[2nd SHIFT]

Artificial Intelligence

Textbook for CLASS 8

...the future is now

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Contents

Preface

The impact that Artificial Intelligence is having on our present day lives is already phenomenal. AI has made inroads into work places in practically all sectors and at a personal level–it influences what we buy, the kind of music we listen to, where we travel, what we read, what we watch...the list can go on. Artificial Intelligence has revolutionized the way we live and work.

It is important that young learners understand the relevance and importance of Artificial Intelligence. This book has been written as per the prescribed CBSE syllabus for Artificial Intelligence. It focuses on the required 21st century skills and is in keeping with the Government of India's New Education Policy (NEP)-2020 for students.

The topics covered in this book include an introduction to Artificial Intelligence, its usage in our daily lives as well as in practically all sectors of our economy, the benefits that mankind is accruing as a result of usage of AI, the human machine interaction and the understanding that AI is not a replacement but an extension of human capabilities. Students will learn about the domains of Artificial Intelligence, the impact that AI will have on achieving UN's Sustainable Development Goals and how AI can help in making the world a better place. Students will also learn about smart cities, smart schools and smart homes and the gadgets and technologies that make them "smart".

It is important that students gain an awareness of the kind of jobs that will be in demand in the coming years and what those jobs entail. It is not just technical skills that will be required for future jobs but soft skills too will play an important role for the future generations to be successful in their chosen careers–both of which have been discussed and covered.

Start-ups play an important role in the economy of a country- they are where novel innovations take place, they generate jobs, provide exciting learning opportunities to the young and contribute towards making a healthier economy. Case studies of successful start-ups in different industries have been included to give students an idea of growth trajectory of these start-ups and what contributed to their success.

As AI has now become integral to a large number of products and services, many organisations are developing AI code of ethics. These are important as they highlight the risks and benefits of AI-powered machines and gadgets and establish guidelines for their responsible use and development. The AI code of ethics provides stakeholders with guidance when faced with an ethical decision regarding the use of artificial intelligence and it is important that students get to know and appreciate ethical usage and development of AI as they will be the future users, creators and developers of this technology.

Rajiv Sodhi
Poonam Sodhi

Syllabus

CBSE | DEPARTMENT OF SKILL EDUCATION

CURRICULUM FOR CLASS VIII (INSPIRE MODULE)

OBJECTIVE OF THE MODULE

The objective of this module/curriculum is to develop a readiness for understanding and appreciating Artificial Intelligence and its application in our lives.

This module/ curriculum focuses on:

- Helping learners understand the world of Artificial Intelligence and its applications through games, activities and multi-sensorial learning to become AI-Ready.
- Introducing the learners to three domains of AI in an age appropriate manner.
- Allowing the learners to construct meaning of AI through interactive participation and engaging hands-on activities.

LEARNING OUTCOMES

Learners will be able to

- Identify and appreciate Artificial Intelligence and describe its applications in daily life.
- Relate, apply and reflect on the Human-Machine Interactions.
- Identify and interact with the three domains of AI: Data, Computer Vision and Natural Language Processing.
- Undergo assessment for analysing their progress towards acquired AI-Readiness skills.
- Imagine, examine and reflect on the skills required for the futuristic opportunities.
- Unleash their imagination towards smart homes and build an interactive story around it.
- Understand the impact of Artificial Intelligence on Sustainable Development Goals to develop responsible citizenship.
- Research and develop awareness of skills required for jobs of the future.
- Describe the potential ethical considerations of AI.
- Gain awareness about AI bias and AI access.
- Develop effective communication and collaborative work skills.

UNIT WISE DISTRIBUTION

UNIT	DURATION	PERIODS
1. Excite	02 Hours 40 Mins	4 Periods
2. Relate	02 Hours	3 Periods
3. Purpose	02 Hours	3 Periods
4. Possibilities	02 Hours	3 Periods
5. AI Ethics	03 Hours 20 Mins.	5 Periods
Total	**12 Hours**	**18 Periods**

DETAILED CURRICULUM

UNIT (INSPIRE)	ACTIVITY/SESSION	LEARNING OUTCOMES
1. EXCITE	**Session:** Introduction to AI and setting up the context of the curriculum	To identify and appreciate Artificial Intelligence and describe its applications in daily life.
	Ice Breaker Activity: Dream Smart Home idea Learners to design a rough layout of floor plan of their dream smart home.	
	Recommended Activity: The AI Game The AI Game Learners to participate in three games based on different AI domains. • **Game 1:** Rock, Paper and Scissors (based on data) • **Game 2:** Mystery Animal (based on Natural Language Processing - NLP) • **Game 3:** Emoji Scavenger Hunt (based on Computer Vision - CV)	To relate, apply and reflect on the Human-Machine Interactions. To identify and interact with the three domains of AI: Data, Computer Vision and Natural Language Processing.
	Recommended Activity: AI Quiz (Paper Pen/Online Quiz)	To undergo an assessment for analysing progress towards acquired AI-Readiness skills.
	Recommended Activity: To write a letter Writing a Letter to one's future self Learners to write a letter to self-keeping the future in context. They will describe what they have learnt so far or what they would like to learn someday.	To imagine, examine and reflect on the skills required for futuristic job opportunities.
2. RELATE	**Video Session: To watch a video** Introducing the concept of Smart Cities, Smart Schools and Smart Homes.	Learners' to relate to application of Artificial Intelligence in their daily lives.
	Recommended Activity: To write an Interactive Story Learners' to draw a floor plan of a Home/ School/ City and write an interactive story around it using the Story Speaker extension in Google docs.	To unleash their imagination towards smart homes and build an interactive story around it. To relate, apply and reflect on the Human–Machine interactions.
3. PURPOSE	**Session:** Introduction to UN **Sustainable Development Goals**	To understand the impact of Artificial Intelligence on Sustainable Development Goals to develop responsible citizenship.
	Recommended Activity: Go Goals Board Game • Learners to answer questions on Sustainable Development Goals	
4. POSSIBILITIES	**Session: Theme-based research and Case Studies** • Learners will listen to various case-studies of inspiring start-ups, companies or communities where AI has been involved in real-life. • Learners will be allotted a theme around which they need to search for present AI trends and have to visualise the future of AI in and around their respective theme.	To research and develop awareness of skills required for jobs of the future. To imagine, examine and reflect on the skills required for the futuristic opportunities. To develop effective communication and collaborative work skills.
	Recommended Activity: Job Ad Creating activity • Learners to create a job advertisement for a firm describing the nature of job available and the skill-set required for it 10 years down the line. They need to figure out how AI is going to transform the nature of jobs and create the Ad accordingly.	
5. AI ETHICS	**Video Session: Discussing about AI Ethics**	To understand and reflect on the ethical issues around AI.
	Recommended Activity: Ethics Awareness • Students play the role of major stakeholders and they have to decide what is ethical and what is not for a given scenario.	
	Session: AI Bias and AI Access • Discussing about the possible bias in data collection • Discussing about the implications of AI technology.	To gain awareness around AI bias and AI access.
	Recommended Activity: Balloon Debate • Students divide in teams of 3 and 2 teams are given the same theme. One team goes in affirmation to AI for their section while the other one goes against it. • They have to come up with their points as to why AI is beneficial/ harmful for the society.	To let the students analyse the advantages and disadvantages of Artificial Intelligence.

1 Introduction to Artificial Intelligence

In this chapter, you will learn about:

- *Meaning of Intelligence.*
- *Types of Intelligence.*
- *Meaning of Artificial Intelligence.*
- *Definition of Artificial Intelligence.*
- *Difference between Human and Artificial Intelligence.*
- *Need for adopting Artificial Intelligence technology.*
- *Advantages and Disadvantages of Artificial Intelligence.*

What Is Intelligence?

You might be regularly coming across the word "Intelligent" and probably have a general understanding of its meaning.

Intelligence is the ability to think, to learn from experience, to solve problems, and to adapt to new situations.

Human intelligence is the mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment. (Britannica)

Reasoning, planning, thinking abstractly, comprehending complex ideas, problem solving and learning from experience are all facets of human intelligence. Adaptation involves making a change in oneself in order to cope more effectively with the environment. It can also mean changing the environment or finding an entirely new environment.

In order to effectively adapt, an individual draws upon several cognitive abilities such as perception, learning, memory, reasoning, and problem solving. Intelligence, hence is not a single ability but is a combination of many abilities. There are widespread differences in every individuals' ability to reason, solve problems, and learn because of which there are differences in their ability to cope with demanding and challenging situations.

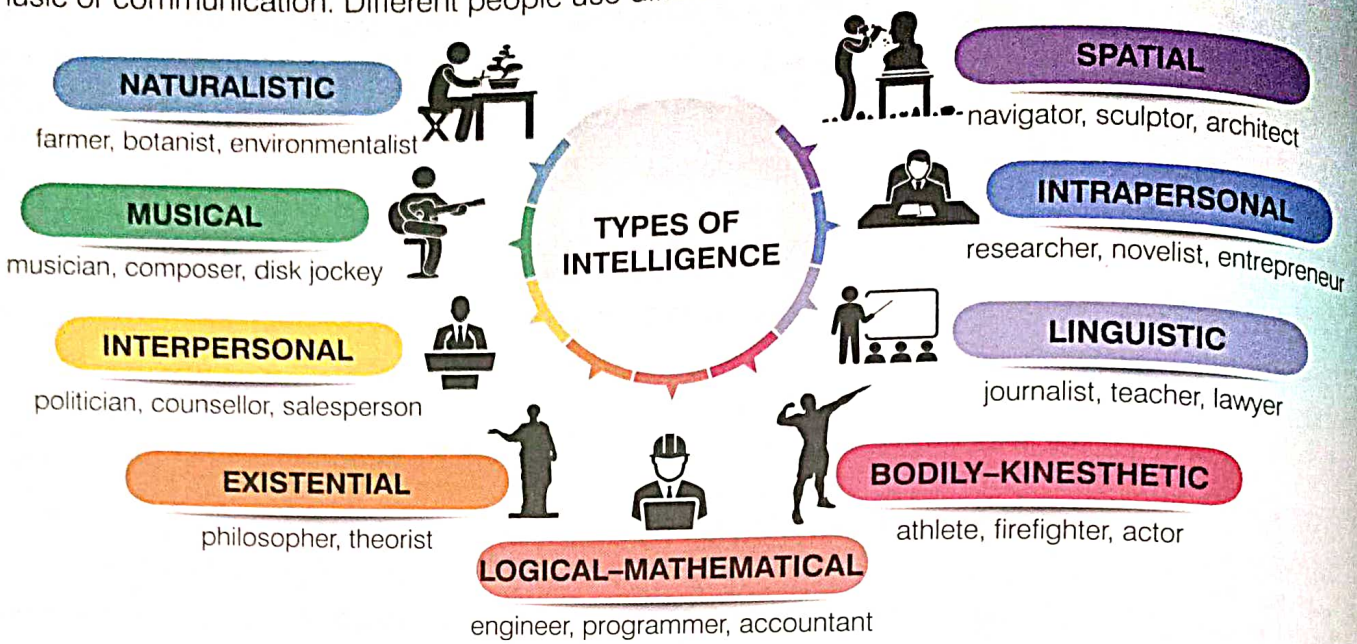
Types of Intelligence

Howard Gardner

Have you ever wondered why some people are better at sports, others better at mathematics, while some others better at painting, reading, or playing an instrument?

In the year 1983, Howard Gardner, a neuropsychologist proposed the existence of different types of intelligence. In his book "Frames of Mind" he postulated the Multiple Intelligences Theory and said that people do not have just one kind

of intelligence but multiple kinds which enables them to have a range of abilities and be skilled in different areas. Some people may be very good at logic and mathematics while others at sports, music or communication. Different people use different combinations of intelligences.



Logical-Mathematical Intelligence

Logical-Mathematical intelligence refers to the ability to analyse problems rationally, identify logical or numerical patterns, perform mathematical operations easily, think conceptually and reason well. People having logical mathematical are able to look for patterns and relationships between objects, classify objects, solve puzzles and perform mental math. They use critical thinking to solve problems and are able to propose innovative and logical solutions. They ask questions, propose hypotheses, experiment, and reach conclusions scientifically.

Logical-Mathematical Intelligence

- Seek order
- Reason scientifically
- Identify relationships
- Enjoy testing theories
- Like completing puzzles
- Excel at calculating numbers
- Solve problems instinctively
- Analyze abstract ideas
- Perform operations at a rapid rate

Career choices amongst those with high Logical-Mathematical intelligence include becoming scientists, mathematicians, engineers, accountants and programmers.

Linguistic Intelligence

Linguistic Intelligence refers to the ability to learn languages easily and use language effectively having good communication skills. People having strong Linguistic intelligence are good at learning different languages, are able to use language accurately to convey their meaning, enjoy reading and writing, have a good vocabulary, understand and follow grammar rules and are skillful writers and orators. They express their thoughts and feelings

through writing. They enjoy creative writing, writing songs, poems and stories, playing word games, telling jokes and stories and learning new languages.

Career choices amongst those with high Linguistic Intelligence include becoming editors, lyricists, writers, journalists, public speakers and teachers.

Spatial Intelligence

Spatial Intelligence refers to the ability to visualize with the mind's eye i.e. to be able to visualise objects from different angles and rotate, transform, and manipulate them, to solve spatial problems of navigation. It is the ability to think in three dimensions.

People having strong spatial intelligence can perceive the visual world accurately and perform modifications based on perception, are able to recognize and manipulate patterns, are good at spatial reasoning, mental imagery and artistic and graphic skills, and have a high awareness of their surrounding environments. They have a good sense of direction and are also good at solving puzzles, interpreting pictures, graphs and charts, reading maps, solving mazes and playing construction games.

Career choices amongst those with high Spatial Intelligence include becoming engineers, surgeons, painters, scientists, architects, pilots, sailors, chess players and artists.

Musical Intelligence

Musical Intelligence refers to the ability to discern pitch, rhythm, beats and tone. People with strong Musical Intelligence have an aptitude for learning and playing musical instruments, are able to recognize and create musical tones and rhythms and are able to express ideas and feelings through sound and music. They can easily learn songs and can identify the different instruments playing in a song. They are drawn to sound and enjoy singing and dancing. They have a good sense of rhythm and can easily detect incorrect pitches or if instruments are out-of-tune.

Career choices amongst those with high Musical Intelligence include becoming musicians, composers, band directors, music critics, music conductors, sound engineers, recording engineers and audiologists.

Beethoven, one of the greatest music composers, wrote his best pieces of music after going deaf. He said that he imagined the notes of every single instrument in the orchestra in his head.

Bodily-Kinesthetic Intelligence

Howard Gardner has defined Bodily-Kinesthetic Intelligence as, *"the ability to solve problems or create products using the body or parts. It is the intelligence of strength, endurance, flexibility, balance, dexterity, movement, expression, and body language."*

People with strong Bodily-Kinesthetic Intelligence are able to use the whole body to express ideas and feelings. They are good at body movement, performing actions, and physical control as well as excellent hand-eye coordination and dexterity. They remember by doing rather than seeing or hearing. They enjoy creating things with their hands. They have a good sense of timing and have very good control of automatic and voluntary movements, so they can use their body in a competent way to solve different problems. They are good at dancing, acting, imitating gestures and playing sports.

Career choices amongst those with high Bodily-Kinesthetic Intelligence include becoming dancers, professional athletes, builders, acrobats and sculptors.

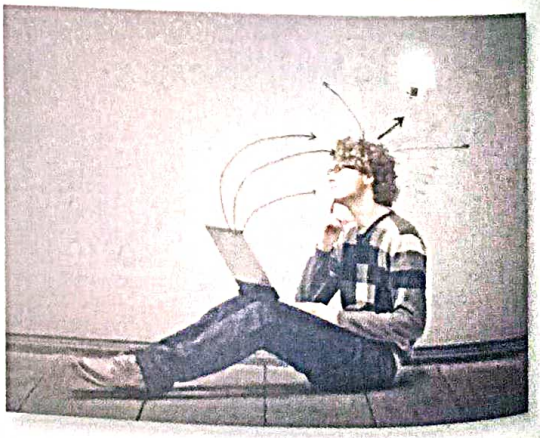
Interpersonal Intelligence

Interpersonal Intelligence refers to the ability to understand and interact effectively with others. People with strong Interpersonal Intelligence are sensitive to the moods, temperaments and feelings of others and easily empathize with others. They communicate well, work effectively in teams, help others and are good at managing relationships. They can look at situations from the perspective of different people and adapt accordingly. They are social and tend to make a lot of friends.

Career choices amongst those with high Interpersonal Intelligence include becoming politicians, teachers, therapists, diplomats, salespeople and negotiators.

Intrapersonal Intelligence

Intrapersonal Intelligence refers to the ability to explore one's inner world i.e., to be introspective and use that information about one's thoughts and feelings to guide decisions and actions. It is the ability to understand oneself. As people with strong Intrapersonal Intelligence are aware of their wishes, feelings, moods and expectations, they use that information to intelligently manage their lives. They are aware of their strengths and weaknesses. They are good at communicating and making better decisions under stressful situations as compared to those who do not possess a high level of intrapersonal intelligence. They set goals for themselves and focus on achieving them.



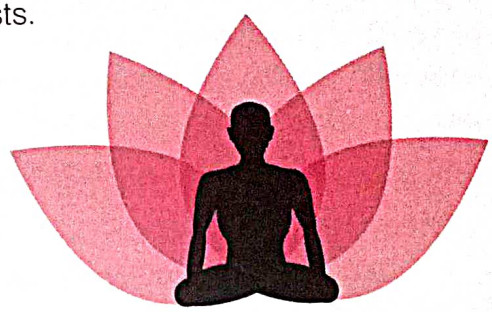
Career choices amongst those with high Intrapersonal Intelligence include becoming writers, therapists, spiritual leaders, guidance counsellors and philosophers.

Naturalistic Intelligence

Naturalistic Intelligence refers to the ability to appreciate, identify, categorize and classify patterns in the natural environment and connect the things of everyday life with nature. People with strong Naturalistic Intelligence have a sensitivity towards nature and appreciation for it. They are interested in the world of plants and animals and other objects in nature; like having animals around them and interacting with them. They can identify the variety that exists in the natural world and have a special sensitivity towards the environment. They have a natural curiosity to investigate their environment and are inspired and like being in contact with nature. They enjoy outdoor activities like camping, hiking, gardening and participating in activities to preserve the environment.

Career choices amongst those with high Naturalist Intelligence include working as horticulturists, botanists, conservationists, naturalists, geologists and agriculturists.

Existential Intelligence



Existential Intelligence refers to the ability to understand and contemplate philosophical topics relating to mankind's existence. People with strong Existential Intelligence focus on philosophical questions such as origin of mankind, what constitutes consciousness, meaning of life and man's purpose on earth. They reflect on their existence and think about the meaning of life, why we are born, why we die, what could happen after death and what is consciousness. They have the ability to use collective values and intuition to understand others and the world around them.

Career choices amongst those with high Existential Intelligence include becoming philosophers, counsellors, theologists and life coaches.

Artificial Intelligence

Artificial intelligence (AI) is defined as the intelligence of a machine or computer that enables it to imitate or mimic human capabilities. It is the simulation of human thinking by machines. AI-enabled machines mimic the way humans learn and solve complex problems.

Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks. The core idea of Artificial intelligence is to build machines and algorithms that are capable of performing computational tasks that would otherwise require human-like brain functions.

Artificial Intelligence-Definition

John McCarthy

The term Artificial Intelligence was coined by John McCarthy, an American computer scientist. He presented his definition of Artificial Intelligence at a conference on the campus of Dartmouth College, USA in the year 1956. He defined Artificial Intelligence as, *"The science and engineering of making intelligent machines, especially intelligent computer programs".*

Various organisations have defined Artificial Intelligence. Some of the definitions are:

Niti Aayog: National Strategy for Artificial Intelligence

AI refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem solving and decision-making. Initially conceived as a technology that could mimic human intelligence, AI has evolved in ways that far exceed its original conception. With incredible advances made in data collection, processing and computation power, intelligent systems can now be deployed to take over a variety of tasks, enable connectivity and enhance productivity.

World Economic Forum

Artificial intelligence (AI) is the software engine that drives the Fourth Industrial Revolution. Its impact can already be seen in homes, businesses and political processes. In its embodied form of robots, it will soon be driving cars, stocking warehouses and caring for the young and elderly. It holds the promise of solving some of the most pressing issues facing society, but also presents challenges such as inscrutable "black box" algorithms, unethical use of data and potential job displacement. As rapid advances in machine learning (ML) increase the scope and scale of AI's deployment across all aspects of daily life, and as the technology itself can learn and change on its own, multi-stakeholder collaboration is required to optimize accountability, transparency, privacy and impartiality to create trust.

European Artificial Intelligence (AI) leadership, the path for an integrated vision

AI is not a well-defined technology and no universally agreed definition exists. It is rather a cover term for techniques associated with data analysis and pattern recognition. AI is not a new technology, having existed since the 1950s. While some markets, sectors and individual businesses are more advanced than others, AI is still at a relatively early stage of development, so that the range of potential applications, and the quality of most existing applications, have ample margins left for further development and improvement.

Encyclopedia Britannica

Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.

Difference between Human Intelligence and Artificial Intelligence

Human intelligence is created by nature-God's gift—it is innate. Artificial Intelligence on the other hand is a man-made intelligence. Artificial intelligence as compared to humans is better at certain types of tasks that require simple rules and calculations. On the other hand, humans are better at other types of tasks such as those that require thinking, creativity, and critical thinking.

- Humans can perform multiple tasks simultaneously, while computers generally excel at performing one task well.
- Human brains contain a large number of interconnected neurons. Artificial Intelligence systems don't have these and instead rely on complex algorithms to process information.

- Humans can adapt to changes easily because of which people are able to learn and become good at various tasks. Artificial Intelligence systems need a lot of training and take much longer to adjust to new changes.
- Humans use the brain's memory, computing power and ability to think, whereas Artificial Intelligence-based systems depend on data and instructions that are fed into the system.
- Humans can process a limited amount of information in a given time period, having limited memories. Artificial Intelligence systems on the other hand, can process huge amount of information in a very short time.
- Artificial Intelligence systems can complete certain tasks faster and more accurately than humans can. They are also better at understanding complex patterns or structures.
- Human Intelligence relies on natural cognitive abilities such as intuition, creativity, empathy, reflexes, etc. Artificial Intelligence on the other hand, relies mostly on data processing power and rule-based programming.
- Humans may tend to be subjective whereas Artificial Intelligence systems are objective.
- Humans are social beings and have self-awareness and are sensitive to others' feelings. They are much better at social interactions as compared to Artificial Intelligence systems.
- Humans are versatile and can quickly adapt to changes. Artificial Intelligence systems on the other hand, need data and training to adapt to changes and take much longer.

Given below is a table of differences between Artificial intelligence and Human intelligence:

Human Intelligence Vs Artificial Intelligence

HUMAN INTELLIGENCE	ARTIFICIAL INTELLIGENCE
Possess innate intelligent	Created by human intelligence
Human brain is analogous	Artificial Intelligence is digital
Good at multitasking	Good at excelling in one task. Can't multitask that well
Process information through interconnected neurons in the brain	Use complex algorithms to process information
Adapt easily to changes	Take much longer to adjust to changes
Use their brain's memory, computing power and ability to think along with other cognitive skills, to solve problems	Depend only on data and instructions fed to them to solve problems
Can process limited information in a given time period	Can process large amount of information much faster in a shorter time period
Good social skills	Below average social skills
Use many skills to make decisions and solve problems	Only use logic to solve problems
May be subjective	Objective
Process information slower	Process information faster
Learn from past mistakes	Can't learn on their own from past mistakes but learn from data fed and training
Can handle limited amount of data	Can handle a lot more data than humans

Need for Adopting Artificial Intelligence Technology

Artificial intelligence technology offers several benefits some of which are:

- ***AI adds intelligence to existing products.***

  Many products that are already in use, are improved with integration of AI technology. For example: Netflix offers users personalized movie recommendations. It makes use of AI, Machine Learning and Data to study the watch history of a particular user and matches it with the movie preferences of others who have similar taste in movies. Another example is Siri- Apple's personal assistant, which was added as a feature to the existing Apple products.

- ***AI automates repetitive learning.***

  AI performs high-volume, computerized tasks with accuracy and without any fatigue.

- ***AI systems get smarter with each successful round of data processing.***

  As the data processing happens much faster with AI than with humans, AI systems become experts much faster than humans, making them a very good option for aiding data-related decision-making.

- ***In a number of different applications, AI systems are capable of significantly outperforming humans.***

  For many applications, in a number of cases, computers are processing like humans but at much faster speeds and with much more processing power than the human brain can produce. This is why, AI technology has become so important.

- ***AI gets the most out of data.***

  Data is a very valuable asset for any business. It empowers one to make informed decisions. AI algorithms when applied to data, help in identifying trends and extracting insights from complex data sets. Analysis obtained from AI is far more detailed and relevant than would be possible otherwise.

Advantages of Artificial Intelligence

Some of the main advantages of Artificial Intelligence are:

Perform repetitive and tedious jobs: Many repetitive and tedious jobs can be carried out by Artificial intelligence, thereby enabling people to have time to focus on other tasks.

24x7 availability: Unlike humans, AI systems can work 24x7 continually without any break.

High accuracy and speed along with less errors: With proper programming, AI systems are prone to less errors and have a high level of speed and accuracy.

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

Useful for risky areas: AI machines can be deployed in places which are risky for humans such as defusing a bomb, exploring the ocean floor, etc.

Unbiased decisions made by logic: Decisions made by humans may be biased as they tend to be influenced by their attitudes, beliefs, perceptions and emotions. AI on the other hand, is

practical, rational and lacks emotions—which enables more accurate decision-making.

Digital Assistants for businesses: Many businesses use AI-powered chatbots or voice bots to answer questions posed by their clients on their websites, reducing the need for human intervention.

Usage in day-to-day life: The applications that we use on our mobile phones and websites are AI based. AI is being used in practically all fields, be it education, medicine, entertainment, space exploration, e-commerce, transportation, aviation, finance, agriculture and many others.

Ground-breaking research and innovations: AI has enabled a number of ground-breaking research. Many latest innovations have been possible because of usage of AI tools.

Disadvantages of Artificial Intelligence

While Artificial Intelligence offers several advantages, it has certain disadvantages too. Some of the disadvantages of AI are:

High Implementation Cost: The hardware and software required for AI is very costly. It requires maintenance and needs to stay updated in order to be current and meet the latest requirements.

Lack of creativity: The AI machines can only do the tasks for which they have been trained or programmed. Unlike humans, AI can't think out of the box. Increase dependency on machines: With the continuing increase in availability of devices and technology powered by AI, people are getting more dependent on them and there is a danger of humans becoming lazy.

Causing Unemployment: While AI will be creating many jobs, artificial intelligence may also result in some job losses. The need for human interference is decreasing with the usage of AI-enabled machines.

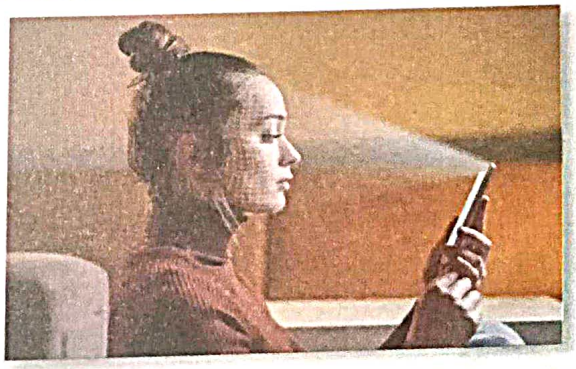
Requirement for large amount of data: Effectiveness of AI is dependent on the quantity and quality of its data. In the absence of proper data, the results given by AI will not be accurate.

Lack understanding of Ethics: It is difficult to incorporate ethics and morality in AI.

Lack of emotions: AI lacks emotions and cannot make any kind of emotional attachment with humans. The ability to bond with people, which is crucial for team management, cannot be replicated by machines.

Application of Artificial Intelligence in Daily Life

Artificial intelligence has a wide range of applications in our daily lives. It has enabled us to simplify our lives by saving us time, money and effort. Some examples of artificial intelligence that we generally come across in our daily lives but may not be aware that they are driven by AI are as under:



Facial Recognition

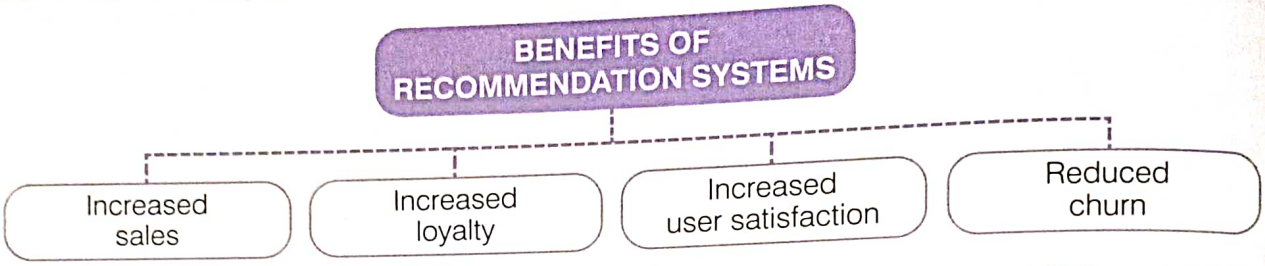
Many of the devices that we use such as mobile phones, laptops and computers use facial recognition techniques by using face filters to detect and identify before unlocking, in order to provide secure access.

Google Maps

Travelling to a new place is no longer confusing as we can open our phone's map app and type in our destination. The app shows the directions, the best and shortest route as well as where the traffic jams are. The app's algorithm uses AI.

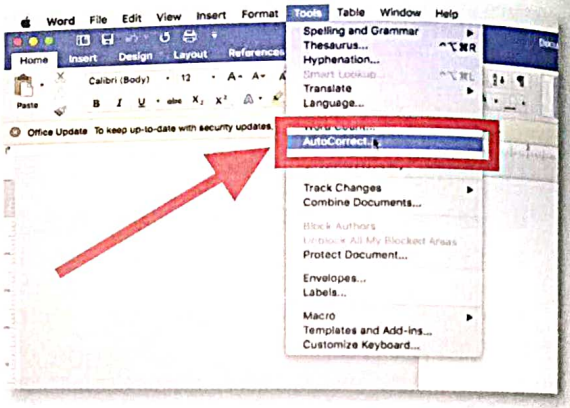
Recommendation System

Several platforms such as e-commerce, entertainment websites, social media, YouTube, etc., all use the recommendation system to get user data and accordingly provide customized recommendations to users to increase engagement. This is an AI application.



Autocorrect

When typing a document, there are inbuilt auto-correcting tools for correcting spellings and grammatical mistakes. Artificially intelligent algorithms detect incorrect language usage and make appropriate recommendations for change.



Online Interaction with banks and online-payments

Artificial Intelligence is used by banks to facilitate customers by enabling them to make online payments and completing other banking tasks online instead of them having to physically go to banks to deposit cheques, withdraw cash and perform many other bank related tasks.

The automatic emails we get from banks if we make an ordinary transaction, is an example of AI being at work. AI keeps an eye on our account and tries to alert us if it suspects any potential fraud.

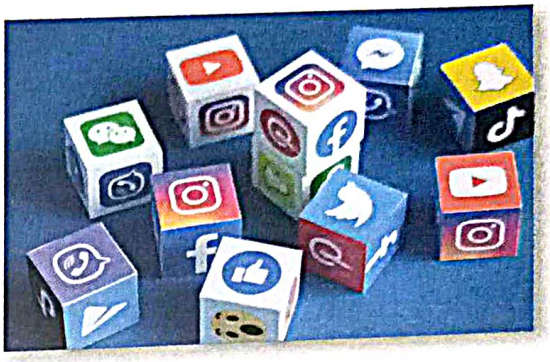
Spam Filters

The email that we use in our day-to-day lives has AI which filters out spam emails and sends them to the spam folder, so that we only get the filtered emails

Smart Home Devices

Most of the smart home gadgets we purchase use artificial intelligence to learn our habits and automatically change settings as per our preferences. For example: There are smart thermostats that change the temperature-dependent on our preferences, smart lights which change the colour and intensity of lights dependent on time, and much more. Voice assistants such as Siri or Alexa are used to control the smart home gadgets.

Social Media



AI customizes what we see on our social media accounts such as on Facebook, Twitter, Instagram, etc. AI also makes friends' recommendations and recognizes and filters out fake news.

EXERCISES

I. Multiple Choice Questions

1. **Differences in each individual's ability to cope with demanding and challenging situations is due to differences in their ability to:**
   - (a) reason ☐
   - (b) solve problems ☐
   - (c) learn ☐
   - (d) all the above ☐
2. **Howard Gardner, a neuropsychologist postulated the theory of:**
   - (a) Multiple Intelligences ☐
   - (b) General Intelligence ☐
   - (c) Emotional Intelligence ☐
   - (d) Fluid Intelligence ☐
3. **Persons having a high level of which intelligence are likely to be sensitive to the moods, temperaments and feelings of others:**
   - (a) Spatial Intelligence ☐
   - (b) Linguistic Intelligence ☐
   - (c) Interpersonal Intelligence ☐
   - (d) Intrapersonal Intelligence ☐
4. **Persons having a high level of which intelligence are likely to be good at using language effectively and having good communication skills:**
   - (a) Spatial Intelligence ☐
   - (b) Linguistic Intelligence ☐
   - (c) Musical Intelligence ☐
   - (d) Intrapersonal Intelligence ☐

5. Who coined the term "Artificial Intelligence"?

(a) Marvin Minsky ☐ (b) Jürgen Schmidhub

(c) Allen Newell ☐ (d) John McCarthy

6. Artificial Intelligence systems rely on _____ to process information.

(a) neurons ☐ (b) complex algorithms

(c) humans ☐ (d) intuition

7. Artificial Intelligence is:

(a) analogous ☐ (b) digital

(c) good at multi-tasking ☐ (d) good at adapting easily to changes

II. True or False

1. Different people use different combination of intelligences.

(a) True (b) False

2. Artificial Intelligence aims to develop intelligent machines.

(a) True (b) False

3. People having a high level of Spatial Intelligence are likely to be good at reading social cues.

(a) True (b) False

4. Human intelligence is innate.

(a) True (b) False

5. Artificial Intelligence systems are versatile and can quickly adapt to changes.

(a) True (b) False

6. Artificial Intelligence systems lack understanding of ethics.

(a) True (b) False

III. Answer the following questions:

1. What is Intelligence?
2. What are the different types of intelligences as proposed by Howard Gardner? Explain them briefly.
3. Who coined the term "Artificial Intelligence"?
4. Give any four differences between human and artificial intelligence.
5. Name any three benefits that artificial intelligence technology offers.
6. Briefly explain any three applications of Artificial Intelligence that we use in our daily lives.

ACTIVITY 1

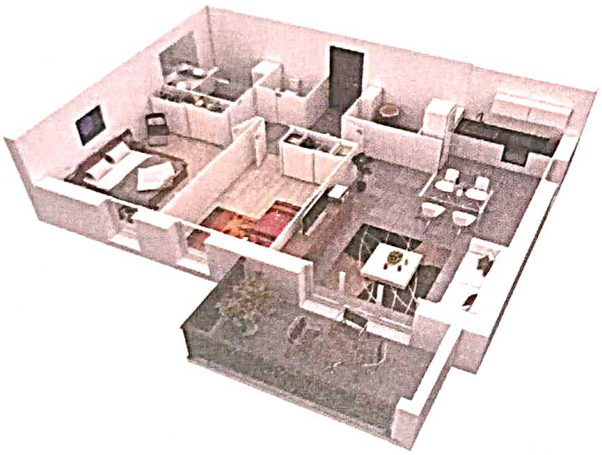
Type out a small document in "Microsoft Word" while deliberately making some spelling and grammatical mistakes. Observe whether the inbuilt auto-correcting tool corrects your spellings and grammatical mistakes.

ACTIVITY 2

How does artificial intelligence help you in your daily life? Fill in your ideas in the chart given below:

ACTIVITY 3

Given below is a 3 D image of a typical home.



Our homes for all of us are special. You must be having thoughts about how you would like your dream home to be. Would you like a special play room for yourself—where you may place board games, have a table tennis table or else have a library containing a collection of books of all your favourite authors? If you are fond of gardening, you may be wanting a garden where you would plant the flowers of your choice. If you had to design your home, what would your home look like? What are the smart gadgets and luxuries that you would include.

Put down your ideas and draw a floor plan of your dream home. Include any gadgets and devices that you think would make your home "smart".

ANSWERS

I. Multiple Choice Questions

1. (d) 2. (a) 3. (c) 4. (b) 5. (d) 6. (b) 7. (b)

II. True or False

1. (a) 2. (a) 3. (b) 4. (a) 5. (b) 6. (a)

2

History of Artificial Intelligence

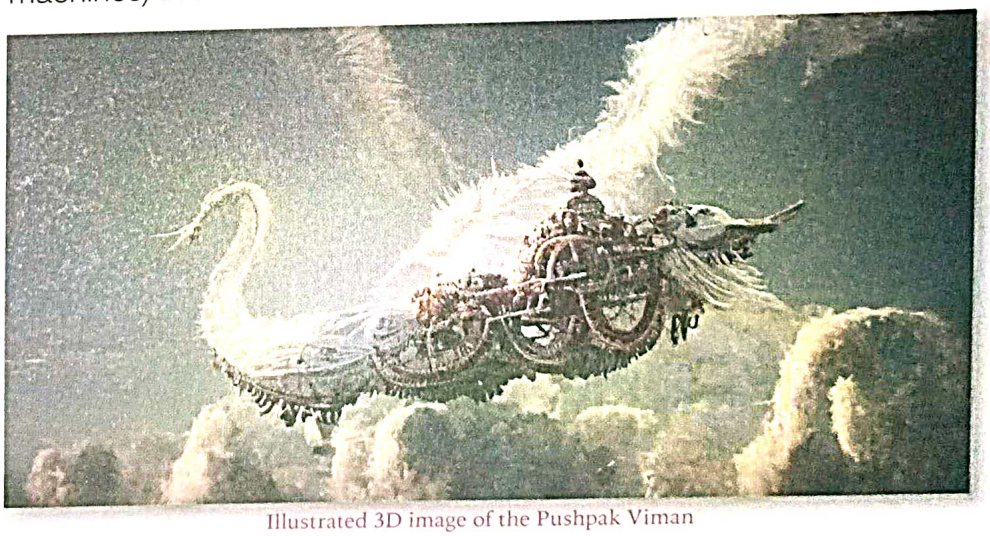
In this chapter, you will learn about:

- *Beginning of the study of Artificial Intelligence*
- *A Timeline of Important Developments in Artificial Intelligence*
- *Artificial Intelligence from 1900 to 1950*
- *Artificial Intelligence in 1950's*
- *The Golden Years – Early Enthusiasm (1956-1974)*
- *The First AI Winter (1974-1980)*
- *Artificial Intelligence in 1980's*
- *The Second AI Winter (1987-1993)*
- *The Emergence of Intelligent Agents (1993-2011)*
- *Big Data, Advanced Machine Learning (Year 2012 till date)*
- *AI Today*

Beginning of the Study of Artificial Intelligence

The concept of Artificial Intelligence is not new and can be traced back to ancient times where there were myths and stories of artificial beings endowed with intelligence or consciousness. These ancient cultures imagined futuristic technologies and there have been many references in mythology about automation and self-moving machines - mechanical men, which is the modern-day equivalent of robots. The giant bronze automaton (robot) "Talos" is a popular example. Talos was made to protect the Greek city of Europa from the attacks of pirates and invaders. He circled the island's shores three times daily.

Many stories exist in the Ramayana, Mahabharata, and other epics that mention automation and mechanised men. In Hindu myths, automatons were made by the engineer god Vishwakarma. *Pushpak Vimana* was the magical flying craft mentioned in Hindu mythology. Another tale describes the automated and robotic soldiers designed and crafted after Buddha's death by the *King Ajatasatru*, to protect Buddha's bodily remains. The King used automatons to guard. These automatons were called as the *bhuta vahana yantra* (spirit movement machines) in the form of humanoid and animals.

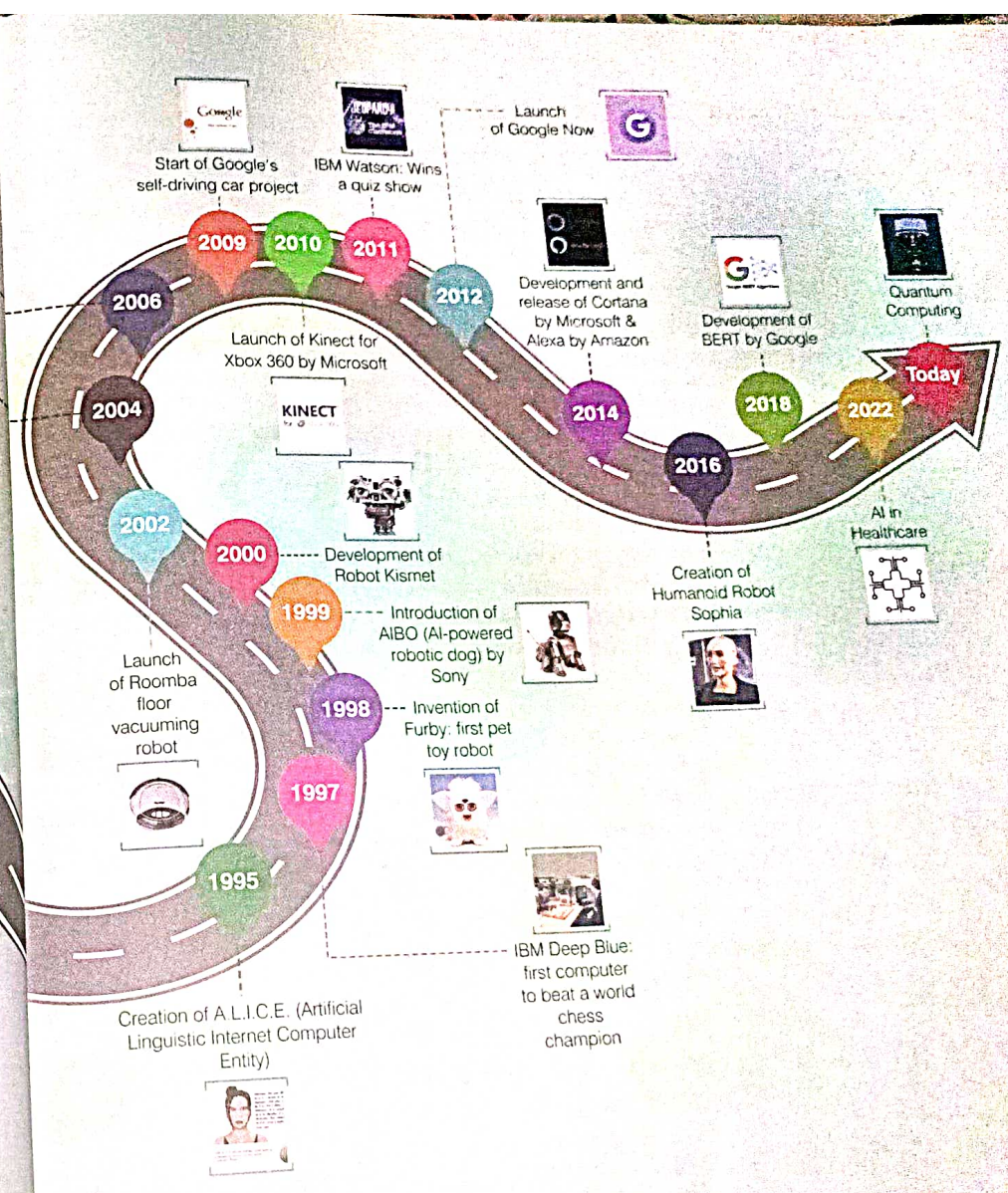


Illustrated 3D image of the Pushpak Viman

Over the centuries, humans have had the idea of human-like objects with a mind of their own. Artificial Intelligence can be considered to be inspired from the robots and automations of earlier eras.

A Timeline of Important Developments in Artificial Intelligence

Over the past several centuries, various theologists, mathematicians and philosophers mused about the concept of artificial Intelligence wherein they thought and wrote about mechanical techniques, calculating machines and many other gadgets that all led to the concept of incorporating human thought in non-human beings.



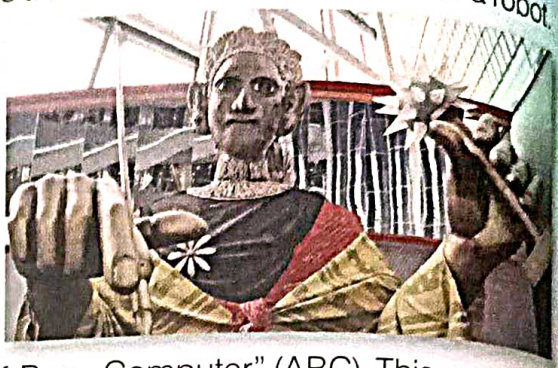
Artificial Intelligence from 1900 to 1950

Year 1921

Karel Čapek, a Czech playwright, released his science fiction play "Rossum's Universal Robots" (English translation). His play explored the concept of factory-made artificial people whom he called "robots." This was the first known reference to the word "robot."

Year 1927

The science fiction film titled "Metropolis" featured a robotic girl called Maria. This robotic girl physically looked just like her human counterpart. This film was the first on-screen depiction of a robot.



Year 1929

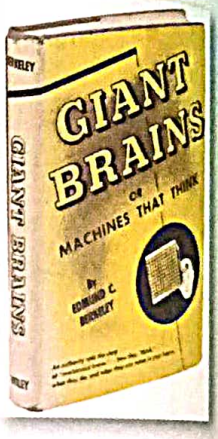
Makoto Nishimura, a Japanese professor created "Gakutensoku", the first robot to be built in Japan. The robot could move his head and hands as well as change his facial expressions.

Year 1939

John Vincent Atanasoff and Clifford Berry created "Atanasoff-Berry Computer" (ABC). This computer weighed 700-pounds. It could solve 29 simultaneous linear equations.

Year 1949

Edmund Berkeley in his book, "Giant Brains: Or Machines That Think" mentioned the memorable phrase "a machine, therefore, can think." Berkeley wrote, *"These machines are similar to what a brain would be if it were made of hardware and wire instead of flesh and nerves. It is, therefore, natural to call these machines mechanical brains. Also, since their powers are like those of a giant, we may call them giant brains."*



Artificial Intelligence in 1950's

Year 1950

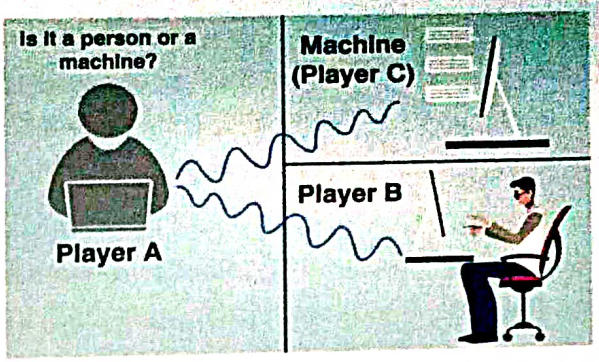
Alan Turing, a British mathematician, explored the mathematical possibility of artificial intelligence. He said that if humans use available information, along with reason in order to solve problems and make decisions — then why can't machines also do the same thing?

Turing wrote a paper titled, *"Computing Machinery and Intelligence"* on the topic of Artificial Intelligence, in which he proposed the idea of "The Imitation Game." This proposal later became the "Turing Test." The Turing Test is a game to determine whether a machine can demonstrate human intelligence. It is a three-person game in which a computer uses written communication to try to fool a human interrogator into thinking that it is another person. If the computer can engage in a conversation with a human without being detected as a machine, it has demonstrated human intelligence.

The Turing Test:

In this test, one person, player A, plays the role of an interrogator. The human interrogator (player A)

is isolated from the other two players. The interrogator poses written questions to players B and C who are in a different room. Of B and C, one is human and the other is a computer. The interrogator is aware of that one of the players is the computer. The conversation between all players is via a keyboard and a screen. The objective is for the interrogator to determine which player is the computer on the basis of questions and their responses. If the computer succeeds in "fooling" the interrogator into thinking its responses were generated by a human, it passes the Turing test. However, no computer till date has passed the Turing test but of late some have come close to it.



Year 1950

Claude Shannon, "the father of information theory," published a paper titled "Programming a Computer for Playing Chess." It was a first article to discuss the development of a chess-playing computer program. The article describes how a machine or computer could be made to play a reasonable game of chess. In recognition of Shannon's numerous contributions to the field of information theory, an award has been instituted called the Claude E. Shannon Award. It is the highest honour in the field of information theory.


Chapter XI on "The Electronic Chess Player" explains how Dr. Claude E. Shannon of the Bell Telephone Laboratories "programs" an electronic or a mechanic computer for chess play—and his conclusions in regard to the ability of a "chess robot."

Still photo by Dr. B. Lasker (right)

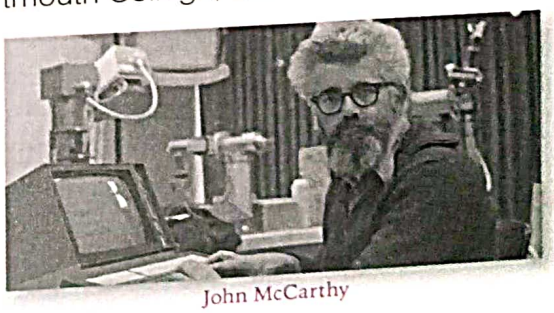
Year 1952

Arthur Samuel, a computer scientist, developed a checkers playing computer program.

Year 1956

The term ***"Artificial Intelligence"*** was coined by ***John McCarthy*** who presented his definition of Artificial Intelligence at a conference on the campus of Dartmouth College, USA in the year 1956.

McCarthy defined Artificial Intelligence as "the science and engineering of making intelligent machines." This conference, led by John McCarthy, defined the scope and goals of AI. The Dartmouth College conference was the beginning of AI research. John McCarthy together with ***Alan Turing, Marvin Minsky, Allen Newell, and Herbert A. Simon***, are considered to be the ***"founding fathers"*** of Artificial Intelligence.


John McCarthy

The Golden Years – Early Enthusiasm (1956-1974)

During this period, rapid advances were made in the sphere of AI. AI became an established body of scientific research, along with industrial applications. Storage capabilities of computers increased, and they also became faster and cheaper.

Advancements were made in AI programming by scientists and researchers. The success of AI le to the important research universities such as MIT, Stanford, University of Edinburgh, and Carneg Mellon receiving grants of millions of dollars.

Arthur Samuel

Year 1958

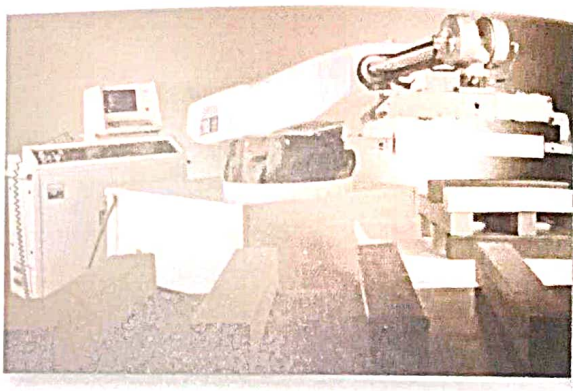
John McCarthy developed the programming language "LISP" for artificial intelligence research. LISP still continues to be used and remains a popular programming language.

Year 1959

Arthur Samuel, an American pioneer in the field of computer gaming and artificial intelligence coined the term ***"machine learning"***. He defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed."

Year 1961

The American inventor George Devo, designed the first industrial robot. It was called "Unimate." Unimate was installed on an assembly line for the first time at a General Motors die casting plant in Trenton, New Jersey. It was employed in such tasks as welding parts to the car body and transporting die castings - tasks that were dangerous for humans. Unimate revolutionized manufacturing all over the world.



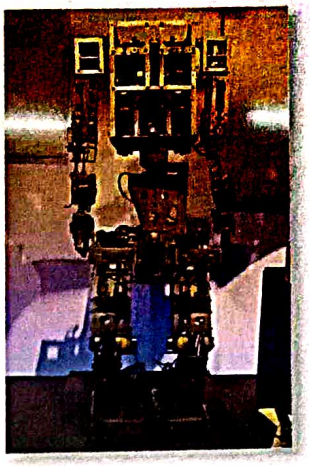
Year 1966

ELIZA, the first chatbot (an interactive chat-based computer program) was created at the MIT Artificial Intelligence Laboratory by Joseph Weizenbaum. ELIZA operates by recognizing key words or phrases from the input to reproduce a response using those keywords from pre-programmed responses. For example: If a person says, "My sister is a good artist." ELIZA would pick up the word 'sister' and respond by asking an open-ended question such as 'Tell me more about your family.' This created an illusion of understanding, and the person would feel that he was having an interaction with a real human being, even though the process was a mechanized one.

Year 1968

2001: A Space Odyssey is a science fiction film produced and directed by Stanley Kubrick. HAL (Heuristically programmed ALgorithmic computer) is an artificial intelligence computer that controls the systems of the spacecraft and interacts with the ship's astronaut crew as if it were human. A malfunction causes HAL's interaction to become "negative." This movie led to a debate over the risks created by the development of super intelligence and the potential of AI as a threat to humans.

Year 1972



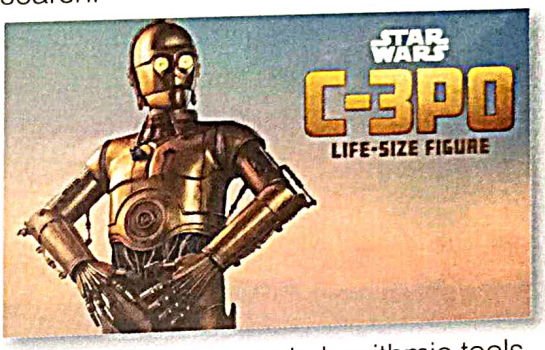
The first intelligent humanoid robot was developed in Japan at the Waseda University. It was named WABOT-1. It consisted of a limb-control system, a vision system, and a conversation system. The WABOT-1 was able to communicate with a person in Japanese. It was also able to measure distances and directions to the objects using external receptors, artificial ears and eyes, and an artificial mouth.

The WABOT-1 walked with his artificial lower limbs and was able to grip and transport objects with artificial hands that used tactile-sensors.

The First AI Winter (1974-1980)

The duration between 1974-1980 was known as The First AI Winter. This refers to the time period during which there was reduced interest in AI research. Computer scientists had to deal with a severe shortage of funding from the key funding organizations for research.

Year 1977



The film "Star Wars" was released. The film features C-3PO, a humanoid robot who is designed as a protocol droid and is "fluent in more than seven million forms of communication."

Artificial Intelligence in 1980's

In the 1980s, AI research picked up pace again owing to increased funding and algorithmic tools. Governments as well as industrial establishments started funding AI research once again with billions of dollars. "Deep learning" techniques which allowed computers to learn using experience became popular. AI Expert system that emulates the decision-making ability of a human expert was designed.

Year 1980

WABOT-2 was built at Waseda University. The WABOT-2 was the first milestone in developing a "personal robot". Playing a keyboard instrument was set up as an intelligent task for the WABOT-2 to accomplish, since an activity such as playing a keyboard instrument requires human-like intelligence and dexterity.

WABOT-2 was defined as a "specialist robot". The robot musician WABOT-2 can converse with a person, read a normal musical score with its eye, and play tunes of average difficulty on an electronic organ. The WABOT-2 is also capable of accompanying a person while he listens to the person singing.

Year 1980

The first national conference of the American Association of Artificial Intelligence took place at Stanford University, USA.

Year 1984

The film "Electric Dreams", directed by Steve Barron, was released. The film is about a young man who buys a state-of-the-art computer called "Edgar." The computer develops thoughts and emotions and begins to turn its affections toward the man's attractive female neighbour. This artificially intelligent computer and his human owner find themselves in a romantic rivalry over the man's female neighbour.

Year 1986

In October of 1986, Mercedes-Benz initiated a research project named "Prometheus" (Program for European traffic with highest efficiency and unprecedented safety) that explored the future o mobility – by seeking ways cars can avoid accidents on their own. Mercedes engineers built a prototype named Vision Information Technology Application (VITA) capable of braking, accelerating and steering without any input from the driver. The on-board computers relied on automatic image processing technology to analyse the road ahead and apply the brakes if they sensed a collision with another object was imminent.

The vision-guided Mercedes-Benz robotic van, designed at the Bundeswehr University Munich, in Munich, Germany, achieved a speed of 59.6 miles per hour on streets without traffic.

The Second AI Winter (1987-1993)

During the first half of 1980's, many companies made unrealistic claims like: "It is now possible to program human knowledge and experience into a computer... Artificial intelligence has finally come of age." The researchers, however, were aware of the limitations and worried that the increased hype around AI, may lead to disappointment. The fear of the researchers was proved to be right. The cost of the AI-specific equipment outweighed the promised returns. Expert systems proved too expensive to maintain.

The period between 1987 to 1993 is known as the second AI winter. During this period, governments and investors either stopped or drastically reduced funding for AI research because of fear of lack of returns.

The Emergence of Intelligent Agents (1993-2011)

Artificial intelligence researchers began to create and utilize sophisticated mathematical approaches at a greater rate than they had before. The processing power of computers increased. More collaboration started taking place between AI and other academic fields such as engineering, operational research, and mathematics which led to enhancements and the accomplishment of measurable and verifiable results. Researchers became more focused on finding solutions to specific problems rather than anything and everything. AI started to be used successfully in the technology industry. Artificial Intelligence also started to become data driven. It started gaining recognition as a more serious "scientific" discipline.

Year 1995

A.L.I.C.E. which stands for Artificial Linguistic Internet Computer Entity, was created by Dr Richard Wallace. ALICE was inspired by ELIZA. The website still exists in the same state it was launched.

and users can chat with the ALICE chatbot anytime they want. ALICE chatbot relies on more pre-configured templates to handle her interactions and has a limited learning capacity. ALICE uses a series of rules that match user input against patterns to help her determine how to respond.

Year 1997

"Deep Blue," IBM's chess-playing supercomputer, became the first system to win a chess game and match against Gary Kasparov—the reigning world chess champion. Deep Blue's victory is considered a defining moment in the history of artificial intelligence and has been the subject of several books and films.

Year 1998

Dave Hampton and Caleb Chung invented "Furby", the first "pet" electronic robotic toy for children. It resembles a hamster or owl-like creature. It was first revealed at the 1998 American International Toy Fair by American toy manufacturer Tiger Electronics.

Year 1999

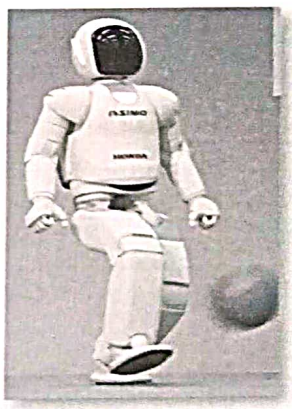
Sony introduced AIBO (Artificial Intelligence Robot), an AI-powered robotic dog designed to be an "intelligent and trainable robot companion." In the year 1999, AIBO could respond to more than a hundred voice commands such as, it could walk, bark, whine, growl, wag its tail, play with a ball, etc.

Year 2000

The robot "Kismet" that could recognize and simulate emotions with its face was developed at the Massachusetts Institute of Technology (MIT) by Professor Cynthia Breazeal. Kismet was structured like a human face with eyes, lips, eyelids, and eyebrows.

Year 2000

Honda created a humanoid robot called ASIMO (Advanced Step in Innovative Mobility). The Japanese word "Asi" also stands for 'leg' and 'Mo' for 'mobility'.



Year 2001

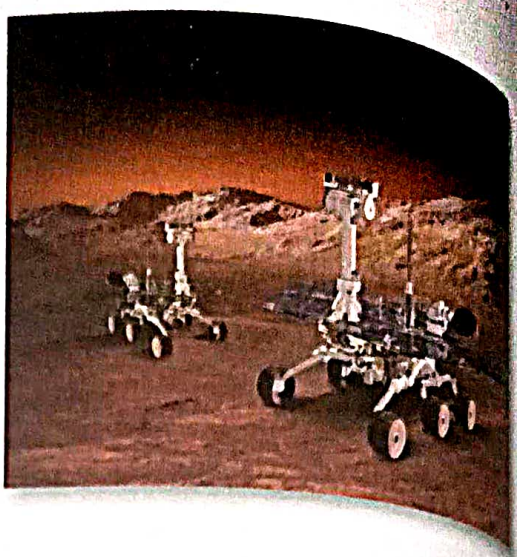
The film ***"AI: Artificial Intelligence"*** directed by Steven Spielberg was released. The movie is set in a futuristic society and tells the story of David, a childlike android (advanced humanoid child) uniquely programmed with the ability to love. The tagline of the movie said: "David is 11 years old. He weighs 60 pounds. He is 4 feet, 6 inches tall. He has brown hair. His love is real. But he is not."

Year 2002

iRobot launched the Roomba floor vacuuming robot. The Roomba is an autonomous robotic vacuum cleaner. It had a set of sensors that enable the

Roomba to navigate the floor area of a home. These sensors could detect the presence of obstacles, dirty spots on the floor, and steep drops (so as to avoid falling down the stairs).

Year 2004



NASA's robotic exploration rovers "Spirit" and "Opportunity" navigated the planet Mars' surface without human intervention. The mission of rover was to study the chemical and physical composition of the surface of Mars at various locations in order to help determine whether water had ever existed on the planet and to search for other signs that the planet might have supported some form of life. Spirit and Opportunity each found evidence for past wet conditions that possibly could have supported microbial life.

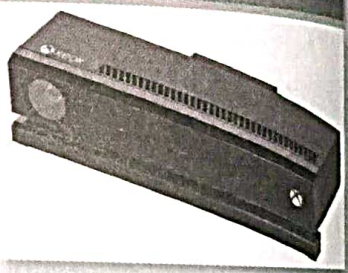
Year 2006

Several big companies such as Twitter, Facebook, and Netflix started using AI.

Year 2009

Google's secretly started a self-driving car project on one premise—which was to build an autonomous vehicle by the year 2020. It was called "Project Chauffeur". It passed Nevada's self-driving test in the year 2014.

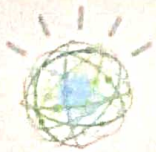
Year 2010



Microsoft's "Kinect for Xbox 360" was launched. It was the first gaming device with the capability to track human body movements using a 3D camera and infrared detection.

Year 2011

IBM created a natural language question answering computer called "Watson" which defeated two former jeopardy champions, Ken Jennings, and Brad Rutter, in a television quiz show in America. Watson is a computer running software called Deep QA. "Watson" can understand questions posed in natural language and answer them. Watson was named after IBM's founder Thomas J. Watson.



Watson is an efficient analytical engine that pulls many sources of data together in real-time, discovers an insight, and deciphers a degree of confidence.

Year 2011

Apple released its virtual assistant called "Siri" on iOS operating systems. Siri uses a natural-language user interface to infer, observe, answer, and recommend things to its human user.

Big Data, Advanced Machine Learning (Year 2012 till date)

Year 2012

Google launched its intelligent personal assistant called "Google Now". Google Now was implemented as an aspect of the Google Search application. It recognized repeated actions that a user performs on the device such as repeated appointments, search queries, etc. and displayed more relevant information to the user in the form of "cards".

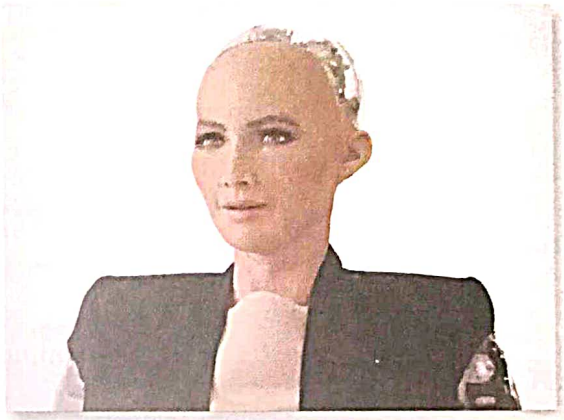
Year 2014

Microsoft and Amazon developed and released their respective virtual personal assistants—Microsoft's "Cortana" and Amazon's "Alexa" respectively. Cortana uses the Bing search engine to perform tasks. Alexa can perform many tasks such as internet searches, order products, play music, create calendar events as well as several other tasks. Alexa makes use of machine learning and artificial intelligence to perform these tasks.

Cortana Alexa

Year 2016

"Sophia" is a social humanoid robot created by the company Hanson Robotics in the year 2016. Sophia's likeness to an actual human being is what distinguishes her from other humanoids, along with her ability to see, make facial expressions, and communicate through AI. Sophia can imitate human gestures and facial expressions and is able to answer certain questions and make simple conversations on predefined topics. Sophia gets visual information on her surroundings using computer vision algorithms and can follow faces, maintain eye contact, and also recognize individuals.



In the year 2017, Sophia was conferred citizenship by Saudi Arabia and became the first robot to get citizenship of any country.

Year 2016

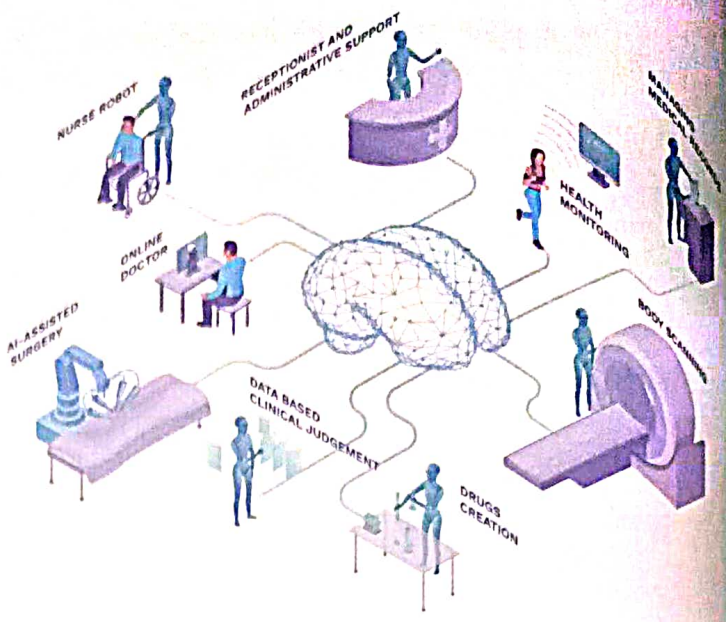
Google released "Google Home". Google Home is a Wi-Fi connected smart speaker with multiple integrated microphones. It uses AI to act as a "personal assistant" to help users remember tasks, create appointments, give users direct access to their music and other audio and search for information by giving voice commands.

Year 2018

Google developed BERT (Bidirectional Encoder Representations from Transformers) BERT is a neural network-based technique for natural language processing (NLP) pre-training. In simple words, BERT is AI language model that Google applies to search results.

Year 2022

Scientists successfully used AI in many healthcare areas that included reducing sepsis deaths, predicting cardiac events, detecting breast cancer, lung cancer, osteoporosis, heart disease, bladder cancer, fractures, to enable pathology and to monitor diabetic retinopathy and Parkinson's.



AI Today

AI has been improving process efficiency, decreasing manual labour and errors, and extracting insights from big data. The impact of AI can already be seen in applications that people use every day—be it in transport, healthcare, education, finance, law, and many other areas. There has been a tremendous increase in computational power which is extending the AI revolution and impacting businesses and academic organizations all over the world.

EXERCISES

1. Multiple Choice Questions

1. Who is known as the Father of Artificial Intelligence?
   (a) John McCarthy ☐ (b) Alan Turing
   (c) Fisher Ada ☐ (d) Allen Newell
2. Name of the first AI programming language is:
   (a) C ☐ (b) LISP
   (c) FORTRAN ☐ (d) BASIC
3. LISP was created by:
   (a) Allen Newell and Herbert Simon ☐ (b) Marvin Minsky
   (c) Alan Turing ☐ (d) John McCarthy
4. Who proposed the idea of "The Imitation Game"?
   (a) Joseph Weizenbaum ☐ (b) Paul Baron
   (c) Alan Turing ☐ (d) John McCarthy
5. The term "machine learning" was coined by:
   (a) Alan Turing ☐ (b) Arthur Samuel
   (c) Dave Hampton ☐ (d) George Devo
6. The first intelligent humanoid robot was developed in Japan and was named:
   (a) Sophia ☐ (b) Watson
   (c) WABOT-1 ☐ (d) ELIZA

7. **An AI winter refers to a period of:**

(a) increased funding and reduced interest in artificial intelligence research. ☐

(b) increased funding and increased interest in artificial intelligence research. ☐

(c) reduced funding and reduced interest in artificial intelligence research. ☐

(d) none of the above. ☐

8. **In the year 1986, a research project named Prometheus (Program for European traffic with highest efficiency and unprecedented safety) that explored the ways cars can avoid accidents on their own was initiated by:**

(a) Mercedes-Benz ☐ (b) Audi ☐

(c) Toyota ☐ (d) Tesla ☐

9. **The chess-playing supercomputer that became the first system to win a chess game and match against Gary Kasparov - the reigning world chess champion was called:**

(a) WABOT-2 ☐ (b) Deep Blue ☐

(c) Watson ☐ (d) Kismet ☐

10. **Two former jeopardy champions, Ken Jennings and Brad Rutter were defeated by IBM's natural language question answering computer called:**

(a) ASIMO ☐ (b) Watson ☐

(c) Wabot-1 ☐ (d) Sophia ☐

II. True or False

1. Sophia is the first robot to get citizenship of any country.

(a) True (b) False

2. "Watson" is IBM's humanoid robot.

(a) True (b) False

3. Xbox was the first gaming device with the capability to track human body movements using a 3D camera and infrared detection.

(a) True (b) False

4. Google's secret self-driving car project was called Project Chauffeur.

(a) True (b) False

5. NASA's robotic exploration rovers "Spirit" and "Opportunity" navigated the planet Mars' surface without human intervention.

(a) True (b) False

6. "Roomba" was the first chatbot created at the MIT Artificial Intelligence Laboratory by Joseph Weizenbaum.

(a) True (b) False

7. The first industrial robot designed by George Devo was called "Unimate."

(a) True (b) False

8. Amazon's "Alexa" and Apple's "Siri" are both virtual assistants.

(a) True (b) False

9. Claude Shannon is known as "the father of information theory."
   (a) True (b) False
10. The Turing Test is a game to determine whether a machine can demonstrate human intelligence.
   (a) True (b) False

III. Answer the Following Questions

1. Alan Turing wrote a paper on the topic of Artificial Intelligence in which he proposed the idea of "The Imitation Game." What did this subsequently lead to and what was Turing trying to explore?
2. Who coined the term "Artificial Intelligence"? How did he define Artificial Intelligence?
3. How did "Unimate"—the first industrial robot, revolutionize manufacturing all over the world.
4. When was the first chatbot created? What is it called?
5. What is the meaning of the term "AI Winter"?
6. How was WABOT-2 different from WABOT-1?
7. What caused the Second AI Winter (1987-1993)?
8. What is "Deep Blue"? Why is it famous?
9. What are "Spirit" and "Opportunity" robotic rovers known for?
10. Name and briefly write two features each of any two virtual personal assistants.

ACTIVITY 1

Divide the class into smaller groups. Let each group trace the evolution of Artificial Intelligence during a decade (a period of ten years) allotted to them starting from the year 1950 till date. Each group representative can present their research findings to the class highlighting the advancements in AI during the decade for which they did the research.

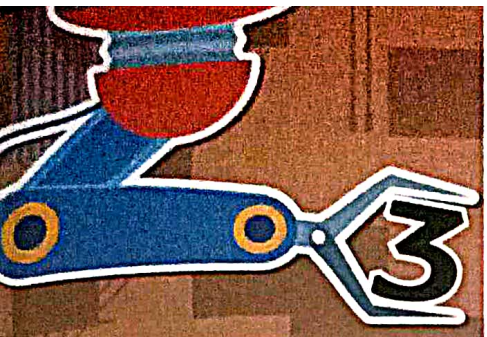
ANSWERS

I. Multiple Choice Questions

1. (a) 2. (b) 3. (d) 4. (c) 5. (b) 6. (c) 7. (c) 8. (a) 9. (b) 10. (b)

II. True or False

1. (a) 2. (b) 3. (b) 4. (a) 5. (a) 6. (b) 7. (a) 8. (a) 9. (a) 10. (a)



Human-Machine Interaction

In this chapter, you will learn about:

- *What does Human-Machine Interaction Mean?*
- *How does Human-Machine Interaction Work?*
- *Types of Interfaces*
- *Types of Human-Machine Interaction*
- *Advantages of Human-Machine Interface*
- *Future Outlook*
- *Challenges*

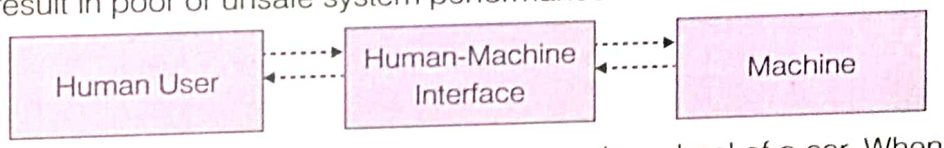
What Does Human-Machine Interaction Mean?

Human-machine interaction is described as the interaction and communication between human users and machines via a human-machine interface. Earlier, the interaction used to be just traditional machines in industries, but since a long time now, the interaction also relates to computers, digital systems or devices for the Internet of Things (IoT).

How Does Human-Machine Interaction Work?

In order for proper communication to take place between humans and machines, interfaces are required. User interfaces are the places where or actions by which the user engages with the machine.

Human-Machine Interface (HMI) is the principal point of contact between the human and a machine or process. It is very important to properly select and implement the interface as it can have a critical impact on the use and overall efficiency of the machine. Poor HMI can result in poor or unsafe system performance.



A simple example of interface is the steering wheel of a car. When you turn the steering wheel of the car, an action is triggered. Similarly, when you press a light or a fan switch, an action is triggered. This is an example of a human directly controlling a device. Other examples of directly controlling the device include typing in text, touch screen, mouse, voice or gestures.

The systems can also automatically identify what the human wants. For example: lights in a room automatically switch on when someone enters.

In the case of automation, machines are controlled by computers, and as such, human-machine interactions become human-computer interactions. However, the nature of human-machine interaction is not changed, as the computer in this case is a part of the machine and part of the machine-to-human interface.

Technologies and computer systems are performing important tasks in industries as well as in our daily lives. Sensors and interfaces allow them to be operated.

Machines can be controlled by touch, voice, gestures or virtual reality (VR) glasses.

Types of Interfaces

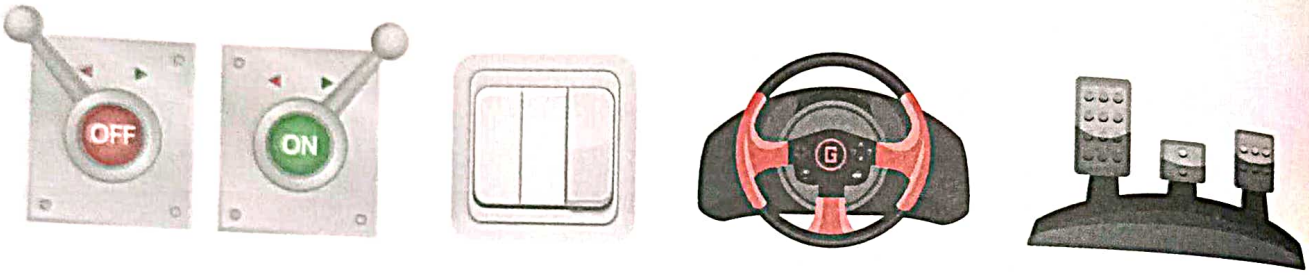
Interfaces are of two types:

- Human-to-machine interfaces: These are input devices used by humans to communicate with machines (sending commands to machines) e.g. keyboard, mouse, touch screen, joystick, etc.
- Machine-to-human interfaces: These are output devices used by machines to communicate with humans (enable humans to get updates as to how their commands are getting processed) e.g. display screens, audio systems.

Both types of interfaces are responsible for effective and efficient operation.

Types of Human-Machine Interaction

In earlier days, switches, levers, steering wheels and buttons used to be the main means of controlling machines.



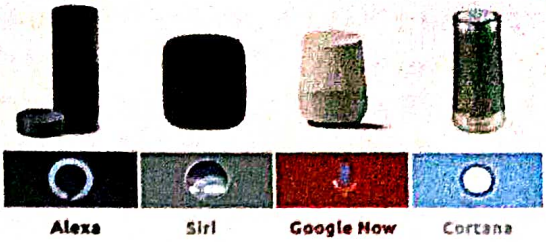
With the invention of the keyboard and mouse, text could be inputted as a command in order to give instructions to the computer system. The mouse was a means of graphic control. It enabled users to click on fields selected by them and activate them.

The touch screen now enables users to use their fingers to perform actions directly on the device.

We can enlarge whatever we see on the screen by spreading two fingers. This is called a multi-touch input. This was the beginning of gesture control.

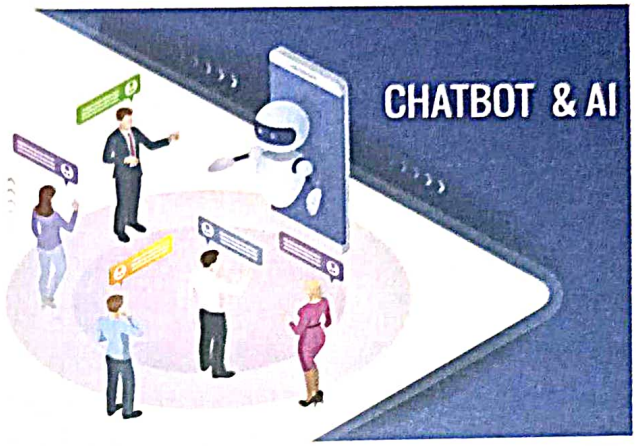
Many body wearables have sensors that automatically collect data, analyse and display information to the user.

Voice control digital assistants such as Siri, Alexa, Google Home and Cortana carry out the commands issued by the users.



Gesture control enables making gestures in the air for enabling a system to be switched on. For example: switching on a television by making a gesture in the air. Gesture control has a number of advantages over touch screens. Users don't have to touch the device and can issue commands from a distance. Gesture control is an alternative to voice control.

Chatbots "work" in customer service and give written or spoken information. They reply automatically to request from customers and keep on learning. The more chatbots understand and the better they respond, the closer they come to communication that resembles a conversation between two humans. If more information is available to the chatbots, they can respond in a more specific way and give more appropriate replies.



Today's chatbots ability to communicate with people is improving at a rapid pace, owing to artificial intelligence.

Augmented, Virtual and Mixed Reality are technologies that can also be an interface between humans and machines. Virtual, augmented and mixed reality are not only used for games, but also in practically all fields today. Example: healthcare, manufacturing.

Advantages of Human-Machine Interface

Human-Machine Interface offers several advantages. Some of them are:

- User-Friendliness: Human-Machine Interfaces have the ability to control any system or device effectively. HMI increases the comfort level and happiness of people when used for relaxation and for entertainment. In industries, with a single HMI, one will be able to interact with various machines or devices within the industrial set-up from the same location.

- Higher Productivity: HMI systems help in increasing production. Though most of the tasks performed using this technology can be performed by human beings, manual processes usually take longer and are less effective.
- Higher Worker Satisfaction: HMIs have been found to improve employees' satisfaction in an industry as HMIs allow the employees to interact directly with the machine from an interface.
- Reduced Cost of Hardware: Human-Machine interface enables reducing the cost of equipment such as that of consoles, panels, cables, etc.
- Flexibility of Operation Control: HMI enables customization of interface based on specific needs or preferences. HMI's can track, monitor and support different systems. While a single worker can't operate multiple machines simultaneously, he can simultaneously operate several screens. This way, tracking information for different processes becomes easier. It also becomes easier to control operations because a worker can execute multiple tasks at the same time.
- Enhance data saving and recording: HMIs can store raw data for many years and the data is easily accessible. Human-Machine Interface systems provide quick and efficient data accessibility.
- Improved Efficiency and Higher Output: Human-Machine Interfaces improve efficiency in various production processes which lead to higher output.
- Data Translation: HMI's translate the industrial control system data into readable and visual representations. An operator is able to see the graphical representation of the system and also control them.

For businesses to improve production, they need to incorporate advanced technology in processes involved in industrial production. Human-Machine Interface is one such technology. HMI helps businesses to enable their employees to perform tasks with the help of automation tools to increase efficiency. It also reduces labour costs as well as risk of human errors. With the competitive need for optimisation and rapid technological advancements, the implementation of HMI's in various industries is rapidly increasing.

Future Outlook

Machines will continue to adapt more and more to human requirements and habits. Virtual reality, augmented reality and mixed reality will allow the machines to be remotely controlled as a result of which humans will be able to expand their realm of experience and field of action. Machines will become smarter with the aid of artificial intelligence. With technological advancements, machines will be able to process more and more data in a shorter time, so the ability of machines to "think" on their own will increase.

In future, more and more data from different sensors will be combined to capture and control complex processes as well. There will be fewer input devices in future than are present today, such as remote controllers, computer keyboards or ON/OFF switches. If computer systems, devices and machines keep on learning and obtain access to more data, they will also become more and more like humans. They will be able to perform some of the tasks of sensory organs. A camera will allow them to see, a microphone will let them hear, and clothing fitted with sensors will convey touch. So, machines will be able to analyse what is going on around them with the aid of sensors which will enable new forms of interaction between the human and the machines. Companies have already

started working to replicate the human senses with the aid of sensors, so for example: In near future "A gas sensor will be able to 'smell'. The mobile phone with a gas sensor will be able to "smell" particular foods being cooked in the vicinity. The digital assistant may then recommend visiting the close by restaurant that may be offering the favourite snack of the human.

As machines keep on getting better at interpreting signals, fully autonomous cars will become common. With human needs becoming more identifiable and accurate, robots may be used for caring for people.

Challenges

The more complex the contribution made by machines is, the more important it is to have clear, proper and efficient communication between the machine and the human users. The technology behind the machine must clearly understand the command as it is meant. If it doesn't, then there's the risk of misunderstandings – and the system won't work as it should.

Machines are highly dependent on sensors to be controlled or to respond automatically. So, development of interfaces and sensors need to be done with meticulous precision and very good measures need to be implemented for data protection so that hackers don't manage to get access to it. It is also important that operating a machine should not become too complex or require too much familiarization. Smooth communication between human and machine also needs the shortest possible response time between command and action, otherwise the interaction will not be perceived by the human user as being natural.

EXERCISES

I. Multiple Choice Questions

1. HMI stands for:
   - (a) Human-Machine Interaction ☐
   - (b) Human-Machine Interface ☐
   - (c) Human-Machine Industry ☐
   - (d) Human-Machine Implementation ☐
2. Interface is a method for:
   - (a) Getting information from a user. ☐
   - (b) Giving information to a user. ☐
   - (c) Neither a nor b ☐
   - (d) Both a and b ☐
3. Improper selection of interface can result in:
   - (a) Poor system performance ☐
   - (b) Unsafe system performance ☐
   - (c) Impaired efficiency of the machine ☐
   - (d) All the above ☐
4. An example of a human indirectly controlling a device is:
   - (a) Pressing a light switch to open the light ☐
   - (b) Autonomous car ☐
   - (c) Steering the wheel of a car while driving ☐
   - (d) Typing in a text using a keyboard ☐

5. An example of an output device is:

(a) Monitor ☐ (b) Joy stick ☐

(c) Mouse ☐ (d) Touch screen ☐

II. True or False

1. Human-Machine Interaction is limited to traditional machines in industries and doesn't include computers.

   (a) True (b) False

2. Human-Machine Interface (HMI) is the principal point of contact between the human and a machine or process.

   (a) True (b) False

3. Output devices are used by humans to communicate with machines.

   (a) True (b) False

4. Many body wearables have sensors that automatically collect data, analyse and display information to the user.

   (a) True (b) False

5. HMI has many advantages but it can't help in improving industrial production for businesses.

   (a) True (b) False

III. Answer the Following Questions:

1. What does Human-Machine Interaction mean?
2. What is an interface? Explain the two types of interfaces giving two examples of each.
3. How do gesture control devices work? What advantage do they offer over touch screen?
4. List three advantages that Human-Machine Interface offers.
5. What advancements will be made in machines in the foreseeable future?
6. What are the challenges that human-machine interaction may face in future?

A debate may be organised in class on the topic." Will machines become smarter than humans."

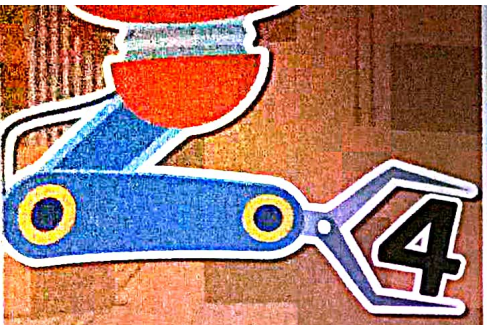
ANSWERS

I. Multiple Choice Questions

1. (b) 2. (d) 3. (d) 4. (b) 5. (a)

II. True or False

1. (b) 2. (a) 3. (b) 4. (a) 5. (b)



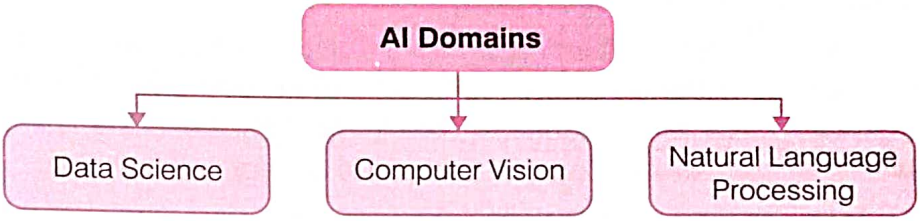
Domains of Artificial Intelligence and their Applications

In this chapter, you will learn about:

- *The interrelation of the three domains of Artificial Intelligence*
- *What is data and its importance in Artificial Intelligence?*
- *Data sources*
- *What is Data Science?*
- *Applications of Data Science in Manufacturing, Healthcare, Finance, Gaming, E-Commerce, Banking, Internet Search and Transport*
- *Data Science based AI Game-Rock, Paper, Scissors*
- *What is Computer Vision?*
- *Applications of Computer Vision*
- *Computer Vision based AI Game: Emoji Scavenger Hunt*
- *What is Natural Language Processing?*
- *Some Applications of Natural Language Processing*
- *Natural Language Processing based AI Game: Mystery Animal*

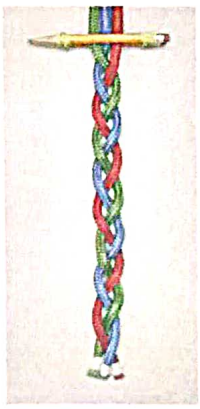
The three main domains of Artificial Intelligence include:

1. Data Science
2. Computer Vision
3. Natural Language Processing



These three domains, while being distinct from each other, together, constitute the concept of Artificial Intelligence.

How Are The Three Domains of Artificial Intelligence Interrelated To Each Other?



Take three different strands of colour and work them into a braid. As an analogy—the first strand is the Data Science, the second strand is the Computer Vision strand and the third strand is the Natural Language Processing Strand. Just like the different parts of a machine work together towards moving the machine smoothly, similarly, the domains of AI help the AI to function smoothly. Together all these three strands constitute the concept called Artificial Intelligence.

What is Data?

In order to make machines Artificially Intelligent, training has to be given to them. Machines are fed with data. Data is a collection of raw facts, such as numbers, words, observations, measurements, symbols, or even pictures that are collected as a source of information. Data is the key for helping AI systems learn effectively. It is the most important part of all Data Analytics and Artificial Intelligence. If we don't have any data, we will not have anything for reference or analysis and will not be able to train AI models.

Importance of Data in Artificial Intelligence?

This training of the AI systems is done by feeding them data. If data fed to the machines is not proper, the outcome given by the machine will also not be proper and the results will be inaccurate.

What is GIGO?

(Garbage In, Garbage Out)

The quality of information coming out cannot be better than the quality of information that went in.

Data Sources

Where should one obtain data from? Data is everywhere. Newspaper, websites, journals, online, everything is made up of data only. Data in general can be collected from various sources which could be – data from databases, data in excel sheets, etc. It is important to make sure that data is taken only from reliable sources so that it is correct and authentic.

Some important ways to collect data are via:

- Surveys
- Web Scrapping
- Cameras
- Observations
- Sensors
- API (Application Program Interface)

Completeness
Are all the records complete?

Accessibility
Can the data be easily accessed?

Quality
Are all the records correct?

Connectivity
Can the different datasets be joined together?

Quantity
Is the amount of data sufficient?

Validity
Is the data valid?

Data Science

Data science is essentially obtaining anything of value out of data. It can be defined as obtaining insights and information out of data. Data Science focuses on analysing the past or current data and predicting the future outcomes with the objective of making informed decisions.

This domain of Artificial Intelligence deals with huge volumes of data in order to find unseen patterns and derive meaningful information for better decision-making.

Some Applications of Data Science

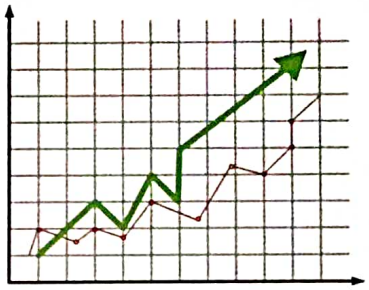
Manufacturing

Data provides manufactures with valuable insights for speeding up execution time, increasing profit, reducing costs, minimizing risk, etc.

Data science is being used in the manufacturing industry for several reasons such as:

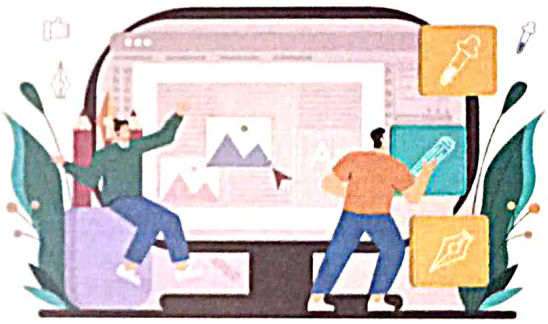
Prediction of faults and preventive maintenance: Prediction of faults and preventive maintenance is a technique to predict when an in-service machine will fail so that maintenance can be planned in advance. It helps in reducing down-time and minimizes maintenance costs. It also helps in finding causes for equipment malfunctions.

Forecasting sales: Forecasting sales involves taking the historical sales data of a given product and using data analysis to estimate future demand. Having an estimate of how many products will be sold permits better planning—in terms of allocation of resources, profit estimations, quantities to be produced, cash flow required, etc.



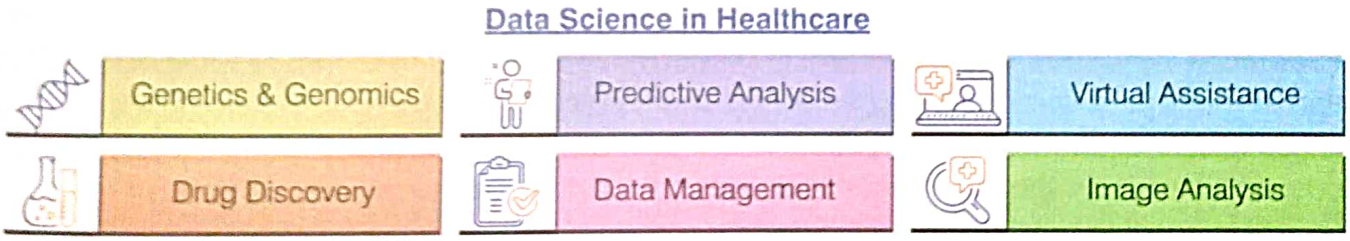
Reducing energy costs: Energy consumption patterns can be understood using data science. This enables data analysts to look at gaps and identify areas where energy consumption can be reduced and costings optimised.

Product design and development: Data science is being widely applied in product design and development. Data science algorithms and methods are used to collect and analyse data on various parameters to design the products so that they meet customers' needs and expectations.



Price optimization: Data analysts analyse data of order history, customer behaviour, inventory, etc. to put things into perspective and determine the right prices for specific products.

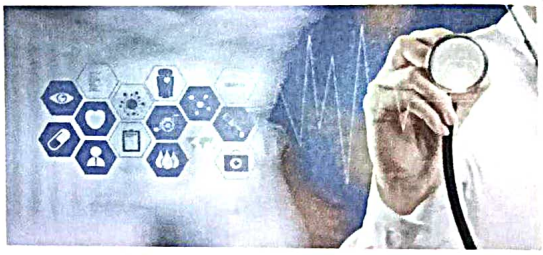
Healthcare



Some uses of data science in healthcare industry include:

Drug discovery: Many pharmaceutical and biotech companies are using data science to drive innovation in drug discovery. Data scientists use traditional drug discovery research and add the ability to extract knowledge from the data. Data analytics can help in reducing the cost and speeding up clinical trials by identifying and analysing various data points such as the participants' demographic and historical data and by examining past clinical trial data.

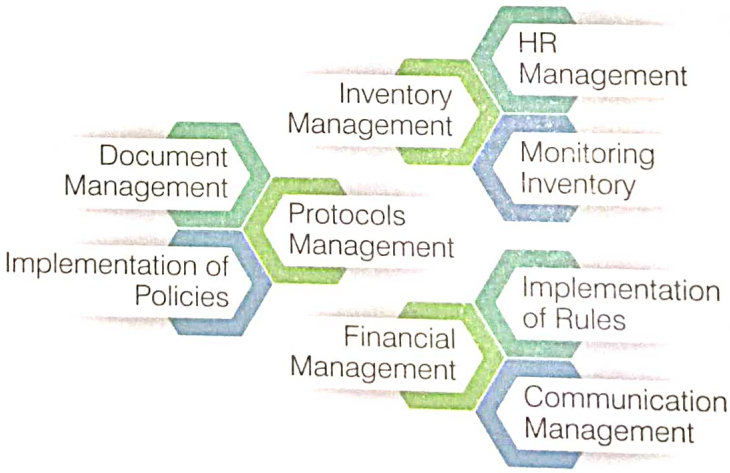
Early detection of disability diseases: Using big data analysis, it becomes possible to detect disability earlier than clinical diagnoses, which allows taking timely and appropriate action. Many data driven apps and wearable and sensor devices help in identifying early warning signs of illness.



Diagnostics: Diagnosis of diseases is made easier and quicker by data science applications as the data analysis of the patient facilitates early detection of health issues.

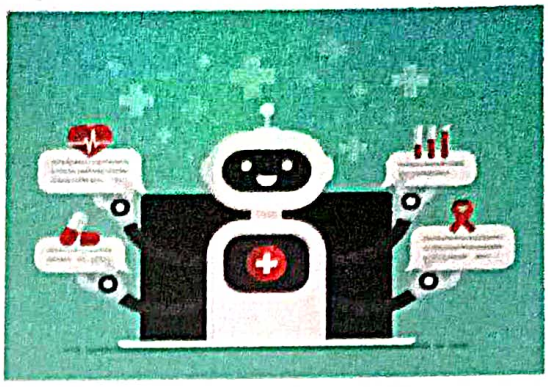
Automation of hospital administrative processes Automation means making repetitive tasks automatic, so that the extra time saved in the process can then be utilised elsewhere. The amount of data generated by healthcare is growing very fast with usage of telemedicine, medical devices, personal health trackers, and other health tech devices, so the data is only going to keep increasing. Automated data management enables automation in other areas of hospital administration.

Health Administration Tasks



Predictive Analytics in Healthcare: A predictive analytical model utilizes historical data, finds patterns from the data, and generates accurate predictions. The analysis of current and historical healthcare data allows healthcare professionals to make more effective clinical decisions, predict trends, and even manage the spread of diseases. Predictive models in Data Science correlate and associate every data point to symptoms, habits, and diseases.

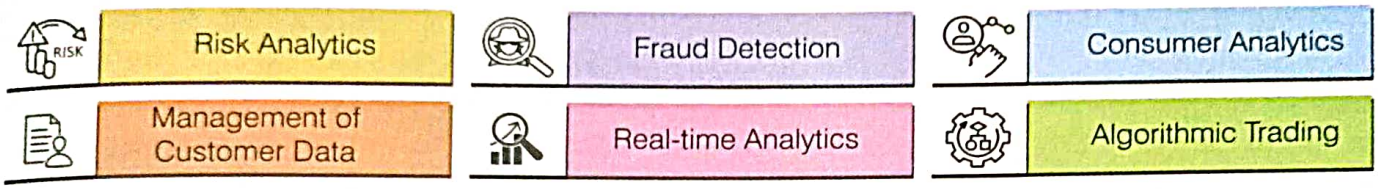
Health chatbots: Chatbots are designed by data scientists to help people get a better idea of their health by putting in certain health information about themselves and getting an accurate diagnosis. Chatbot algorithms are trained on huge amount of healthcare data, that includes symptoms of diseases, diagnostics, markers, and available treatments. Chatbots collect patient's data, they also schedule medical appointments as they are integrated into the hospital database from where they can extract information on availability of doctors and schedule appointments accordingly.



Finance

Data Science has been instrumental in automating various financial tasks.

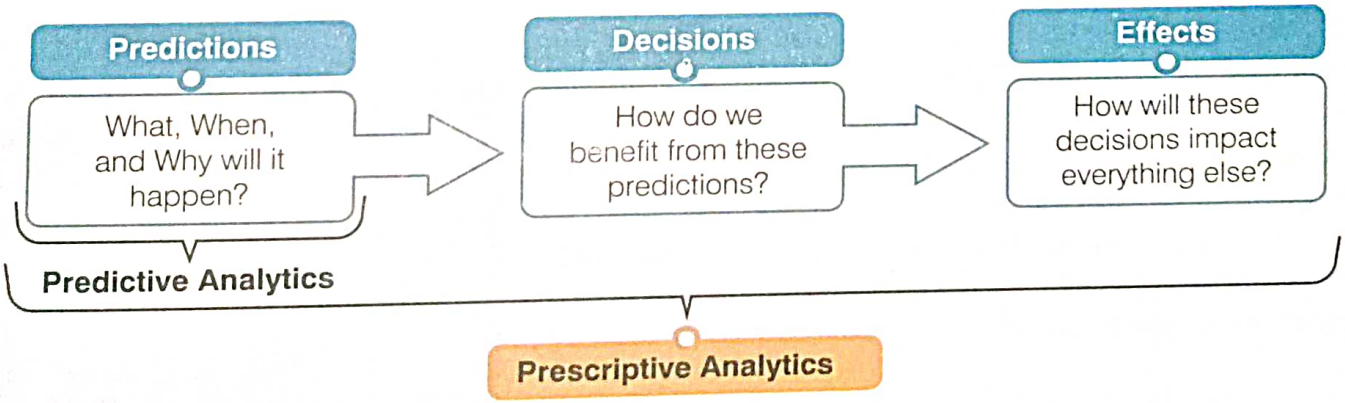
Data Science in Finance



Some applications of Data Science in the financial industries are:

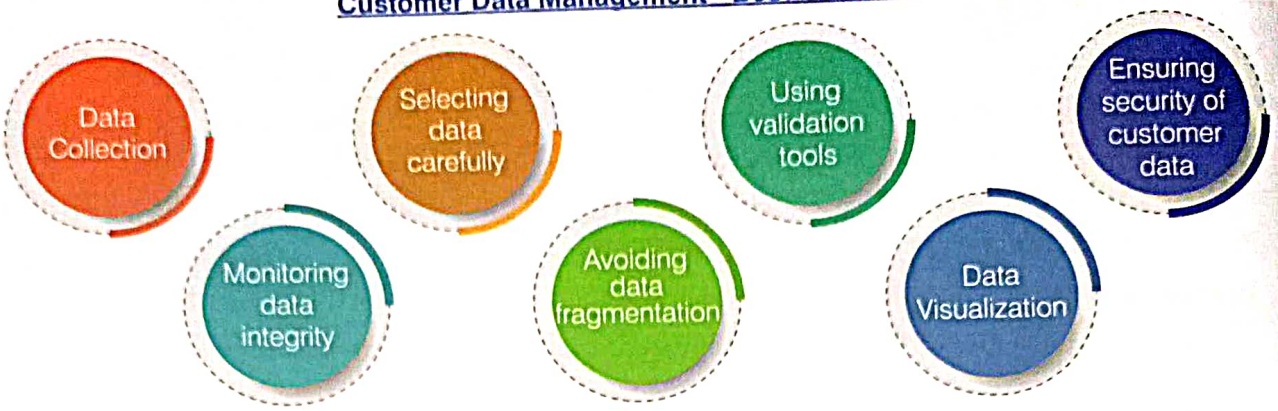
Automating risk analytics: Risk analytics help in creating specific business strategies, so as to create and maintain trust worthiness—both in the market place as well as amongst the customers of the financial institutions. Data Science in finance analyses market trends and customer data. The software used for risk analytics enables organizations to predict the ups and downs of business and hence take appropriate action to minimize losses.

Predictive analytics: Predictive analysis in financial sector involves analysing and interpreting financial data to calculate the possible future outcomes. Data Science has enabled improvements in the speed and accuracy of analytics owing to which financial institutions can increase the scope of its implementation and apply it across more areas of their businesses.



Customer data management: The data of customers helps financial institutions to keep track of their transactions. Earlier, organizations stored data by using traditional methods. But now, data science in finance is helping the financial institutions to manage and store their customers' data efficiently.

Customer Data Management - Best Practices

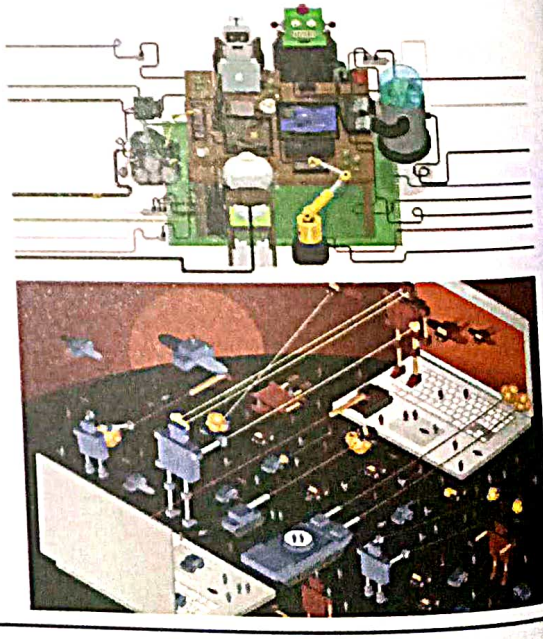


Financial fraud detection: With increase in digitalisation and online transactions, there is an increase in unethical activities (such as false claims) against which the financial institutions have to guard themselves. Data Science in finance helps to deal with such problems. It has enabled the security systems of the financial institutions to become extremely secured and productive. The data science software algorithms try to learn from past data and then use their learning experience to predict the risks that may occur in the future. This helps the financial companies in taking appropriate action.

Personalized relationship with customers: Personalized services enable the financial institution to build a good relationship with their customers and increase their sales by offering them what they are interested in. Data Science and Machine Learning is used for building applications that generate insights and analyse customer interactions to provide a personalized service to customers.

Gaming

Gaming is another area where Data Science is being extensively used. Sony, Nintendo, Activision-Blizzard, etc. all use data science.



Some uses of Data Science in Gaming include:

Game data analytics: Data science is used to improve the players' engagement and retention through the collection and storage of their information and gaming history and then analysing the same such as playing time, quitting points, scores, etc. The players can start up where they left off instead of starting the game afresh.

Game design: The game designs play a very important part in keeping the players engaged and interested in playing. Data science is used for building models that utilize Insights gained from gaming data to guide designs and improve gaming models.

Identity and fraud detection: Identity and payment fraud tend to occur often in gaming because of which gaming companies require a high level of security for the players' personal information and the transactions performed by them. Data science algorithms make it easier to detect frauds due to the vast amount of data they can quickly process.

E-Commerce

Data science is being widely used in E-commerce and retail industries.

Some Applications of Data Science in E-Commerce

1. Making personalised recommendations
2. Price optimization
3. Customer feedback analysis
4. Inventory management
5. Fraud detection

Some of the ways in which data science is being used in e-commerce is:

Making personalised recommendations: E-commerce websites use a technology called recommendation systems. This system tracks the kinds of products a person buys, the pages he visits and is interested in etc. and then using data science to analyse this data, provides individuals purchase recommendations which are based on their profile. This is the reason when we visit e-commerce sites, we tend to receive individual personalized recommendations that are based on our browsing history and purchase pattern.

Price optimization: Data science-based price optimization algorithms consider various parameters such as buying patterns of the customers, location of the customers, price of similar products sold by a competitor, etc. Using this analysis, these e-commerce websites find optimal selling prices for their products which are affordable for the customer, yet they offer a profit to the ecommerce site.

Customer feedback analysis: It is very important for e-commerce sites to obtain customer feedback and analyse it to understand what the customers feel about their products and services and take necessary action to rectify the deficiencies. Data science-enabled techniques help in this analysis.

Inventory management: For an e-commerce company that shows certain items as available on their website, it is very important that those items be available in their inventory. E-Commerce companies sell thousands of items to crores of people, so it is important that their inventory is properly managed. This balance between demand of items and their availability in the inventory is made possible by using efficient data analytic algorithms. This way, they can make sure that the products that are in demand are always available.

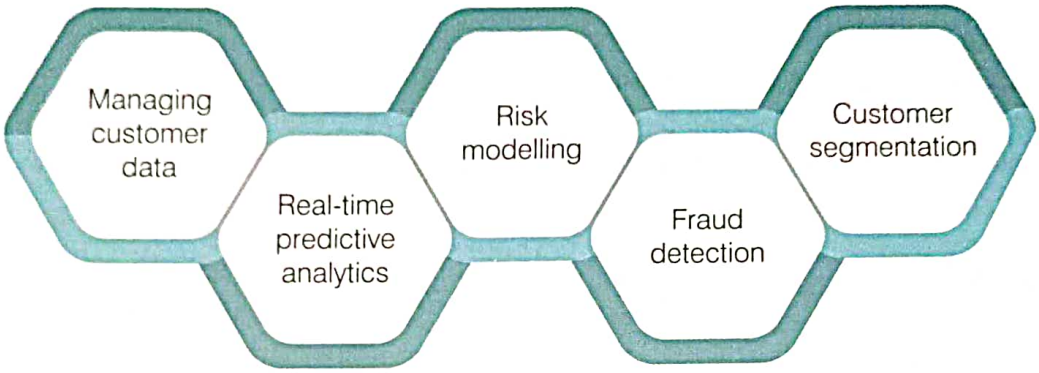
Fraud detection: With increase in online shopping and online payment modes used by shoppers, it becomes important for these companies to prevent credit card frauds. Data science is being used by the e-commerce businesses to detect and manage frauds. There are also some customers who keep buying items and then returning them all the time. These customers also get identified using data science.

Banking

Banking sector utilises a large number of Data Science applications.

Some applications of Data Science used in banking are:

Some Applications of Data Science in Banking



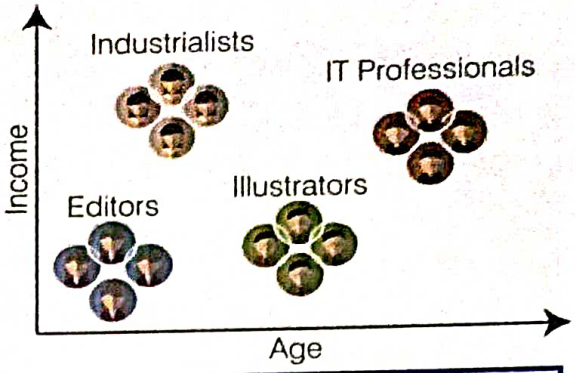
Managing customer data: Banks are required to collect and store huge amount of data. Rather than just storing the data, data science analysts can select only the relevant data out of the huge accumulated data and analyse it in order to gain useful insights about their customers' behaviours, interactions, and preferences.

Real-time predictive analytics: In order to make smarter strategic decisions and effectively solve problems, real time and predictive analytics are of immense value. Real-time analytics help in understanding the problem that the business is facing, and predictive analytics help in selecting the right technique to solve it. Analytics help in foreseeing any potential problem that may arise in future which gives time to take corrective measures to avoid its occurrence.

Risk modelling: Data science has helped in creating new risk management models which are able to accurately identify complex patterns in large amount of data. Risk modelling is very important for investment banks as they use it to analyse the rate of defaults. The bankers use the information obtained to develop strategies to reinforce their lending schemes. It is also useful as a guide for pricing their various financial instruments.

Fraud detection: Fraud detection by banking institutions involves monitoring and analysing customers' activity, and to detect irregularities if any, in the transactions carried out by them. Data analytic and machine learning algorithms work towards detection and prevention of fraud involving credit cards, accounting, insurance, etc. This is of crucial importance in providing security to the customers.

Customer segmentation: While no two individuals are alike, yet people can be categorised or segmented based on their age, income and other parameters. Segmenting the customer base using data analytics enables the banking institutions to effectively allocate marketing resources, improve customer service and help in loyalty and retention of customers.

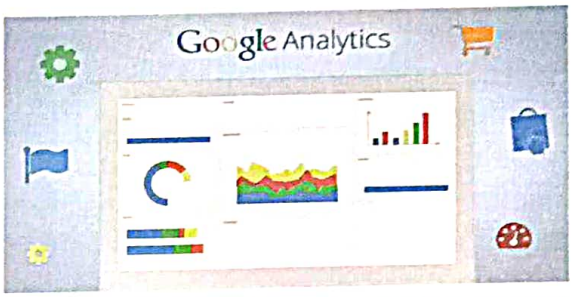


Internet Search

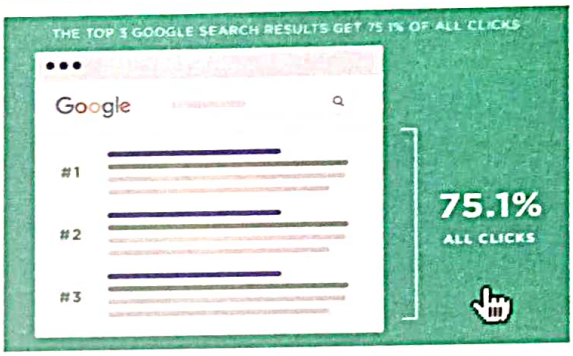
An internet search engine is a specialized computer server that searches for information on the Web. The search results of a user query are often returned as a list (also sometimes called "hits"). The list may consist of web pages, images, and other types of files. Search engines like Yahoo, Google, Ask, Bing, AOL, etc. make use of data science algorithms.

Data science is used for:

Site search analysis: The site search analysis is the search behaviour of the visitor which includes key word and key phrase searches, filter selections, etc. The analysis helps in improving sales and profits and enhances customer satisfaction.



Ranking search results: It is important for a visitor to get the most relevant documents at the top of the displayed list of retrieved documents, as per his or her search query. For that reason, it is important for search engines to have a good retrieval model. A retrieval model is considered good if the retrieved document is very similar to the query. Data science algorithms are used to make good retrieval models.

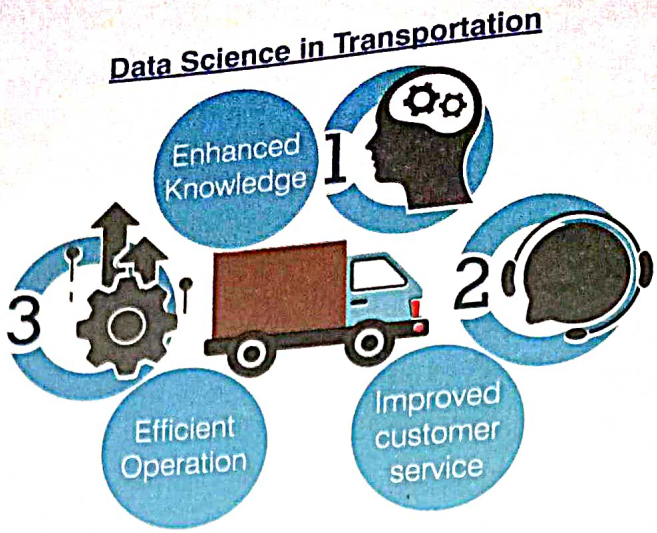


Delivering the best result for searched query in a fraction of seconds: There is a huge amount of data available on the web. It would not be possible to search for what we want unless there was some way of sorting through the vast amount of information available. The search engines sort through billions of web pages and present the list of the most relevant results in fraction of seconds. This is made possible by using data science algorithms.

Search engine optimization: Data science helps in search engine optimization by understanding the customers' requirements, personalizing their experience by understanding their preferences and creating marketing campaigns in keeping with the needs of their site customers.

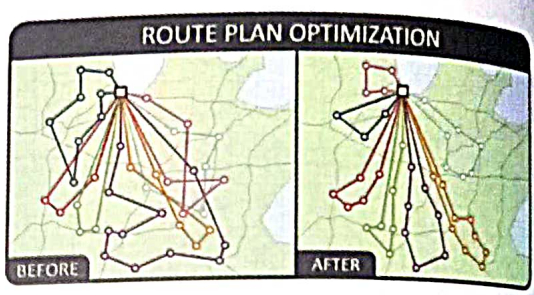
Transport

There are a large number of applications of Data Science in the transport industry. Data Science usage has increased with the introduction of self-driving cars.



Some applications of Data Science in transport industry include:

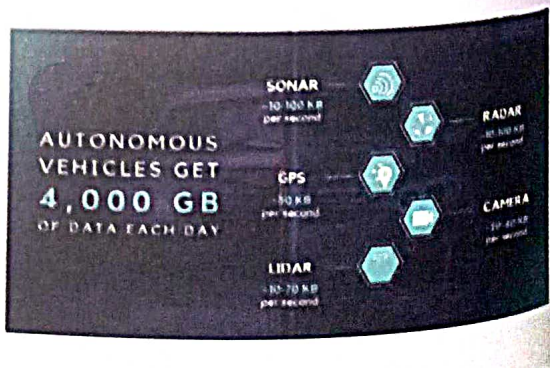
Route optimization: Determining the quickest and the most efficient route to a destination point is known as route optimization. Data science's routing algorithms help the logistic companies in route optimization. Number of products ordered, their delivery location, frequency of orders, weather, fuel consumption as well as many other parameters are taken into consideration by the routing algorithms.



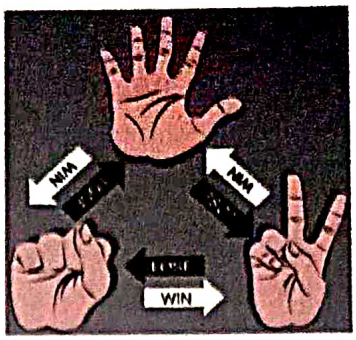
Monitoring driver behaviour: Drivers falling asleep, getting distracted, getting stressed, etc. are all factors that tend to cause vehicle accidents. There are a number of physiological sensors that can conveniently generate signals giving information on the driver's measure of impairment. This data can come from multiple sources and data analytic algorithms put it all together and analyse the data to give the measure of impairment, so that the driver can be cautioned and an accident prevented.

Price optimization for transport companies: The logistics market faces a lot of competition owing to which the profit margins are low. There is a need for these companies to quickly adjust their prices in keeping with the changes in demand and supply. Data science-based algorithms are used for this purpose.

Multiple analysis for driverless cars: The role of data science is critical in building autonomous vehicles. Several indicators such as battery charge monitors, diagnostic instrumentation, etc. need to be taken into consideration which require multiple analysis on several data bases. The outcome of these gets translated into insights and based on these insights, actions get taken.



Data Science based AI Game—Rock Paper Scissors



Rock Paper Scissors is a hand game originating from China. It is usually played between two players, in which each player simultaneously forms one of three shapes—"rock", "paper", or "scissors" with an outstretched hand. Each player either holds out their fist for rock, or flat hand for paper, or their index and middle finger for scissors.

Rock crushes scissors, scissors cut paper, and paper covers rock. A rock beats scissors, scissors beat paper by cutting it, and paper beats rock by covering it.

Rules of the Game:

- Rock wins against scissors
- Paper wins against rock; and
- Scissors win against paper.
- If both players throw the same hand signal, it is considered a tie, and play resumes until there is a clear winner.

The AI Data Science based Rock, Paper and Scissors Game is just a replica of the game Rock, Paper and Scissors. In this game, the machine tries to predict the next move of the player. The machine tries to win after learning from the player's moves.

The link for the game is:

https://www.afiniti.com/corporate/rock-paper-scissors

Computer Vision

Computer vision works in much the same as human vision. Computer vision trains machines to perform the same functions as a human eye, but it does so with cameras, data and algorithms.

What is Computer Vision?

Computer Vision is a field of AI that trains computers to capture and interpret information from image and video data. In simple words, computer vision enables computers to "see", analyse and understand the content of digital images such as photographs and videos. Using computer vision, the computers can accurately identify and locate objects and can then react to what they "see".

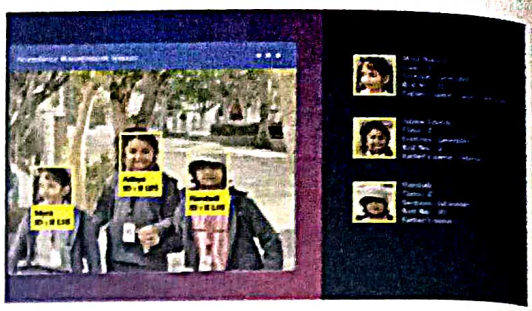
A picture or an image can be broken down into pixels which are the smallest elements of a picture. Computer Vision converts pictures into pixels and tries to make sense of what is in the picture through the pixels. After breaking down the picture into pixels, the computer also has to be able to extract information from the pixels and interpret what that represents.

Some Applications of Computer Vision

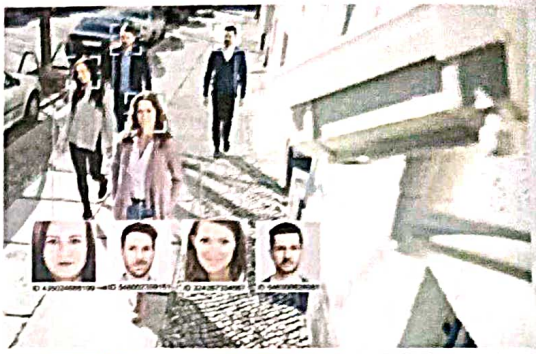
Facial Recognition in multiple industries

Facial recognition system is a technology that is capable of identifying or verifying a person's identity from a digital image or a video from a video source or real-time.

Facial recognition is being implemented for:



Attendance: Moving away from the tradition pen and paper registers to mark attendance or undergoing one person at a time biometric scan, facial recognition permits identifying several persons at the same time, thereby removing the wait time or the inconvenience of capturing attendances in offices, manufacturing units and educational institutions.



Security: There are a large number of security-related applications of the Facial Recognition technology. This technology is applied for surveillance where suspicious activities or suspicious behaviour of persons can be detected and any attacks prevented. It is also being used by customs and border patrols officers to keep unwanted visitors out of a country and control entry into and departure from the country. Smart home solutions use facial recognition to check if a person can enter their home.

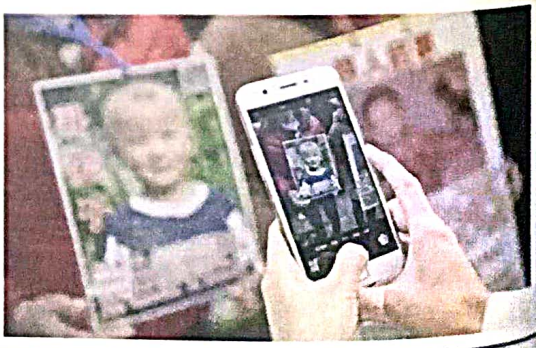
Access Control: Face Recognition systems help control access to personal devices, residences, vehicles, offices and other premises. With Face Recognition, access would be enabled only for individuals themselves or for those whom they authorize.

Self-Payment systems: In some departmental stores, people can pay for their purchases using the facial recognition without the assistance of cashiers.

Internet search engines: Image search engines use this technology. Facebook can track its users across the internet and other Facebook profiles with image data provided through user sharing.

Airports: Many airlines use on-board facial recognition technology. Several airports around the world have set up face matching systems to help board passengers faster and more safely.

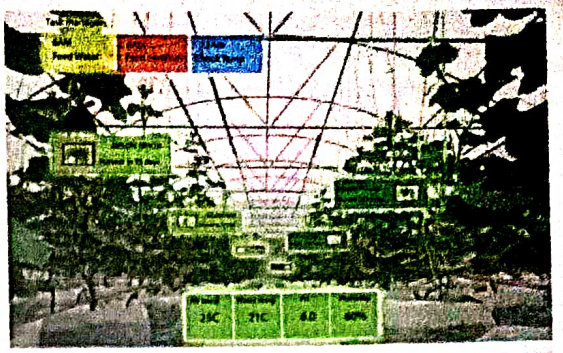
Speeding up hotel check-in: Hotels have started using face recognition to enable guests to skip front desk lines and cut down the time required for check-in process.



Personalising recommendations by tour operators: Tour operators offer face recognition-recommended tour options. The Facial Recognition solution, determines which of the tourist activities, presented to the viewer on the tour operators' website, is likely to be most liked by the traveller.

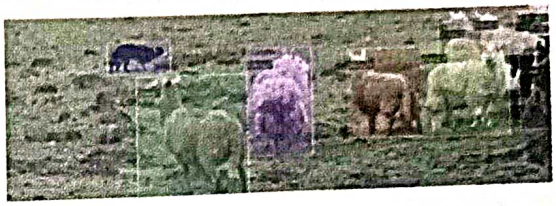
Tracking missing people: Facial recognition is helping in tracking missing people.

Agriculture



Crop Monitoring: Fields can be remotely monitored by using drones installed with cameras enabled with computer vision and geothermal technology. It can identify fertile as well as non-fertile areas, monitor crop health and soil conditions.

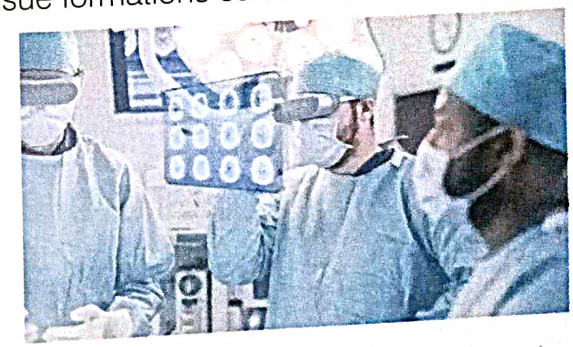
Pesticide spraying: Drones with spray guns and cameras enabled with computer vision can identify areas that need pesticide and spray accordingly. This is a much faster and safer method of spraying pesticides as only the required amount and in required areas gets sprayed. The farmers also avoid direct contact and exposure to pesticides.



Monitor livestock: Computer vision technology is used for monitoring the health of livestock accurately with real time data, count their numbers using drones, track their movements and monitor their food supply.

Healthcare

Computer-aided inspection of X-ray, CT, and MRI scans: Computer vision technologies helps in detection of anomalies of internal organs while viewing MRI, CAT and X-Ray scans, detection of microscopic bone fractures, early-stage detection of new tissue formations such as tumours etc.



Surgeries: Computer Vision technology is being used for Pre-operative and surgical planning, navigation for on-going surgeries, Integration with robotic surgery planning software, MRI-based arthroplasty planning, visualizing arteries and blood flow during surgeries, etc. It also helps in keeping track of surgical instruments before and after surgery.

Diagnosis of diseases: Using the 3D images of 2D pictures and scans created by computer vision, the technology can read the images and analyse them to highlight symptoms and signs of disease. It detects minute anomalies and deviations from the norm, that can be overlooked by physicians during manual observations. This facilitates the doctors in getting a better understanding of the patient's health condition. For example: Retina scans and subsequent analysis help in early-stage detection of eye development anomalies.

Medical Research: Computer vision helps in speeding up the process of investigating and testing new treatments and technologies. This is enabling scientists in researching and releasing new medications faster and more economically.

Sports

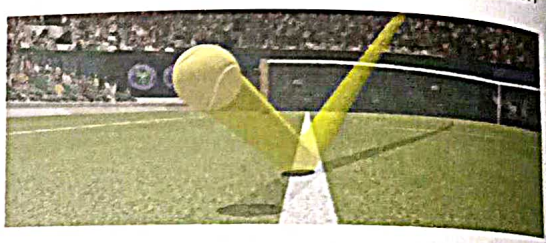
Computer Vision technology is being deployed in several areas of sports. Some of them include:

Improving viewer's experience: Computer vision enables broadcasters to enhance the viewers experience as cameras know where to focus and automatically finding the action instead of just showing a panoramic view of the whole field.

Enhancing sports training sessions: Automatic sports analysis and insight-based analysis play an important role in sports training. Computer vision helps in analysing the performance of players.

Checking referee decisions: Computer vision is being used for 3D simulations and video inspection to check things like offsides, goals, outs, and photo finishes in races.

Mapping athlete positions: Events such as marathons and cycling races have thousands of participants. Computer vision can analyse footage and identify individuals based on attributes such as their jersey number. This can also help organizers automatically update spectators about the results.



Ball tracking: Ball tracking using computer vision helps umpires in knowing which side of the line the ball landed.

Automotive

Computer vision is enabling the automotive sector to become smarter, safer, and more efficient. Some applications of computer vision in automotive industry include:

Quality control: In earlier times, quality control used to be conducted manually. Now, computer vision-enabled cameras at the assembly line are being used for inspection of several details during production such as detecting welding defects which are not visible to the naked eye, detecting functional flaws, accuracy in assembling all electronic components and several other details to ensure product and process quality.

Autonomous driving: The self-driving vehicle is a well-known application of computer vision. Self-driving vehicles need precise visual training to detect or recognize the objects on the street and ride in the proper lane to avoid collisions. These vehicles are equipped with high-definition cameras with a computer vision system along with other sensors and software which can detect the 360 degrees of movements of pedestrians, cyclists, other vehicles, objects and road work. That system guides the car's movement.

Accident prevention: Self-driving systems that are computer vision-enabled can also prevent accidents. These vehicles are fitted with automated braking or collision avoidance systems and when the computer vision-enabled cameras detect pedestrians, vehicles, and other objects, these systems automatically stop the car, in case the driver fails to do so. These systems are now present in vehicles in several countries that include Japan, the US, Australia, and countries in the European Union.

Real-time traffic signs detection: Computer vision algorithms are used for recognising traffic road signs. This is used for autonomous vehicles as well as vehicles having the Advanced Driver Assistance Systems (ADAS). These cameras for traffic sign recognition, are also being used for road maintenance works and road safety.

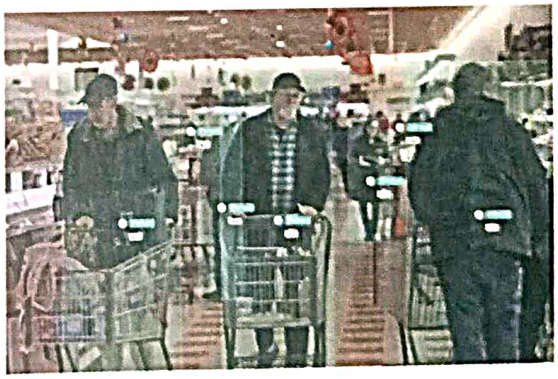
Retail Stores

A large number of retail and e-commerce companies use computer vision solutions in order to meet customer needs in a better manner and to manage inventory.

Some applications of Computer Vision in retail include:

Inventory management: Inventory management means managing inventory in such a manner that it meets customer demand without having too much of extra stock that could go waste, or stocking not enough inventory leading to running out of stock. Computer vision enabled smart cameras and sensor systems are used to track inventory levels and products on shelves in real-time. This is helping retailers in improving efficiency and avoiding stock-outs.

Tracking customer's movement: Retail businesses can track customers' movements across the store on their installed computer vision cameras. This enables them to identify the purchasing pattern of customers, their behaviour as well as the areas in the store that are most frequently visited by them. They can then take informed decisions regarding what to stock as well as the placement of the stock.

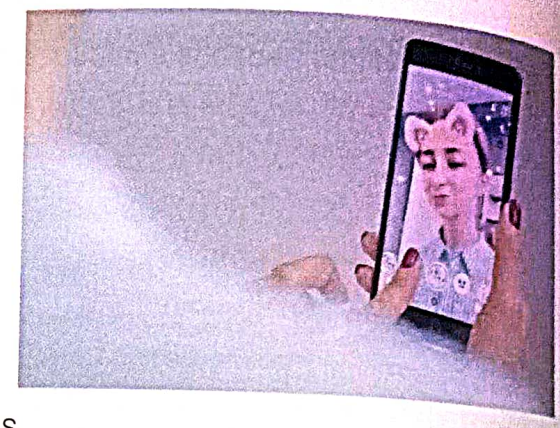


Cashierless stores/self-checkout: Computer vision systems enable in-store cameras and sensors to track products, shelves, and shoppers accurately. The system based on Computer Vision and Artificial Intelligence automatically detects the prices and calculate the bill of products a shopper picks up and automatically charges the shopper for the marked products as he or she exits from the store. An example of such a store is Amazon Go.

Virtual mirror technology: These mirrors are computers that are enabled with several technologies that include advanced computer vision algorithms. The smart mirror enables shoppers to just stand in front of the mirror and choose the clothing they want to try. It can display similar products or the same product in different colours that are available in the store. The shoppers can also select different sizes to know which one fits them perfectly. The shoppers no longer need to wait in long queues in stores to try on different dresses. This helps in enhancing customer experience.

Face Filters

Many photoshop software products such as Adobe photoshop or analogue techniques such as Airbrushing have been in use for enhancing attractiveness or any other manipulation of photographs. However, using these techniques requires a fair amount of skill. Computer Vision technology-based filters, on the other hand, work automatically by using complex algorithms and require little or no input from the user. Because of ease of usage, the filters have become very popular on social media as well as individuals using it for manipulating their photographs.



Computer Vision based AI Game: Emoji Scavenger Hunt

Google's Emoji Scavenger Hunt is a fun game that you can play using your phone's camera. It is a Computer Vision based game. Emoji Scavenger Hunt works by using your phone's camera and machine learning to identify objects in the real world. In this game, the machine initiates the game by showing an emoji—such as, a watch or a newspaper—and ask you to look for the real-life version of that object as a timer counts down. Once you find the object, just point your camera at it and the game should be able to identify whether it is the correct item. You will then move on to the next round, and the game will add a few more seconds onto your timer for every item you find.

This game is an example of how machine learning can be used in fun ways.

Rule of the game:

Find the emoji and point your camera at it before time expires.

The link for playing Emoji Scavenger Hunt is:

https://emojiscavengerhunt.withgoogle.com/

To get started:

Go to https://emojiscavengerhunt.withgoogle.com on your phone.

- Tap the **Let's Play button**.
- You'll start out with 20 seconds on the clock, and the faster you find items in the scavenger hunt, the more time is added to your clock.

- You'll have to tap **Next Emoji** so that Google can take you on to the next item.

If you keep the sound on your phone on, you can hear all the items being identified as they come into the camera's view.

Natural Language Processing (NLP)

We use words to speak to each other. When your friend talks to you, your friend's words are the input received by your ears. Your brain then processes those words and the output is the response that you give to your friend. The language of communication is known to both of you. The natural language is being processed by both of you.

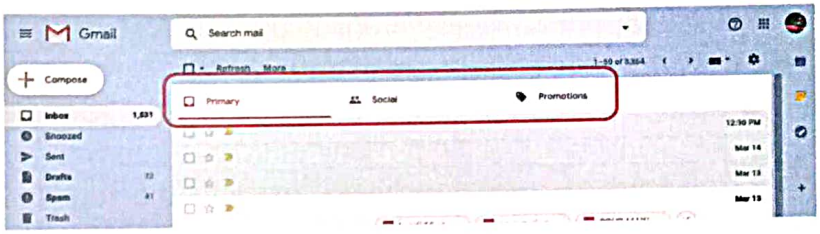
What is Natural Language Processing?

Natural Language Processing is a domain that deals with understanding and responding to human language. NLP allows humans to speak with computers in their own language.

The ability of a computer to understand human language i.e. the command (which is either spoken or written) and to process the command and give an output is called Natural Language Processing.

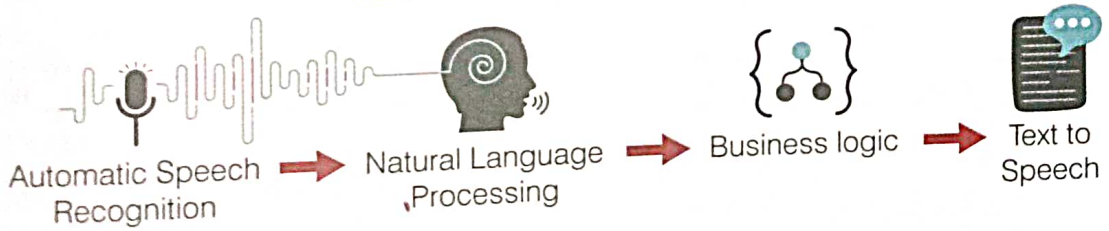
Some Applications of Natural Language Processing are:

Email filters: With communication becoming largely digital, the number of emails that we receive on a daily basis is increasing by the day. Email filters are one of the most basic and initial applications of NLP online. Initially, the e-mails were getting segregated into those that remained in the Inbox and those that went into the Spam mail category. One of the newer applications of NLP is found in Gmail's email classification wherein the system recognizes if emails belong in one of three categories—Primary, Social, or Promotions based on their contents.

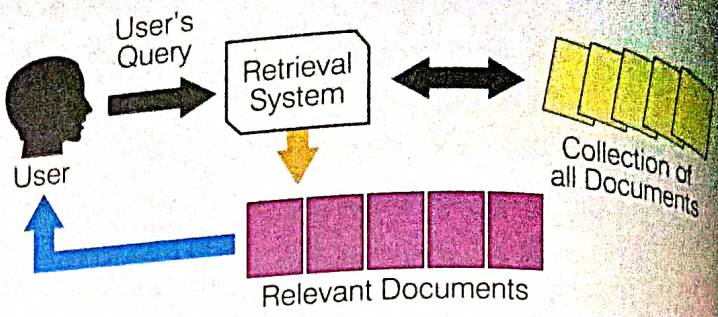


Smart Assistants: Voice assistants, such as Siri, Google Assistant, Cortana and Alexa, can understand and respond to human speech and perform tasks based on voice commands, using NLP technology and speech recognition software. Speech recognition is when a system is able to give output by understanding or interpreting a user's speech as an input or a command. Virtual assistants are available on smartphones, tablet devices, computers and laptop and also as stand-alone devices. These voice assistants start with a signal word. When users say the signal word -also called the **"wake"** words of their voice assistants, they respond by listening to you. For example: When we say, "Hey Siri" and ask a question, "Siri" understands the question and responds appropriately. These voice assistants learn in the same manner as humans learn and always try to improve.

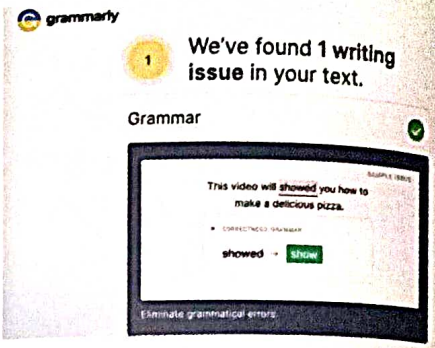
Working of a Voice Assistant



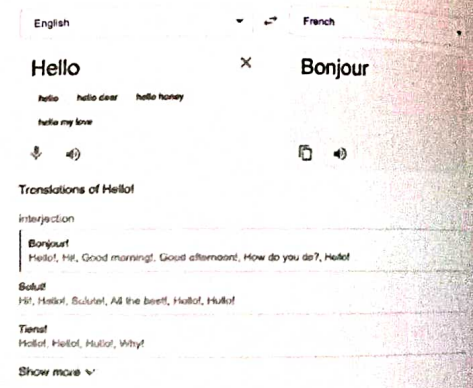
Search results: Search involves understanding language. The search engines need to understand what the user is searching for, and then surf through relevant information from the web and present the same to the user as a list. NLP makes it possible to understand the meaning of words, sentences and texts to generate information, knowledge or new text. The users get instant access to relevant web pages, images, an knowledge cards for any search key phrase that they enter.



Autocorrect, Autocomplete and Predictive Text: Autocorrect and Predictive Texts predict things based on what we type and finish the word or suggest what should be typed next. Autocorrect, corrects the words which are misspelt or just changes the word to make the meaning of the sentence proper and clear. Predictive Text customizes to the language used by the individual user. All these utilize NLP technology.

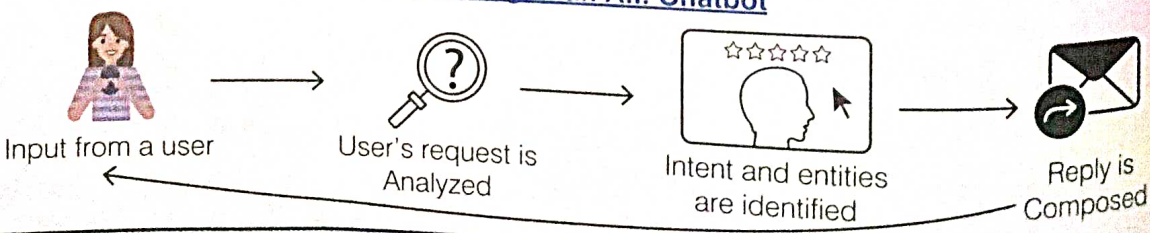


Language translation: Machine Translation is the procedure of automatically converting the text in one language to another language while keeping the meaning intact. There are translation tools such as "Google Translate" available that help many individuals as well as businesses in properly translating text into the required language. Earlier, machine translation systems were dictionary-based and rule-based, and they were limited in terms of proper translations. With the help of NLP, online translators can translate languages more accurately and present grammatically correct results.



Chatbots: Many companies use chatbots for their apps and websites, to answer basic queries of customers. Chatbots are programs that are similar to voice assistants. They are available to assis customers 24/7. This saves the companies from hiring staff for answering simple queries and the customers benefit by not having to wait to interact with a customer care executive. Apart from answering simple queries, chatbots today are also recommending products as well as getting feedback from the customers. Chatbots can do almost everything which earlier a customer helpline person used to do This facilitates smooth customer experience.

Working of an A.I. Chatbot



Digital phone calls: When we call large companies, in many of them, automated systems direct customer calls to a service representative or online chatbots, which respond to our requests with helpful information. This is done using NLP. Many times, we also hear "this call may be recorded for training purposes". This recording gets put in the database so that the NLP system can learn and improve itself.

Sentiment analysis: NLP is used for sentiment analysis. It is the technique of analysing words in a text so that the general sentiment or the emotional tone of the text can be understood and categorised as either positive, negative or neutral. NLP techniques classify keywords and phrases according to whether they contain specific positive, negative or neutral sentiments. This enables businesses to be aware about the strength of their relationships.

POSITIVE
Loved your work.

NEUTRAL
Good job but I will expect a lot more in future.

NEGATIVE
Totally dissatisfied with the service.

Social Media Monitoring: NLP techniques are used by businesses to analyse social media posts and generate useful insights into what the customers think about their products. Social media monitoring is also done by these businesses to understand the issues and problems that their customers face with regard to their products. Governments, too, monitor social media, to identify any potential threats to the security of the country.

Targeted Advertising: Targeted advertising is a type of online advertising in which only relevant advertisements are shown to the users based on their online activity. Targeted advertising works mainly on keyword matching as well as recent websites visited by the users and the time spent by them on specific sites, etc.

Natural Language Processing based AI Game: Mystery Animal

Mystery Animal is a game based on Natural Language Processing.

In this game, the player has to guess the animal by asking a maximum of twenty questions to AI using his voice. Any yes and no questions can be asked—such as "Do you live in water?", "Do you eat meat?"

The link for this game is:

https://experiments.withgoogle.com/mystery-animal

Rules of the Game: You can only ask Yes-No questions such as 'Are you a reptile?' or 'Do you have feathers?'. You need to create good questions that help in narrowing down the animal. See whether or not you are able to guess the animal in 20 questions.

For each question asked by the player, the computer will answer aloud. There is no typing or reading needed. The computer understands the questions posed to it in natural language and gives an answer.

EXERCISES

I. Multiple Choice Questions

1. **NLP stands for:**
   (a) Neuro-Logical Presentation ☐ (b) Natural Language Processing
   (c) Neutral Language Processing ☐ (d) Natural Learning Process

2. **Computers are able to identify and process images like the humans do, using:**
   (a) NLP ☐ (b) Data Science
   (c) Computer Vision ☐ (d) Prototyping

3. **Which of the following is an application of Artificial Intelligence?**
   (a) Automatic door ☐ (b) Self-serving kiosk
   (c) Self-driving car ☐ (d) Self-watering plant systems

4. **Data Science in E-Commerce is used for:**
   (a) Price optimization ☐ (b) Inventory management
   (c) Fraud detection ☐ (d) All the above

5. **Monitoring driver behaviour using AI helps in:**
   (a) Selling more cars ☐ (b) Profit maximization
   (c) Preventing accidents ☐ (d) Inventory management

6. **Rock Paper Scissors is an AI game based on:**
   (a) Data Science ☐ (b) Computer Vision
   (c) Natural Language Processing ☐ (d) None of the above

7. **Mystery Animal is an AI game based on:**
   (a) Data Science ☐ (b) Computer Vision
   (c) Natural Language Processing ☐ (d) None of the above

8. **Emoji Scavenger Hunt is an AI game based on:**
   (a) Data Science ☐ (b) Computer Vision
   (c) Natural Language Processing ☐ (d) None of the above

9. **Facial recognition is being used by police for:**
   (a) Tracking missing people ☐ (b) Identifying criminals
   (c) Keeping track of suspects ☐ (d) All the above

10. **AI in surgeries is used for:**
    (a) Visualizing arteries and blood flow during surgeries
    (b) Replacing surgeons
    (c) Eliminating the need for nursing staff
    (d) None of the above

II. True or False

1. Data Science involves obtaining useful insights and information out of data.
   (a) True (b) False
2. In healthcare, clinical diagnoses enable quicker detection of disabilities as compared to big data analysis.
   (a) True (b) False
3. Data Science has been instrumental in automating various financial tasks.
   (a) True (b) False
4. The game designs play a very important part in keeping the players engaged and interested in playing AI-based games.
   (a) True (b) False
5. The search engines sort through billions of web pages and present the list of the most relevant results in fraction of seconds by using computer vision algorithms.
   (a) True (b) False
6. Computer Vision converts pictures into pixels.
   (a) True (b) False
7. Individuals need to possess a fair amount of technical skill to use face filters.
   (a) True (b) False
8. NLP allows humans to speak with computers in their own language.
   (a) True (b) False
9. Segregating emails into Inbox and Spam mail categories is done using Chatbots.
   (a) True (b) False
10. Sentiment Analysis can be done using NLP.
    (a) True (b) False

III. Answer the Following Questions

1. Name the three domains of Artificial Intelligence. How are these three domains interrelated?
2. What is the importance of data in artificial intelligence?
3. Define Data Science? Write about any three applications of Data Science.
4. What is Computer Vision? Write about any three applications of Computer Vision.
5. What is Natural Language Processing (NLP)? Write about any three applications of Natural Language Processing.
6. Name the program that detects unwanted mails and moves them to a different folder.
7. What is Facial recognition? Write about any three areas where this technology is being deployed.
8. What is virtual mirror technology?
9. How is Computer Vision technology being used in autonomous vehicles?
10. What are chatbots? What advantages do they offer to businesses?

IV. Class Discussion

Divide the class into three groups. Assign each group one domain of Artificial Intelligence. Let e... group make a presentation to the whole class on the applications of the domain of AI assigned ... them.

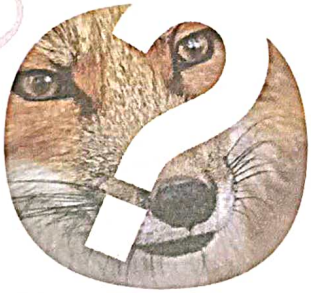
ACTIVITY 1

Identify the games from the photographs given below. Play these games using the links given in t... chapter.

(i)

(ii)

(iii)



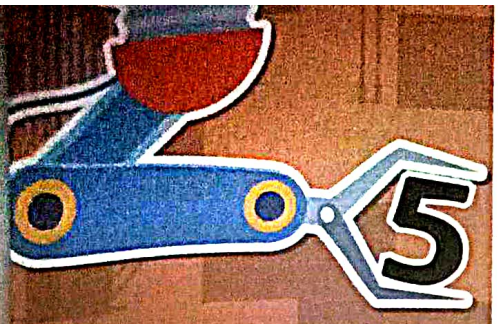
ANSWERS

I. Multiple Choice Questions

1. (b) 2. (c) 3. (c) 4. (d) 5. (c) 6. (a) 7. (c) 8. (b) 9. (d) 10. (a)

II. True or False

1. (a) 2. (b) 3. (a) 4. (a) 5. (b) 6. (a) 7. (b) 8. (a) 9. (b) 10. (a)



Future of Artificial Intelligence

In this chapter, you will learn about:

- *Artificial Intelligence as it is today.*
- *Narrow Artificial Intelligence and General Artificial Intelligence*
- *Future of Artificial Intelligence*
- *Future of Artificial Intelligence in Automotive Sector, Cyber Security, Chatbots and Virtual Assistants, Healthcare and Financial Industry.*
- *Looking Ahead*

Artificial Intelligence Today

The AI-powered gadgets that seemed like luxury a while ago, have now become a part of our everyday lives. The AI technology is prevalent in practically all spheres of life–we use it without realising it is AI powered.

Whether it is using a search engine to look for information, using voice assistants on our phones, asking Alexa, Google Assistant or Siri to answer our questions and perform functions, encountering facial recognition at multiple places, being provided answers by chatbots, coming across speech recognition, or witnessing advanced automation in various gadgets–what is common in all these is that they all are AI enabled. Even when we apply for jobs, in many large organisations, AI does the initial screening of resumes.

AI and machine learning are replacing the traditional methods of computing. This is causing a change in the style of conducting day to day businesses of companies and their performances. AI has pervaded practically all industries.

Narrow AI

There are limitations to what AI is capable of today. Typically, AI can execute one task at a time. Most AI applications in use today can be categorized as being narrow AI. Narrow AI is also known as weak AI. In Narrow AI, the algorithms are designed to perform a single task, and any knowledge gained from performing that task will not automatically get applied to other tasks. Narrow AI simulates human behaviour in machines, but it does so with a narrow range of abilities. It cannot perform tasks by "thinking" of something unless it has been specifically programmed for it.

Humans, on the other hand, possess Generalized Intelligence as they possess the cognitive abilities to learn, recognize patterns, form concepts, understand, apply logic and reason. They can plan, innovate, solve problems, make decisions, remember information, and use language to communicate.

Narrow AI	General AI
Inferior to human intelligence.	Similar to human intelligence.
Also known as weak AI.	Also known as strong AI or full AI.
Lacks artificial consciousness or cognitive abilities.	Has human-like consciousness and cognitive abilities.
IBM Watson, Alpha Go, and Google Assistant are some examples.	Yet to become a reality.
Can't solve unfamiliar problems.	Can solve unfamiliar problems.

Future of AI

AI is still a long way away from reaching a point wherein it is comparable to human intelligence. It is not a case of "humans or computers" but rather "humans and computers" which would work together in complex systems for advancements in all fields. Businesses, governments, and large companies have realised the potential of AI, and the funding and focus on AI research has increased which will facilitate accelerated growth in AI-based technological advancements.

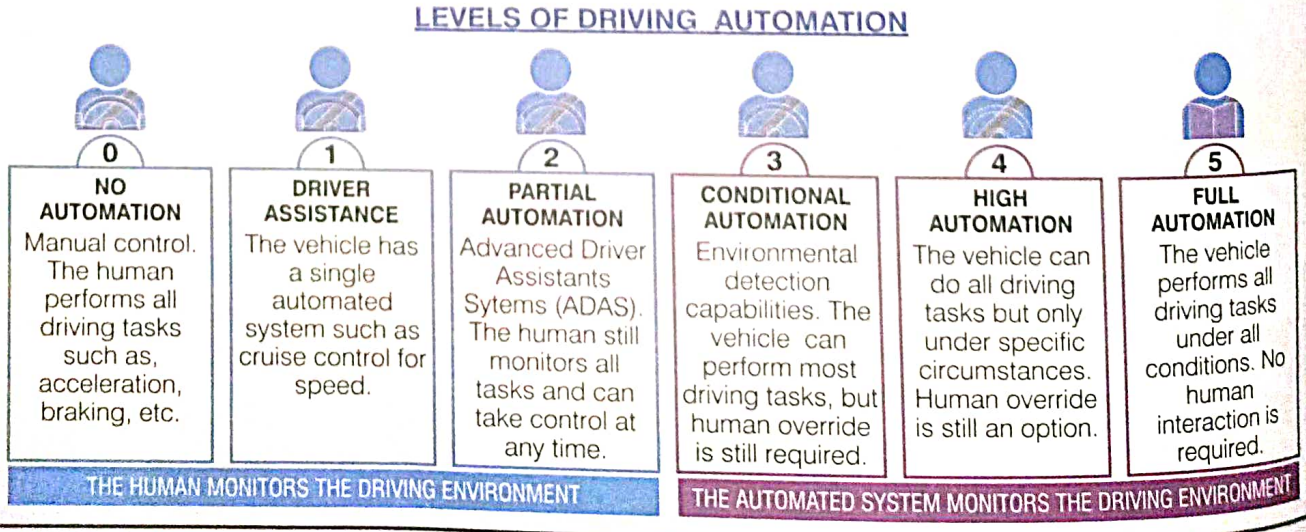
A look at the Future of AI in some of the Industries

Having already learnt about the future of AI in a few sectors in Class VII, let us look at the future of AI in some other areas.

Automotive Sector

AI has already been used in the automotive sector and its usage is going to increase in the coming years. As the technology continues to improve, more applications of AI will be implemented in the automotive sector. Self-drive cars are already available and being manufactured by many companies such as Tesla, Volvo, Ford, BMW, Mercedes-Benz, to name a few. However, they are still not fully autonomous.

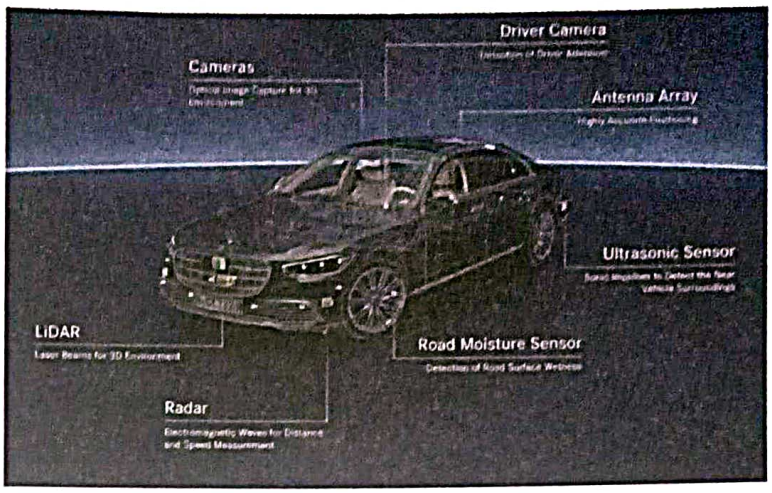
SAE International has outlined six levels of driving automation (Level 0 to level 5). These levels identify how autonomous a vehicle is. The less human intervention an automated car requires to operate, the higher its level of automation. For example: Does the car need a human behind the wheel, or can it drive without the driver?



Mercedes Benz's Drive Pilot system is an example of Level 3 automation. These vehicles can navigate around traffic, detect weather conditions, and automatically merge when lanes of traffic end. However, the system is limited to certain geo-fenced areas.

Companies such as Waymo and Cruise are testing fully autonomous driving and driverless taxis are being operated in some cities but are not yet common.

Autonomous vehicles perceive the environment around the vehicle, using a variety of sensors – Radar, Lidar(light detection and ranging sensors) and ultrasonic sensors, as well as video cameras positioned in different parts of the vehicle. These sensors and cameras are used for monitoring the position of nearby vehicles, measuring distances, detecting road edges, detecting curbs and other vehicles, detecting traffic lights, reading road signs, tracking other vehicles, and looking for pedestrians. The vehicle then takes pre-programmed actions based on what those sensors detect.



There are still some challenges to be overcome before the autonomous cars can be commonly used in all places, but these challenges will be overcome in the near future.

In the near future AI in automotive industry will:

- Address environmental issues and shall focus on improving vehicle safety, performance, and efficiency and reducing emissions.
- Develop new manufacturing processes and automate more tasks in factories.
- Design better and safer vehicles.
- Be able to handle all aspects of driving such as navigation, traffic management and parking.
- Design cars that can communicate with each other and with other road users.
- Make driving more pleasurable and safer.
- Learn driver's preferences and provide personalized recommendations.
- Help drivers avoid accidents by automatically taking necessary evasive action.
- Help reduce car accidents by up to 90%.
- Develop car-sharing schemes by matching drivers with others undertaking similar journeys thereby reducing need for car ownership.
- Be able to sync with personal calendars, suggest alternative routes based on real-time traffic conditions.
- Design vehicles that will be more autonomous.

Cyber Security

What is Cyber Security?

A cyberattack is an attempt by hackers to damage or destroy a computer network or system. It is

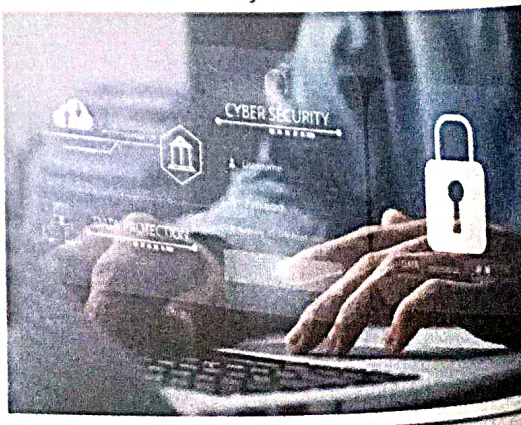
any offensive attempt that targets computer information systems, computer networks, infrastructures, or personal computer devices. The number of cyber threats that individuals and organizations face is increasing.

Cyber Security is the application of technologies, processes, and controls to protect systems, networks, programs, devices, and data from cyberattacks. Cyber Security helps to protect critical systems and sensitive information from digital attacks. Cyber Security is an ever-growing industry that is developing and evolving to protect individuals and organizations from cyberattacks.

As the data being generated today is exponentially increasing, it is going to get more and more difficult for humans to implement cyber protection and hence the role of AI in cyber security is going to increase.

AI cyber security will be complementing cyber security experts by taking over some of the task AI-enabled machines process vast volumes of data quickly and accurately and identify informati that is unusual. This will enable humans to examine the deviations identified by AI.

You must be aware of the danger of using weak passwords and the advice that is always given to make sure that the passwords should be strong so that hackers are unable to access your accounts. Adding AI-based biometrics such as facial recognition, to a strong password, will add an additional layer of security.

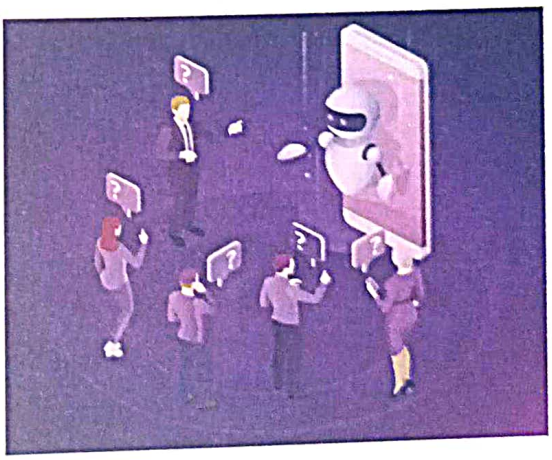


In the near future, AI in Cyber Security will:

- Monitor, analyse, and respond to security issues at a much faster pace than human analysts.
- Identify low-level signal jamming before it disrupts and brings down the network.
- Play an important role in identifying and predicting threats in cyber security.
- Will not only detect potential security threats, vulnerabilities, and malicious activities, but shall stop them before they cause any harm.
- Filter through information very quickly to find any potential dangers owing to AI's strength in the very high speed and accuracy of processing data.
- Protect IoT devices that are vulnerable to cyber threats by detecting deviations in traffic and sending warnings to security administration personnel.
- Provide a real-time understanding of an expanding enterprise attack surface.
- Data breaches that occur due to human error will be avoided by using AI.
- Train organizations in being able to distinguish between legitimate and malicious files, connections, devices, and users.
- Recognize typical patterns in network activity or data access; identify, evaluate, flag anomalies, and decide if response or any intervention is required.
- Make organizations aware of likely malicious cyberattack routes, so that network vulnerabilities can be addressed.
- Prepare organizations by exposing them to simulation attacks, so they become aware of how to mitigate these threats.
- Make organizations capable of handling AI driven cybercrimes.
- Manufacture machines that eventually protect themselves.

AI-Powered Chatbots and Virtual Assistants

Chatbots



AI-powered chatbots are now being used routinely in industries such as healthcare, finance, marketing and sales, travel and hospitality etc. Businesses are incorporating better artificial intelligence capabilities for their chatbots so that they are able to handle the specific issues customers have and can understand more complex questions that may be posed to them. Such chatbots are able to understand customers' queries and provide the information that customers frequently tend to require. The customer gets the information they need in a way that is cost-effective for the business. The chatbots are able to classify and forward customer requests for processing and can provide users with personalized offers and support. This is reducing the need for human staff.

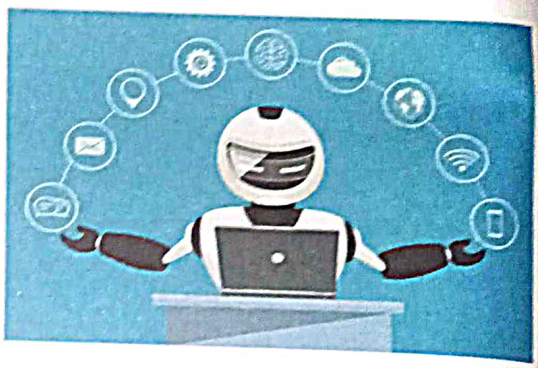
In future, chatbots will:

- Change the way businesses communicate and understand their customers.
- Be able to deliver a more personalized customer experience.

- Be able to provide more precise insights and intelligent recommendations at a faster pace.
- Save business money through customer service, internal processes, and marketing efforts.
- Possibly get incorporated throughout a business's website, app, and social media platforms.
- Be available on mobile phones and other mobile devices.
- Provide users with communication at a level that is close to human-to-human interaction.
- Become so good at communication that it will seem as though communicating with a human being.
- Work together with other mobile apps, such as, face and gesture recognition, translation, etc.

Virtual Assistants

Many of us are using AI-powered virtual assistants when we speak to Alexa, Cortana, or Google home. A virtual assistant is an application program that recognizes natural language voice instructions and completes activities for a user.



AI-powered Virtual Assistants assist us with our daily work and do many things such as ordering food from our favourite restaurants, selecting the right music, switching on lights, sending emails, etc. These Artificial Intelligence Virtual Assistants can also assist with a business and help them in saving a significant amount of money. Virtual assistants in offices can assist with marketing, website architecture, and many other administrative tasks.

In the near future, virtual assistants will be able to:

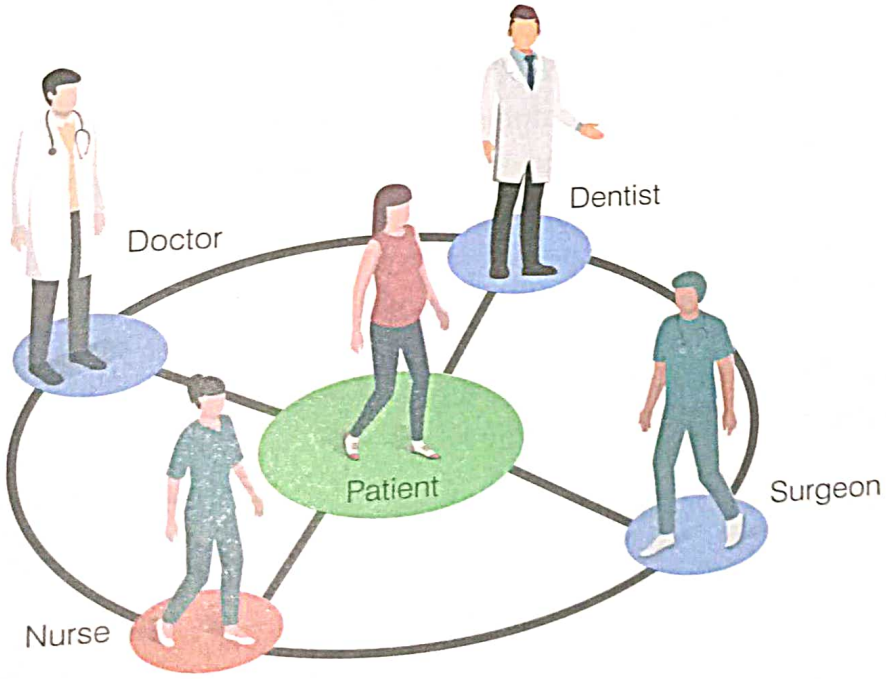
- Help employees and customers of organizations by increasing efficiency and providing support.
- Perform more everyday tasks, thereby enabling employees to spend more time on other duties.
- Provide increased customized automated solutions.
- Answer complex inquiries, offer recommendations and predictions, and even conduct a discussion.
- Extract information and sophisticated data from dialogues.
- Recognize behavioural patterns and adapt based on new data by merging new knowledge gained with past knowledge.
- Help in e-commerce by helping consumers as they browse–recommending products that are popular, suggesting options to add accessories and answering questions about sizes, their availability, warranties, etc.
- Provide support for shopping, buying, and owning experiences throughout the consumer's journey.
- Assist in providing personalized and differentiated experiences to consumers.
- Become a new digital workforce that will function along with the human workforce.
- Get amalgamated with Internet of Things and become available on gadgets such as wearable devices, home gadgets, etc.

Healthcare

Healthcare industry has greatly benefitted from the rapid advancement in AI technology and further advancements in AI will continue to benefit healthcare industry even more.

In the near future, some AI-based advancements in healthcare will be in the following areas:

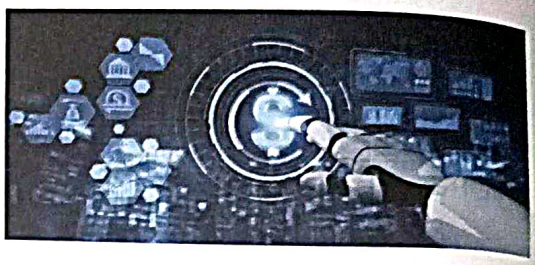
- Healthcare will largely rely on data.
- Disease diagnosis will be faster, more accurate and less invasive. Early detection will significantly increase the patient's chances of successful treatment.
- There will be a shift from "healthcare" to "health." While diseases will not be eliminated, it will become possible to identify them earlier, intervene proactively, and better understand its progression to help patients.
- Focus will be on wellness which will be professionally managed by healthcare companies.
- Individual wearable and non-wearable devices that track key health indicators and provide real-time feedback. These will play a supplemental role as a personal health advisor.
- Drug discoveries will be faster using automation and customization of research and trials, and scientists will also run virtual clinical trials.
- Portable medicine such as telemedicine, in which health care providers treat patients over phone or video, is one healthcare delivery method, which will increase.
- Healthcare providers will be increasingly engage in remote patient monitoring.
- Focus will be on patient centric care where the patients will participate in decisions regarding their own care, to make sure that it meets their needs.



- Care facilities—both virtual and physical, will provide patient-centric delivery of products, care, wellness, and well-being.
- Nanotechnology and proton therapy, will serve as alternatives to traditional surgery, making treatments safer and less invasive.

- 3D printing to create prosthetic limbs and 4D artificial organs printed from living tissue to replace organs will take place.
- Implementation of neural interfaces that let prosthetic devices interact directly with the wearer's brainwaves to move in reaction to their thoughts will happen.
- Precision medicine, which is patient centric, will be increasingly practised. Precision medicine uses data analytics and new technologies to tailor-make care for specific individuals, considering several parameters such as patients' genetic make-up, socioeconomic status, etc.

Finance



The financial sector is actively implementing artificial intelligence technologies for various purposes such as the security of funds, client experience, filling gaps within financial services offerings, management decision-making and many others.

In the near future, AI in financial sector will be instrumental in providing new, as well as improving on many existing facilitations, which include:

- More stringent preservation of consumer confidentiality.
- Increased security of funds and personal data.
- Faster detection of unusual transactions.
- Speedier and more accurate financial transactions.
- Timely detection and blocking of a dubious transaction or unauthorized access to data.
- Identification of clients through the speech processing and facial recognition.
- Customized access to accounts and information, as per the preference of the user.
- Quick recognition of suspicious transactions attempts to steal or forge a digital identity, and other possible fraudulent activities.
- Improved information exchange and interaction between clients and financial institutions.
- Personalized offers of financial services to the customers.
- Text and voice-based customised reminders and prompts offered by robotic advisers to customers.
- Easy availability of detailed analysis of the clients' income, expenses, requests, previous transactions, and risks to the financial advisers.
- Automation of internal work processes of financial institutions which would result in reduction of human-based errors.
- Real time processing of market data enabling investment decisions to be automated.
- More positive customer experience.

Looking Ahead

AI technology is advancing at a very fast pace and is not going to be limited to just making routine and mundane tasks easier. There are certain tasks that AI can perform more quickly and effectively than humans. For example: Voice-based personal assistants such as Siri and Alexa schedule meetings, offer users real time answers to the users' queries, respond to their requests, play the preferred song lists of users and perform many other activities. These free up the users for other activities. These personal assistants become more intelligent every day as they constantly renew and update the knowledge they have about their users.

As many of the routine tasks will become automated, some jobs many cease to exist, but new jobs that will involve working with AI will be created. The World Economic Forum estimates that by 2025, technology will create at least 12 million more jobs than it destroys. There will be a growing demand for data analysts and scientists, AI and machine learning specialists and many others.

AI is currently not equipped to fully understand languages. Work is ongoing in this area. If AI gets this capability, then AI systems would be able to read and understand everything written and AI may soon have the ability to interpret human conversations as effectively as people can.

Jobs will become more exciting as people will learn to work along with AI to solve problems in new ways. The adoption of new technology will permit humans to have more time to be creative and entrepreneurial and focus on higher-value tasks that require interpersonal interactions. They are likely to become more innovative and perform and deliver better on higher value tasks.

EXERCISES

I. Multiple Choice Questions

1. **Typically, AI today can execute:**
   - (a) One task at a time
   - (b) Two tasks at a time
   - (c) Three tasks at a time
   - (d) Many tasks at a time

2. **Narrow Intelligence:**
   - (a) is superior to human intelligence.
   - (b) is inferior to human intelligence.
   - (c) can solve unfamiliar problems.
   - (d) enables possessing cognitive abilities.

3. **SAE International has outlined _____ levels of driving automation.**
   - (a) three
   - (b) four
   - (c) five
   - (d) six

4. **In the near future, AI in automotive industry will:**
   - (a) focus on improving vehicle safety and reducing emissions.
   - (b) design vehicles that will be more autonomous.
   - (c) Both a and b
   - (d) Neither a nor b

5. Adding AI-based biometrics such as facial recognition, to a password,
   (a) add an additional layer of security. ☐ (b) reduces security. ☐
   (c) confuses users. ☐ (d) neither helps nor adds to security. ☐
6. In future, chatbots will:
   (a) be able to deliver a more personalized customer experience.
   (b) be able to provide intelligent recommendations at a faster pace.
   (c) Save businesse's money through customer service, internal processes, and marketing efforts.
   (d) All the above
7. Patient centric care means:
   (a) patients will participate in decisions regarding their own care. ☐
   (b) customized care plan will be developed for individual patients. ☐
   (c) information is fully shared in a timely manner so that patients and their family members can make informed decisions. ☐
   (d) All the above ☐

II. True or False

1. Humans possess Narrow Artificial Intelligence.
   (a) True (b) False
2. The less human intervention an automated car requires to operate, the higher is its level of automation.
   (a) True (b) False
3. As the data being generated today is exponentially increasing, it is going to get more difficult for humans to implement cyber protection.
   (a) True (b) False
4. In future, healthcare's focus will be on wellness which will be professionally managed by healthcare companies.
   (a) True (b) False
5. AI is currently equipped to fully understand languages.
   (a) True (b) False

III. Answer the Following Questions

1. State any three differences between Narrow AI and General AI.
2. What are the sensors and cameras used for in autonomous vehicles?
3. What advancements owing to AI technology would the automotive industry see in the near future?
4. What is the meaning of cyberattack?
5. Explain cyber security and the role that AI can play in helping human cyber security experts.
6. How is AI able to monitor, analyse, and respond to security issues at a much faster pace than human analysts?
7. What improvements is AI likely to offer to chatbots and virtual assistants in future?
8. Write about any three AI-based advancements that may be seen in healthcare in near future.

9. What are the various purposes for which artificial intelligence technologies are used in the financial sector?

10. Write briefly about the broad changes that AI will bring about in our lives in the coming years.

Imagine you are in the year 2030 and write a letter to your future self. Your letter should include the following:

- Description of all that you have learnt so far and all that you would like to learn in future.
- Imagine, examine, and reflect on skills that you are likely to require for futuristic opportunities.
- Include all the things that you see yourself doing and experiencing in future especially related to usage of AI in your day-to-day life.

ANSWERS

I. Multiple Choice Questions

1. (a) 2. (b) 3. (d) 4. (c) 5. (a) 6. (d) 7. (d)

II. True or False

1. (b) 2. (a) 3. (a) 4. (a) 5. (b)

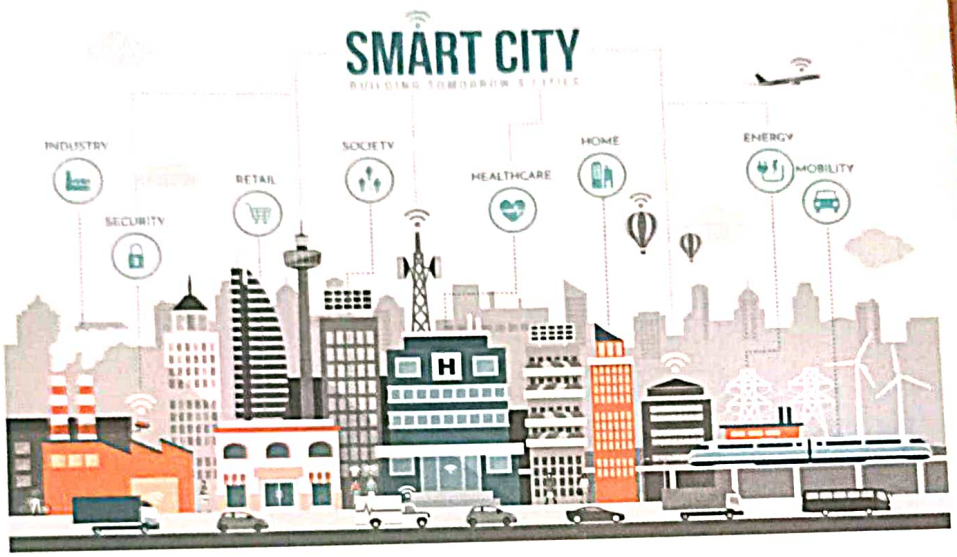
6 Smart Cities, Smart Schools and Smart Homes

In this chapter, you will learn about:

- *What is a Smart City?*
- *An Example of a Smart City/Nation—Singapore*
- *Components of Smart Cities*
- *Features of a Smart City—Transportation, Energy Conservation and Efficiency, Environmental Concerns, Waste Management and Sanitation, Smart Buildings*
- *How do Smart Cities work?*
- *Smart Schools*
- *Advantages of Smart Schools*
- *Smart Homes*
- *What are Smart Home*
- *Advantages of Smart Homes*
- *Some Smart Home Technologies*

Smart Cities

What is a Smart City?



Over the years, a large number of people have migrated from villages and smaller towns to cities. As a result, cities are becoming increasingly more populated and complex to manage. The city governments are using many technological tools to improve various facets of the quality of life which include providing better transport systems, social welfare, economic growth and sustainable environments and many others. One such tool that is used to manage cities is ICT (Information and Communication Technology) and is associated with the concept of smart cities.

A smart city is an urban city that has become more efficient and more environmentally friendly by using digital technology. Being a smart city means using all available technologies and resources in an intelligent and coordinated manner to develop urban centers that are at once integrated, habitable, and sustainable. *(Barrionuevo, Berrone, and Ricart (2012).*

Smart cities use electronic and technological-based infrastructure to collect real time data and insights and use this to make informed

decisions and create effective solutions for solving the city's problems such as improving day to day operations that include public transport, sanitation, water and power supply, quality of government services and citizen's welfare amongst others. The intent is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology.

An Example of a Smart City/Nation

Singapore is an example of smart city/nation. It uses sensors and IoT-enabled cameras to monitor the cleanliness of public spaces, crowd density and the movement of locally registered vehicles. Energy use, waste production and water use are monitored in real time. Autonomous vehicles are being tested on the roads. Testing is on for an elderly monitoring system to ensure the health and well-being of Singapore's senior citizens. Singapore has been consistently receiving top Smart City Index rating for the past few years. The Smart City Index is produced by the Institute for Management Development (IMD) in Lausanne, Switzerland, and the Singapore University of Technology and Design (SUTD). The Smart Cities' Index looks at how well cities are adopting digital technologies and improving the lives of the people who live there.

Components of a Smart City

The different components of a smart city include smart infrastructure, smart transportation, smart energy, smart health care and smart technology. These components are what make the cities smart and efficient.

Technologies such as Information and Communication Technology (ICT), Internet of Things (IoT) devices, software solutions, user interfaces (UI) and communication networks, artificial intelligence, machine learning, dashboards and big data (BD) are helping in transforming traditional cities into smart cities. The IoT is a network of connected devices—such as vehicles, sensors or home appliances that can communicate and exchange data.

Features of a Smart City

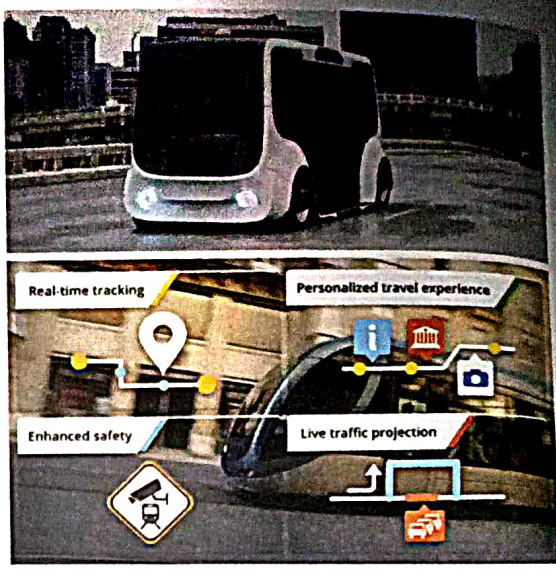
Automation, IOT and AI are accelerating smart city adoption. Some of the features of smart cities include:

Transportation

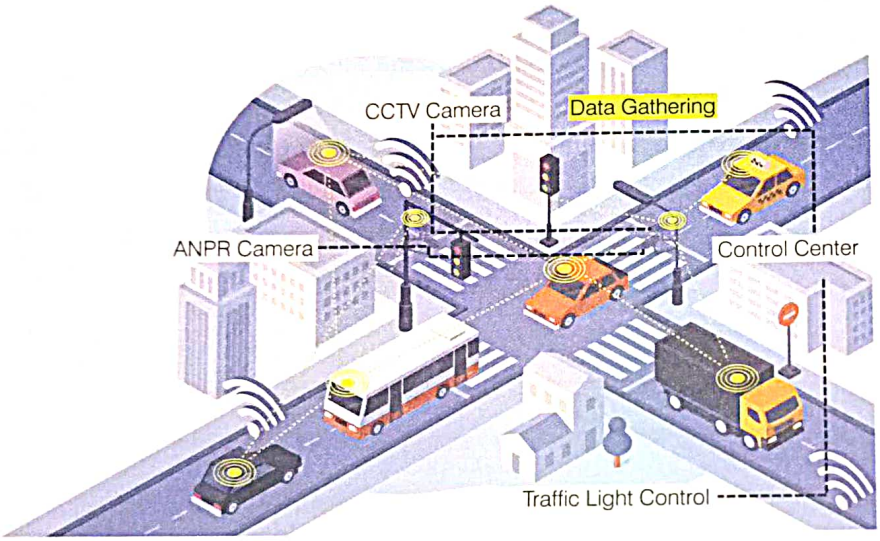
Smart transportation solutions are clean and efficient. They help in reducing traffic congestion, thereby helping in having cleaner air and reduced energy consumption. When the public transportation system is good, people tend to leave their vehicles at home more often, which help contribute to a more sustainable environment.

Smart Public Transit

Smart buses and rail transportation systems offer passengers a convenient and efficient means of travelling. They are equipped with advanced computing, wireless communication, and global navigation satellite system (GNSS). They coordinate services and take care of the commuter's needs. Smart public transit system focuses on improving efficiency and rider satisfaction. Smart transportation solutions are clean and efficient. They help in reducing traffic congestion, thereby helping in having cleaner air and reduced energy consumption.



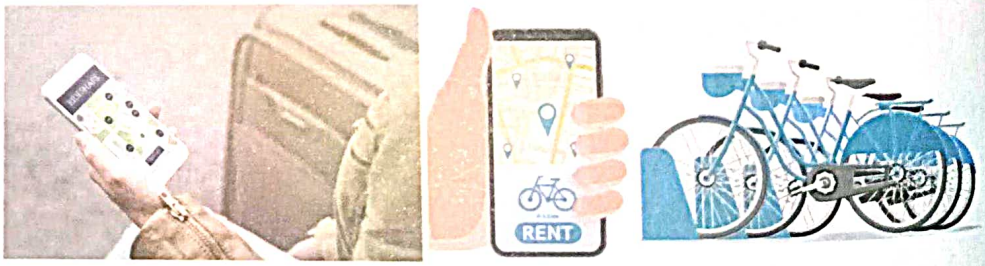
Smart Traffic Management



Smart Traffic Management Systems are technology solutions that are adopted for fast, cost-effective improvements in safety and traffic flow in the city. These help in increasing efficiency and reliability as well as creating cost savings. These systems utilize sensors, cameras, cellular routers and automation to monitor and automatically direct traffic and reduce congestion.

Traffic flow is monitored and analysed in order to optimize streetlights and prevent roadways from becoming too congested based on the time of the day.

Ride-sharing and bike-sharing



The shared use of travel modes, has been rapidly increasing in the last few years. This shared travel mode enables users to gain short-term access to transportation modes on an as-needed basis. These have been made possible because of ICT enabling easy use of shared mobility options by commuters using mobile apps on their smartphones. In addition, the shared travel provides an environmentally better solution as it reduces carbon emissions by reducing traffic congestion.

Smart Parking Meters

Apps help drivers find available parking spaces without having to keep driving looking for a vacant spot. These smart meters also accept digital payment.

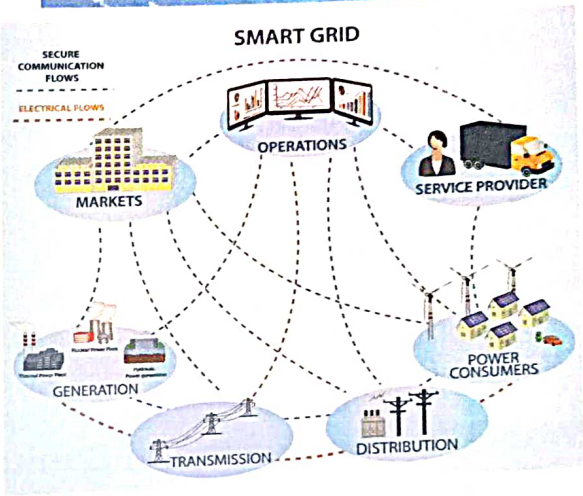
Electric Public Transport

The adoption of electric public transport is increasing all over the world. They offer sustainable mobility solutions, as they significantly reduce greenhouse gases (GHG) emissions, air and noise pollution, and dependence on fossil fuels.

Energy Conservation and Efficiency

Smart Grid

Smart grid is an electrical grid with automation, IT systems and communication. It can monitor flow of power from point of generation to points of consumption and can control the flow of power in keeping with the power that is getting generated in "real time". This enables smart grids to supply power on demand, monitor energy outages, identify losses, take appropriate actions and improve operations.



Smart Sensors

A smart sensor is a sensor that takes some predefined action when it senses the appropriate input. They are used for monitoring and controlling mechanisms for many environments such as smart grids, exploration and many science applications. For example: smart streetlights dim when there are no cars or pedestrians present on the road.

Environmental Concerns

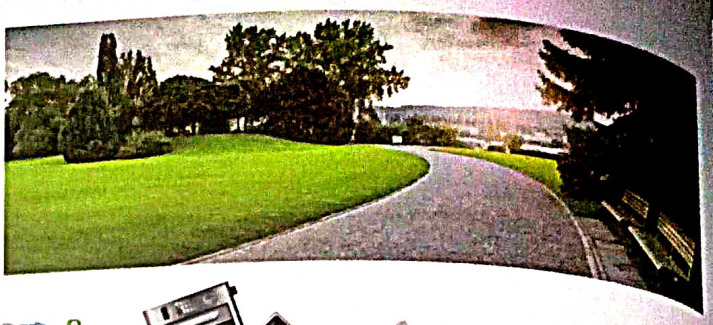
About 56% of the world's population live in cities and it is expected that this will increase to 66% by 2050 meaning nearly 7 out of 10 people will live in cities. To mitigate the environmental impacts of this urban migration and tackle climate change, the concept of smart cities assumes even greater importance.

The report by the Intergovernmental Panel on Climate Change (IPCC) has forecasted global warming of 1.5°C by 2040. And cities are of particular concern as they consume 78 percent of the world's energy and produce more than 70 percent of greenhouse gas emissions.

Majority of the world's economic activity, energy consumption and greenhouse gas emissions occur in cities. Therefore, in order to significantly cut emissions, cities will need to use less energy and use renewable energy whenever possible. Countries around the world have set large targets for cutting greenhouse gas emissions. If such goals are to be achieved, cities will need to use significantly less energy.

Smart Cities are engaged in:

- Creating green spaces.
- Strategies to save water and energy.
- Conservation of freshwater.
- Better waste management.



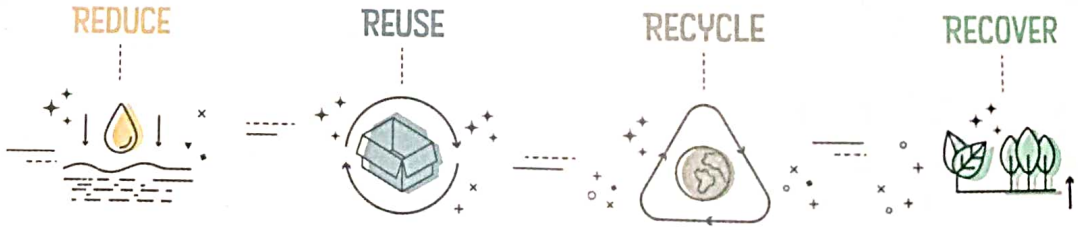
- Reduction of pollution.
- Enabling reduction in demand through efficient urban design and lifestyle changes.
- Investment in climate resilient infrastructure.
- Establishment of platforms for sharing knowledge.
- Incorporating climate and biodiversity concerns into urban programmes and policies.
- Investing in nature.

  Investment in conservation generates positive economic returns, and provides practical gree recovery options.

Waste Management and Sanitation

The production of waste increases with urbanization and increased consumption.

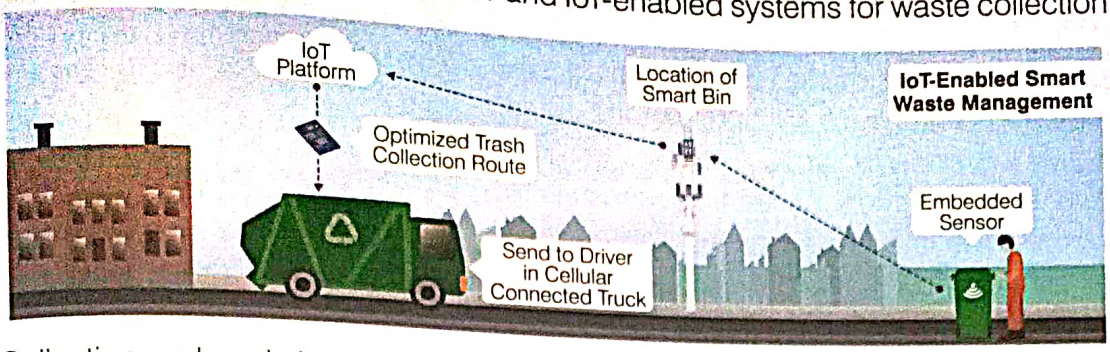
4Rs OF WASTE MANAGEMENT



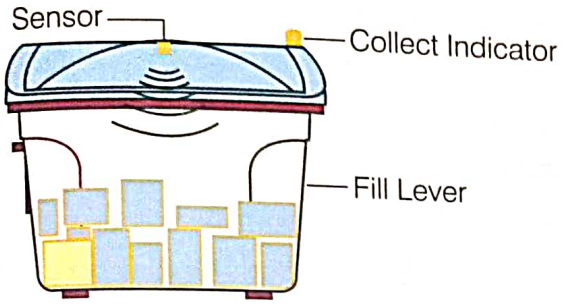
Some solutions being provided by smart cities for waste management and sanitation include:

- Management of waste trucks and urban infrastructure.
- Utilization of information and communication technology (ICT) in waste management.
- Using sensors to measure water parameters and guarantee the quality of drinking water.
- Provision of proper wastewater removal and drainage.
- Waste classification and segregation.

- Using internet-connected trash cans and IoT-enabled systems for waste collection and removal.



- Collection and analytics of data from sensors on smart garbage bins (SGBs).



- Planning and optimization of waste truck routes.

Smart Buildings

New buildings are constructed with sensors. These:

- Provide real time space management.
- Detect leaks in water mains and other pipe system.
- Ensure public safety.
- Monitor the structural health of buildings.
- Detect wear and tear.
- Notify officials when repairs are needed.

Smart city technologies also facilitate urban manufacturing and make urban farming more efficient, enable energy efficiency and space management.

How Do Smart Cities Work?

Smart cities use IoT devices and other technologies to improving the quality of life of people as well as for achieving economic growth.

They:

- Gather data in real time using the connected smart sensors present throughout the city.
- Assess the collected data to draw meaningful insights from it.
- Communicate the insights gathered to the decision makers.

The city officials use these insights to optimize operations, create solutions and improve the quality of life for residents. Some examples of smart cities around the world are Singapore; New York City, USA; Tokyo, Japan and Dubai, UAE.

Smart Schools

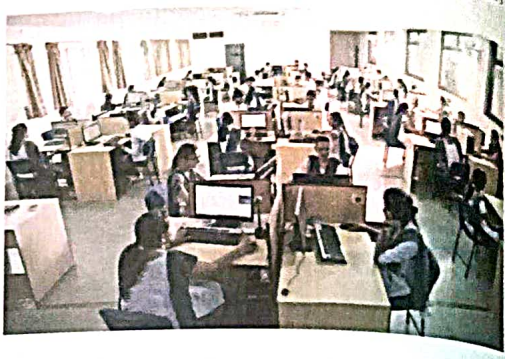
Smart schools differ from traditional schools in how smart technology and digital tools such as laptops, tablet devices, Interactive whiteboards, projectors, etc. are used to maximize and improve student's learning experience. Smart schools provide an interactive learning environment. These schools also empower teachers to deliver more engaging lessons.

Advantages of Smart Schools

Some advantages that Smart Schools offer, include:

1. Easy access to information

Smart classrooms have internet connections, so the smart gadgets being used in the classrooms such as laptops, tablet devices, etc are net connected and can search for information on the internet.



2. Easy access to online resources

The smart schools store classroom resources digitally, so the information can be accessed by anyone, anytime, and from anywhere. For virtual classes, this is a big advantage as both students and teachers have very convenient access to everything they need for effective teaching and learning.

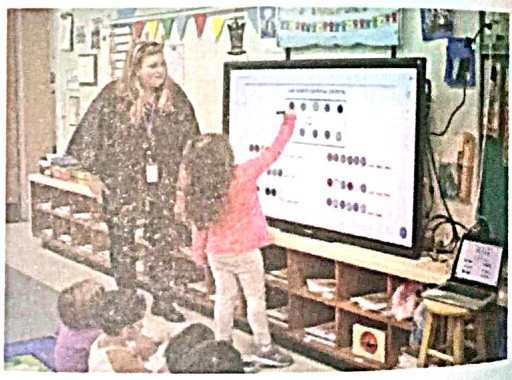
3. Interactive teaching environment

The teaching environment is interactive where both students and teachers have definite roles to play. This helps in improving interaction between the students and teachers and they are able to communicate outside the school with the help of emails and messages.

4. Use of digital medium for classroom work

Students can use tablet devices for taking notes and don't need to carry heavy school bags having thick paper notebooks and textbooks.

5. Better understanding of topics by using digital tools



Many tools such as power point presentations, audio sessions, video screenings, projection of net searched latest relevant information (relevant to the topic under study) etc. are used for teaching topics in classrooms. These make the lessons easy to understand and involve and engage students better.

6. Promoting Green Environment

Use of digital tools reduces the need for paper, pens, print outs, etc, thereby being more environment-friendly and also reducing carbon footprint.

7. Continued availability of resource material after the class lecture

Classes are recorded, so if students miss school due to sickness or any other reason, they would still get access to whatever was covered in class and not miss out. Even if students did not fully understand a topic that was taught in class, they can always go through the recording later, in order to clear their doubts and understand the topic better.

8. Learning at their own pace

Resource material is available online—so students can access information whenever they want and learn at their own pace.

9. Interaction with parents

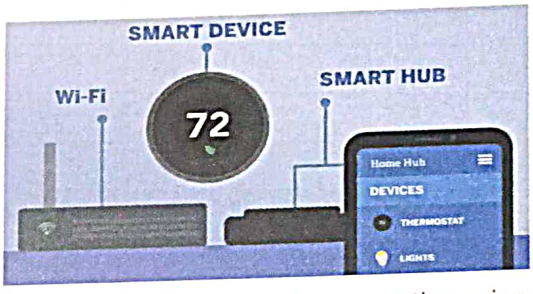
Smart technology provides a convenient and efficient way for parents to remain informed about various matters such as parent teacher meetings, upcoming examination schedules, home works, feedback on their children's performance, etc. and to connect with teachers.

BENEFITS OF SMART SCHOOLS FOR PARENTS

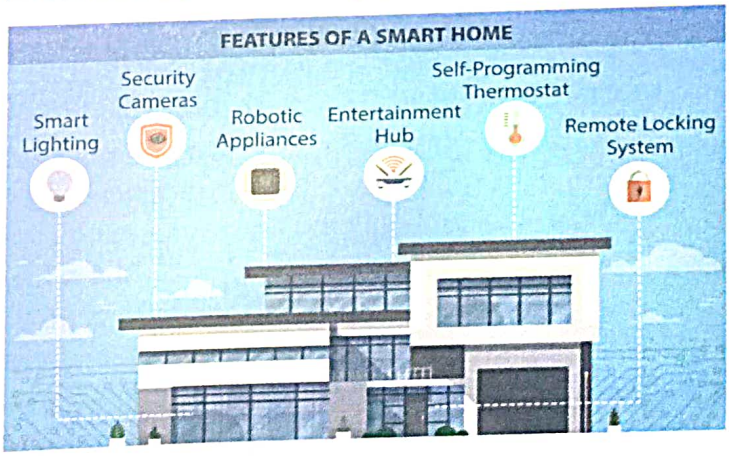
- They are kept informed through SMS if their child has reached school or is absent.
- They gain instant access through SMS about progress report of their child.
- They know the homework details of their child.
- They become part of their child's academic activities with instant communication from the school.

Smart Homes

What are Smart Homes?



As human beings, we endeavour to make our day to day living more convenient and easier for ourselves. One of the main functions of smart homes is to improve the quality of life and convenience in the home. Another function of smart homes is to provide greater security and more efficient use of energy. Smart home means a home where certain devices are connected to the Internet, otherwise known as Internet of Things (IoT) devices. These devices automate tasks and/or allow remote access. It denotes the use of automated processes and technical systems where devices are remotely controlled and connected via internet. Common smart home devices include smart lights, smart thermostats, smart locks, video doorbells, smart security cameras and many others. These may be controlled by various methods such as apps, remote controls, switches, voice assistants such as Alexa or Siri or artificial intelligence.



The heart of the smart home is the central control unit (known as the hub or gateway), with which various smart components are connected by wi-fi and can be controlled from the personal computer, laptop, smartphone or tablet.

In homes that are not "smart", every device in the home needs humans, to manually start processes and activate each device individually at the right time. The smart home on the other hand, enables the devices to communicate with each other.

Devices start, control and monitor specific processes in the home on their own, on the basis of how they are programmed. As the devices are interoperable, they can communicate with each other.

Many home attributes such as lighting, temperature, entertainment systems, appliances, home security such as access control and alarm systems can be monitored and controlled in a Smart Home.

For example: a smart thermostat switches the heating off as soon as it receives information from the sensors of other devices, that no one is at home any more. Smart LED lights automatically emit different tones of colour depending on the time of the day.

Advantages of a Smart Home

- Smart home systems and devices often operate together and automate actions based on required settings of the home owner.
- Home owners are provided a lot of comfort and convenience as don't need to do a lot of manual work that they did before. For example: They no longer need to start individual devices and processes manually at the right time.
- Devices such as motion sensors or cameras ensure greater security by enabling homes to be monitored, from whereever the home owners may be.
- Thermostats and smart lighting help save energy. Lights can be programmed to automatically switch on when one enters home and also switches off when no one is at home.
- All the devices in the home are accessible from one point.
- Remote control access enables the home owner to use his mobile phone to switch on or switch off gadgets from wherever he is. For example: Turn on the washing machine before arriving home, so that clothes are already washed by the time he arrives home.
- Smart home systems are flexible in that they can accommodate new devices with the existing ones. So, the home owner can upgrade to the latest versions as technology advances.
- Alerts can be enabled and sent on smart phones for situations such as detection of a burglar on the smart camera, fire or any other hazard.
- Smart home is relatively easy to set up, even if the homeowners are not very technically savvy.

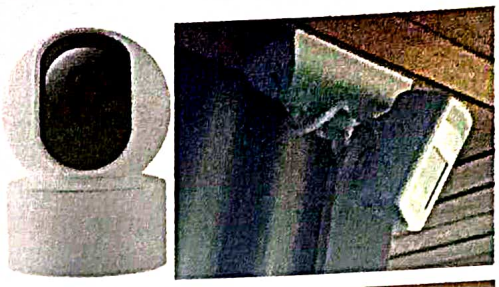
Some Smart Home Technologies

Smart Thermostat: Setting the heating or cooling to a desired temperature.

A smart thermostat is paired with a smart device such as a phone, tablet, or any other internet-enabled gadget. This enables the home owner to have control over the heating/cooling system of the home as it allows scheduling, monitoring and remotely controlling home temperatures. The smart thermostat can register the home owners' temperature preferences and automatically modify to their required temperature settings. The homeowner can set the heating/cooling to the desired temperature before arriving home.

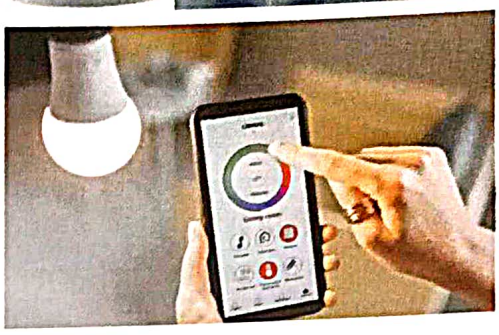
Smart Security Cameras and Smart Motion Sensors

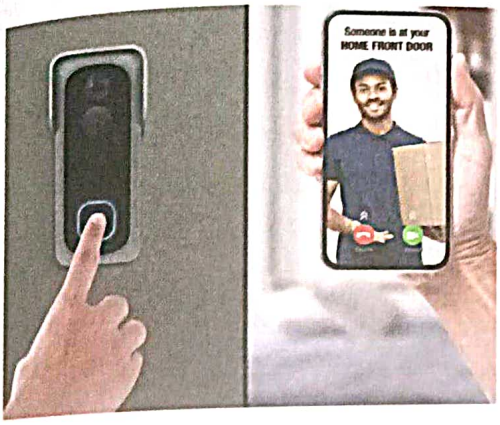
Smart cameras enable the home owners to monitor their homes when they are away. Smart motion sensors are able to identify the difference between residents, visitors, pets and burglars, and can send alerts if suspicious activity is detected.



Smart Lights

Smart lights can be controlled remotely. They can detect when someone is in the room and accordingly adjust the lighting. The preference of the home owner can be programmed, and the lights accordingly maintain the required level of brightness. They can also be programmed to switch on and switch off, thereby saving energy.



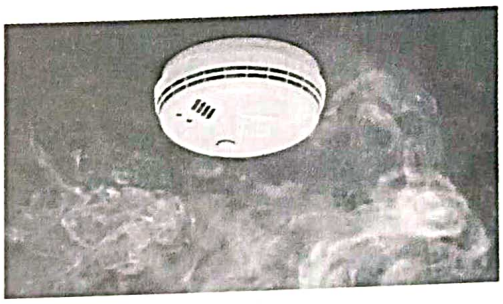


Smart Doorbells

The smart doorbells come with a camera so the home owner (from wherever he may be) can see who's at the door on his smart phone.

Smart Smoke Detectors

These smoke detectors sound an alarm when smoke is detected and can also send alerts.



Smart Speakers and Displays

These smart devices can be voice controlled. Smart assistants such as Alexa and Google home link to smart speakers and other devices to automate various gadgets. Voice commands to Alexa or google home can get them to play music, give answers to several questions, order food from restaurants, etc.

Smart Electronics and Entertainment

By linking speakers and smart TV, the volume is controlled from the smart phone or from a smart remote. Smart TVs connect to the internet to access content through applications, such as on-demand video and music. Several smart TVs also include voice or gesture recognition.

EXERCISES

I. Multiple Choice Questions

1. Over the years, a large number of people have migrated:
   (a) from villages and smaller towns to cities.
   (b) from cities to villages and smaller towns.
   (c) Both a and b
   (d) Neither a nor b
2. The city governments are using technological tools to improve various facets of quality of life that include providing:
   (a) better transport systems ☐ (b) social welfare
   (c) economic growth ☐ (d) all the above
3. The criteria followed for housing in smart city is:
   (a) water conservation ☐ (b) energy efficiency
   (c) sustainable design and architecture ☐ (d) all the above
4. The IoT is a network of devices that:
   (a) are connected and can communicate and exchange data.
   (b) are not connected.
   (c) are connected but can't communicate and exchange data with each other.
   (d) none of the above
5. Smart grids can:
   (a) supply power on demand ☐ (b) monitor energy outages
   (c) identify energy losses ☐ (d) all the above
6. The report by the Intergovernmental Panel on Climate Change (IPCC) has forecasted global warming of _____ by the year 2040.
   (a) 3°C ☐ (b) 1.5°C
   (c) 4.5°C ☐ (d) 2.5°C
7. Smart schools:
   (a) enable better understanding of topics by using digital tools.
   (b) use conventional teaching methods.
   (c) are unable to cater to the learning needs of students.
   (d) are not desirable.
8. The heart of the smart home is the central control unit known as:
   (a) alexa ☐ (b) siri
   (c) the hub or gateway ☐ (d) cortana

II. True or False

1. Cities are becoming increasingly more populated and complex to manage.
   (a) True (b) False

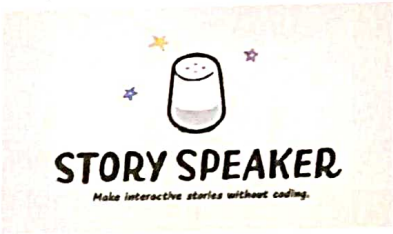
2. ICT (Information and Communication Technology) is not associated with the concept of smart cities.
   (a) True (b) False
3. The shared travel mode enables users to gain short-term access to transportation modes on an as-needed basis.
   (a) True (b) False
4. All the devices in a smart home are accessible from one point.
   (a) True (b) False
5. Several smart TVs also include voice or gesture recognition.
   (a) True (b) False

III. Answer the Following Questions

1. What is a smart city?
2. What are the features of a smart city? Explain any two features briefly.
3. How do smart cities work?
4. What are smart schools? How are they different from traditional schools?
5. Briefly describe any three advantages of smart schools.
6. What are smart homes?
7. Explain any three advantages of smart homes.
8. Name any three smart home technologies and explain how they work.

IV. Creating a Story

Write a story to explain your dream house to your classmates using Story Speaker



Story Speaker is tool that lets anyone create talking, interactive stories with no code. You can write a story in Google Docs, push a button, and play it instantly on your Google Home (or any other device with the Google Assistant).

Resources:

Introduction to Story Speaker:

https://www.youtube.com/watch?v=wsrzvYYvhH8&feature=youtu.be

Link to read more about story speaker:

https://docs.google.com/document/d/1hFrBtsBbF2LoZ1FFpXEH7L6fWH1lj24W1-itXnKSXK8/edit

Log in to Goggle Docs. Then download Story Speaker add-on to your google document. Use the basic template to create the story using Google Extension of Story Speaker for Google Docs.

NOTE: The Following Things Matter in Writing The Interactive Story:

- *Simple use of language*
- *Clarity in thinking*
- *Ability to recognize patterns in an instruction*
- *Need to give sequence of events*
- *Appropriate choice of words when giving an instruction*

ACTIVITY 1

Watch the following videos:

(1) Link for smart cities video: https://www.youtube.com/watch?v=d1DndVz9dAs

(2) Link for smart home video: https://www.youtube.com/watch?v=i73n-LTXPIM

Students can look at other videos also of smart cities and smart homes. After watching the videos, students should discuss:

- What features they liked about the smart cities and the smart homes.
- Students should review the floor plan of the smart home that they had drawn in the previous chapters and now:

(a) Write down their expectations of a smart home.

What I Expect a Smart Home to Have

(b) Redesign their floor plan based on what they have read and seen about smart homes. List the new things that they will be adding to the floor plan that they will now be redesigning.

Redraw the New Smart Home Floor Plan

ANSWERS

I. Multiple Choice Questions

1. (a) 2. (d) 3. (d) 4. (a) 5. (d) 6. (b) 7. (a) 8. (c)

II. True or False

1. (a) 2. (b) 3. (a) 4. (a) 5. (a)

7

Sustainable Development Goals

In this chapter, you will learn about:

- What is Sustainable Development?
- Sustainable Development Goals
- Brief Description of the Sustainable Development Goals
- Role of AI in achieving Sustainable Development Goals

What is Sustainable Development?

Humans over a period of time, have been consuming more resources than the earth can regenerate. Natural resources are not limitless, and careless and excessive consumptions of these resources have already affected biodiversity, forests, water bodies, soils and air quality and triggered climate change, soil erosion, poor air quality and undrinkable water.

Sustainable development is the idea that humans must live and meet their needs without compromising the ability of future generations to meet their own needs. In simple terms, the development has to be sustainable over a period of time–such that neither the planet's resources run out in our lifetime, nor in that of our future generations.

World Commission on Environment and Development have defined Sustainable Development as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs."

The aim of sustainable development is to balance our economic, environmental, and social needs, so that the resulting prosperity is not just for the present generations but also for future generations.

What Are Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

The 17 SDGs are interlinked—they recognize that action in one area will affect outcomes in others, and that development must balance social, economic, and environmental sustainability. The SDGs are included in a UN Resolution called the 2030 Agenda for sustainable development, which aims at fostering a more sustainable future. This agenda intends to counteract global problems, such as poverty, inequality, climate, environmental degradation, and justice.

It is built on the assumptions that:

- Economic prosperity, social progress and environmental protection go hand in hand and must be brought together.
- All the SDGs are interconnected and have to be jointly pursued.
- A collective effort involving various actors (governments, corporations, and the civil society) is needed to transform our global society.

These goals were designed to be a "blueprint to achieve a better and more sustainable future for all".

Brief Description of the Sustainable Development Goals

Goal	Brief Description
1. No Poverty	End poverty in all its forms everywhere.
2. Zero Hunger	End hunger, achieve food security and improve nutrition and promote sustainable agriculture.
3. Good Health and Well-being	Ensure healthy lives and promote well-being for all at alll ages.
4. Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Gender Equality	Achieve gender equality and empower all women and girls.
6. Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.
7. Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

9. Industry Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10. Reduced Inequalities	Reduce inequality within and among countries.
11. Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable.
12. Responsible Consumption and Production	Ensure sustainable consumption and production patterns.
13. Climate Action	Take urgent action to combat climate change and its impacts.
14. Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Role of Artificial Intelligence in Achieving Sustainable Development Goals

AI technology enables new technologies that improve efficiency and productivity and can play a very important role in helping the global attempts of achieving sustainability and meeting the UN's Sustainable Development Goals (SDGs).

The role that AI is already playing and can increasingly play in achieving each of the seventeen goals is as under:

Goal 1: No Poverty

AI-machine learning models can be used to identify the poorest regions in the world and accordingly provide real-time resource allocation to them through satellite mapping. Economic aid can then go to those who need it the most, which will help in reducing poverty. Improving agricultural yield using AI also helps in reducing poverty.

Goal 2: Zero Hunger

Artificial Intelligence can be effectively used for forecasting food shortages and for improving nutrition and promoting sustainable agriculture. AI solutions can be used to suggest crop and land use optimization and precision farming resulting in higher yields that will help in reducing hunger. AI can hence play a role starting right from food production to its transportation and subsequent distribution.

Goal 3: Good Health and Well-Being

AI has enabled new scientific breakthroughs and drug discoveries in healthcare. Healthcare programs and diagnostics are significantly improved through AI. AI is enabling digital health services such as disease diagnosis, treatment and patient and public health management (using mobile devices with smartphone cameras) for a large number of people which is much more than could otherwise be addressed by the existing healthcare systems. AI's pattern recognition application is being used to identify patients at risk of developing certain medical condition due to their lifestyle, environmental, genetic, or other factors and therefore enabling preventive measures to be taken.

Goal 4: Quality Education

In physical classroom settings, teachers often do not have the time for highly personalised teaching and feedback. Virtual and responsive personalized learning is enabled by AI wherein learning environments are immersive and interactive. AI is enabling learning material to become accessible to all–wherever they may be in the world, as long as they have an internet connection. AI's data analytics which can collect, and process huge amounts of data is being used to constantly review and improve study modules and courses-enabling current, accurate and updated availability of teaching learning material.

Goal 5: Gender Equality

Gender equality is imperative to ensure that no one is left behind. AI is empowering women for growth and new opportunities. AI-powered coders use gender-sensitive language to write job postings that are more inclusive. This helps in increasing the diversity of the workforce. AI, therefore, can play a role in advancing gender equality in our society.

Goal 6: Clean Water and Sanitation

AI can address many challenges related to clean water and sanitation. AI is being used to innovate services related to water delivery, sanitation, monitoring water quality and predicting maintenance requirements of infrastructure. The AI-based sensors are being used for predicting sanitation and consumption patterns for improving provisions of safe water and sanitation to people.

Goal 7: Affordable and Clean Energy

The AI-powered systems analyse data related to energy collection and provide insights on energy consumption patterns, identify energy leakages, and monitor health of the devices and equipment as well as alert the operator when maintenance is needed. It offers flexibility to the energy suppliers to adjust the supply with demand. AI in renewable energy can be used to manage the intermittency, and also offer improved safety, efficiency, and reliability. AI in the renewable energy sector can address many of the current challenges being faced in supplying clean and affordable energy.

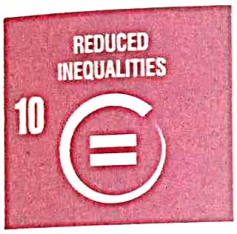
Goal 8: Decent Work and Economic Growth

The concept of decent work has been championed by the International Labour Organization. "It involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for all, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men." It focuses on the quality of employment and the sense of security and social protection felt by the worker. AI technology is being used to automate jobs that are risky, time consuming as well as expensive. AI is playing a role in predictive maintenance of systems, production plants, dams, bridges, etc–making it safer for people who work on them. AI helps in increasing efficiency of organizations, thereby contributing to economic growth.

Goal 9: Industry, Innovation, and Infrastructure

AI-based research is being used for increasing efficiency and improving the sustainability of industries and societies. AI research and technology has enabled a large amount of innovations. They are being used to manufacture better quality goods in a shorter duration of time as well as facilitating distribution in an optimised manner. AI is playing an important role in building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation.

Goal 10: Reduced Inequalities



In order to reduce inequalities and ensure a life of dignity for all, political, economic, and social policies should pay particular attention to the needs of disadvantaged and marginalized communities.

AI can help in reducing inequality in several ways some of which include automating legal advice, identifying inequalities in legal practices and regulations and creating new and equal foundations, automating, and making tools available for translating documents, textbooks, and legal frameworks in local languages.

Goal 11: Sustainable Cities and Communities

AI enables smarter and more efficient design of cities and communities. AI-enabled smart public transit system improves efficiency. Smart transportation solutions provided by AI are clean and efficient as they reduce traffic congestion which not only saves energy consumed but also aids in having cleaner air. AI facilitates smarter planning of infrastructure and helps in creating sustainable communities. Readily available and easy access to data through AI technologies enable citizens to make informed choices for themselves as well as for their collective communities.

Goal 12: Responsible Consumption and Production

As per United Nations, Responsible Consumption and Production is about doing more and better with less. It is also about ensuring economic growth without environmental degradation, increasing resource efficiency, and promoting sustainable lifestyles. Sustainable consumption and production can also contribute substantially to poverty reduction and the move towards low-carbon and green economies.

"AI is yielding optimal consumption and production levels with vertical green farms, eliminating waste, and vastly improving yields and resource efficiency." — AI XPRIZE. AI can reduce inefficiencies in production, improve quality of goods produced and optimize logistics.

Goal 13: Climate Action

Extreme weather events are increasing in frequency. AI can help us by reducing emissions, improving energy efficiency, and increasing the use of renewable energy sources.

There are many ways in which AI can contribute to climate change mitigation, e.g. through energy efficiency or by reducing emissions from transportation, agriculture, and industry. AI can also help in building early warning systems, better predicting extreme weather events, and developing plans to mitigate them. "Go-Green" is important and AI can play a very important role facilitating that.

Goal 14: Life Below Water

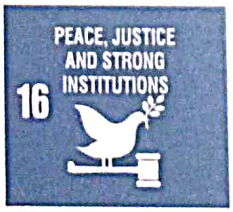
Pollution and other human activities are causing a lot of degradation, which is having severe implications for marine life and other ecosystems. There is an urgent need to responsibly manage and protect all marine life.

Artificial Intelligence technology can play a role towards this end and is being used for several purposes such as monitoring and reinstating coral reefs, fisheries management and formulating strategies to reduce plastic pollution of oceans. AI technologies are being used for gathering large volumes of data about the ocean environment, marine life, biodiversity, earthquakes, tsunamis, ocean temperatures, etc. AI tools are being used to help clean oceans by extracting plastic pollution.

Goal 15: Life on Land

Deforestation and land degradation lead to a loss of natural habitats and biodiversity. Many animal and plant species are facing extinction unless action is taken to reduce or stop the loss of local biodiversity. AI tools can track land-animal migration, population levels and hunting activities. This will aid in addressing illegal poaching and promote sustainable land ecosystem. Data gathered with the aid of AI tools, about forests such as land cover, land use, biodiversity metrics, enable forest officials to monitor and manage forests and policy makers to undertake environmental conservation measures.

Goal 16: Peace, Justice, and Strong Institutions



In order to provide access to justice for all and build effective, accountable, and inclusive institutions at all levels, AI applications are being used for purposes such as e-governance, and personalised services. AI tools are used for gathering data to see real time situations and their continual development over a period of time; analysis of data for informed decision-making and implementing solutions and tracking global conflicts and human right abuses. Frauds can, not only be detected but also prevented using AI tools.

Goal 17: Partnerships for Goals

Strong global, national, regional, and local cooperation and partnerships are required to be able to achieve the desired sustainable development goals. Ideas, knowledge, and innovation can be quickly shared across the globe by better access to technology. AI technology solutions can help stakeholders get specific and relevant guidance on how to act towards achieving the SDGs. Effective knowledge and technology transfer to least developed and developing nations will bring equity to global, national, and regional development outcomes.

I. True or False

1. Over a period of time, earth is generating more resources than what the humans can consume.
   (a) True (b) False
2. Natural resources are limitless.
   (a) True (b) False
3. The Sustainable Development Goals (SDGs) are also known as the Global Goals.
   (a) True (b) False
4. All the SDGs are interconnected and have to be jointly pursued.
   (a) True (b) False
5. AI is already playing a role in achieving the sustainable development goals.
   (a) True (b) False

II. Answer the Following Questions

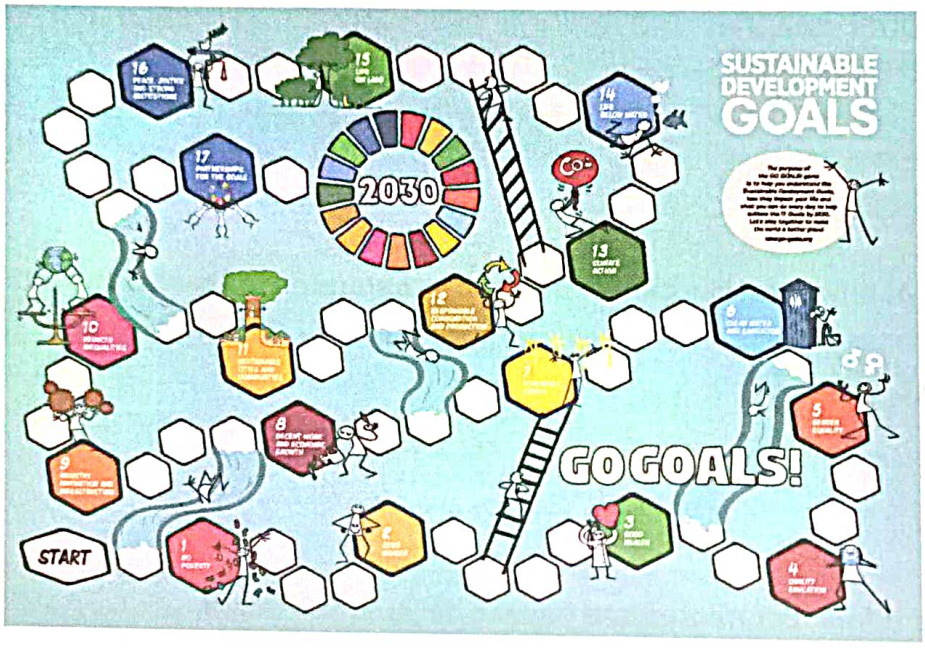
1. What does sustainable development mean?
2. Why is sustainable development important?
3. Briefly describe each of United Nations General Assembly's 17 Sustainable Development Goals.
4. How can Artificial Intelligence help in achieving the following Sustainable Development Goals of?
   (i) No poverty
   (ii) Zero hunger
   (iii) Clean water & sanitation
   (iv) Climate action
   (v) Life below water

In order to gain an understanding of social issues about the sustainable development goals through a board game, students should download the game called Go-Goals.

Link for downloading this game is:
https://go-goals.org/downloadable-material/

Downloadable material includes: *Board Game, Game Rules, Player Tokens & Dice and Questions.*

This game is similar to that of Snakes and Ladders. Play the game in groups of five. Players advance the number of spaces by rolling a dice. Players move up and down the ladder in a manner similar to that as in the game of Snakes and Ladders. If a player lands on SDG goal field (1-17), he/she will draw a card that corresponds to the goal number. Another player will read the card question. If the player answers correctly, he/she can roll the dice again. The first player to arrive on "2030" is the winner.



ANSWERS

I. True or False

1. (b) 2. (b) 3. (a) 4. (a) 5. (a)

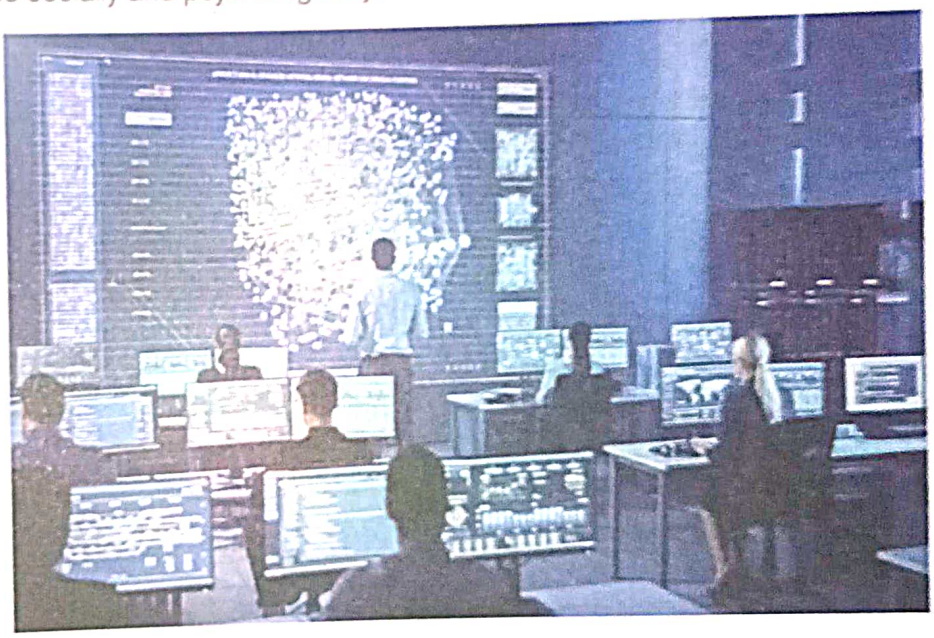
8 Skills Required For Futuristic Opportunities

In this chapter, you will learn about:

- *Why to Choose a Career in Artificial Intelligence?*
- *Skills Required for a Career in Artificial Intelligence: Technical Skills and Soft Skills*
- *Some Popular Career Choices in Artificial Intelligence*
- *Looking Ahead: Skills Required Ten Years From Now*

Why to Choose a Career in Artificial Intelligence?

The AI revolution is shaping the way we live and work. There is a huge demand for AI professionals across all the industries and this demand is slated to grow exponentially in the coming years. AI professionals work on real life challenges, innovate, and develop solutions that impact and benefit not for just businesses but also our day-to-day lives. A career that gives an opportunity to solve real life problems, is hugely satisfying. The field of AI is currently facing a skill shortage, so being a competent, AI professional would be a highly rewarding and satisfying career– not just financially but also socially and psychologically.



The applications of AI can be seen in various sectors. This cutting edge technology field has got a huge potential and has the power to transform the future of businesses, economies, and societies.

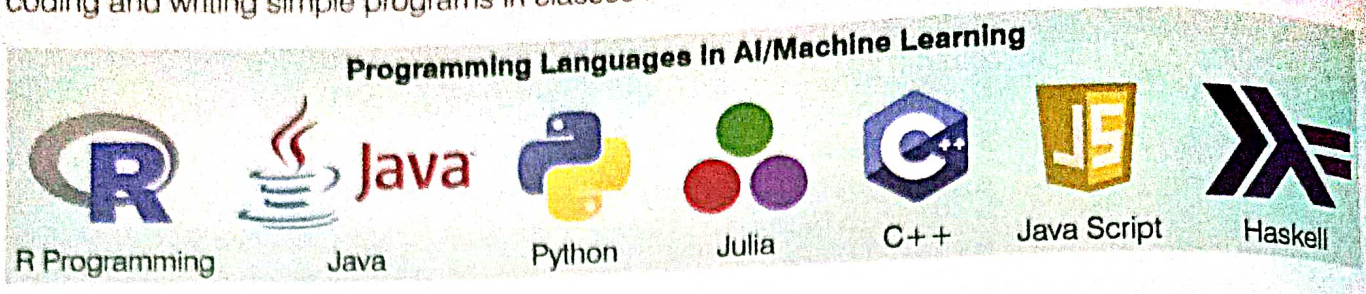
Skills Required for a Career in Artificial Intelligence

In addition to technical skills, interpersonal (soft) skills are required to work efficiently, collaborate well with others in the team and manage everything with ease. A few of the important technical and soft skills required are as follows.

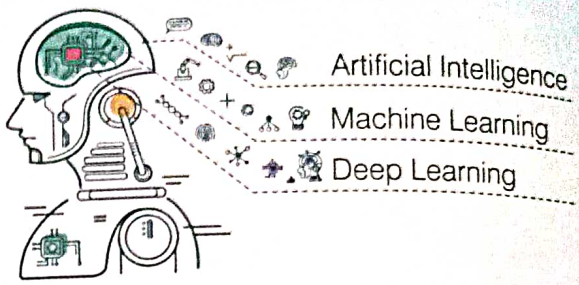
Technical Skills

Programming Languages

Ability to program is a required fundamental skill. You must be able to write code based on your needs and use-cases. Knowledge and proficiency in programming languages such as Python, Java, R, C++, JavaScript, etc., are important and required for writing code. You will be learning about coding and writing simple programs in classes IX and X.



Domain Knowledge



"Domain knowledge is knowledge of a specific, specialized discipline or field, in contrast to general knowledge". Wikipedia. Domain knowledge in Artificial Intelligence is required for a career in AI. Having domain knowledge helps in understanding the risks and challenges that need to be addressed as well as to develop innovative technologies to address those challenges. Having in-depth, specialised knowledge of their own field is important for professionals to work effectively in their field and relate and interact with other experts. Besides knowledge in your own domain, it is also useful to get some domain knowledge of the Industry Verticals like Healthcare, Retail, Finance, Manufacturing, Logistics, Travel etc as it would be useful to understand the use cases of AI in those Industries.

Good Knowledge of Mathematics

AI professionals work on algorithms and therefore require good mathematical knowledge to be able to efficiently solve AI problems.

Data Science and Statistics

Data science is a collection of data to analyse and make decisions based on the analysis. It uses scientific methods, processes, algorithms, and insights from many types of datasets. At the root o data science is statistics. This is a core part of AI. Statistics involves data collection, interpretation, and analysis which is required to understand patterns in AI.

Understanding Graphs

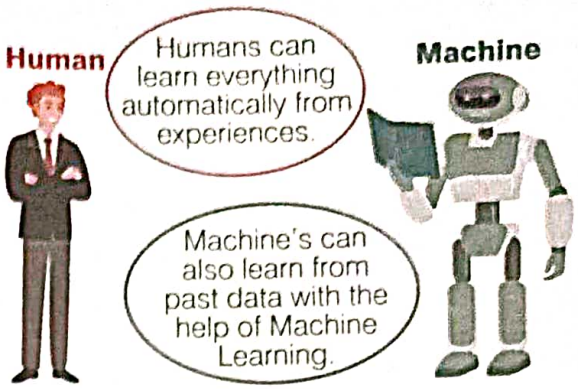
One should be able to interpret graphs to understand what they convey. With Artificial intelligence it becomes easier to discover insights, patterns, and relationships in data by looking and analysin different graphs.

Probability

Sound knowledge of probability and probability distribution is needed while working in th field of AI.

Machine Learning

Machine Learning is a subset of artificial intelligence. *It is defined as "the field of study that gives computers the ability to learn without explicitly being programmed." Arthur Samuel.*

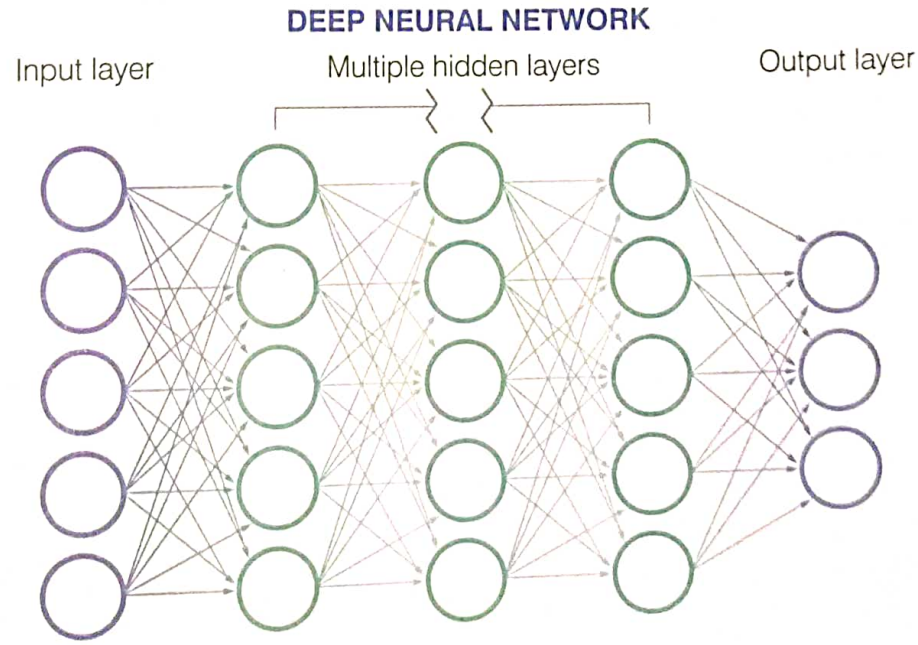


The knowledge of machine learning is required in artificial intelligence as machine learning teaches the machines to be intelligent. The computer-based algorithms learn and improve by themselves by using data and through experiences. There are various applications of machine learning such as in search engine suggestions, medicine, computer vision, predictive analytics, etc.

Deep Learning

Deep learning is a branch of machine learning and data science that mimics how humans gain specific knowledge. The model of computing used in deep learning is inspired by the structure of the brain and therefore this model is called the artificial neural network. The artificial neural network mimics the human brain so deep learning is also a kind of mimic of human brain. In deep learning, we don't need to explicitly program everything.

Deep learning is of immense value for data scientists in collecting, interpreting, and analysing huge volumes of data easily and at a high speed. Deep learning is the technology behind driverless cars.



Data Engineering

Data engineering refers to the building of systems to enable the collection and usage of data. Data engineering helps to make data more useful and available for all those who need to work with data. Data engineers convert raw data into usable information that is used for analytical or operational purposes by data scientists and business analysts. They are responsible for building data pipelines to bring together information from different source systems and collecting them in a single place that represents the data uniformly.

Soft Skills

While one may have the required subject expertise and knowledge level, soft skills are still essential to help become a better well-rounded professional. Some of the required soft skills include:

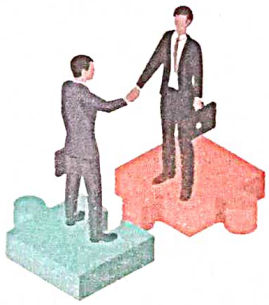
Communication Skills

Possessing good communication skills means having the ability to communicate your ideas clearly and accurately to others using a proper and suitable tone along with appropriate body language while delivering your message. A good communicator can effortlessly communicate his innovative ideas with teammates, managers, or clients. Written communication skills are also as important as verbal skills. Technical personnel must be able to communicate their ideas clearly and precisely in writing

Lack of ability in communicating well on the other hand, will result in making it difficult to explain what one wants to do or get done. Even a good idea or an innovative thought may be rejected as it may not be properly communicated and hence not understood by others in the team and decision-makers.

Collaboration

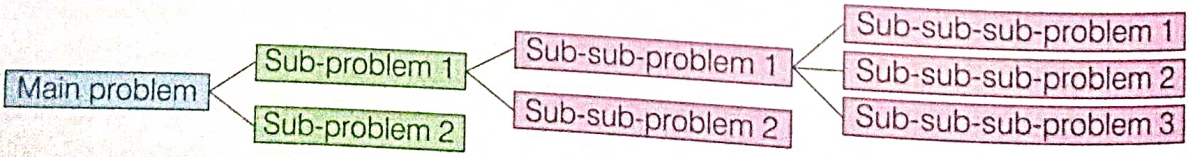
Collaboration is the process of people working together to complete a task or achieve a goal. To address complex business problems and nurture creativity, collaboration plays a very important role. In most AI jobs, it is not just one individual working alone, but a team of people working together. It is important to be able to work comfortably and collaborate with other team members so as to deliver best solutions in a timely manner. Collaboration improves outcomes!



A large percentage of businesses use social collaboration tools for enhancing business processes.

Analytical Thinking

An analytic approach tries to reduce a system to its elementary elements so as to study in detail and understand the types of interaction that exist between them. An analytic thinker is able to identify and define problems, extract key information from data and develop workable solutions for the problems identified in order to test and verify the cause of the problem and develop solutions to resolve the problems identified.

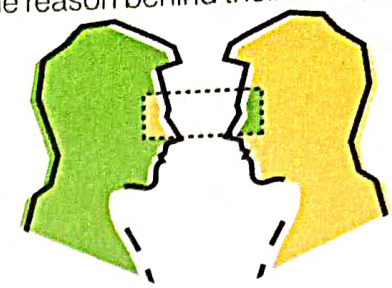


Empathy

Empathy is "the action of understanding, being aware of, being sensitive to, and vicariously experiencing the feelings, thoughts, and experiences of another." Merriam-Webster.

Empathy is the ability to emotionally understand what other people feel, see things from their point of view, and imagine yourself in their place. Essentially, it is putting yourself in someone else's position and feeling what they are feeling. Empathy does not necessarily mean that you have to agree with everyone, but it enables you to understand what others are feeling and the reason behind their actions.

Empathy contributes to collaboration and cooperation. There is a need for future AI systems to be empathetic—so as to provide more natural interactions with humans by taking people's feelings and moods into consideration. Being an empathetic AI developer will be an important requirement for such development tasks.



Emotional Intelligence

Emotional intelligence is the ability to be aware of, control, and express one's emotions and to be aware of the emotions of others. People possessing good emotional intelligence can work well with others and show empathy.

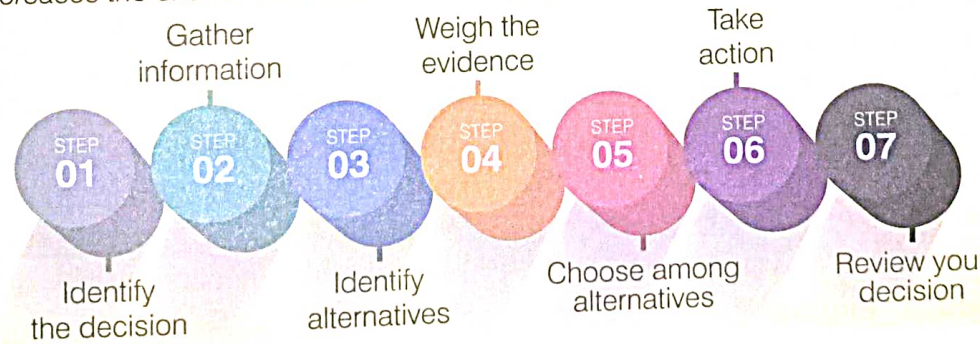
Decision making

Decision-making skills are important as one should be able to make the right decisions at the right time and also be aware of the consequences of making certain decisions and the impact these decisions could have. In order to make the right decisions, one should be able to calculate the risks and challenges if one makes some decisions. Correct decision-making ability is crucial not only for the success of the individual and the team but also for making the clients and customers happy.

7 STEPS TO EFFECTIVE DECISION-MAKING

Decision-making is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions.

Using a step-by-step decision-making process can help in making well thought-out decisions by organizing relevant information and identifing alternatives. This approach increases the chances that the most satisfying possible alternative would be chosen.



Creativity

The ability to think out of the box is important for AI professionals. They should be able to think of creative ways of solving problems such that the solutions are easy, effective, viable and feasible. This will help in developing unique products and services.

Curiosity

Individuals possessing curious minds want to know more, learn more, and implement more. AI professionals possessing a curious mind, tend to develop innovative ideas and plans that can solve problems. They build cutting-edge technologies that benefit people.

Some Popular Career Choices in Artificial Intelligence

Some popular career choices in AI include:

Research Scientist: Research scientists' job involves conducting various experiments and processing and analysing data to get the right results.

Big Data Engineer: A big data engineer builds and manages the big data infrastructure and tools of an organization.

Full-Stack Developer: A full-stack developer is a web developer or engineer who works with both the front (client side) and back (server side) ends of a website or application. Full stack developers provide an end-to-end service and can be involved in projects that involve databases and building user-facing websites.

Data scientist: A data scientist makes use of data, statistics, and computer modelling to solve complex problems.

Machine Learning Engineer: Machine learning engineers work as part of a larger data science team. They design and create machine learning models and retrain the systems when required.

Robotic Scientist: A robotic scientist conducts research and carries out the designing and development of robotic systems.

Business Intelligence Developer: A business intelligence developer is an engineer who is in charge of developing, deploying, and maintaining Business Intelligence interfaces such as data visualization and interactive dashboards, query tools, data modelling tools, etc.

Analytics Manager: An Analytics Manager transforms raw data into business insights that are useful for decision-making and strategic planning.

Data Warehouse Engineer: A Data Warehouse Engineer manages the entire back-end development life cycle for the organisation's data warehouse.

Looking Ahead: Skills Required Ten Years From Now

AI capabilities have become crucial in the workplaces of the future. Many industries now have a hybrid model-where AI and human's work side by side and this is going to increase in the coming years. As per the World Economic Forum, "by the year 2025, machines will displace 80 million jobs and about 100 million jobs will be created in the IT industry with these new sets of skills". Individuals

will hence need to cultivate and develop these skills so as to be able to be future ready and get jobs in different job domains in the IT industry, as per the requirement of industries and businesses.

TOP 10 SKILLS OF 2025

- Analytical thinking and innovation
- Active learning and learning strategies
- Complex problem-solving
- Critical thinking and analysis
- Creativity, originality and initiative
- Leadership and social influence
- Technology use, monitoring and control
- Technology design and programming
- Resilience, stress tolerance and flexibility
- Reasoning, problem-solving and ideation

TYPE OF SKILLS

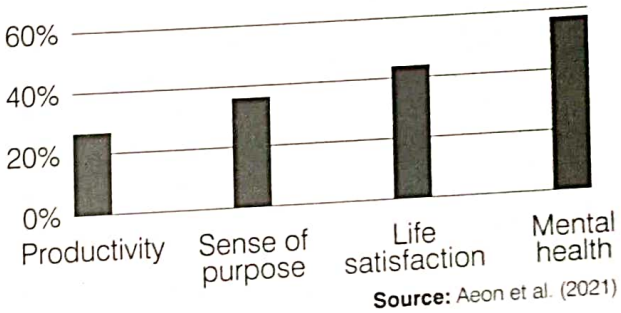
- Problem-solving
- Self-management
- Working with people
- Technology use and development

Source: Future of Jobs Report 2020, World Economic Forum

Time Management

Effective time management skills are important whether one works from home, from an office or manages one's own business. The ability to be able to prioritise and accomplish tasks in a time bound manner is important for effective performance and workplace delivery. Time management is about working smarter rather than harder. Time management skills help to avoid stress and enhance decision-making ability. Effective time management leads to a better work life balance which is going to be getting more difficult in future unless individuals learn proper time management.

BENEFITS OF TIME MANAGEMENT



Source: Aeon et al. (2021)

Emotional Intelligence

Emotional Intelligence (EQ) is the ability to be aware of, expressing and controlling our emotions and be aware of the emotions of others. Future jobs will continue to have a human element and the need to work closely with others in a collaborative manner. Individuals with high EQs will do well and be in demand in the future AI-based workplaces.

HOW TO INCREASE EMOTIONAL INTELLIGENCE

1. Be assertive but not aggressive.
2. Utilize leadership skills.
3. Practise self-awareness.
4. Respond instead of reacting to conflict.
5. Practise ways to maintain a positive attitude.
6. Utilize active listening skills.
7. Be motivated.
8. Empathize with others.
9. Take criticism well.
10. Be approachable and sociable.

Flexibility

In the workplace of the future, change will be inevitable. Employees will need to be flexible and adapt to shifting workplaces, expectations, and required skill sets as new technologies will develop, automation will increase, and pace of work will evolve very fast. They will need to have the mindset to not view the rapid changes as a concern but be mentally resilient and view them as opportunities for growth.

Adaptability

Adaptability is the capacity to handle change. It means being able to change our action or approach to do things, to suit a new situation. It may require learning new skills as per changing circumstances and responding quickly to new responsibilities and requirements. Future AI workforce will need to be adaptable to change and be able to conceptualize multiple ideas at the same time. They will need to become multi-taskers.

"It is not the strongest of the species that survives, nor the most intelligent, it is the one that is most adaptable to change."- Charles Darwin

Leadership Skills

With an increasing shift towards diversity and more fluid organizational structures, leadership skills assume a greater importance for all individuals and not just for those who are heading organizations, departments, or divisions. Good leadership brings the best out of other people and makes sure they can progress and succeed. As remote working and fluid organizational structures become more common in future, individuals will need to take on leadership roles to address issues and develop solutions.

Active and Continuous Learning

Individuals having active mindsets and the desire to continually learn are willing to take on new challenges, learn from their mistakes, and actively seek to expand their knowledge. It helps them to be flexible and adaptable to change. They understand that expanding their abilities and acquiring more skills will enable them to progress and achieve more. Future AI jobs will require such people because technologies will be evolving fast and the need to retrain and be willing and able to acquire new skills will be the need of the hour.

Self-Management

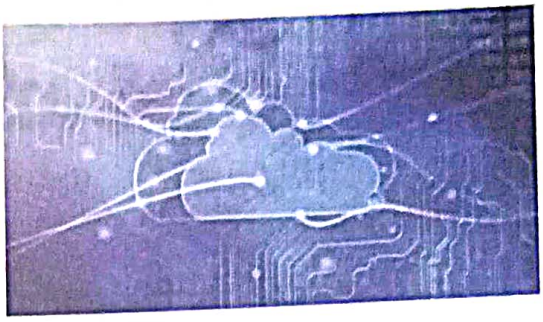
Self-management is the ability to work independently and handle one's job without needing motivation or supervision from others. This ability in employees is important for effective functioning of an organisation. Employees will need to know their strengths, demonstrate self-control, self-motivation, and integrity.

Augmented Reality, Virtual Reality and User Experience

Many businesses are now creating their presence in metaverse, which highlights the importance of *Augmented Reality and Virtual Reality* technologies. Shared virtual work environments that can provide immersive experiences to employees will continue to increase in future, so expertise in Augmented and Virtual Reality technology will be in demand.

Cloud Computing

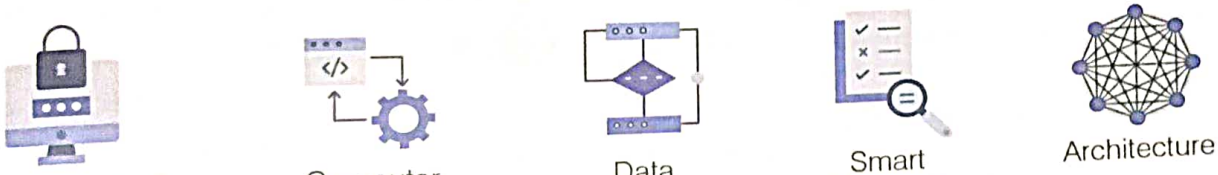
More and companies are switching from server infrastructures to cloud solutions. Cloud technology is cost-effectiveness and so many businesses are keen to adopt it. Practically everything will be moving on the cloud and its multiple service offerings. So, cloud development would be an important skill to learn for future AI-related jobs.



Blockchain Development

Blockchain has the ability to keep the data unique with high security. Blockchain market is expanding at a fast pace and there will be a need to have personnels who are experts in blockchain development.

TOP 5 BLOCKCHAIN SKILLS



Blockchain is being used in various industries and is getting a boost from Government initiatives.

Blockchain to be Used to Push Farm Exports

Govt aims to incentivise farmers to take up chemical-free processes

Yogima Sharma
@timesgroup.com

New Delhi: India's natural farming could soon get a technological push through blockchain, as the government plans to use the technology across all export driven crops to increase the country's food shipments and incentivise farmers to take up chemical free processes.

The Niti Aayog has launched a pilot project in collaboration with the Himachal Pradesh government on apple farming, to ensure quality production while also monitoring the produce across the entire storage and supply chain.

"Lack of quality produce and traceability has hampered India's food exports apart from disincentivising growers. Blockchain technology can help bridge this gap," a senior government official told ET.

"By recording information about products at every stage of the agricultural supply chain, a blockchain helps remove redundant processes, ensure quality control and monitor storage conditions," the official added.

Tech Take

Blockchain to help store data of the crop and its produce

Storage and supply chain to be monitored at all levels

Will help in better quality production, reduce wastage

Pilot project launched in HP for apples

Model will be replicated for grapes, mangoes and others

After the completion of the pilot project on apples, the technology will be replicated across other crops including mangoes, bananas, grapes and pomegranates, besides vegetables.

India ranks second in fruits and vegetable production in the world, after China, but its share in the global fruits and vegetable market is just 1%.

Under the blockchain technology, IoT sensors are used to generate crop data and its storage, distribution of grown crops to the food processing companies, supply of processed food to wholesalers and retailers and its storage. Through this, even consumers can backtrace the supply chain to ensure quality products while buying.

According to the Agriculture and Processed Food Products Export Development Authority, India exported fresh fruits and vegetables worth about $1.52 billion in 2021-22, with fruits accounting for $750.7 million and vegetables for $767.01 million.

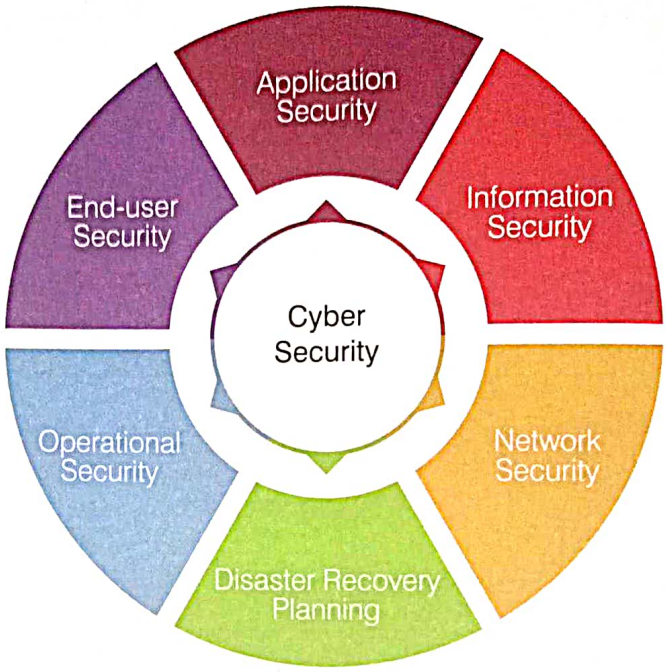
Exports of processed fruits and vegetables totalled $1.73 billion. These included about $1.12 billion of processed vegetables including pulses and $610.09 million of processed fruits and juices.

Major destinations for India's fresh fruits and vegetables include Bangladesh, the UAE, Nepal, the Netherlands, Malaysia, Sri Lanka, the UK, Oman and Qatar.

(Source: The Economic Times, New Delhi- Monday 2nd January 2023)

Cybersecurity

The risk of data losses is high and the need for cyber security to prevent data losses from hackers viruses and by data theft is increasing. Experts in cyber security having skills in cyber security information, security network, security and vulnerability assessment will be in demand.



EXERCISES

I. Multiple Choice Questions

1. **Why are people interested in pursuing a career in Artificial Intelligence?**
   (a) There is a huge demand for AI professionals across all the industries.
   (b) The field of AI is currently facing a skill shortage.
   (c) It is a highly rewarding and satisfying career.
   (d) All the above
2. **Which amongst the following is a technical skill?**
   (a) ability to program ☐ (b) communication skills
   (c) collaboration ☐ (d) creativity
3. **Deep learning models can**
   (a) analyse small volumes of data at a high speed.
   (b) analyse huge volumes of data easily at a high speed.
   (c) analyse huge volumes of data easily but at a slow speed.
   (d) analyse small volumes of data at a slow speed.
4. **The ability to think out of the box is known as:**
   (a) collaboration ☐ (b) curiosity
   (c) creativity ☐ (d) empathy

5. **People possessing good emotional intelligence:**

(a) can work well with others. ☐ (b) show empathy. ☐

(c) are aware of the emotions of others. ☐ (d) all the above ☐

II. True or False

1. **In addition to technical skills, interpersonal (soft) skills are required to work efficiently.**

   (a) True (b) False

2. **The knowledge of machine learning is required in artificial intelligence.**

   (a) True (b) False

3. **Domain knowledge refers to general knowledge.**

   (a) True (b) False

4. **Data engineers convert raw data into usable information.**

   (a) True (b) False

5. **Empathy contributes to collaboration and cooperation.**

   (a) True (b) False

III. Answer the Following Questions

1. Why is a career in artificial intelligence desirable amongst the youth today?
2. Name and briefly describe any three technical skills that are important for working in the field of Artificial Intelligence.
3. Name and briefly describe any three soft skills that are important for working in the field of Artificial Intelligence.
4. Name and briefly describe any three popular career choices in the field of Artificial Intelligence.
5. Name and explain any two technical skills that will be in demand in the field of Artificial Intelligence ten years from now.
6. What does cloud computing mean? Why do businesses want to adopt this technology?
7. Why is cyber security assuming greater importance?

ACTIVITY 1

(1) What kind of skills {technical as well as non-technical (soft)} do employers in the field of Artificial Intelligence look for, in the people they hire? Write down in the table provided. Would the skill set requirement from employees remain the same ten years from now or would there be some changes?

Soft Skills	Technical Skills

Soft Skills (10 years later)	Technical Skills (10 years)

(2) (a) Many new jobs will be created with the advancement of AI. Search for the current and emerging trends in employment and then prepare a Future Job Advertisement poster. The job is for ten years later from now. The job can be in any of the following sectors:

(i) Health

(ii) Security

(iii) Education

(iv) Transport

(v) Entertainment

(vi) Service

The job advertisement should contain information about the company that is hiring and the skills that the company is looking for in their employees.

(b) Write down the reasons why you choose this particular job for the advertisement that you have prepared.

ANSWERS

I. Multiple Choice Questions

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

II. True or False

1. (a) 2. (a) 3. (b) 4. (a) 5. (a)

9 Case Studies of Start-ups

In this chapter, you will learn about:

- *What is a Start-Up?*
- *Artificial Intelligence and Start-Ups*
- *Brief Case Studies of Some Start-Ups in the Healthcare, Entertainment, E-Commerce, and Education sectors*

What is a Start-Up?

The term start-up refers to a company that is in the initial stages of business. Start-ups are founded by one or more entrepreneurs who want to develop and bring to market, a unique product or service for which they believe there is demand. *It aims at bringing innovation and building ideas quickly.* Funding sources for start-ups include family and friends, venture capitalists, crowdfunding, and loans.

Start-ups come with high risk as likelihood of failure is very high. On the other hand, start-ups can also be very unique places to work as they are focussed on innovation and provide great opportunities to learn.

Artificial Intelligence and Start-Ups

Artificial Intelligence is a technology that starts up, in varied sectors– be it medical diagnosis, entertainment, education, transportation or many others, are applying to scale up, innovate, and remain competitive in the current times. While many companies on the surface appear non-technical, yet they have many components that use AI to make their operations more efficient and increase innovation of their products and services. AI is being successfully applied in the real world. Many of the start-ups have achieved the Unicorn status. Unicorn is a term given only to those 'start-ups' who have a valuation of over a billion dollars.

Brief Case Studies of Some Start-Ups in Various Sectors

Healthcare

There is a growing emphasis on technology in the healthcare domain, wherein AI is being used for diagnosing patients, providing more affordable care options, and quickening the pace of drug discovery and development.

Drug discovery is the process of identifying new medicines for treating or curing human diseases. Historically, the discovery of new medicines has generally been slow and labour-intensive. Till date, the discovery of modern drugs remains a long and expensive process which may often not even be successful. AI-enabled solutions are playing a crucial role in accelerating drug discovery.

Insilico Medicine

Insilico Medicine is an artificial intelligence-driven pharma-technology company headquartered in Hong Kong. The company and its scientists are working towards extending human productive longevity and transforming the drug discovery and drug development process through excellence in biomarker discovery, drug development, digital medicine, and aging research.

Its mission is to accelerate drug discovery and drug development and rapidly bring novel breakthrough medicines to patients. In the year 2017, NVIDIA selected Insilico Medicine as one of the Top 5 AI companies in its potential for social impact. In the year 2018, it received the Frost & Sullivan 2018 North American Artificial Intelligence for Aging Research and Drug Development Award.

1mg

1mg is an Indian digital healthcare platform. It was founded in the year 2013 in Gurgaon, Haryana. It has grown exponentially in terms of app downloads and user engagement. 1mg has subsequently been acquired by Tata Digital following which it is renamed Tata 1mg.

This Health Tech start-up's mission is to make healthcare accessible, understandable, and affordable for a billion Indians. Medicines are provided to the customers through the mobile app or the website.

The platform provides various services such as buying medicines online by uploading prescriptions and getting them home delivered, booking free collection of samples from home for laboratory tests and e-consultation–consulting a doctor from the comfort of one's home and online Questions and Answers.

The platform uses its app for spreading information related to the medicines and sending notifications and emails to reach people.

Entertainment

AI can analyse a user's preferences and behaviour patterns to recommend similar content that they might enjoy watching or listening to. This personalization of content helps in user retention which Netflix and Spotify do routinely. AI also helps in improving the quality of streaming, search optimization, detecting and preventing cyber-attacks and providing targeted advertisement to users.

Netflix

Netflix was a US–based start-up that was founded by Reed Hastings and Marc Randolph in the year 1997. In the year 1997, Netflix was a DVD rental firm. The founders knew that people liked to watch movies and they thought of how they could make it more convenient for people. Netflix's kept analysing their market. They saw the opportunity to use the internet to decentralize entertainment and give users a

new viewing experience with good sound and video quality. During the years 2003 to 2006, Netflix started using AI algorithms to provide additional suggestions and recommendations to users based on their preferences.

"We named our company Netflix in 1998 because we believed Internet-based movie rental represented the future, first as a means of improving service and selection, and then as a means of movie delivery." – Reed Hastings

To find new subscribers in overseas markets, Netflix established agreements with cable network operators in every regional market and gained millions of new subscribers in overseas markets. Today, Netflix is the largest online entertainment provider globally. They managed their success with innovative thinking and by adopting futuristic technology.

E-Commerce

AI is constantly transforming the E-Commerce industry. AI is being used to offer a highly personalized shopping experience with the help of virtual buying assistants, voice searches and chatbots and also in deciding where E-Commerce stores feature and sell various products to its customers. AI is improving the overall online shopping experience for both customers and retailers.

Amazon

Jeffrey P. Bezos started Amazon out of his garage when he was 30 years old. In the year 1994, internet revolution was happening, and Bezos left his job on the Wall Street and started an internet company. He decided to sell books online after going through a list of several items that he could potentially sell on the internet because of the low cost of books and a high demand for them.

The initial start-up capital was funded by Bezos parent's personal savings. From the very beginning, Bezos contended that Amazon was not merely a retailer of consumer products but was a technology company whose business was simplifying online transactions for consumers. He believed that to succeed as an online retailer, a company needed to "Get Big Fast." In the year 2002, Amazon launched Amazon Web Services (AWS). Amazon moved into the cloud computing area with Amazon AWS, as well as the crowdsourcing area with Amazon Mechanical Turk in the years 2005-2011. During the years 2011-2015, Amazon starts offering streaming services like Amazon Music and Amazon Video.

Now, Amazon.com is a vast Internet-based enterprise that sells books, music, movies, housewares, electronics, toys, and many other goods, either directly or as the agent between other retailers and Amazon's millions of customers. Today, it is one of the biggest e-commerce marketplaces in the world.

"If you're not stubborn, you'll give up on experiments too soon. And if you're not flexible, you'll pound your head against the wall, and you won't see a different solution to a problem you're trying to solve."

—Jeff Bezos

Flipkart

While working at Amazon, the two brothers–Sachin Bansal and Binny Bansal recognized the future of the eCommerce industry. They left their job and launched their own e-commerce company in India and named it Flipkart. Flipkart is the first Indian e-commerce company. It was established in the year 2007.

At the time when Flipkart was established, people were not buying online. The founders found out that the reason was that they were not trusting this new method of purchasing and did not want to pay upfront. So, Flipkart innovated the idea of a cash on delivery strategy. The business model of Flipkart has been based on solving the problem of people.

Flipkart works on the Business to Consumer Business Model where it becomes the bridge between the sellers and consumers. It is delivering the products to the customers by picking from the sellers.

Flipkart now has multiple categories of products listed. Flipkart tries to cater to all types of customers by making almost every kind of product available on their site i.e. making it a one-store solution.

Flipkart's success is owing to two major things, one is that they built trust in the audience, and second that they became customer friendly. Now, a large number of customers pay an upfront payment in place of cash on delivery.

Education

AI is transforming the way we teach and learn. Artificial Intelligence is being used to customize the experience of different learning groups, teachers, and tutors. Artificial Intelligence helps in finding out what a student does and does not know, and builds a personalized study schedule for each learner; provides customized digital learning interfaces and digital textbooks.

Platforms such as Grammarly use human linguists along with AI tools such as natural-language processing and machine learning to automate suggestions for ways to make writing clearer and more grammatically correct. Grammarly is an AI-powered writing assistant. It helps improve existing content by fixing any grammatical errors, checks for correctness, clarity and engagement and keeps writing concise by avoiding words that tend to get overused. It can also be used along with any content editor.

Grammarly

Grammarly was founded in the year 2009 and has since then remained abreast of the latest NLP technologies over the years. The founders of Grammarly initially developed a plagiarism checking software called MyDropbox in the year 2002. This was widely used by hundreds of universities. The co-founders of MyDropbox sold the company in 2007 as they realised that further worldwide expansion was going to be difficult. They started developing a software which would have wider applications. They developed Grammarly, a software designed to help people write better.

Grammarly is an AI–powered writing enhancement platform that helps individuals write more clearly and effectively by providing automated recommendations for grammar, spelling, diction, and punctuation suggestions in real-time as users write. It is used by individuals and organizations in a variety of sectors, including education. Many students and educators use Grammarly to help improve their writing skills and to catch errors in their writing.

Grammarly can be used to improve writing emails, social media posts, and academic papers. It is available as a web-based service and as a mobile app, so it can be used on a variety of devices. Grammarly focused heavily on user feedback which is used to further improve the software.

Some of their strategies that led to their success are that they sold their product only within the market that they knew, directly implemented user feedback into the development of the product, constantly evolved their product, used income from the product to further expand and develop the product, introduced a free version of their software, and gradually built up specific social media accounts relative to their client base.

KinderLab Robotics

Bers, a Child Study and Human Development professor developed a prototype of a robotic toy that teaches problem-solving skills to 4 to 7 year-olds using computer science principles. She, along with Rosenberg co-founded KinderLab Robotics in the year 2013.They focussed on creating toys and educational tools that enable young children to learn critical technical, problem-solving, and cognitive skills in a developmentally appropriate and playful way.

After testing their toys in schools for six months and promoting them at educator trade shows, KinderLab started shipping the kits in selling largely to schools. Sales picked up quickly and the founders were able to repay the loans they had taken to get started. While KinderLab Robotics primarily targets selling to educators, individuals also buy from their website.

Another invention by KinderLab Robotics is Kibo, a robot which is now in use by schools in several countries. Kibo emphasizes concepts such as sequencing that are relevant to coding, and also supports learning in math, reading, and writing.

Bers' philosophy is, "I just want to impact the next generation of citizens—and they need to learn new skills and think in new ways."

Current Scenario

Today, AI has become essential for an increasing number of businesses as the reliance on technology is increasing. Start-ups are applying AI in different and fascinating ways so as to be able to provide to their customers, the experience they now expect and take for granted. AI is enabling start-ups to innovate and remain competitive by making their operations more efficient. Start-ups using AI, learn from data which facilitates them in making informed decisions. AI is acting as an Enabler for tech as well as non-tech start-ups.

EXERCISES

I. Multiple Choice Questions

1. Start-Ups:
   (a) come with high risk. ☐ (b) come with low risk.
   (c) failure rate of start-ups is low. ☐ (d) are very easy to establish and grow.
2. Start-Ups:
   (a) are founded by entrepreneur/s.
   (b) develop and try to bring to market, a unique product or service.
   (c) believe there is a market for their product or service.
   (d) all the above
3. Start-Ups:
   (a) are unable to provide good opportunities to employees to learn.
   (b) focus on innovation.
   (c) are in the final stages of business.
   (d) all the above
4. Artificial Intelligence is a technology that start-ups in varied fields are using
   (a) e-commerce ☐ (b) medicine
   (c) transportation ☐ (d) all the above
5. AI is enabling start-ups to:
   (a) innovate ☐ (b) remain competitive
   (c) make their operations more efficient ☐ (d) all the above

II. True or False

1. Start-ups can be very unique places to work.
   (a) True (b) False
2. Family, friends, and venture are unlikely to fund start-ups.
   (a) True (b) False
3. Start-ups using AI, learn from data which facilitates them in making informed decisions.
   (a) True (b) False
4. While AI is acting as an Enabler for tech, it is unable to do so for non-tech start-ups.
   (a) True (b) False
5. Netflix was a start-up in Healthcare sector.
   (a) True (b) False

III. Answer the Following Questions

1. What is a start-up?
2. Does artificial intelligence play a role in helping start-ups?
3. Name a start-up in the:
   (i) healthcare industry (ii) e-commerce industry

4. What do you think differentiates start-ups from regular businesses?
5. Do you think founders play an important role in the growth of start-ups?

Search the internet for case studies of inspiring start-ups in the fields of:

(i) Security
(ii) Education
(iii) Service
(iv) Transportation
(v) Health
(vi) Entertainment

The class can be divided in groups of four students and each group be assigned one of the above fields. Each group may then prepare a brief presentation on the start-up researched by them and present it to the entire class.

ANSWERS

I. Multiple Choice Questions

1. (a) 2. (d) 3. (b) 4. (d) 5. (d)

II. True or False

1. (a) 2. (b) 3. (a) 4. (b) 5. (b)

10 Artificial Intelligence Ethics

In this chapter, you will learn about:

- *Meaning of Ethics*
- *Ethics in Artificial Intelligence*
- *Why are Ethics in Artificial Intelligence important?*
- *Focus Area of AI Ethics*
- *Features of An Ethical Artificial Intelligence System*
- *Principles for Artificial Intelligence Ethics*
- *Some Ethical Concerns Relating to Use of Artificial Intelligence: AI Bias–Bias in Data Collection, AI and Morality, AI and Privacy, AI Access, Ownership, Environmental Concerns, AI Creating Unemployment.*
- *AI for Good*

What is the Meaning of Ethics?

Ethics is a system of moral principles. It is concerned with what is morally right and wrong. Ethics help us in making choices that contribute to the common good of all. Ethical principles guide our behaviour and help us in making decisions that create positive impacts and steer us away from being unjust. Ethics influence our decision-making and the way we lead our lives.

What are Ethics in Artificial Intelligence?

Ethics in AI are the moral and ethical considerations that are involved in developing and using Artificial Intelligence. They are a set of guidelines that advise on the design and outcomes of artificial intelligence. AI ethics are intended for the development and responsible use of artificial intelligence technology.


Why should we care about AI ethics?

We, as humans, tend to have biases and if not careful, these biases may get reflected in our data. The AI tools by and large rely on large volumes of various types of data to develop insights. If the data is faulty, inadequate or biased, the projects that get built based on that data can have potentially harmful consequences even though they are unintended.

"AI ethics is a set of values, principles, and techniques that employ widely accepted standards of right and wrong to guide moral conduct in the development and use of AI technologies."

The field of AI ethics also focuses on questions such as: What are the responsibilities of designers and users of AI systems? How to ensure that the AI-powered machines act as per the set of values defined and required by us.

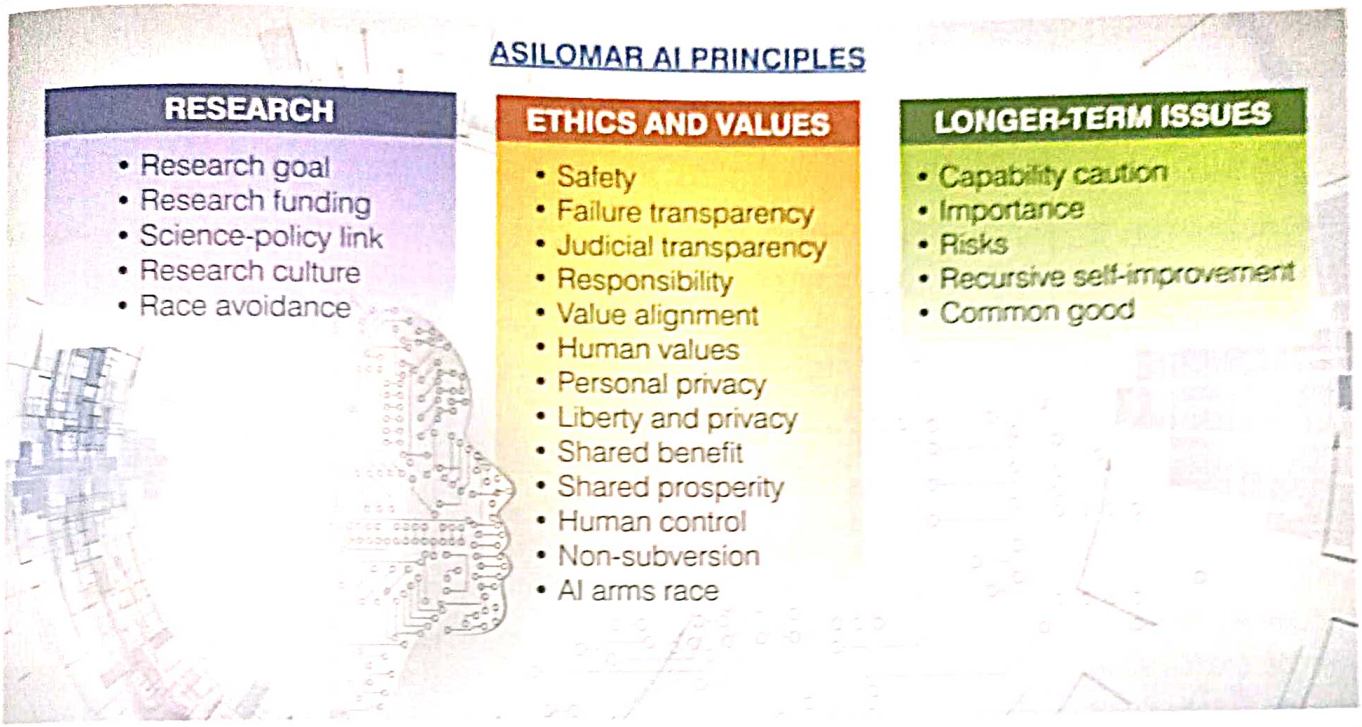
Why Are AI Ethics Important?

As AI has now become integral to a large number of products and services, many organisations are developing AI code of ethics. These

are important as they highlight the risks and benefits of AI-powered machines and gadgets and establish guidelines for their responsible use.

The AI code of ethics provides stakeholders with guidance when faced with an ethical decision regarding the use of artificial intelligence.

Many AI experts and scholars have got together and created a set of 23 guidelines that are referred to as the Asilomar AI Principles.



What do we need?

- International and national policies and regulatory frameworks to ensure that these emerging technologies benefit humanity as a whole.
- A human-centred AI. AI must be for the greater interest of the people, not the other way around.

—UNESCO

Laws of Robotics

Asimov proposed three "Laws of Robotics " and later added the "zeroth law".

Law 0:

A robot may not injure humanity or through inaction, allow humanity to come to harm.

Law 1:

A robot may not injure a human being or through inaction, allow a human being to come to harm, unless this would violate a higher order law.

Law 2:

A robot must obey orders given to it by human beings, except where such orders would conflict with a higher order law.

Law 3:

A robot must protect its own existence as long as such protection does not conflict with a higher order law.

Focus Area of Artificial Intelligence Ethics

AI ethics focus on four broad areas, namely Safety, Security, Privacy and Fairness.

Safety refers to how the AI system can avoid harming humans and also protect intellectual property rights and privacy.

Security refers to how well the AI system is able to prevent other systems from attacking it as well as the systems own capability to protect itself from being hacked or manipulated by unethical humans who may want to misuse it for wrong purposes such as stealing identities or money.

Privacy refers to the level of safety of personal information, where it is being stored, whether it is being shared across with any other establishments, how the personal data is being used, etc.

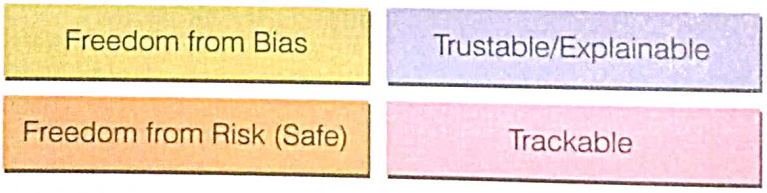
Fairness refers to whether or not individual human's rights as a consumer are being protected when they interact with and use a company's AI-powered services or products.

Features of An Ethical Artificial Intelligence System

An ethical AI System should:

- use data responsibly.
- be unbiased.
- have a positive purpose.
- observe data privacy rights.
- be explainable.
- be reliable and trustworthy.
- incorporate mechanisms that reflect societal values.
- promote safety, privacy, trustworthiness, fairness, transparency, accountability, and inclusion.
- be able to learn from experience over time to improve its performance and capabilities.
- be designed in ways that respect human rights.
- consider the impact on society when developing the technologies.

Ethical AI Principles - Key Traits



Principles for Artificial Intelligence Ethics

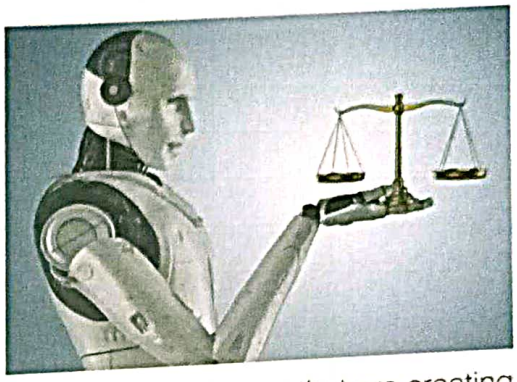
Principles for AI ethics are a set of rules and guidelines that are meant to help protect society from the negative effects of Artificial Intelligence. These principles aim to protect people, the environment, and the economy.

- Human Rights must be respected.

- Human dignity must be ensured.
- Respect for individual freedom and equality.
- AI systems must be understandable and intelligible for people.
- Transparency must be maintained.
- AI implementation must be impartial and avoid discrimination.
- AI should not be created with any evil intention.
- AI systems should be designed for benefiting human's and for human progress.

Some Ethical Concerns Relating to Use of Artificial Intelligence

AI Bias–Bias in Data Collection



Bias in data collection is a distortion which results in the collected data not being truly representative of the population that is intended to be represented. Sampling bias results from groups of individuals being over or underrepresented during the data collection process.

AI bias occurs because humans choose the data that algorithms use, and also decide how the results of those algorithms will be applied. It is, hence, easy for unconscious biases to enter machine learning models. In order to create non-biased algorithms, the data that is used has to be bias-free and the developers that are creating these algorithms need to make sure they are not transferring any of their own biases to the machine.

Amazon stopped using a hiring algorithm after finding it favoured applicants based on words like "executed" or "captured" that were more commonly found on men's resumes, for example.

Artificial intelligence technology, if built on biased data and assumptions, can harm how people live, work and progress through their lives. It is, therefore, important to identify all the potential areas of bias, fix the AI solutions accordingly and create the AI technology with the right approach so that the potential that AI has to do good in the world is realised.

AI and Morality

Deployment of AI algorithms in society has social impacts that could be positive or negative. It is important to consider whether the technology being created will benefit humanity or will it result in hurting humanity more than helping it. It is important for the technology developers to consider questions such as: How is the technology that I am working on going to be used? What social impact will it have? Will people benefit from it or get harmed by it?

A moral dilemma–Autonomous (self-driving) cars

An autonomous car is a vehicle that is capable of sensing its environment and moving with little or no human involvement. The numbers of such cars are only going to increase on the roads in the future. There are several ethical challenges that these cars will present on a day-to-day basis.

Humans, while driving their cars make moral decisions of everyone. When a driver chooses to slam on the brakes to avoid hitting a person walking in the middle of the road, the driver makes the moral decision to shift the risk of injury from the pedestrian to the people in the car.

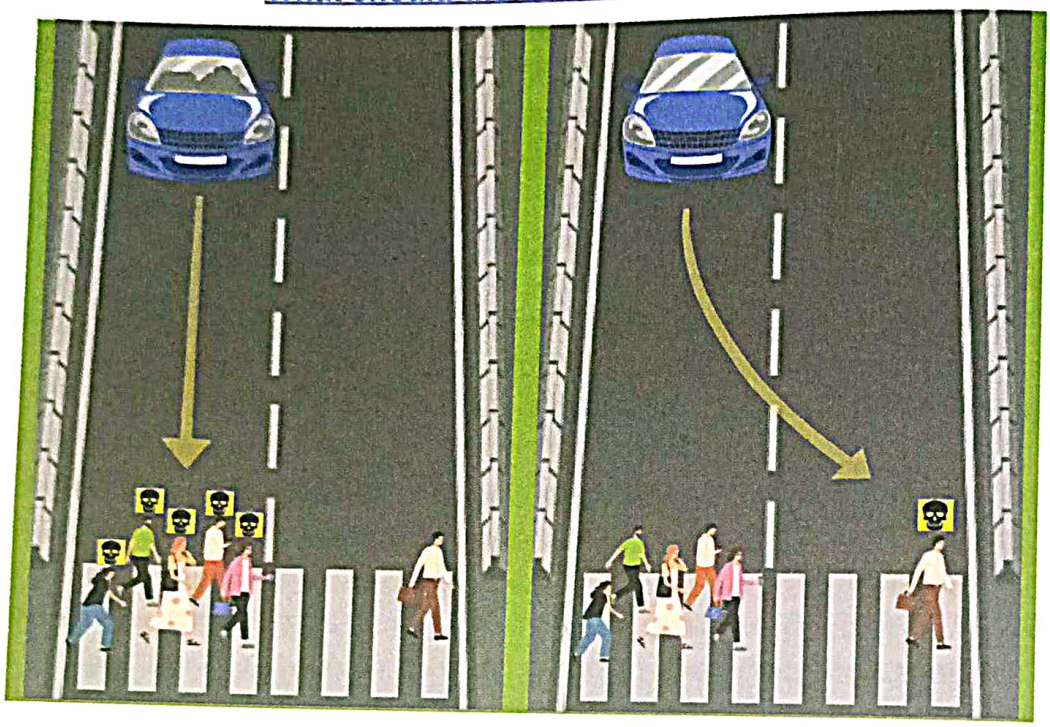
Let's imagine a situation where the brakes of an autonomous car have failed and it is heading at great speed towards large number of pedestrians crossing the road. The car can either stay on its course and injure more people or it can divert from its path to reduce the number of people it would injure.

In this situation, it is not a human driver who is going to take the decision, but the car's algorithm.

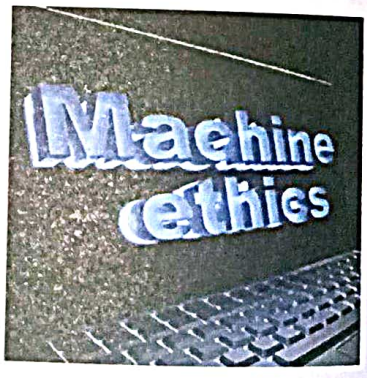
What would you choose, to stay on course or deviate a little? Do you think there is only one right answer?

There is no one right or wrong answer. The choice would differ from person to person because each person has a different perspective. This is a typical ethical dilemma, which shows the importance of ethics in the development of technologies.

What should the self-driving car do?



AI and Privacy



We live in a digital world today and a lot of data get shared. Data from networks, social media pages, mobile phones, and other devices add to the volume of information that businesses use to train their Artificial Intelligence-based models.

People do not know how their data is being used by companies but they care about their privacy and do not want their data to be wrongly shared. Organizations should make conscious efforts to protect customer data. They should establish a data protection privacy culture. Artificial Intelligence should be designed keeping data privacy in mind.

AI Access

AI access means making AI more accessible. While Artificial Intelligence is now finding its way in almost all domains, not everyone has access to it. The AI-enabled devices are expensive and

everyone cannot afford them. Those who are unable to gain access, miss out on learning about AI and other such new technologies.

Ownership

Some of the things (media content for example) created by AI may be misleading and incorrect. Who is to be held accountable for such things that AI creates? Is it the developers working for the organization that created such products or is it the organization itself?

AI is also being used to create art and music pieces. Who would be the owner of it or who would have intellectual property rights over it?

Environmental Concerns

Developers that work on AI, use data on the cloud while working and developing their algorithms. The computers that keep the AI and cloud infrastructure consume an enormous amount of power and create a lot of carbon emissions. So, it's important to find a solution to deal with this problem.

AI Creating Unemployment

With the rapid technological advancement that has taken place in recent years, automation, robots and computers are increasingly being used in domains that were earlier considered exclusively human. This is being viewed as a threat to the labour market. A number of jobs are increasingly being automated and the number is only going to increase in future.

Almost all industries such as manufacturing, agriculture, retail, hospitality, logistics, transportation, etc. use and benefit from AI. Many jobs in these industries will become redundant as AI-based systems will automate them. While new technologies such as AI, make some jobs redundant, they also create new jobs.

As per United Nations Department of Economic and Social Affairs, "Throughout history, technological innovations have enhanced the productivity of workers and created new products and markets, thereby generating new jobs in the economy. This will be no different for AI, 3D printing and robotics."

In the long run, there will be a shift towards more AI-dominated jobs while low skill labour intensive jobs that are repetitive in nature will get eliminated. The work force will require upskilling and reskilling. Jobs in AI, IT, engineering, and software development are likely to grow substantially, as these professionals will be required to develop, update, and maintain the AI technologies of the future.

AI for Good

AI for Good is a year-round digital platform of the United Nations, where AI innovators and problem owners, students, engineers, philanthropic organizations, etc. learn, discuss and connect to identify practical AI solutions to advance the UN Sustainable Development Goals. Impact is created by bringing together a broad network of interdisciplinary researchers, governments, and corporates to identify, prototype and scale solutions that bring positive change.

AI for Good is an endeavour for making people's lives better through effective use of technology. AI for good projects involves developing and applying artificial intelligence-based solutions to further goals in areas such as sustainability, health, humanitarian aid, social justice, etc.

AI for social good projects

There are many ongoing projects in areas such as healthcare, education, or the environment, etc. in government organizations, universities and industry labs which are not commercially motivated but are governed by more noble objectives. These projects are called AI for Social Good (AISG) projects.

EXERCISES

I. Multiple Choice Questions

1. Ethics:
   (a) is a system of moral principles.
   (b) are irrelevant when developing software.
   (c) Both a and b
   (d) Neither a nor b
2. Ethics in AI are:
   (a) the moral and ethical considerations involved in developing and using Artificial Intelligence.
   (b) a set of guidelines that advise on the design and outcomes of artificial intelligence.
   (c) intended for the development and responsible use of artificial intelligence technology.
   (d) all the above.
3. AI Security refers to:
   (a) how well the AI system is able to prevent other systems from attacking it.
   (b) the systems own capability to protect itself from being hacked or manipulated.
   (c) ability to prevent unethical humans from stealing identities or money.
   (d) all the above
4. AI bias occurs because:
   (a) humans choose the data that algorithms use.
   (b) humans decide how the results of those algorithms will be applied.
   (c) both a and b
   (d) neither a nor b

5. **For AI to be made responsible:**

(a) governments and businesses should together define standards and best practices for AI development and its usage. ☐

(b) relevant legislation should be drafted for data privacy and security. ☐

(c) a code of ethics should be developed and implemented. ☐

(d) all the above ☐

II. True or False

1. **Ethics help us in making choices that contribute to the common good of all.**

(a) True (b) False

2. **Biases of developers never get reflected in their data.**

(a) True (b) False

3. **Privacy refers to how the AI system can avoid harming humans.**

(a) True (b) False

4. **Impact on society should be considered when developing AI technologies.**

(a) True (b) False

5. **With the advancement of technology, everyone now has access to AI.**

(a) True (b) False

III. Answer the Following Questions

1. What are ethics? Why are ethics in Artificial Intelligence important?
2. What are the focus areas of Artificial Intelligence ethics? Explain briefly.
3. What are some of the features that an Artificial Intelligence system should incorporate? Explain any two features briefly.
4. How does Artificial Intelligence Bias occur?
5. What can Artificial Intelligence developers do to ensure that the algorithms and systems developed by them are free of bias?
6. What are the moral issues related to autonomous cars?
7. Why should ethical practices be followed while developing solutions using Artificial Intelligence?
8. What is AI for Good?

ACTIVITY 1

(1) List the advantages and disadvantages of Artificial Intelligence.

(2) Have a debate in class on each of the topics given as under. The class may be divided in two groups. Divide each group into two subgroups wherein the first subgroup will prepare to speak for the topic and the second subgroup will prepare to speak against the topic.

(i) Use of Artificial Intelligence will lead to unemployment.

(ii) Artificial Intelligence is beneficial for society.

(iii) Is Artificial Intelligence a boon or a bane?

(3) Given below is a moral dilemma. Do you think there is a one right or wrong answer?

Imagine there are two families of four people out for a ride in a hot air balloon. Suddenly the balloon starts to move towards the earth instead of staying airborne. To stabilize it, one family needs to take the parachute and go out the balloon or else it will come crashing down.

Who should be thrown out of the hot air balloon?

ANSWERS

I. Multiple Choice Questions

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

II. True or False

1. (a) 2. (b) 3. (b) 4. (a) 5. (b)