EMERGING TRENDS

1*1+3*1+5*1=9 Marks

- Emerging trends are the state-of-the-art technologies, which gain popularity and set a new trend among users.
- Emerging trends will make a huge impact (in the future) on digital economy and interaction in digital societies.

Emerging Trends

- Artificial intelligence
  - Machine Learning
  - Natural Language Processing
  - Immersive experience
    - Virtual reality
    - Augmented reality
  - Robotics
- Big Data
- Internet of Things
- Cloud computing
- Grid computing
- Blockchains

Artificial Intelligence (AI)

- Artificial Intelligence endeavors(tries) to simulate the natural intelligence of human beings into machines, thus making them behave intelligently.
- An intelligent machine is supposed to imitate some of the cognitive functions of humans like learning, decision- making and problem solving.
- In order to make machines perform tasks with minimum human intervention, they are programmed to create a knowledge base and make decisions based on it.
- AI system can also learn from past experiences or outcomes to make new decisions.

- Some of the examples of application of artificial intelligence are:

1. Smartphone are able to guide you to take the fastest route to your destination by analyzing real time data.
2. On uploading a photo on a social networking site, that your friends in the photograph were recognized and tagged automatically.
3. The intelligent digital personal assistants like Siri, Google Now, Cortana, Alexa are all powered by AI.

General Examples

1. Voice Assistants (Siri, Alexa, Google Assistant)

AI Role: Uses **speech recognition** to understand what you say and **NLP** to process the meaning.

Example: You say *"Play my favorite song"*, and it searches your playlist and starts the song.

2. Email Spam Filter

AI Role: Uses **machine learning** to classify emails as “Spam” or “Not Spam” by analyzing patterns like words, links, and sender details.

Example: Ads and fake prize emails go directly into the *Spam* folder automatically.

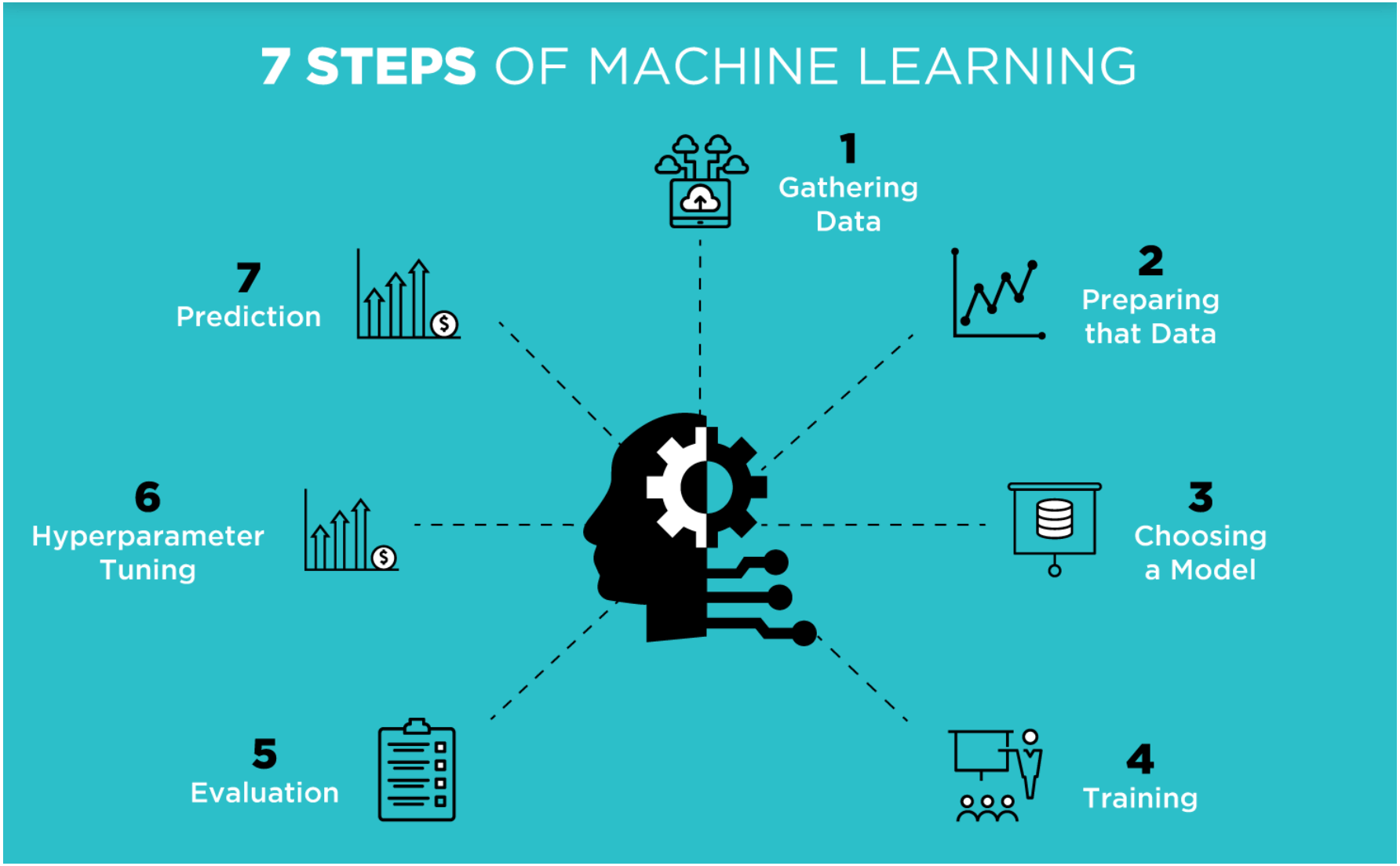
3. Face Unlock in Smartphones

AI Role: Uses **computer vision** to detect and recognize your face for authentication.

Example: You look at your phone, and it instantly unlocks without typing a password.

Machine Learning

- Machine Learning is a subsystem of Artificial Intelligence, wherein computers have the ability to learn from data using statistical techniques, without being explicitly programmed.
- 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.


7 STEPS OF MACHINE LEARNING
1
Gathering Data
2
Preparing that Data
3
Choosing a Model
4
Training
5
Evaluation
6
Hyperparameter Tuning
7
Prediction

General Examples:

1. We train a machine learning model with past data of house sizes and prices. Then, we can predict the price for a new house size.
2. Model guesses the fruit type for new measurements.
3. To predict whether a student passes (1) or fails (0).

- **Data** → Hours studied vs. exam result.
- **Model** → Logistic regression(event occurring or not) learns the probability of passing.
- **Prediction** → If probability > 50%, predict “Pass”; otherwise “Fail”.

Natural Language Processing (NLP)

- An NLP system can perform text-to- speech and speech-to-text conversion.
- It deals with the interaction between human and computers using human spoken languages, such as Hindi, English, etc.
- It is possible to search the web or operate or control our devices using our voice.
- The predictive typing feature of search engine and the spell checking features are examples of Natural Language Processing (NLP).

- Machine translation is a rapidly emerging field where machines are already able to translate texts from one language to another with fair amount of correctness.
- Another emerging application area is automated customer service where a computer software can interact with customers to serve their queries or complaints.

Immersive Experiences

- Immersive experiences allow us to visualize, feel and react by stimulating our senses.

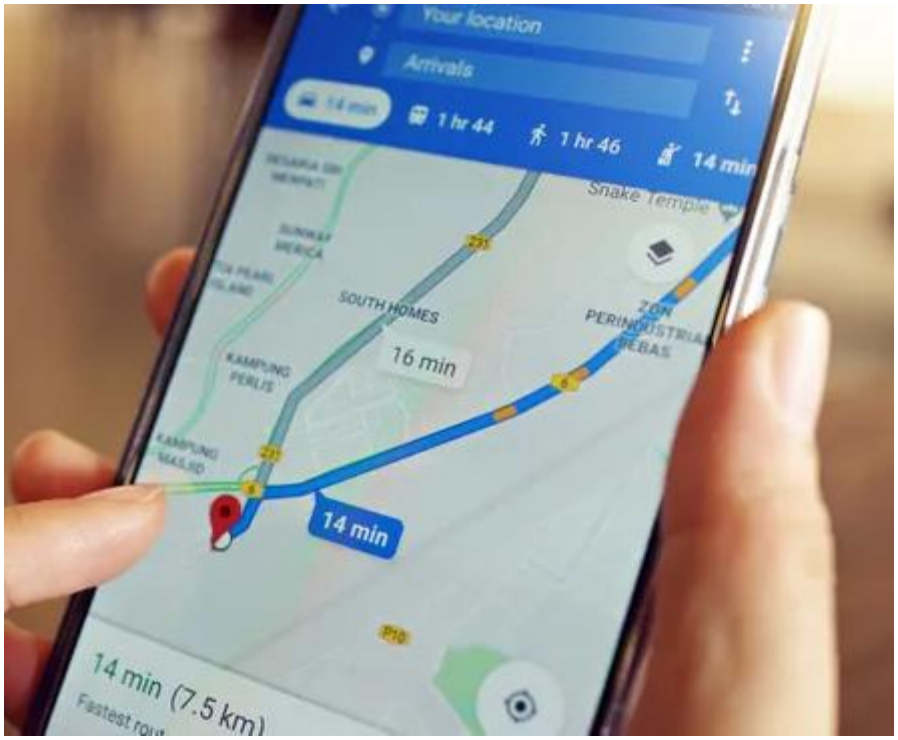
[An **immersive experience** is when technology makes you feel like you are *inside* or *part of* a virtual or simulated environment, so much that you forget about the real world around you.]

- 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 experience can be achieved using virtual reality and augmented reality.**

Virtual Reality

Virtual Reality Headset

Location-based Augmented Reality



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 by a computer, which means it can follow the instructions given through computer programs.
- Robots were initially conceptualized for doing repetitive industrial tasks that are boring or stressful for humans.
- 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 the 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, working in conjunction with onboard sensors and GPS. They are being used in many fields, such as journalism, filming and aerial photography, shipping at short distances, disaster management, search and rescue operations, healthcare, geographic mapping and structural safety inspections, agriculture, wildlife monitoring.

NASA's Mars Exploration Rover (MER)

https://youtu.be/0-oQRSViZQE

Sophia is a humanoid

https://www.youtube.com/shorts/hxSZQ6Wfh-E?feature=share

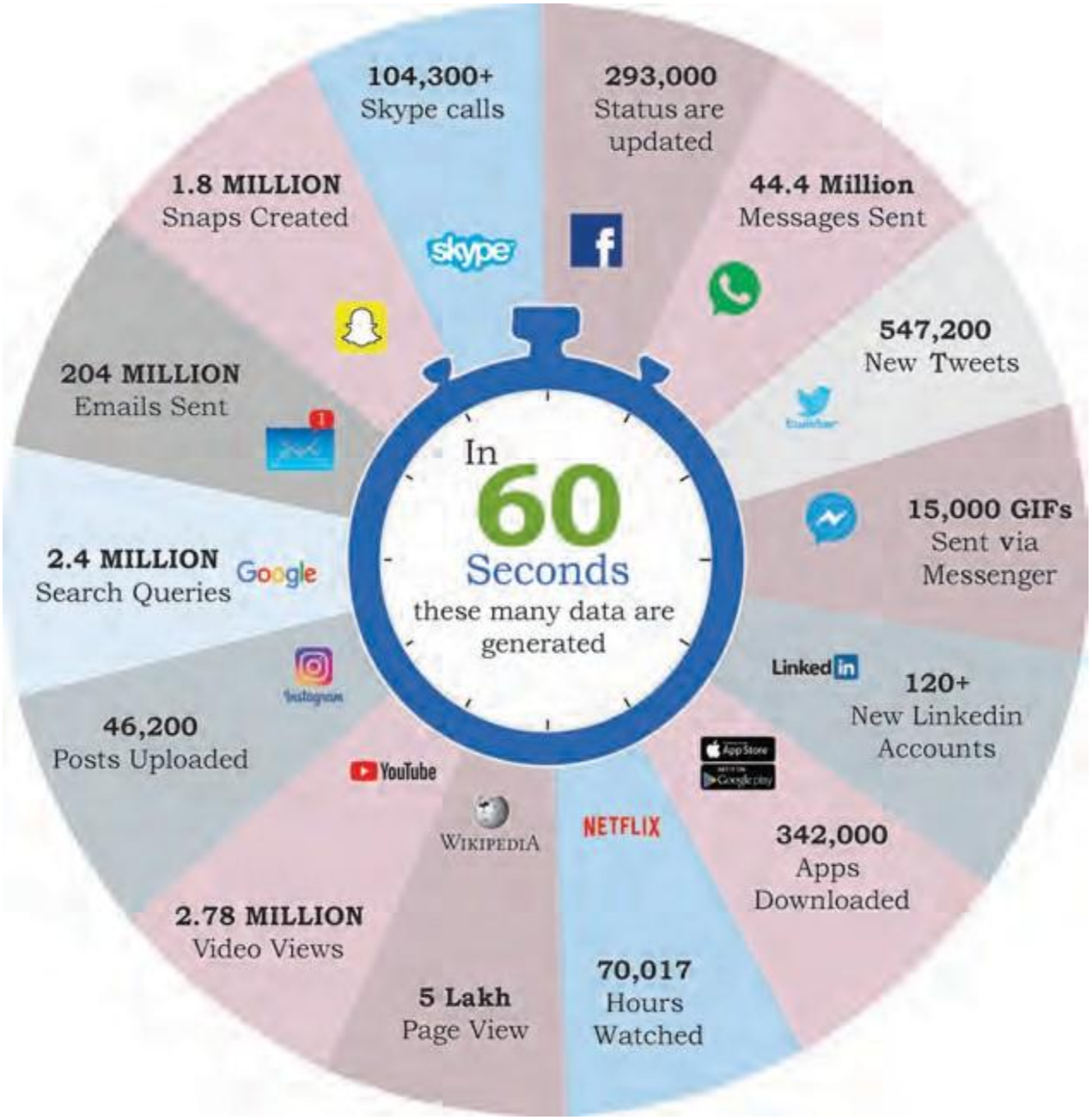
https://www.youtube.com/shorts/FqAO4dAsyFA?feature=share

Drone

BIG DATA

- There are over a billion Internet users, and a majority of the world's web traffic is coming from smartphones.
- At the current pace, around 2.5 quintillion bytes of data are created each day, and the pace is increasing with the continuous evolution of the Internet of Things (IoT).
- This results in the generation of data sets of enormous volume and complexity is called *Big Data*.
- Such data cannot be processed and analyzed using traditional data processing tools as the data is not only voluminous, but also unstructured like our posts, instant messages and chats, photographs that we share through various sites, our tweets, blog articles, news items, opinion polls and their comments, audio/video chats, etc.

- Big Data not only represents voluminous data, it also involves various challenges like integration, storage, analysis, searching, processing, transfer, querying and visualization of such data.
- Big data sometimes hold rich information and knowledge which is of high business value, and therefore there is a keen effort in developing software and methods to process and analyze big data.


104,300+
Skype calls
293,000
Status are updated
1.8 MILLION
Snaps Created
44.4 Million
Messages Sent
547,200
New Tweets
204 MILLION
Emails Sent
In
60
Seconds
these many data are generated
15,000 GIFs
Sent via Messenger
2.4 MILLION
Search Queries
120+
New Linkedin Accounts
46,200
Posts Uploaded
342,000
Apps Downloaded
2.78 MILLION
Video Views
70,017
Hours Watched
5 Lakh
Page View
skype
Google
YouTube
WIKIPEDIA
NETFLIX
Linked in

Characteristics of Big Data

(A) Volume

(B) Velocity

(C) Variety

(D) Veracity

(E) Value

(A) Volume

- This refers to the **size of the data**. Big data means a large volume of data cannot be handled using regular software like traditional databases.

(Ex: Data present in facebook, youtube)

(B) Velocity

- It represents **how fast data being created** and processed. Big data is produced at very high speed.

(live updates from news websites, weather sensors)

(C) Variety

- Big data comes **in many forms**, such as structured, semi-structured and unstructured data.
- Some examples are text, images, videos, web-pages and so on.

Facebook stores data in **many formats** —

- **Text** (posts, comments, messages)
- **Images** (profile pictures, memes)
- **Videos** (reels, live streams)
- **Audio** (voice messages)
- **Structured data** (user profiles, friend lists, likes)
- **Unstructured data** (free-form posts, captions, hashtags)

(D) Veracity

- Veracity refers to the **trustworthiness of the data** because processing such incorrect data can give wrong results.

(E) Value

- Big data can help to **find useful patterns and information**-but only if we use it in the right way.

Example: A company may use Big data to understand customer behavior and improve their services.

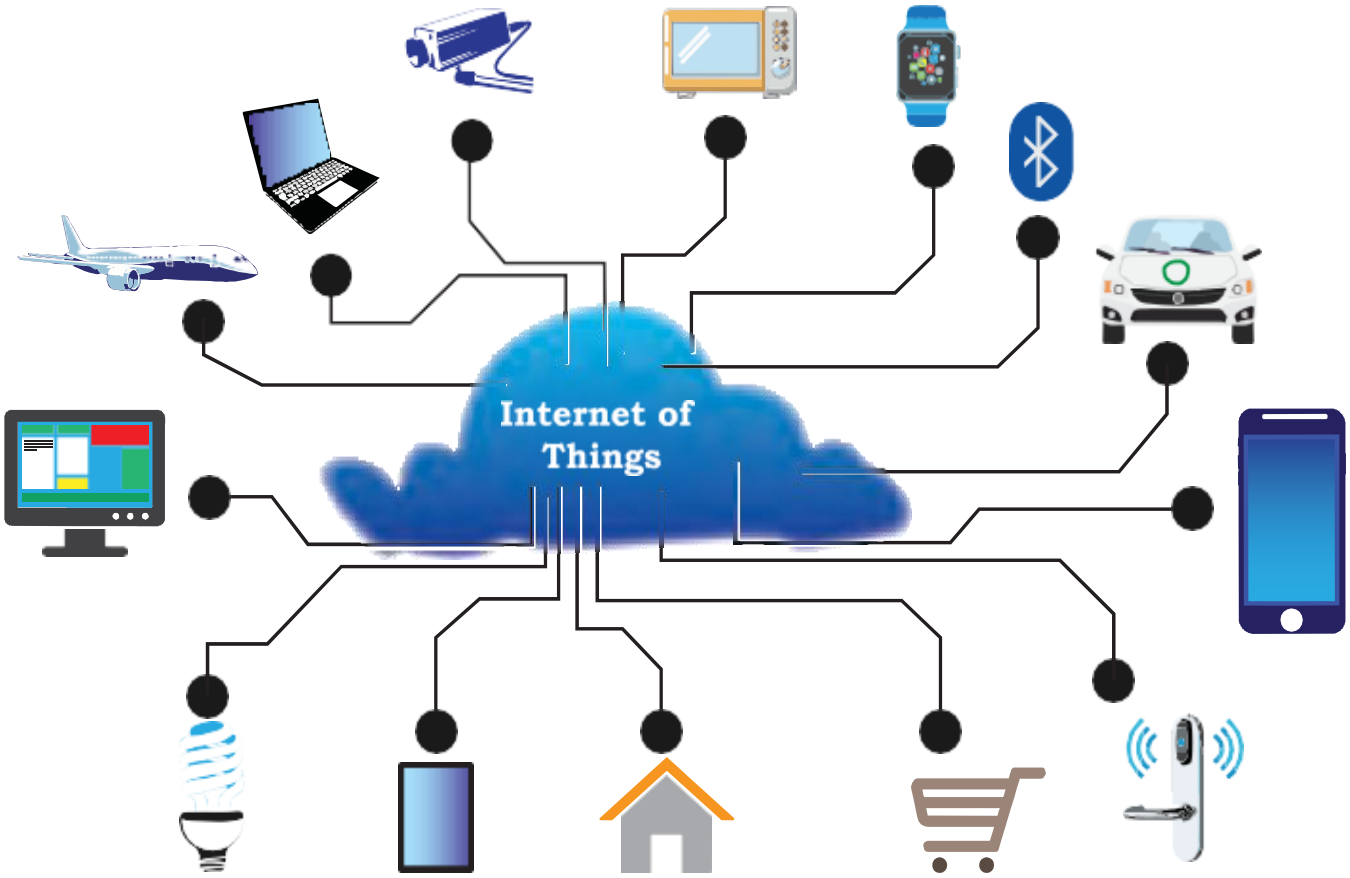
Data Analytics

- "Data analytics is the process of examining data sets in order to draw conclusions about the information they contain, with the aid of specialized systems and software."
- They are used in commercial industries to enable organizations **to make more informed business decisions**.
- In the field of science and technology, it can be useful for researchers to verify or disprove scientific models, theories and hypotheses.
- Pandas is a library of the programming language Python that can be used as a tool to make data analysis much simpler.

Internet of Things (IoT)

- The 'Internet of Things' is a network of devices that have an embedded hardware and software to communicate with other devices on the same network.
- At present, in a household, many devices have advanced hardware (microcontrollers) and software. These devices are used in isolation from each other, with maximum human intervention needed for operational directions and input data. IoT tends to bring together these devices to work in collaboration and assist each other in creating an intelligent network of things.
- 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.

INTERNET OF THINGS (IOT)



Types of IoT

- **Web of Things (WoT)**
- **Sensors**
- **Smart Cities**

1) Web of Things (WoT)

Web of Things (WoT) is a concept that uses web technologies to connect and control smart devices over the internet. It makes devices to talk to each other using web services instead of separate apps.

How is WoT Different from IoT?

Internet of Things (IoT)	Web of Things (WoT)
Connects physical devices to the Internet	Uses the Web to control and manage these devices
Usually needs separate apps for each device	Tries to provide a common platform for all devices
Focuses on connecting hardware	Focuses on creating a user-friendly interface via the Web

2. Sensors

- Sensors are small electronic devices that detects changes in the environment and send that information to other systems or devices to take action.

Sensors Work in a Mobile Phone

Two main sensors help with screen rotation:

- **Accelerometer**:
  - Detects the **position and movement** of your phone.
  - Helps the phone understand if it is being held **upright** or **sideways**.
- **Gyroscope (Gyro)**:
  - Detects the **rotation** or **tilt** of the phone.
  - Works along with the accelerometer to give more **accurate motion data**.
- So when you tilt or rotate your phone, these two sensors work together to **adjust the screen orientation**.

A smart sensor:

- A **smart sensor** is an advanced type of sensor. It not only detects input from the environment, but also:
- **Processes the data** using built-in computing power.
- **Performs specific functions** automatically.
- **Sends the processed data** to other devices or systems.

Ex: Air conditioners, Automatic lights, mobile brightness control, Security alarms, automatic doors, Smart watches, fitness bands.

3. Smart Cities

- A Smart City uses technology, like computers, the Internet, and sensors, to make the city run better.

Smart cities help in:

- Saving time and energy
- Keeping the city clean and safe
- Making life more comfortable for people

Need of Smart cities:

As more people move to cities, they are getting more crowded. This creates many problems, such as:

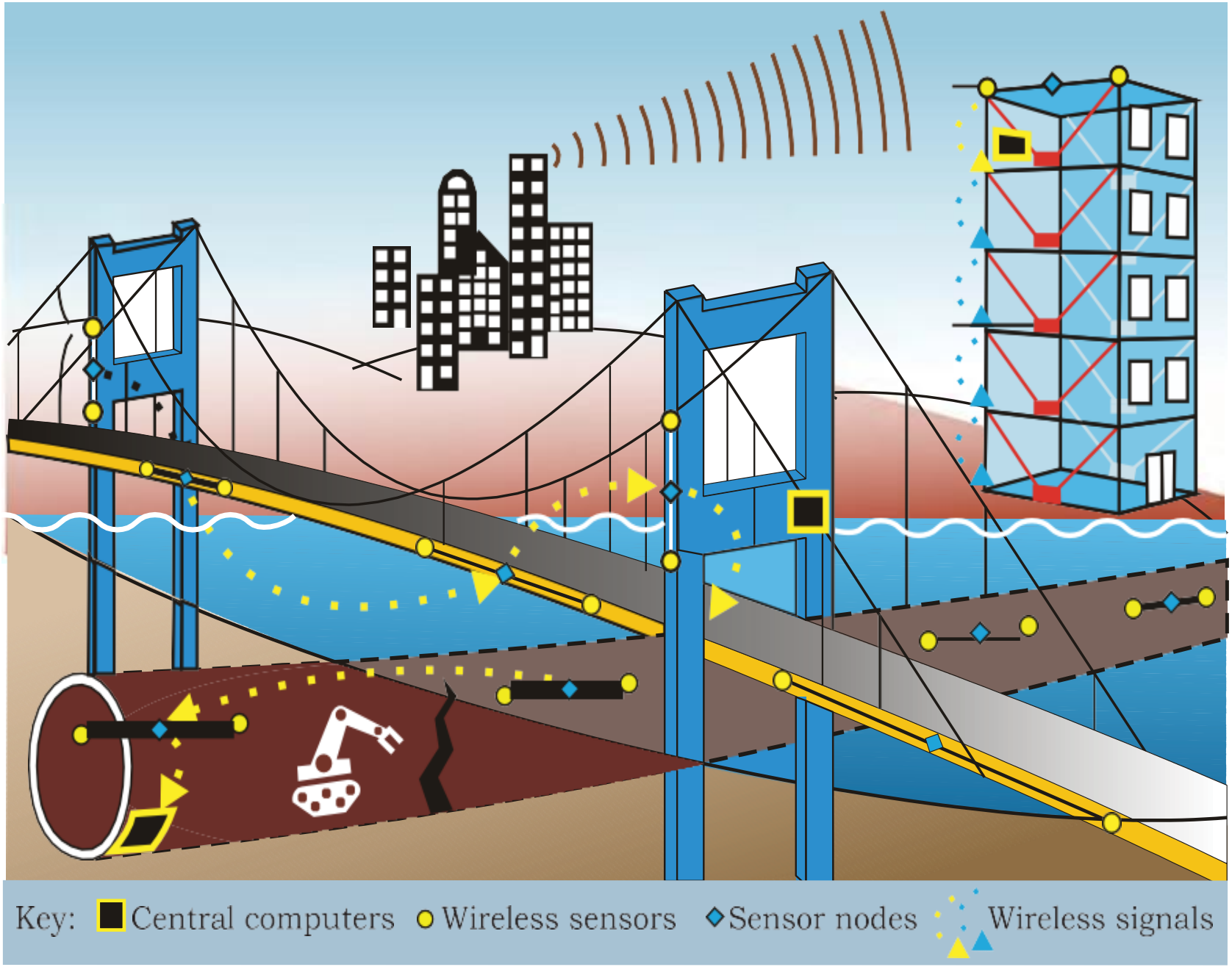
- Traffic jams
- Pollution
- Garbage and waste
- Not enough clean water
- Health and safety issues
- Overloaded roads, bridges, electricity, etc.

Smart cities use:

- **Sensors** to collect information (like traffic or weather)
- **Wireless networks** to send this information
- **Computers** to study the data and take action

Examples of Smart City Technology

- **Smart Buildings**: Can feel earthquakes and send alerts to people nearby.
- **Smart Bridges**: Can find cracks or loose parts and send a warning to engineers.
- **Smart Tunnels**: Can detect traffic or water leaks and send the info to control centers.
- **Smart Traffic Lights:** Change based on real-time traffic to avoid jams.
- **Smart Garbage Bins:** Tell the cleaning team when they are full.


Key:
Central computers
Wireless sensors
Sensor nodes
Wireless signals

Cloud Computing

Cloud computing means using computer services through the Internet.
These services include:

- **Software** (like apps)
- **Hardware** (like servers)
- **Storage** (to save files)
- **Databases** (to store and manage information)

- You don’t need to have powerful computers to use these services. As long as you have an Internet connection, you can access them from any device like a mobile phone, tablet, or laptop.

SERVICE PROVIDERS

There are companies called cloud service providers that offer cloud services.
Some popular providers are:

- **Google Cloud**
- **Microsoft Azure**
- **Amazon Web Services (AWS)**
- These companies usually charge money based on how much you use, just like your electricity bill.

Examples of Cloud Computing

- Storing photos in Google Drive or iCloud
- Watching videos on YouTube or Netflix
- Writing documents in Google Docs
- Playing games online that save your progress

Why Is Cloud Computing Useful?

- **Access from Anywhere**: You can use your files and apps from any place, at any time.
- No need for powerful devices
- Saves money
- Scalable
- Backup and Recovery

Cloud Services

- A better way to understand the cloud is to interpret everything as a service.
- A service corresponds to any facility provided by the cloud.
- There are three standard models to categorize different computing services delivered through cloud.
- These are
  - Infrastructure as a Service (IaaS),
  - Platform as a Service (PaaS),
  - Software as a Service (SaaS).

A) Infrastructure as a Service (IaaS)

A) INFRASTRUCTURE AS A SERVICE (IAAS)

IaaS provides hardware and basic computing tools through the Internet.

You can get:

- Virtual machines (VMs)
- Storage and backup
- Servers
- Operating systems

You don’t need to buy or manage this hardware yourself. Instead, you can rent it from cloud providers, and pay only for what you use.

Example: Hosting a website on a rented server instead of buying your own.

Benefits:

- Saves cost of buying servers
- No need for physical space
- No worries about setup or maintenance

(B) Platform as a Service (PaaS)

B) PLATFORM AS A SERVICE (PAAS)

PaaS provides a ready-made environment for building and running software applications.

You don’t have to install or set up anything like Web servers, Programming tools, Databases etc.

- Ex: Google cloud, Amazon web services, Microsoft Azure

(C) Software as a Service (SaaS)

- Saas gives you ready-to-use software applications over the internet. You just login and start using them-no need to install anything.
- Ex: Gmail, NetFlix, Zoom, Google doc, Microsoft Office 365, Drop Box

Grid computing

- Grid computing is a method where many computers from different locations work together to solve a single large problem. These computers are connected through the internet or a local network, and each one shares its processing power and memory.

Grid can be of two types —

(i) Data grid:

Focuses on managing large amounts of data.

Supports multiple users who access and work with data stored across different places.

(ii) CPU or processor grid:

Focuses on sharing computer power.

Divides a big job into subtasks, and each subtask is done by a different computer.

Software used in Grid Computing

To connect and manage all the nodes in a grid, special software called middleware is used. One popular toolkit is:

Globus toolkit: open source software. Website:

http://toolkit.globus.org/toolkit

Blockchains

A blockchain is a digital system where a group of computers work together to keep a shared, secure record of transactions. Each computer has a full copy of the record, which makes it safe, open and reliable.

Working of blockchain:

Data is saved in blocks. Each block is like a small, secure folder that stores group of transactions.

Blocks are added one after the other, forming a chain of blocks-hence the name blockchain.

Before a new block is added, all the computers in the network must approve it.

Since everyone has the same copy, no single person can change the data.

Examples of blockchain applications:

1. Bitcoin and other cryptocurrencies- Blockchain is used to record all digital currency transactions.
2. Online voting system-Each vote is recorded on a block chain to make elections secure.
3. Land Record Management
4. Supply chain tracking-Companies use blockchain to track goods from factories to store, ensuring safety and quality.