the robots.

6. NLP stands for

(a) Natural Language Processing
(b) New Language Processing
(c) New Logical Program
(d) Natural Looking Program

Ans. (*a*) It is the ability of a computer program to understand human language as it is spoken and written -referred to as natural language. It is a component of artificial intelligence.

7. In grid computing, a grid is

(a) a modem
(b) a router
(c) any network device
(d) a computer

Ans. (*d*) Grid computing is a group of network computers which work together as a virtual super computer to perform large tasks.

8. Which of the following is/are an advantage(s) of blockchain technology?

(a) It allows smart devices to speak to each other better and faste.
(b) It provides durability.
(c) It provides reliability.
(d) All of the above

Ans. (*d*) The blockchain technology provides durability, reliability and longevity with decentralised network and it allows smart devices to speak to each other better and faster.

9. AR stands for

(a) All Reality
(b) Artificial Reality
(c) Augmented Reality
(d) Artistic Reality

Ans. (*c*) AR is a sub-version of immersive experiences, standing for Augmented Reality.

10. Mohan found that he could search for a product in a shopping site using voice search. This is an instance of

(a) Natural language processing
(b) Immersive experience
(c) Grid computing
(d) Block chain technology

Ans. (*a*) Predictive typing , speech recognition etc., are all applications of natural language processing , that help human beings make their searching process comfortable and faster.

11. …… uses a system of distributed computing to process large tasks using multiple nodes in a network.

(a) Grid computing (b) Cloud computing

(c) Block chain technology (d) None of these

Ans. (*a*) Grid computing is a group of networked computers which work together as a virtual supercomputer to perform large tasks, such as analysing huge sets of data or weather modeling.

12. Which of the following is not a characteristic of Big Data?

(a) Volume (b) Velocity

(c) Variety (d) Variable

Ans. (*d*) The five characteristics of big data are : Volume, Velocity, Variety ,Veracity and Value. The term Big Data refers to all the data that accumulates from different data sources. This data is not only of enormous volume but also grows rapidly, is of large varieties and contains data of rich value.

13. Which among the following makes transactions more safer?

(a) Grid computing

(b) Block Chains

(c) Virtual reality

(d) Augmented reality

Ans. (*b*) Blockchain technology is most simply defined as a decentralized, distributed ledger that records the provenance of a digital asset. By inherent design, the data on a blockchain is unable to be modified, which makes it a legitimate disruptor for industries like payments, cybersecurity and healthcare.

14. Mohini found that while looking at a thriller movie the environment around her was changing , giving her a feel of as if she was in the Movie. This is done using

(a) Natural Language Processing

(b) Immersive Experience

(c) Robotics

(d) None of the above

Ans. (*b*) An immersive experience pulls a person into a new or augmented reality, enhancing everyday life (by making it more engaging or satisfying) via technology. They often use one or more technologies linked together.

15. The different types of GRIDS in Grid computing are

(a) Data Grid

(b) Computational Grid

(c) Collaborative Grid

(d) All of the aboave

Ans. (*d*) Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. Types of Grid computing are : Data Grid,Computational Grid and Collaborative Grid.

• Case Based MCQs

Direction *Read the case and answer the following questions.*

16. Mr. Jack as Mechanical Engineer is not very conversant with the emerging technologies of today. He wants to be clear about some of the terms that he gets to hear here and there everyday . Help him with the correct options to be clear about the terms.

(i) A kind of technology, where human like machines are built with injected technology to help people in different tasks .

(a) Cloud computing (b) VoIP

(c) Blockchains (d) Robotics

(ii) He heard that some cities are smart, what is meant by a smart city?

(a) A city with smart people

(b) A city with smart cars

(c) A city built with smart infrastructure that can communicate to a central controlling location

(d) A city with robots

(iii) He found that when he types anything in Google search , the suggestions arrive in the list .This is an instance of

(a) robotics

(b) blockchain technology

(c) natural language processing

(d) All of the above

(iv) He found a new movie in the town that gives feelings and puts the audience in the situation of the movie. This is an instance of

(a) immersive experience (b) robotic technology

(c) NLP (d) None of these

(v) He wanted to know that which senses are used in virtual reality?

(a) Sight and Touch (b) Sight and Sound

(c) Sight and Smell (d) None of these

Ans. (i) (*d*) Robotics is an emerging technology, where human resembling machines are built with embedded knowledge and intelligence to perform and assist in human activities.

(ii) (*c*) In general, a smart city is a city that uses technology to provide services and solve city problems.

(iii) (*c*) Autolist of suggestions appearing in Google search is an instance of natural language processing.

(iv) (*a*) An immersive experience is one that pulls a person into a new or augmented reality.

(v) (*b*) Virtual reality is primarily experienced through two of the five senses Sight and Sound.

A smart city uses Information and Communication Technology (ICT) to improve operational efficiency, share information with the public and provide a better quality of government service and citizen welfare. People are able to live and work within the city, using its resources.

17. Ms. Paramita a Research Scholar at Calcutta University has got a new project on Robot development. She is not very conversant about robots and robotics. Help her by solving the questions regarding robots to make her concepts clear.

(i) Which of the following is not true about robots?
(a) They have life
(b) They work on artificial intelligence
(c) They can have visual features also
(d) Both (b) and (c)

(ii) Which of the following is/are type(s) of robots?
(a) Humanoids (b) Pre-programmed
(c) Tele-operated (d) All of these

(iii) Which of the following branch is not a part of robotics?
(a) Computer engineering (b) Mechanical engineering
(c) Electrical engineering (d) Chemical engineering

(iv) Which of the following statement(s) concerning the implementation of robotic systems is/are correct?
(a) Implementation of robots can save existing jobs.
(b) Implementation of robots can create new jobs.
(c) Robotics could prevent a business from closing.
(d) All of the above

(v) A robot is
(a) programmable (b) non-programmable
(c) Both (a) and (b) (d) None of these

Ans. (i) (*a*) Robots are devices engineered by human beings . They do no have life.
(ii) (*d*) Robots can be Humanoids look like humans , Pre-programmed or Tele-operated by telephone.
(iii) (*d*) Robot development is based on Computer, Mechanical and Electrical engineering principles.
(iv) (*d*) Robotics can save existing jobs , create jobs and help businesses to develop from adverse situations.
(v) (*a*) Since robots are human designed, comprising of intelligence , electronic boards and programs , they are programmable.

PART 2
Subjective Questions

• Short Answer Type Questions

1. List some of the cloud-based services that you are using at present. **(NCERT)**

Ans. (i) **IaaS** cloud-based services, pay-as-you-go for services such as storage, networking and virtualisation.
(ii) **PaaS** hardware and software tools available over the Internet.
(iii) **SaaS** software that's available *via* a third-party over the Internet.

2. Write full forms of the following
(i) VR (ii) AR (iii) AI (iv) IoT

Ans. (i) VR – Virtual Reality
(ii) AR – Augmented Reality
(iii) AI – Artificial Intelligence
(iv) IoT – Internet of Things

3. Write a short note on NLP.

Ans. NLP stands for Natural Language Processing . It is one of the emerging trends. In natural language processing, human language is separated into fragments so that the grammatical structure of sentences and the meaning of words can be analysed and understood in context. This helps computers read and understand spoken or written text in the same way as humans.

4. What do you understand by IoT? Write some of its applications. **(NCERT)**

Ans. Internet of Things (IoT) is a phenomenon that connects the things (the smart devices) to the internet over wired or wireless connections.

Some of its potential applications are as follows
(i) **Home appliance** Some examples of home appliances are fridges, cookers, coffee makers, heaters, HVAC, TVs, DVD players, lights, doors, windows etc.
(ii) **Wearables** Some examples of wearbles are clothes, shoes, hats, watches, heart monitors etc.
(iii) **Vehicles** Some examples of vehicles are cars, buses, bicycles, trains etc.
(iv) **Factories** Some examples of factories are machines, robots, warehouse shelves, parts within machines, tools etc.
(v) **Agriculture** Bio-chip transponders on farm animals and plants, farm humidity and temperature sensors etc.
(vi) **Food** Sensors for monitoring the condition of food.

5. Write a short note on cloud computing. **(NCERT)**

Ans. Cloud computing is internet-based computing, whereby shared resources, software and information are provided to computers and other devices on demand, like the electricity grid.

A basic definition of cloud computing is the use of the Internet for the tasks you perform on your computer for storage, retrieval and access. The "cloud" represents the Internet. Cloud computing services are delivered through a network, usually the Internet.

6. What are sensors used for? Write its types.

Ans. People use sensors to measure temperature, gauge distance, detect smoke, regulate pressure and a myriad of other uses. Because analog signals are continuous, they can account for the slightest change in the physical variable (such as temperature or pressure).

The most frequently used different types of sensors are classified based on the quantities such as Electric current or Potential or Magnetic or Radio sensors, Humidity sensor, Fluid velocity or Flow sensors, Pressure sensors, Thermal or Heat or Temperature sensors, Proximity sensors, Optical sensors.

7. What is on-demand service? How it is provided in cloud computing? **(NCERT)**

Ans. On-demand computing is an enterprise-level model of technology by which a customer can purchase cloud services as and when needed.

For example, if a customer needs to utilise additional servers for the duration of a project, they can do so and then drop back to the previous level after the project is completed.

On-demand self service refers to the service provided by cloud computing vendors that enables the provision of cloud resources on demand whenever they are required. In on-demand self service,the user accesses cloud services through an online control panel.

8. How IoT and WoT are related? **(NCERT)**

Ans. **Internet of Things** (**IOT**) allows us to interact with different devices through Internet with the help of smartphones or computers. But to interact with 'n' number of different devices, we need to install 'n' different apps.

Web of Things (**WoT**) allows the use of web services to connect anything in the physical world, besides human identities on web.

IoT along with WoT helps to create smart homes, smart offices, smart cities and so on.

9. What are the types of immersive experience?

Ans. There are two types of immersive experiences, which are as follows

(i) One being when you are actually in a physical environment.

(ii) The other type of experience is where you are shown around a real or imagined environment *via* desktop, tablet, mobile or *via* VR (Virtual Reality) headset.

10. Write some uses of Virtual Reality.

Ans. There are some uses of Virtual Reality, which are as follows

(i) In military

(ii) In sport

(iii) In mental Health

(iv) In medical Training

(v) In education

(vi) In fashion

11. List some of the applications of Augmented Reality.

Ans. There are few applications of Augmented Reality, which are as follows

(i) **In Surgery** Augmented Reality and the healthcare industry seem like the perfect match. Complicated medical procedures could be massively improved using AR technology.

(ii) **In Engineering** Production and manufacturing have been disrupted by innovative technology.

Augmented Reality has provided another tool for the creation and maintenance of complicated and expensive machines, making it easier for engineers to carry out repairs.

(iii) **In Military** Despite seeming like a relatively new application of Augmented Reality, the first fully functioning. AR system was developed at the US Air Force Research Laboratory back in 1992.

12. What are the disadvantages of smart city?

Ans. There are some disadvantages of smart city as

(i) Lack of public awareness and social responsibility.

(ii) Building and maintaining the infrastructure is costly and challenging.

(iii) Demands 24×7 connectivity and power supply.

(iv) Security issues in terms of public data.

(v) May lead a way towards social discrimination.

13. How are robots helpful in our daily life and industries?

Ans. They are used routinely to carry out many tasks that people don't want to do because such jobs are boring, dirty or dangerous. Robots can also be programmed to carry out some tasks that are too complex for humans. Robots most obviously impact everyday life in the service capacity. In households, robots, like cooking bots, lawn-mower and vacuum bots ease jobs.

Industrial robots have helped to boost productivity, safety and time savings. Robots are able to produce incredibly accurate, consistent and high quality work without needing breaks or holidays off. Industrial robots also help to remove workers from the hazardous environments and back breaking labor.

• Long Answer Type Questions

14. Explain the term big data. Also, explain its characteristics.

Ans. The generation of data sets of enormous volume and complexity called Big Data. Big data is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. Big data can be analysed for insights that lead to better decisions and strategic business moves**.**

The characteristics of big data are as follows

(i) **Volume** The most prominent characteristic of big data is its enormous size. If a particular data set is of such large size that it is difficult to process it with traditional DBMS tools, it can be termed as big data.

(ii) **Velocity** It represents the rate at which the data under consideration is being generated and stored. Big data has an exponentially higher rate of generation than traditional data sets.

(iii) **Variety** It asserts that a data set has varied data, such as structured, semi-structured and unstructured data. Some examples are text, images, videos, web pages and so on.

(iv) **Veracity** Big data can be sometimes inconsistent, biased, and noisy or there can be abnormality in the data or issues with the data collection methods. Veracity refers to the trustworthiness of the data because processing such incorrect data can give wrong results or mislead the interpretations.

(iv) **Value** Big data is not only just a big pile of data, but also possess to have hidden patterns and useful knowledge which can be of high business value.

15. Explain cloud computing in detail and also specifying its types.

Ans. Cloud computing is the delivery of computing services including servers, storage, databases, networking, software,

analytics, and intelligence over the Internet to offer faster innovation, flexible resources and economies of scale. You typically pay only for cloud services you use, helping lower your operating costs, run your infrastructure more efficiently and scale as your business needs change.

There are three types of cloud deployments categorized based on an organization's ability to manage and secure assets as follows

(i) **Public Cloud** It is managed by third party which provides cloud services over the Internet to public. They offer solutions for minimizing IT infrastructure costs and act as a good option for handling peak loads on the local infrastructure. A public cloud is meant to serve multiple users, not a single customer.

(ii) **Private Cloud** It is distributed system that works on a private infrastructure and providing the users with dynamic provisioning of computing resources.

(iii) **Hybrid Cloud** It is a heterogeneous distributed system resulted by combining facilities of public cloud and private cloud. For this reason, they are also called heterogeneous clouds.

16. Explain artificial intelligence along with their applications.

Ans. Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.

The intelligence demonstrated by machines is known as artificial intelligence. Artificial intelligence has grown to be very popular in today's world. It is the simulation of natural intelligence in machines that are programmed to learn and mimic the actions of humans.

These machines are able to learn with experience and perform human-like tasks. As technologies such as AI continue to grow, they will have a great impact on our quality of life. It's natural but everyone today wants to connect with AI technology somehow, may it be as an end-user or pursuing a career in artificial intelligence.

Some applications of artificial intelligence are as follows

(i) **Administration** AI systems are helping with the routine, day-to-day administrative tasks to minimise human errors and maximise efficiency. Transcriptions of medical notes through NLP and helps structure patient information to make it easier for doctors to read it.

(ii) **Telemedicine** For non-emergency situations, patients can reach out to a hospital's AI system to analyse their symptoms, input their vital signs and assess if there's a need for medical attention. This reduces the workload of medical professionals by bringing only crucial cases to them.

(iii) **Assisted Diagnosis** Through computer vision and convolutional neural networks, AI is now capable of reading MRI scans to check for tumours and other malignant growths, at an exponentially faster pace than radiologists can, with a considerably lower margin of error.

(iv) **Robot-assisted Surgery** Robotic surgeries have a very minuscule margin-of-error and can consistently perform surgeries round-the-clock without getting exhausted. Since they operate with such a high degree of accuracy, they are less invasive than traditional methods, which potentially reduces the time patients spend in the hospital recovering.

(v) **Vital Stats Monitoring** A person's state of health is an ongoing process, depending on the varying levels of their respective vitals stats. With wearable devices achieving mass-market popularity now, this data is not available on tap, just waiting to be analysed to deliver actionable insights. Since vital signs have the potential to predict health fluctuations even before the patient is aware, there are a lot of live-saving applications here.

17. What is Machine Learning?

Ans. **Machine Learning (ML)** is a type of Artificial Intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so.

Machine learning algorithms use historical data as input to predict new output values.

Recommendation engines are a common use case for machine learning. Other popular uses include fraud detection, spam filtering, malware threat detection, business process automation (BPA) and predictive maintenance.

Machine learning is important because it gives enterprises a view of trends in customer behavior and business operational patterns, as well as supports the development of new products. Many of today's leading companies, such as Facebook, Google and Uber, make machine learning a central part of their operations. Machine learning has become a significant competitive differentiator for many companies.

Classical machine learning is often categorised by how an algorithm learns to become more accurate in its predictions.

There are four basic approaches

(i) Supervised learing

(ii) Unsupervised learing

(iii) Semi-supervised learning

(iv) Reinforcement learing

18. Differentiate cloud computing and grid computing.

Ans. Differences between cloud computing and grid computing are

Cloud computing	Grid computing
Cloud computing follows client-server computing architecture.	Grid computing follows a distributed computing architecture.
Scalability is high.	Scalability is normal.
Cloud computing is more flexible than grid computing.	Grid computing is less flexible than cloud computing.
Cloud operates as a centralised management system.	Grid operates as a decentralised management system.

19. Write in short on how Grid computing can help process jobs better. Also compare the advantages and disadvantages of it.

Ans. The major benefit of computer grids over single supercomputers lies in their flexibility and computing

power. Using a computer grid for large amounts of data is more efficient than doing so on a single, memory-hungry supercomputer. It is also more reliable due to reduced downtime risks and is considerably less expensive.

Grid computing is a data processing choice for large companies and academic institutes. It is efficient, affordable and fast while delivering high levels of accuracy and data integrity. Computer grids can involve risks, but, as mentioned earlier, check and balance measures can greatly mitigate them.

In short, computer grids are one of the most attractive and cost-effective means of getting massive computing loads processed. And it's an area of computing technology that is growing fast as data loads increase exponentially across many industries.

Advantages of Grid Computing

(i) They are not that expensive.
(ii) They are quite efficient and reliable machines and can solve complex problem in limited time.
(iii) They are scalable.
(iv) Grid Computing follows distributed computing architecture.
(v) Grid Computing is application oriented.
(vi) They work in a decentralized management system.
(vii) They can use existing hardware.
(viii) Can easily associate with other organization.
(ix) Tasks and instructions can be performed in parallel speeding.
(x) Grid computing works in a group if any one of the computer is unavailable the workload is distributed across the remaining computers.
(xi) The grid computing can be upgrade on the fly without scheduling downtime.

Disadvantages of Grid Computing

(i) They are not interactive for job submissions.
(ii) Grid system is not fully evolved.
(iii) Difficult in sharing resources across different admins.
(iv) Grid environment can work with smaller servers.
(v) Some Application may not work with full potential.

20. How does Natural Language Processing work? Write few of its practical applications.

Ans. It's an intuitive behaviour used to convey information and meaning with semantic cues such as words, signs or images. While the terms AI and NLP might conjure images of futuristic robots, there are already basic examples of NLP at work in our daily lives.

In natural language processing, human language is separated into fragments so that the grammatical structure of sentences and the meaning of words can be analyzed and understood in context. This helps computers read and understand spoken or written text in the same way as humans.

NLP combines computational linguistics-rule-based modeling of human language—with statistical, machine learning and deep learning models. NLP drives computer programs that translate text from one language to another, respond to spoken commands and summarize large volumes of text rapidly—even in real time.

Practical Applications

(i) **Search Autocorrect and Autocomplete** Whenever you search for something on Google, after typing 2-3 letters, it shows you the possible search terms. It's a wonderful application of natural language processing and a great example of how it is affecting millions around the world, including you and me. Search autocomplete and autocorrect both help us in finding accurate results much efficiently.

(ii) **Language Translator** It translates a piece of text in one language to another .The technique behind it is Machine Translation.

Machine Translation is the procedure of automatically converting the text in one language to another language while keeping the meaning intact.

Due to evolution in the field of neural networks, availability of humongous data and powerful machines, machine translation has become fairly accurate in converting the text from one language to another.

Today, tools like Google Translate can easily convert text from one language to another language. These tools are helping numerous people and businesses in breaking the language barrier and becoming successful.

(iii) **Social Media Monitoring** More and more people these days have started using social media for posting their thoughts about a particular product, policy or matter. These could contain some useful information about an individual's likes and dislikes. Hence analyzing this unstructured data can help in generating valuable insights. Natural Language Processing comes to rescue here too.

Today, various NLP techniques are used by companies to analyze social media posts and know what customers think about their products.

(iv) **Chatbots** Customer service and experience are the most important thing for any company. It can help the companies improve their products and also keep the customers satisfied. But interacting with every customer manually, and resolving the problems can be a tedious task. This is where Chatbots come into the picture. Chatbots help the companies in achieving the goal of smooth customer experience.

Chapter Test

Multiple Choice Questions

1. ..... allows users to have access to their digital resources from any part of the world.
(a) Phone (b) Tablet
(c) Computer (d) Cloud computing

2. Google drive is a ..... area in the cloud.
(a) personal (b) special
(c) public (d) None of these

3. SaaS stands for
(a) System as a Service (b) Synchronisation as a Service
(c) Software as a Service (d) None of these

4. ..... is an application area of voice / speech recognition.
(a) Playing back simple information (b) Call steering
(c) Automated identification of caller (d) All of these

5. In cloud computing , the cloud means
(a) a world of computers/ devices on a network that store and supply information to clients
(b) computing in a local network
(c) computing at high speed
(d) computing in a metropolitan area network

Short Answer Type Questions

6. Write some disadvantages of robots.

7. Justify the following statement-
'Storage of data is cost-effective and time-saving in cloud computing.' (**NCERT**)

8. Five friends plan to try a startup. However, they have a limited budget and limited computer infrastructure. How can they avail the benefits of cloud services to launch their startup? (**NCERT**)

9. Write the use of virtual reality in gaming.

Long Answer Type Questions

10. Write some advantages of robots .

11. Explain the practical usage of big data in various industries .Also, list names of such fields where they are used.

12. What is your view on PaaS ? Write few examples of PaaS.

13. Explain the sensor component of IoT system.

14. Compare advantages and disadvantages of smart cities.

Answers

Multiple Choice Questions

1. *(d)* ***2.*** *(a)* ***3.*** *(c)* ***4.*** *(d)* ***5.*** *(a)*