II JAI SRI GURUDEV II
Sri Adichunchanagiri Shikshana Trust®

SJB Institute of Technology

(Affiliated to Visvesvaraya Technological University, Belagavi & Approved by AICTE, New Delhi)
No. 67, BGS Health & Education City, Dr. Vishnuvardhan Road,
Kengeri, Bengaluru-560060
Web:www.sjbit.edu.in,Email:principal@sjbit.edu.in, Phone:080-28612445/46, Fax: 080-28612651

Department of Management Studies (MBA)

NOTES

Subject Name : EMERGING EXPONENTIAL TECHNOLOGIES

Subject Code: 20MBA301

Semester: III

EMERGING EXPONENTIAL TECHNOLOGIES

Objective of the Course:

1. To understand the emerging technologies applicable in field of Management. 2. To study data science as a tool for decision making in Management

3. To understand the concept of AI, IOT and AR.

4. To study other emerging technologies in Management.

Module -1 Introduction to Emerging Technologies—9 hours

Evolution of technologies; Introduction to Industrial revolution; Historical background of the Industrial Revolution; Introduction to Fourth industrial revolution (IR 4.0); Role of data for Emerging technologies; Enabling devices and networks for emerging technologies (programmable devices); Human to Machine Interaction; Future trends in emerging technologies

Module -2 Data Science-7 hours

Overview for Data Science; Definition of data and information; Data types and representation; Data Value Chain; Data Acquisition; Data Analysis; Data Curating; Data Storage; Data Usage; Basic concepts of Big Data.

Module -3 Artificial Intelligence (AI)- 9 hours

Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI, Applications of AI in Agriculture, Health, Business (Emerging market), Education, AI tools and platforms (eg: scratch/object tracking).

Module -4 Internet of Things (IoT)- 9 hours

Overview of IOT; meaning of IOT; History of IOT; Advantages of IOT; Challenges of IOT; IOT working process; Architecture of IOT; Devices and network; Applications of IOT at Smart home; Smart grid; Smart city; Wearable devices; Smart farming; IOT tools and platforms; Sample application with hands on activity.

Module-5 Augmented Reality (AR) and Virtual Reality (VR)- 9 hours

Introduction to AR, Virtual reality (VR), Augmented Reality (AR) vs mixed reality (MR), Architecture of AR systems. Application of AR systems (education, medical, assistance, entertainment) workshop oriented hands demo.

Module-6 Ethics, Professionalism and Other Emerging Technologies-7Hours

Technology and ethics, Digital privacy, Accountability and trust, Treats and challenges.
Other Technologies: Block chain technology, Cloud and quantum computing, Autonomic computing, Computervision, Cyber security, Additive manufacturing (3D Printing)

Module -1 Introduction to Emerging Technologies—9 hour

In general the emerging technologies encompass new technologies that are currently developing, or will be developed, over the next 5–10 years, and which can significantly change the business models and social environment. These include information technology, wireless data communication, man-machine communication, on-demand printing, bio-technologies, and advanced robotics. The World Economic Forum's Global Agenda Council on Emerging Technologies reveals recent trends in technological changes in its Top 10 Emerging Technologies. By identifying the most important technological breakthroughs, the Council aims to raise awareness of the potential and to guide investment, regulation and public understanding of such emerging technologies. For 2014, the Council dentified 10 new technologies that could reshape our society in the future: Bodyadapted Wearable Electronics, Nanostructured Carbon Composites, Mining Metals from Desalination Brine, Grid-scale Electricity Storage, Nanowire Lithium-ion Batteries, Screenless Display, Human Microbiome Therapeutics, RNA-based Therapeutics, Quantified Self (Predictive Analytics), and Brain-computer Interfaces (World Economic Forum 2014).

Evolution of technologies

1.2 The Emerging Markets that will Define the World The term emerging market first appeared in 1981 and was reported by economists at the International Finance Corporation (IFC) when the group promoted the first mutual fund investments in developing countries. Antoine van Agtmael who coined the term, emerging markets, now runs a fund management company with US $24 billion invested in those markets. He believes that the combined GNP of today's emerging markets will overtake that of the developed economies. In the next 50 years, emerging markets will be twice the size of today's economic leaders. Assuming that information technology is deployed to full effect, the populations of these countries would be wealthier, healthier and better educated (The Economist 2007). Since then, references to emerging markets have been popularized by the media, used in foreign policy and trade debates, and proliferated in investment fund prospectuses and multinationals' annual reports. The definition of the term varies widely to the referenced countries and depending who is reporting it (Khanna and Palepu 2010). Two decades later, a former Goldman Sachs economist came up with the term "BRIC" that comprises of Brazil, Russia, India and China as countries whose growth will shape the world economy in the coming decades (Cocks 2014). Later "S" was added to become BRICS that included South Africa. There is also another version BRIICS which included Indonesia and South Africa. The Asian Development Bank (ADB) has identified 25 countries as emerging market economies: Argentina, Brazil, Chile, China, Columbia, Czech Republic, Egypt, Hong Kong, Hungary, India, Indonesia, Israel, Rep of Korea, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Federation, South Africa, Singapore, Taipei, Thailand, and Turkey. Of the 25 economies, 11 are in Asia, seven in Europe, five in Latin America, 1 in the Middle East, and 1 in Africa (Park and Mercado 2013). In mid-2013, Bloomberg listed the top 20 emerging markets as China, South Korea, Thailand, Peru, Czech Republic, Malaysia, Turkey, Chile, Russia, Indonesia, Columbia, Poland, Namibia, Zambia, South Africa, Mexico, Brazil, Hungary, Morocco and Philippines. The list of markets is not that different from ADB, with the exception it is more inclined towards the African continent (Bloomberg Markets 2013).

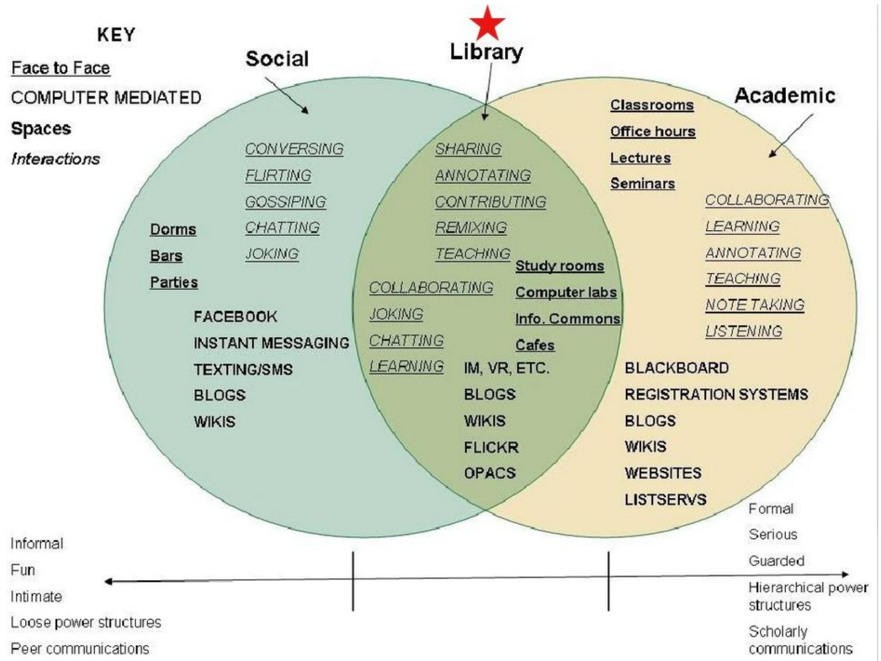
UNIT 1

Introduction to Emerging Technologies

Emerging technology is a term generally used to describe a new technology, but it may also refer to the continuing development of an existing technology; it can have slightly different meaning when used in different areas, such as media, business, science, or education. The term commonly refers to technologies that are currently developing, or that are expected to be available within the next five to ten years, and is usually reserved for technologies that are creating, or are expected to create, significant social or economic effects.

Emerging digital technologies have generated new opportunities while creating new legal challenges, particularly related to copyrights, trademarks, patents, royalties, and licensing.

For example, the development of new digital communication technologies and media has given rise to novel issues relating to the digital reproduction and distribution of copyrighted works. The federal government, affected industries, and groups advocating for the public interest have taken (and continue to take) action to craft appropriate protections and offer legal certainty to copyright owners, digital technology companies, the public, and other interested parties.


KEY
Face to Face
COMPUTER MEDIATED
Spaces
Interactions
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Library
Academic
CONVERSING
FLIRTING
GOSSIPING
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Bars
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FACEBOOK
INSTANT MESSAGING
TEXTING/SMS
BLOGS
WIKIS
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ANNOTATING
CONTRIBUTING
REMIXING
TEACHING
COLLABORATING
JOKING
CHATTING
LEARNING
Study rooms
Computer labs
Info. Commons
Cafes
IM, VR, ETC.
BLOGS
WIKIS
FLICKR
OPACS
Classrooms
Office hours
Lectures
Seminars
COLLABORATING
LEARNING
ANNOTATING
TEACHING
NOTE TAKING
LISTENING
BLACKBOARD
REGISTRATION SYSTEMS
BLOGS
WIKIS
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Informal
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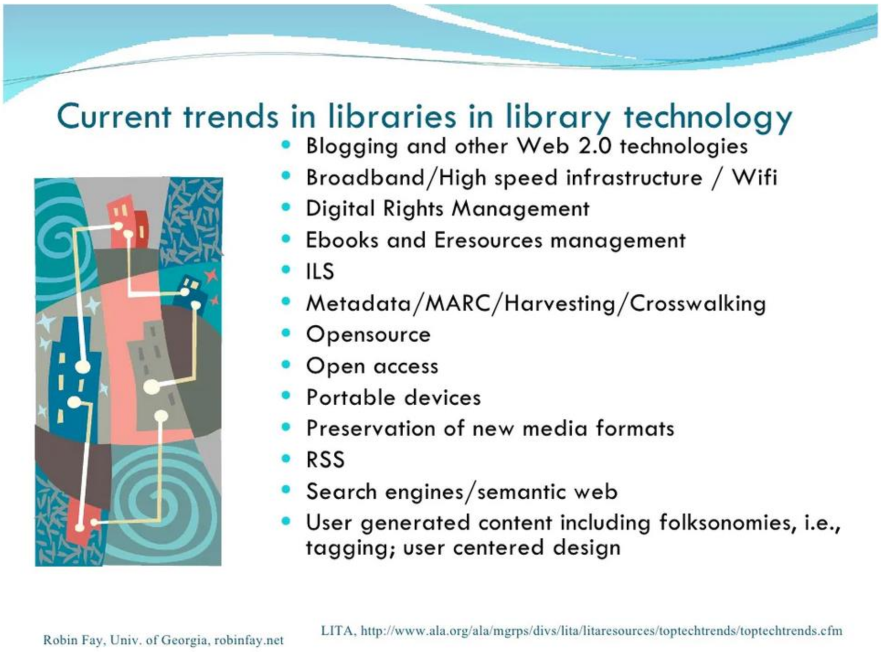
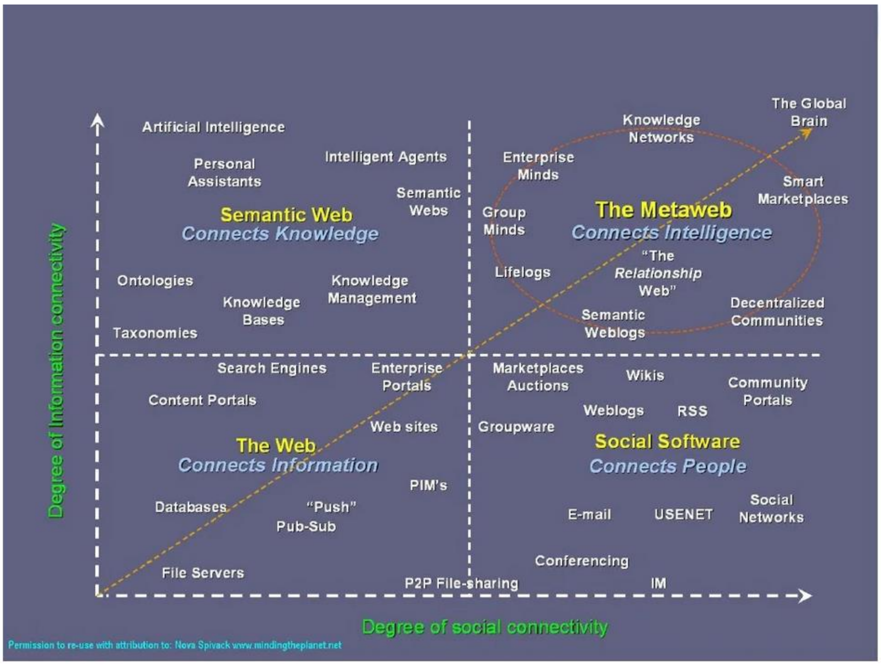
Formal
Serious
Guarded
Hierarchical power structures
Scholarly communications

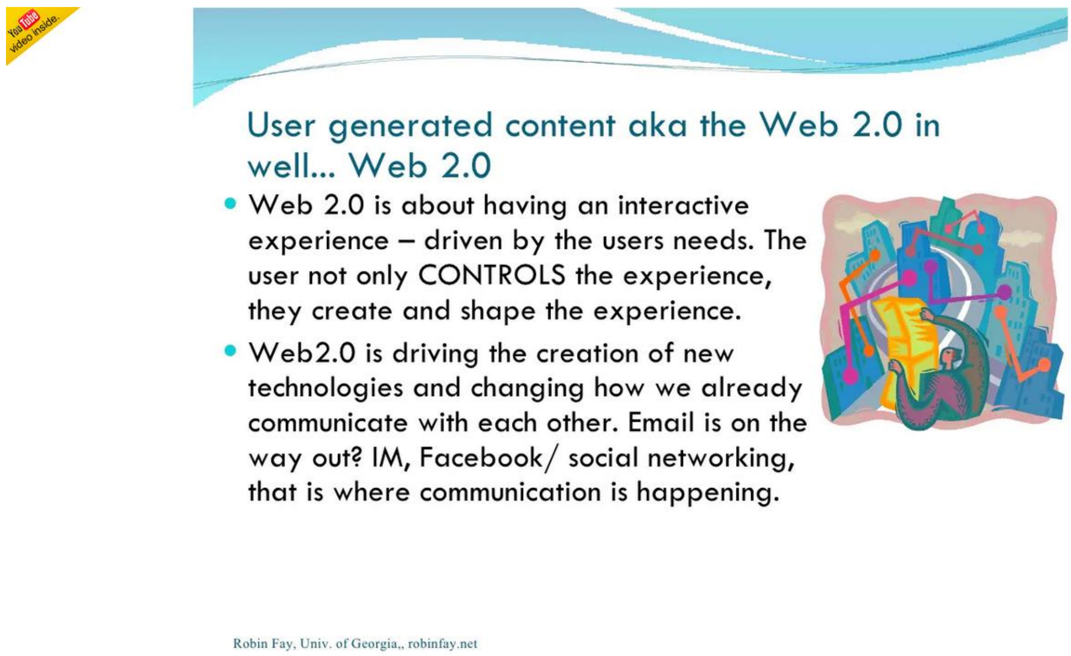

Current trends in libraries in library technology
Blogging and other Web 2.0 technologies
Broadband/High speed infrastructure / Wifi
Digital Rights Management
Ebooks and Eresources management
ILS
Metadata/MARC/Harvesting/Crosswalking
Opensource
Open access
Portable devices
Preservation of new media formats
RSS
Search engines/semantic web
User generated content including folksonomies, i.e., tagging; user centered design
Robin Fay, Univ. of Georgia, robinfay.net
LITA, http://www.ala.org/ala/mgrps/divs/lita/litaresources/toptechtrends/toptechtrends.cfm



Opensource

- Let's look at opensource just a little.
- Opensource is software that is released and licensed to the public for use and/or modification. It may be developed by one developer, a team, or a community.
- Opensource is free to use; however, hidden costs include server space/staff time as well as for pay extras. Opensource has both advantages and disadvantages.

Robin Fay, Univ. of Georgia,, robinfay.net



The Industrial Revolution marked a period of development in the latter half of the 18th century that transformed largely rural, agrarian societies in Europe and America into industrialized, urban ones.

Goods that had once been painstakingly crafted by hand started to be produced in mass quantities by machines in factories, thanks to the introduction of new machines and techniques in textiles, iron making and other industries.

Historical background of the Industrial Revolution

Introduction to Fourth industrial revolution (IR 4.0)

Industry 4.0 refers to a new phase in the Industrial Revolution that focuses heavily on interconnectivity, automation, machine learning, and real-time data. Industry 4.0, also sometimes referred to as IIoT or smart manufacturing, marries physical production and operations with smart digital technology, machine learning, and big data to create a more holistic and better connected ecosystem for companies that focus on manufacturing and supply chain management. While every company and organization operating today is different, they all face a common challenge—the need for connectedness and access to real-time insights across processes, partners, products, and people.

That's where Industry 4.0 comes into play.

Industry 4.0 isn't just about investing in new technology and tools to improve manufacturing efficiency—it's about revolutionizing the way your entire business operates and grows. This resource will provide you with an in-depth overview on the topic of Industry 4.0 and IIoT, including information on the following:

- The Evolution of Industry from 1.0 to 4.0
- Basic IIoT Concepts and Glossary of Terms
- Smart Manufacturing Use Cases
- Whom is Industry 4.0 For?
- Benefits of Adopting an Industry 4.0 Model
- Challenges to Consider and Overcome
- How Epicor Can Help Your Business

The world of manufacturing is changing. To survive and thrive now, you have to be willing to invest in Industry 4.0. This resource will help you get started.

Evolution of Industry from 1.0 to 4.0

Before digging too much deeper into the what, why, and how of Industry 4.0, it's beneficial to first understand how exactly manufacturing has evolved since the 1800s. There are four distinct industrial revolutions that the world either has experienced or continues to experience today.

The First Industrial Revolution

The first industrial revolution happened between the late 1700s and early 1800s. During this period of time, manufacturing evolved from focusing on manual labor performed by people and aided by work animals to a more optimized form of labor performed by people through the use of water and steam-powered engines and other types of machine tools.

The Second Industrial Revolution

In the early part of the 20th century, the world entered a second industrial revolution with the introduction of steel and use of electricity in factories. The introduction of electricity enabled manufacturers to increase efficiency and helped make factory machinery more mobile. It was during this phase that mass production concepts like the assembly line were introduced as a way to boost productivity.

The Third Industrial Revolution

Starting in the late 1950s, a third industrial revolution slowly began to emerge, as manufacturers began incorporating more electronic—and eventually computer—technology into their factories. During this period, manufacturers began experiencing a shift that put less emphasis on analog and mechanical technology and more on digital technology and automation software.

The Fourth Industrial Revolution, or Industry 4.0

In the past few decades, a fourth industrial revolution has emerged, known as Industry 4.0. Industry 4.0 takes the emphasis on digital technology from recent decades to a whole new level with the help of interconnectivity through the Internet of Things (IoT), access to real-time data, and the introduction of cyber-physical systems. Industry 4.0 offers a more comprehensive, interlinked, and holistic approach to manufacturing. It connects physical with digital, and allows for better collaboration and access across departments, partners, vendors, product, and people. Industry 4.0 empowers business owners to better control and understand every aspect of their operation, and allows them to leverage instant data to boost productivity, improve processes, and drive growth.

Basic IIoT Concepts and Glossary of Terms

There are hundreds of concepts and terms that relate to IIoT and Industry 4.0, but here are 12 foundational words and phrases to know before you decide whether you want to invest in Industry 4.0 solutions for your business:

- **Enterprise Resource Planning (ERP):** Business process management tools that can be used to manage information across an organization.
- **IoT:** IoT stands for Internet of Things, a concept that refers to connections between physical objects like sensors or machines and the Internet.

- **IIoT:** IIoT stands for the Industrial Internet of Things, a concept that refers to the connections between people, data, and machines as they relate to manufacturing.
- **Big data:** Big data refers to large sets of structured or unstructured data that can be compiled, stored, organized, and analyzed to reveal patterns, trends, associations, and opportunities.
- **Artificial intelligence (AI):** Artificial intelligence is a concept that refers to a computer's ability to perform tasks and make decisions that would historically require some level of human intelligence.
- **M2M:** This stands for machine-to-machine, and refers to the communication that happens between two separate machines through wireless or wired networks.
- **Digitization:** Digitization refers to the process of collecting and converting different types of information into a digital format.
- **Smart factory:** A smart factory is one that invests in and leverages Industry 4.0 technology, solutions, and approaches.
- **Machine learning:** Machine learning refers to the ability that computers have to learn and improve on their own through artificial intelligence—without being explicitly told or programmed to do so.
- **Cloud computing:** Cloud computing refers to the practice of using interconnected remote servers hosted on the Internet to store, manage, and process information.
- **Real-time data processing:** Real-time data processing refers to the abilities of computer systems and machines to continuously and automatically process data and provide real-time or near-time outputs and insights.
- **Ecosystem:** An ecosystem, in terms of manufacturing, refers to the potential connectedness of your entire operation—inventory and planning, financials, customer relationships, supply chain management, and manufacturing execution.
- **Cyber-physical systems (CPS):** Cyber-physical systems, also sometimes known as cyber manufacturing, refers to an Industry 4.0-enabled manufacturing environment that offers real-time data collection, analysis, and transparency across every aspect of a manufacturing operation.

Now that you have a better understanding of some of the core concepts related to Industry 4.0, you're ready to dig deeper into how smart manufacturing can revolutionize the way you run and grow your business.

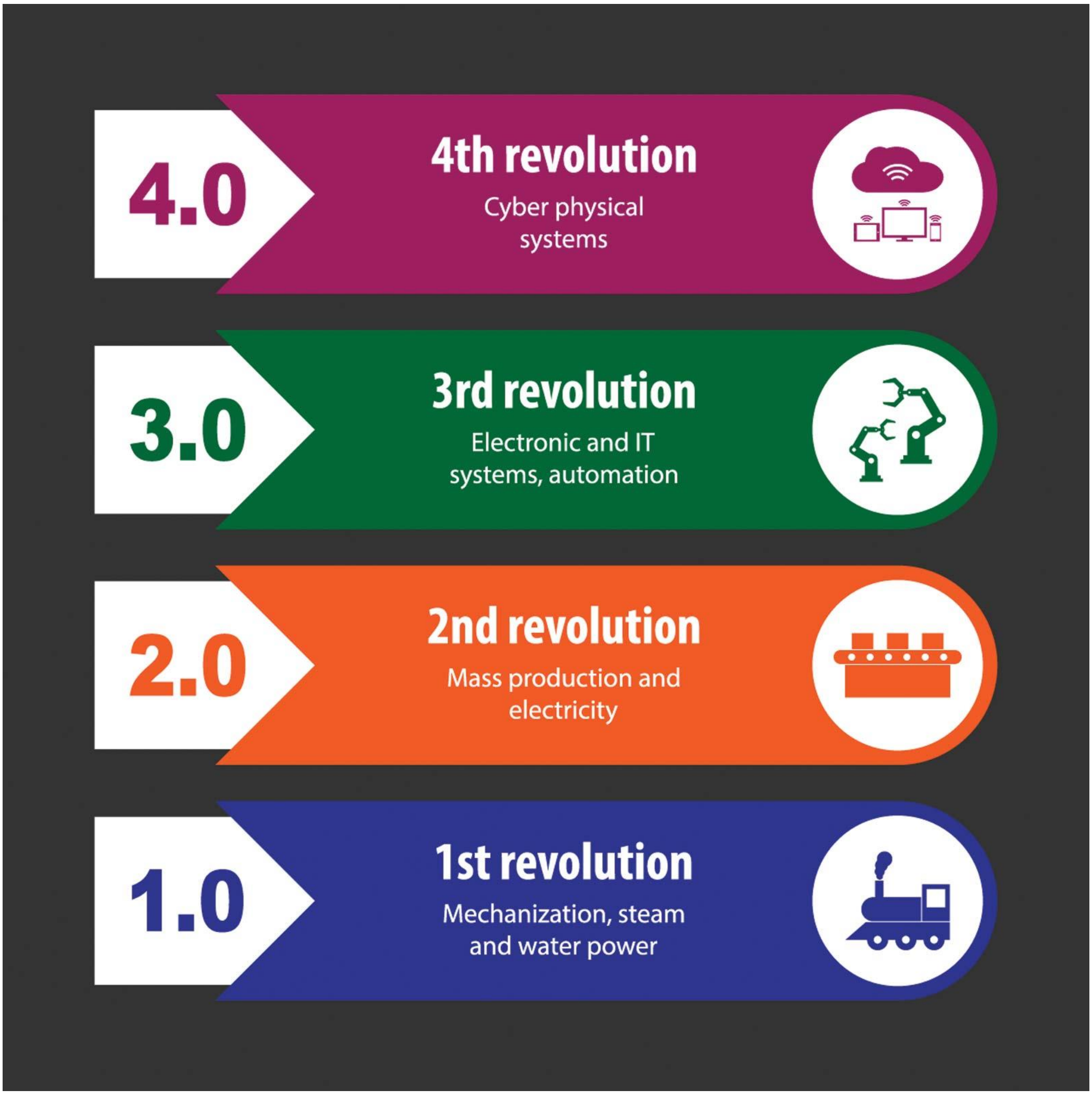
Smart Manufacturing Use Cases

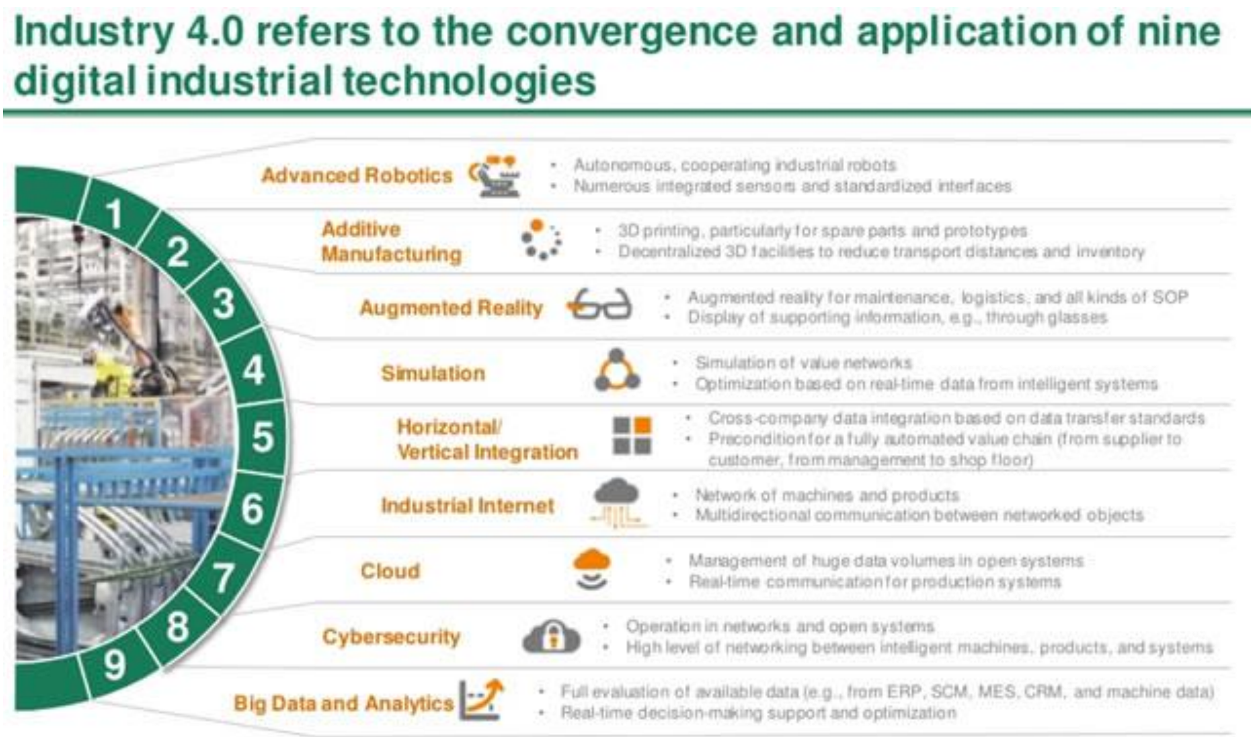
One of the best ways to understand the concept of smart manufacturing better is to think about how it could be applied to your business, or a business similar to your business. Here are three use cases that can help you understand the value of Industry 4.0 in a manufacturing operation:

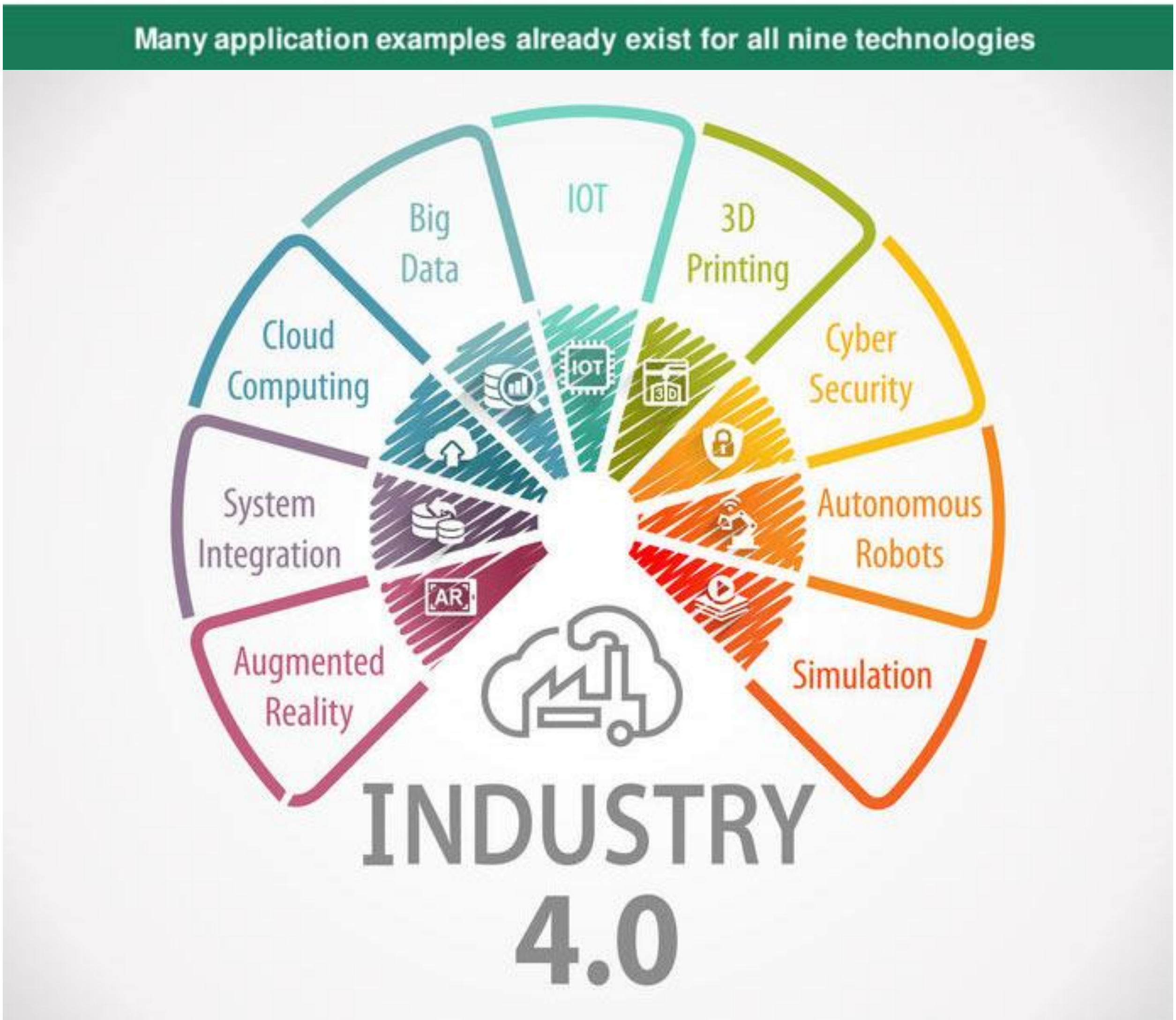
- **1. Supply chain management and optimization—**Industry 4.0 solutions give businesses greater insight, control, and data visibility across their entire supply chain. By leveraging supply chain management capabilities, companies can deliver products and services to market faster, cheaper, and with better quality to gain an advantage over less-efficient competitors.
- **2. Predictive maintenance/analytics—**Industry 4.0 solutions give manufacturers the ability to predict when potential problems are going to arise before they actually happen. Without IoT systems in place at your factory, preventive maintenance happens based on routine or time. In other words, it's a manual task. With IoT systems in place, preventive maintenance is much more automated and streamlined. Systems can sense when problems are arising or machinery needs to be fixed, and can empower you to solve potential issues before they become bigger problems. Predictive analytics allow companies to not just ask reactive questions like, "what has happened?," or "why did it happen?," but also proactive questions like, "what is going to happen," and, "what can we do to prevent it from happening?" These type of analytics can enable manufacturers to pivot from preventive maintenance to predictive maintenance.

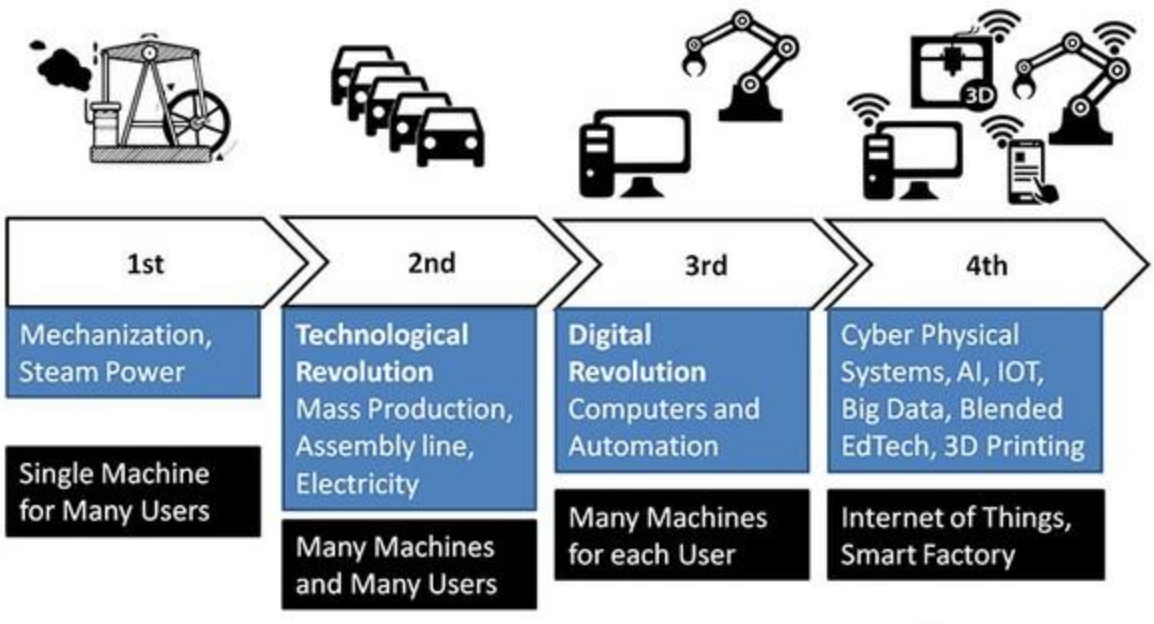
- **3. Asset tracking and optimization—**Industry 4.0 solutions help manufacturers become more efficient with assets at each stage of the supply chain, allowing them to keep a better pulse on inventory, quality, and optimization opportunities relating to logistics. With IoT in place at a factory, employees can get better visibility into their assets worldwide. Standard asset management tasks such as asset transfers, disposals, reclassifications, and adjustments can be streamlined and managed centrally and in real time.

The point of reviewing these use cases is to help you imagine and start thinking about how smart manufacturing could be integrated into your own organization. How do you actually decide if Industry 4.0 is right for you?

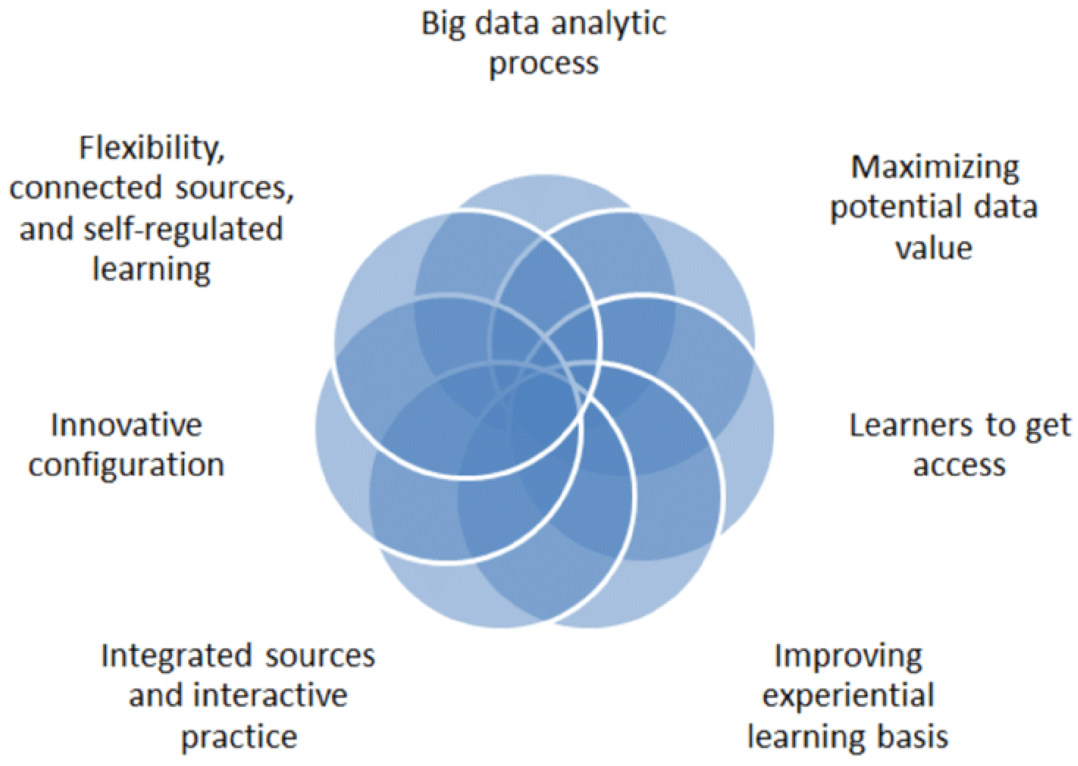



Industry 4.0 refers to the convergence and application of nine digital industrial technologies
1 Advanced Robotics
Autonomous, cooperating industrial robots
Numerous integrated sensors and standardized interfaces
2 Additive Manufacturing
3D printing, particularly for spare parts and prototypes
Decentralized 3D facilities to reduce transport distances and inventory
3 Augmented Reality
Augmented reality for maintenance, logistics, and all kinds of SOP
Display of supporting information, e.g., through glasses
4 Simulation
Simulation of value networks
Optimization based on real-time data from intelligent systems
5 Horizontal/ Vertical Integration
Cross-company data integration based on data transfer standards
Precondition for a fully automated value chain (from supplier to customer, from management to shop floor)
6 Industrial Internet
Network of machines and products
Multidirectional communication between networked objects
7 Cloud
Management of huge data volumes in open systems
Real-time communication for production systems
8 Cybersecurity
Operation in networks and open systems
High level of networking between intelligent machines, products, and systems
9 Big Data and Analytics
Full evaluation of available data (e.g., from ERP, SCM, MES, CRM, and machine data)
Real-time decision-making support and optimization

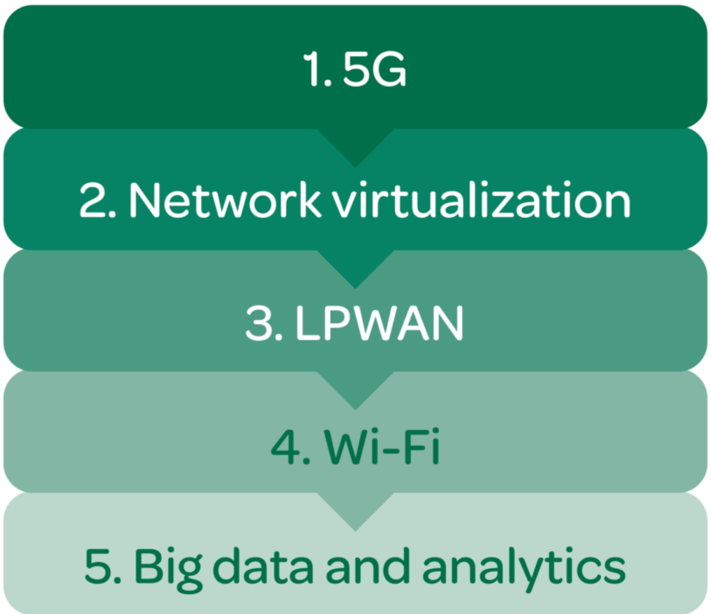

Many application examples already exist for all nine technologies
Big Data
IOT
3D Printing
Cloud Computing
Cyber Security
System Integration
Autonomous Robots
Augmented Reality
Simulation
AR
INDUSTRY 4.0



Role of data for Emerging technologies:

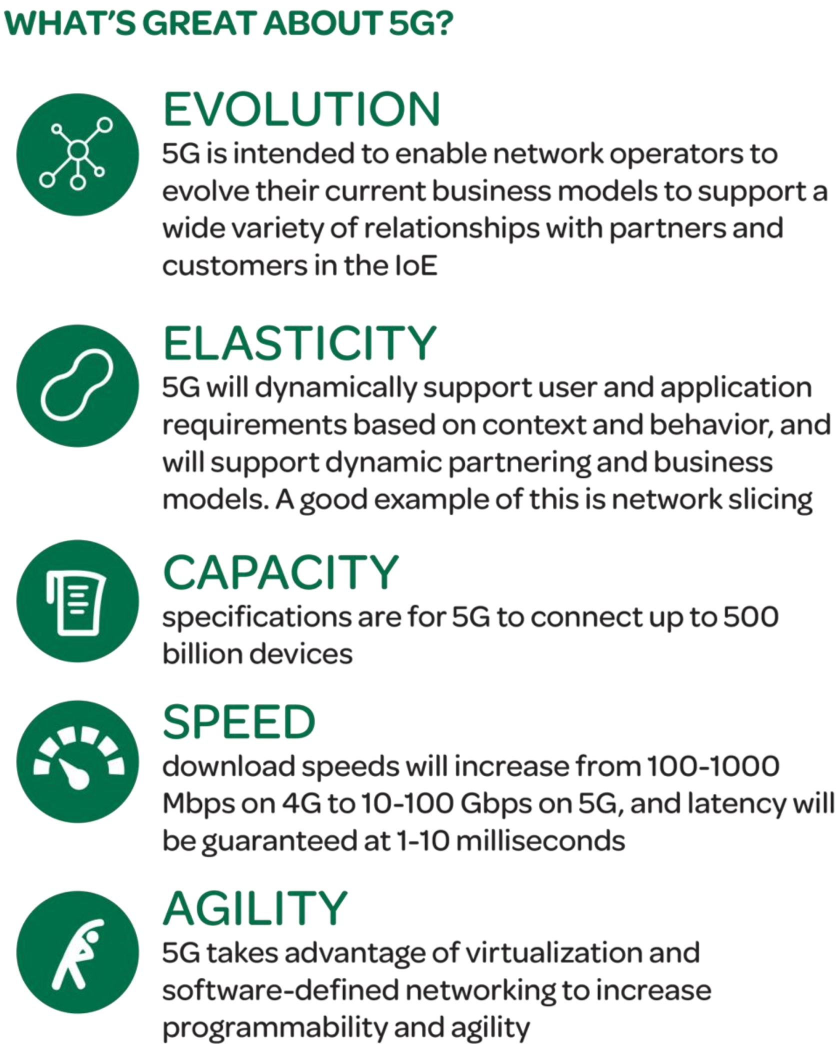


Enabling devices and networks for emerging technologies



The 5G Effect

Next-generation 5G technology will play a crucial part in shaping the future for real-time IoT/IoE applications because it promises fast, reliable, always-on connectivity over a mobile network. SIM-based applications like connected cars, infotainment, vehicle telematics and augmented reality will benefit from its seamless mobility and high payload capacity. The technology is also highly scalable and reliable and offers very low latency.



Source: TM Forum, 2015

5G is suitable for wide-band, high data-rate applications, where range is not an issue. But even though 5G devices will consume less energy than 4G/LTE devices, they will still require more power than devices that are designed specifically for low-power networks. This makes 5G unsuitable for some small, battery- powered devices that need to operate for several years without maintenance, such as those installed in hard-to-reach locations. However, if a 5G device is permanently connected to a vehicle or some other continuous power source, energy consumption will not be an issue.

Benefits of low-power networks

Low-power access networks are especially good for connecting devices that consume little battery power. LPWAN provides connectivity over a long range for low data rate applications such as the battery-operated sensors that measure liquid levels in remote agricultural or industrial storage tanks. These types of sensors send tiny amounts of data very occasionally and need to run for years on a single battery. The LoRa Alliance has developed LoRaWAN as an LPWAN standard.

Narrow-band IoT (NB-IoT) is another LPWAN technology and an emerging standard produced by the 3rd Generation Partnership Project (3GPP) for low-power communication between IoT devices. The main features of the technology are good indoor coverage, long reach, low latency, long device battery life and support for large numbers of devices. NB-IoT is a cost-effective solution for network operators because it can use cell site infrastructure that's in place already such as masts, antennas and baseband equipment.

Virtualization's impact

Network functions virtualization (NFV), software-defined networking (SDN) and cloud technologies promise to radically change communications service providers' networks and back- office environments from a physical world of dedicated hardware and siloed support systems to one where everything is software-based and easy to change.

NFV allows network functions to be instantiated on-demand, when and where they are needed, enabling networks and services to be rapidly created while making efficient use of computing resources. This is good news for the IoE. As the number of devices starts to mushroom, networks will need to scale rapidly and on-demand.

SDN with its unified control plane will allow IoE applications to set priorities for machine-to-machine communications, ensuring that each service (including non-IoE services) receives the appropriate level of priority for forwarding its data traffic through the network. This is how 5G network slicing will be accomplished.

A major challenge for service providers is having to manage hybrid networks made up of both physical and virtual components during the transition from physical to virtual networks, which could take ten years or more to complete.

Service providers will rely on cloud-based service orchestration using automated processes to provision new services across these hybrid networks and rapid, real time updates along with tightly integrated service assurance functions.

WI-FI

Public access Wi-Fi is on the rise and the IEEE 802.11 standard and variants of it are likely to stay around for some time to come, which is why so many IoT device manufacturers are also making use of the technology. Uses include home security and other connected home applications like solar panel monitors where the device is likely to remain close in proximity to a Wi-Fi access point during normal operation.

Wi-Fi is inexpensive to operate and doesn’t require any special network technology beyond a Wi-Fi connection and a household power adaptor. Security also has been a concern. Recently, however, the Wi-Fi Alliance has introduced a low power, long range version of Wi-Fi called Wi-Fi HaLow, which is designed to extend Wi-Fi solutions for IoT.

Big data and predictive analytics

Predictive analytics using statistical machine-learning algorithms can be applied to most types of historical data to support a wide range of use cases from sales forecasts and marketing campaigns, to social media trending, usage hot- spots, diagnostic information, fault management and so on. This in turn can drive strategic, operational and tactical decisions across the business.

In the case of omnichannel, for example, artificial intelligence can be applied to determine customer behavior, user experience or product and service usage trends. “By analyzing more data we can significantly improve the customer experience,” says Rigas Parathyras, Lead Digital Architecture, Liberty Global. “Not only can we be more proactive at the help desk by calling the customer before they call us, [we can] even automate problem resolution.”

Several TM Forum Catalyst projects have been looking at using analytics to improve customer centricity for applications including IoE. In addition, the Analytics Big Data Repository project focuses on standardizing a structured data lake so that service providers will be able to quickly and cheaply implement and test new, innovative analytics ideas and services.

Blockchain: The next big thing?

A key issue when it comes to monetizing the IoE is how to handle trillions of dollars' worth of transactions, many of them for very small amounts, while maintaining security and privacy expectations. As Craig Bachmann, Senior Director, Open Digital Program, TM Forum points out in this article, a distributed ledger technology like blockchain could be the answer.

First developed for bitcoin, blockchain is a highly distributed database that can handle huge volumes of tamper-proof records in a continuously growing list. Instead of a central authority maintaining a single ledger recording participants' bitcoin ownership and transfers, there is a 'community of witnesses' which together record transactions.

This could work for high-volume IoE data transactions that require privacy and security – for example, individual transfers of collision-avoidance data for autonomous vehicles that must remain anonymous and untraceable.

Analysys Mason has outlined nine areas where network operators could use blockchain technology, such as for OSS/BSS processes like billing, eSIM provisioning and number portability databases or in micropayment-based business models for digital assets like music, mobile games, gift cards and loyalty points.

1. Internet of Things (IoT), sensors and biometrics

The IoT has had an enormous impact on every industry, creating a "design platform" that enables the development of a variety of applications.

Key business trends enabled by IoT, sensors and biometrics include : automation and "Smart Everything", empowered consumers, on-demand logistics and services, traceability and sustainability.

EVOLUTION OF IOT

In 1999, The British technology pioneer Kevin Ashton use the term “Internet of Things” first time to describe the system in which all devices with sensors in the real world connected to each other. The term “Internet of Things” is new to us but the concept of using devices to monitor and control exists from the decade. In the late 1970s, the systems that remotely monitor meters on the electrical grid used.

The term IoT is an interconnected network of smart objects using the Internet, sensors, and RFID is able to transfer data without human interaction over the network. It consists of the (i) network which interconnects objects by using Internet technologies (ii) set of technologies such as Radio Frequency Identifications (RFIDs) and sensors

2. Artificial intelligence (A.I.)

A.I. describes advanced, smart computing techniques used to analyse complex problems and data. It helps define patterns in data and provide predictive analytics.

A.I. enables the automation/Smart Everything trend, powering new applications for autonomous robotics, creating new ways of engaging with today’s empowered consumers, and solving ever new challenges in real-time.

3. Open, structured and linked data

Almost any useful business-to-business or business- to-consumer application needs data from multiple sources. Integrating all this information is extremely difficult, especially if it’s unstructured.

The more data can be open, structured and linked, the stronger impact they will have in enabling greater interoperability, especially in business trends such as empowered consumers, traceability, and automation/Smart Everything.

4. Autonomous logistics

In the same way that self-driving cars are disrupting personal transportation, there is a surge of applications that are taking advantage of autonomous systems for logistics.

Robotics and A.I. are other technologies that are contributing to the advancement of autonomous logistics, which is a key enabler for business trends such as on-demand logistics, and automation/ Smart Everything.

5. Blockchain and distributed data

The interest in blockchain has expanded across industry as a way to share data and information across a large number of participants, while offering the possibility of greater data and transactional security.

Blockchain offers new capabilities and is helping to re-ignite interest in other approaches to managing distributed data, such as edge computing and distributed data warehouses.

This technology is being rapidly evaluated today as a potential enabler for traceability, especially in food safety applications.

6. Computer vision

While early advances in computer vision focused exclusively on image recognition, the field has expanded. Vision systems can now observe environments and make decisions and conclusions to support a variety of applications, especially to aid in product quality control in the warehouse.

This technology is enabling many business trends, most notably automation/Smart Everything—and is creating efficiency and speed in support of on-demand logistics and services.

7. Voice recognition

Voice recognition and natural language processing have advanced—and are driving the adoption of personal assistant devices.

This new "conversational commerce" is emerging as a hot new trend that is impacting brands, companies, and marketplaces. These players are increasingly connecting with consumers through apps and voice to improve product research, answer questions and simplify purchases.

This technology enabler will have the biggest impact on the trends: empowered consumer and automation/Smart Everything.

8. Robotics

Robotic systems take on many forms, whether carrying out actions autonomously or semi-autonomously or acting in concert with other robots or people for more complex tasks.

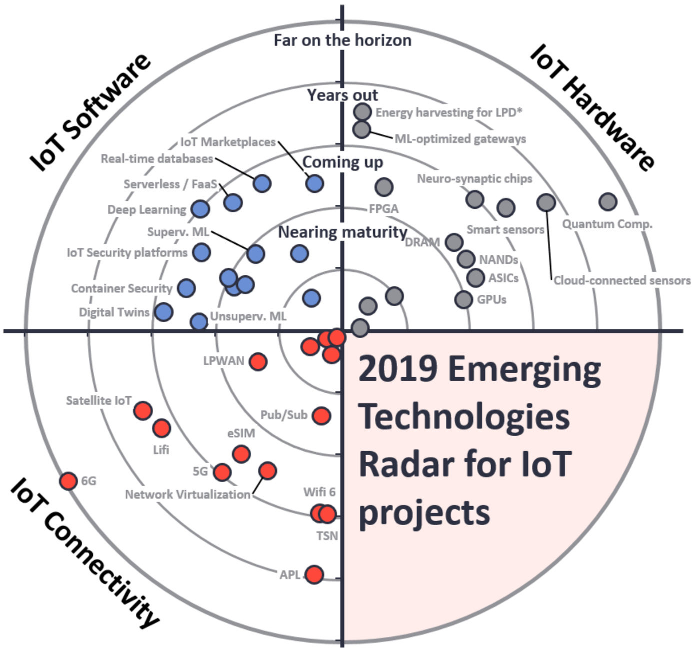
A new trend in robotics is "collaborative robots" (also referred to as cobots or co-robots) in which robots are interacting with people in warehouses and manufacturing settings.

Robotics is a key enabler in the automation/Smart Everything trend. It is also assisting in the scaling of mass customisation.

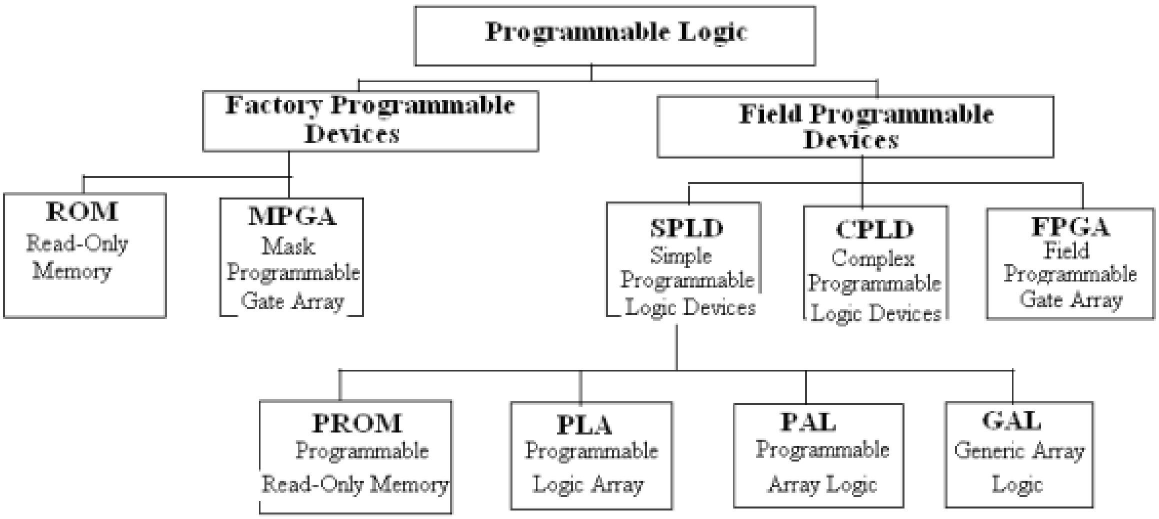
9. Augmented, virtual (AR/VR) and mixed reality

The ability to superimpose digital images and information into the real world using mobile phones, displays and wearable headsets is helping to improve accuracy and efficiency in industrial and commercial settings.

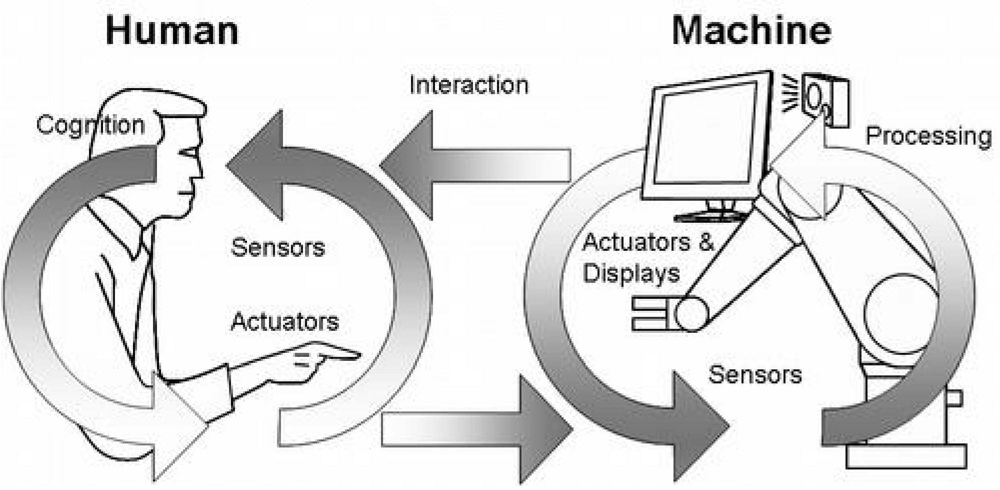
These systems will have a big impact in driving new advances in the automation/Smart Everything and empowered consumer business trends.

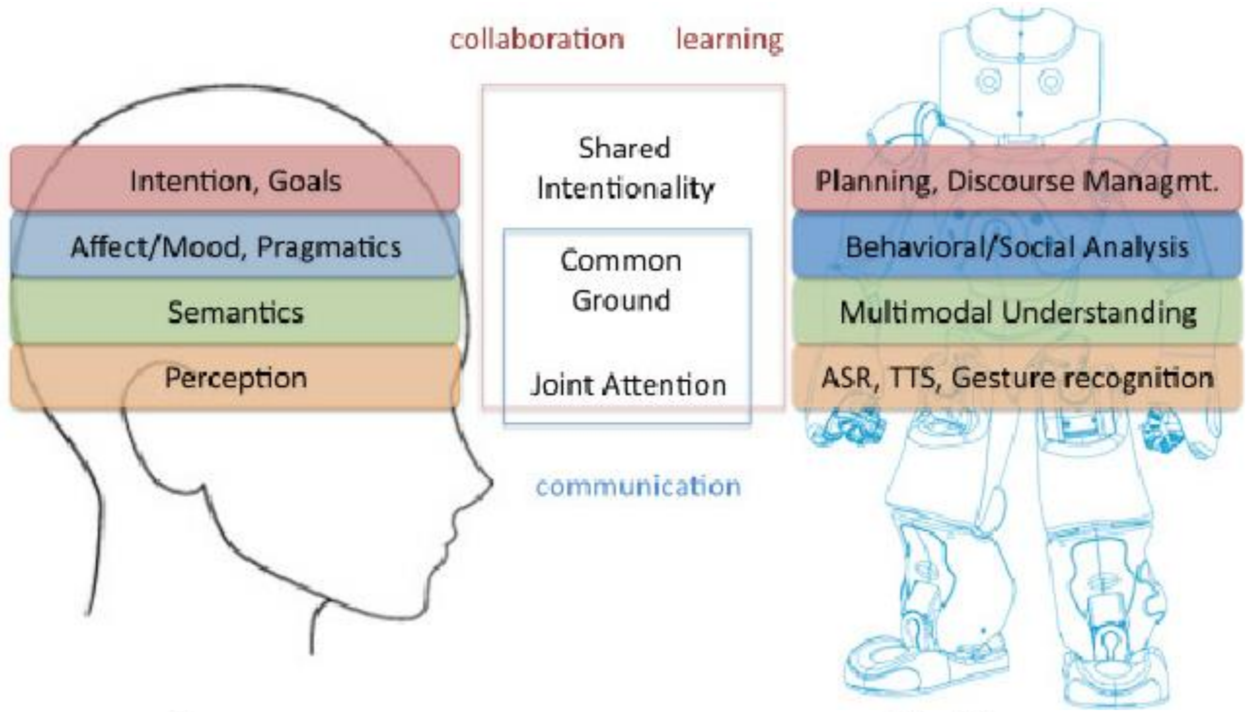


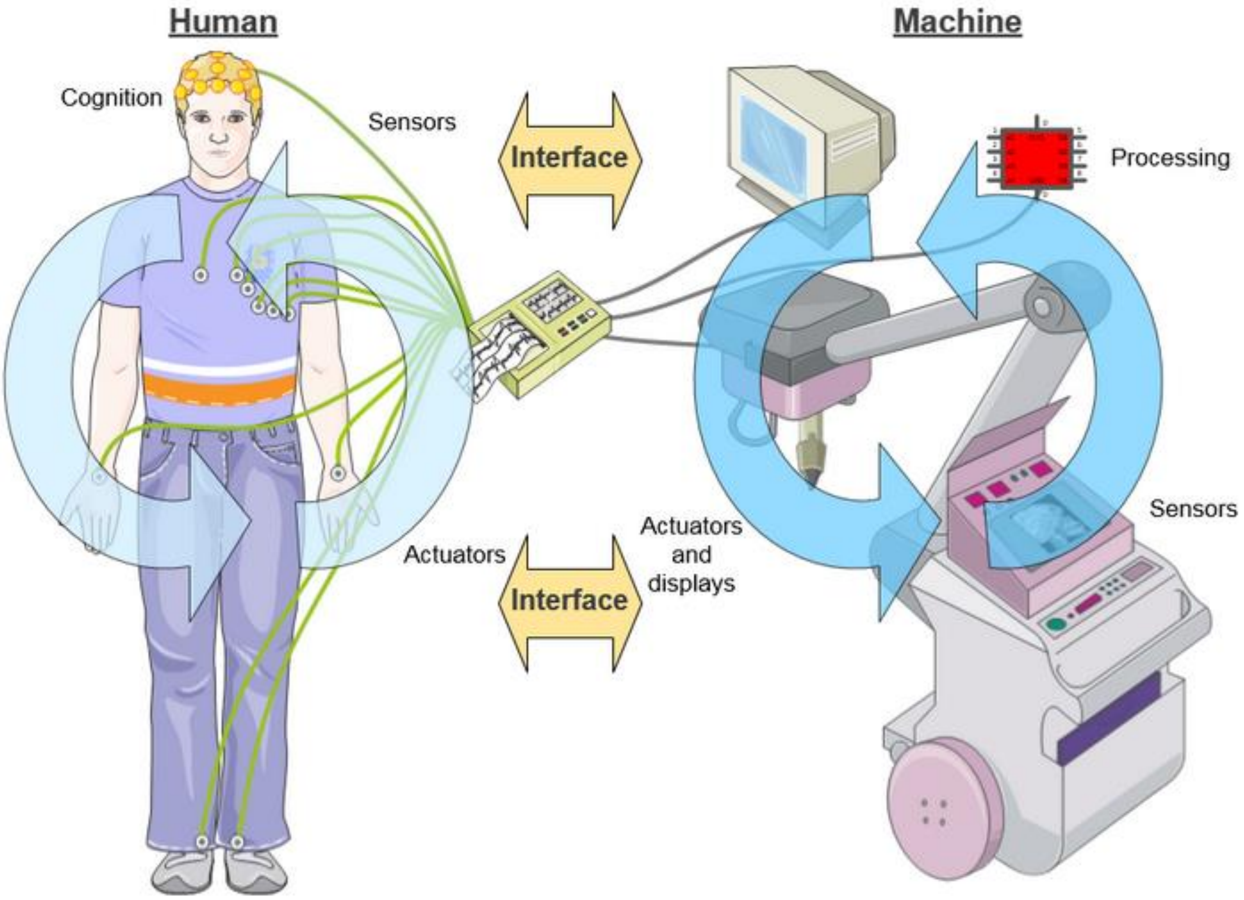
Programmable devices :



Human to Machine Interaction







Technologies and computer systems are assuming important tasks in everyday life and industry – visibly or behind the scenes. Sensors and interfaces allow them to be operated. But how do users and computers communicate with and respond to each other? Machines can be controlled by touch, voice, gestures or virtual reality (VR) glasses.

What is human-machine interaction?

HMI is all about how people and automated systems interact and communicate with each other. That has long ceased to be confined to just traditional machines in industry and now also relates to computers, digital systems or devices for the Internet of Things (IoT). More and more devices are connected and automatically carry out tasks. Operating all of these machines, systems and devices needs to be intuitive and must not place excessive demands on users.

How does human-machine interaction work?

Smooth communication between people and machines requires interfaces: The place where or action by which a user engages with the machine. Simple examples are light switches or the pedals and steering wheel in a car: An action is triggered when you flick a switch, turn the steering wheel or step on a pedal. However, a system can also be controlled by text being keyed in, a mouse, touch screens, voice or gestures.

The devices are either controlled directly: Users touch the smartphone's screen or issue a verbal command. Or the systems automatically identify what people want: Traffic lights change color on their own when a vehicle drives over the inductive loop in the road's surface. Other technologies are not so much there to control devices, but rather to complement our sensory organs. One example of that is virtual reality glasses. There are also digital assistants: Chatbots, for instance, reply automatically to requests from customers and keep on learning.

Chatbots and digital assistants

Artificial intelligence and chatbots in human-machine interaction

Eliza, the first chatbot, was invented in the 1960s, but soon ran up against its limitations: It couldn't answer follow-up questions. That's different now. Today's chatbots "work" in customer service and give written or spoken information on departure times or services, for example. To do that, they respond to keywords, examine the user's input and reply on the basis of preprogramed rules and routines. Modern chatbots work with artificial intelligence. Digital assistants like Google Home and Google Assistant are also chatbots.

Virtual Reality, Augmented Reality, Mixed Reality:

Virtual, augmented and mixed reality are not only used for fun and games, but also in Industry 4.0. Apps for Microsoft HoloLens enable virtual training courses for technicians, for example. The Fraunhofer Institute for Factory Operation and Automation (IFF) lets out its mixed reality lab Elbedome to companies. They can use six laser projectors to show machines, factories or entire cities on a 360-degree surface, giving developers or customers the impression of standing right in the planned factory.

A three-dimensional, high-quality depiction of the environment is supplied by the 3D image sensor chip REAL3™ from Infineon. It is fitted in mobile devices, such as some smartphones from Asus and Lenovo. The time-of-flight principle is used here: The image sensor chip measures the time an infrared light signal needs to travel from the camera to the object and back. The devices thus enable direct access to augmented reality: They detect a change in position by means of motion tracking, while the distances of objects are measured by depth perception. Spatial learning ensures the devices recognize places they have already captured.

Opportunities and challenges

Even complex systems will become easier to use thanks to modern human-machine interaction. To enable that, machines will adapt more and more to human habits and needs. Virtual reality, augmented reality and mixed reality will also allow them to be controlled remotely. As a result, humans expand their realm of experience and field of action.

Machines will also keep on getting better at interpreting signals in future – and that’s also necessary: The fully autonomous car must respond correctly to hand signals from a police officer at an intersection. Robots used in care must likewise be able to “assess” the needs of people who are unable to express these themselves.

The more complex the contribution made by machines is, the more important it is to have efficient communication between them and users. Does the technology also understand the command as it was meant? If not, there’s the risk of misunderstandings – and the system won’t work as it should. The upshot: A machine produces parts that don’t fit, for example, or the connected car strays off the road.

What is human-machine interaction?

Human-machine interaction is all about how people and automated systems interact with each other. HMI now plays a major role in industry and everyday life: More and more devices are connected and automatically carry out tasks. A user interface that is as intuitive as possible is therefore needed to enable smooth operation of these machines. That can take very different forms.

How does human-machine interaction work?

User interfaces in HMI are the places where or actions by which the user engages with the machine. A system can be operated by means of buttons, a mouse, touch screens, voice or gesture, for instance. One simple example is a light switch – the interface between the machine "light" and a human being. It is also possible to differentiate further between direct control, such as tapping a touch screen, and automatic control. In the latter case, the system itself identifies what people want. Think of traffic lights which change color as soon as a vehicle drives over the inductive loop in the road's surface.

What trends are there in human-machine interaction?

Gesture control is at least as intuitive as voice control. That means robovacs, for example, could be stopped by a simple hand signal in the future. Google and Infineon have already developed a new type of gesture control by the name of "Soli": Devices can also be operated in the dark or remotely with the aid of radar technology. Technologies that augment reality now also act as an interface. Virtual reality glasses immerse users in an artificially created 3D world, while augmented reality glasses superimpose virtual elements in the real environment. Mixed reality glasses combine both technologies, thus enabling scenarios to be presented realistically thanks to their high resolution.

What opportunities and challenges arise from human-machine interaction?

Modern HMI helps people to use even very complex systems with ease. Machines also keep on getting better at interpreting signals – and that is important in particular in autonomous driving. Human needs are identified even more accurately, which means robots can be used in caring for people, for instance. One potential risk is the fact that hackers might obtain information on users via the machines' sensors. Last but not least, security is vital in human-machine interaction. Some critics also fear that self-learning machines may become a risk by taking actions autonomously. It is also necessary to clarify the question of who is liable for accidents caused by HMI.

Where is human-machine interaction headed?

Whether voice and gesture control or virtual, augmented and mixed reality, HMI interaction is far from reaching the end of the line. In future, data from different sensors will also increasingly be combined to capture and control complex processes optimally. The human senses will be replicated better and better with the aid of, for example, gas sensors, 3D cameras and pressure sensors, thus expanding the devices' capabilities. In contrast, there will be fewer of the input devices that are customary at present, such as remote controllers.

Future trends in emerging technologies.

1.5G Technology- A Boon For Businesses in 2021

The rapid growth in interest and importance of technology innovations in emerging markets is evidenced by the exponential increase of published articles about innovation. Although there is much R&D investment in the emerging markets, there is a distinct approach being undertaken. The brand of innovation is called "jugaad" in India, "zizhu chuangxin" in China, "gambiarra" in Brazil and "jua kali" in Kenya. The English translation is associated with DIY or "make do and mend or just do it."

The term '5G' has been creating a buzz for almost half a decade now and since it has rolled out, it definitely, like its predecessors, has created a revolution of a kind. The advent of 5G is one of the most enigmatic new upcoming technologies that could impact businesses in 2020. Many industry experts have termed 5G as the future of communication and to a great extent, it is true.

"5G wireless networks will support 1,000-fold gains in capacity, connections for at least 100 billion devices and a 10 GB/s individual user experience of extremely low latency and response times, as stated by Huawei. "Deployment of these networks will emerge between 2020 and 2030."

The most striking achievement of 5G will be its speed which is expected to clock at 20 GB/s. Now, how fast are we discussing? Let us take an example of these newest technology trends.

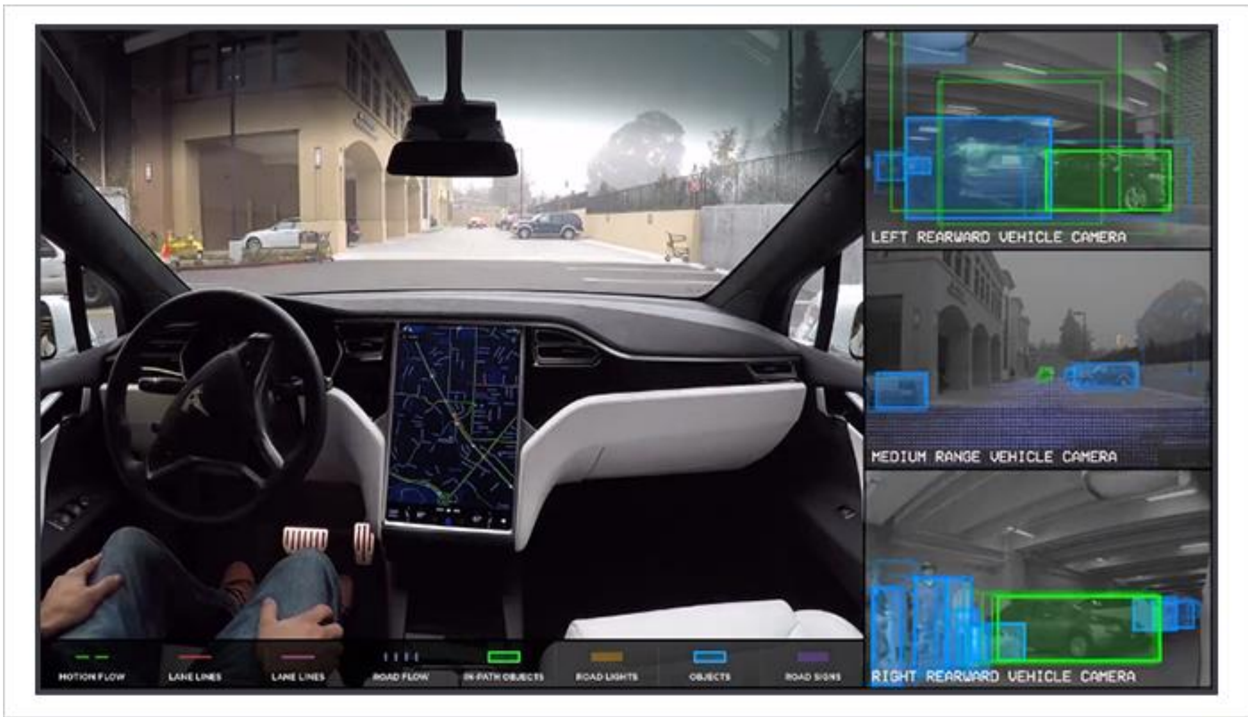
Suppose you download the contents of an (approx) 5 GB DVD at an average of 50 MB/s. It will take roughly about 13 minutes. Now the same will take barely 2 seconds to download on 5G at top speed. The heterogeneous network distribution.

Some noteworthy goals of the 5G technology include

- Amplified broadband for mobile communication
- Object-specific transformation with increased connectivity
- Unlimited scope for IoT enhancement under the newest technology trendsIncreased flexibility and support
- Increased flexibility and support

2. Autonomous Driving- An Easy, Safe Driverless Drive

- You must be apprised of companies like Tesla, Alphabet, and Waymo, and the one thing that is common among them is their objective, which is to craft impeccable autonomous vehicles. The idea of a driverless car in itself generates a considerable amount of excitement.
- Tesla and SpaceX founder and chief Elon Musk already has the future design of autonomous vehicles and aims to go big in this industry. During an interview Elon has stated, “From our standpoint, if you fast forward a year, maybe a year and three months, but next year for sure, we’ll have over a million Robo-taxis on the road.”
- Examples of newest technology trends and functions like automated braking, lane-changing, and automation of other in-car systems are on their way to being streamlined with the guidance of data capture and analytics.



3. Edge computing- Bridging the Gap Between Data Storage and Computation

Today, the primary concern of every industry is the laggy approach that sometimes affects the overall management of the operations. Therefore, industries are focusing more on the efficiency and the response rate of computing, through which data analysis is made. And here comes the role of edge computing.

Edge computing, one of the current trends in technology, brings data storage and computation closer to the businesses, and hence, ameliorates the response times and saves bandwidth. Also, it weighs more like the latest trend in technology because the industries are rapidly empowered with sophisticated and specialized resources, which is bound to reduce the latency.

The primary advantages of Edge computing include

- Edge computing enhances the security to a new level by countering the issues of local compliance, privacy regulations, and data sovereignty. Although many believe that edge computing, in fact, expands the vulnerable surface for attacks, it clearly nullifies the impact of an organization.

- Speed gets massively enhanced with the help of edge computing as it reduces the amount of latency under the latest technological trends in postmodern era. For example, autonomous vehicles require faster processing of data since every millisecond matters on the roads matters. By confining data analysis to the edge, the speed of processing the data can be massively improved.
- Edge computing reduces the cost of retaining the data significantly by categorizing each data from the management perspective. As data can be retained in edge locations, it significantly reduces the bandwidth cost and all but eliminates the redundant storage.
- As of now, edge computing is being fueled by the rapid evolution of the Internet of Things (IoT) and in the future, it will create an unstructured architecture over a set of distributed cloud services. For instance, we have drones that directly communicate with the enterprise IoT platform and conduct peer-to-peer exchanges. One such example is the latest package delivery drone by Amazon.

https://youtu.be/pzi7vqGos6U (Amazon Zeppelin deploying delivery drones)

4. Democratization- A Democracy in Technology

The term democratization is derived from the word democracy. Like in a democracy, everyone has equal rights and responsibility, similarly, the democratization of technology refers to the easy access of technical domain to everyone, irrespective of their profession and place.

Gartner asserts four key aspects of the democratization of technology trends that will make the latest technological trends in the postmodern era after 2020:

- Application development
- Design
- Knowledge
- Data and analytics

The best example of democratization can be credited to the developers, who will be able to generate data models without learning the skills of a data scientist.

However, there is still a concern that what are the latest technology trends in information technology will emerge, because it will also enable people to exploit easy-to-use tools, which may pose harm to society.

5. Human Augmentation- Enhancing Cognitive Abilities

Human augmentation can be defined as a process by which a person’s physical and cognitive ability is strengthened. Once implanted in a human being, it will enable the person to execute tasks that were earlier impossible for him.

For instance, we have miners who use wearables to enhance their safety. Then the cases of human augmentation in soldiers are a highly anticipated topic and are in pursuit behind the curtains by the armed forces of many countries, as per reports.

https://youtu.be/TXBybQEGt0M (The real life creation of super soldiers | The Future Of War)

6. Distributed Cloud- Connecting Operations to Cloud Services

The trends in cloud storage and cloud computing are already embraced by industries across the globe and the next big thing that is going to hit the tech ecosystem is the distributed cloud system. Distributed Cloud helps in connecting the public cloud distributed operation of cloud services to specific locations.

It’s expected that by 2020, 75% of the enterprise-generated data will be processed regardless of the centralized data center. This new upcoming technology of 2020 will be a significant breakthrough in cloud infrastructure.

Distributed Cloud is still in its infancy and there is a long way to go. Many companies are up with their service subsets to be used in a distributed way.

7. DARQ- An Asset for Hiring and Training

Shaping as one of the latest technological trends in postmodern era this year, Distributed ledger technology (such as blockchain), Artificial intelligence (AI), Extended reality (including virtual and augmented reality), and Quantum computing, abbreviated to DARQ form one such future technology trend of 2020 that business must integrate on priority. So, when you approach hiring, training, and employee retention in 2020, keep DARQ in mind.

Volkswagen, for instance, is already cashing in on one of the biggest new technology trends of 2020. It uses quantum computing to test traffic flow optimization and accelerate battery development.

8. Personal Profiling- Enhancing Adaptation to Latest Technologies

Digital integration into people's lives has become so deep that data analytics has more information than they could ever analyze with current technology. As consumer analytics becomes a crude priority of every business, the latest tech trend is profiling consumers by examining how they interact with the technology in hand.

To analyze the gateways to profiling user spending patterns, we need to answer questions like:

- What social media apps do they most visit?
- How do they curate their social profiles?
- What pictures do they post?
- What all places they check into on social media?

9. AI Products- For the Ease of Life

Artificial technology or AI is not a new term in the IT-sphere, but now there are further verticals of AI that are shaping the industries globally and this is eventually making the technology features in the top IT trends today.

AI technology trends, including products like AlterEgo, a mind-reading wearable, and citizen robots like Sophia, are promos on how big AI technology will get in 2020. Companies like Domino's and Doordash are already experimenting with drones and robot delivery.

10. Data-Driven Policing- Countering Data Breaches and Cyber-Attacks

Ever since the European Union's General Data Protection Regulation (GDPR) tightened the bolts on privacy and data protection laws, businesses and consumers alike have become more aware of their vulnerability to data breaches and cyber-attacks.

According to Gartner, by 2020, nearly 70% of organizations will be exposed to personal data archiving. That's a 60% growth since 2018 when the number was at 10%.

Emerging and latest technological trends in postmodern era like cryptocurrency will be one of those upcoming technologies that are yet to be compliant with privacy laws. An insertion of personal data into public blockchains can be a major worry for 75% of public blockchains by 2020. As a result, an entire ecosystem, based on data-driven technologies, that is constantly growing in its interconnections is a key tech trend that businesses can benefit from by forging early-on partnerships.

11. Momentary Markets- For the Transformation of Customer Analytics and Advertising

Real-time opportunities to capture "momentary markets" will change the face of customer analytics and advertising in ways hard to imagine. As digital realities get more sophisticated and narrowed down to an exclusive reality of each moment, global technology trends will align towards more customized and on-demand experiences to fulfill customer needs.

To do this, businesses will need to combine real-time analytics capabilities with sophisticated back-end systems to capture constantly altering customer needs. Pairing this with constantly updating digital demographics will open new alleys for businesses to discover unmet customer needs.

12. Automation- For Advancements in Analytics

One of the most emerging trends in information technology, Automation is aimed to augment people and propel business operations. It combines packaged software, machine learning tools, and automation tools to deliver the results. In the next couple of years, automation of data science will empower scientists to churn out advanced analysis.

For example, businesses in retail will need it to compete with cashier-less AMAZON GO stores. Automation has already had us welcome cashier-less AMAZON Go stores across the US, but according to CNBC, the number will be 3,000 of its cashier-less AMAZON GO stores by 2021.

UNIT-2

Overview for Data Science:

Data Science is a multidisciplinary field that utilizes scientific inference and mathematical algorithms to extricate important insights from a lot of structured and unstructured data. These algorithms are actualized by means of computer programs which are generally run on amazing hardware since it requires a lot of processing. Data Science is a blend of statistical mathematics, machine learning, data analysis and visualization, domain knowledge and computer science.

Definition of data and information

What is Data?

Data is a raw and unorganized fact that required to be processed to make it meaningful. Data can be simple at the same time unorganized unless it is organized. Generally, data comprises facts, observations, perceptions numbers, characters, symbols, image, etc.

Data is always interpreted, by a human or machine, to derive meaning. So, data is meaningless. Data contains numbers, statements, and characters in a raw form.

What is Information?

Information is a set of data which is processed in a meaningful way according to the given requirement. Information is processed, structured, or presented in a given context to make it meaningful and useful.

It is processed data which includes data that possess context, relevance, and purpose. It also involves manipulation of raw data.

Information assigns meaning and improves the reliability of the data. It helps to ensure undesirability and reduces uncertainty. So, when the data is transformed into information, it never has any useless details.

KEY DIFFERENCE

- Data is a raw and unorganized fact that is required to be processed to make it meaningful whereas Information is a set of data that is processed in a meaningful way according to the given requirement.
- Data does not have any specific purpose whereas Information carries a meaning that has been assigned by interpreting data.
- Data alone has no significance while Information is significant by itself.
- Data never depends on Information while Information is dependent on Data.
- Data measured in bits and bytes, on the other hand, Information is measured in meaningful units like time, quantity, etc.
- Data can be structured, tabular data, graph, data tree whereas Information is language, ideas, and thoughts based on the given data.
- **Data Vs. Information**

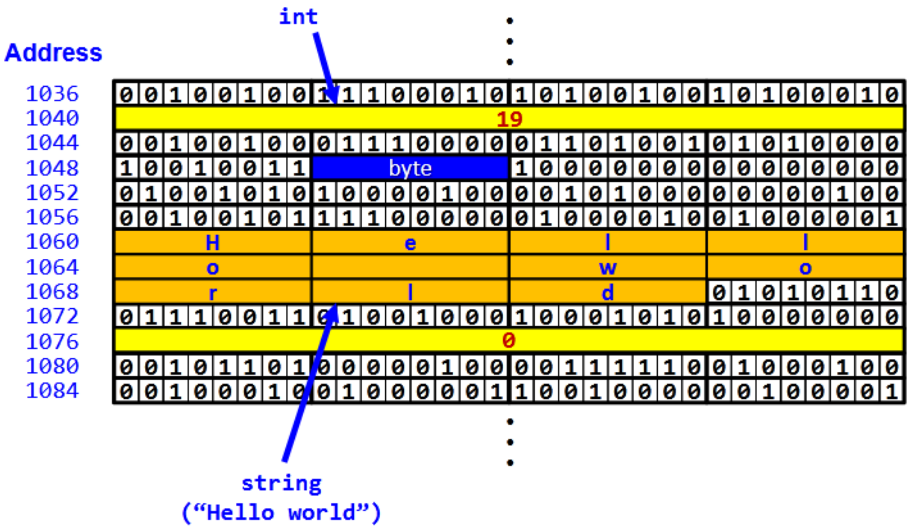
Parameters	Data	Information

Parameters	Data	Information
Description	Qualitative Or Quantitative Variables which helps to develop ideas or conclusions.	It is a group of data which carries news and meaning.
Etymology	Data comes from a Latin word, datum, which means “To give something.” Over a time “data” has become the plural of datum.	Information word has old French and middle English origins. It has referred to the “act of informing.”. It is mostly used for education or other known communication.
Format	Data is in the form of numbers, letters, or a set of characters.	Ideas and inferences
Represented in	It can be structured, tabular data, graph, data tree, etc.	Language, ideas, andthoughts based on the given data.
Meaning	Data does not have any specific purpose.	It carries meaning that has been assigned by interpreting data.
Interrelation	Information that is collected	Information that is processed.
Feature	Data is a single unit and is raw. It alone doesn’t have any meaning.	Information is the product and group of data which jointly carry a logical meaning.
Dependence	It never depends on Information	It depended on Data.
Measuring unit	Measured in bits and bytes.	Measured in meaningful units like time, quantity, etc.
Support for Decision making	It can’t be used for decision making	It is widely used for decision making.
Contains	Unprocessed raw factors	Processed in a meaningful way
Knowledge level	It is low-level knowledge.	It is the second level of knowledge.
Characteristic	Data is the property of an organization and is not available for sale to the public.	Information is available for sale to the public.
Dependency	Data depends upon the sources	Information depends upon data.

Parameters	Data	Information
	for collecting data.	
Example	Ticket sales on a band on tour.	Sales report by region and venue. It gives information which venue is profitable for that business.
Significance	Data alone has no signifiance.	Information is significant by itself.
Meaning	Data is based on records and observations and, which are stored in computers or remembered by a person.	Information is considered more reliable than data. It helps the researcher to conduct a proper analysis.
Usefulness	The data collected by the researcher, may or may not be useful.	Information is useful and valuable as it is readily available to the researcher for use.
Dependency	Data is never designed to the specific need of the user.	Information is always specific to the requirements and expectations because all the irrelevant facts and figures are removed, during the transformation process.

Data types and representation:

The memory

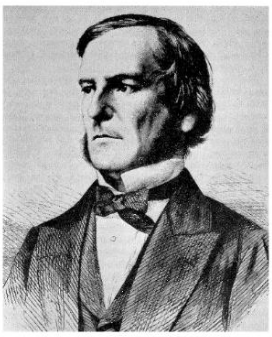


How much memory do we have?

Our laptop has few Gbytes of memory:

1 Kilo (K)	=	2^{10}	=	1,024
1 Mega (M)	=	2^{20}	=	1,048,576
1 Giga (G)	=	2^{30}	=	1,073,741,824
1 Tera (T)	=	2^{40}	=	1,099,511,627,776

Boolean Algebra



George Boole, 1815-1864

In computer science and computer programming, a **data type** or simply **type** is an attribute of data which tells the compiler or interpreter how the programmer intends to use the data. Most programming languages support basic data types of integer numbers (of varying sizes), floating-point numbers (which approximate real numbers), characters and Booleans. A data type constrains the values that an expression, such as a variable or a function, might take. This data type defines the operations that can be done on the data, the meaning of the data, and the way values of that type can be stored. A data type provides a set of values from which an expression (i.e. variable, function, etc.) may take its values.

Data types are used within type systems, which offer various ways of defining, implementing, and using them. Different type systems ensure varying degrees of type safety.

Almost all programming languages explicitly include the notion of data type, though different languages may use different terminology.

Common data types include:

- Integer
- Floating-point number
- Character
- String
- Boolean

For example, in the Java programming language, the type *int* represents the set of 32-bit integers ranging in value from −2,147,483,648 to 2,147,483,647, as well as the operations that can be performed on integers, such as addition, subtraction, and multiplication. A color, on the other hand, might be represented by three bytes denoting the amounts each of red, green, and blue, and a string representing the color's name.

Most programming languages also allow the programmer to define additional data types, usually by combining multiple elements of other types and defining the valid operations of the new data type. For example, a programmer might create a new data type named "complex number" that would include real and imaginary parts. A data type also represents a constraint placed upon the interpretation of data in a type system, describing representation, interpretation and structure of values or objects stored in computer memory. The type system uses data type information to check correctness of computer programs that access or manipulate the data.

Classes of data types

Primitive data types

Primitive data types are typically types that are built-in or basic to a language implementation.

Machine data types

All data in computers based on digital electronics is represented as bits (alternatives 0 and 1) on the lowest level. The smallest addressable unit of data is usually a group of bits called a byte (usually an octet, which is 8 bits). The unit processed by machine code instructions is called a word (as of 2011, typically 32 or 64 bits). Most instructions interpret the word as a

binary number, such that a 32-bit word can represent unsigned integer values from 0 to

or signed integer values from to . Because of two's complement, the machine language and machine doesn't need to distinguish between these unsigned and signed data types for the most part.

Floating-point numbers used for floating-point arithmetic use a different interpretation of the bits in a word. See Floating-point arithmetic for details.

Machine data types need to be *exposed* or made available in systems or low-level programming languages, allowing fine-grained control over hardware. The C programming language, for instance, supplies integer types of various widths, such as short and long. If a corresponding native type does not exist on the target platform, the compiler will break them down into code using types that do exist. For instance, if a 32-bit integer is requested on a 16 bit platform, the compiler will tacitly treat it as an array of two 16 bit integers.

In higher level programming, machine data types are often hidden or *abstracted* as an implementation detail that would render code less portable if exposed. For instance, a generic numeric type might be supplied instead of integers of some specific bit-width.

Boolean type

The Boolean type represents the values true and false. Although only two values are possible, they are rarely implemented as a single binary digit for efficiency reasons. Many programming languages do not have an explicit Boolean type, instead interpreting (for instance) 0 as false and other values as true. Boolean data refers to the logical structure of how the language is interpreted to the machine language. In this case a Boolean 0 refers to the logic False. True is always a non zero, especially a one which is known as Boolean 1.

Enumerations

The enumerated type has distinct values, which can be compared and assigned, but which do not necessarily have any particular concrete representation in the computer's memory; compilers and interpreters can represent them arbitrarily. For example, the four suits in a deck of playing cards may be four enumerators named *CLUB*, *DIAMOND*, *HEART*, *SPADE*, belonging to an enumerated type named *suit*. If a variable *V* is declared having *suit* as its data type, one can assign any of those four values to it. Some implementations allow programmers to assign integer values to the enumeration values, or even treat them as type-equivalent to integers.

Numeric types

Such as:

- The integer data types, or "non-fractional numbers". May be sub-typed according to their ability to contain negative values (e.g. unsigned in C and C++). May also have a small number of predefined subtypes (such as short and long in C/C++); or allow users to freely define subranges such as 1..12 (e.g. Pascal/Ada).
- Floating point data types, usually represent values as high-precision fractional values (rational numbers, mathematically), but are sometimes misleadingly called reals (evocative of mathematical real numbers). They usually have predefined limits on both their maximum values and their precision. Typically stored internally in the form $a \times 2^b$ (where a and b are integers), but displayed in familiar decimal form.
- Fixed point data types are convenient for representing monetary values. They are often implemented internally as integers, leading to predefined limits.
- Bignum or arbitrary precision numeric types lack predefined limits. They are not primitive types, and are used sparingly for efficiency reasons.

Composite types

Composite types are derived from more than one primitive type. This can be done in a number of ways. The ways they are combined are called data structures. Composing a primitive type into a compound type generally results in a new type, e.g. *array-of-integer* is a different type to *integer*.

- An array (also called vector, list, or sequence) stores a number of elements and provide random access to individual elements. The elements of an array are typically (but not in all contexts) required to be of the same type. Arrays may be fixed-length or expandable. Indices into an array are typically required to be integers (if not, one may stress this relaxation by speaking about an associative array) from a specific range (if not all indices in that range correspond to elements, it may be a sparse array).
- Record (also called tuple or struct) Records are among the simplest data structures. A record is a value that contains other values, typically in fixed number and sequence and typically indexed by names. The elements of records are usually called *fields* or *members*.
- Union. A union type definition will specify which of a number of permitted primitive types may be stored in its instances, e.g. "float or long integer". Contrast with a record, which could be defined to contain a float *and* an integer; whereas, in a union, there is only one type allowed at a time.
    - A tagged union (also called a variant, variant record, discriminated union, or disjoint union) contains an additional field indicating its current type for enhanced type safety.
- A set is an abstract data structure that can store certain values, without any particular order, and no repeated values. Values themselves are not retrieved from sets, rather one tests a value for membership to obtain a boolean "in" or "not in".
- An object contains a number of data fields, like a record, and also a number of subroutines for accessing or modifying them, called methods.

Many others are possible, but they tend to be further variations and compounds of the above. For example, a linked list can store the same data as an array, but provides sequential access rather than random and is built up of records in dynamic memory; though arguably a data structure rather than a type *per se,* it is also common and distinct enough that including it in a discussion of composite types can be justified.

String and text types

Such as:

- A character, which may be a letter of some alphabet, a digit, a blank space, a punctuation mark, etc.
- A string, which is a sequence of characters. Strings are typically used to represent words and text, although text in all but the most trivial cases involves much more than a sequence of characters.

Character and string types can store sequences of characters from a character set such as ASCII. Since most character sets include the digits, it is possible to have a numeric string, such as "1234". However, many languages treat these as belonging to a different type to the numeric value 1234.

Character and string types can have different subtypes according to the required character "width". The original 7-bit wide ASCII was found to be limited, and superseded by 8 and 16-bit sets, which can encode a wide variety of non-Latin alphabets (such as Hebrew and Chinese) and other symbols. Strings may be either stretch-to-fit or of fixed size, even in the same programming language. They may also be subtyped by their maximum size.

Note: Strings are not a primitive data type in all languages. In C, for instance, they are composed from an array of characters.

Abstract data types

Any data type that does not specify the concrete representation of the data is an abstract data type. Instead, a formal *specification* based on the data type's operations is used to describe it. Any *implementation* of a specification must fulfill the rules given. Abstract data types are used in formal semantics and program verification and, less strictly, in design.

Beyond verification, a specification might immediately be turned into an implementation. The OBJ family of programming languages for instance bases on this option using equations for specification and rewriting to run them. Algebraic specification[3] was an important subject of research in CS around 1980 and almost a synonym for abstract data types at that time. It has a mathematical foundation in Universal algebra.[4] The specification language can be made more expressive by allowing other formulas than only equations.

A typical example is the hierarchy of the list, bag and set data types. All these data types can be declared by three operations: *null*, which constructs the empty container, *single*, which constructs a container from a single element and *append*, which combines two containers of the same type. The complete specification for the three data types can then be given by the following rules over these operation:

- null is the left and right neutral: append(null,A) = A, append(A,null) = A.

- for a list, append is associative: append(append(A,B),C) = append(A,append(B,C)).

- bags add commutativity: append(B,A) = append(A,B).

- finally, a set is also idempotent: append(A,A) = A.

Access to the data can be specified likely, e.g. a *member* function for these containers by:

- member(X,single(Y)) = eq(X,Y)

- member(X,null) = false

- member(X,append(A,B)) = or(member(X,A), member(X,B))

Other types

Types can be based on, or derived from, the basic types explained above. In some languages, such as C, functions have a type derived from the type of their return value.

Pointers and references

Main article: Reference (computer science)

The main non-composite, derived type is the pointer, a data type whose value refers directly to (or "points to") another value stored elsewhere in the computer memory using its address. It is a primitive kind of reference. (In everyday terms, a page number in a book could be considered a piece of data that refers to another one). Pointers are often stored in a format similar to an integer; however, attempting to dereference or "look up" a pointer whose value was never a valid memory address would cause a program to crash. To ameliorate this potential problem, pointers are considered a separate type to the type of data they point to, even if the underlying representation is the same.

Function types

Main article: Function type

While functions can be assigned a type, too, their type is not considered a data type in the setting of this article. Here, data is viewed as being distinct from algorithms. In programming, functions are strongly related to the latter. But, because a central tenet of universal data processing is that algorithms can be represented as data, e.g., textual description and binary programs, the contrast between data and functions has limits. In fact, not only can functions be represented by data, but functions can also be used to encode data. Many contemporary type systems focus strongly on function types and many modern languages allow functions to operate as first-class citizens.

To exclude functions from the being treated as data types is not uncommon in related fields.[citation needed] Predicate logic for instance does not allow the application of quantifiers on function or predicate names.

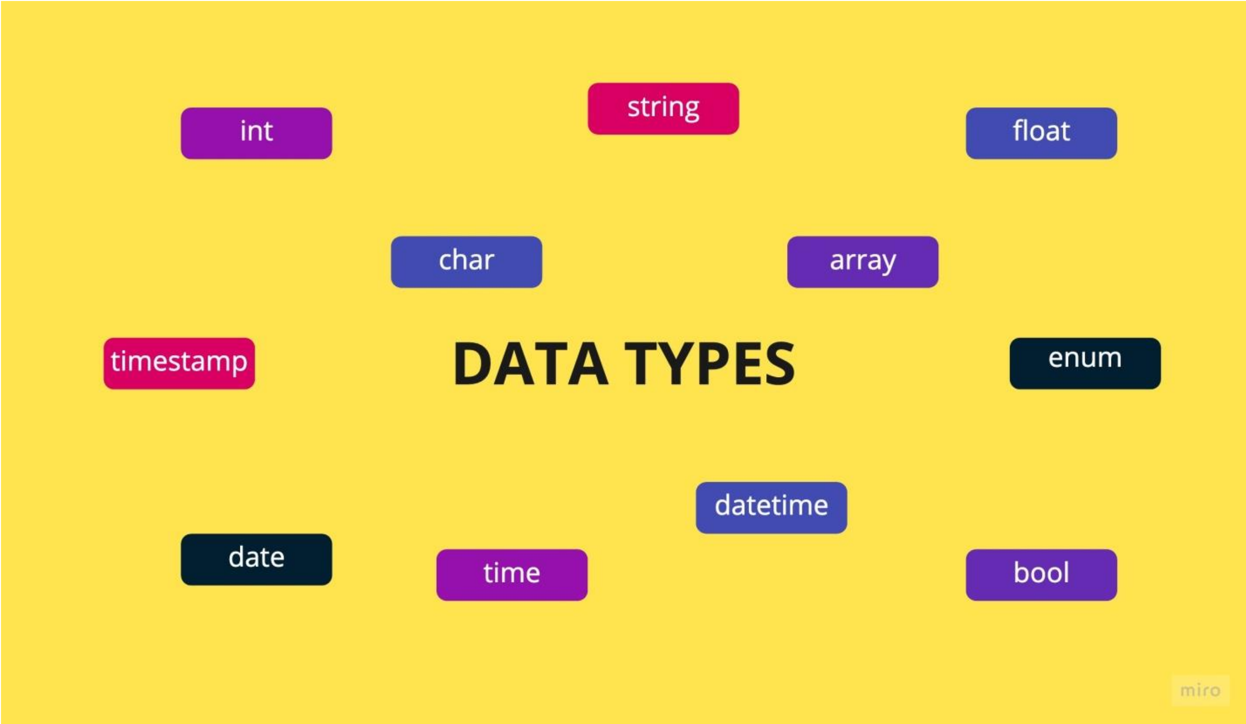
Meta types

Main article: Metaclass

Some programming languages represent the type information as data, enabling type introspection and reflection. In contrast, higher order type systems, while allowing types to be constructed from other types and passed to functions as values, typically avoid basing computational decisions on them.[citation needed]

Utility types

For convenience, high-level languages may supply ready-made "real world" data types, for instance *times*, *dates*, *monetary values*, and *memory*, even where the language would allow them to be built from primitive types.



Integer (int)

It is the most common numeric data type used to store numbers without a fractional component (-707, 0, 707).

Floating Point (float)

It is also a numeric data type used to store numbers that may have a fractional component, like monetary values do (707.07, 0.7, 707.00).

Please note that *number* is often used as a data type that includes both *int* and *float* types.

Character (char)

It is used to store a single letter, digit, punctuation mark, symbol, or blank space.

String (str or text)

It is a sequence of characters and the most commonly used data type to store text. Additionally, a string can also include digits and symbols, however, it is always treated as text.

A phone number is usually stored as a *string* (+1-999-666-3333) but can also be stored as an *integer* (9996663333) .

Boolean (bool)

It represents the values *true* and *false.* When working with the boolean data type, it is helpful to keep in mind that sometimes a boolean value is also represented as 0 (for false) and 1 (for true).

Enumerated type (enum)

It contains a small set of predefined unique values (also known as elements or enumerators) that can be compared and assigned to a variable of enumerated data type.

The values of an enumerated type can be text-based or numerical. In fact, the *boolean* data type is a pre-defined enumeration of the values *true* and *false*.

For example, if ***rock*** and ***jazz*** are the enumerators, an enumerated type variable *genre* can be assigned either of the two values, but not both.

Assuming that you are asked to fill in your preferences on a music app and are asked to choose *either one* of the two genres via a dropdown menu, the variable *genre* will store either *rock* or *jazz.*

With enumerated type, values can be stored and retrieved as numeric indices (0, 1, 2) or strings.

Array

Also known as a list, an array is a data type that stores a number of elements in a specific order, typically all of the same type.

Since an array stores multiple elements or values, the structure of data stored by an array is referred to as an array data structure.

Each element of an array can be retrieved using an integer index (0, 1, 2,…), and the total number of elements in an array represents the length of an array.

For example, an array variable *genre* can store one or more of the elements ***rock***, ***jazz***, and ***blues***. The indices of the three values are 0 (rock), 1 (jazz), and 2 (blues), and the length of the array is 3 (since it contains three elements).

Continuing on the example of the music app, if you are asked to choose one or more of the three genres and you happen to like all three (cheers to that), the variable *genre* will store all three elements (rock, jazz, blues).

Date

Needs no explanation; typically stores a date in the **YYYY-MM-DD** format (ISO 8601 syntax).

Time

Stores a time in the **hh:mm:ss** format. Besides the time of the day, it can also be used to store the time elapsed or the time interval between two events which could be more than 24 hours. For example, the time elapsed since an event took place could be 72+ hours (72:00:59).

Datetime

Stores a value containing both date and time together in the **YYYY-MM-DD hh:mm:ss** format.

Timestamp

Typically represented in Unix time, a timestamp represents the *number of seconds* that have elapsed since midnight (00:00:00 UTC), 1st January 1970.

It is typically used by computer systems to log the precise date and time of an event, down to the number of seconds, in a format that is unaffected by time zones. Therefore unlike datetime, the timestamp remains the same irrespective of your geographical location.

Data Representations

Computer handles data in the form of ‘0’(Zero) and ‘1’ (One). Any kind of data like number, alphabet, special character should be converted to ‘0’ or ‘1’ which can be understood by the Computer. ‘0’ and ‘1’ that the Computer can understand is called **Machine language**. ‘0’ or ‘1’ are called ‘**Bi**nary Digi**t**s’(BIT). Therefore, the study of data representation in the computer is important.

- A **bit** is the short form of **Binary digit** which can be ‘0’ or ‘1’. It is the basic unit of data in computers.

- A **nibble** is a collection of 4 bits (Binary digits).

- A collection of 8 bits is called **Byte**. A byte is considered as the basic unit of measuring the memory size in the computer.

- **Word length** refers to the number of bits processed by a Computer’s CPU. For example, a word length can have 8 bits, 16 bits, 32 bits and 64 bits (Present day Computers use 32 bits or 64 bits)

Computer memory (Main Memory and Secondary Storage)is normally represented in terms of KiloByte (KB) or MegaByte (MB). In decimal system, 1 Kilo represents 1000, that is , 10^3. In binary system, 1 KiloByte represents 1024 bytes that is 2^{10}. The following table represents the various memory sizes:

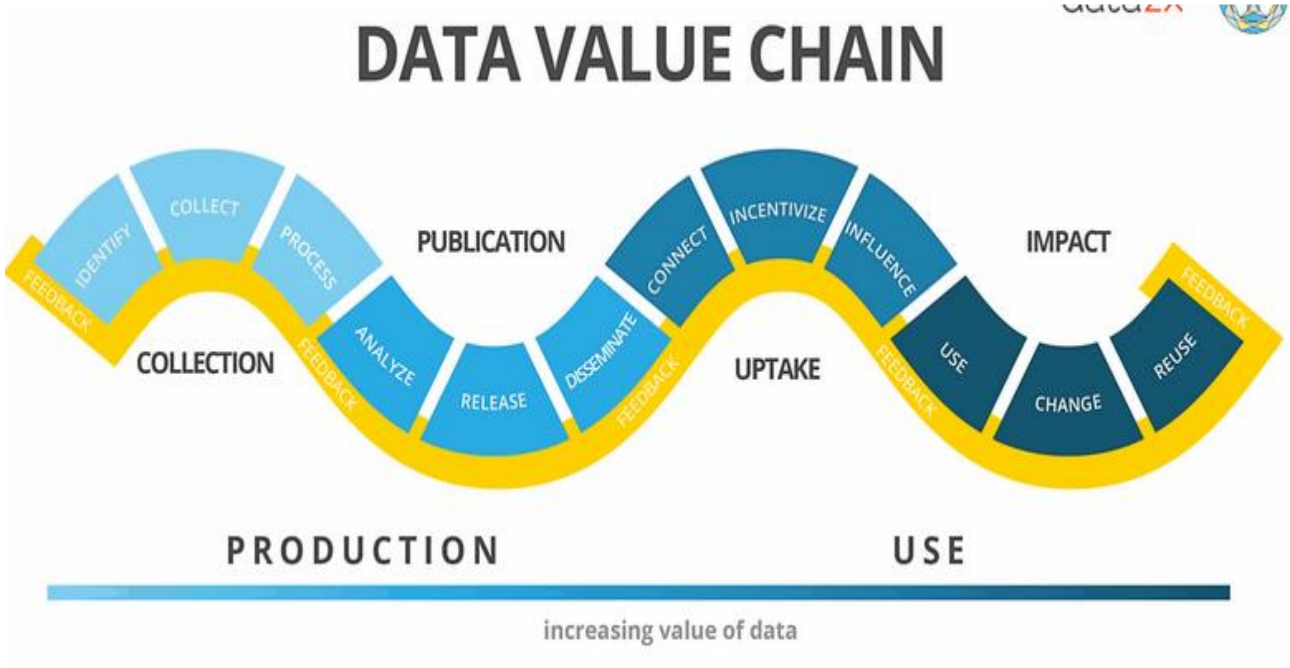
Bytes are used to represent characters in a text. Different types of coding schemes are used to represent the character set and numbers. The most commonly used coding scheme is the **American Standard Code for Information Interchange** (ASCII). Each binary value between 0 and 127 is used to represent a specific character. The ASCII value for (blank space) is 32 and the ASCII value of numeric 0 is 48. The range of ASCII values for lower case alphabets is from 97 to 122 and the range of ASCII values for the upper case alphabets is 65 to 90.

The speed of a computer depends on the number of bits it can process at once.

For example, a 64- bit computer can process 64-bit numbers in one operation, while a 32-bit computer break 64-bit numbers down into smaller pieces, making it slower

Data Value Chain

The data value chain describes the process of data creation and use from first identifying a need for data to its final use and possible reuse. The data value chain has four major stages: collection, publication, uptake, and impact. These four stages are further separated into twelve steps: identify, collect, process, analyze, release, disseminate, connect, incentivize, influence, use, change, and reuse. Throughout the process, from one end of the value chain to another and back again, there should be constant feedback between producers and stakeholders. The data value chain can be used as a teaching tool to show the complex set of steps from data creation to use and impact or as a management tool to monitor and evaluate the data production process.



Data Acquisition: This refers to the collection of raw data from both internal and external sources. The first phase of data collection involves identifying what data to collect and then establishing a process to do so (i.e. conducting a survey or retrieving automated IoT data). Decisions made here will affect the quality and usability of data throughout its life-cycle.

- Data Processing & Cleansing - Bad data in equals bad insights out so, once data is collected, it must be, processes organized and cleansed. This involves cleaning data - identifying and correcting corrupt, inaccurate, or irrelevant data - as well as converting raw data into a format that is usable, integratable and machine readable.

Data Analysis: Now that data has been cleansed, labeled and is primed for usage, the real fun can begin. Datasets can now be analyzed and used to uncover trends, patterns and other insights that can enhance decision making.

Data Curating: Integration & Enrichment - Data curation and integration refers to the collection of processes required to merge data from multiple sources into one, cohesive dataset. During this process, data is also enriched, meaning that contextual metadata (the data that makes larger datasets discoverable) is added or updated.

Data Storage:

What is file storage?

Inexpensive and simply constructed, data is stored in files and folders. This is commonly found on hard drives and means that the files look exactly the same to the hard drive as they do to the user.

What is block storage?

Data is stored in evenly-sized blocks. Although more expensive and complex and less scalable, block storage is ideal for data that must be frequently accessed and edited.

What is object storage?

Data is stored as objects with metadata and unique identifiers. Although it is generally less expensive to store data this way, object storage is only ideal for data that doesn't need to be edited.

Data Usage

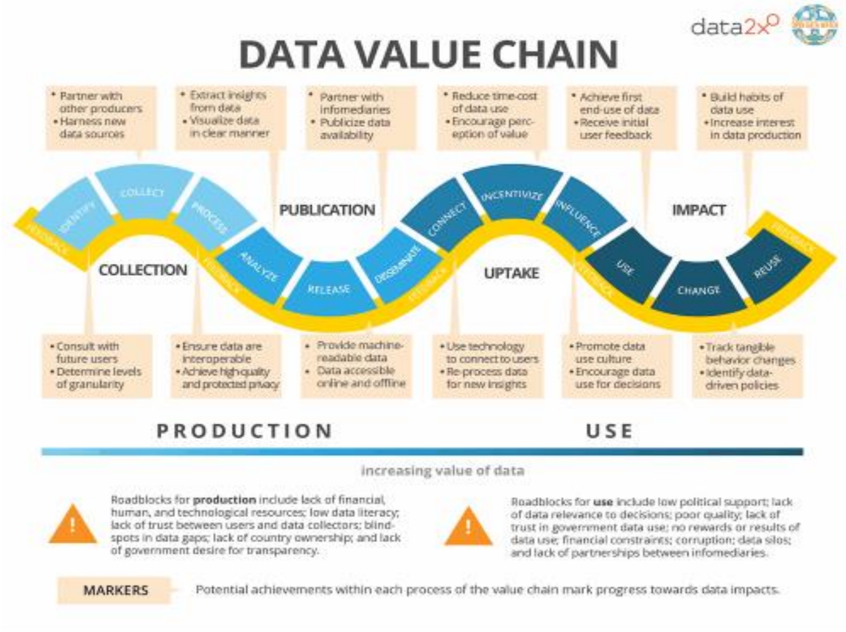
Basic concepts of Big Data

Though the terminology used to label the various components of the data value pipeline can vary from institution to institution, typically the data value chain is broken down into 5 key categories:

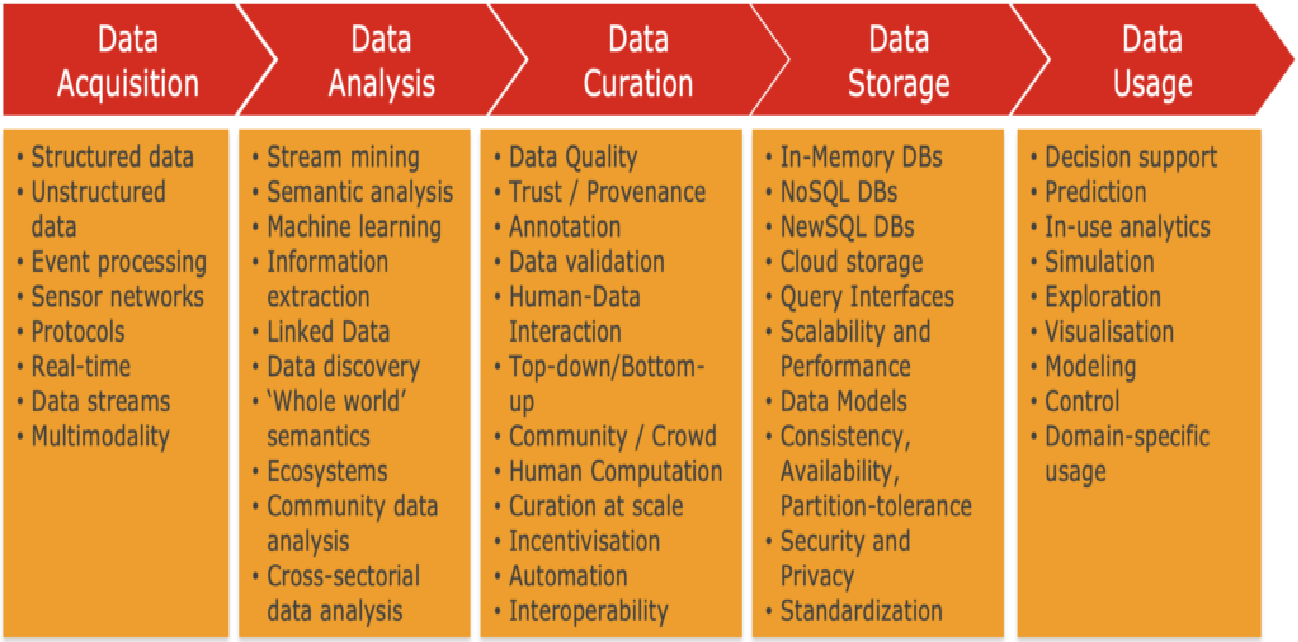
Data Capture & Acquisition - This refers to the collection of raw data from both internal and external sources. The first phase of data collection involves identifying what data to collect and then establishing a process to do so (i.e. conducting a survey or retrieving automated IoT data). Decisions made here will affect the quality and usability of data throughout its life-cycle.

1. Data Processing & Cleansing - Bad data in equals bad insights out so, once data is collected, it must be, processes organized and cleansed. This involves cleaning data - identifying and correcting corrupt, inaccurate, or irrelevant data - as well as converting raw data into a format that is usable, integratable and machine readable.
2. Data Curation, Integration & Enrichment - Data curation and integration refers to the collection of processes required to merge data from multiple sources into one, cohesive dataset. During this process, data is also enriched, meaning that contextual metadata (the data that makes larger datasets discoverable) is added or updated.
3. Data Analysis - Now that data has been cleansed, labeled and is primed for usage, the real fun can begin. Datasets can now be analyzed and used to uncover trends, patterns and other insights that can enhance decision making.
4. Data ROI or Monetization - The final step of the process is the application of data analytics processes to solve real-world problems and, in a business setting, increase revenue. This can be done by either using data analytics to optimize the efficiency internal operations and decrease overhead costs or by using data-driven insights to identify and exploit new revenue streams.
5. In addition, the data value chain is more than just an outline of technical steps, achieving ROI with data requires significant cultural changes as well. Cultivating data literacy amongst non-technical users and promoting data democratization are also key

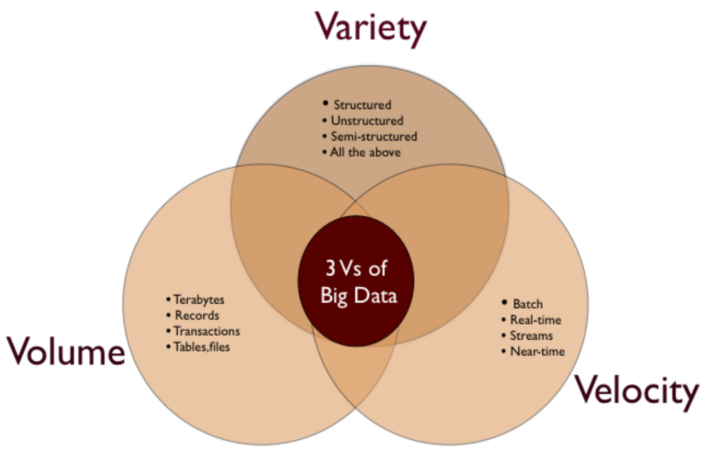
parts of the success equation.

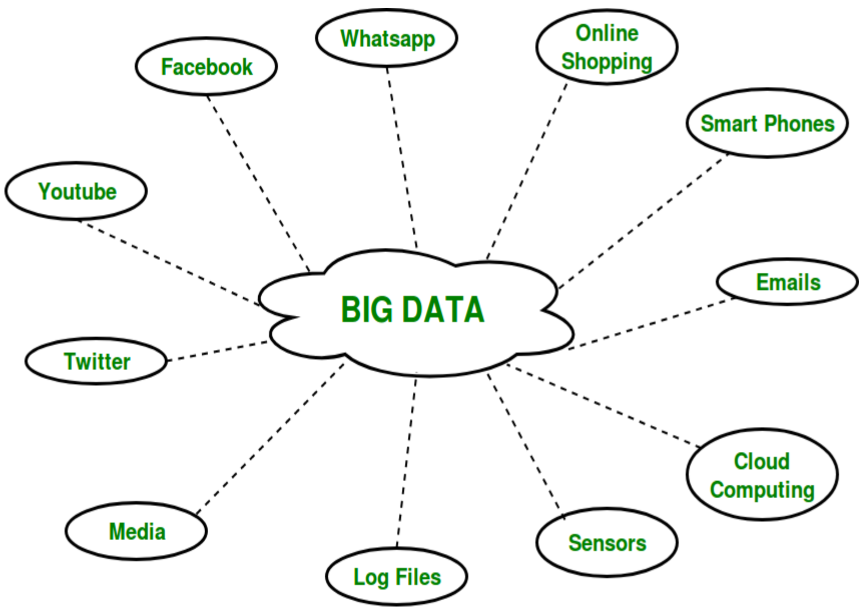


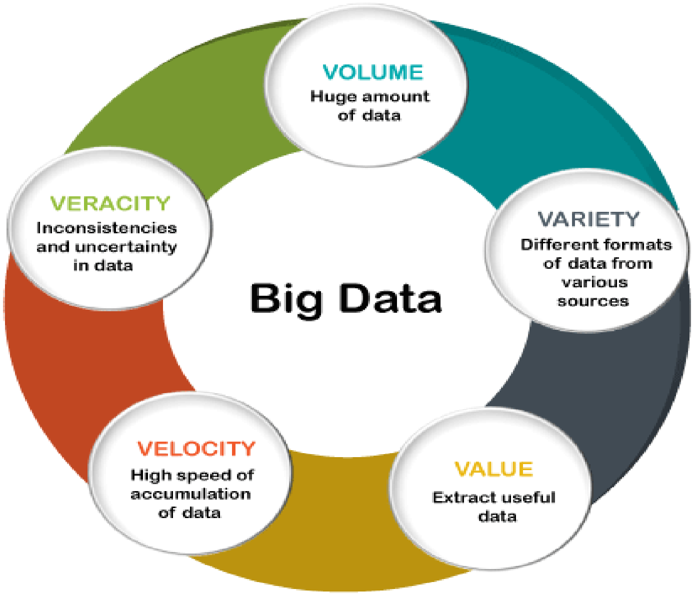
"The Data Value Chain: Moving from Production to Impact" - <u>https://opendatawatch.com/publications/the-data-value-chain-moving-from-production-to-impact/</u>

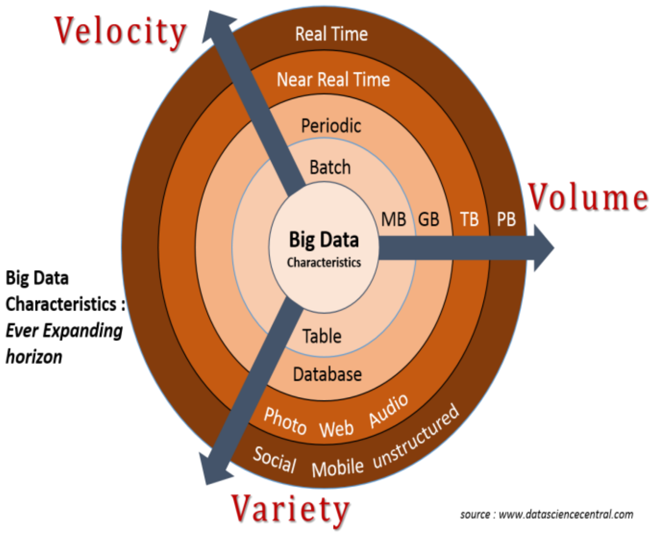


Basic concepts of Big Data

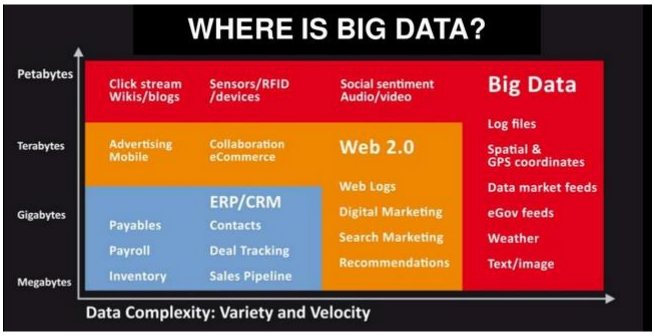




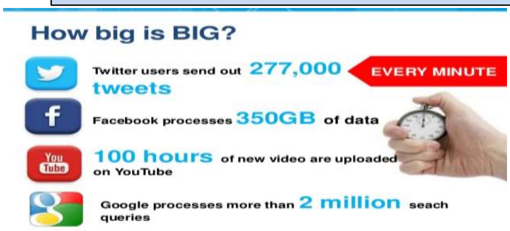

VOLUME
Huge amount of data
VARIETY
Different formats of data from various sources
VALUE
Extract useful data
VELOCITY
High speed of accumulation of data
VERACITY
Inconsistencies and uncertainty in data
Big Data

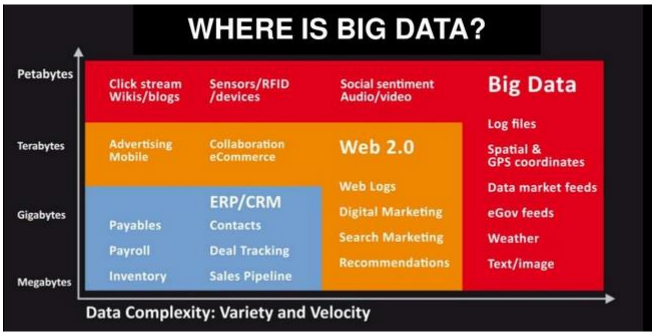

Velocity
Real Time
Near Real Time
Periodic
Batch
Volume
MB GB TB PB
Big Data
Characteristics
Table
Database
Photo Web Audio
Social Mobile unstructured
Variety
Big Data Characteristics : Ever Expanding horizon
source : www.datasciencecentral.com

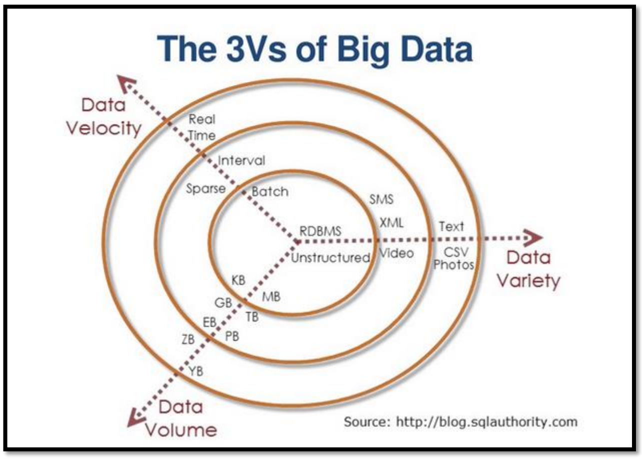
BIG DATA!!!!!!



BIG DATA!!!!!!







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YOUTUBE LINKS:

https://youtu.be/_ZcVQxvfjio

MODULE 3

Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI, Applications of AI in Agriculture,
Health, Business (Emerging market), Education, AI tools and platforms (eg: scratch/object tracking).

CONCEPT OF AI

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.

How does AI work?

In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states. In this way, a chatbot that is fed examples of text chats can learn to produce lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples.

AI programming focuses on three cognitive skills: learning, reasoning and self-correction.

Learning processes. This aspect of AI programming focuses on acquiring data and creating rules for how to turn the data into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.

Reasoning processes. This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.

Self-correction processes. This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.

Why is artificial intelligence important?

AI is important because it can give enterprises insights into their operations that they may not have been aware of previously and because, in some cases, AI can perform tasks better than humans. Particularly when it comes to repetitive, detail-oriented tasks like analyzing large numbers of legal documents to ensure relevant fields are filled in properly, AI tools often complete jobs quickly and with relatively few errors.

This has helped fuel an explosion in efficiency and opened the door to entirely new business opportunities for some larger enterprises. Prior to the current wave of AI, it would have been hard to imagine using computer software to connect riders to taxis, but today Uber has become one of the largest companies in the world by doing just that. It utilizes sophisticated machine learning algorithms to predict when people are likely to need rides in certain areas, which helps proactively get drivers on the road before they're needed. As another example, Google has become one of the largest players for a range of online services by using machine learning to understand how people use their services and then improving them. In 2017, the company's CEO, Sundar Pichai, pronounced that Google would operate as an "AI first" company.

What are Examples of Artificial Intelligence?

- Siri, Alexa and other smart assistants
- Self-driving cars
- Robo-advisors
- Conversational bots
- Email spam filters
- Netflix's recommendations

History of AI

The **history of artificial intelligence** (**AI**) began in antiquity, with myths, stories and rumors of artificial beings endowed with intelligence or consciousness by master craftsmen. The seeds of modern AI were planted by classical philosophers who attempted to describe the process of human thinking as the mechanical manipulation of symbols. This work culminated in the invention of the programmable digital computer in the 1940s, a machine based on the abstract essence of mathematical reasoning. This device and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The birth of artificial intelligence 1952–1956

In the 1940s and 50s, a handful of scientists from a variety of fields (mathematics, psychology, engineering, economics and political science) began to discuss the possibility of creating an artificial brain. The field of artificial intelligence research was founded as an academic discipline in 1956.

Cybernetics and early neural networks

The earliest research into thinking machines was inspired by a confluence of ideas that became prevalent in the late 1930s, 1940s, and early 1950s. Recent research in neurology had shown that the brain was an electrical network of neurons that fired in all-or-nothing pulses. Norbert Wiener's cybernetics described control and stability in electrical networks. Claude Shannon's information theory described digital signals (i.e., all-or-nothing signals). Alan Turing's theory of computation showed that any form of computation could be described digitally. The close relationship between these ideas suggested that it might be possible to construct an electronic brain.

What are the advantages and disadvantages of artificial intelligence?

Artificial neural networks and deep learning artificial intelligence technologies are quickly evolving, primarily because AI processes large amounts of data much faster and makes predictions more accurately than humanly possible.

While the huge volume of data being created on a daily basis would bury a human researcher, AI applications that use machine learning can take that data and quickly turn it into actionable information. As of this writing, the primary disadvantage of using AI is that it is expensive to process the large amounts of data that AI programming requires.

Advantages

- Good at detail-oriented jobs;
- Reduced time for data-heavy tasks;
- Delivers consistent results; and
- AI-powered virtual agents are always available.

Disadvantages

- Expensive;
- Requires deep technical expertise;
- Limited supply of qualified workers to build AI tools;
- Only knows what it's been shown; and
- Lack of ability to generalize from one task to another.

Levels of AI

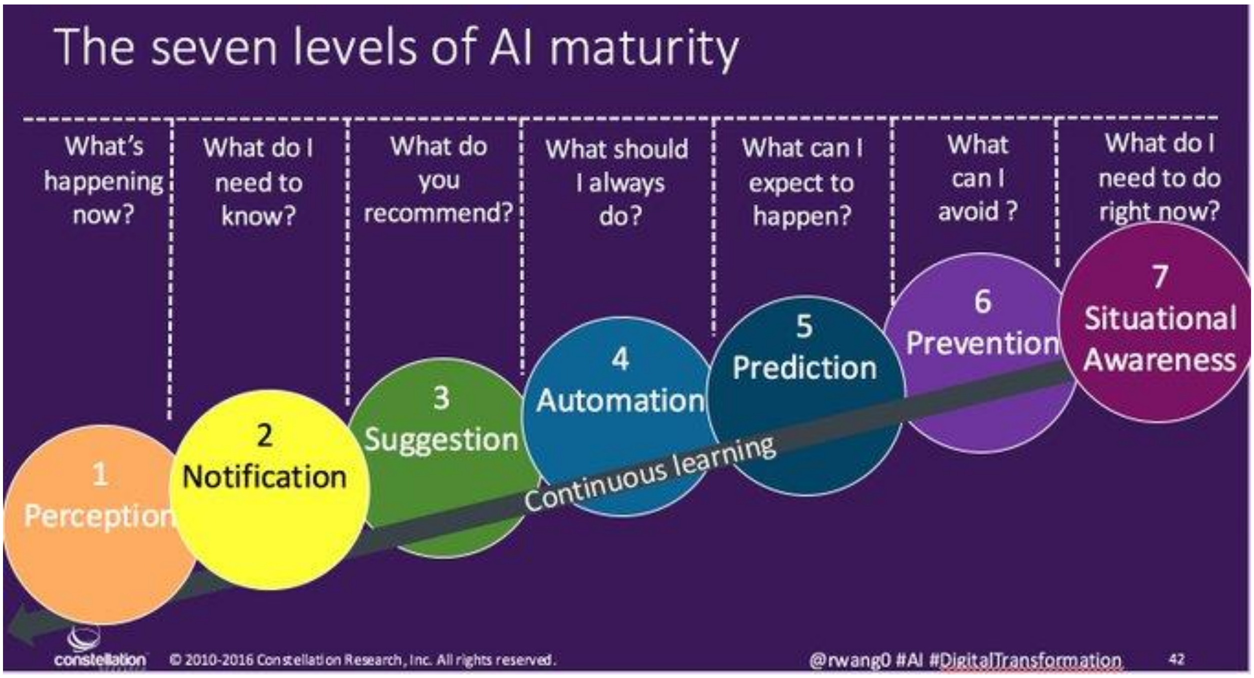
Level 5	Fully automated system which never requires human intervention
Level 4	Automation - A public service runs itself unless it hits an extreme case where it requires human intervention
Level 3	Semi-autonomous - Computers monitoring and running e.g. a regulatory system
Level 2	Close supervision - Routine administration of systems e.g. energy networks with difficult decisions referred to a human
Level 1	Simple augmentation - data entry, processing, Identifying clusters of activity, profiling, etc e.g. in fraud detection
Level 0	No automation - people powered public services

In self driving cars, the following levels have been agreed by the industry (paraphrasing is mine):

- Level 0 - no automation - You do all the work, this is most cars
- Level 1 - driver augmentation - You do most of the work but e.g. the car might moderate speed
- Level 2 - close supervision - The driver can take hands and feet off the controls but must remain ready to jump in.
- Level 3 - semi-autonomous - The car can take over the routine monitoring so the driver can relax until alerted
- Level 4 - automation - The car drives itself unless it is in an ‘extreme’ situation like a dirt road
- Level 5 - full automation - The car outperforms people even in ‘extreme’ environments.

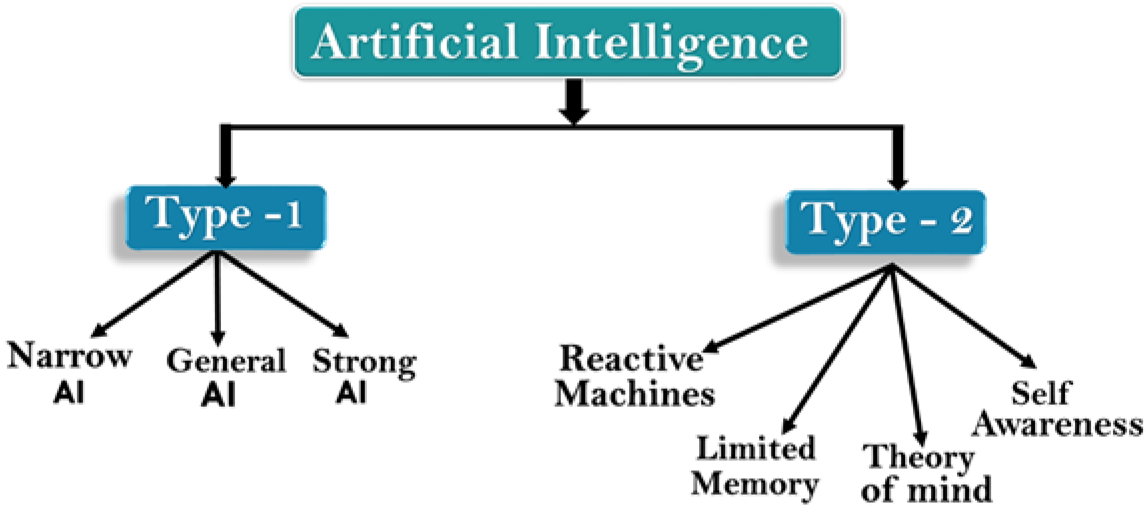
For context Tesla is currently about Level 2.5 (although officially at level 2) and companies like Ford are aiming for level 4. Level 4 is what Oxbotica will be testing next year when they run a fleet of cars between Oxford and London.

This type of segmentation can be useful for getting a handle on machine learning in the public sector. I've been experimenting with what a similar set of levels might mean for public services.



Types of AI:

Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionally of AI. Following is flow diagram which explain the types of AI.



AI type-1: Based on Capabilities

1. Weak AI or Narrow AI:

- Narrow AI is a type of AI which is able to perform a dedicated task with intelligence.The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.
- Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.
- Apple Siriis a good example of Narrow AI, but it operates with a limited pre-defined range of functions.
- IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.
- Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.

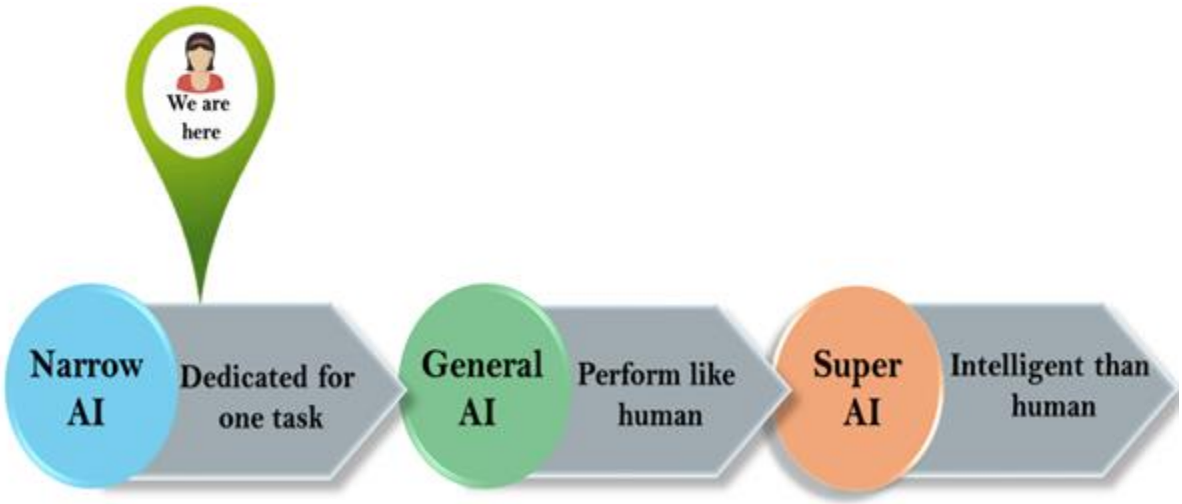
2. General AI:

- General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.
- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.

- Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human.
- The worldwide researchers are now focused on developing machines with General AI.
- As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

3. Super AI:

- Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI.
- Some key characteristics of strong AI include capability include the ability to think, to reason,solve the puzzle, make judgments, plan, learn, and communicate by its own.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.



Artificial Intelligence type-2: Based on functionality

1. Reactive Machines

- Purely reactive machines are the most basic types of Artificial Intelligence.
- Such AI systems do not store memories or past experiences for future actions.
- These machines only focus on current scenarios and react on it as per possible best action.
- IBM's Deep Blue system is an example of reactive machines.

- Google's AlphaGo is also an example of reactive machines.

The most basic types of AI systems are purely reactive, and have the ability neither to form memories nor to use past experiences to inform current decisions. Deep Blue, IBM's chess-playing supercomputer, which beat international grandmaster Garry Kasparov in the late 1990s, is the perfect example of this type of machine.

Deep Blue can identify the pieces on a chess board and know how each moves. It can make predictions about what moves might be next for it and its opponent. And it can choose the most optimal moves from among the possibilities.

But it doesn't have any concept of the past, nor any memory of what has happened before. Apart from a rarely used chess-specific rule against repeating the same move three times, Deep Blue ignores everything before the present moment. All it does is look at the pieces on the chess board as it stands right now, and choose from possible next moves.

This type of intelligence involves the computer perceiving the world directly and acting on what it sees. It doesn't rely on an internal concept of the world. In a seminal paper, AI researcher Rodney Brooks argued that we should only build machines like this. His main reason was that people are not very good at programming accurate simulated worlds for computers to use, what is called in AI scholarship a "representation" of the world.

The current intelligent machines we marvel at either have no such concept of the world, or have a very limited and specialized one for its particular duties. The innovation in Deep Blue's design was not to broaden the range of possible movies the computer considered. Rather, the developers found a way to narrow its view, to stop pursuing some potential future moves, based on how it rated their outcome. Without this ability, Deep Blue would have needed to be an even more powerful computer to actually beat Kasparov.

Similarly, Google's AlphaGo, which has beaten top human Go experts, can't evaluate all potential future moves either. Its analysis method is more sophisticated than Deep Blue's, using a neural network to evaluate game developments.

These methods do improve the ability of AI systems to play specific games better, but they can't be easily changed or applied to other situations. These computerized imaginations have no concept of the wider world – meaning they can't function beyond the specific tasks they're assigned and are easily fooled.

They can't interactively participate in the world, the way we imagine AI systems one day might. Instead, these machines will behave exactly the same way every time they encounter the same situation. This can be very good for ensuring an AI system is trustworthy: You want your autonomous car to be a reliable driver. But it's bad if we want machines to truly engage with, and respond to, the world. These simplest AI systems won't ever be bored, or interested, or sad.

2. Limited Memory

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

This Type II class contains machines can look into the past. Self-driving cars do some of this already. For example, they observe other cars' speed and direction. That can't be done in a just one moment, but rather requires identifying specific objects and monitoring them over time.

These observations are added to the self-driving cars' preprogrammed representations of the world, which also include lane markings, traffic lights and other important elements, like curves in the road. They're included when the car decides when to change lanes, to avoid cutting off another driver or being hit by a nearby car.

But these simple pieces of information about the past are only transient. They aren't saved as part of the car's library of experience it can learn from, the way human drivers compile experience over years behind the wheel.

So how can we build AI systems that build full representations, remember their experiences and learn how to handle new situations? Brooks was right in that it is very difficult to do this. My own research into methods inspired by Darwinian evolution can start to make up for human shortcomings by letting the machines build their own representations.

3. Theory of Mind

- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

Machines in the next, more advanced, class not only form representations about the world, but also about other agents or entities in the world. In psychology, this is called “theory of mind” – the understanding that people, creatures and objects in the world can have thoughts and emotions that affect their own behavior.

This is crucial to how we humans formed societies, because they allowed us to have social interactions. Without understanding each other’s motives and intentions, and without taking into account what somebody else knows either about me or the environment, working together is at best difficult, at worst impossible.

If AI systems are indeed ever to walk among us, they’ll have to be able to understand that each of us has thoughts and feelings and expectations for how we’ll be treated. And they’ll have to adjust their behavior accordingly.

4. Self-Awareness

- Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

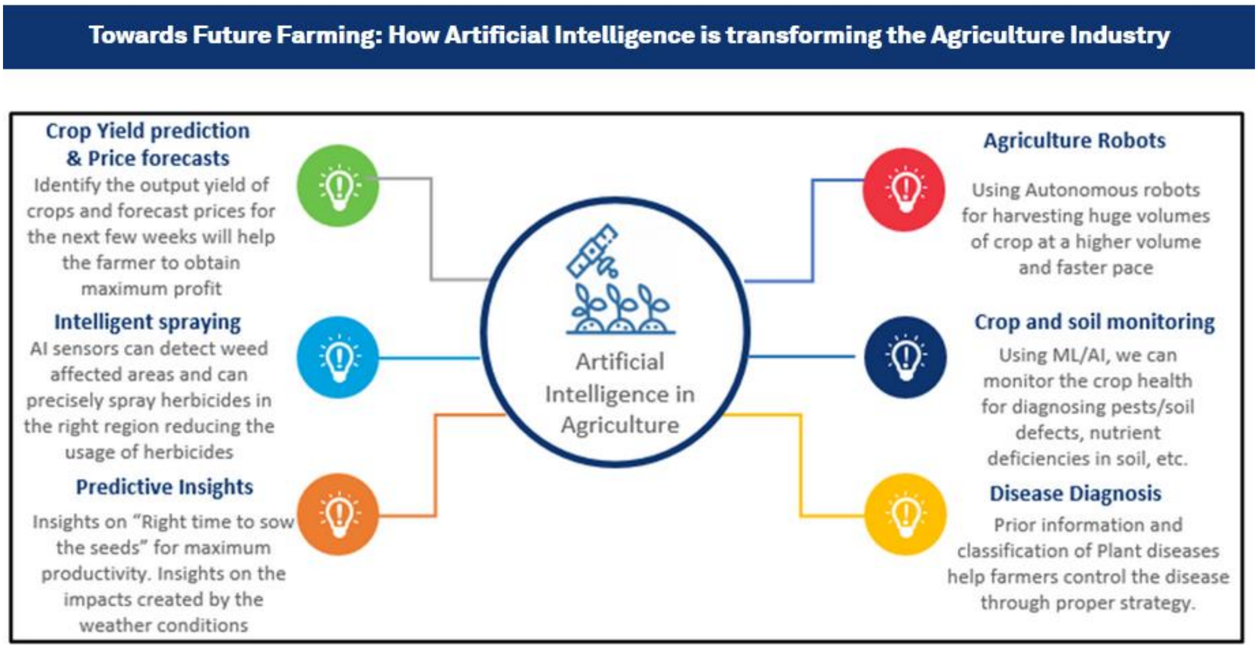
The final step of AI development is to build systems that can form representations about themselves. Ultimately, we AI researchers will have to not only understand consciousness, but build machines that have it.

This is, in a sense, an extension of the “theory of mind” possessed by Type III artificial intelligences. Consciousness is also called “self-awareness” for a reason. (“I want that item” is a very different statement from “I know I want that item.”) Conscious beings are aware of themselves, know about their internal states, and are able to predict feelings of others. We assume someone honking behind us in traffic is angry or impatient, because that’s how we feel when we honk at others. Without a theory of mind, we could not make those sorts of inferences.

While we are probably far from creating machines that are self-aware, we should focus our efforts toward understanding memory, learning and the ability to base decisions on past experiences. This is an important step to understand human intelligence on its own. And it is crucial if we want to design or evolve machines that are more than exceptional at classifying what they see in front of them.

Applications of AI in Agriculture

Technology has redefined farming over the years and technological advances have affected the agriculture industry in more ways than one. Agriculture is the mainstay occupation in many countries worldwide and with rising population, which as per UN projections will increase from 7.5 billion to 9.7 billion in 2050[1], there will be more pressure on land as there will be only an extra 4% of land, which will come under cultivation by 2050. This means that farmers will have to do more with less. According to the same survey, the food production will have to increase by 60% to feed an additional two billion people. However, traditional methods are not enough to handle this huge demand. This is driving farmers and agro companies to find newer ways to increase production and reduce waste. As a result, Artificial Intelligence (AI) is steadily emerging as part of the agriculture industry’s technological evolution. The challenge is to increase the global food production by 50% by 2050[2] to feed an additional two billion people.AI-powered solutions will not only enable farmers to improve efficiencies but they will also improve quantity, quality and ensure faster go-to-market for crops.



Using AI for intelligent spraying of chemicals – Brings in cost savings

Every day, farms produce thousands of data points on temperature, soil, usage of water, weather condition, etc. With the help of artificial intelligence and machine learning models, this data is leveraged in real-time for obtaining useful insights like choosing the right time to sow seeds, determining the crop choices, hybrid seed choices to generate more yields and the like.

AI systems are helping to improve the overall harvest quality and accuracy – known as precision agriculture. AI technology helps in detecting disease in plants, pests and poor nutrition of farms. AI sensors can detect and target weeds and then decide which herbicide to apply within the region. This helps in reduced usage of herbicides and cost savings. Many technological companies developed robots, which use computer vision and artificial intelligence to monitor and precisely spray on weeds. These robots are able to eliminate 80% of the volume of the chemicals normally sprayed on the crops and bring down the expenditure of herbicide by 90%. These intelligent AI sprayers can drastically reduce the number of chemicals used in the fields and thus improve the quality of agricultural produce, and bring in cost efficiency.

Using AI-based robots for farm harvesting – Tackling the labor challenge

Have you ever wondered who actually picks the produce from the agricultural land? Well, in most cases, it is not the traditional farm worker but robotic machines that are capable of doing bulk harvesting with more accuracy and speed that are responsible for getting the produce on your kitchen table. These machines help improve the size of the yield and reduce waste from crops being left in the field.

Many companies are working on improving agricultural efficiencies. There are products like autonomous strawberry-picking machine[1] and a vacuum apparatus that can harvest mature apples from trees. These machines use sensor fusion, machine vision and artificial intelligence models to identify the location of the harvestable produce and help pick the right fruits.

Agriculture is the second largest industry after Defense where service robots market have been deployed for professional use. The International Federation of Robotics estimates that as many as 25,000 agricultural robots have been sold —matching the number used for military purposes.

Using AI for predictive analytics – Enables right decision-making

Predicting the best time to sow

The difference between a profitable year and a failed harvest is just the timely information on a simple data point of timing of sowing the seed. To combat this, scientists of ICRISATused a predictive analytics tool to arrive at a precise date for sowing the seeds to obtain maximum yield. It even gives insights on soil health and fertilizer recommendations in addition to a 7-day weather forecast.

Crop yield predictions and price forecasts

For many farmers, the biggest worry is the price fluctuation of the crop. Due to unstable prices, farmers are never able to plan a definite production pattern. This problem is highly prevalent in crops like tomatoes that have very limited shelf time. Companies are using satellite imagery and weather data to assess the acreage and monitor crop health on a real-time basis. With the help of technologies like big data, AI and machine learning, companies can detect pest and disease infestations, estimate the tomato output and yield, and forecast prices. They can guide the farmers and governments on the future price patterns, demand level, type of crop to sow for maximum benefit, pesticide usage etc.

Innovative startups are using AI in the field of agriculture. A Berlin-based agricultural tech startup3developed a multi-lingual plant disease and pest diagnostic app, which uses various images of the plant to detect diseases; a smartphone collects the image that is matched with a server image and then a diagnosis of that particular disease is provided and applied to the crop using intelligent spraying technique. In this way, the application uses AI and ML to solve plant diseases. Over seven million farmers have downloaded this app and it has helped identify over 385 crop diseases among field crops, fruits, and vegetables.

To summarize, AI solves the scarcity of resources and labor to a large extent and it will be a powerful tool that can help organizations cope with the increasing amount of complexity in modern agriculture. It is high time that big companies invest in this space.

Can AI replace the knowledge that farmers have always had? The response is probably no for now- but definitely in the near future, AI will complement and challenge the way decisions are made and improve farming practices. Such technological interventions are likely to lead to better agricultural practices, yields, and qualitatively improve the lives of farmers.

Artificial Intelligence in Healthcare: Applications and Threats

At the initial stage, technology was merely used to automate the most routine and monotonous tasks and cut down on the use of paper through digitization of health records while also aiding in the easy flow of this information among insurance companies, hospitals, and patients.

From employing it to detect links between genetic codes, put to use surgical robots, or even for maximizing hospital efficiency, AI has proven to be a boon for the healthcare industry

1. Support in Clinical Decisions

It's obviously imperative for health professionals to take every crucial piece of information into consideration while diagnosing patients. As a result, this leads to sifting through various complicated unstructured notes kept in medical records. If there's a mistake in keeping track of even a single relevant fact, the life of a patient could be put at risk.

The assistance of Natural Language Processing (NLP) makes it more convenient for doctors to narrow down all relevant information from patient reports.

Artificial Intelligence holds the ability to store and process large sets of data, which can provide knowledge databases and facilitate examination and recommendation individually for each patient, thus helping to enhance clinical decision support.

This technology can be relied upon by doctors for aid in detecting risk factors through unstructured notes. An interesting example of this is IBM's Watson has been employing AI for predicting heart failure.

2. Enhance Primary Care and Triage through Chatbots

People have a tendency of booking appointments with their GP at the slightest threat or medical issue, which could often turn out to be a false alarm or something which could be cured of self-treatment.

Artificial Intelligence assists in enabling smooth flow and automation of primary care, allowing doctors to stress over more crucial and dire cases.

Saving money on avoidable trips to the doctor, patients can benefit from medical chatbots, which is an AI-powered service, incorporated with smart algorithms that provide patients with instant answers to all their health-related queries and concerns while also guiding them on how to deal with any potential problems.

These chatbots are 24/7 available and have the capacity to deal with multiple patients at the same time.

3. Robotic Surgeries

AI and collaborative robots have revolutionized surgeries in terms of their speed, and depth while making delicate incisions. Since robots don't get tired, the issue of fatigue in the middle of lengthy and crucial procedures is eliminated.

AI machines are capable of employing data from past operations to develop new surgical methods. The preciseness of these machines reduces the possibility of tremors or any unintended or accidental movements during the surgeries.

Robotic Surgery

A few examples of Robots developed for surgeries are Vicarious Surgical which combines virtual reality with AI-enabled robots so surgeons can perform minimally invasive operations as well as **Heartlander**, a miniature mobile robot developed by the robotics department at Carnegie Mellon University, which was developed to facilitate therapy on the heart.

4. Virtual nursing assistants

AI systems facilitate virtual nursing assistants that can perform a range of tasks from conversing with patients to directing them to the best and effective care unit. These virtual nurses are available 24/7 and can respond to queries as well as examine patients and provide instant solutions.

Presently many AI-powered applications of virtual nursing assistants presently enable more regular interactions between patients and care providers between office visits to avoid any unnecessary hospital visits. The world's first virtual nurse assistant Care Angel, can even facilitate wellness checks through voice and AI.

5. Aiding in the accurate diagnosis

AI has the capacity to surpass human doctors and help them detect, predict, and diagnose diseases more accurately and at a faster rate. Likewise, AI algorithms have proved to be not only accurate and precise at specialty-level diagnostics, but also cost-effective in terms of detecting diabetic retinopathy.

For instance, PathAI is developing machine learning technology to aid pathologists in making more accurate diagnoses. The company's current goals include reducing error in cancer diagnosis and developing methods for individualized medical treatment.

Buoy Health is an AI-based symptom and cure checker that uses algorithms to diagnose and treat illness. Here's how it works: a chatbot listens to a patient's symptoms and health concerns, then guides that patient to the correct care based on its diagnosis.

6. Minimizing the burden of EHR use

EHRs have played an integral role in the healthcare industry's journey towards digitalization, yet its switch has introduced a variety of issues in association with cognitive overload, endless documentation, and user burnout.

The EHR developers have started making use of AI for creating more intuitive interfaces and automating a couple of the routine processes that consume a great degree of the user's time.

While voice recognition and dictation are helping in enhancing the clinical documentation process, yet natural language processing (NLP) tools may not go as far. AI can also aid in processing routine requests from the inbox, such as medication refills, and result in notifications. It can also aid in prioritizing tasks that require the clinician's attention, making it simpler for the users to operate with their to-do lists.

What are the Threats of Artificial Intelligence in Healthcare?

As per a report from the Brookings Institution, there are several risks associated with AI in healthcare that need to be addressed. Below are a couple of the threats which had been identified by the Institution's report :

Errors and Injuries

One of the biggest risks that AI in healthcare holds is that the AI system might at times be wrong, for instance, if it suggests a wrong drug to a patient or makes an error in locating a tumor in a radiology scan, which could result in the patient's injury or dire health-related consequences.

AI errors are potentially different for at least two reasons. While errors can obviously take place by human medical professionals as well yet what makes this crucial is that an underlying error, an error in an AI system could lead to injuries for thousands of patients.

2. Data availability

Yet another threat posed by AI systems is that training these systems requires massive amounts of data from multiple sources which include pharmacy records, electronic health records, insurance claims records, etc.

Since the data is fragmented and patients often see different providers or switch insurance companies the data gets complicated and less comprehensible as a result of which the risk of error and the cost of data collection escalates.

3. Privacy concerns

The collection of huge datasets and the exchange of data between health systems and AI developers to enable AI systems leads to many patients believing that this could violate their privacy, leading to the filing of lawsuits.

Another area where the employment of AI systems raises this issue is that AI has the capability of predicting private information about patients even if the patient has never given the information.

For instance, Parkinson's disease could be detected by an AI system with the trembling on a computer mouse even if the person hasn't revealed the information to anyone else which could be considered a violation of privacy by the patient.

4. **Bias and inequality**

Since AI systems absorb and learn through the data with which they are trained, they can also absorb the biases of the available data. For example, if the data incorporated in AI is mainly collected in academic medical centers, the developing AI systems will have less awareness about, and as a result, will treat less effectively, patients from populations that do not typically frequent academic medical centers.

5. **Could lead to shifts in the profession**

In the long run, the employment of AI systems could lead to shifts in the medical profession. Particularly in areas like radiology where most of the work gets automated.

This raises the concern that a high degree of employment of AI might lead to a fall in human knowledge and capacity over the years, making providers fail in detecting AI errors as well as in the further development of medical knowledge.

Applications of AI in Education Sector

Below are a handful of applications of AI which are helping in shaping and defining the educational experience of the present and the future.

1. Personalized Learning

Artificial Intelligence is being employed for personalizing learning for each student. With the employment of the **hyper-personalization** concept which is enabled through machine learning, the AI technology is incorporated to design a customized learning profile for each individual student and to tailor-make their training materials, taking into consideration the mode of learning preferred by the student, the student's ability and experience on an individual basis.

2. Voice assistants are in

Yet another AI component being fruitfully employed by educators in learning is voice assistants. These include Amazon's Alexa, Apple Siri, Microsoft Cortana, etc. These **voice assistants** allow the students to converse with educational materials without the involvement of the teacher. They can be employed in home and non-educational environments for facilitating interaction with educational material or to access any extra learning assistance.

3. Aiding educators in administrative tasks

Teachers don't just battle the work of education-oriented duties but are also handed the responsibility of handling the classroom environment and dealing with a variety of organizational tasks.

They are handed a variety of non-teaching duties which include evaluation of essays, exam papers grading, dealing with the necessary paperwork, handling HR and personnel-related issues, arranging and managing classroom materials, handling the duties relating to booking and managing field trips, interacting and responding with parents, aiding with interaction and issues relating to the second language, keeping track of sick or absentees, as well as providing a learning environment.

In the case of higher education, AI-powered systems are being used to reduce human bias during the process of admission and enhance the credibility of the process since these systems use given specific criteria to select applications in admissions. Hence these systems have helped enhance oversight in the process of admissions.

4. Breaking barriers

Artificial intelligence tools and devices have been aiding in making global classrooms accessible to all irrespective of their language or disabilities. These programs are all-inclusive.

For instance, Presentation Translator is a free PowerPoint plug-in that develops subtitles in real-time of what the teacher is saying. This also helps aid the sick absentees as well as students requiring a different pace or level when it comes to learning or even in case they wish to understand a particular subject that is unavailable in their own school. Barriers are being torn down like never before.

5. Differentiated and individualized learning

Adjusting learning on the basis of the specific requirements of individual students has been the priority of educators for years, yet AI will enable a differentiation level, that is highly strenuous for teachers who have to handle 30 students in every class.

Many companies like Content Technologies and Carnegie Learning are presently developing intelligent instruction design and digital platforms which adopt AI for offering learning, testing, and feedback to students from pre-K to college level that offers them the challenges they are prepared for, detects knowledge gaps, and redirects to fresh topics whenever suitable.

6. Smart Content

Yet another way in which AI revolutionizes the education industry is by adding fresh approaches for students to achieve success. Smart content is a pretty popular term among educators, organizations, students, and educators as it makes learning more simple.

When we refer to smart content we actually imply varying types of virtual content that includes digitized guides of textbooks, video conferencing as well as video lectures.

The learning experience can now be enhanced by robots by developing customizable learning interfaces and digital content that is applicable to students of different grades, for elementary and post-secondary schools. The content becomes easy to grasp by separating it into coherent chunks, shedding light on integral lesson stuff, and also summarizing the main points.

Audio and video content can also be created. Through this, students can easily gain access to all important materials, grasp in a more swift manner and achieve their academic targets.

An example of one such platform is Netex Learning. The platform enables professors to develop, manage as well as update digital content in a single location. It also encourages students with a high-impact learning experience by enabling microlearning, skills mapping, as well as content recommendations

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MODULE 3

Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI, Applications of AI in Agriculture,
Health, Business (Emerging market), Education, AI tools and platforms (eg: scratch/object tracking).

CONCEPT OF AI

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.

How does AI work?

In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states. In this way, a chatbot that is fed examples of text chats can learn to produce lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples.

AI programming focuses on three cognitive skills: learning, reasoning and self-correction.

Learning processes. This aspect of AI programming focuses on acquiring data and creating rules for how to turn the data into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.

Reasoning processes. This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.

Self-correction processes. This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.

Why is artificial intelligence important?

AI is important because it can give enterprises insights into their operations that they may not have been aware of previously and because, in some cases, AI can perform tasks better than humans. Particularly when it comes to repetitive, detail-oriented tasks like analyzing large numbers of legal documents to ensure relevant fields are filled in properly, AI tools often complete jobs quickly and with relatively few errors.

This has helped fuel an explosion in efficiency and opened the door to entirely new business opportunities for some larger enterprises. Prior to the current wave of AI, it would have been hard to imagine using computer software to connect riders to taxis, but today Uber has become one of the largest companies in the world by doing just that. It utilizes sophisticated machine learning algorithms to predict when people are likely to need rides in certain areas, which helps proactively get drivers on the road before they're needed. As another example, Google has become one of the largest players for a range of online services by using machine learning to understand how people use their services and then improving them. In 2017, the company's CEO, Sundar Pichai, pronounced that Google would operate as an "AI first" company.

What are Examples of Artificial Intelligence?

- Siri, Alexa and other smart assistants
- Self-driving cars
- Robo-advisors
- Conversational bots
- Email spam filters
- Netflix's recommendations

History of AI

The **history of artificial intelligence** (**AI**) began in antiquity, with myths, stories and rumors of artificial beings endowed with intelligence or consciousness by master craftsmen. The seeds of modern AI were planted by classical philosophers who attempted to describe the process of human thinking as the mechanical manipulation of symbols. This work culminated in the invention of the programmable digital computer in the 1940s, a machine based on the abstract essence of mathematical reasoning. This device and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The birth of artificial intelligence 1952–1956

In the 1940s and 50s, a handful of scientists from a variety of fields (mathematics, psychology, engineering, economics and political science) began to discuss the possibility of creating an artificial brain. The field of artificial intelligence research was founded as an academic discipline in 1956.

Cybernetics and early neural networks

The earliest research into thinking machines was inspired by a confluence of ideas that became prevalent in the late 1930s, 1940s, and early 1950s. Recent research in neurology had shown that the brain was an electrical network of neurons that fired in all-or-nothing pulses. Norbert Wiener's cybernetics described control and stability in electrical networks. Claude Shannon's information theory described digital signals (i.e., all-or-nothing signals). Alan Turing's theory of computation showed that any form of computation could be described digitally. The close relationship between these ideas suggested that it might be possible to construct an electronic brain.

What are the advantages and disadvantages of artificial intelligence?

Artificial neural networks and deep learning artificial intelligence technologies are quickly evolving, primarily because AI processes large amounts of data much faster and makes predictions more accurately than humanly possible.

While the huge volume of data being created on a daily basis would bury a human researcher, AI applications that use machine learning can take that data and quickly turn it into actionable information. As of this writing, the primary disadvantage of using AI is that it is expensive to process the large amounts of data that AI programming requires.

Advantages

- Good at detail-oriented jobs;
- Reduced time for data-heavy tasks;
- Delivers consistent results; and
- AI-powered virtual agents are always available.

Disadvantages

- Expensive;
- Requires deep technical expertise;
- Limited supply of qualified workers to build AI tools;
- Only knows what it's been shown; and
- Lack of ability to generalize from one task to another.

Levels of AI

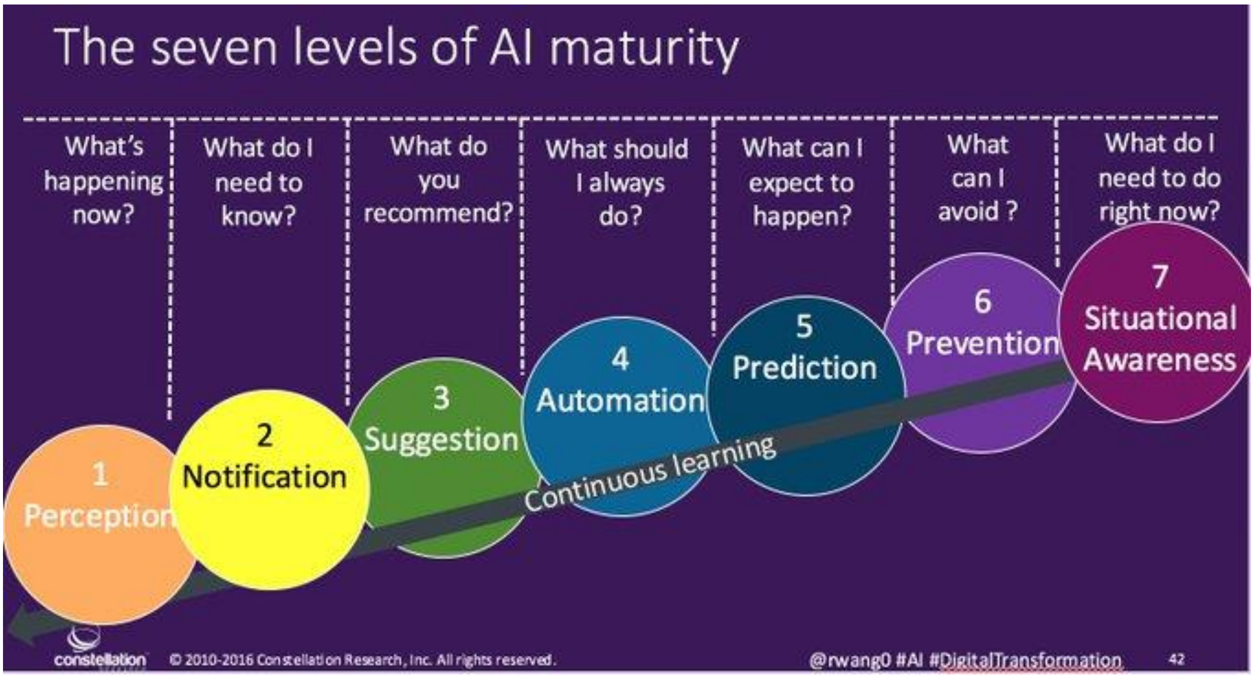
Level 5	Fully automated system which never requires human intervention
Level 4	Automation - A public service runs itself unless it hits an extreme case where it requires human intervention
Level 3	Semi-autonomous - Computers monitoring and running e.g. a regulatory system
Level 2	Close supervision - Routine administration of systems e.g. energy networks with difficult decisions referred to a human
Level 1	Simple augmentation - data entry, processing, Identifying clusters of activity, profiling, etc e.g. in fraud detection
Level 0	No automation - people powered public services

In self driving cars, the following levels have been agreed by the industry (paraphrasing is mine):

- Level 0 - no automation - You do all the work, this is most cars
- Level 1 - driver augmentation - You do most of the work but e.g. the car might moderate speed
- Level 2 - close supervision - The driver can take hands and feet off the controls but must remain ready to jump in.
- Level 3 - semi-autonomous - The car can take over the routine monitoring so the driver can relax until alerted
- Level 4 - automation - The car drives itself unless it is in an 'extreme' situation like a dirt road
- Level 5 - full automation - The car outperforms people even in 'extreme' environments.

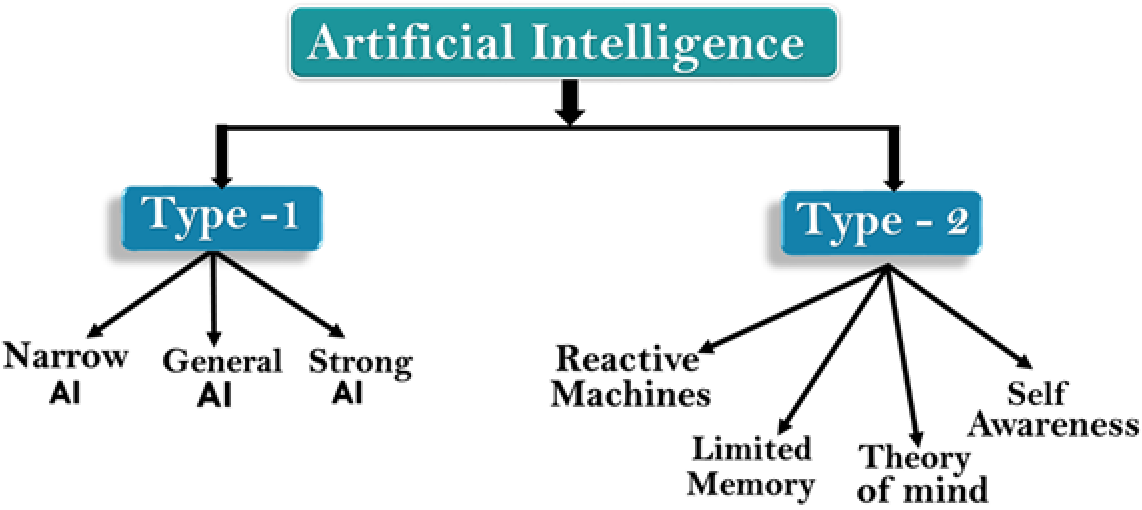
For context Tesla is currently about Level 2.5 (although officially at level 2) and companies like Ford are aiming for level 4. Level 4 is what Oxbotica will be testing next year when they run a fleet of cars between Oxford and London.

This type of segmentation can be useful for getting a handle on machine learning in the public sector. I've been experimenting with what a similar set of levels might mean for public services.



Types of AI:

Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionally of AI. Following is flow diagram which explain the types of AI.



AI type-1: Based on Capabilities

1. Weak AI or Narrow AI:

- Narrow AI is a type of AI which is able to perform a dedicated task with intelligence.The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.

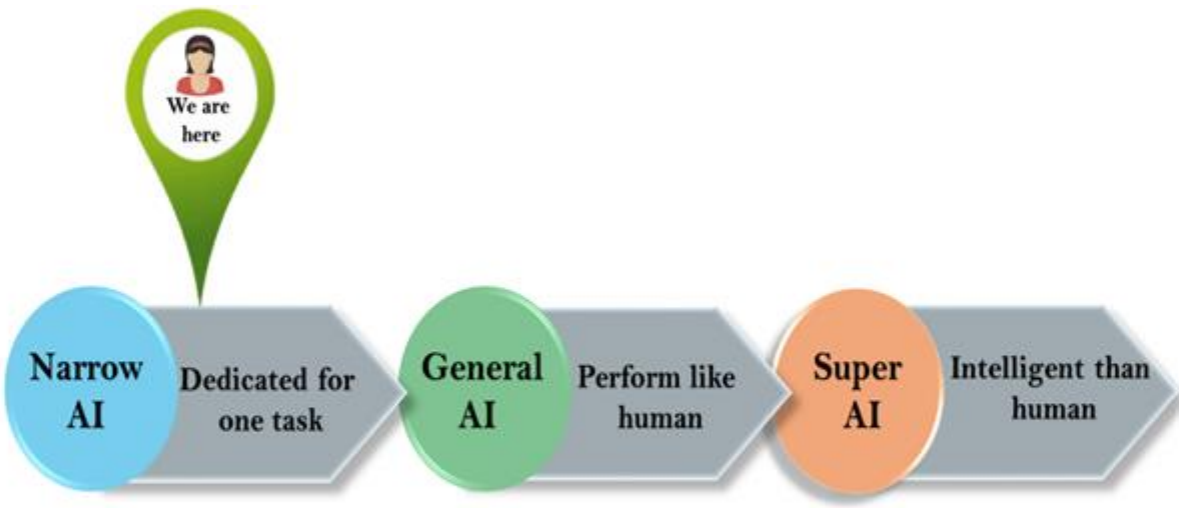
- Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.
- Apple Siriis a good example of Narrow AI, but it operates with a limited pre-defined range of functions.
- IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.
- Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.

2. General AI:

- General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.
- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.
- Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human.
- The worldwide researchers are now focused on developing machines with General AI.
- As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

3. Super AI:

- Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI.
- Some key characteristics of strong AI include capability include the ability to think, to reason,solve the puzzle, make judgments, plan, learn, and communicate by its own.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.



Artificial Intelligence type-2: Based on functionality

1. Reactive Machines

- Purely reactive machines are the most basic types of Artificial Intelligence.
- Such AI systems do not store memories or past experiences for future actions.
- These machines only focus on current scenarios and react on it as per possible best action.
- IBM's Deep Blue system is an example of reactive machines.
- Google's AlphaGo is also an example of reactive machines.

The most basic types of AI systems are purely reactive, and have the ability neither to form memories nor to use past experiences to inform current decisions. Deep Blue, IBM's chess-playing supercomputer, which beat international grandmaster Garry Kasparov in the late 1990s, is the perfect example of this type of machine.

Deep Blue can identify the pieces on a chess board and know how each moves. It can make predictions about what moves might be next for it and its opponent. And it can choose the most optimal moves from among the possibilities.

But it doesn't have any concept of the past, nor any memory of what has happened before. Apart from a rarely used chess-specific rule against repeating the same move three times, Deep Blue ignores everything before the present moment. All it does is look at the pieces on the chess board as it stands right now, and choose from possible next moves.

This type of intelligence involves the computer perceiving the world directly and acting on what it sees. It doesn't rely on an internal concept of the world. In a seminal paper, AI researcher Rodney Brooks argued that we should only build machines like this. His main reason was that people are not very good at programming accurate simulated worlds for computers to use, what is called in AI scholarship a "representation" of the world.

The current intelligent machines we marvel at either have no such concept of the world, or have a very limited and specialized one for its particular duties. The innovation in Deep Blue's design was not to broaden the range of possible movies the computer considered. Rather, the developers found a way to narrow its view, to stop pursuing some potential future moves, based on how it rated their outcome. Without this ability, Deep Blue would have needed to be an even more powerful computer to actually beat Kasparov.

Similarly, Google's AlphaGo, which has beaten top human Go experts, can't evaluate all potential future moves either. Its analysis method is more sophisticated than Deep Blue's, using a neural network to evaluate game developments.

These methods do improve the ability of AI systems to play specific games better, but they can't be easily changed or applied to other situations. These computerized imaginations have no concept of the wider world – meaning they can't function beyond the specific tasks they're assigned and are easily fooled.

They can't interactively participate in the world, the way we imagine AI systems one day might. Instead, these machines will behave exactly the same way every time they encounter the same situation. This can be very good for ensuring an AI system is trustworthy: You want your autonomous car to be a reliable driver. But it's bad if we want machines to truly engage with, and respond to, the world. These simplest AI systems won't ever be bored, or interested, or sad.

2. Limited Memory

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

This Type II class contains machines can look into the past. Self-driving cars do some of this already. For example, they observe other cars' speed and direction. That can't be done in a just one moment, but rather requires identifying specific objects and monitoring them over time.

These observations are added to the self-driving cars' preprogrammed representations of the world, which also include lane markings, traffic lights and other important elements, like curves in the road. They're included when the car decides when to change lanes, to avoid cutting off another driver or being hit by a nearby car.

But these simple pieces of information about the past are only transient. They aren't saved as part of the car's library of experience it can learn from, the way human drivers compile experience over years behind the wheel.

So how can we build AI systems that build full representations, remember their experiences and learn how to handle new situations? Brooks was right in that it is very difficult to do this. My own research into methods inspired by Darwinian evolution can start to make up for human shortcomings by letting the machines build their own representations.

3. Theory of Mind

- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

Machines in the next, more advanced, class not only form representations about the world, but also about other agents or entities in the world. In psychology, this is called "theory of mind" – the understanding that people, creatures and objects in the world can have thoughts and emotions that affect their own behavior.

This is crucial to how we humans formed societies, because they allowed us to have social interactions. Without understanding each other's motives and intentions, and without taking into account what somebody else knows either about me or the environment, working together is at best difficult, at worst impossible.

If AI systems are indeed ever to walk among us, they'll have to be able to understand that each of us has thoughts and feelings and expectations for how we'll be treated. And they'll have to adjust their behavior accordingly.

4. Self-Awareness

- Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

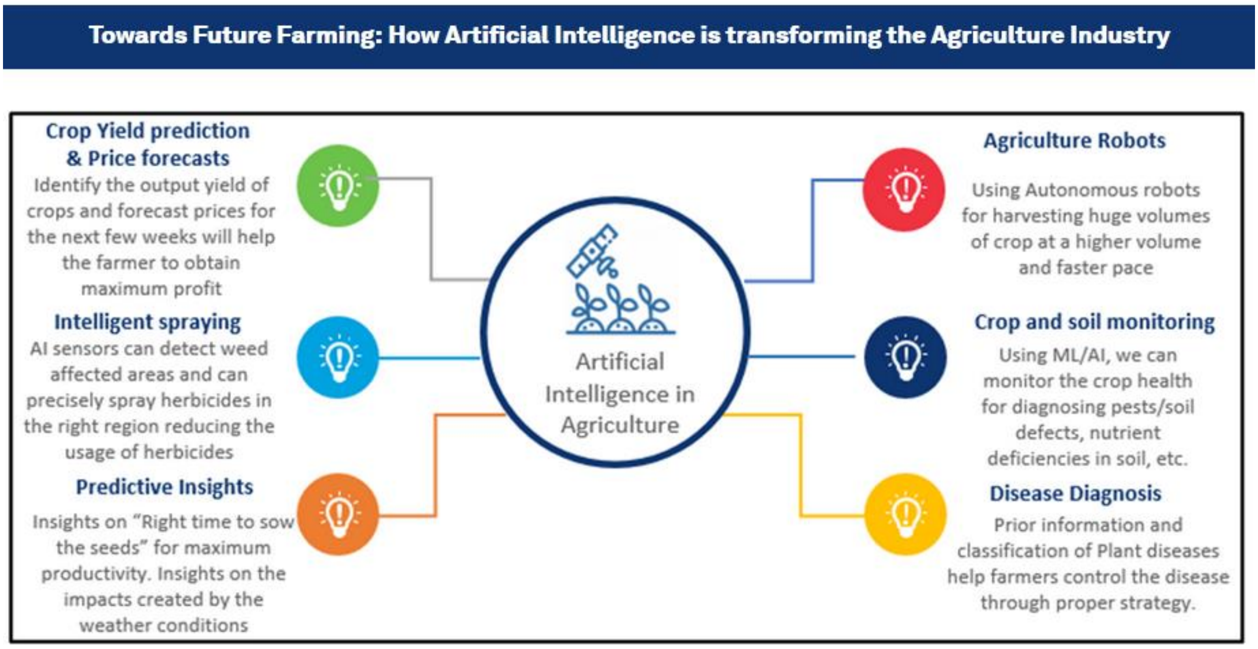
The final step of AI development is to build systems that can form representations about themselves. Ultimately, we AI researchers will have to not only understand consciousness, but build machines that have it.

This is, in a sense, an extension of the "theory of mind" possessed by Type III artificial intelligences. Consciousness is also called "self-awareness" for a reason. ("I want that item" is a very different statement from "I know I want that item.") Conscious beings are aware of themselves, know about their internal states, and are able to predict feelings of others. We assume someone honking behind us in traffic is angry or impatient, because that's how we feel when we honk at others. Without a theory of mind, we could not make those sorts of inferences.

While we are probably far from creating machines that are self-aware, we should focus our efforts toward understanding memory, learning and the ability to base decisions on past experiences. This is an important step to understand human intelligence on its own. And it is crucial if we want to design or evolve machines that are more than exceptional at classifying what they see in front of them.

Applications of AI in Agriculture

Technology has redefined farming over the years and technological advances have affected the agriculture industry in more ways than one. Agriculture is the mainstay occupation in many countries worldwide and with rising population, which as per UN projections will increase from 7.5 billion to 9.7 billion in 2050[1], there will be more pressure on land as there will be only an extra 4% of land, which will come under cultivation by 2050. This means that farmers will have to do more with less. According to the same survey, the food production will have to increase by 60% to feed an additional two billion people. However, traditional methods are not enough to handle this huge demand. This is driving farmers and agro companies to find newer ways to increase production and reduce waste. As a result, Artificial Intelligence (AI) is steadily emerging as part of the agriculture industry's technological evolution. The challenge is to increase the global food production by 50% by 2050[2] to feed an additional two billion people.AI-powered solutions will not only enable farmers to improve efficiencies but they will also improve quantity, quality and ensure faster go-to-market for crops.



Using AI for intelligent spraying of chemicals – Brings in cost savings

Every day, farms produce thousands of data points on temperature, soil, usage of water, weather condition, etc. With the help of artificial intelligence and machine learning models, this data is leveraged in real-time for obtaining useful insights like choosing the right time to sow seeds, determining the crop choices, hybrid seed choices to generate more yields and the like.

AI systems are helping to improve the overall harvest quality and accuracy – known as precision agriculture. AI technology helps in detecting disease in plants, pests and poor nutrition of farms. AI sensors can detect and target weeds and then decide which herbicide to apply within the region. This helps in reduced usage of herbicides and cost savings. Many technological companies developed robots, which use computer vision and artificial intelligence to monitor and precisely spray on weeds. These robots are able to eliminate 80% of the volume of the chemicals normally sprayed on the crops and bring down the expenditure of herbicide by 90%. These intelligent AI sprayers can drastically reduce the number of chemicals used in the fields and thus improve the quality of agricultural produce, and bring in cost efficiency.

Using AI-based robots for farm harvesting – Tackling the labor challenge

Have you ever wondered who actually picks the produce from the agricultural land? Well, in most cases, it is not the traditional farm worker but robotic machines that are capable of doing bulk harvesting with more accuracy and speed that are responsible for getting the produce on your kitchen table. These machines help improve the size of the yield and reduce waste from crops being left in the field.

Many companies are working on improving agricultural efficiencies. There are products like autonomous strawberry-picking machine[1] and a vacuum apparatus that can harvest mature apples from trees. These machines use sensor fusion, machine vision and artificial intelligence models to identify the location of the harvestable produce and help pick the right fruits.

Agriculture is the second largest industry after Defense where service robots market have been deployed for professional use. The International Federation of Robotics estimates that as many as 25,000 agricultural robots have been sold —matching the number used for military purposes.

Using AI for predictive analytics – Enables right decision-making

Predicting the best time to sow

The difference between a profitable year and a failed harvest is just the timely information on a simple data point of timing of sowing the seed. To combat this, scientists of ICRISATused a predictive analytics tool to arrive at a precise date for sowing the seeds to obtain maximum yield. It even gives insights on soil health and fertilizer recommendations in addition to a 7-day weather forecast.

Crop yield predictions and price forecasts

For many farmers, the biggest worry is the price fluctuation of the crop. Due to unstable prices, farmers are never able to plan a definite production pattern. This problem is highly prevalent in crops like tomatoes that have very limited shelf time. Companies are using satellite imagery and weather data to assess the acreage and monitor crop health on a real-time basis. With the help of technologies like big data, AI and machine learning, companies can detect pest and disease infestations, estimate the tomato output and yield, and forecast prices. They can guide the farmers and governments on the future price patterns, demand level, type of crop to sow for maximum benefit, pesticide usage etc.

Innovative startups are using AI in the field of agriculture. A Berlin-based agricultural tech startup3developed a multi-lingual plant disease and pest diagnostic app, which uses various images of the plant to detect diseases; a smartphone collects the image that is matched with a server image and then a diagnosis of that particular disease is provided and applied to the crop using intelligent spraying technique. In this way, the application uses AI and ML to solve plant diseases. Over seven million farmers have downloaded this app and it has helped identify over 385 crop diseases among field crops, fruits, and vegetables.

To summarize, AI solves the scarcity of resources and labor to a large extent and it will be a powerful tool that can help organizations cope with the increasing amount of complexity in modern agriculture. It is high time that big companies invest in this space.

Can AI replace the knowledge that farmers have always had? The response is probably no for now- but definitely in the near future, AI will complement and challenge the way decisions are made and improve farming practices. Such technological interventions are likely to lead to better agricultural practices, yields, and qualitatively improve the lives of farmers.

Artificial Intelligence in Healthcare: Applications and Threats

At the initial stage, technology was merely used to automate the most routine and monotonous tasks and cut down on the use of paper through digitization of health records while also aiding in the easy flow of this information among insurance companies, hospitals, and patients.

From employing it to detect links between genetic codes, put to use surgical robots, or even for maximizing hospital efficiency, AI has proven to be a boon for the healthcare industry

1. Support in Clinical Decisions

It's obviously imperative for health professionals to take every crucial piece of information into consideration while diagnosing patients. As a result, this leads to sifting through various complicated unstructured notes kept in medical records. If there's a mistake in keeping track of even a single relevant fact, the life of a patient could be put at risk.

The assistance of Natural Language Processing (NLP) makes it more convenient for doctors to narrow down all relevant information from patient reports.

Artificial Intelligence holds the ability to store and process large sets of data, which can provide knowledge databases and facilitate examination and recommendation individually for each patient, thus helping to enhance clinical decision support.

This technology can be relied upon by doctors for aid in detecting risk factors through unstructured notes. An interesting example of this is IBM's Watson has been employing AI for predicting heart failure.

2. Enhance Primary Care and Triage through Chatbots

People have a tendency of booking appointments with their GP at the slightest threat or medical issue, which could often turn out to be a false alarm or something which could be cured of self-treatment.

Artificial Intelligence assists in enabling smooth flow and automation of primary care, allowing doctors to stress over more crucial and dire cases.

Saving money on avoidable trips to the doctor, patients can benefit from medical chatbots, which is an AI-powered service, incorporated with smart algorithms that provide patients with instant answers to all their health-related queries and concerns while also guiding them on how to deal with any potential problems.

These chatbots are 24/7 available and have the capacity to deal with multiple patients at the same time.

3. Robotic Surgeries

AI and collaborative robots have revolutionized surgeries in terms of their speed, and depth while making delicate incisions. Since robots don't get tired, the issue of fatigue in the middle of lengthy and crucial procedures is eliminated.

AI machines are capable of employing data from past operations to develop new surgical methods. The preciseness of these machines reduces the possibility of tremors or any unintended or accidental movements during the surgeries.

Robotic Surgery

A few examples of Robots developed for surgeries are Vicarious Surgical which combines virtual reality with AI-enabled robots so surgeons can perform minimally invasive operations as well as **Heartlander**, a miniature mobile robot developed by the robotics department at Carnegie Mellon University, which was developed to facilitate therapy on the heart.

4. Virtual nursing assistants

AI systems facilitate virtual nursing assistants that can perform a range of tasks from conversing with patients to directing them to the best and effective care unit. These virtual nurses are available 24/7 and can respond to queries as well as examine patients and provide instant solutions.

Presently many AI-powered applications of virtual nursing assistants presently enable more regular interactions between patients and care providers between office visits to avoid any unnecessary hospital visits. The world's first virtual nurse assistant Care Angel, can even facilitate wellness checks through voice and AI.

5. Aiding in the accurate diagnosis

AI has the capacity to surpass human doctors and help them detect, predict, and diagnose diseases more accurately and at a faster rate. Likewise, AI algorithms have proved to be not only accurate and precise at specialty-level diagnostics, but also cost-effective in terms of detecting diabetic retinopathy.

For instance, PathAI is developing machine learning technology to aid pathologists in making more accurate diagnoses. The company's current goals include reducing error in cancer diagnosis and developing methods for individualized medical treatment.

Buoy Health is an AI-based symptom and cure checker that uses algorithms to diagnose and treat illness. Here's how it works: a chatbot listens to a patient's symptoms and health concerns, then guides that patient to the correct care based on its diagnosis.

6. Minimizing the burden of EHR use

EHRs have played an integral role in the healthcare industry's journey towards digitalization, yet its switch has introduced a variety of issues in association with cognitive overload, endless documentation, and user burnout.

The EHR developers have started making use of AI for creating more intuitive interfaces and automating a couple of the routine processes that consume a great degree of the user's time.

While voice recognition and dictation are helping in enhancing the clinical documentation process, yet natural language processing (NLP) tools may not go as far. AI can also aid in processing routine requests from the inbox, such as medication refills, and result in notifications. It can also aid in prioritizing tasks that require the clinician's attention, making it simpler for the users to operate with their to-do lists.

What are the Threats of Artificial Intelligence in Healthcare?

As per a report from the Brookings Institution, there are several risks associated with AI in healthcare that need to be addressed. Below are a couple of the threats which had been identified by the Institution's report :

Errors and Injuries

One of the biggest risks that AI in healthcare holds is that the AI system might at times be wrong, for instance, if it suggests a wrong drug to a patient or makes an error in locating a tumor in a radiology scan, which could result in the patient's injury or dire health-related consequences.

AI errors are potentially different for at least two reasons. While errors can obviously take place by human medical professionals as well yet what makes this crucial is that an underlying error, an error in an AI system could lead to injuries for thousands of patients.

3. Data availability

Yet another threat posed by AI systems is that training these systems requires massive amounts of data from multiple sources which include pharmacy records, electronic health records, insurance claims records, etc.

Since the data is fragmented and patients often see different providers or switch insurance companies the data gets complicated and less comprehensible as a result of which the risk of error and the cost of data collection escalates.

6. Privacy concerns

The collection of huge datasets and the exchange of data between health systems and AI developers to enable AI systems leads to many patients believing that this could violate their privacy, leading to the filing of lawsuits.

Another area where the employment of AI systems raises this issue is that AI has the capability of predicting private information about patients even if the patient has never given the information.

For instance, Parkinson's disease could be detected by an AI system with the trembling on a computer mouse even if the person hasn't revealed the information to anyone else which could be considered a violation of privacy by the patient.

7. **Bias and inequality**

Since AI systems absorb and learn through the data with which they are trained, they can also absorb the biases of the available data. For example, if the data incorporated in AI is mainly collected in academic medical centers, the developing AI systems will have less awareness about, and as a result, will treat less effectively, patients from populations that do not typically frequent academic medical centers.

8. **Could lead to shifts in the profession**

In the long run, the employment of AI systems could lead to shifts in the medical profession. Particularly in areas like radiology where most of the work gets automated.

This raises the concern that a high degree of employment of AI might lead to a fall in human knowledge and capacity over the years, making providers fail in detecting AI errors as well as in the further development of medical knowledge.

Applications of AI in Education Sector

Below are a handful of applications of AI which are helping in shaping and defining the educational experience of the present and the future.

1. Personalized Learning

Artificial Intelligence is being employed for personalizing learning for each student. With the employment of the **hyper-personalization** concept which is enabled through machine learning, the AI technology is incorporated to design a customized learning profile for each individual student and to tailor-make their training materials, taking into consideration the mode of learning preferred by the student, the student's ability and experience on an individual basis.

2. Voice assistants are in

Yet another AI component being fruitfully employed by educators in learning is voice assistants. These include Amazon's Alexa, Apple Siri, Microsoft Cortana, etc. These **voice**

assistants allow the students to converse with educational materials without the involvement of the teacher. They can be employed in home and non-educational environments for facilitating interaction with educational material or to access any extra learning assistance.

3. Aiding educators in administrative tasks

Teachers don't just battle the work of education-oriented duties but are also handed the responsibility of handling the classroom environment and dealing with a variety of organizational tasks.

They are handed a variety of non-teaching duties which include evaluation of essays, exam papers grading, dealing with the necessary paperwork, handling HR and personnel-related issues, arranging and managing classroom materials, handling the duties relating to booking and managing field trips, interacting and responding with parents, aiding with interaction and issues relating to the second language, keeping track of sick or absentees, as well as providing a learning environment.

In the case of higher education, AI-powered systems are being used to reduce human bias during the process of admission and enhance the credibility of the process since these systems use given specific criteria to select applications in admissions. Hence these systems have helped enhance oversight in the process of admissions.

4. Breaking barriers

Artificial intelligence tools and devices have been aiding in making global classrooms accessible to all irrespective of their language or disabilities. These programs are all-inclusive.

For instance, Presentation Translator is a free PowerPoint plug-in that develops subtitles in real-time of what the teacher is saying. This also helps aid the sick absentees as well as students requiring a different pace or level when it comes to learning or even in case they wish to understand a particular subject that is unavailable in their own school. Barriers are being torn down like never before.

5. Differentiated and individualized learning

Adjusting learning on the basis of the specific requirements of individual students has been the priority of educators for years, yet AI will enable a differentiation level, that is highly strenuous for teachers who have to handle 30 students in every class.

Many companies like Content Technologies and Carnegie Learning are presently developing intelligent instruction design and digital platforms which adopt AI for offering learning, testing, and feedback to students from pre-K to college level that offers them the challenges they are prepared for, detects knowledge gaps, and redirects to fresh topics whenever suitable.

6. Smart Content

Yet another way in which AI revolutionizes the education industry is by adding fresh approaches for students to achieve success. Smart content is a pretty popular term among educators, organizations, students, and educators as it makes learning more simple.

When we refer to smart content we actually imply varying types of virtual content that includes digitized guides of textbooks, video conferencing as well as video lectures.

The learning experience can now be enhanced by robots by developing customizable learning interfaces and digital content that is applicable to students of different grades, for elementary and post-secondary schools. The content becomes easy to grasp by separating it into coherent chunks, shedding light on integral lesson stuff, and also summarizing the main points.

Audio and video content can also be created. Through this, students can easily gain access to all important materials, grasp in a more swift manner and achieve their academic targets.

An example of one such platform is Netex Learning. The platform enables professors to develop, manage as well as update digital content in a single location. It also encourages students with a high-impact learning experience by enabling microlearning, skills mapping, as well as content recommendations

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Module -4 Internet of Things (IoT)

The Internet of Things (IoT) describes the network of physical objects—“things”—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025. Oracle has a network of device partners.

Why is Internet of Things (IoT) so important?

Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects—kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things.

By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate.

What technologies have made IoT possible?

While the idea of IoT has been in existence for a long time, a collection of recent advances in a number of different technologies has made it practical.

- **Access to low-cost, low-power sensor technology.** Affordable and reliable sensors are making IoT technology possible for more manufacturers.
- **Connectivity.** A host of network protocols for the internet has made it easy to connect sensors to the cloud and to other "things" for efficient data transfer.
- **Cloud computing platforms.** The increase in the availability of cloud platforms enables both businesses and consumers to access the infrastructure they need to scale up without actually having to manage it all.
- **Machine learning and analytics.** With advances in machine learning and analytics, along with access to varied and vast amounts of data stored in the cloud, businesses can gather insights faster and more easily. The emergence of these allied technologies continues to push the boundaries of IoT and the data produced by IoT also feeds these technologies.
- **Conversational artificial intelligence (AI).** Advances in neural networks have brought natural-language processing (NLP) to IoT devices (such as digital personal assistants Alexa, Cortana, and Siri) and made them appealing, affordable, and viable for home use.

What is industrial IoT?

Industrial IoT (IIoT) refers to the application of IoT technology in industrial settings, especially with respect to instrumentation and control of sensors and devices that engage cloud technologies. Refer to thisTitan use case PDF for a good example of IIoT. Recently, industries have used machine-to-machine communication (M2M) to achieve wireless automation and control. But with the emergence of cloud and allied technologies (such as analytics and machine learning), industries can achieve a new automation layer and with it create new revenue and business models. IIoT is sometimes called the fourth wave of the industrial revolution, or Industry 4.0. The following are some common uses for IIoT:

- Smart manufacturing
- Connected assets and preventive and predictive maintenance
- Smart power grids
- Smart cities
- Connected logistics
- Smart digital supply chains

  - **What industries can benefit from IoT?**
  - Organizations best suited for IoT are those that would benefit from using sensor devices in their business processes.
  - **Manufacturing**
  - Manufacturers can gain a competitive advantage by using production-line monitoring to enable proactive maintenance on equipment when sensors detect an impending failure. Sensors can actually measure when production output is compromised. With the help of sensor alerts, manufacturers can quickly check equipment for accuracy or remove it from production until it is repaired. This allows companies to reduce operating costs, get better uptime, and improve asset performance management.
  - **Automotive**
  - The automotive industry stands to realize significant advantages from the use of IoT applications. In addition to the benefits of applying IoT to production lines, sensors can detect impending equipment failure in vehicles already on the road and can alert the driver with details and recommendations. Thanks to aggregated information gathered by IoT-based applications, automotive manufacturers and suppliers can learn more about how to keep cars running and car owners informed.
  - **Transportation and Logistics**
  - Transportation and logistical systems benefit from a variety of IoT applications. Fleets of cars, trucks, ships, and trains that carry inventory can be rerouted based on weather conditions, vehicle availability, or driver availability, thanks to IoT sensor data. The inventory itself could also be equipped with sensors for track-and-trace and

temperature-control monitoring. The food and beverage, flower, and pharmaceutical industries often carry temperature-sensitive inventory that would benefit greatly from IoT monitoring applications that send alerts when temperatures rise or fall to a level that threatens the product.

- **Retail**
- IoT applications allow retail companies to manage inventory, improve customer experience, optimize supply chain, and reduce operational costs. For example, smart shelves fitted with weight sensors can collect RFID-based information and send the data to the IoT platform to automatically monitor inventory and trigger alerts if items are running low. Beacons can push targeted offers and promotions to customers to provide an engaging experience.
- **Public Sector**
- The benefits of IoT in the public sector and other service-related environments are similarly wide-ranging. For example, government-owned utilities can use IoT-based applications to notify their users of mass outages and even of smaller interruptions of water, power, or sewer services. IoT applications can collect data concerning the scope of an outage and deploy resources to help utilities recover from outages with greater speed.
- **Healthcare**
- IoT asset monitoring provides multiple benefits to the healthcare industry. Doctors, nurses, and orderlies often need to know the exact location of patient-assistance assets such as wheelchairs. When a hospital's wheelchairs are equipped with IoT sensors, they can be tracked from the IoT asset-monitoring application so that anyone looking for one can quickly find the nearest available wheelchair. Many hospital assets can be tracked this way to ensure proper usage as well as financial accounting for the physical assets in each department.
- **General Safety Across All Industries**
- In addition to tracking physical assets, IoT can be used to improve worker safety. Employees in hazardous environments such as mines, oil and gas fields, and chemical and power plants, for example, need to know about the occurrence of a hazardous event that might affect them. When they are connected to IoT sensor–based applications, they can be notified of accidents or rescued from them as swiftly as possible. IoT applications are also used for wearables that can monitor human health and environmental conditions. Not only do these types of applications help people

better understand their own health, they also permit physicians to monitor patients remotely.

History of IoT

The Internet of Things (IoT) has not been around for very long. However, there have been visions of machines communicating with one another since the early 1800s. Machines have been providing direct communications since the telegraph (the first landline) was developed in the 1830s and 1840s. Described as “wireless telegraphy,” the first radio voice transmission took place on June 3, 1900, providing another necessary component for developing the Internet of Things. The development of computers began in the 1950s.

One additional and important component in developing a functional IoT was IPV6’s remarkably intelligent decision to increase address space. Steve Leibson, of the Computer History Museum, states, “The address space expansion means that we could assign an IPV6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths.” Put another way, we are not going to run out of internet addresses anytime soon.

Realizing the Concept

The Internet of Things, as a concept, wasn’t officially named until 1999. One of the first examples of an Internet of Things is from the early 1980s, and was a Coca Cola machine, located at the Carnegie Melon University. Local programmers would connect by Internet to the refrigerated appliance, and check to see if there was a drink available, and if it was cold, before making the trip.

By the year 2013, the Internet of Things had evolved into to a system using multiple technologies, ranging from the Internet to wireless communication and from micro-electromechanical systems (MEMS) to embedded systems. The traditional fields of automation (including the automation of buildings and homes), wireless sensor networks, GPS, control systems, and others, all support the IoT.

Simply stated, the Internet of Things consists of any device with an on/off switch connected to the Internet. This includes almost anything you can think of, ranging from cellphones to building maintenance to the jet engine of an airplane. Medical devices, such as a heart monitor implant or a biochip transponder in a farm animal, can transfer data over a network and are members the IoT. If it has an off/on switch, then it can, theoretically, be part of the system.

Challenges in Internet of things (IoT)

The Internet of Things (IoT) has fast grown to be a large part of how human beings live, communicate and do business. All across the world, web-enabled devices are turning our global rights into a greater switched-on area to live in. There are various types of challenges in front of IoT.

Security challenges in IoT :

1. **Lack of encryption –** Although encryption is a great way to prevent hackers from accessing data, it is also one of the leading IoT security challenges. These drives like the storage and processing capabilities that would be found on a traditional computer. The result is an increase in attacks where hackers can easily manipulate the algorithms that were designed for protection.
2. **Insufficient testing and updating –** With the increase in the number of IoT(internet of things) devices, IoT manufacturers are more eager to produce and deliver their device as fast as they can without giving security too much of although. Most of these devices and IoT products do not get enough testing and updates and are prone to hackers and other security issues.
3. **Brute forcing and the risk of default passwords –** Weak credentials and login details leave nearly all IoT devices vulnerable to password hacking and brute force. Any company that uses factory default credentials on their devices is placing both their business and its assets and the customer and their valuable information at risk of being susceptible to a brute force attack.
4. **IoT Malware and ransomware –** Increases with increase in devices. Ransomware uses encryption to effectively lock out users from various devices and platforms and still use a user's valuable data and info. **Example –** A hacker can hijack a computer camera and take pictures.

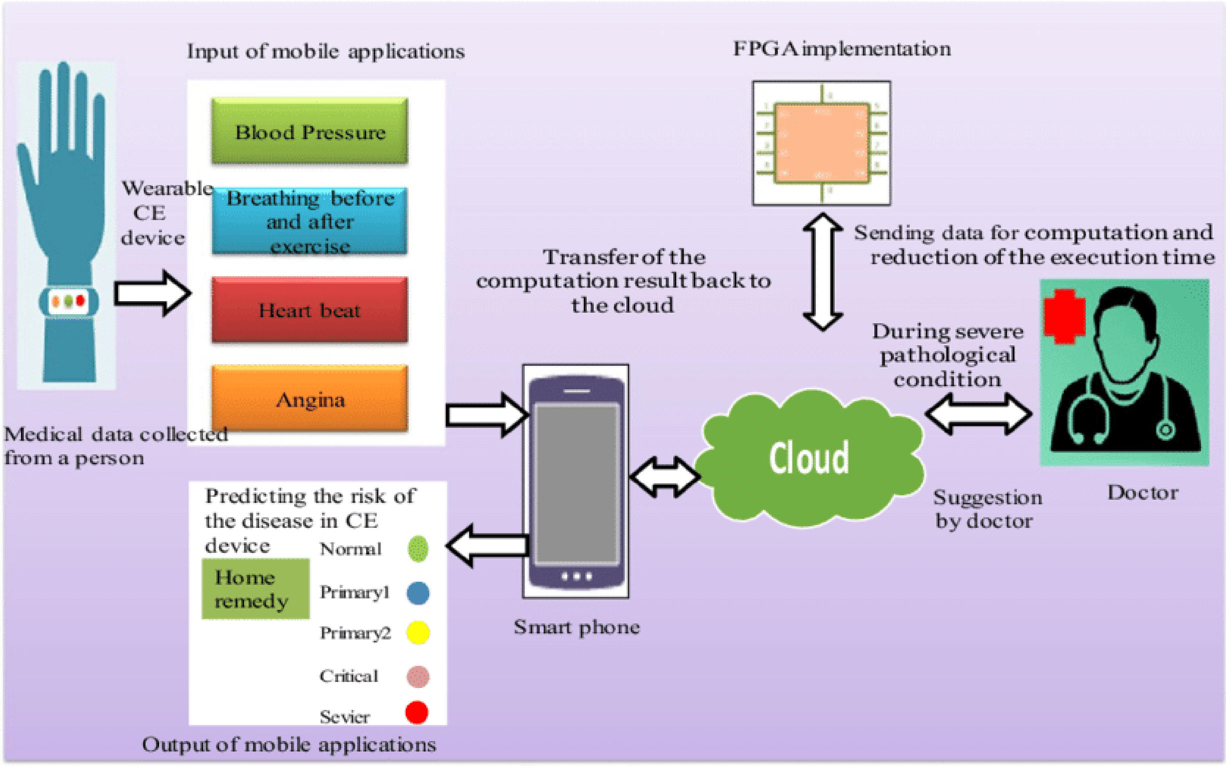
By using malware access points, the hackers can demand ransom to unlock the device and return the data.

5. **IoT botnet aiming at cryptocurrency –**
   IoT botnet workers can manipulate data privacy, which could be massive risks for an open Crypto market. The exact value and creation of cryptocurrencies code face danger from mal-intentioned hackers.
   The blockchain companies are trying to boost security. Blockchain technology itself is not particularly vulnerable, but the app development process is.

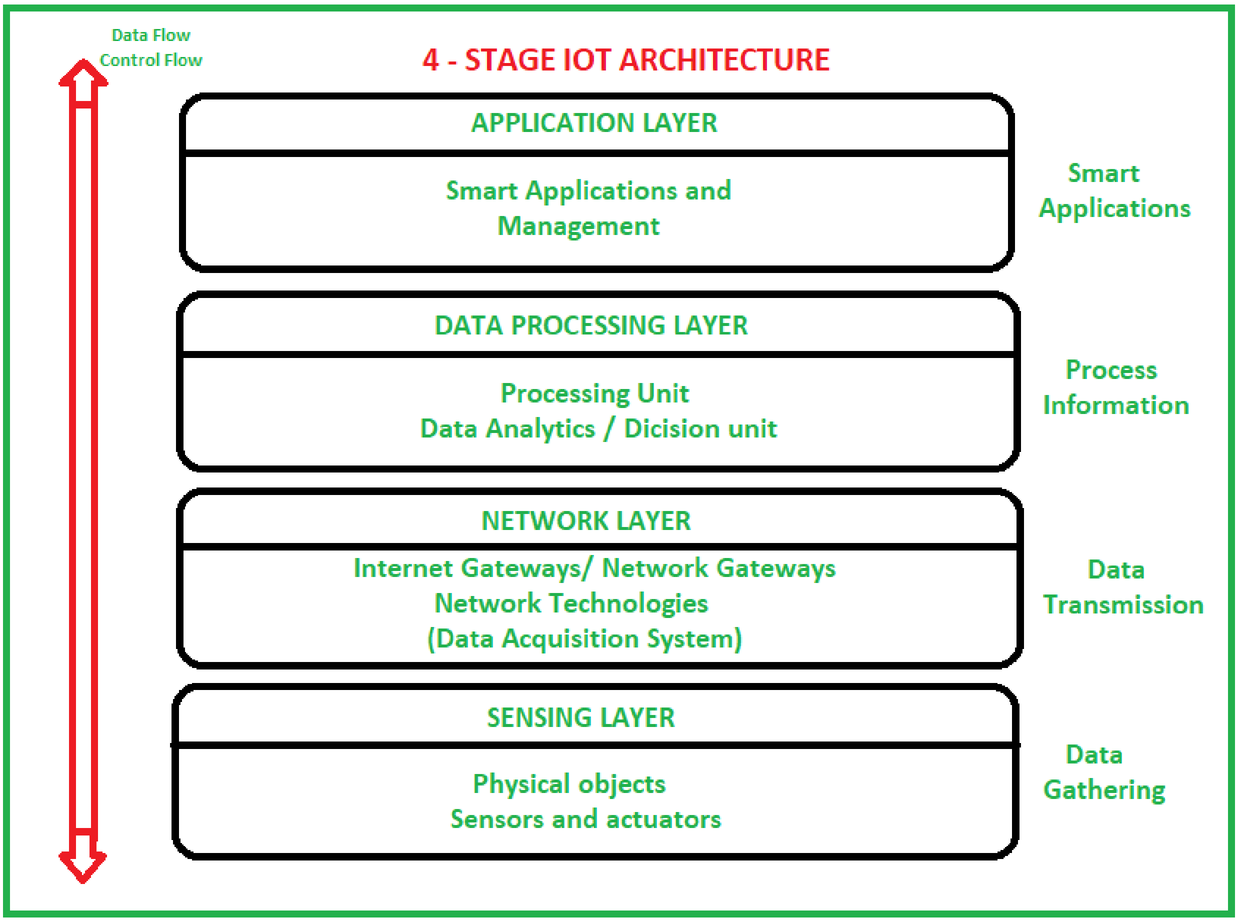
IOT working process

An IoT system consists of sensors/devices which "talk" to the cloud through some kind of connectivity. Once the data gets to the cloud, software processes it and then might decide to perform an action, such as sending an alert or automatically adjusting the sensors/devices without the need for the user.

But if the user input *is* needed or if the user simply wants to check in on the system, a user interface allows them to do so. Any adjustments or actions that the user makes are then sent in the opposite direction through the system: from the user interface, to the cloud, and back to the sensors/devices to make some kind of change.



Architecture of IOT



1. **Sensing Layer** – Sensors, actuators, devices are present in this Sensing layer. These Sensors or Actuators accepts data(physical/environmental parameters), processes data and emits data over network.
2. **Network Layer** – Internet/Network gateways, Data Acquisition System (DAS) are present in this layer. DAS performs data aggregation and conversion function (Collecting data and aggregating data then converting analog data of sensors to digital data etc). Advanced gateways which mainly opens up connection between Sensor networks and Internet also performs many basic gateway functionalities like malware protection, and filtering also some times decision making based on inputted data and data management services, etc.
3. **Data processing Layer** – This is processing unit of IoT ecosystem. Here data is analyzed and pre-processed before sending it to data center from where data is accessed by software applications often termed as business applications where data is monitored and managed and further actions are also prepared. So here Edge IT or edge analytics comes into picture.
4. **Application Layer** – This is last layer of 4 stages of IoT architecture. Data centers or cloud is management stage of data where data is managed and is used by end-user applications like agriculture, health care, aerospace, farming, defense, etc.

Devices and network

IoT devices are the nonstandard computing devices that connect wirelessly to a network and have the ability to transmit data, such as the many devices on the internet of things (IoT).

IoT involves extending internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally "dumb" or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the internet. They can also be remotely monitored and controlled.

What is an example of an IoT device?

Connected devices are part of an ecosystem in which every device talks to other related devices in an environment to automate home and industry tasks. They can communicate usable sensor data to users, businesses and other intended parties. The devices can be categorized into three main groups: consumer, enterprise and industrial.

Consumer connected devices include smart TVs, smart speakers, toys, wearables and smart appliances.

In a smart home, for example, devices are designed to sense and respond to a person's presence. When a person arrives home, their car communicates with the garage to open the door. Once inside, the thermostat is already adjusted to their preferred temperature, and the lighting is set to a lower intensity and color, as their smart watch data indicates it has been a stressful day. Other smart home devices include sprinklers that adjust the amount of water given to the lawn based on the weather forecast and robotic vacuum cleaners that learn which areas of the home must be cleaned most often.

THIS ARTICLE IS PART OF

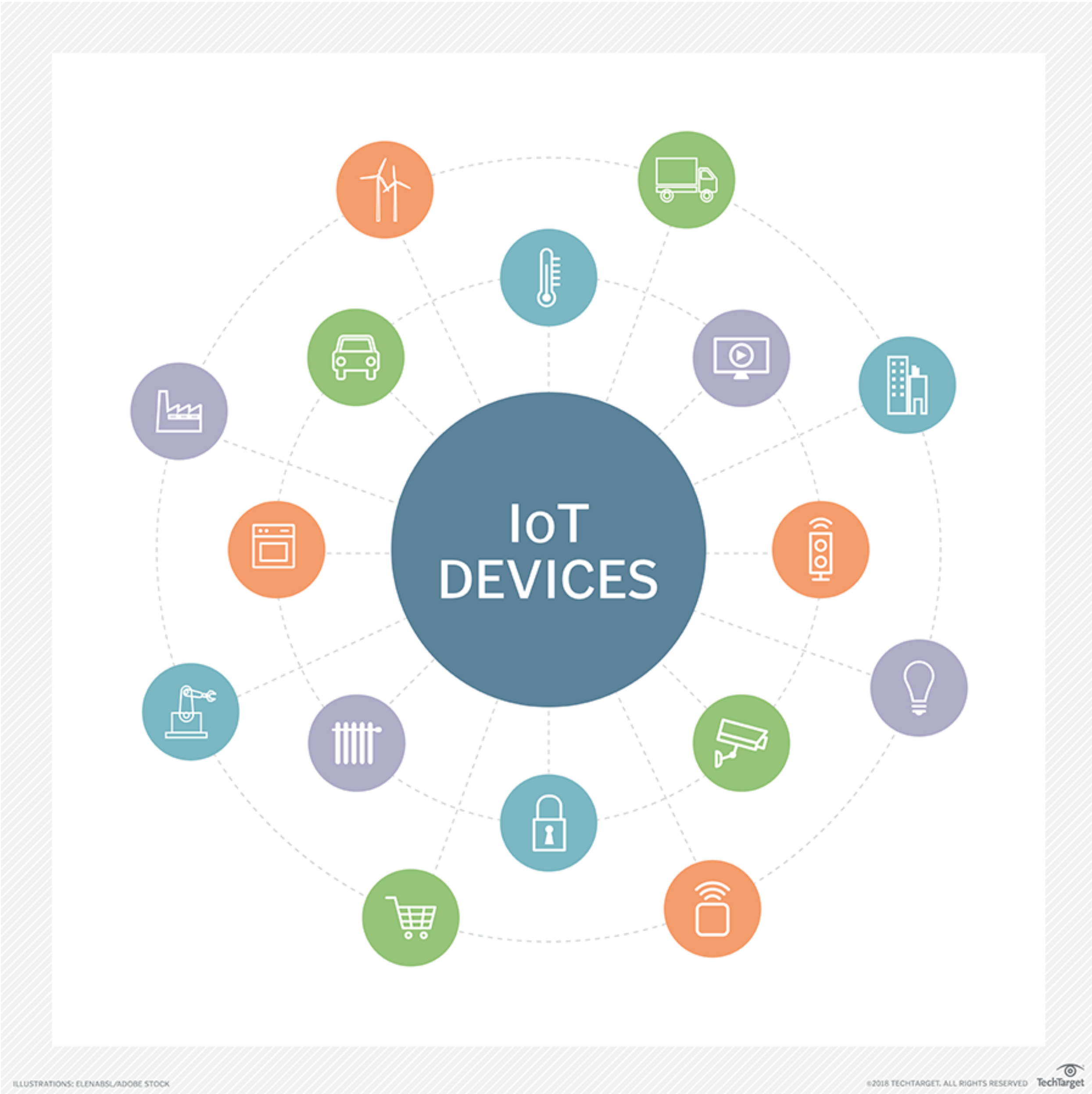
Ultimate IoT implementation guide for businesses

- Which also includes:

- **Top 8 IoT applications and examples in business**
- **Create the right approach to IoT adoption and scalability**
- **5 IoT security threats to prioritize**

Enterprise IoT devices are edge devices designed to be used by a business. There are a huge variety of enterprise IoT devices available. These devices vary in capability but tend to be geared toward maintaining a facility or improving operational efficiency. Some options include smart locks, smart thermostats, smart lighting and smart security. Consumer versions of these technologies exist as well.

In the enterprise, smart devices can help with meetings. Smart sensors located in a conference room can help an employee locate and schedule an available room for a meeting, ensuring the proper room type, size and features are available. When meeting attendees enter the room, the temperature will adjust according to the occupancy, the lights will dim as the appropriate PowerPoint loads on the screen and the speaker begins his or her presentation.



IoT device connectivity and networking

The networking, communication and connectivity protocols used with internet-enabled devices largely depend on the specific IoT application deployed. Just as there are many different IoT applications, there are many different connectivity and communication options.

Communication protocols include CoAP, DTLS, MQTT, DDS and AMQP. Wireless protocols include IPv6, LPWAN, Zigbee, Bluetooth Low Energy, Z-Wave, RFID and NFC. Cellular, satellite, Wi-Fi and Ethernet can also be used.

Each option has its tradeoffs in terms of power consumption, range and bandwidth, all of which must be considered when choosing connected devices and protocols for a particular IoT application.

In most cases, IoT devices connect to an IoT gateway or another edge device where data can either be analyzed locally or sent to the cloud for analysis. Some devices have integrated data processing capabilities that minimized the amount of data that must be sent to the cloud or to the data center. This type of processing often uses machine learning capabilities that are integrated into the device, and is becoming increasingly popular as IoT devices create more and more data.

Smart grid; Smart city; Wearable devices; Smart farming(IoT in Agriculture: 5 Technology Use Cases for Smart Farming (and 4 Challenges to Consider) (easternpeak.com))

IoT use cases in agriculture (with examples)

1.Monitoring of climate conditions

2. Greenhouse automation

3. Crop management

4. Cattle monitoring and management

5. Precision farming

6. Agricultural drones

7. Predictive analytics for smart farming

8. End-to-end farm management systems

Smart grid; Smart city;-

https://esci-ksp.org/wp/wp-content/uploads/2014/09/smartgrid-newdirection1.pdf

bing.com/videos- Smart grid; Smart city; - Bing video

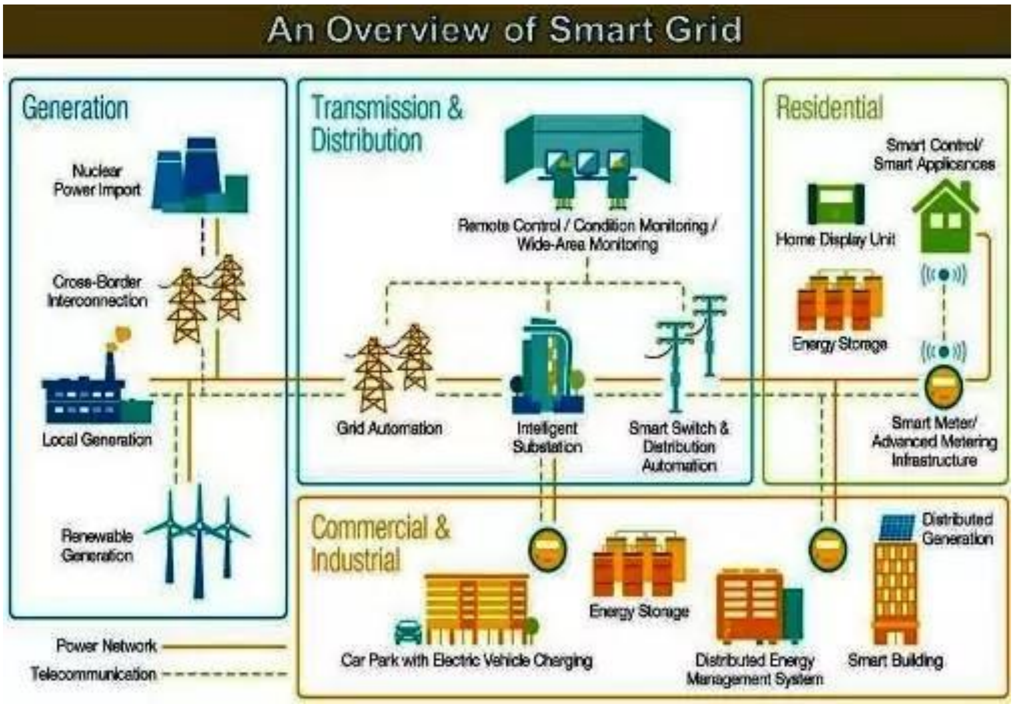
Smart Grid can be defined as a smart electrical network that combines electrical systems and smart digital communication technology. It performs two-way communication between power suppliers and consumers. Nowadays, we are very familiar with the word 'Smart grid'.

What is Smart grid technology?

In this section, we are going to explain the **complete overview of Smart Grid Technology**.

In a simple word, Smart Grid can be defined as a smart electrical network that combines electrical systems and smart digital communication technology. It is a self-sufficient electrical power network systems which are based on **digital automation technology for monitoring**, control, and analysis within the supply chain.

It performs two-way communication between power suppliers and consumers. A smart grid has capable of controlling electrical power from multiple and widely distributed generation sources, like wind turbines, solar power plant and many more.



Smart Grid Components

Smart Grid components are a group of intelligent appliances and heavy equipment that plays an important role in the generation, transmission, and the distribution of electrical energy. These appliances are smart enough to understand the working and how to utilize them.

Advantages of Smart Grid

A smart grid performs lots of smart work. so Advantages of the smart grid are as mentioned below.

- The smart grid provides better power management technologies through its integrated systems. This provides a better user interface.
- It has also provided with a better protective management system in case of emergency.
- It also provides a better supply and demand management.
- It has reduced Carbon emission Technology.
- Better Quality power.
- Lower cost of operation, maintenance, and management for both utility and consumers.
- It provides more efficient and improved security and protection.
- It has also provided the convenience of reading meters remotely. Meter readers will not have to appear physically to check the meter readings. It will all be done through IT resources.

Applications of Smart Grid

These are the *Applications of the smart grid*.

- Quick recovery after any disturbances in the transmission network.
- Reduction of generation coast.
- Reduction in peak demands.
- They improve the adeptness of transmission networks.
- They possess the ability to integrate other renewable energy sources through distributed generations and microgrids.

What is the role of IoT in Smart Cities?

What is the role of IoT in Smart Cities? (finextra.com)

In general, the term IoT (Internet of Things) refers to the rapidly growing number of digital devices – the quantity is now billions – these devices can communicate and interact with others over the network/internet worldwide and they can be remotely monitored and controlled. The IoT includes only smart sensors and other devices. On the operational level of

IoT, for example weather data is collected. IoT offers new opportunities for cities to use data to manage traffic, cut pollution, make better use of infrastructure and keep citizens safe and clean.

Role of the smartphone in IoT

- IoT for the average person is the smartphone because it is going to be everywhere and everyone carries a smartphone all day
- We use it for a large number of daily tasks to interact with other smart devices
- Interaction with IoT using a smartphone simply because this is the computing platform that we are most likely to have with us at any point in time
- Concerned that something is not quite right with our IoT-enabled device (e.g. when your own car got a “Check Engine” light), we will be able to run a professional vehicle scan diagnostic tool from our smartphone to read diagnostic trouble codes

which is cheaper than bringing it to a professional car mechanic to diagnose the problem

- IoT means that consumers will have more options when it comes to smart devices (interaction with those devices through the smartphone)
- More possibilities like connecting your smartphone with a washing machine to get a graph to see the water usage and electricity over the past few weeks/months
- In all, every IoT device such as washing machines, refrigerators or cars are able to send and receive data to specially configured servers on the Internet – they are able to connect and communicate over the Internet

Understanding the role of smart city and its components in the IoT era

Tokyo, the city with the world's largest population density keeps growing and boasting the largest number of people of all the cities in the world. Japan's capital is the largest urban area worldwide with a population of more than 38 million people (38,050,000 people). In addition, more than 31 million people (32,275,000 people) live in Jakarta, Indonesia and around 26 million in Delhi, India. According to forecasts, 60% of the world's population will live in major cities by 2030.

The consequences: freshwater scarcity, pile of garbage, collapse of traffic and air pollution. How can we cope with these challenges? One key is Smart City - the networked and intelligent city. It stands for better quality of life and lower consumption of resources. Here are five components of the smart city and their impact in the IoT era:

1. Smart Infrastructure

2. The City Air Management Tool (CyAM)

3. Traffic Management

4. Smart Parking

5. Smart Waste Management

IOT tools and platforms- 12 Open Source Internet of Things (IoT) Platforms and Tools (geekflare.com)

IoT platforms and tools are considered as the most significant component of the IoT ecosystem. Any IoT device permits to connect to other IoT devices and applications to pass on information using standard Internet protocols. IoT platforms fill the gap between the device sensors and data networks. It connects the data to the sensor system and gives insights using back-end applications to create a sense of the plenty of data developed by the many sensors.

12 Open Source Internet of Things (IoT) Platforms and Tools

- Zetta. Zetta is API based IoT platform based on Node.js. ...
- Arduino. If you are seeking to make a computer that can perceive and exercise stronger control over the real world when related to your ordinary stand-alone computer, then Arduino can ...
- OpenRemote. ...
- Node-RED. ...
- Flutter. ...
- M2MLabs Mainspring. ...
- ThingsBoard. ...
- Kinoma. ...
- Kaa IoT Platform. ...
- SiteWhere. ...

Sample application with hands on activity.

20 Exciting IoT Project Ideas & Topics For Beginners [2021] | upGrad blog

Module-5 Augmented Reality (AR) and Virtual Reality (VR)

- Introduction to AR, Virtual reality (VR), Augmented Reality (AR) vs mixed reality (MR), Architecture of AR systems. Application of AR systems (education, medical, assistance, entertainment) workshop oriented hands demo.

Augmented Reality (AR) and Virtual Reality (VR)

Introduction to AR

Augmented reality (**AR**) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.

AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects.[3] The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment).[4] This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment.[4] In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality.

The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations, which are perceived as natural parts of an environment. The earliest functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Laboratory in 1992.

- The distinctions between VR and AR come down to the devices they require and the experience itself: **AR uses a real-world setting** while VR is completely virtual. ... VR requires a headset device, but AR can be accessed with a smartphone. AR enhances both the virtual and real world while VR only enhances a fictional reality.
- Augmented Reality Apps are software applications which merge the digital visual (audio and other types also) content into the user's real-world environment. ... Some other popular examples of AR apps include **AcrossAir, Google Sky Map, Layar, Lookator, SpotCrime, PokemonGo** etc.
- There are various uses of AR software like training, work and consumer applications in various industries including public safety, healthcare, tourism, gas and oil, and marketing.
- The first commercial application of AR technology was the yellow “first down” line that began appearing in televised football games in 1998. Some other popular examples of AR apps include AcrossAir, Google Sky Map, Layar, Lookator, SpotCrime, PokemonGo etc. We have collected 8 examples of augmented reality apps and how they can impact the future of mobile technology.

Categories of AR Apps and Examples of their Usage:

- **a) Augmented Reality in 3D viewers:**
- This allows users to put life-size 3D models in their environment with or without the use of trackers. Trackers are the simple images that 3D models can be linked to in Augmented Reality.
- *Examples: AUGMENT, Sun Seeker, etc.*

- **Sun-Seeker:**
- Sun-Seeker is an AR app which provides a flat compass view and a 3D view showing the solar path, its hour intervals, its equinox, winter and summer solstice paths, sunrise and sunset times, twilight times, magic hours and also a Map view showing solar direction for each daylight hour. The app runs on both the mediums i.e., Android and iOS. The app has got 3+ ratings from its users.
- Photographers – For planning ideal light conditions, sunrise or sunset directions, golden and blue hour times
- Cinematographers – To search for the exact exposure of Sun, directions and times for any location.
- **Real Estate** Buyers – To search for the sun exposure properties that the customers are considering
- Drivers – To find how long the car will remain in the shade at any parking spot
- Campers – To find where to camp, sit or pitch an umbrella
- Gardeners – Helps to search for ideal locations for planting and seasonal sunlight hours
- Architects – For visualizing the spatial variability of the solar angle throughout the year.

ARGON4:

- This is a fully-featured web browser that has the ability to display augmented reality content created with the argon. js Javascript framework.
- argon.js makes it easier for adding augmented reality content to the web applications in a platform and technology-independent way and supports the real-time AR capabilities of the Argon4 Browser. The Argon4 browser is available on both iTunes App Store and Google Play Store.

AR Browser SDK:

- This is a browser created by ARLab. This browser allows the users to add augmented reality geolocation view to the Android and or iOS application in less than 5 minutes. With user-friendly API (Application Programming Interface), it can be fully customized. The framework takes care of all the complex functions of the augmented reality browser.

- It provides video support.
- It adds and removes single POIs in real time.
- It can run on any device.
- It offers great performance and memory management.
- It has an exceptionally light view, smooth and accurate movements.
- It provides custom activities like SMS, call, email, video, social networks and more.

Augmented Reality Games:

- AR Gaming software is probably the most common type of App. These apps create mesmeric gaming experiences that use your actual surroundings.
- *Examples: Pokémon Go, Parallel Kingdom, Temple Treasure Hunt, Real Strike, Zombie Go, etc.*

REAL STRIKE:

- This is a popular shooting AR game which is available only on iOS. The users get a real life shooting experience in this game and can record their fights and also create their own videos.
- There is a pool which has been polluted by nuclear waste and a group of pests is just around the corner so players have to stop them infecting the earth.
- Users use their phone to scan the mark. The game offers night and thermal vision goggles to get a clear view even in the evening to complete your mission.

Augmented Reality GPS:

- AR applications in smartphones generally include Global Positioning System (GPS) to spot the user's location and its compass to detect device orientation.
- *Examples: AR GPS Compass Map 3D, AR GPS Drive/Walk Navigation, etc.*

AR GPS Drive/Walk Navigation:

- The application makes use of the smart phone's GPS and camera to execute a car navigation system with an augmented reality-powered technology. It is easier and safer than the normal navigation system for the driver. This application is available only on Android.

- This app guides the drivers directly by the virtual path of the camera preview video which makes it easy for them to understand. The drivers do not need to map the map the path and the road while using this app. The driver can see the real-time camera preview navigation screen to get driving condition without hindering his safety.
- Apart from AR, **Virtual Reality** is also gaining significant traction in the mobile industry.
- AR apps act as a magic window for the viewers that lets them see the holograms and manipulate 3D models.

Virtual Reality (VR)

Virtual Reality (VR) is a computer-generated environment with scenes and objects that appear to be real, making the user feel they are immersed in their surroundings. This environment is perceived through a device known as a Virtual Reality headset or helmet.

- Virtual reality or VR is a technology that creates a virtual environment. People interact in those environments using, for example, VR goggles or other mobile devices. It is a computer-generated simulation of an environment or 3-dimensional image where people can interact in a seemingly real or physical way.

- Games, surgery and flight simulators are the most well known uses of virtual reality but other, lesser well known applications include: Visualisations, e.g. geographical. Study and treatment of addictions. Weather forecasting.
- Virtual reality can be used by coaches and players to train more efficiently across a range of sports, as they are able to watch and experience certain situations repeatedly and can improve each time. Essentially, it's used as a training aid to help measure athletic performance and analyze technique.
- There are a wide variety of applications for virtual reality which include:
- Architecture
- Sport
- Medicine
- The Arts
- Entertainment

Types of VR

- The only limits to a VR experience are the availability of content and computing power. There are 3 primary categories of virtual reality simulations used today: non-immersive, semi-immersive, and fully-immersive simulations.

Augmented Reality (AR) vs mixed reality (MR)

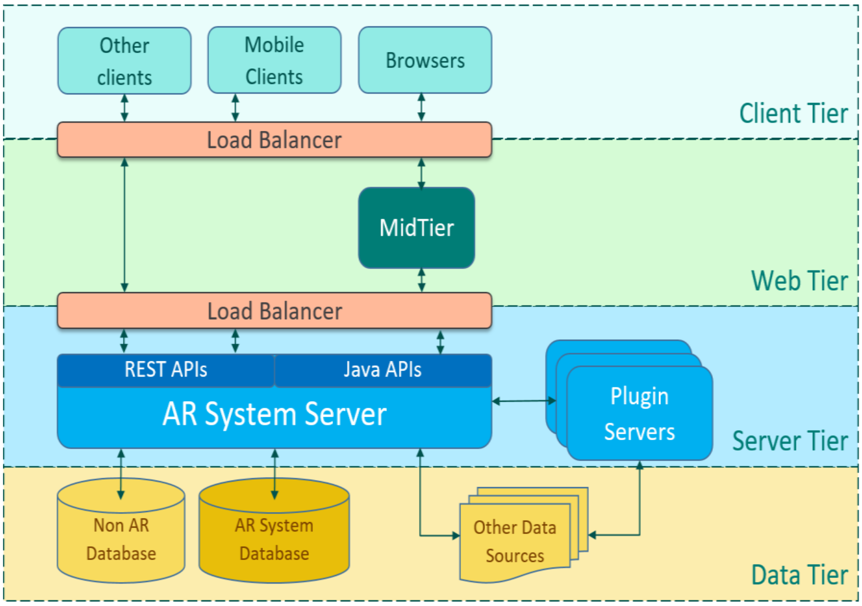
Augmented reality (AR) adds digital elements to a live view often by using the camera on a smartphone. ... In a Mixed Reality (MR) experience, which combines elements of both AR and VR, real-world and digital objects interact.

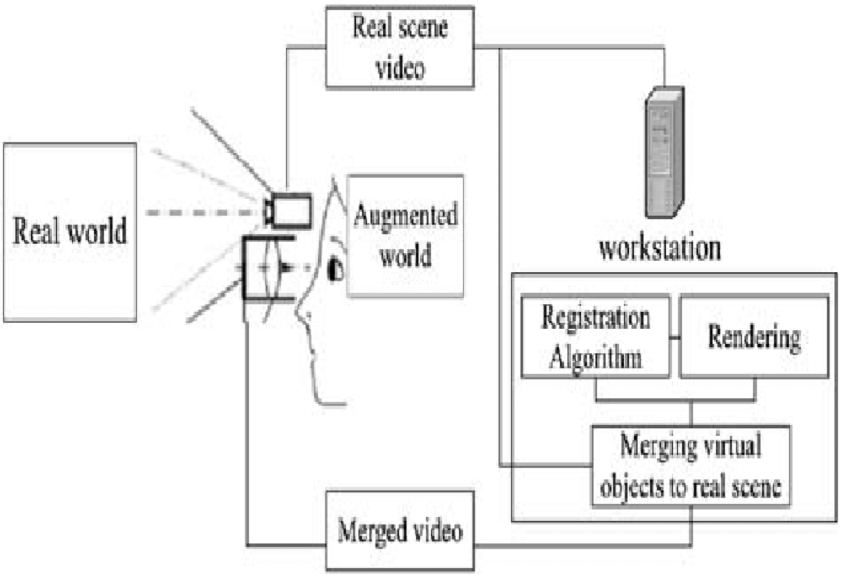
- In a Mixed Reality (MR) experience, which combines elements of both AR and VR, real-world and digital objects interact. Mixed reality technology is just now starting to take off with Microsoft’s HoloLens one of the most notable early mixed reality apparatuses.

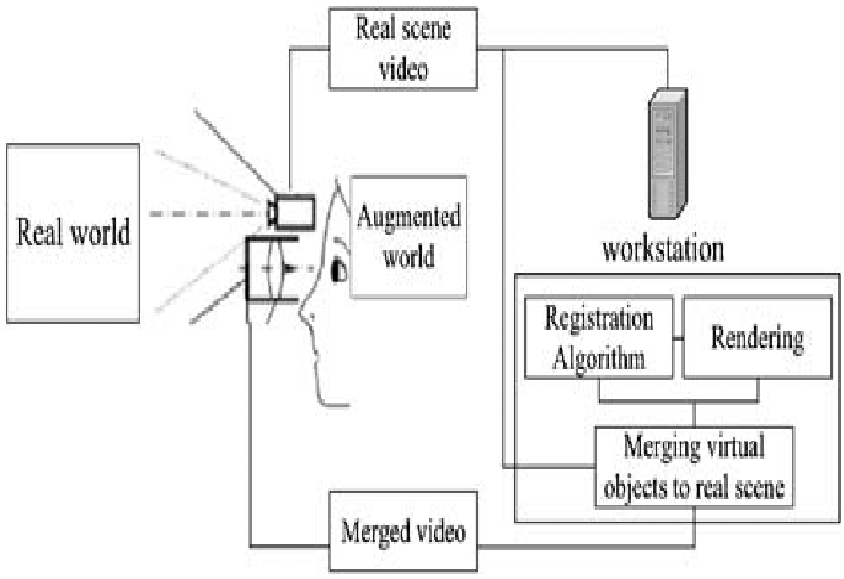
- Using Virtual Reality Technologies
  From gaming, to movies, to medicine, the uses for Virtual Reality, Augmented Reality, and Mixed Reality are expanding.
- Healthcare—For training, such as for surgical simulations
- Film and TV—For movies and shows to create unique experiences
- Virtual travel—For virtual trips to an art museum—or another planet—all from home
- Professional sports—For training programs like STRIVR to help pro and amateur athletes
- Gaming—For over 1,000 games already available, from first-person shooters to strategy games to role-playing adventures
- Augmented Reality (AR) can provide architects with the ability to digitally interact with their projects past the computer screen by merging a digital model over a physical space. AR creates a 3D version of the proposed model and places it over the physical reality in the project's real environment.

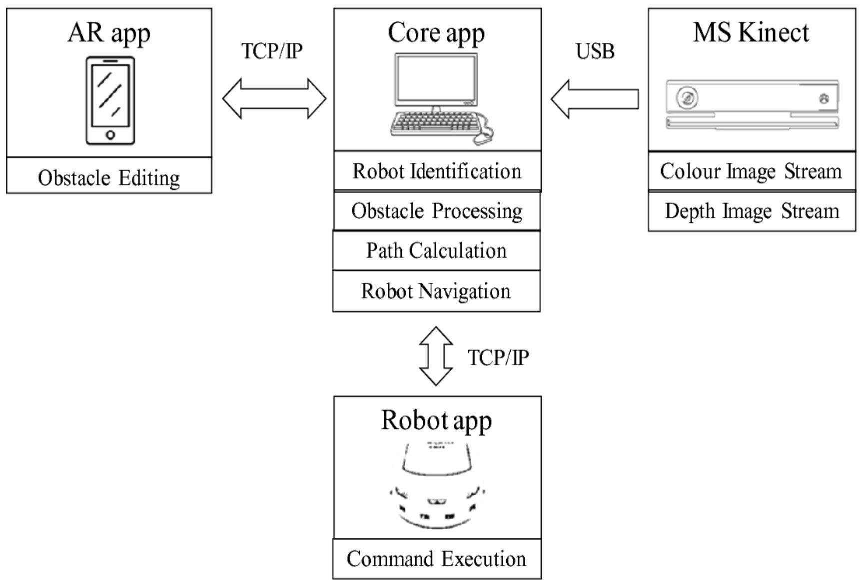
Architecture of AR systems

- There are many applications in the manufacturing sector waiting to be explored by augmented reality. These include predictive maintenance, streamlined logistics, more efficient product design and development, optimized assembly schedule and processes, and expert support with data management.


Other clients
Mobile Clients
Browsers
Client Tier
Load Balancer
MidTier
Web Tier
Load Balancer
REST APIs
Java APIs
AR System Server
Plugin Servers
Server Tier
Non AR Database
AR System Database
Other Data Sources
Data Tier


Real scene video
Real world
Augmented world
workstation
Registration Algorithm
Rendering
Merging virtual objects to real scene
Merged video





Augmented reality (AR) is an **interactive experience of a real-world environment** where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.

Virtual reality (**VR**) is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality include entertainment (e.g. video games), education (e.g. medical or military training) and business (e.g. virtual meetings). Other distinct types of VR-style technology include augmented reality and mixed reality, sometimes referred to as extended reality or XR.[1]

Currently, standard virtual reality systems use either virtual reality headsets or multi-projected environments to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual environment. A person using virtual reality equipment is able to look around the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality typically incorporates auditory and video feedback, but may also allow other types of sensory and force feedback through haptic technology.

Forms and methods

One method by which virtual reality can be realized is simulation-based virtual reality. Driving simulators, for example, give the driver on board the impression of actually driving an actual vehicle by predicting vehicular motion caused by driver input and feeding back corresponding visual, motion and audio cues to the driver.

With avatar image-based virtual reality, people can join the virtual environment in the form of real video as well as an avatar. One can participate in the 3D distributed virtual environment as form of either a conventional avatar or a real video. Users can select their own type of participation based on the system capability.

In projector-based virtual reality, modeling of the real environment plays a vital role in various virtual reality applications, such as robot navigation, construction modeling, and airplane simulation. Image-based virtual reality systems have been gaining popularity in computer graphics and computer vision communities. In generating realistic models, it is essential to accurately register acquired 3D data; usually, a camera is used for modeling small objects at a short distance.

Desktop-based virtual reality involves displaying a 3D virtual world on a regular desktop display without use of any specialized VR positional tracking equipment. Many modern first-person video games can be used as an example, using various triggers, responsive characters, and other such interactive devices to make the user feel as though they are in a virtual world. A common criticism of this form of immersion is that there is no sense of peripheral vision, limiting the user's ability to know what is happening around them.

A Omni treadmill being used at a VR convention.

A Missouri National Guardsman looks into a VR training head-mounted display at Fort Leonard Wood in 2015

A head-mounted display (HMD) more fully immerses the user in a virtual world. A virtual reality headset typically includes two small high resolution OLED or LCD monitors which provide separate images for each eye for stereoscopic graphics rendering a 3D virtual world, a binaural audio system, positional and rotational real-time head tracking for six degrees of movement. Options include motion controls with haptic feedback for physically interacting within the virtual world in an intuitive way with little to no abstraction and an omnidirectional treadmill for more freedom of physical movement allowing the user to perform locomotive motion in any direction.

Augmented reality (AR) is a type of virtual reality technology that blends what the user sees in their real surroundings with digital content generated by computer software. The additional software-generated images with the virtual scene typically enhance how the real surroundings look in some way. AR systems layer virtual information over a camera live feed into a headset or smartglasses or through a mobile device giving the user the ability to view three-dimensional images.

Mixed reality (MR) is the merging of the real world and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time.

A cyberspace is sometimes defined as a networked virtual reality.[5]

Simulated reality is a hypothetical virtual reality as truly immersive as the actual reality, enabling an advanced lifelike experience or even virtual eternity.

workshop oriented hands demo

- https://www.youtube.com/watch?v=oH_LfXnklRw
- https://www.youtube.com/watch?v=NOKJDCqvvMk

Module-6

Ethics, Professionalism and Other Emerging Technologies

Technology and ethics, Digital privacy, Accountability and trust, Treats and challenges. Other Technologies: Block chain technology, Cloud and quantum computing, Autonomic computing, Computer vision, Cyber security, Additive manufacturing (3D Printing).

Technology and Ethics

- Technology ethics is **the application of ethical thinking to the practical concerns of technology**. The reason technology ethics is growing in prominence is that new technologies give us more power to act, which means that we have to make choices we didn't have to make before.
- Types of Technology Ethics. Technology ethics are principles that can be used to govern technology including factors like risk management and individual rights. They are basically used to **understand and resolve moral issues** that have to do with the development and application of technology of different types.
- Businesses are faced with many ethical challenges, particularly when it comes to the use of technology. ... Ethical issues such as **how we treat others, use information, engage with employees, manage resources, approach sustainability, and impact the world around us** all affect how we view companies.
- **The following are common areas of technology ethics.**
- Access Rights. Access to empowering technology as a right or freedom.
- Accountability. The rules of accountability for decisions made by technology.
- Digital Rights. ...

- Environment. ...
- Existential Risk. ...
- Freedom. ...
- Health & Safety. ...
- Human Enhancement.
- Ethics in information technology is important because it **creates a culture of trust, responsibility, integrity and excellence in the use of resources**. Ethics also promotes privacy, confidentiality of information and unauthorized access to computer networks, helping to prevent conflict and dishonesty.
- One of the most immediate reasons why digital ethics are important is because **how we present, indeed construct our persona(s) effects the way in which our communication and intentions will be received**. The notion that individual ethics impact our arguments is nothing new.
- Access rights: access to empowering technology as a right·
- Accountability: decisions made for who is responsible when considering success or harm in technological advancements·
- Digital Rights: protecting intellectual property rights and privacy rights·
- Environment: how to produce technology that could harm the environment·
- Existential Risk: technologies that represent a threat to the global quality of life pertaining to extinction·
- Freedom: technology that is used to control a society raising questions related to freedom and independence·
- Health & Safety: health and safety risks that are increased and imposed by technologies
- Human Enhancement: human genetic engineering and human-machine integration

- Human Judgment: when can decisions be judged by automation and when do they acquire a reasonable human?
- Over-Automation: when does automation decrease quality of life and start affecting society?
- Precaution Principle: Who decides that developing this new technology is safe for the world?
- Privacy: protection of privacy rights
- Security: Is due diligence required to ensure information security?
- Self Replicating Technology: should self replicating be the norm?
- Technology Transparency: clearly explaining how a technology works and what its intentions are
- Terms of Service: ethics related to legal agreements.

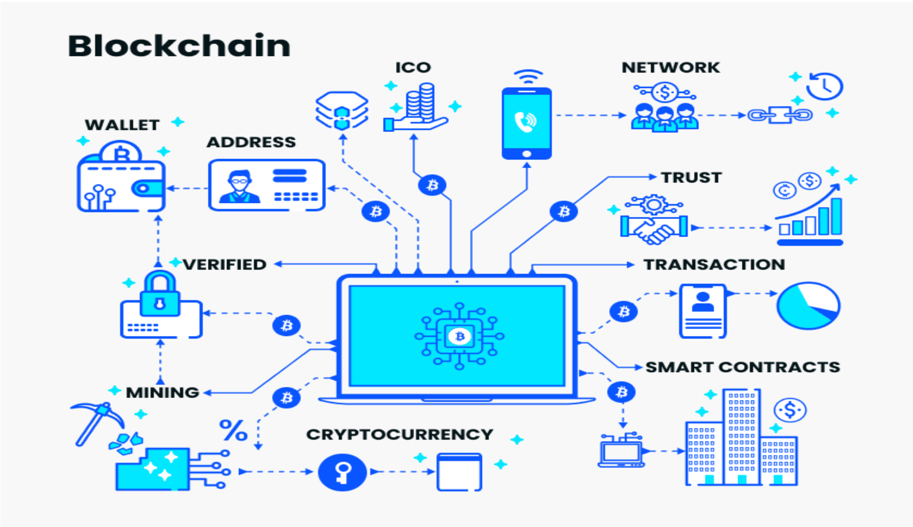
Current issues

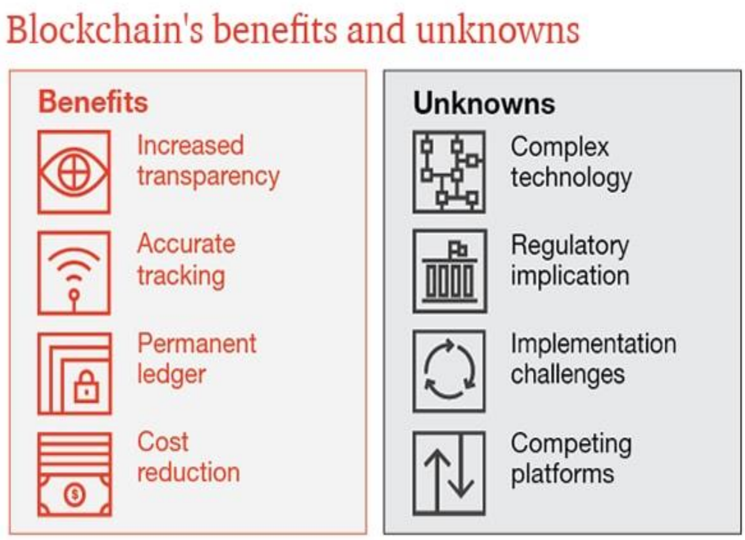
- Copyrights
- Cybercriminality
- Privacy vs Security: Full Body airport scanners
- Privacy and GPS technologies
- Genetically Modified Organisms
- Pregnancy Screening Technology
- Technology and Ethics in the Music Industry
- User Data
- Drones
- Pet cloning

Information and communications technologies (ICTs)

- organizations have seen an increase in the amount of technology that they rely on to communicate within and outside of the workplace. However, these implementations of technology in the workplace create various ethical concerns and in turn a need for further analysis of technology in organizations. As a result of this growing trend, a subsection of techno ethics known as organizational techno ethics has emerged to address these issues.

Other Technologies:



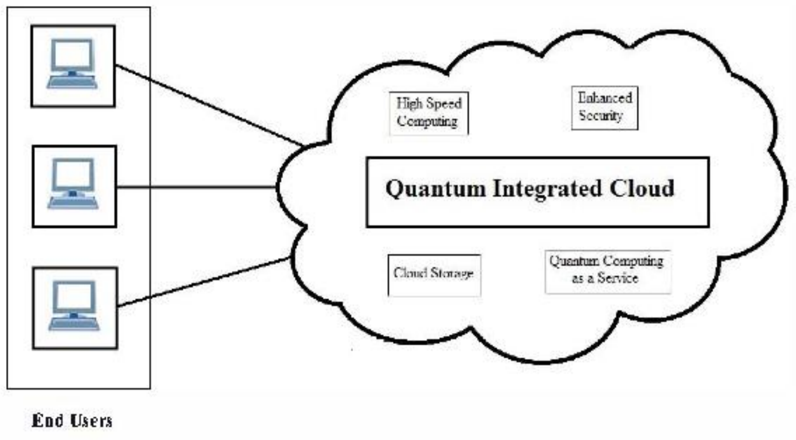


- Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved.
- **Why blockchain is important:**
- Business runs on information. The faster it's received and the more accurate it is, the better. Blockchain is ideal for delivering that information because it provides immediate, shared and completely transparent information stored on an immutable ledger that can be accessed only by permissioned network members.
- A blockchain network can track orders, payments, accounts, production and much more. And because members share a single view of the truth, you can see all details of a transaction end-to-end, giving you greater confidence, as well as new efficiencies and opportunities.

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.

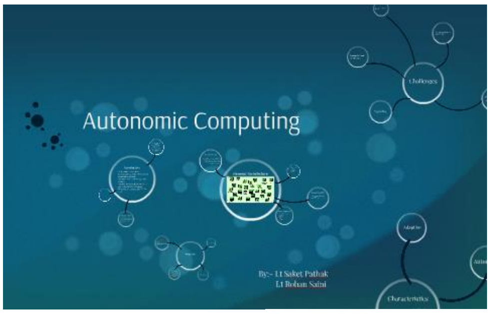
- The original **Blockchain** is open-source technology which offers an alternative to the traditional intermediary for transfers of the crypto-currency **Bitcoin**. The intermediary is replaced by the **collective verification of the ecosystem** offering a huge degree of traceability, security and speed.

Cloud and quantum computing



- Cloud-based quantum computing: is the invocation of quantum emulators, simulators or processors through the cloud. Increasingly, cloud services are being looked on as the method for providing access to quantum processing.

- Quantum computers achieve their massive computing power by initiating quantum physics into processing power and when users are allowed access to these quantum-powered computers through the internet it is known as quantum computing within the cloud.



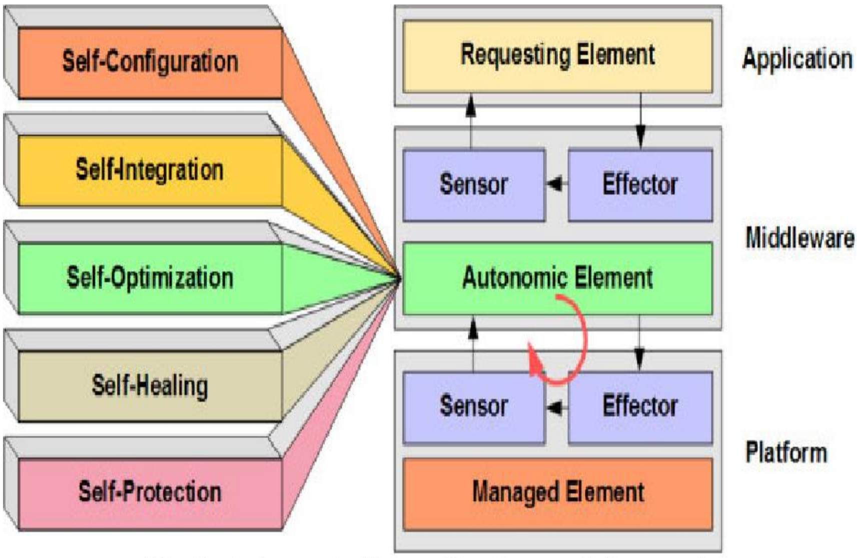


Fig 2: Autonomic Computing-Layered Approach

Autonomic computing is **a computer's ability to manage itself automatically through adaptive technologies** that further computing capabilities and cut down on the time required by computer professionals to resolve system difficulties and other maintenance such as software updates.

- Computer vision is a field of artificial intelligence (AI) that **enables computers and systems to derive meaningful information from digital images, videos** and other visual inputs — and take actions or make recommendations based on that information.
- Machine learning is **used in computer vision in the interpreting device and interpretation stage**. Relatively, machine learning is the broader field, and this is evident in the algorithms that can be applied to other fields. The fields most closely related to computer vision are image processing and image analysis.
- **Computer vision** is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos.

Cyber security

- Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. It's also known as information technology security or electronic information security. The term applies in a variety of contexts, from business to mobile computing, and can be divided into a few common categories.

- **Network security** is the practice of securing a computer network from intruders, whether targeted attackers or opportunistic malware.
- **Application security** focuses on keeping software and devices free of threats. A compromised application could provide access to the data its designed to protect. Successful security begins in the design stage, well before a program or device is deployed.
- **Information security** protects the integrity and privacy of data, both in storage and in transit.
- **Operational security** includes the processes and decisions for handling and protecting data assets. The permissions users have when accessing a network and the procedures that determine how and where data may be stored or shared all fall under this umbrella.
- **Disaster recovery and business continuity** define how an organization responds to a cyber-security incident or any other event that causes the loss of operations or data. Disaster recovery policies dictate how the organization restores its operations and information to return to the same operating capacity as before the event. Business continuity is the plan the organization falls back on while trying to operate without certain resources.

End-user education addresses the most unpredictable cyber-security factor: people. Anyone can accidentally introduce a virus to an otherwise secure system by failing to follow good security practices. Teaching users to delete suspicious email attachments, not plug in unidentified USB drives, and various other important lessons is vital for the security of any organization.

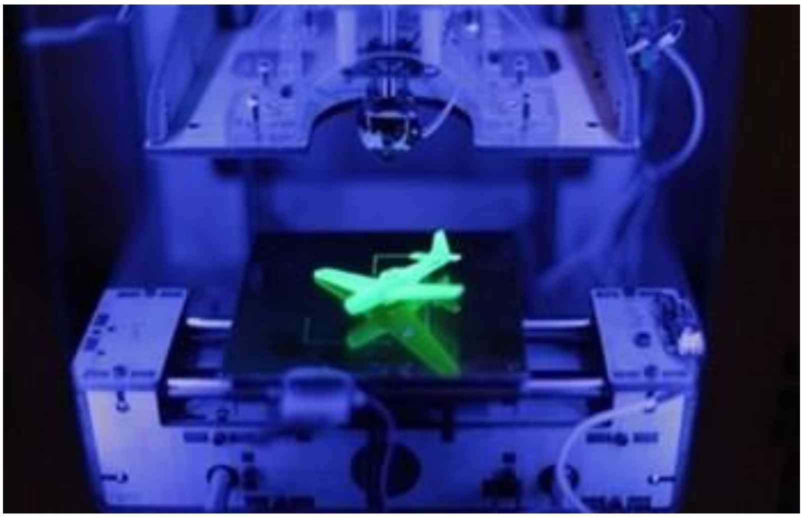
Types of cyber threats

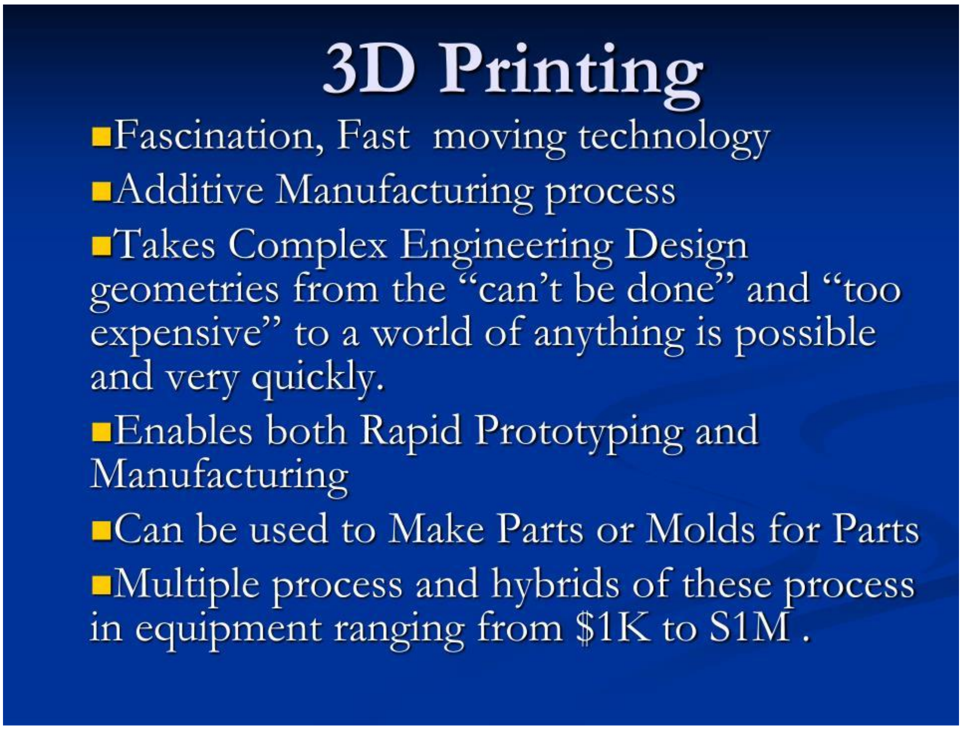
- Cybercrime
- Cyber-attack
- Cyberterrorism
- Malware: Malicious Software

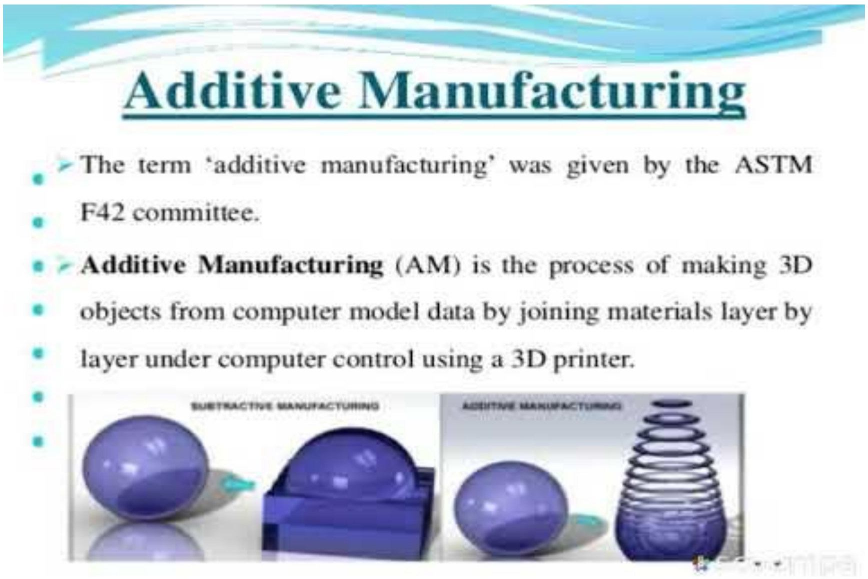
- Virus
- Trojans
- Spyware
- Ransomware
- Adware
- Botnets

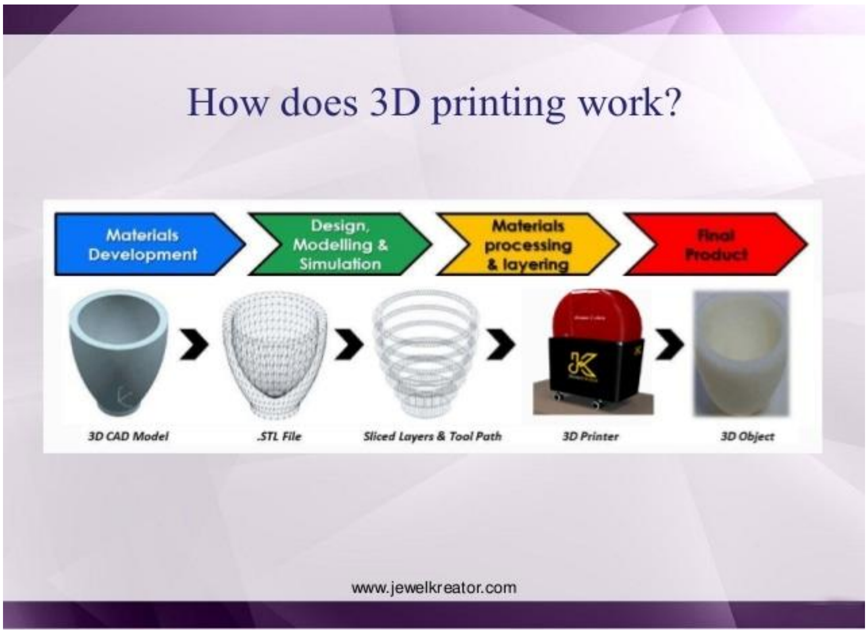
Additive manufacturing (3D Printing)

- 3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file.
- The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced cross-section of the object.
- 3D printing is the opposite of subtractive manufacturing which is cutting out / hollowing out a piece of metal or plastic with for instance a milling machine.
- 3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.




3D Printing
Fascination, Fast moving technology
Additive Manufacturing process
Takes Complex Engineering Design geometries from the "can't be done" and "too expensive" to a world of anything is possible and very quickly.
Enables both Rapid Prototyping and Manufacturing
Can be used to Make Parts or Molds for Parts
Multiple process and hybrids of these process in equipment ranging from $1K to S1M .





Advantages

- Flexible Design
- Rapid Prototyping

- Print on Demand
- Strong and Lightweight Parts
- Minimizing Waste
- Cost Effective
- Ease of Access
- Environment Friendly

Disadvantages

- Limited Materials
- Restricted Build Size
- Post Processing
- Large Volumes
- Reduction In Manufacturing Jobs
- Copyright Issues

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Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
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3	Augmented Reality and Virtual Reality: Empowering Human, Place and Business	Timothy Jung, M. Claudia tom Dieck	-	2019

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