Edusoft™
ITS (P) Ltd.
Educational Publishers

Available on the Android App Store

Class VIII

In Line with National Education Policy

My Dream Book of ARTIFICIAL INTELLIGENCE

CBSE CODE 417

Award Winning Publisher

- Experiential learning assignments
- CBSE recommended pedagogy
- E-Content for smartboard
- Mobile App for students
- Test Paper Generator
- Course-end AI projects
- AI Lab Sessions

- ✦ Conceptual Skills
- ✦ Technical Skills
- ✦ Life Skills

ISO 9001:2015 Certified Company

Class VIII

ARTIFICIAL INTELLIGENCE

Predicting Future

Concept by:
Gagan Agarwal
Founder & M.D.

Composed by:
David S.
CLDP, MCA
(25 yrs. experience in IT)

Contributed by:
Hitesh Saini

CONTENTS

Topic Covered...

A WORD FOR TEACHERS AND LEARNERS

As we read this, AI has arrived already to influence our future. This course on AI is a timely and great initiative by the CBSE in extension to the offering of *Skill subjects* at Secondary and Senior Secondary level aligned with the *sustainable development goals* that focus on *green economy*. *Ethical implementation of AI*, bound with guiding rules and policies, can be a boon for future careers, industries and a force to usher us into the era of green economy.

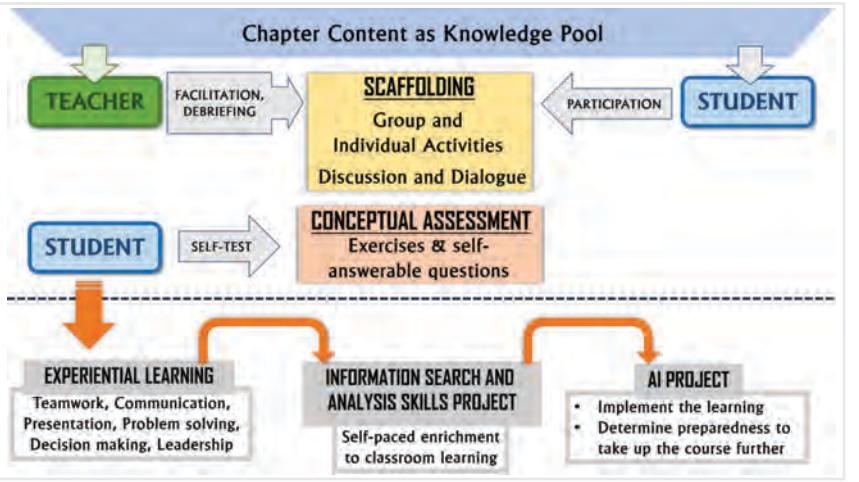
ARTIFICIAL INTELLIGENCE – Predicting Future Series is a humble effort in enabling both the teachers and the students in preparing ground for developing an understanding about AI and its applications.

The book is designed strictly in line with the *curriculum recommended by the CBSE* and promotes the suggested *pedagogy to develop AI mindset and the skillset*.

HOW TO USE THIS BOOK?

Following points will help teachers ensure effective coverage of the course:

1. **The explicit teaching model:** Do not teach but discuss things with the students. The teaching mode should be a dialog rather than lecture. Use the content of the book as a *knowledge pool for reference*.
2. **The scaffolding technique:** The activities will prepare students to understand what is discussed with them. *60% of the planned time* should go in activities.
3. **Experiential Learning:** By exploring beyond the learning, this allows the students learn through open ended approach and articulate their ideas clearly on what they learn. This section will inculcate in them the life skills such as *teamwork, communication & presentation skills, problem understanding & critical thinking, decision making & problem solving, leadership skills & independent thinking*.

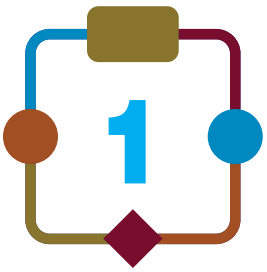


4. **Information search and analysis skills project:** This *self-paced learning* provides the students freedom to explore more about AI concepts.
5. **Conceptual skills assessment:** This section serves the purpose of a quick test of what has been learnt. Teacher should *encourage that students solve it themselves*. Teacher must play only the role of a facilitator.
6. **AI Project:** Students bring all their *technical, conceptual and life skills* to showcase what they have learnt. How well they do it determines how well they are prepared to take up this course further in the coming years.

UNIT 1: EXCITE

Unit Introduction

This unit focuses on building the groundwork for learning various aspects of Artificial Intelligence in entire course. This unit will help you in developing an interest in AI and explore the basics of human intelligence, types of artificial intelligence in a very simple way and understanding the three core domains on which the working of AI is based.



INTRODUCTION TO ARTIFICIAL INTELLIGENCE

OBJECTIVES

By the end of this chapter you will be able to:

- Define the term browser fingerprinting.
- Define the term Artificial Intelligence in 4 different ways.
- List the challenges faced in achieving AI for machines.
- Understand 5 major traits of human intelligence.

This is social networking age. We all spend a considerable amount of time online depending on our interests and requirements. When we browse through social websites and online stores, a lot of suggestions pop-up or slide-in in our way. Where have they come from? A programmed component of the web site or mobile app is doing it. The big question is - *How does these programs know what we might be interested in?* Answer is, we are tracked right from the moment we logon to any online platform until we logoff. Websites and apps are programmed to track us in various ways like:

- Which pages and other web sites we visited?
- Which section of a web page we scrolled up to?
- Which links or buttons we clicked?
- How much time we spent on a web page?
- Which products or services we clicked on to?
- How much time we spent in reading the features of a product?
- Which products did we add to shopping cart but didn't buy?
- Which products we did buy?
- Which products we marked as 'liked'?
- Which products we bought and later returned?
- How often we visit which web sites or particular section of a website?

These are a few examples of how our browsing is tracked which is called our *browsing signature* or *browser fingerprinting*.

This data is analysed by the intelligent programs and as a result we are recommended new products likely to interest us thereby increasing the chances of we end up buying them. Isn't it intelligent?

These programs compile such huge data chunks from millions of visitors daily and churn out the intelligent results out of it. This analysis of such an enormous amount of data to produce useful patterns of visitor's browsing habits, interests and buying preferences is called *analytics*.

This is one glimpse of artificial intelligence. But we did not recognize it as artificial intelligence because it worked so naturally around us that it did not feel like AI. What works, does not surprise us much, no?

So, as we read this and buckle up to explore AI and its concepts, it has already been the part of our lives. Many exciting things are happening out there in this field which we shall soon discover.

But, first things first. The basics!

Just like many other fields of study, Artificial Intelligence is also one such field. But what is so exciting about it?

AI is the field of conceiving, designing and developing machines which should perform tasks that usually require human intelligence.

AI is the art and science of developing machines running on intelligent algorithms that make them capable of thinking, acting and learning like human beings.

This very nature of AI field makes it a huge umbrella of technology which covers all the domains and application areas which can be influenced by it in a revolutionary manner.

Think of what a machine as intelligent as a human being can do in any field!

The impact is tremendous and very promising. Hardly any field of application would be left out. Medical and health care, research and development, manufacturing, sales, travel, education, defence, real estate, FMCG etc. all would be revolutionised by the touch of AI. This way, AI, as a field has remarkable scope in career building no matter which domain you belong to.

Some methods to use browser fingerprinting are:

- **Cookies**
- **HTML 5 Canvas fingerprinting**
- **IP Address of the device**

Understanding Artificial Intelligence

The term Artificial Intelligence was first coined by Stanford researcher John McCarthy in 1956. In plain and simple words, *the ability of a machine to think and learn is called artificial intelligence*.

The AI field refers to the study of the principles, concepts and technology for building such machines and systems that should think, act and learn like humans.

Machines possessing AI should be able to interact with their environment and perceive it through various stimuli such as visual perception, speech

recognition, language comprehension etc. in the form of received data and respond to them, based on gathered intelligence.

According to **McCarthy:**

"AI is the science and engineering of making intelligent machines."

INTERACTIVE ACTIVITY: IMPACT OF AI ON DAILY LIFE

Think of zooming in a little farther into the future. Let us assume, after a decade, how is AI going to influence our life and help us in our day-to-day activities?

List at least 7 such findings which, in future, may be greatly influenced by AI.

Why AI Today?

Why artificial intelligence is a buzzword today in the field of computer science? The simple reason is that today we are technologically more advanced and ready to do better research and experiment in this field. We have computers with faster computational power, we have an enormous amount of data to process thanks to constant online presence of people, we have identified a number of important application areas where AI could prove extremely useful and we are now becoming able to program computers in much better way with complex and intelligent algorithms.

AI Challenges

Having understood the traits of human intelligence, we can easily figure out the challenges posed in the path to achieving true AI. Some of the obvious challenges are to make machines who are able to do the following:

- Retain the facts as knowledge.
- Recall the knowledge in a situation.
- Think, analyse and apply logic.
- Make useful and accurate predictions.
- Make decisions and upgrade their intelligence algorithm themselves.

So, the biggest challenge is to develop a machine or a computer that can store knowledge and improve its own program to solve new problems with its evolved or improved intelligence.

Human Intelligence and Machines

Intelligence is a process that evolves by the time and has practically no limit.

What makes humans intelligent is their ability to reason. But what triggers reasoning? What stimulates us to initiate the process of reasoning? The answer is *sensing*. We sense, we perceive, we receive a variety of stimuli from our surroundings and then we *process* that input. This processing of what we sense is called reasoning. This power has been given to animals too but up to the extent of their ability to survive. We humans had never been meant for just to survive. Human brain reasons at a very higher and different level than animals. This power of reasoning determines our actions.

A human brain senses, reasons and then, finally, acts upon it. For example, we come across an old friend, recognise him or her and greet him or her.

We sense through our receptive organs. How should a machine sense?

A machine should first know what it is supposed to sense and then it should be able to sense (input) images, patterns, faces, signatures, prints, textures, audio, moving images, numbers etc.

What should it sense from these? - the purpose is another aspect. For instance, in an image of a group of people, is it supposed to sense entire image, a face or just the background?

So, sensing is not just about simple input. That can be achieved by scanners and sensors. The purpose of sensing is determined by the *intelligence*.

Image scanner, audio sensor, speech recognition engine, fingerprint recognition program, motion sensor, thermal sensor, light sensors, proximity (distance) sensor, chemical sensors, barometric sensors are the equipment which play central role where a machine is able to receive various stimuli from its surroundings.

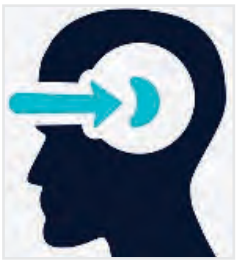
After sensing, what to do with the stimulus (input) is entirely the problem domain of artificial intelligence. Comparing facts and making decisions like in an Expert System, recognising speech and identifying the language to process the command given in voice, assessing the situation, identifying blocks and barriers during movement and deciding the course of movement, making logical comparisons, ability to understand the evidence and its weightage, planning before action by considering all available facts, able to compare complex rules to solve problems etc. are some of the basic expectations from a machine in the field of AI.

Then comes the action, the outcome, the response which, again, falls in the domain of AI. Responding with voice, moving in a particular direction or taking a pause before next movement, accomplishing a task as desired etc. are expected of the intelligent machine.

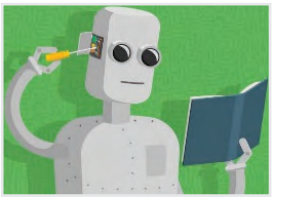
Human intelligence is the combination of the following traits:

Perception

Humans perceive their surroundings with their sensory organs. Then the objects that make the surroundings are identified and recognized depending on the retained knowledge about the world. A machine can have artificial sensory organs like cameras, scanners, photosensors for light, thermo-sensors for temperature etc. to picture and understand the surroundings. Think of a robot or machine designed to move in a closed area like office or factory, more complex environments are railway platforms & airports and most complex of them is a busy road.



Learning



Humans learn in many ways – guidance and training by others or by self-paced trial and error method. They retain the learning by practice, remembering and applying it in various situations. Getting machines learn and remember is quite challenging. Machines are being developed to learn by trial and error. For example, a machine playing a strategy game like chess may keep looking for a move that matches the closest correct move and stores it for further usage. This is like learning by rote. Generalised learning is difficult as it demands application of learning in various situations by using previous knowledge and experience.

Problem Solving

In a simple situation, a machine can be programmed into looking for, finding and applying the possible steps of solution to achieve a set goal. Such machines are useful in a specific task-oriented environment like bottling plant, loading/ unloading of items, counting, assembling parts etc. In a generalized situation, a machine needs to be trained into selecting the best suited approach to achieve the goal and then retain it for future use. Machine should be able to analyse and update its algorithm in such a way as to recognize similar situation and able to understand that such and such previously learnt solution is needed to be applied. This is what AI is trying to achieve.

Reasoning

Logical reasoning is the distinct characteristic of human brain. Reasoning has broadly 2 types: *Deductive* and *Inductive*. In deductive reasoning the facts are analysed and guarantee a conclusion. For example:

Raj is a non-vegetarian so he will also eat a vegetable if non-vegetarian dish is not available.

Some more examples of deductive reasoning are:

- All bats are mammals, all mammals give birth to young ones; therefore, all bats give birth to young ones.
- Dogs can smell from a longer distance, Jade is a dog; therefore, Jade can smell from a longer distance.
- Obtuse angles are more than 90 degrees, this angle is 120 degrees so, it must be obtuse angle.

In inductive reasoning, facts only support the conclusion without any guarantee. For example:

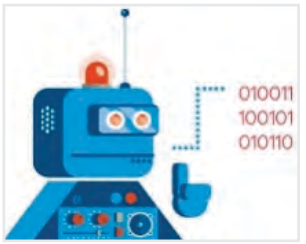
Ram falls sick most often when he eats eggs. Ram must be allergic to eggs.

Some more examples of inductive reasoning are:

- The first egg taken from the pot is boiled, the second egg taken from the pot is boiled; therefore, all the eggs in the pot are boiled.
- Fish is a non-vegetarian dish, Rajesh loves to eat non-vegetarian dishes; therefore, Rajesh loves to eat fish.
- Most of the pass-outs hired from the local college are loyal employees so, the company prefers to hire pass-outs from the local college.

Hardest challenge in AI is to develop machines that are able to apply inductive reasoning which needs a critical and intelligent analysis of the available facts in different scenarios or contexts on the basis of previous experience.

Language



Learning any language is a complex process even for humans unless a methodical approach, right kind of training and enough practice is not involved. Language contains grammar and words – word with multiple meanings, words with similar meanings (synonyms), similar sounding words (homophones), speech accents, symbols, signs and special notations. After learning the language, an endless variety of sentences can be formed which is challenging for a machine to do. AI based voice response systems and chat bots etc. are being developed in a restricted application area but there is still a lot needs to be done.

INDIVIDUAL ACTIVITY: SMART HOME OF MY DREAMS

You might have earlier read about it or seen in some movie, but what is your unique idea of a smart home. If you have the freedom to conceive the design of your own smart home, how do you visualise it? Its dimensions, height, number of stories, unique features, different rooms, backyard, front-yard, drive way, surroundings, garden, terrace, security, appliances and equipment, facilities and luxuries, its location and look etc.

Let us have a floor plan of your dream smart home!

Note: Use a pencil for initial drawing for easier corrections/modifications.

LEARNING POINTS

- Tracking of user's browsing habits make his/her browser signature.
- Enormous amount of data to produce useful patterns of visitor's browsing habits, interests and buying preferences is called analytics.
- The ability of a machine to think and learn is called artificial intelligence.
- AI is the science and engineering of making intelligent machines.
- The biggest challenge is to develop a machine or a computer that can store knowledge and improve its own program to solve new problems with its evolved or improved intelligence.
- What makes humans intelligent is their ability reason.
- The purpose of sensing is determined by the *intelligence*.
- In deductive reasoning the facts are analysed and guarantee a conclusion.
- In inductive reasoning, facts only support the conclusion without any guarantee.

KEYWORDS

- **Browsing signature/ browser fingerprinting:** Pattern of a user's browsing habit.
- **Analytics:** Analysis of enormous amount of data to produce useful patterns.
- **Algorithm:** A process or logical set of rules to solve a problem or perform a calculation.
- **Sensing:** Perceiving an external stimulus.
- **Reasoning:** Thinking logically to reach a conclusion.
- **Expert system:** A system that compares facts and makes decisions.

ASSESSMENT

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Users' regular browsing habits together make his/ her _____.

   a. Browser fingerprinting
   b. Browsing signature
   c. Both a) and b)
   d. None of these

2. Process of producing useful patterns by processing enormous amount of data is called _____.

a. Data processing
b. Sensing
c. Analytics
d. Reasoning

3. The term Artificial Intelligence was first coined by whom?

a. John McCarthy
b. Tim Berners Lee
c. Charles Babbage
d. Bill Gates

4. Which of the following capabilities is a challenge to develop in machines?

a. Retain facts as knowledge
b. Recall the knowledge
c. Think, analyse and apply logic
d. All of these

5. What makes humans intelligent is their ability to _____.

a. Sense
b. Think
c. Reason
d. Read

6. Reasoning has broadly two types – deductive and _____.

a. Addictive
b. Inductive
c. Logical
d. Calculative

B. Fill in the blank.

Inductive, Algorithm, Deductive, Knowledge, Learn

1. The ability of a machine to think and _____ is called artificial intelligence.
2. An AI machine is supposed to retain the facts as _____.
3. An AI machine should be able to upgrade its _____ to use the retained learning.
4. In _____ reasoning, the facts are analysed and guarantee a conclusion.
5. In _____ reasoning, the facts only support the conclusion without any guarantee.

C. State whether True or False.

1. Artificial intelligence is the science of developing intelligence in animals and birds. ☐
2. The biggest challenge is to develop machines that retain knowledge to solve new problems. ☐
3. The purpose of sensing is determined by the intelligence. ☐
4. Generalised learning is easier for machines to implement. ☐
5. Logical reasoning is the distinct characteristics of animals. ☐

D. Answer the following questions.

1. What do you mean by browser fingerprinting?
2. What is McCarthy's definition of AI?
3. List any two challenges in achieving true AI for machines.
4. What do you mean by sensing and reasoning?

E. Categorise the following statements into deductive and inductive reasoning:

1. Anu finds the reviews of a newly released movie very good so she is convinced that she will like that movie.
2. A language teacher finds that students learn and perform better in tests with practical, real-life assignments so he includes such assignments in all his lessons.
3. My teacher said that the highest test scorer will get a chocolate as reward. I scored highest in the test so I look forward to get the chocolate.
4. David likes computer programming. Python is a programming language so David likes Python.
5. The sum of all angles in a triangle is always 180 degrees so in a right-angled triangle, sum of two of the angles will be 90 degrees.
6. Monkeys often steal fruits from our orchard. Today, some guavas were plucked from the trees so they must have been stolen by monkeys.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://kids.kiddle.co/Artificial_intelligence*
- *https://www.iste.org/explore/artificial-intelligence/teaching-kids-what-ai-and-isnt*
- *https://www.aisingapore.org/talentdevelopment/ai4k-2/*
- *https://www.roboticsbusinessreview.com/ai/3-basic-ai-concepts-explain-artificial-intelligence/*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a 1000 words write-up or a 5 slide presentation on **How insects Inspire Artificial Intelligence.**

2 ARTIFICIAL INTELLIGENCE: TYPES AND TECHNIQUES

OBJECTIVES

By the end of this chapter you will be able to:

- Define 2 types of AI based on complexity of intelligence.
- Define 4 types if AI based on the functionality.
- Understand 3 major techniques on which AI works.

Relating from previous chapter: Introduction to Artificial Intelligence

Earlier we learnt about the definition and meaning of Artificial Intelligence and how it is different from human intelligence. We also identified the challenges in achieving AI for machines.

In this chapter, we shall learn various categories in which machine AI falls and the techniques that contribute to AI.

Artificial intelligence can be categorised in different ways. Two important bases on which AI can be categorised are:

- **Complexity of intelligence**
- **Functionality**

AI Types on the Basis of Complexity of Intelligence

Artificial intelligence that works with limited functionality and needs some prior information to be fed in order to accomplish a task is called weaker or narrow AI. On the other hand, any device or machine that is equipped with human-like intelligence is said to be showing strong AI.

Narrow or weak artificial intelligence

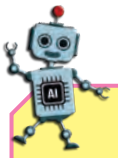
Machines that exhibit a limited extent of intelligence to accomplish a single, or certain simple tasks are said to have narrow/ weak intelligence. Such machines are deployed to perform some repeated tasks.

Some examples are:

- Performing web-wide search of content (e.g. Google search)
- Recognising face among several single image shots or group images.
- Self-driven vehicles.
- Voice interface-based assistants such as Alexa and Siri.
- Any logic-based game such as a card game slot equipped with artificial intelligence loaded with the possible permutations of different sets of cards and rules of the game.
- A robot collecting empty food trays from the tables in a restaurant.
- A car driving simulator.
- A website suggesting similar products depending on the items bought by the user earlier.

Key features of narrow AI:

1. **Perform a dedicated assigned task.**
2. **Limited to a particular field of application.**
3. **Has a predefined set of functions.**



IBM WATSON

Watson by IBM is an AI based Question-Answer system that answers the questions asked in natural language. It is developed by the team headed by David Ferrucci. Its first successful implementation was done at Memorial Sloan K. Cancer Centre, New York where it helps in lung cancer treatment.

Watson is able to gather massive data from encyclopaedias, newspapers, dictionaries, and databases. Then it analyses the immense amount of data to generate various hypothses which help it to answer the new questions posed by the users. It runs on Linux operating system and 90 powerful server computers of IBM equipped with 16 TB RAM and 3,5 GHz 8-core micro-processors.

Strong or generalised artificial intelligence

Machines with strong intelligence are capable of not only "think" like humans but also able to retain the learning developed by the tasks accomplished. Such learned intelligence is used to solve the same problem in different scenarios. It is this type of intelligence which makes for the scope of actual AI to be developed in future. Such machines can be thought of having intelligence in the beginning like that of a child and later they learn and grow their intelligence like that of an adult. Some expected scenarios as an outcome of strong AI could be:

- A self-learning diagnostic system loaded with information regarding diseases and possible symptoms along with rules to diagnose the diseases.
- An airplane training system that functions without the help of a trainer.
- An intelligent chat-bot that understands customer's needs and suggests solutions by its learned intelligence.
- A teaching robot that learns by answering students' queries and thereby enhancing its teaching skills.

Key features of strong AI:

1. **Perform variety of tasks in changing context like responding to a question in different ways.**
2. **Smart like humans. Think and respond like humans do.**
3. **Capable of applying retained knowledge to solve new problems.**

AI Types on the Basis of Functionality

On the basis of functionality, artificial intelligence can be classified into four types:

- **Reactive machines**
- **Limited memory**
- **Theory of mind**
- **Self-awareness.**

Reactive machines

As the name suggests, a reactive machine knows how to respond to a particular stimulus (input) on the basis of a set of rules and the logic to apply those rules in all possible scenarios. They show the most basic type of AI. They do not store learning by previous problem solving. Computers that play strategy games against humans are examples of reactive machines.

IBM DEEP BLUE

In 1997, the world chess champion Gary Kasparov was beaten by IBM's Deep Blue – a chess playing supercomputer. Earlier versions of Deep Blue were beaten by Kasparov. Deep Blue was capable of computing 200 million positions or moves per second with a processing speed of 11 Gigaflops. The Deep Blue program was written in C programming language and it ran on AIX operating system over 480 VLSI chips.

Limited Memory

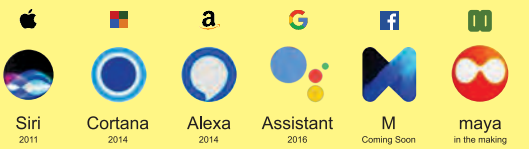
Such machines are equipped with the logic of sensing the changes occurring around such as an object changing its place or position at a distance. Machines with limited memory cannot retain the learning. The observations or logical details related to completing the task are not retained by the machine to apply them again next time. Next time, in the same situation, logic to resolve the problem is executed afresh. Self-driven cars, chat bots and customer response systems are based on limited memory functionality.

SELF-DRIVEN CAR - WAYMO

Google's subsidiary Waymo developed this self-driven car after research that began in 2007. After several test drives and improvements the self-driven version of Waymo with no driver and any human help was tested successfully on real roads in Texas.

Waymo is equipped with a rooftop camera – LiDAR to create a 3D vision for the car 200 meters around. Overall, it has 6 such sensors. It has GPS sensors to help it assess road conditions and lane positions. Gyroscopes, tachometers and altimeters fitted inside the car help it maintain its direction and balance. The car is able to identify other vehicles and obstacles in front and around. It identifies traffic signals and hand gestures made by other commuters.

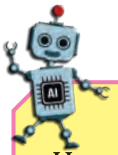
AMAZON ALEXA, GOOGLE ASSISTANCE, APPLE SIRI AND MICROSOFT CORTANA



Alexa, Assistant, Siri and Cortana are voice driven virtual assistants by their respective companies. They are just like voice-driven wizards, equipped with speech recognition and natural language processing technologies, which can do a lot of things for you such as answering almost any question on any topic, set reminders for you, doing weather forecasts, playing your preferred music, delivering messages, switch to various channels such as sports, education, markets, entertainment etc. Today Alexa has around 90000 functions and skills that it can perform for the user. Google Assistant identifies objects, songs, user preferences and allows E-commerce by voice. Users can set voice shortcuts for common commands. Siri can navigate locations. Coratana is available with Windows 10 systems to provide voice based commands and search features using Microsoft's search engine Bing.

Theory of mind

Machines based on this concept of intelligence are capable of interacting socially. They are able to respond suitably to others by exhibiting understanding of their emotions and gestures. Research is ongoing in this field and certain very encouraging results have been achieved but, still, a lot more needs to be done in this direction.



HUMANOIDS

Humanoids are the robots that look like humans exteriorly. The humanoids closest to humans in looks and expressions are Androids.

Humanoids, today, are used for various purposes like teaching, ocean exploration (Ocean One by Stanford Robotics Lab), to carry out search and rescue missions (ATLAS by Boston Dynamics), Sports (Soccer playing robot Nao by Aldeberan Robotics playing RoboCup Standard Platform League), biological and chemical tests (Petman by Boston Dynamics), caregiver robots for patients and senior citizens as companions and respond to emotions (Robear by RIKEN and Sumitomo Riko, Pepper by Softbanks Robotics), Sophia by Hanson Robotics appeared in talk shows and won citizenship of Saudi Arabia, self autonomous robot Mitra by Invento Robotics, India.

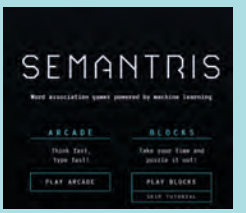
Self-awareness

Such machines are truly intelligent machines. Such machines, of course, do not exist as this book is being written but endeavours to develop machines that exhibit intelligence exactly like us humans are ongoing.

There is another form of AI called *Artificial Superintelligence* which is the highest form of AI using which machines will surpass human intelligence owing to their speed, capability to process astronomical amount of data and self-evolving smarter algorithms. What kind of world would that be with Super AI machines around is hard to predict.

ACTIVITY: SEMANTRIS – THE WORD ASSOCIATION GAME

Go to **https://research.google.com/semantris/** and click on PLAY BLOCK button. It shows a set of blocks with words. You need to enter a clue for any word and AI system tries to guess the related word. For example, if you type: vast blue waves then it will guess the word Ocean.



The AI system is trained into several million examples and variations of text pieces so that it is capable to relate the phrase entered by you with the closest possible word.

Semantris is built by Ben Pietrzak, RJ Mical, Steve Pucci, Maria Voitovich, Mo Adeleye, Diana Huang, Catherine McCurry, Tomomi Sohn, and Connor Moore.

How does it work?: This is a demonstration of how a computer can understand what you speak to it in everyday language.

Several millions of lines of human conversations have been used to teach this AI system to figure out how real human conversations occur.

Once the AI is trained, it is able to predict how likely one statement would follow another as a response. The AI is simply taking in what you type and doing a lookup into a pool of many possible responses to find the most likely ones. The technique used is called ***machine learning***. In the next section you will learn about machine learning.

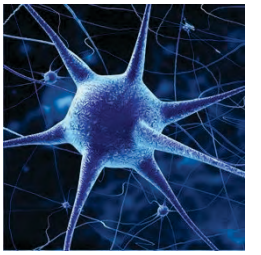
How does Artificial Intelligence Work?

How do machines learn? By now, you must be curious to find out how AI actually works. Functioning of AI is based on enormous amount of data. For example, if a machine is to be taught to distinguish between a cat and a dog, it needs to be run through several thousand different images of dogs and cats so that later it uses the "learning" from these images to identify a dog or a cat.

At the heart of AI technology is huge amount of data. Then, there are filters based on algorithms that determine which data is useful for processing and which is to be discarded. Third part of the functioning is the "learning brain" which is built on the complex algorithms. It is able to identify patterns and trends in the data to develop learning out of it. The fields of statistics and data analytics help in this process.

There are various technologies, theories and methods and subfields on which AI is based today. Let us have a brief look at the most accepted and popular ones.

AI and Neurons



Our nervous system contains millions of neurons. Neurons are the microscopic cells that carry information (sensory signals and responses) throughout the nervous system and in to the brain. Millions of neurons form a communication network for the information to travel across our nervous system. Study of neurons focuses on how human brain and nervous system works. A lot of research has been done in this direction. This research has made the basis of Connectionism – neuron like computing. Each neuron in the brain is a tiny processor and brain is the big machine composed of millions of these processors. AI focuses on building a network of artificial neurons.

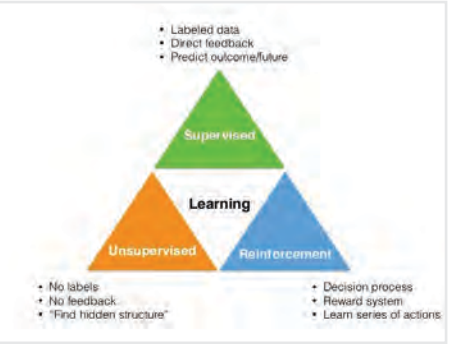
Artificial Neural Networks (ANN)

In 1954, at Massachusetts Institute of Technology (MIT), Farley and Clark developed a 128-neurons system which could memorise simple patterns and then distinguish one pattern among many. The algorithm was developed in such a way that each neuron was able to hold the information taught (fed repeatedly) to it by a computer program. Computer program repeatedly fed various combinations of patterns to the artificial neurons system so that they retained possible combinations of various features of patterns.

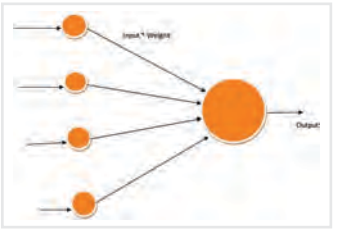
ANN has paved the foundation for machine learning.

Machine Learning (ML)

ML is not an AI concept. It is a sub-set of AI. It enables a computer system to learn from experience without programming it further. This technique is used to make computer perform accurate predictions after analysing the input given to it.



Machine learning has following approaches:



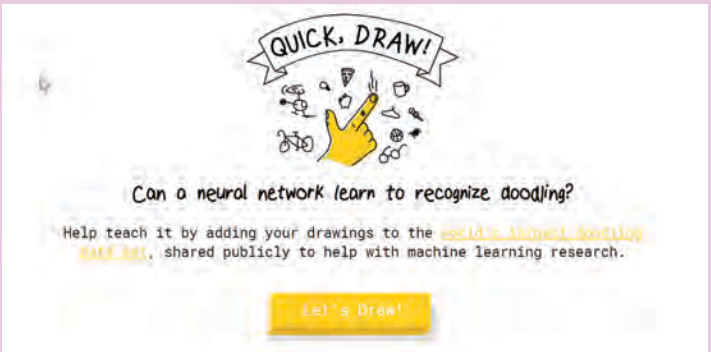
Supervised ML: In this approach, the computer system equipped with ML ability is fed with the inputs and also informed about what prediction it is supposed to do. After the prediction, the new findings are stored by the machine for doing any new predictions in future. For example, a routing software learns to find the fastest possible route by checking the patterns in traffic data and road condition (street, flooded, bad road etc.).

Unsupervised ML and Deep Learning: In this approach, machine is fed only with input data but not the desired output details. It uses *input data* to analyse enormous amount of data in its knowledge base to find out any useful patterns it can. Such machines are considered more intelligent and their process of data analysis is called deep learning. After prediction, the output is stored by the machine to use it for performing any future predictions. Deep learning machines are helpful in finding new trends and patterns in data. For example, a machine can predict which students are likely to show improved/declined performance in next exam by analysing performance data of the students in entire school.

Reinforcement Learning: This type of learning is based on the concept of *reward and punishment*. A machine learning the steps to accomplish a task learns the correct steps by failing and passing at each step. For each failure there is a punishment which helps the machine realise that the step was wrong while a reward helps machine learn the right step. For example, an AI system is designed to find the shortest and fastest route between two points. For every obstacle it encounters, it learns that the movement or turn was wrong (punishment) so next time it tries the alternate path which lets it move further distance (reward) until another obstacle. Eventually, the learning of correct route is reinforced. Robotics, industrial automation, supply chains, games, information compilation, automated vehicles are some practical applications of reinforced learning.

AI LAB

Visit https://quickdraw.withgoogle.com/ and help the machine predict what you are drawing.



LEARNING POINTS

- Artificial intelligence that works with limited functionality is called weaker or narrow AI.
- Machines with strong intelligence are capable of not only "think" like humans but also able to retain the learning developed by the tasks accomplished.
- A reactive machine knows how to respond to a particular stimulus (input) on the basis of a set of rules and the logic to apply those rules in all possible scenarios.
- Machines with limited memory cannot retain the learning. Next time, in the same situation, logic to resolve the problem is executed afresh.
- Machines based on theory of mind concept of intelligence are capable of interacting socially.
- Self-aware machines are truly intelligent machines and exhibit intelligence exactly like us humans.
- In supervised learning, the machine is fed with the inputs and also informed about what prediction it is supposed to do.
- In unsupervised learning, machine is fed only with input data but not the desired output details.
- Reinforcement learning is based on the concept of reward and punishment.

KEYWORDS

- **Weak AI:** AI that works with limited functionality.
- **Strong AI:** AI capable of "thinking" like humans and retain learning.
- **Supervised ML:** Predictions done with the aid of the details of the task to be done.
- **Unsupervised ML:** Machine figures out patterns on its own.
- **Reinforcement Learning:** Learning based on reward-punishment approach.

ASSESSMENT

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Machine with _____ intelligence works in a limited functional area.
   a. Narrow b. Weak
   c. Both a) and b) d. None of these
2. Machines with strong intelligence are able to retain _____.
   a. Data b. Learning
   c. Language d. Skill
3. A self-driven car is an example of which of the following?
   a. Reactive machines b. Theory of mind
   c. Limited memory d. Self-awareness

4. Which of the following is considered the highest level of intelligence?

a. Supervised machine learning
b. Unsupervised ML
c. Reinforced learning
d. Reactive machines

B. Fill in the blanks.

Socially, Narrow, Strong, Reactive

1. _____ AI performs a dedicated assigned task.
2. _____ AI applies retained knowledge to solve new problems.
3. An AI machine playing a strategy game against human is a _____ machine.
4. Machines based on theory of mind are capable of interacting _____.

C. State whether True or False.

1. A robot capable of picking up empty dishes in a restaurant and dump them in the dishwasher is based on strong AI.
2. Generalised AI is capable to solve the problem by learned experience.
3. A reactive machine is the most intelligent of all.
4. Machines based on limited memory concept cannot retain learning.

D. Answer the following questions.

1. What is the basic difference between weak and strong AI?
2. Write one characteristic of each of the following types of AI machines:
   i. Reactive machines
   ii. Limited Memory
   iii. Theory of mind
   iv. Self-awareness
3. What do you mean by deep learning?
4. Write a brief note on reinforced learning.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://machinelearningforkids.co.uk/*
- *https://www.ibm.org/activities/machine-learning-for-kids*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Create a write up on **Humanoid Robots designed and developed in India.**

3 APPLICATIONS OF ARTIFICIAL INTELLIGENCE

OBJECTIVES

By the end of this chapter you will be able to:

- List the potential capabilities of AI.
- List different areas which AI can influence.
- Understand how different application areas will be impacted by AI.

Relating from previous chapter: Artificial Intelligence: Types and Techniques

Earlier we learnt about the types of AI on the basis of complexity of intelligence and functionality. We also learnt about AI and Neural networks. Then we discovered how machines learn in various ways.

In this chapter, we shall discover how AI can impact various fields and trigger breakthroughs.

Our basic understanding of AI is built-up now. We know that machines with weak AI exist and are being developed and extensive researches are underway for stronger AI through various techniques of machine learning.

Let us now find out how AI must potentially influence various fields.

While searching something online, using maps to find a route, doing online shopping or reading updates on our social media account, it is AI working in background in one way or other.

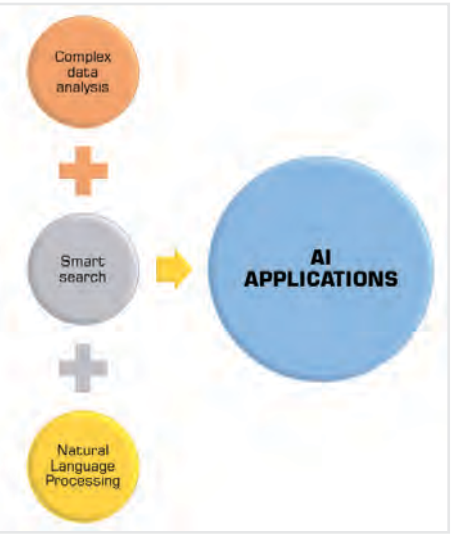
Let us look at some major areas where AI is playing a distinct role.

What AI can do?

To understand how AI can influence various fields of industries and areas of daily life, we must be clear what we can accomplish with AI. Generally, currently AI is capable of the following:

- **Complex analyses of bulk text data:** AI is capable to process enormous amount of data at higher speed. This capability can be used in many different ways such as finding trends and patterns in data-sets, predicting future trends from current data, and forecasting useful information etc. Almost every industry uses data analysis for a variety of purposes.
- **Analysis of complex forms of data – images and sound:** AI can analyse images and sounds to find various patterns in them. This capability can be very helpful in many areas.
- **Smart search:** Everyone looks for some kind of information at one point of time or other. AI driven search system can produce smart search results helping the user in many ways they might not have thought about. Search systems have great opportunity in a variety of fields.
- **Natural language processing (NLP):** Ability of AI to understand human speech can have many uses. Making smart communication systems and response systems is main application of NLP.

Note: *In the next chapter, you will learn about 3 main domains of AI – Data, Computer Vision and Natural Language Processing in detail.*



Task Based Classification of AI

On the basis of what task an AI system should and can perform, AI can be broadly classified into three – ordinary tasks, formal tasks and expert level tasks.

Ordinary tasks: These are easy to learn and perform. Generally, they include voice recognition, speech recognition, processing graphical inputs, audio-visual inputs, language translation, reasoning, automated tasks like factory robots do.

Formal tasks: Mathematical calculations, complex scientific calculations and derivations, strategy games.

Expert level tasks: Analysis of scientific data, processing enormous amount of data and predicting trends and patterns in various industries etc.

A machine can be developed with algorithms to learn ordinary tasks. Then this learning can be used to learn formal tasks and finally, machine can develop algorithms to perform expert level tasks.

Applications of AI

The capabilities of AI described before have tremendous potential to revolutionalise almost every field of industry and daily life. Let us have a look at them.

Education and Training

This is a huge field with tremendous scope of AI. 21st century classrooms are supported by AI. Predicting performance, designing curriculum, smart assessments, helping teachers in correction of assignments and identifying students who need more help, technology-based classes, remote-teaching-learning, educational research, working out assignments, developing projects, automated training systems, immersive training, virtual-reality based training, 3D learning environments, robot-assisted teaching and training, co-curricular activities such as excursions, designing master training programs for trainers are a few of the applications in this field.


Lego EV3 Robot to learn robotics coding

Machine learning is used to create smart education systems which deliver adaptive (content that adapts according to the capacity of the learner) educational content to the learners after analysing their response and performance.

AI-BASED EDUCATION TOOLS

Cram101 of Content Technologies Inc. applies data analytics to create smaller pieces of learning guides from a vast ocean of textbook content. These guides contain summaries, exercises and practice tests etc. making it easier for students to follow.

MATHiaU by Carnegie Learning uses AI to provide personalised learning in Mathematics, which adapts to students' learning needs. It also provides a visualization of progress, easy feedback to help the student improve on learning style.

University of South California uses AI to create smart virtual environments that generate 3D images and animations for better learning.

AI enabled systems in the form of robots and interactive computers help teachers by assisting in classroom teaching and delivering lectures.

NLP capability is harnessed in making voice driven intelligent responsive learning systems. Voice operated Question-Answer based systems are also the outcome of NLP in education.

Integration of AI with other technologies such as Cloud can make smart education reach in remote areas.

Key applications of AI in education are:

- Smart content generation
- Customised learning
- Adaptive learning
- Data visualization of performance and feedback
- Education consulting and counselling
- Immersive learning environments
- Smart teaching

Customer Support Systems

Various businesses, schools, banks and public services etc. deploy customer support systems in the form of people, computers, equipment and response systems. AI revolutionizes the customer support and response systems using natural language processing and smart search capabilities in following ways:

Chatbots: AI-enabled chat systems are called chatbots because it is hard to tell if it is a machine or human being on the other side. AI chatbots are smarter than traditional chat engines in that they respond with much helpful information quickly as compared to humans. Equipped with voice recognition system, chatbots can understand natural human language which makes them easier to use. This saves a lot of users' time and effort in finding useful information.

Speech recognition is concerned with understanding "what" is spoken while voice recognition is concerned with "who" is speaking. For voice recognition a machine needs to be trained to identify which person in particular is speaking.

AI enabled support systems: Any support system like customer response systems, service support systems and most Interactive Voice Response Systems (IVRS) use speech recognition as part of Natural Language Processing (NLP) feature of AI. They can understand and interpret what is spoken by the user and figure out what query has been asked or what assistance has been sought. This speech is processed to identify keywords in the input voice. AI system is already trained with millions of human conversation data. It takes the text generated out of user's voice and figures out what request has been made – is it order status check or is it order cancellation request or some sort of feedback/complaint or any change requested in the current order? etc. In response the data extracted from the service provider's database is used to synthesise the answer in the form of text and speech which is sent back to the user. Google Assistant, Amazon Alexa are popular examples.

They use NLP to understand spoken language and answer structured questions. They understand customer intent faster and accurately then respond in a better way. Multi-lingual systems are useful in answering to the user in his/her native language.

Public addressing and alert systems: Such AI-enabled systems are useful in home and industrial security like identifying an unauthorized face in any area and raising an alert. Publicly addressing and guiding people in case of emergency such as fire break out or earthquake.

Key applications of AI in Customer support are:

- Better customer experience
- Improved public relation
- Useful for physically challenged
- Multi-language interpretation
- Faster and accurate guidance

Service-oriented Businesses

Various businesses do not manufacture products but provide services. Banking sector, Education, public transport, domestic services, tours & travel, hotels are such businesses. The main asset of such businesses is data. AI systems take in the data generated by these businesses and their customers to produce results in following useful ways:

- Checking patterns useful to offer new services – AI can suggest if any new service can be introduced.
- Understanding customer behaviour – AI can reveal if customers are liking/disliking certain services.
- Assessing customer loyalty – AI can alert if some customers may quit using the services.
- Assessing service quality – AI analyses customer feedback and experience to assess the decline in the quality of service delivery.
- Assessing service improvement areas - AI analyses customer feedback and experience to suggest ways to improve the quality of service delivery.
- Predicting future customer behaviour – AI can see trends if customers may buy or quit new more services.
- AI-driven recruitment industry is transforming to use AI for automated assessments and psychometric evaluations to reduce time-to-hire, costs and better quality.

Product-oriented Businesses

Businesses that produce or manufacture tangible products may use AI as described above. In addition, they can use AI in various stages of product development life cycle – product planning,

design, manufacturing and delivering. Automobile industry, factories, construction are some major areas. Some popular AI applications in product-driven businesses are:

Autonomous vehicles: Driverless taxis, autonomous drones to deliver items like pizza or medicine, smart missiles are some potential applications.

Smart home devices: AI-driven home appliances (smart refrigerator, smart TV), home security systems (Smart intruder alert), communication systems (AI phones and video conferencing) and home maintenance systems (AI solar power, waste disposal, water filter) make people's lives convenient and add value to it by understanding your needs and adapting to your preferences automatically by self-customization.

Smart homes and cities: Durable homes which withstand changing weather, maintaining inner temperature, equipped with smart devices are not farther dreams. Smart cities equipped with AI-enabled traffic control systems minimize traffic congestion and perform smart route search, smart citizen safety systems, disaster prevention and alert systems, smart public transport system are some features of smart cities.

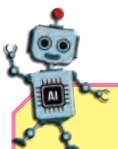
Robots: AI-driven autonomous, intelligent robots in public areas, homes, schools, industries, restaurants, hospitals etc. enhance public assistance and can minimize threat to human lives such as underground constructions, mining, oil-extraction, heavy-machines operations etc.

E-Commerce and retail businesses

E-commerce industry is extremely vast today. It records billions of transactions and user activities daily. With every passing moment, bulk amount of data is generated which can only be handled by AI-enabled systems for various purposes. Amazon, Walmart, Flipkart, Alibaba and all popular online E-Commerce platforms have already been using and have invested heavily in AI to get their businesses to new heights and to enhance customer experience. Some of the key operations in which AI is used in E-Commerce are:

- Digital marketing
- Customer relation
- Product delivery, service tracking and product cataloguing
- Financials, Logistics and human resource and advertisements
- New product design

Since AI depends on huge amount of data to learn and perform the data generated from user's clicks on the items, the details of items purchased, location of the user and several such variables are taken in by AI system to provide better shopping experience to the user such as quick and easy access to items of interest, suggesting related popular items, comparing selected item with other similar items etc. As user browses E-commerce website, this dynamic experience is provided to the user intelligently by AI system.



AI IVR

Amazon Polly – An AI IVR with Indian voices: Aditi & Raveena. Policybazaar.com has implemented this interactive voice response system to process customer calls that converts text into human speech – natural and friendly.

redBus uses AI to showcase customer reviews in a much effective way.

Haptik – personal organizer and reminder app uses AI for accurate operations.

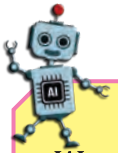
Social Media Platforms, News and Entertainment

After E-commerce, this is another large area where generation of data has no limits. Today, online social interactions, news search and entertainment through music, movies, games and stories are merged into an abstract form online. Several billion bytes of data travels online every second. Online platforms use this ocean of data for various purposes. Majority of them is to promote their services and products and to enrich user experience with innovative and quality offerings.

Entertainment, gaming and media industry thrive on subscription and viewership. Increasing viewer-base is their growth indicator. Machine learning can help in advanced analytics of viewership data and market trends. AI can help in improving and developing content in multiple languages easily. Content presentation, special viewer experience, better audio-video technology can be helped greatly by AI. AI based analysis of customer preferences and choice of entertainment sources can help customize offerings for the customers. Some of the major applications could be:

- Movie production (screenwriting, storyboarding, scheduling, budgeting etc.)
- Automatic multilingual subtitles
- Editing and recording
- Marketing and promotion
- Targeted advertisement insertions
- Content (news) compilation and organization
- User experience (games, movies and music)

Facebook, Instagram and many news websites use AI make their platforms more intelligent in response, maintain user privacy, prevent security lapse and to analyze trends that help them come up with new ideas to enhance and grow their business.



AI IN SOCIAL MEDIA

Woo – relations app uses AI to curate profiles and photographs in seconds as compared to half a day otherwise.

Facebook uses Machine Learning to enable us to get timely help to people in need.

Public Services

Government and private public service systems are also a fertile ground for AI.

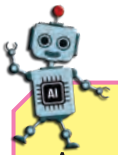
Public transport: AI systems can control city transport systems such as Metro rails, taxis and buses. Some common uses are: routing of vehicles, smart traffic control minimizing congestion, security and, disaster prevention, smart parking, crowd control and time management etc.

Healthcare: Decision systems for heart stroke prevention, patient risk alert systems, expert diagnosis systems, patient referral systems, patient rehabilitation through AI-enabled physiotherapy assistant, data analytics for prevention of disease outbreak, sampling and research, hospital safety and disaster prevention system, Smart ambulance, AI-assisted surgery, health consultation, genetic data analysis are some major applications of AI in healthcare industry.

Demographic Trends: Studies related to population can be revolutionized by AI remarkably. Population related data is immense and used in various ways. Research and data management in this area need AI intervention. Emerging patterns in the demographics of an area or section of

community, looking for patterns in population data such as poverty, hunger, homelessness, unemployment, nutrition, child birth, education etc. to anticipate problems are certain areas which, AI can handle since it majorly involves data analytics. This way, by predicting trends in demographic data, AI can help in addressing many social issues efficiently.

Environmental Data Analytics: Data related to land, agriculture, forest, rivers, water quality, roads, mountains, air quality, weather, ocean, various ecosystems, industries related to and affecting environment, bio-diversity etc. makes an enormous lot of data. Power of AI can be a game changer in analysing trends in it. Enhancing living conditions for rural areas, preventing damage to environment, managing damage due to natural calamities, improving agricultural practices and improving environmental care can be achieved in an efficient way through AI as it is faster and it can process such huge data-sets to produce trends which were not possible earlier.



AI AND EXPERT SYSTEMS

An expert system is a self-contained, less complicated system composed of a Knowledge Base (KB) and an Inference Engine (IE). KB stores the facts and details about the applicable field such as a particular disease or a field of engineering etc. These details are called rules and they are organized mostly in an if-then pattern.

Let us understand the role of Knowledge Base and Inference Engine with a simple example.

- if cough is dry then medicine X
- if patient is less than 15 years then patient is a child
- if patient is a child then medicine X

Inference engine asks questions from the user (most probably a medical practitioner) then refers to the KB. Then it draws conclusions by comparing the facts returned by the rules defined in the KB with the inputs from the user.

How? Let us see.

- Does patient have dry cough?
- What is the age of the patient?

If answers to the first question is YES and the age of the patient is 12 years, then inference engine can figure out by going through the rules that such child patient should be prescribed medicine X.

Electronics Industry

The core of entire electronics industry is the *silicon* chip. All major players – Google, Apple, Intel, Cadence, AMD, Analog Devices, Ineda, Qualcomm, Nvidia etc. have already initiated 5th generation (5G) AI-based micro-processors. Most of them have their chip-design setups in Hyderabad and Bangalore.

All the sub-industries that come under the umbrella of electronics are soon going to offer AI-chip based intelligent devices, equipment, appliances and vehicles which will function in a much better way like self-fault-diagnostic, self-alert systems, television that adapts to channel shuffle depending on each family member's preference, cars with better safety features and fuel efficiency etc. Such devices would be able to connect with a network for better performance - this is termed as Internet of Things (IoT).

Robotics is the primary emerging field in this industry. Robotics will, then, pave the way of its applications in other industries. In 2017, more than 3000 robots have been purchased by Indian companies – automotive, hospital and defense as major players.

AI IN EDUCATION

SP Robotics Works – an education startup in Robotics and IoT, uses AI based teaching – both physical and online.

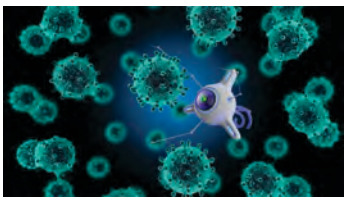
Research and Development

AI has tremendous potential to impact research and development in all the fields such as public health, automobile, environment & ecology, life sciences, education, defense, social crises – poverty, hunger, homelessness and crimes. There are many more such industries where AI-driven research can play vital role. Research is majorly concerned with browsing and compiling data then generating information in many useful ways. AI systems are capable to process continuously input bulk data very fast and generate useful patterns and predictions better than human brain. This can help greatly in research. The Natural Language Processing (NLP) capability (understanding natural human speech) can help voice-based search and process audio and sound inputs. Computer Vision (CV) capability of AI helps in identifying and processing visual data from images. This can also help in processing image-based research. Machine learning algorithms can enable the self-learning systems to help in innovative design and intelligent predictions. Deep Learning can revoutionalize visual search, photograph recognition, 3D designs and physical world design and systems that can perform intelligent research faster and produce summaries without human intervention.

AI IN MEDICINE

BenevolentBio, London, is using artificial intelligence (AI) and machine learning to accelerate and improve drug discovery.

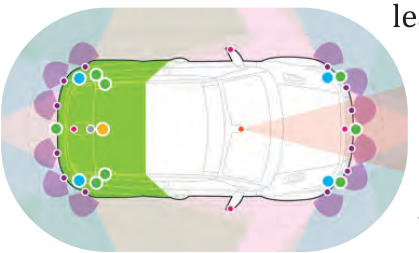
Other Potential-AI Applications



Personal AI Assistant: Loaded with advisory algorithms, such assistant can help the person in many ways like weight training, nutrition consultation, reminders and alerts, personal tracker etc. It is like an intelligent and selfless companion.

AI Nano Bots: Intelligent microscopic machines which can be administered in human body and trained into locating infected site and initiate necessary cure. They can help in what MRI and X-ray miss out.

Intelligent prosthetics: Artificial body parts which are easy to operate and use due to their self-learning algorithms.



Smart Automobiles: Cars that learn the route, its prevailing conditions and weather where you drive daily. They can help in avoiding accidents when driver is distracted, following traffic rules for safety, finding best route to drive, intelligent parking etc. Self-test vehicles can diagnose any fault in them.

Smart sensors: Almost every electronic device needs sensors. Self-learning sensors can function proactively better as compared to human brain and can raise timely alarm and alerts.

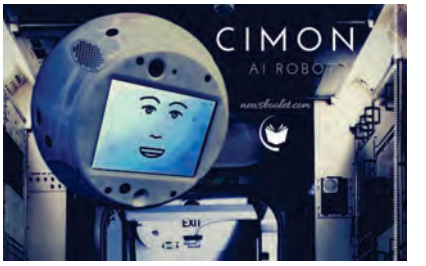
Fraud detection and counterfeited documents: AI enabled system can not only detect banking transactional frauds instantly, it can also anticipate such threat by its ability to see patterns in the transactional data.

Photo-based search: This capability of AI is called Data Vision which will revolutionise E-Commerce, crime detection and research.

Robo helpers: Teaching, patient care, help for doctors, engineers, miners, senior citizens, defense personnel, law-enforcing bodies, disaster management and relief teams, public service places (railways, airports etc.), agriculture, heavy machinery operations etc. are the areas where robo helpers are soon going to be a common sight.

Innovative product design: New products designed with AI-assisted innovation would increase the productivity and quality of designs.

Architectural Engineering: AI systems can help in designing new buildings, cities and regenerate new designs from existing ones.



Space exploration: Astronomical figures, space visuals, data sent by space rovers and satellites can be easily analysed by AI-based systems and amazing predictions/ conclusions can be derived addressing many unanswered questions regarding the mysteries of space. CIMON, an AI-enabled robot is used by Space-X, in their space station.

AI-based Defense: Defense training simulations, weapon design, missile control systems, bomb-diffusing robots, anti-ballistic systems, navigation, surveillance, drones, signaling etc. are major areas which AI can impact for a smarter defense system for any nation.

LEARNING POINTS

- AI is capable of complex analysis of text, images and sound, smart search, and natural language processing.
- AI has tremendous potential to impact all major fields and industries such as education; customer support; service oriented businesses; product oriented businesses; documentation and publishing; sports; E-commerce; social media; public services; electronics industry; research and development; and entertainment, gaming and media.

KEYWORDS

- **Immersive training:** Interactive learning environment simulating real-life setup to teach skills and techniques.
- **Virtual reality:** A simulated 3D environment that seems real and user can interact with it using special equipment such as gloves, helmet and visors fitted with sensors. VR helps in immersive learning also.

- **Adaptive content:** Content that is delivered according to the choice and capacity of the user or learner.
- **Cloud:** A term used for Internet-based ecosystem which allows access to software and services and data storage online instead of having them installed on one's computer.
- **Data visualization:** Graphical presentation of data in the form of trends and patterns by the help of dynamic charts and maps.
- **Chatbot:** AI-based interactive online chat system mostly used in customer support and enquiry.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. AI is capable to process enormous amount of _____.
   a. Text b. Images
   c. Audio d. All of these
2. Ability of AI to understand human speech is called _____.
   a. Language processing b. Human language processing
   c. Natural language processing d. Human speech processing
3. Content that changes according to the needs of the user is called _____.
   a. User-friendly content b. Adaptive content
   c. Intelligent content d. Streaming content
4. The ability of AI that can be used in voice operated response systems is _____.
   a. NLP b. Text processing
   c. Speech recognition d. Visualisation
5. An expert system is composed of a _____ and an _____.
   a. Database, query engine b. Knowledge base, search engine
   c. Database, inference engine d. Knowledge base, inference engine
6. _____ capability of AI helps in analysis of visual data such as images.
   a. Computer vision b. NLP
   c. Machine learning d. All of these

B. Fill in the blank:

Banking, Inference engine, Chatbots, Education, 5G, NLP

1. Making smart communication systems is main application of _____.
2. Chat engines enabled with AI are called _____.
3. The two service oriented businesses are _____ and _____.
4. In an expert system, _____ sits between the user and Knowledge base.
5. AI-based microprocessor are _____ computing.

C. State whether True or False.

1. A nano-bot is a microscopic machine that can be administered in human body.
2. Autonomous vehicles maximise risk of life due to an accident.
3. AI is best suited for space missions since it can process enormous amount of data.
4. User who learn at different pace find adaptive content difficult to follow.
5. Cloud-based software needs to be installed on the computer first.

D. Answer the following questions.

1. List main capabilities of AI.
2. What is NLP? How does it help in education and customer support field?
3. Briefly list the ways in which AI can help in E-Commerce industry.
4. How do NLP, Data Vision and Machine learning help in research and development field?

E. Match the impact of AI in column A with their application area in column B.

1. Adaptive learning and smart teaching.	a. Sports
2. AI enabled IVRS.	b. Media/Entertainment
3. Developing better game strategy.	c. E-commerce
4. Comparing items purchased by user.	d. Education
5. Automatic multilingual subtitles.	e. Customer support

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://becominghuman.ai/how-different-sectors-are-using-ai-26470ba334ab*
- *https://callminer.com/blog/16-examples-of-artificial-intelligence-across-6-industries/*
- *https://learn.g2.com/industries-using-ai*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a 1000 words write-up or a 5 slide presentation on **What role AI is playing in education field today?**.

4 DOMAINS OF ARTIFICIAL INTELLIGENCE

OBJECTIVES

By the end of this chapter you will be able to:

- List 3 domains of artificial intelligence.
- Describe the characteristics of 3 AI domains.
- Explore practical aspects of 3 AI domains.
- Understand how 3 AI domains are interrelated.

Relating from previous chapter: Applications of Artificial Intelligence

Earlier we learnt about the capabilities of AI and its potential applications in various fields and industries. We also discovered some exciting breakthroughs with AI.

In this chapter, we shall discover about the basic asset of AI that is data. We shall also discover other important domains of AI and their inter-relationship.

In every technology involving computers, the underlying concept is input-processing-output. In AI, this can be rewritten as data-analysis-prediction.

Data, as enormous it can get is better, makes the foundation for AI. All other capabilities of AI revolve around data. Data is the key of the three domains of AI. Let us have a look at the following 3 domains of AI and discover how they are related together.

- **Data**
- **Computer Vision**
- **Natural Language Processing (NLP)**

Data

Like any computer-based system, AI driven machines also need data to process. With AI systems, data is as good as much it can be arranged for processing. In fact, huge and constant in-flow of data for an AI system is a prerequisite. More the data, better an AI system would be put to use. A distinct feature of an AI system is its ability to handle huge amounts of data. The reason is that an AI system does not process the data like a traditional computer does. An AI system, more than processing, "analyses" the data and tries to identify some sort of trend or pattern in it, depending on what it has been asked (programmed) to do. For example, if an AI system used by an E-Commerce website is supposed to predict as to how many customers are likely to buy a popular product in the coming year too, then as much bulk of purchase data for that product is available, the better. With higher numbers of purchases of that product, the predictions would be more accurate because more variables will be available to analyse. So, the bottom line is higher the bulk of data, more accurate is the prediction.

Some possible variables in the above example are:

- How many customers checked the product once, twice and thrice?
- How many bought it after one visit, two or more visits?
- How many customers recommended the product to others?
- How many new customers bought it on recommendations?
- How many customers returned the product?
- What are the product reviews and feedbacks?
- What are the new feature upgrades in the product?
- What is the comparative price of the product over the years?

So, with enormous data feed to the AI systems, businesses can harness the power of AI for business projections, identifying problems, threats and opportunities, performance analyses, addressing social issues etc.

A little more than 2.5 billion GB of data is produced daily in the world.

AI GAME - ROCK, PAPER AND SCISSORS

Go to *https://www.afiniti.com/corporate/rock-paperscissors* and play the game Rock, Papers and Scissors with the AI system which will try to predict your next move by analyzing your previous moves thereby, winning the game.

Try out the following approaches:

1. Making moves in a particular pattern like showing rock in consecutive 5 moves.

   Note your observations of AI system response:

2. Making random moves:

   Note your observations of AI system response:

This exercise underlines the importance of variety and amount of data for better predictions. Higher the data volume, more accurate would be the prediction for the next move.

- What did you learn from the game?
- List the different sources from where you can collect data.

What is Big Data?

The term *Big Data* refers to an enormous volume of data which is not possible for traditional databases and software techniques to process. There are two main features of Big Data – volume and speed.

The volume of Big Data is in exponents. It includes huge data-sets of structured and unstructured or random data. There is not a specifically defined structure in which entire Big Data set can be defined. For example, constant data generated by the activities of online visitors and users on a popular E-Commerce website such as Amazon. Can you imagine the amount of data that is generated every second? Traditional computer systems are not capable of handling such enormous volume of data.

The second aspect is the pace or speed at which such data is generated. An E-commerce website is working 24X7 every day, non-stop with several thousand different transactions occurring every

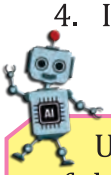
second. Traditional computer systems are not able to collect and compile such huge data generating at such an overwhelming speed.

Data Collection and Data Selection

Not all data available are of use for an AI system to perform the analysis or task at hand. Of enormous amount of data, relevant and suitable data need to be identified and arrangements made to provide it as input to the AI system.

Data quality: Depending on the sources of data and the way they are collected; the quality of data may vary. Quality data are that which are relevant to the task to be accomplished. The sources of data can be internal (employee's activities) or external (customers, dealers, and suppliers etc.). External data needs to be refined before feeding it to the AI system. Following are the common challenges in the way to ensure data quality:

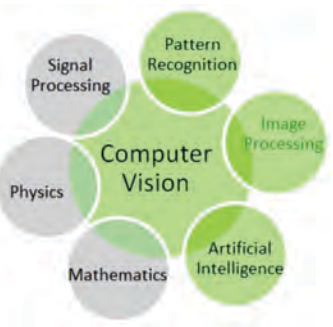
1. Practically, it is hard to determine what data is needed or not.
2. The enormous pool of data is constantly increasing with every passing moment which poses a challenge to control its dynamic size. The AI program algorithms need to be updated with dynamically changing data sets.
3. Higher investments in data handling expertise and training.
4. Investments in continuous updates if AI algorithms and processes of data collection.



University of Alabama uses AI to analyse data of its 40,000 students to visualize solutions out of data to improve their various processes and operations such as creating better learning programs, redefining course content, predict the performances, suggesting improvements in the system like a consultant, counselling for career, helping in building efficient grading and assessment systems.

Computer Vision

One rich form of data is graphics, images and video. Processing graphics and video to recognize some pattern in them falls under the AI domain of computer vision. Intelligent machines analyse enormous graphical data, understand them for one or more patterns. One simple example could be a face captured by a CCTV camera in a market place and the AI machine is able to match that face with a picture of a known criminal in the huge crime database of the city and raise an alarm. Machine may not be instructed to do so but it has been trained through algorithms and repeated feeding of earlier data so that now it is aware what to do if a match is found. Such process of learning from repeated exposure to data and retaining the learning of patterns and trends is called *deep learning*.



So, *Computer Vision simply refers to the artificial intelligence of a machine to analyse constant feed of huge visual data, understanding various patterns in it and finally making decisions on it.*

More than 3 billion images are shared online daily.

To make computer vision work effectively, the machine is first trained by feeding it variety of bulk data. For example, if a machine is fed with the images of known criminals in police records then it must store the distinct features on the basis of which a face is recognised. Machine does not try to store every faced in its memory – that is already there in database but here algorithms help AI machine create patterns of facial features. Later these patterns would help the AI machine map these patterns and the face descriptions in the crime database to the faces they capture through constant feed of several CCTV cameras in a city. As the time passes, AI machine becomes more and more "intelligent" in matching the faces accurately.

AI GAME - EMOJI SCAVENGER HUNT

Go to *https://emojiscavengerhunt.withgoogle.com* and show images to the AI system while AI system displays some emojis to you. The AI system will guess as to what you have been showing to it. Try showing some hand-drawn images to check if AI system is able to recognise them by matching them with emojis.

- What difficulties you faced while playing this game?
- How did you overcome these difficulties?
- What is computer vision?

Natural Language Processing

Natural Language Processing (NLP) is the technology applied to enable computers to understand the languages spoken by humans. In certain contexts, audio needs to be produced from the digital text.

Majorly, NLP is a branch of Artificial Intelligence that enables interaction between humans and computer system through interpreting what has been spoken by the user.

This includes speech recognition, audio to text and text to audio conversion and processing audio data.

Google Translate is one such application of NLP. Interactive Voice Response Systems (IVRS) use NLP. Google Assistant, Cortana, Siri, Alexa use NLP techniques to interact intelligently.

Natural Language Processing works by the help of special algorithms which convert the unstructured voice data or speech into a form that is identified and understood by a computer system. By the help of language rules, semantics and pronunciation variation rules, algorithms try to interpret what has been spoken and then it is digitized into a form that works for the computer as detailed command to perform a task.

NLP works on two aspect – syntax and semantics of the language.

Syntax refers to the grammar of the language and sentence formations. This is easier to apply since a language has a structured set of rules.

Semantics refers to the interpretation of the meaning carried by the words which depends on the context. This is a big challenge since it involves figuring out the context, tone, emotions and expressions carried by the voice.

NLP plays a central role in human-machine interactions and has remarkable commercial and social viability in various ways such classification of text and documents, interpreting and translating languages, speech recognition, generating meaningful text information or audio information, interaction among the machines and between humans and machines, development of systems in various fields based on a Question-Answer engine etc.

AI GAME - MYSTERY ANIMAL

Go to *https://experiments.withgoogle.com/mystery-animal* and guess the animal by asking 20 questions to the AI system. AI will select the animal randomly. Try asking specific and short questions like "Are you a herbivore?" or "Are you a bird?" etc.

- Describe what you understood about the game.
- What is NLP?

How the three domains are related to each other?

Though we have learnt about the three domains of AI separately but practically, they are closely related. Data, in the form of visuals, is helpful in Computer Vision and data in the form of speech, voice, audio and music, can help in natural language processing. When data is available in the form of audio-visuals then both, Computer Vision and NLP come into play.

We communicate through text, speech, gestures, signs, signals, writing and expressions. These all ways help us in perceiving the world around us. Broadly, the abovementioned ways of communication fall into two categories – vision and language.

Vision forms the basis of visual communication to or by a machine involves reconstruction of the perceived image in the "brain" of the machine. Here, machine is trying to perceive the visual input. Then it is recognised and finally the image is reorganised in the "brain" of the machine and the perception is completed.

For example, recognising a face, understanding facial expressions to figure out the emotions, perceiving a 3D world as simple as a small empty box and as complex as a crossroad of a metro city during rush hour.

So, very efficient and useful applications can be designed by integrating Data, Computer Vision and NLP.

Scenario 1 (Simple): Audio Book

Imaging an old, printed novel needs to be converted into an audio book by an AI system. The scanned images of the pages in the book form the visual data while the text on the page forms the input for language processing. In such a case, both Computer Vision and Natural Language Processing (recognising letters, words, phrases, meaning and punctations and then interpreting the text) are applied.

Scenario 2 (Complex): Processing news information

Think of a news bulletin which includes face of the news reader, audio of what he is speaking, text appearing in the screen and a video clip of the incident (with audio of its own). This is a complex input to process and involves visuals as well as spoken words. Here, Computer Visions and NLP both should be integrated in the AI system that processes the news bulletin to, let us say, create a summary of the news item.

LEARNING POINTS

- Data is the key of the three domains of AI.
- Huge and constant in-flow of data for an AI system is a prerequisite.
- Computer Vision simply refers to the artificial intelligence of a machine to analyse constant feed of huge visual data, understanding various patterns in it and finally making decisions on it.
- Natural Language Processing (NLP) is the technology applied to enable computers to understand the languages spoken by humans. In certain contexts, audio needs to be produced from the digital text, written or printed word.
- When data is available in the form of audio-visuals then both, Computer Vision and NLP come into play.

KEYWORDS

- **Big Data:** Enormous amount of complex data with continuous feed including text, visuals (image & video) and audio (speech, voice, music, sound).
- **Computer Vision (CV):** Ability of an AI system to take in visual data and process it.
- **NLP:** Natural Language Processing is the function of AI to understand human speech, voice and convert digital or written text into speech.

ASSESSMENT

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Data is the key of the _____ domains of AI.

   a. Two b. Three
   c. Five d. Eight

2. _____ the bulk of data, more accurate are the predictions by AI.

   a. Organised b. Lower
   c. Higher d. Structured

3. An AI system processing CCTV camera recordings to recognise a face is a scenario referring to which of the following AI domains?

   a. Data b. Computer Vision
   c. NLP d. All of these

4. Responding in speech to the questions asked by the user refers to which of the following AI domains?

   a. Data b. Computer Vision
   c. NLP d. Both b) and c)

5. An AIO system trying to recognise a snapshot of a handwritten note. This integrates which of the following domains of AI?

a. Data
b. Computer Vision
c. NLP
d. All of these

B. State whether True or False.

1. With as little data as possible, an AI system works better.
2. An AI system can find more patterns to recognise in bulk data.
3. Computer Vision refers to producing visual output by an AI system.
4. Google Assistant and MS Cortana are examples of NLP implementation.
5. NLP and Data Vision cannot be integrated together.

C. Answer the following questions.

1. List four real life examples of enormous data generation.
2. Why is it necessary for an AI system to be fed with enormous amount of data to learn its task?
3. List three major challenges in ensuring desired data quality for an AI system.
4. Briefly list any two examples of Computer Vision and NLP integration.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://thenextweb.com/artificial-intelligence/2018/07/18/a-beginners-guide-to-ai-computer-vision-and-image-recognition/*
- *https://discuss.analyticsvidhya.com/t/download-link-launching-analytics-vidhyas-ai-comic-issue-1-automating-attendance-using-computer-vision/81302*
- *https://academickids.com/encyclopedia/index.php/Natural_language_processing*

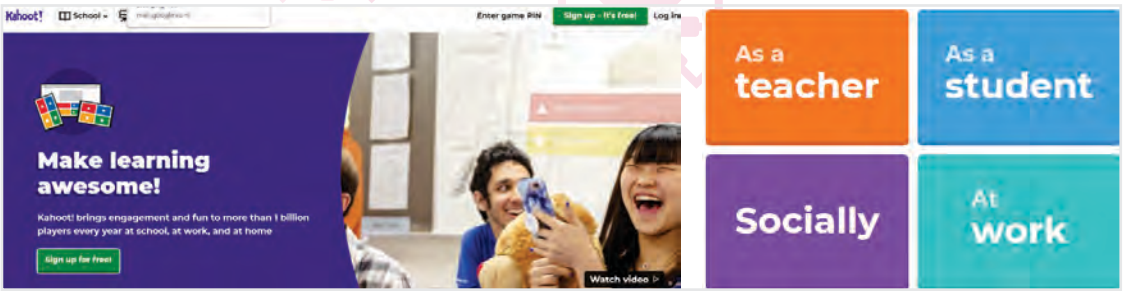
Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a note of your thoughts on **Can a machine learn language like a child does?**

INTERVENING ACTIVITIES

ACTIVITY 1 – AI QUIZ

This activity can be performed using pen and paper or going to an online open source quiz website such as *www.kahoot.com.* Click on *Sign* up and register as student. Create a quiz of 10 questions related to AI. You can pickup the questions from this and previous chapters or take help from your teacher.



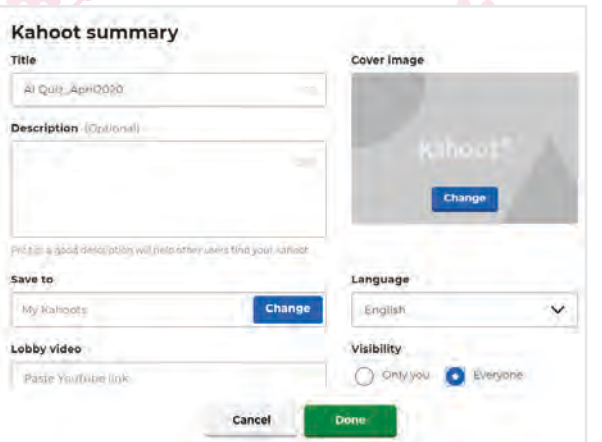
You can register easily if you have already a Gmail account. So, it is advisable that you create a Gmail account first. Kahoot will ask you to type in a unique username and you are ready to explore Kahoot.

To create quiz, click on **Settings** at the top left corner of the window. In the **Kahoot summary** popup, enter a title such as My AI Quiz. Set the visibility to *Everyone*. You can leave other details to default. If you wish, you can upload your cover image. Finally, click on **Finish** button. The blank quiz will be created.

How to add questions in the quiz?

To add a new question:

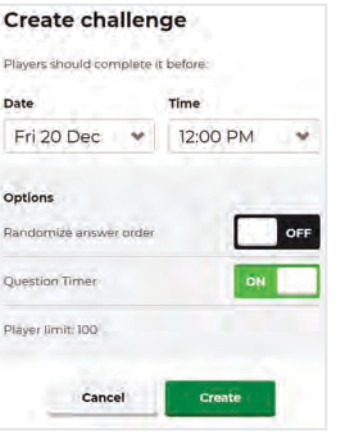
1. Click on **Add question** button in the left pane.
2. Type the question in the question box as shown here.
3. You can add any image also.
4. Click on the **seconds** circle and select the time limit for this question.
5. Drag and set up the points.

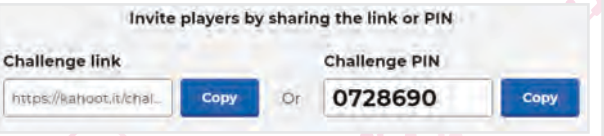


6. Click four possible options as answers.
7. To mark the correct answer, click the tick mark against the correct option. The circle of the tick mark will turn green.
8. This way you can add other questions.
9. Click on **Preview** button to see how the quiz looks like.
10. Finally, click on **Done** button.

How to share your quiz challenge with others?

1. After clicking **Done** button. Click on **Challenge** button.
2. In the **Create challenge** pop-up, set the deadline and click on **Create** button.
3. In the next screen, copy the link or quiz pin and share it with your friends using email or messaging, inviting them to take the challenge.





ACTIVITY 2 – A LETTER TO MY FUTURE SELF

Imagine you got the futuristic technology that allows you to travel across time and communicate to your future self. Imagine a year far deep in the future (let's say, year 2035). Write a letter to your future-self, mentioning your daily life experiences and comparing them with those in year 2035.

Discuss with your teacher to provide a guiding template to you for the letter.

UNIT 2: RELATE

Unit Introduction

Having built the sufficient ground in AI concepts in the unit Excite, this unit help you relate the capability and potential of AI with our domestic routine such as home. In this unit, we shall discover the relevance of AI in our day-to-day lives and try to visualize impact of AI on it.

1 ARTIFICIAL INTELLIGENCE IN DAILY LIFE

OBJECTIVES

By the end of this chapter you will be able to:

- Understand the influence of AI in 7 major aspects of daily life.
- Understand what Smart City means.
- Understand the features of an AI-powered smart city.

We have seen earlier the applications of artificial intelligence in various industries and fields.

Let us explore the influence of AI in our daily life as we use various online services or any equipment or gadgets that could be AI enabled.

INTERACTIVE ACTIVITY: OUR MODERN LIFE STYLE

Look around! Observe. Think over. Reflect on your daily routine of one entire week. What is your online presence (e.g. Twitter/ Facebook/ Instagram/ Snapchat) and smart gadgets (e.g. smart phone/smart watches) interaction?

The most obvious place to look for AI in action behind the scenes are our online interactions over social media.

Social Media

Social platforms do not own or rarely create their own content. All we see on social media is the content created by other people like us or the companies promoting their offerings. It becomes the responsibility of the social media platform to ensure that no offensive content is uploaded from any source. For instance, abusive language, racial comments, violent pics and videos, cyberbullying etc. To monitor, prevent and check this is a herculean task as every moment billions of posts, comments, pictures, videos and other stuff is uploaded and shared. This is where artificial intelligence comes in use. AI's deep learning algorithms on Twitter, Facebook, Pinterest, Instagram and other social

platforms monitor and check such content amazingly fast and efficiently. In the process, the algorithms enhance their learning and increase their efficiency in fighting this menace. You must have heard many times people getting warnings for their content or having their accounts blocked by the web site admin.

Following are the other ways in which AI algorithms help improve social media platforms in different ways:

1. Learning user preferences and recommending friends, groups, tweets etc.
2. Learning user browsing behaviour and recommending events, products and services.
3. Delete offensive material and counter cyberbullying.
4. Enhancing overall user experience to maintain good customer relations.
5. Tailoring the feed of timelines and notifications according to the user's past interests.
6. Making job matches and network prospective candidate with the potential employer on professional networking platform such as LinkedIn.
7. Identifying different objects in the images and search them online.

Every minute, averagely 3 lakhs status updates are created on Facebook by more than 2 billion people updating their statuses 293,000 times per minute.

Email

Popular email websites such as Google, Microsoft etc. use AI in following ways:

1. To segregate, sort and organise our email messages into various categories and folders. These algorithms prevent a lot of spams from entering your inbox and other frequent mail folders.
2. Smart email drafting: In Gmail, the AI algorithm learns from the mails drafted by the user earlier and suggests smart insertions and edits while drafting a new mail. This enriches the user experience of composing a mail.
3. Similarly, AI algorithms suggest smart replies depending on the content of the mail received. For example, "Thank you.", "I am interested." etc.
4. Colourful follow-up reminders (called nudge) appear in older mails "nudging" you what to do with that email. For example, they prompt you to reply an old unread mail.

Chatbots and Assistants

Chatbots – intelligent chat engines and assistants such as Google Assistant, Apple Siri, Amazon Alexa and Microsoft Cortana use Natural Language Processing algorithms mostly to learn language phrases, keywords and sentence formation to understand quickly and accurately what user means. They learn from the interactions and respond in a better way with customized responses depending on the users and devices. This way, chatbots and assistants simulate a conversation with a real person.

AI algorithms also use Computer Vision technique to perform image-based search, scanning bar codes and QR codes and finding people depending on face recognition. These assistants integrate AI powered search for predictive and smart searches.

Online Shopping

Majority of people prefer to buy online and spend a good amount of time on retail and E-Commerce websites. AI algorithms help greatly in creating realistic user experience.

1. Products are recommended according to the user's interest and product catalog browsing habits. AI algorithms learn from user's dynamic buying behaviour and do real time query on the product database to display related and relevant products.
2. AI also considers user's location in suggesting locale specific services like nearest restaurants and other public services.
3. Other recommendation examples are music depending on days (Friday night), frequent mood (choice of songs), weather, latest movie releases depending on user's location and preferred language, music video playlist depending on favourite artist or genre.

Every time we click on a product image, song or video, AI is using it to teach itself to serve better listings next time to keep you interested and earning millions to the website – keeping both the parties happy.

Games

Video games have long back embraced AI to induce intelligence into the game design. Strategy games, sports-based games, combat games and racing games use AI algorithms to provide a dynamic, adaptive and realistic look and feel of the game. User gets immersed into it. AI algorithms in an AI-based game analyse all the previously played games and learn to devise new strategies to win against the opponent. Multi-player online games have the advantage to learn from several thousand games played. Such game keeps becoming more and more challenging and thus interesting after every set of games played.

Google's AlphaGo program that plays the board game Go, is world's first computer program to defeat a professional human Go world champion. AlphaGo AI's deep neural networks select the next move, predict the winner by learning from the previous games and millions of player moves with an approach called reinforcement learning.

AlphaZero is capable of beating world champions of Chess, Shigo and Go.

Learning Platforms

Online learning platforms are developing AI-based smart tabs and online learning platforms that provide adaptive smart content which adapts to the learning capacity and pace of the learner. AI algorithms help in assessments, creating summaries and suggesting more learning topics to the learner. AI assists teacher in delivering lectures and query handling.

Movies, Music and News

Entertainment platform are using AI to stream content as per our preferences and interest. New movies and videos are recommended depending on what we regularly watch. Automatic playlists and suggested subscriptions are generated by AI algorithms depending on our previous interactions, reviews and ratings.

The Idea of a Smart City

The term *smart* refers to *quick-witted intelligence*. So, a smart device has intelligence that makes it capable to:

- Take input in smart ways such as understanding spoken words, scanning images, faces, gestures and fingerprints, perceiving surroundings (temperature, distance, location etc.)
- Process input in an innovative way to retain the result as learning and using it for future processing.
- Responding or giving output and predictions in the form which is closer to human nature such as spoken human language, relevant recommendations, visual feedback/ guidance, alerts and reminders etc. Predictions are also used for self-learning by the AI algorithm.

What is a smart city? A city that uses information technology and other technological advancements to enhance quality of public services, adequate management of resources to provide real value for life to live in is termed smart city.

In essence, a smart city should provide conditions conducive to live in (clean, healthy environment, quick access to services) and work (clean, non-stop energy and better connectivity) without running the risks for future generations (sustainable).

Think of a whole city which is equipped with variety of such smart devices and installations. A city with efficient systems and clean air with intelligent surroundings! Wouldn't you love to live in such a city?

ACTIVITY: SMART CITY

Step 1: Watch the videos: Watch the following short videos. You may note down your quick observation on paper.

https://www.youtube.com/watch?v=mQR8hxMP6SY (4 min.)

https://www.youtube.com/watch?v=Wcz4kPRMrQU (2.44 min.)

https://www.youtube.com/watch?v=hRY-ZUlJXY0 (20 min.)

Step 2: Debriefing and discussion: Discuss your observations of the above videos regarding smart cities with the teacher. Then, listen to what teacher has to say on the findings of the videos to develop your understanding about smart cities running on AI.

Smart City and AI

Population is growing. Cities are expanding to accommodate increasing number of people, vehicles and buildings. AI can prove a boon for this impending challenge in near future.

There are various services and operations that go on in an urban setup.

Traffic and Parking

Traffic includes following major components. Each can be managed by AI for better experience:

Vehicles: AI-enabled smart-cabs with navigation system to find the shortest and fastest possible dynamic routes; AI-enabled pooling among multiple commuters depending on their location, daily routine and schedule; cab availability and auto-pickup scheduling on the basis of user preferences and profile; cab AI system integrated with traffic control AI for traffic rules compliance and citizen safety; auto-alarm system to alert nearest help (pickup, police, ambulance) during breakdown or accidents; enhanced user experience during commute (access to latest news, entertainment etc.); autonomous transport vehicles (driverless or free hand) controlled by central AI system; personal vehicles with AI controlled proactive fuel system to locate nearest fuel station; accident-proof system to control the

vehicle if driver is distracted or sleeps; smart speed control system for different road conditions (crowd, bad road, highway, water clogged).

Traffic: AI-enabled traffic congestion monitoring system integrated with traffic signal system for better traffic control; intelligent diversion controls for incidents like road construction, public rally or disaster; AI system that calculates toll automatically as vehicle follows the route; warning and alert system to minimize traffic rule violations; digital documentation integrated with AI system alerting about document expiry and renewal. An AI system can learn from the data feed and predict future traffic conditions. AI enabled vehicle interception in case of hit-and-run or escape from crime scene – the traffic sensors single out the vehicle by its make, colour and other features out of several records in the database when number plate is hidden.

Parking: Real-time parking occupancy status or parking map can be generated by simple AI. AI apps locate and reserve parking, extend parking hours and pay for it. Predicting and suggesting future parking vacancy by analysing previous data.

Lighting and Water Supply

Smart electricity grid which controls city power distribution and load balance depending on dynamically changing power demands; finding patterns and trends in power consumption to assess adequate power usage; integrated security systems that predict accidents due to short-circuits by analysing electricity connections health and age data. Same system can be replicated for water supply management and to check water wastage and pollution sources.

Waste Management

Imagine dustbins and waste containers signalling the central waste collection unit that they are about to fill so that waste collection can be initiated. Hazardous waste detection; segregating waste with the help of bots; intelligent water treatment plants etc. are some areas of AI application.

Environment and Pollution Control

Machine learning and AI enabled bots/drones can help in agricultural data collection to optimise farming processes. Collecting and analysing huge amount of data regarding various variables related to air, water and land pollution; predicting air quality and impending epidemic due to air/water-bourne diseases; collecting marine life data, data related to rivers and other water bodies; analysing data related to climate change, rains and temperatures; understanding human activities involved in spoiling the environment etc. are major potential areas for AI and Machine Learning applications. Accurate weather prediction and disaster (storm, earthquake etc.) predictions by AI systems can help greatly in disaster response services and strategies. This is the part of AI-enabled Climate Informatics. In short, environment has the largest, most complex and frequent data which makes an enormous amount which AI systems can utilise to optimise all the processes related to environmental care, research and issues.

Hospitals and Schools

Surgical robots, expert diagnostic systems, smart patient care and medical operations devices, expert post-discharge advising and care system, centralised blood bank and donors database management, smart doctor's assistants are some common AI application examples. In future we can see smart device-based patient therapy, hospital administration, patient management, health data analysis, epidemic detection and monitoring would be taken care of by applying deep learning techniques. The huge data would help AI-systems to learn and gain intelligence to provide self-reliant efficient services.

Brain-Computer Interface (BCI): For the patients who are challenged in speech, hearing, vision or movement, a brain-computer interface is conceived by Partners Healthcare Systems, USA, which will enable such patients to express through AI-enabled computers. These computers will also be used to map their brain memory with the AI-system so that any memory loss later could be restored up to some extent.

In schools, AI-enabled systems can be helpful in many ways such as personalised assessments, teacher assistants, simple bots to help in day-to-day administration, answer sheets corrections, performance predictions, lab assistants, science project development, student health advise systems, practice question paper predictions and students psychological development.

Governance

Today, wave of digitisation has already morphed the traditional governance into E-Governance. With the aid of AI, Machine Learning and Deep Learning, E-Governance can achieve greater heights of achievements such as prediction of trends in huge demography of the country, hunger, poverty, natural disasters, housing, infrastructure, agriculture, urbanisation, education for unreached, crime prevention and safety, implementation and impact assessment of schemes etc.

Centre of Excellence in Artificial Intelligence set up by the National Informatics Centre (NIC), India will work closely with various ministries and government departments to promote innovation in application of AI to take e-governance services to the next level in near future.

Public Safety and Security

Some of the ways AI can revolutionise public safety and security are monitoring outdoor activities in market places, public places and abandoned areas of the cities through AI-enabled surveillance system, robots in fire-fighting and rescue operations, preventing crime by predicting likely criminal activities and marking danger zones, detecting and preventing fake news propagation, enabling law enforcement bodies to exploit power of AI in taking pre-emptive actions against crimes, spotting and checking domestic violence particularly against women and children etc.

In schools, AI-enabled systems can be helpful in many ways such as personalised assessments, teacher assistants, simple bots to help in day-to-day administration, answer sheets corrections, performance predictions, lab assistants, science project development, student health advise systems, practice question paper predictions and students psychological development.

LEARNING POINTS

- Social media, Email services, chatbots, online shops, online gaming, learning platforms and media are using AI for enhanced performance and enriched user experience.
- A smart city is livable and workable without running the risks for future generations (sustainable).

KEYWORDS

- **Smart City:** A liveable, workable and sustainable city.
- **Cyberbullying:** Act of insulting, stalking and shaming someone online for any reason.
- **Sustainable:** Not harmful for environment, community and future generation.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. AI is suitable to use with social media platforms in which of the following ways?
   a. AI can learn from the data
   b. Bulk of data is sufficient for AI to train itself
   c. Both a) and b)
   d. None of these
2. Colourful follow-up reminders appearing beside email message are called _____.
   a. Smart reminders
   b. Smart email
   c. Both a) and b)
   d. None of these
3. To perform image-based search, an AI-enabled assistant can use which of the following techniques?
   a. NLP
   b. Computer Vision
   c. QR Code
   d. Bar code
4. Products and services can be recommended to the user by an AI-enabled system depending on user's _____?
   a. Location
   b. Day
   c. Time of the day
   d. All of these
5. The three characteristics of a smart city are conducive conditions to live, work and _____.
   a. Sustainability
   b. Power efficiency
   c. Safety
   d. Travel

B. Fill in the blank.

Smart assistants, Learn, Sustainability, Online presence, Social platforms

1. Twitter is an example of our _____.
2. _____ usually do not own the content.
3. Alexa, Siri and Cortana are examples of _____.
4. Every time we click during browsing, AI algorithm uses it to _____.
5. Ability of ensuring safety of environment, communities and future generations is called _____.

C. State whether True or False.

1. Checking offensive content is not the responsibility of the social media platform.
2. Intelligent chat engines are called chatbots.
3. AI algorithms help greatly in creating realistic user experience online.
4. Strategy games cannot use artificial intelligence.
5. Adaptive smart content is suitable for all types of learners.

D. Answer the following questions in one line.

1. What is smart email drafting?
2. What is a nudge?
3. How chatbots accurately understand what user has spoken?
4. Give an example of realistic user experience during online shopping.
5. List any 5 areas where AI can make a city smart.

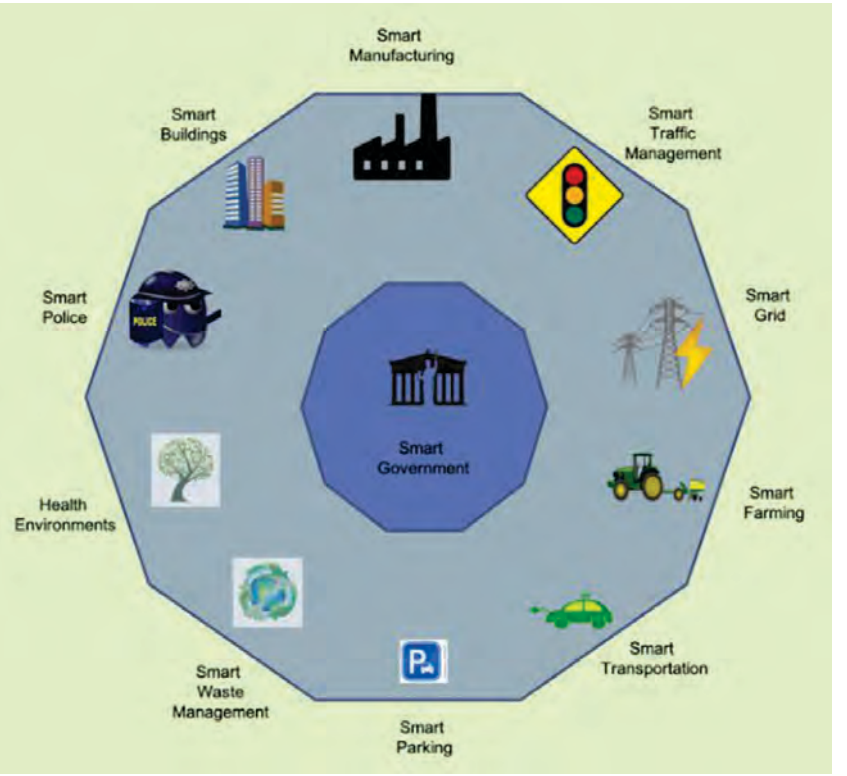
LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://www.geeksforgeeks.org/impacts-of-artificial-intelligence-in-everyday-life/*
- *https://www.digitalistmag.com/improving-lives/2019/05/28/6-ways-ai-improves-daily-life-06198539*
- *https://study.com/academy/lesson/artificial-intelligence-in-everyday-life.html*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a chart representing a home the center and smart devices attached to it through thin lines. Use your creativity to make the chart stand out uniquely.



2 FUTURE YEARS WITH AI: SMART GADGETS AND HOMES

OBJECTIVES

By the end of this chapter you will be able to:

- Understand the term Internet of Things and its features.
- List main characteristics of a smart home.
- Understand how a smart home works.
- Describe the features of an AI-powered smart home.

Relating from previous chapter: Artificial Intelligence in Daily Life

We have learnt about how AI would influence our daily lives in the times to come. This session will extend your learning further about smart homes equipped with smart gadgets and appliances that run on artificial intelligence.

We often listen people talking about smart devices and smart homes. We already have smart devices around. A smartphone has been the most common of them all. The idea behind smart devices is the question: Like *smart phones, can intelligence be embedded in other electronic devices and appliances?*

INTERACTIVE ACTIVITY: BRIEF GROUP DISCUSSION

What is your view and vision regarding smart gadgets? Do you think, it is possible to have smart gadgets around? If yes, what is your imagination or expectation? Discuss.

The Internet of Things (IoT)

Before exploring about smart devices, appliances and equipment (together called *gadgets*), let us understand what does the term Internet of Things (IoT) mean. Consider the following scenarios:

- As you get up in the morning, switching off the alarm clock, which sends a signal to the geyser and it turns on heating.
- As your school bus enters the school gate, the gate sensors detect the chip in the id cards of all the 55 students in the bus and sends a confirmation message to all parents and school's attendance system. (The face reader fitted in the bus "tells" the gate scanner that count of students is one less than the count of id cards. AI-system in the gate scanner quickly scans all the faces in the face reader of the bus and compares them with the bus database. The absent student is spotted and alert is sent to the parents).
- Your school canteen checks day's menu and lists food items on your tab, you confirm your order and get it fresh during recess.
- You push your answer sheets in the digital answer sheet collector and within seconds the digital AI-equipped examiner connected with it, detects your handwriting, checks your answers and flashes the score on your tab.

- As you start back from home, from your tab, you send a signal to the oven at home to keep the noodles hot as you arrive.
- Your refrigerator senses the milk going out of stock and signals the online store the required quantity of fresh milk.
- You control devices at your home through a mobile app.

Did you notice something common in all these scenarios? Yes, devices (alarm clock and geyser, school gate sensor and face reader, answer sheet collector and answer sheet examiner, school canteen menu system and your tablet, oven and refrigerator) are "talking" to each other. How? Through embedded sensors and chip-controllers.

What is the medium of this entire communication? Cloud or Internet. All these "things" are communicating through control chips with each other over Internet. Welcome to the *Internet of Things*!

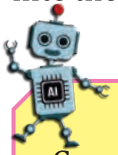
The Internet of Things (IoT) is the concept of networking devices which communicate over Internet to share data and signals in order to execute the required tasks accomplished.

Imagine the possibilities!

The platform of the IoT provides an environment where sensors embedded in the devices communicate with each other. Each device is either programmed or, in future, AI-enabled to decide what to do with the data and how to use data to *train* itself (with the help of machine & deep learning) for executing the same task in a better way in future.

IoT Gadgets

By 2020, more than 20 billion devices would be on IoT. IoT devices, appliances and equipment fall into the categories such as domestic appliances, personal accessories, vehicles and even toys.



GOOGLE-LEVI'S IoT JACKET

Google in a tie-up with Levi's introduces the platform Jacquard to create a jacket with sensors and electronics in its fabric that answers your phone call while you are driving, sends your gestures to your smartphone to operate it.

Some popular IoT devices are:

- Google Home Voice Controller and Amazon Echo Plus to control digital equipment like TV, music system etc.
- Smart doorbell camera that has AI that recognises your guests.
- Smart locks operable through mobile app.
- Mobile robots that help in small domestic chores.
- Universal Remote Controller to control all devices at home.
- Smart mirror that shows notifications as you do your hair.
- Smart watches that track your fitness workout and health data, talks to your phone and shows notifications.
- Car that can figure the location of the nearest fuel station, scan and sense obstructions, knows the preferred route to home and office.

MODERN IoT DEVICES

Search on the internet what all modern IoT devices are around or in making. Spend 30 minutes to look around online and note down your findings to discuss with teacher.

What is a Smart Home?

A home that is equipped with appliances and gadgets that run on smart applications or AI-enabled applications and technologies like IoT to provide a sustainable (not harmful to environment and society), healthy and safe stay is called smart home.

SMART HOME OF MY DREAMS

Step 1: Watch the videos: Watch the following short videos. You may note down your quick observation on paper.

https://www.youtube.com/watch?v=1CajaUoI3vU (2 min.)

https://www.youtube.com/watch?v=U6pJtQLBhWA (6 min.)

Step 2: Debriefing and discussion: Discuss your observations of the above videos regarding smart homes with the teacher. Then, listen to what teacher has to say on the findings of the videos to develop your understanding about smart homes running on AI.

Step 3: Let us pick up the smart home floor plan you made in Unit 1. Compare the features of your smart home with the features you noted from the videos and fill the details in following format:

Features that are in your plan but not in the videos	Features that are both in your plan and the videos.	Features that are not in your plan but in the videos.

Step 4: Redraw the plan to incorporate newly found features and details.

Note: *Use a pencil for initial drawing for easier corrections/modifications.*

Characteristics of a Smart Home?

After watching the videos you must be clear what a future smart home really is. What are the major aspects that need consideration to make a home smart? Let us see:

Kitchen: smart oven operable through alerts from other devices like smartphone, coffee maker that lets you know when coffee beans run out of stock, refrigerator that suggests grocery list depending on the items consumed.

Living room: Digital photo frame synced with your Instagram and Facebook account, smart TV that lists top 3 movies being watched in your friends' group and prompts you to watch them with your friends in real time, a snacks trolley that knows its way around the house.

Washroom: geyser that switches itself on when morning alarm goes off, smart water flow control system as you take bath or shave, a mirror that shows notifications or displays TV feed in its corner.

Bedroom: App operated lights, air conditioner that senses when you are asleep and adjust temperature, alarm clock that also displays number of overnight notifications that came in on your smartphone and that talks to the geyser, your car and other appliances.

Car: knows when its documents need renewal, when it needs next servicing and car wash, knows your regular routes and locates the best and fastest route, senses threats around while driving.

Security: smart burglar sensors, doorbell that recognises your closer ones, lock that opens with voice command and that can talk to your phone, fire alarms and sensors which share data with each other.

In addition to this, there are several other possibilities such as smart lighting system, heating system, air quality system, cleaning and dusting bots, bots that help in small house chores, smart accessories, apparels and footwear.

How Does a Smart Home Function?

Generally, the distance among the devices at a home would be a few meters so Bluetooth and WiFi are most suitable technologies. Appliances are connected with a central controller called smart home hub such as SmartThings and Wink by Samsung. Through this hub, all the devices communicate using Z-Wave protocol. Devices' communication is controlled by the hub.

The smart appliances either work on a schedule called alarms or they work in response to a trigger. For example, geyser turns on when alarm goes off is alarm based action while your car auto-starts sensing your mobile phone in your hands as you approach it is a triggered event.

AI-powered Smart Home

The core of AI is Machine Learning and Deep Learning that make an AI-based system able to process immense data quickly and learn from it to do accurate predictions and derive future trends and patterns.

Imagine a device capable of learning from data collected.

Natural Language Processing and Computer Vision are two techniques that would turn devices into magic. You speak a few words and lights are switched off/on, you show the image of the book in the newspaper to the camera and book is ordered on Amazon, Alexa confirms your order instantly.

Several chores are done just by speaking a few keywords. As you get ready, the cab is being called for airport drop, you schedule your smart cleaner when to clean next and over the time it "learns" when to clean the house.

At the heart of entire AI-based smartness is the learning algorithms which make the devices even smarter as you use them. This is different from concurrent IoT devices. Once AI is integrated, the functionality of these devices evolves and improves in more useful way. These devices, after getting trained, can perform routine tasks on their own such as:

- Preparing grocery list.
- Schedule money transfers and payments.
- Automatically replying to routine messages.
- Managing your appointments on priority-basis.
- Identifying stocks to invest and suggest how much to invest.
- Predicting potential threats such as accidents, break downs, theft etc.
- Information and documents update such as vehicle registration, expiry of food items and medicines, upcoming payments and bills etc.
- Function as your personal health trainer which tracks your food habits, hygiene, personal habits and suggests precautions to take.

- Analyse your study and assessment data and suggest study schedule and guidelines.
- Comfort you with soothing music depending on the stress you face.

In a nutshell, being surrounded with "intelligent", "trainable" and "predicting" appliances makes an "AI-powered smart home". An AI-powered smart home learns to know you better as the time passes and optimises itself to offer better service responses as compared to earlier ones. It may even tell you to upgrade itself and may possibly be able to update itself online with the latest algorithms available on Cloud.

- The Internet of Things (IoT) is the concept of networking devices which communicate over Internet to share data.
- A smart home is equipped with appliances and gadgets that run on smart applications or AI-enabled applications and technologies like IoT.
- Smart home devices communicate through smart home hub over Z-Wave protocol.
- An AI-powered smart home learns to know you better as the time passes and optimises itself to offer better service responses.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. IoT stands for _____.
   a. Intelligence of Things
   b. Integration of Things
   c. Both a) and b)
   d. Internet of Things
2. IoT devices share _____ with each other.
   a. Data
   b. Signal
   c. Intelligence
   d. None of these
3. Smart appliances work on _____ or _____.
   a. Schedule, trigger
   b. Event, interrupt
   c. Schedule, interrupt
   d. Trigger, event
4. An AI-powered device responding to your voice commands is using which of the following?
   a. VoI
   b. NLP
   c. Computer Vision
   d. All of these
5. An AI-powered device responding to your gestures is using which of the following?
   a. VoI
   b. NLP
   c. Computer Vision
   d. All of these

B. Fill in the blank.

Smart home hub, Scheduled, Smartphone, Algorithms, Controller

1. A _____ has been the most common of all the smart devices.
2. Amazon Echo Plus is an example of smart device _____.
3. The IoT devices are controlled by a _____.
4. _____ devices perform the functions at a certain time.
5. At the heart of entire AI-based smartness is the learning _____.

C. State whether True or False.

1. IoT based devices cannot share data.
2. An AI-enabled device can learn what to do with the data.
3. Deep learning helps an AI-system to learn from the data.
4. Every smart home is an AI-powered home today.
5. An AI-enabled may even upgrade its algorithms.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://www.explainthatstuff.com/smart-home-automation.html*
- *http://www.infiniteinformationtechnology.com/iot-smart-city-what-is-smart-home*
- *https://medium.com/syncedreview/ai-biweekly-optimistic-outlook-for-iot-ai-powered-smart-homes-37eae0d76dc4*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a 1000 words write-up or a 5 slides presentation on ***AI-powered smart homes*** by visiting URLs in Information Highway section.

UNIT 3: PURPOSE

Unit Introduction

This unit focuses on understanding the meaning of sustainable development and the 17 Sustainable Development Goals by United Nations. We shall also discover the social issues that these SDGs address and finally, we shall learn how Artificial Intelligence plays vital role in empowering the SDGs.

1 SUSTAINABLE DEVELOPMENT GOALS

OBJECTIVES

By the end of this chapter you will be able to:

- Understand the term sustainable development.
- List 4 Rs and 4 Ps of sustainable development.
- Understand 17 Sustainable Development Goals (SDGs)

Understanding Sustainable Development

Earth is home to mankind, other creatures and plant kingdom. Air, water bodies and land are available to us from nature to live and survive. Humans are the most superior species of all and rule the world. But, being superior means that all the responsibility to take care of Earth, nature and all other living beings lies with us humans. In the efforts of making our lifestyle more comfortable, advanced and luxurious we must draw a line between the need and the greed.

If our efforts for a better life are compromising society, economy and environment then it will create a threat for our future generations to sustain.

This is where *sustainable development* comes into picture.

In simple terms, sustainable development means the economic development that is achieved without harming and depleting natural resources. Looking more closely into the term "sustainable", it is defined as something that is "able to be upheld or defended". Sustainable development takes care of the needs of the present while being concerned about future generations, balancing between economic growth, care for the environment and social well-being.

Today, sustainable development is necessary due to the concerns for preserving the environment, its biodiversity and to ensure a healthy and productive world.

The three fundamental aspects of sustainable development are:

- Economic development
- Social development
- Environmental protection.

Economic development is about ensuring that businesses and other organizations adhere to sustainability guidelines.

Economic development should be **equitable** (fair) in such a way that there are equal opportunities for all in the society such as education, food, health and shelter. On the other hand, economic development should be **viable** (workable) for environment. It must not affect our environment adversely such as pollution, deforestation, global warming and climate change etc.

Social development is about awareness and protection of the health of people from pollution and other harmful activities of businesses. Social development should not happen at the cost of environment. It should be **bearable** by the environment. Adverse examples are overcrowded cities, too much urbanization, disappearing green cover etc.

Environmental protection is the need to protect the environment from the harmful effects of businesses and society both.

The balance of above three is a perfect model of sustainable development. It targets the achievement of 4 Rs which are:

- **Reduce** waste
- **Recycle** waste
- **Recover** wastage
- **Reuse** before discarding

Sustainable development has 4 main pillars (4Ps):

- **People,** who represent the society, culture, civilization and all the issues in society such as poverty, hunger, violence, illiteracy, inequality etc.
- **Planet,** which represents the environmental and natural life as well as all the issues related to it such as pollution, endangered species, climate change etc.
- **Profit,** that represents the economic issues. Businesses run our economy and they compete for profit so that society progresses. But for the blind greed for profit, environment and society should not suffer.
- **Policy,** which refers to the political leadership and implementation of policies to ensure sustainable development.

Today, countries are agreeing to the importance of conserving natural resources. People are adopting greener ways that will improve their health, farmers are practicing smart agriculture and industries are realizing as to how much they can save through energy efficiency.

Sustainable Development Goals

On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development officially came into force. They were adopted by world leaders (including India) in September 2015 at an historic UN Summit. Poverty is the biggest issue for sustainable development. These 17 SDGs are:

1. Complete poverty eradication
2. Zero hunger
3. Good health and well-being

4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduces inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnerships for the goals

Let us categories these goals in Social, Economic and Environmental brackets.

SOCIAL	ECONOMICAL	ENVIRONMENTAL
1. Complete poverty eradication 2. Zero hunger 3. Good health and well-being 4. Quality education 5. Gender equality 6. Clean water and sanitation 7. Affordable and clean energy 11. Sustainable cities and communities 16. Peace, justice and strong institutions	8. Decent work and economic growth 9. Industry, innovation and infrastructure 10. Reduces inequalities 12. Responsible consumption and production 17. Partnerships for the goals	13. Climate action 14. Life below water 15. Life on land

SOCIAL ISSUES AWARENESS

Watch the following images and make your observations.

- What comes to your mind after watching these images?
- What possible actions should be taken to eradicate these crises?

LEARNING POINTS

- Sustainable development means the economic development that is achieved without harming and depleting natural resources.
- The three fundamental aspects of sustainable development are economic development, social development and environmental protection.
- Sustainable development targets the achievement of 4 Rs – Reduce, Recycle, Recover and Reuse.
- Sustainable development has 4Ps - People, Planet, Profit and Policy.
- On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development officially came into force.
- Sustainable development goals address social, economic and environmental issues.

KEYWORDS

- **Sustainable:** That needs to be protected.
- **Sustainable development:** Development that empowers society, boosts economy, does not threats environment and dies not put future generations at risk.

ASSESSMENT

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Which of the following SDGs falls into environment category?
   a. Climate action
   b. Life below water
   c. Life above land
   d. All of these
2. Able to be upheld or defended means _____.
   a. Endangered
   b. Under development
   c. Sustainable
   d. None of these
3. Which of the following is not one of the Rs that sustainable development targets to achieve?
   a. Reduce
   b. Replace
   c. Recycle
   d. Recover
4. Which of the following is not the one of the main pillars of sustainable development?
   a. People
   b. Profit
   c. Policy
   d. None of these
5. Which of the following is environmental SDGs?
   a. Climate action
   b. Clean water and sanitation
   c. Affordable and clean energy
   d. All of these

B. Fill in the blanks.

Bearable, Profit, Humans, Policy, Equitable

1. _____ are the most superior species of all.
2. Economic development should be _____.
3. Social development should be _____ by the environment.
4. _____ refers to the political leadership
5. _____ represents the economic issues.

C. State whether True or False.

1. There should be equal opportunities for all in the society.
2. Sustainable social development leads to overcrowded cities and disappearing green cover.
3. Reduce, recycle and recover related to wastage.
4. Today, people are getting aware and adopting greener ways.
5. Gender equality means equal opportunities for men and women, and boys and girls.

D. Match the following.

Column A	Column B
People	refers to the political leadership and implementation of policies to ensure sustainable development.
Planet	represent the society, culture, civilization.
Profit,	represents the economic issues.
Policy	represents the environmental and natural life

E. Answer the following questions.

1. List the four Rs targeted by sustainable development to achieve.
2. List the four main pillars of sustainable development.
3. List any 2 SDGs each relating to society, economy and environment.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://sustainabledevelopment.un.org/resources/sd21*
- *https://www.sciencedirect.com/topics/earth-and-planetary-sciences/sustainable-development*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a chart showing ***SDGs arranged into 3 categories.*** Use your creativity and imagination in making the chart.

2 AI AND SUSTAINABLE DEVELOPMENT ISSUES

OBJECTIVES

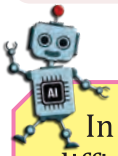
By the end of this chapter you will be able to:

- List 8 characteristics of AI which have potential to address sustainability issues.
- Categorise sustainability issues into 3 categories.
- Understand how AI addresses various sustainability issues.

Relating from previous chapter: Sustainable Development Goals

We are now aware about sustainable development and 17 sustainable development goals from United Nations embraced by major countries including India.

This session will help you explore the possibilities of using AI as a tool to address issues related to sustainable development and achieving sustainable development goals.



In 2017, after the hurricane Harvey passed through Houston, many streets were flooded and difficult to pass while some streets were clear. An AI application analysed satellite images and by applying intelligence of object detection, it helped rescue teams to identify safe escape routes for those trapped by the rising waters.

Following characteristics of AI have potential to play vital role in achieving various sustainable development goals:

- Ability to process immense amount of data.
- Faster processing rate as compared to traditional computing.
- Understanding patterns and trends in the data-sets, for example age data, poverty level, health data and living conditions data of millions of children across the globe.
- Ability to predict future trends from present data patterns.
- Ability to learn from the data patterns.
- Ability to function autonomously to make predictions as more and more data is available.
- Ability to process complex data types such as facial recognition, satellite images, volumes of audio and video, object detection (Computer Vision).
- Ability to understand and respond in natural human language (Natural Language Processing).

AI and Social Issues

The social SDGs are focusing on poverty, hunger, health, education, gender equality, clean water, clean energy, sustainable cities and peace and justice for all.

Let us see how AI can address challenges posed by social SDGs in some of the following ways:

Challenge: Fighting poverty, hunger and health issues.

Answer: Prime area of concern is poverty because if it is taken care of then hunger and health can be dealt-with easily. The solution to poverty is finding a source of income in the form of employment or self-employment. AI-systems can map the money-earning opportunities with the ability of poor to take-up those opportunities. AI can fill this gap between the needy and the opportunity. Mobilisation and settlement of homeless for better earning opportunities can help eradicate poverty crisis. AI-powered educational systems and data-visions on literacy can help policymakers to devise better educational policies and plans.

Challenge: Help policymakers understand the diverse needs of education for the underprivileged children.

Answer: AI-systems can derive patterns that help in understanding the educational needs easily and address them efficiently. For example, AI can create a ***data vision*** to show that in which areas hunger, poverty, health or violence is the barrier in their education.

Challenge: Finding out most suitable ways and modes of education.

Answer: AI-systems can suggest and help in creating customized educational material according to the need of the children. Fun-oriented, game-based and entertaining educational modules can be generated by ***AI-powered learning management systems***. These systems can also empower teachers to perform teaching easily and efficiently. In addition, AI-systems can provide learning feedbacks to improve the achievements of the children.

Challenge: Monitoring climate and environmental trends and identifying clean water resources.

Answer: AI-systems are capable of detecting objects within images. By processing images fed to them by the satellites and other sources, impact of climate change, pollution and global warming on agriculture, clean water sources, people and natural resources, can be assessed. Rich data-views can be generated to help policymakers understand and address the challenges with better strategies/ policies.

Challenge: Developing systems to provide clean water and encourage clean energy usage.

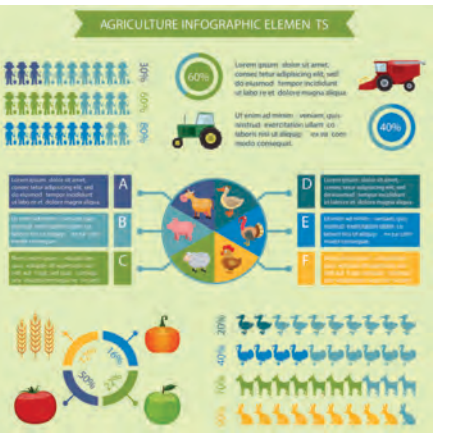
Answer: Use of satellites, drones, ocean and river database, pollution data etc. generate several huge data-sets whose processing is not possible humanly but an AI-powered system can do it quickly and produce various trends and predictions which can show a guiding path to the policymakers to devise laws, means and systems for clean water distribution, to check water wastage, to restore depleted water resources, to preserve water resources. Similarly, tends and patterns in polluted areas can help in encouraging and implementing the use of green and clean energy (wind, solar and nuclear).

Challenge: Smart cities, peaceful living and fighting crimes

Answer: AI systems can be integrated with IoT technology to build smart cities which provide conducive conditions to live and work, and which are energy-efficient and environment-friendly. AI-based surveillance, monitoring and tracking can help minimize crimes and encouraging peaceful living. The monitoring data of infrastructure can be used by AI system to predict any possible disaster or hazard to alert for preventive measures. Face recognition can help in locating missing children and curbing child-trafficking.

AI and Economic Issues

The economic SDGs are focusing on employment, industry innovation and growth, equality, fair consumption and production and partnerships to achieve goals. Let us see some of the ways in which AI can help in addressing economic issues.



Challenge: Smart agriculture.

Answer: AI system can analyse data-sets to predict weather patterns. Data related to pests and plant diseases can help in finding better cures and crop options. Food distribution channels and supply chains can be improved to reduce wastage. AI can play a revolutionary role in agricultural research for new crop species development and increase the efficiency of overall agricultural front.

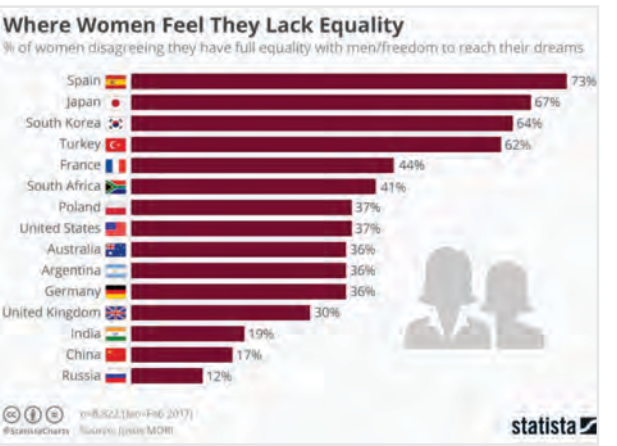
Challenge: Innovations in industry and industrial infrastructure.

Answer: This challenge has tremendous opportunities to deploy AI capabilities. Product research and design, manufacturing and construction, logistics and infrastructure and almost every aspect of an industry can be enhanced using AI's NLP, Computer Visions, and predictive analysis of enormous data-sets. Integrating AI with technologies like IoT and robotics can create development of innovative systems – smart factory, smart infra, smart logistics and smart production /manufacturing.

Challenges: Reducing inequalities and fair consumption and production.

Answer: Inequalities are in various forms – gender, caste, financial etc. AI-systems can compile data-visions for various groups victim of inequality and can help in mapping with the opportunities available or denied to them.

Similarly, AI-systems can look into data-sets of public distribution systems and availability of better ways to ensure availability of services and food without discrimination to everyone. Face recognition can help NGOs fight for the rights of the individuals and help them get justice for the crimes against them. Consumption data can be used to manage adequate production and prevent losses due to over-production and wastage.



Challenges: Collaboration for data and efforts.

Answer: AI is in its primary stages. As it develops, data-sets, data-visions and learning of multiple AI-systems can be integrated to develop more powerful systems. Governments and companies can easily collaborate with immense data for better solutions.

AI and Environmental Issues

Environment and our biosphere are the largest source of almost endless data of immense variety. Wildlife research using Computer Vision techniques, marine research, forest management through imagery and object detection, pollution data-sets, climate data-sets, wildlife conservation research, land and soil quality research, climate-change data,

global warming etc. are some of the several areas related to environment where AI-based systems can create wonders.

ACTIVITY: GO-GOALS SUSTAINABLE DEVELOPMENT GAME

Go to the link: **https://go-goals.org/downloadable-material/** and download the material for Go-goals board game to understand SDGs better. Prepare and play the game under your teacher's guidance.

- AI is helpful in achieving SDGs due to its ability of immense data processing, predictive analysis, learn and function autonomously, object detection through Computer Vision and ability to perform Natural Language Processing.

- **Data vision:** Views plotted out of data in a form that can be easily analysed.
- **Object detection:** Ability of AI system to identify specific object in images and videos. This is called Computer Vision.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Sustainable development encompasses which of the following?
   a. Society b. Economy
   c. Environment d. All of these
2. Which of the following are the Computer Vision ability of AI?
   a. Facial recognition b. Object detection
   c. Both a) and b) d. None of these
3. AI addressing poverty and health issues falls in which of the following categories?
   a. Social b. Economic
   c. Environmental d. None of these
4. AI addressing industry innovation issues falls in which of the following categories?
   a. Social b. Economic
   c. Environmental d. None of these
5. Forest management through satellite imagery falls in which of the following SDG categories?
   a. Social b. Economic
   c. Environmental d. None of these

B. Fill in the blank.

Object detection, Predictive analytics, Data, NLP, Data-vision

1. Processing details about forests of a country is the ability of AI top process bulk _____.
2. Patterns and trends in data-sets are used by AI system to to produce _____.
3. Analysis of immense data by AI systems to see patterns is called _____.
4. Identifying a region of drought in satellite imagery is an example of _____.
5. Creating speech-based learning material for learners can be done using _____ feature of AI.

C. State whether True or False.

1. Earth has enough clean water for another 200 years.
2. Poverty is the prime issue for sustainable development.
3. Clean water and sanitation are environment related SDG.
4. Object detection is a feature related to Computer Vision.
5. The sustainable development pillar *Profit* relates to economic development.

D. Answer the following questions.

1. List any 5 AI features that may help in addressing sustainable development issues.
2. How Computer Vision and NLP may prove helpful in addressing sustainable development issues?
3. How AI can help in understanding educational needs?
4. How AI can help in finding ways to better education?

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://www.2030vision.com/news/artificial-intelligence-the-potential-for-good*
- *https://www.smithsonianmag.com/innovation/artificial-intelligence-future-scenarios-180968403/*
- *https://bernardmarr.com/default.asp?contentID=1828*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a 1000 words write-up or a 5 slide presentation on ***How AI and Machine Learning are being used to solve complex problems*** by visiting the following link:

https://ai.google/education/social-good-guide/?category=examples

UNIT 4: POSSIBILITIES

Unit Introduction

This unit focuses on the career prospects and job opportunities with artificial intelligence in industry and various fields. What knowledge profiles and skill sets are needed in general and specific to major fields to develop a career in the market.

1 AI CAREER PROSPECTS IN INDUSTRY

OBJECTIVES

By the end of this chapter you will be able to:

- List at least 9 job descriptions based on AI.
- List major functional areas of 8 major industries and potential of AI-based jobs in them.
- List job opportunities under Data, NLP, ML and Robotics.

Today, artificial intelligence has crept in quietly, closer and around us in the form of smart apps, devices and portals. It holds tremendous potential to influence every field and every vertical in industry. Due to this reason, AI has emerged as the most popular and promising pathway to pursue a lucrative and exciting career, of course, for the aspirants who have right set of skills and suitable knowledge.

Let us see the industry verticals influenced, or likely to be influenced in future, by AI.

Changing Job Descriptions with AI

The major capability of AI can be summarized under its 5 techniques as follows:

Data

- Handling immense and continuous inflow of data at higher speeds. (Big data processing).
- Identifying trends and patterns in the data-sets.
- Generating data-views of the patterns and trends.
- Predicting future trends useful for planning and making business strategy.

Computer Vision

- Object identification in images.
- Facial-recognition, satellite imagery processing, videos etc.

Natural Language Processing

- Interpreting human speech and language, and responding back.
- Identifying and understanding handwriting.
- Converting text to speech and *vice versa*.

Artificial Neural Networks

- Learning from data-trends and retain it for future predictions more intelligently.
- Machine learning to handle tasks autonomously.

Robotics

- Automated tasks
- Physical assistance
- Search and rescue operations
- Human-life threatening operations (mining, underwater, fires, wildlife, enemy territory)
- Weapon control
- Nano-bots for specialized tasks (blood stream bots for localized treatment, surveillance bots, biological scavengers to fight dirt and diseases etc.)

Considering the above capabilities of AI, the general job descriptions are listed below:

- Building efficient self-learning applications.
- Preparing advanced data-sets for training the ML applications.
- Research and implement ML algorithms.
- Developing high quality prediction systems.
- Develop advanced statistical models.
- Data acquisition, design, model and maintenance of business data-sets to create data-views of business trends.
- Data mining, integration, visualization and modelling.
- Research by applying computer perception, reinforcement learning, NLP etc.
- Research, design and develop robots. (A vast, specialized engineering field).

Artificial Intelligence Industry Verticals

Days are not far when almost every industry will be harnessing the power of AI, mainly to survive competition, keeping up the quality of the services/ products and for manifold growth of the business. Following are some major verticals of industry, most of which have already adopted AI techniques up to some extent:

- E-Commerce
- Customer support
- Education and training
- Healthcare
- Entertainment
- Transport
- Security

- Research and Development

Let us have a look what avenues of career and jobs related to AI the above areas have.

E-Commerce

Major Functional Area	AI Possibilities
• Application development – web interface, app and user experience. • Product development or sourcing. • Inventory, Stock and warehousing. • Promotion and Digital Marketing. • Payment gateways. • Customer service.	**Data** Analytics and predictions from customer data, sales data and product data. **NLP** Chatbots development, customer interactive voice response system (IVRS), voice search. **Computer Vision** Image search, security **Machine Learning** Design and develop AI algorithms for all the data, data acquisition and data modelling to train AI algorithms, research and design of autonomous AI systems, recommending products and comparing products.

Customer support (Call centers & areas dealing directly with customers)

Major Functional Area	AI Possibilities
• Reactive support. • Customer FAQ and education (awareness) • Customer behaviour tracking. • Customer outreach (relation). • Customer feedback response. • Review and goodwill management.	**Data** Gathering, organizing and predictions through analytics of customer data, feedback etc. **NLP** Chatbots development, customer interactive voice response system (IVRS), voice search. **Computer Vision** Image based product search, security, assistance to physically impaired, customer identification and classification techniques. **Machine Learning** Design and develop AI algorithms for customer data-sets for predictions, train AI algorithms with variety of data-sets, develop autonomous algorithms for customer response and outreach.

Education and training

Major Functional Area	AI Possibilities
• Educational content management. • Learners' management (admission, study, assessment, certification, fees etc.) • Trainers' management (recruitment, scheduling, certification, salaries etc.) • Website and app development. • User experience. • Infrastructure management (training venues, studios, communication equipment, hardware and software etc.) • Financial management (fees, expenses, business expansion, funding, loans etc.)	**Data** Predictive analysis of student data as customers, student performance data, course demand data, trainers' database, trainer-student relationship data, sales and other business operations data. **NLP** Chatbots for course enquiry and FAQs, admission assistance, sophisticated virtual assistants for queries on concepts and doubt clearing, career guidance and consultation, exam preparation and informal assessments, educational activities such as group discussions, debates, presentation etc.) **Computer Vision** Image based product search, security, assistance to physically impaired, customer identification and classification techniques. **Machine Learning** Design and develop AI algorithms for customer data-sets for predictions, train AI algorithms with variety of data-sets, develop autonomous algorithms for adaptive course content and customised course content.

Healthcare

Major Functional Area	AI Possibilities
• Patients care and medication management. • Hospitals operations and infrastructure. • Drug research and design. • Financial, budget and health insurance management. • Medical diagnosis and pathology. • Blood bank and organ transplant management. • Security and surveillance • Doctors and human resource management. • Information technology (website, app, digital equipment, robots)	**Data** Data acquisition and classification, creating complex data-sets. **NLP** Chatbots and interactive voice response system (IVRS) for patient support, voice search, fixing doctor's appointment, quick assistance. **Computer Vision** Image based diagnosis (x-ray, MRI, CT scans, nano-bots), assistance to physically impaired, photograph sampling and sorting, document scanning and records management, face recognition, retina scan etc.

Major Functional Area	AI Possibilities
• Records and documentation.	**Machine Learning** Design and develop AI algorithms for patient and operations management, train AI algorithms with variety of data-sets, prediction of various scenarios for doctors, develop autonomous algorithms for handling routine tasks, expert systems for diagnosis. **Robotics** Bots for routine tasks, simple robots to assist surgeons and ward supports, robot aided surgery, remote online surgery assistance etc., Nanobots for localized medication/operations inside human body.

Entertainment and Media

Major Functional Area	AI Possibilities
• Movies and songs. • Web series. • Audio streaming. • Games – online, multi-player, offline and their combinations. • Infotainment, social media, news. • Web theatre, open mic and reality shows	**Data** Gathering, organizing and predictions through analytics of viewers data, collections, Television Rating Point (TRP) data, reviews, movie archive digitalisation. **NLP** Chatbots development for movie booking, search etc., voice search, multi-lingual subtitles, multi-lingual dubbing, mimicry voice generation, speech special effects, song archiving and translations, audio books generation, gaming vice interface, online collaborative talent shows etc. **Computer Vision** Image based search, object identification in videos, film production, film archiving etc. **Machine Learning** Design and develop AI algorithms for predictive analysis of popularity trends, genre trends, collections, artist trends etc., smart algorithm that create scripts, edit media and learn from customer /viewer's behaviour, autonomous algorithms to automate complex tasks in the industry.

Transport

Major Functional Area	AI Possibilities
• Traffic control and planning. • Public transport management. • Commercial vehicles operations. • Rural and urban transport. • Road safety and security. • Transport disaster management. • Transport infrastructure.	**Data** Complex data collection and classification related to vehicles, routes, transport, safety support etc. **NLP** Chatbots for traveler and commuter support, vehicle identification, voice command interface for commercial vehicle control (trains, buses etc.). **Computer Vision** Vehicle and person identification and search, route maps and road guides, crime prevention, remote vehicle control, traffic jam resolution, disaster support through satellite imagery, support in bad weather, natural calamity etc. **Machine Learning** Design and develop AI algorithms for traffic control and diversion systems, surveillance systems, parking management, logistics support etc., train algorithms for autonomous control in routine tasks, predicting disaster patterns, early warning systems, vehicle health prediction and warning etc. **Robotics** Parking assistance, autonomous driver-less vehicles, drone-based service delivery, manufacturing and testing, construction and underground operations, rescue assistance, crime prevention etc.

Security

Major Functional Area	AI Possibilities
• Cybersecurity. • Public security. • Domestic security. • Citizen safety and disaster response management.	**Data** Gathering, organizing and predictions of trends through analytics of criminal records, disaster, deaths, accidents and forensic data etc.

Major Functional Area	AI Possibilities
• Search and rescue operations. • Crime detection and prevention. • Mob and riot control. • Fire fighting. • Law enforcement.	**NLP** Crime scene reach out, distress response system, SOS call system, public address and warning system, etc. **Computer Vision** Satellite image processing for identification, natural disaster detection (storms, floods, fires etc.), search and rescue on land, air and sea, facial recognition for identification, search and nab operations, night vision support for rescue and attack operations, city surveillance and security assistance during mob/ riot situation, forensic research. **Machine Learning** Design and develop AI algorithms for predictive analytics of huge data in this field, train algorithms with data-sets for better service and support, autonomous algorithms for routine support and services, nanobots and testing systems for forensic examinations and research etc., smart AI-systems to anticipate and prevention of cyber attacks etc. **Robotics** Mob control, nano-robots in forensic examinations, weapon control, land, air, sea surveillance, assistance in public emergency like stampede, bomb disposal, fire rescue operations, evacuation assistance, tasks in domestic security system, underground parking and lifts & corridors.

Research and Development

Major Functional Area	AI Possibilities
• Active research. • Documentation. • Analysis. • Training and presentation.	**Data** Gathering, compiling and classifying immense unstructured data.

Major Functional Area	AI Possibilities
	NLP Voice based, multi-lingual smart search engines, translators, handwriting and symbol recognition, voice to text conversion, voice-based command interface for computers. **Computer Vision** Image based search, document recognition, image-based text (photograph) extraction, authentication of documents, dating of documents to find their age, digitization of documents etc. **Machine Learning** Design and develop AI algorithms for search assistants, automated search, instruction-based search, finding patterns, trends and connections among the data-sets, prepare summaries, tabular data, references, bibliographies, glossaries, reckoners and archiving. **Robotics** Space research, ocean research, excavations and archeology related research, environmental research, drone-based research in unreachable areas such as wildlife, underwater, hostile regions, extreme weather condition areas, volcanoes etc.

LEARNING POINTS

- The major capabilities of AI are processing immense data-sets, Computer Vision, NLP, ANN and Robotics
- AI has potential to influence job roles in almost every industry.

KEYWORDS

- **Big data:** Extremely large data-sets.
- **Data-set:** A structured or unstructured collection of values regarding any object, event or transaction.
- **Data-view:** Graphical representation of data-set through dynamic charts, graphs, infographics.
- **Object identification:** Process of identifying a particular object in an image or video such as face in a crowd, number plate of a car jumping red light in a CCTV clip.

- **Facial recognition:** Identifying faces.
- **Satellite imagery:** Dynamic images sent by satellites.
- **Autonomous:** Able to perform a task without external help.
- **Nano-bot:** Microscopic, programmed machines that work in complex environment like human body.
- **Data acquisition:** Process of gathering and compiling data.
- **Data modelling:** Defining data-sets and views.
- **Data mining:** Process of identifying and compiling data useful for analysis.
- **Virtual assistant:** AI-based smart assistant like Alexa and Google Assistant.
- **Voice Command Interface:** A user interface that understands voice commands and instructions.
- **Forensic:** Scientific methods to investigate crimes.
- **SOS:** Save Our Souls – a standard code signal to call for help.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Predicting future trends primarily comes into which of the following capabilities of AI?
   a. Computer Vision b. Data
   c. NLP d. Machine learning
2. Object identification comes into which of the following capabilities of AI?
   a. Computer Vision b. Data
   c. NLP d. Machine learning
3. Which of the following is best suited for assistance in underground rescue operations?
   a. Nanobot b. Chatbot
   c. Robot d. None of these
4. Robotics is helpful in healthcare in which of the following ways?
   a. Nanobots b. Robots
   c. Remote surgery assistance d. All of these
5. Mob control, weapon control, forensic research etc. are AI applications in which domain?
   a. Security b. Healthcare
   c. Transport d. None of these

B. State whether True or False.

1. AI-related jobs are likely to be very few in the industry.
2. Artificial neural networks enable machines to be autonomous.
3. Robots are very expensive hence they are not suitable for rescue or mining operations.
4. Facial recognition is a Computer Vision application.
5. NLP can play a vital role in education and training field.

C. Match the following.

Column A	Column B
1. Education and Training	a. Recommending and comparing products.
2. Healthcare	b. Chatbots and IVRS
3. Entertainment and Media	c. Adaptive and customised content.
4. Customer Support	d. Nanobots for localized medication.
5. E-Commerce	e. Multi-lingual subtitles.

D. Answer the following questions.

1. List any 5 capabilities of AI, one each of its five techniques.
2. How do Computer Vision and NLP help in E-Commerce?
3. How does Computer Vision help in customer support?
4. List any 4 possibilities of AI in education and training field.
5. Briefly describe how robotics can help in various industries.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://www.valuecolleges.com/resources/career-options-ai-robotics/*
- *https://www.bestcolleges.com/blog/future-proof-industries-artificial-intelligence/*
- *https://www.siliconrepublic.com/advice/ai-automation-jobs-future-work*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Create a write up or a 5 slides presentation on **How AI will influence industry?**

2 GETTING READY FOR AI-BASED CAREER

OBJECTIVES

By the end of this chapter you will be able to:

- List 7 major job profiles in AI.
- List technical skills and soft skills for each job profile.
- List the companies which are offering AI-based jobs.
- Indian initiatives in AI.
- Understand the basic career framework for AI Career.

Relating from previous chapter: AI Career Prospects in Industry

Now we know how AI is influencing the career and job prospects owing to its capabilities – immense data handling, NLP, Computer Vision, Machine Learning and Robotics. We also explored some major industry verticals which hold the potential for AI-based career.

In this chapter, we shall explore various skills and qualifications required for AI-based jobs and AI related career path. We shall also discover India's endeavours in the field of AI and, also, about foreign and Indian companies dealing with AI.

Businesses will soon change in operations with AI intervention. When industries will rely on AI, skillful human resource would be required to get it working. For this purpose, a very different kind of skill set and know-how will be required. Let us explore skills, expertise, qualifications and opportunities in AI-based career and jobs.

First, let us prepare ourselves to understand various AI-based job profiles, AI-function areas and skills required.

ACTIVITY: EMERGENCE OF AI-BASED JOBS IN INDUSTRY

Activity goal: Jobs and future skills required that involve AI.

Expected learning: Discover various jobs and career prospects in various fields.

Task 1: Students will form groups of 3 or 4 then pick up (or as allocated by your teacher) one of the following industries – Medicine & Healthcare, Security & Safety, Education & Training, Entertainment & Media, Service & Support, Transport & Logistics. Make a list of various jobs currently emerging in different companies, startups and organisations.

Task 2: Once the job profiles list is in place, for each item (job) in the list, make a list of technical skills (software, tools and knowledge) and soft skills.

The list can be created in softcopy (preferably a presentation application) and presented in the class or submitted to the teacher for open discussion in the class.

AI Job Profiles

The activity done earlier might have informed you well about AI-prospects in industry. Now, let us look at them in a more organized form. The job profiles discussed here are the umbrella terms under

which specific job profiles may vary from company to company due to variety in job requirements and nature of company's business.

AI Business Development Manager

Job description

- Business and technical aspects of AI-based business operations.
- Knowledge of industry trends and product development.
- Work in collaboration with sales and technical teams.
- Define and deploy sales campaigns based on AI/ML.
- Demonstrate to the customer how AI products of the company can help them.

Technical Skills

- Knowledge of cloud services like Google Cloud, Amazon Web Services etc.
- Electronic spreadsheets and any data-modelling application such as Tableau.
- Exposure to AI and Machine Learning environments.
- Preferably IT management and engineering exposure.

Top Educational Qualification

- Masters degree in IT-based business operations, computer science or preferably engineering.

Core Soft Skills

- Passion for customer care and meeting people.
- Extensive communication and negotiation skills.
- Ability to adapt to dynamically changing business scenarios.
- Remember key-product points.
- Ability to understand and overcome customer reaching challenges.
- Team work, proactive planning, anticipate threats, excellent organizational and presentation skills - off-line, on-line and web meetings.

AI Business Analyst

Job description

- Guide in improving processes, products, services and software through data analysis.
- Conduct and coordinate financial, product, market, operational and related research to support strategic and business planning
- Data-driven recommendations after process analysis, requirements identification and assessment.
- Collaborate with business leads and customers to understand data-driven process changes and suggest improvements in their efficiencies.
- Creating a balanced financial and functional view for business improvement (product, services and software etc.)
- Budgeting and forecasting.
- Defining and communicating business requirements to all stakeholders.
- Devising a data-driven road map for the business operations.

Technical Skills

- Data collection and documentations skills.
- Product Life cycle knowledge with basic software development life cycle such as waterfall model.
- Preferably database skills.
- Tools: Office automation tools such as Microsoft Office, Working knowledge of SQL, Google Analytics and Tableau.

Top Educational Qualification

- Professional degree, diploma or recognized certification in Business Analysis.
- Masters in Business Analysis (if one has Business degree or computer science degree).

Core Soft Skills

- Communication and consultative skills, analytical and problem-solving skills, and organisational skills.
- Process modelling and visualization.
- Understanding of various business functional areas.
- Costing, stakeholder management and accurate reporting.

AI Programmer/ Developer

Job description

- Develop applications for AI-based systems and robotic control.
- Work closely with application design team, engineering team and software project managers.
- Requirement based development, enhancement, testing, simulating and getting the code ready for final production.
- Web and app development.
- AI-based UX (User eXperience) and UI (User Interface) developer.
- Developing AI algorithm and agent (any AI object) control program.

Technical Skills

- Knowledge of operating system internals.
- Java/Scala preferably Python and R programming languages.
- Knowledge of C++ systems programming is added advantage.

Top Educational Qualification

- At least bachelor's degree in computer science, software application development, engineering or game development.

Core Soft Skills

- Excellent logical and problem-solving skills.
- Analytical and questioning skills.
- Flair for creativity and innovation.
- Good mathematical skills.
- Ability to work with closer deadlines.

Data Scientist/ ML Systems Researcher

Job description

- Visualise and model complex problems.
- Identifying opportunities through the use of statistical, machine learning, algorithmic and data mining techniques.
- Collaborate with core stakeholders and internal teams for efficient operations and deliver successfully.
- Use tools, applications and analytical techniques to perform predictive analytics and machine learning techniques to solve complex problems and drive business decisions.
- Data modelling and do forecasts for business operations optimisation by drawing conclusions through dashboards and data-views, and by identifying trends and patterns.

Technical Skills

- Working knowledge of analytical projects.
- Knowledge of statistical techniques (classification, clustering, regression etc.) and natural language processing.
- Analytical packages and query languages such as SAS, SPSS and SQL in a business environment.
- Advanced machine learning techniques such as GBM, random forest.
- Coding skills in Java, Python, Scala, R.
- Tools: Microsoft Office and Tableau.

Top Educational Qualification

- Bachelor's Degree in Statistics, Mathematics or Operational Research.
- Preferably a few years working experience in business intelligence or analytics.

Core Soft Skills

- Outstanding communication skills.
- Visualisation, presentations and team dynamics skills.
- Persuasion and preferably negotiation skills.
- Influential and confident personality.

Machine Learning Engineer/ Architect/ Specialist

Job description

- Creating AI-based solutions using various AI Frameworks.
- Choose, plan and implement the right AI-technologies for key business operations.
- Creating AI-based ecosystem for migration of traditional business to AI-powered business.
- Identify risks and constraints in achieving the AI implementation goals and plan accordingly.
- Vast knowledge of AI tools and technology to be able to identify and suggest suitable solutions.
- Keeping abreast with the developments in evolving trends for future innovations and changes.
- Research, design, develop, and modify computer vision and machine learning algorithms and models along with Object detection and preferably NLP ability.
- Building AI team in coordination with HR and Training departments.

Technical Skills

- Several years (at least 8) of technological and project development experience.
- Proven track record of implementing technical solutions for business operations.
- Understanding of business analytics and information systems.
- Knowledge of Machine learning and deep learning approaches.
- Knowledge of relevant programming language preferably Python, R and Java.
- Experience in leading AI Frameworks like Torch, Accord.Net, MS-CNTK etc.
- Knowledge of handling large data-sets (preferably Hadoop, Spark, or BigQuery) and Cloud computing system.

Top Educational Qualification

- Master's degree in computer science with Data Science major.
- Certification in AI-related technology set.
- Preferably a technical project management certification.

Core Soft Skills

- Leadership skills to coordinate and lead multiple teams.
- Outstanding communication, negotiation and analytical skills.
- Deep knowledge of project management.

Big Data Engineer/ Architect

Job description

- Align all IT operations with the goals of the organisation.
- Envision the systems as the source of immense data.
- Understanding of collaborative working of systems, technologies, software being used and to be deployed.
- Plan implementation of Big Data framework in business operations.
- Align data handling requirements for data warehousing and data mining.

Technical Skills

- Big Data tools – Hadoop, Hive, MongoDB, Pig etc.
- Programming tools – HTML5, RESTful, Spark, Python etc.
- Experience of working in Cloud environment.
- Experience in Data warehousing and Data Mining.

Top Educational Qualification

- Master's degree in computer science with Data Science major.
- Certification in AI-related technology set.
- Preferably a technical project management certification.

Core Soft Skills

- Leadership skills to coordinate and lead multiple teams.
- Outstanding communication, negotiation and analytical skills.
- Preferably certification in project management.

ACTIVITY: A JOB OPPORTUNITY FROM FUTURE

Based on the finding of your previous activity and the understanding developed so far, think of a company/ start-up of owned by your team, 10 years from now. Your company deals in certain product or service and plans to adopt AI-based operations and systems.

Then, define a job profile with a designation and create a crisp, concise advertisement covering your company brief, job description, desired technical and soft skills, educational qualifications and any additional, preferable requirements specific to the nature of your company.

Note: Avoid plagiarism from the internet. Take inspiration from online material. Use it with your creativity, vision and ideas to come up with an advert of your own.

Major AI Players in Industry

Let us have a quick glimpse at some major companies and organisations which have already embraced AI and invested heavily on leveraging upon its power in order to get their businesses way beyond competition - to newer heights.

Amazon

- Trading giant Amazon has implemented AI both in customer interactions as well as in business processes.
- Alexa – NLP powered language assistant.
- Amazon Web Services (AWS) – for business intelligence and processes with customers like Tinder, Siemens and NASA.

Apple

- Siri – just like Alexa.
- CreateML tool - to create AI-based training courses.

Facebook

- FAIR – dedicated AI research group working on AI-based tools development for communication and support.
- Facebook platforms already run on AI algorithms for security and better user experience.

Google

- Largest of all, Google has acquired many AI start-ups.
- DeepMind – Prime AI-based Go game world champion.
- TensorFlow – Free Machine Learning development tool.

IBM

- Primary in chatbot and AI-expert systems development.
- Watson – AI expert system which can be integrated into any business system.

Intel

- Invested heavily in AI by buying companies like Nervana and Movidius to develop devices with embedded AI and intelligent IoT devices.

Microsoft

- Cortana – AI-based assistant.
- Azure Cloud services – using and hosting AI-based Machine Learning development tools.

Nvidia

- Graphics processor giant is developing AI and ML powered graphics processing units (GPU) for computers.
- Working on integrating AI with chips in Robotics, IoT devices, Drones and vehicles etc.

Twitter

- Big buyer of AI companies.
- Developing AI applications in Computer Vision, Object detection, sensing etc. for web and mobile devices.

ACTIVITY: BIG AI PLAYERS

Prepare a brief write-up on **OpenAI (openai.com) or Facebook AI Research (FAIR) (research.fb.com)** describing what they do as AI companies.

AI in India

In India, Bangalore and Hyderabad are leading hubs for IT related career and job venues. India has majorly adopted Chatbots, NLP, Object detection and AI business processes.

National Institution for Transforming India (NITI) Aayog's National Program in AI focuses on AI research through AI Taskforce by Commerce and industry department.

Government of India itself is the biggest potential customer for Indian AI start-ups. Instead of entertaining foreign giants, GoI can create formal opportunities for domestic players in providing AI0based services for governance in India and to improve public services through AI.

Currently, NITI Aayog's Data Analytics Cell is involved in AI research focusing on agriculture development through satellite imagery, weather data analytics; AI in radiology and pathology research; complete language processing system for Indian languages to fill language gap among departments and citizens.

The education departments and boards have already taken initiatives to introduce and integrate AI in educational systems and in all subjects. In addition to this, sufficient and suitable courses, like this one, to enable capacity of learners in AI to make them future ready for AI opportunities are already in roll out.

Challenges for AI readiness in India

Lack of awareness and expertise: AI is new to India. We are more of users and clients than developers in this field. People, especially aspiring youth are not properly aware about it and need structured, formal system and policies to be trained in this new trend.

Lack of computing infrastructure: Being a highly advanced and immense data-driven technology, the infrastructure (equipment, software) required for training, research and developing AI-based solution is mostly in the hands of private players and is scattered (not organised). It needs to be managed by strong and efficient government policies and frameworks. Rapid efforts are ongoing in this regard.

Inaccessibility of enough data: Data required to analyse AI potential in all fields, welfare and career prospects is not available in a structured form. Expertise, systems and abilities to compile and analyse such immense data is needed to drive AI-initiatives with full force. For example, how AI can be helpful in improving nutrition of school going children or how all teachers can be empowered with AI-knowhow to improve in their profession.

Indian AI Companies

Manthan	AI-based analytics in retail business. Maya – NLP based business assistant.
Haptik	AI-based enterprise chatbots. ML-based business solutions on Amazon Web Services.
SigTuple	ML-based medical diagnostics. ML-based automated microscope.
Arya.ai	AI solutions to service industry – banking, healthcare etc. Vega – a deep learning algorithm development tool.
Flutura	Big data analytics. IoT based solutions for businesses. Cerebra – business value tool for energy and engineering businesses.
Bash.ai	AI-based assistants. chatbots in automating HR systems.
Niki.ai	AI-based shopping assistant and chatbot. ML-based solutions for online ordering and transaction.
ValueCoders	AI, ML based software development.
ArStudiouz	AI based digital services.
PixelCrayons	Customised AI-based web services and mobile applications.
Prolitus Technologies	Automating start-ups and Small & Medium Enterprises (SMEs) with AI solutions.
Webtunix	Data science consultants, services in data analytics, data mining, NLP, image processing, object detection.

ACTIVITY: INDIAN AI COMPANY

Go online and compile information on any Indian start-up or company which is working remarkably in the field of AI. Prepare a one page write-up covering its history, about its leadership (founder, owner or CEO), market performance and products & services it provides.

Basic AI Career Preparedness Framework

Seeking career in Artificial Intelligence and Machine Learning, demands top-notch skills set in diverse fields and subjects. Here is a basic framework which will help you plan your future efforts for AI-based career.

Basic Subjects	Science, Mathematics (Alternative stream: Commerce, Statistics and financial arithmetic).
Higher Specialisation	Computer Science, MCA, MBA with Business Intelligence/ Informatics.
Programming	At least 2 relevant programming languages – primarily Python and R. Preferably Java.
Data Handling	Database applications MySQL, Oracle, DB2 etc., Google Analytics, Tableau, Scala etc.
Machine Algorithm	ML Tools like TensorFlow.
Cloud Computing	AWS, Google cloud etc.

- AI offers a variety of job profiles and career opportunities in all major industries.
- Overseas companies, such as Google, Amazon, Microsoft, Facebook etc. have taken bigger initiatives in AI.
- India's NITI Aayog's taskforce is working on AI initiatives.
- Many AI start-ups and companies are doing well locally and overseas.
- AI career preparedness requires skills in Math, Computer science, programming, data handling, cloud computing and machine algorithm.

- **Business operations:** All the functions of a business that are used to run the it such as finance, management, production, sales, etc.
- **Industry trends:** Major happenings in industry which create new opportunities and changing ways in the working of industry.
- **Collaboration:** To work as a team and in coordination with others for a common goal.
- **Deploy:** To put to work or to implement the execution of some task or to post personnel for some task.
- **Cloud:** Technology term to refer to that functionality of internet which allows companies to offer robist (crash-proof), secured and fast online services (software & database) and infrastructure (servers, data storage) to other businesses on demand-basis.

- **Data modelling:** Creating visuals out of data in the form of charts and graphs.
- **Process:** Defined, standard way to do a task.
- **Product:** Tangible, useful output of manufacturing and design.
- **Service:** Intangible support such as training, travel service, hotel service, healthcare etc.
- **Strategic:** Key planning for driving towards set goals successfully.
- **Data-driven:** Based on data, output generated after data analysis.
- **Requirements identification:** Understanding what is expected of the system to be developed.
- **Financial view:** A visual that shows how system is doing in terms of money (profit, loss and usage)
- **Functional view:** A visual that shows how a system works.
- **Budgeting:** Allocating funds to different parts of business to utilise.
- **Forecasting:** Predicting how things will happen in future such as sales, profits, new customers etc.
- **Stakeholder:** Involved as integral part of the business or system including beneficiary of it. E.g. teachers, student, parents and management are stakeholders of a school.
- **Roadmap:** A clear (preferably visual) plan of activities to do to achieve set goals.
- **Product life cycle:** Life span of a product since designing till it is used and discarded due to new product. E.g. Windows XP replaced by Windows 7 which is replaced by Windows 10.
- **Waterfall model:** A model that describes activities in which next activity begins when previous is completed (sometime a few activities occur together).
- **Office automation:** A process to add efficiency, speed and accuracy to business tasks. E.g. using MS-Office in business operations.
- **Costing:** Estimating right cost of any product or service considering all expenses done.
- **User eXperience (UX):** The ease and friendliness with which a user works with a graphical system like app or website.
- **User Interface:** The graphical user interface provided to user to use the offered services on website, app or software application etc.
- **Operating system:** Software that controls the functioning of entire computer system, software, data and acts as interface between user and computer system. E.g. Windows, Linux, iOS, Android etc.
- **Analytics:** Analysing data-sets for diverse purposes.
- **Predictive analytics:** Analytics done to see patterns and trends in data and forecast future trends out of it.
- **Optimisation:** Improving design or function using same available resources. E.g. Suggesting better ways to do something quickly and accurately.
- **Framework:** Set of standards, tools and technology to develop or do something.
- **Platform:** Combination of operating system and hardware.
- **Embedded:** Built-in, made part of, loaded with.
- **GPU:** Graphics processing unit - processor to perform arithmetic required to generate and handle computer graphics. Used in games and visual effects industry.

LIFE SKILLS ASSESSMENT

Teachers are requested to assess the students and debrief them on the basis of activities conducted in this chapter. We do not recommend any written assessment for this chapter since it is focused more on awareness-generation and realisation of AI's potential in career building.

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://www.common.org/careers/ai/*
- *https://www.computersciencedegreehub.com/faq/skills-job-artificial-intelligence/*
- *https://www.valuecolleges.com/resources/career-options-ai-robotics/*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Prepare a 1000 words write-up or a 5 slide presentation on ***AI career prospects in game development, robotics or film making***.

https://ai.google/education/social-good-guide/?category=examples

UNIT 5: AI ETHICS

Unit Introduction

This unit focuses on looking at two broad aspects of artificial intelligence – promises and threats. With every new innovation, possibility and technology, come both pros and cons. We shall discover the good promises AI makes and the possible threats AI might have brought with it, and if yes, how to deal with them.

1 ARTIFICIAL INTELLIGENCE AND ETHICS

OBJECTIVES

By the end of this chapter you will be able to:

- Understand ethics and how it relates with AI.
- List at least 10 differences between traditional programming and AI development.
- Understand 7 characteristics of good AI.
- Understand 4 major ethical challenges with AI.
- Understand ethical AI framework.
- Understand the economic aspects of AI.

A set of governing moral principles is called ethics.

Ethics and Existing Systems

The principles and morals that govern someone's behaviour is referred to as ethics for that individual. If the set applies to a group or organization, it is called ethical guidelines for them.

Ethical principles serve as a guideline to distinguish between wrong and right while making decisions or doing something. For example, I may have freedom to walk with a stick rotating in my hand. No harm. But I shouldn't do it on a crowded road or more realistic scenario is of a deserted road with occasional traffic but I still wait behind the driving wheel for the traffic light to turn green though I could've have jumped red light without causing any harm to anyone or simply, when we put our smartphone on vibration in a hospital or movie hall.

So, ethics are moral obligations that we must comply with.

Artificial intelligence is fast in nature, vast in scale and impactful on industries and society. So, like anything fast, vast and powerful, it has potential to cause benefit and harm as well. When AI outcome or predictions will cause benefit, it is good AI, and if harm, then it is unethical AI.

AI is being developed by humans to impact humans finally. The developers and service providers of AI bear the responsibility of its negative aspects. It is for them to make ethical considerations related to the capability of AI and its impact on society and environment up to some extent.

Existing computer programming and software development systems are already governed by codes

and guidelines of ethics. Below is a comparison of traditional programming and AI/Machine Learning. This will clearly show that existing ethics guidelines are not sufficient for AI due to its vast, dynamic and complex nature and its possible deep impact on existing systems.

Traditional Vs AI Programming

Traditional Programming	AI Development
The program is based on a finalized algorithm which is fixed for one or more versions of the program.	Algorithms are dynamic and designed to learn from the data.
Data is required to be processed for desired output.	Data is needed for two purposes broadly: i. to train the machine and ii. To analyse.
Basic approach is linear that is Input-Process-Output.	Basic approach is cyclic that is input-train-analyse-predict-train and so on.
Data is mostly structured and well classified.	Data is unstructured with several variables needed to train the system.
Mostly works with complete data entity such as number, text or image.	Can work with a part of entire data such as a face in a group photograph.
Used to develop automation and productivity applications.	Targets to add efficiency and intelligence to existing and future systems.
Requires training from fundamentals of computing. Does not require prior programming knowledge.	Requires good knowledge of programming, database systems and other related technologies.
Forms a vast field of computer science and computer applications.	Integrates computer science, data science, statistics, math, research and business intelligence.
Follows development models such as Waterfall, Spiral, Agile etc.	Has potential to impact traditional development models to make them smarter.
Deals with a limited size of data. Bulk data is processed in batches.	Deals with complex, dynamically changing and growing immense amount of data collectively called Big Data.

ACTIVITY: AI IN LIGHT OF ETHICS

Visit the following URLs and watch the videos:

https://www.youtube.com/watch?v=vgUWKXVvO9Q (3 min.)

https://www.youtube.com/watch?v=mJ6rjJiIHyo (3 min.)

https://www.youtube.com/watch?v=iZjWEVkDrHY (2 min.)

List the points and discuss how AI could be harnessed for good of all.

The Good AI

An ethical AI system must be developed around the ethical guidelines of a society or people it is going to influence. An ethical reference is a must in place while developing intelligent machines and conceiving their relationships with humans. Ethics work on mutual trust. Human-machine interaction must be within the borderline of such ethics – trust, values and morals. While developing AI-based systems to serve people, consideration must be in practice that it must not compromise the basic ethical boundaries established by society or target group of intended AI users. For example, an NLP based AI assistant must not listen to every conversation you make unless it is activated by the 'wake' command-word.

Keeping with ethical guidelines, power of good AI can be harnessed in following ways:

Optimum use of the present system: Today we have immense data generated during the course of several decades of computing. We also have computers with huge processing speeds. These are two basic prerequisites for AI. Our systems can be utilised to tap into revealing the opportunities hidden in immense data-sets. This was not possible until AI emerged. AI can help us reveal facts and information locked in immense data with super-speed and take quick decisions for the growth of industry, society and economy. The speed and accuracy of predictions, creating data-visions, object detection, language processing etc. can help us achieve a lot which would otherwise take several years.

Enhancing human potential: AI will increase human productivity multi-fold. Trained algorithms function as new tools for humans to achieve which was not possible earlier. Possibilities are many – autonomous system monitoring and autonomous execution of complex tasks. This frees skilled human mind and hand to create, produce and achieve more. Augmented algorithms add efficiency to the system.

Addressing the nonaddressable: The problems which required handling of huge data to find a solution are now addressable. Problems related with society – poverty, hunger, education etc.; with economy – inflation, recession, demand-supply gap etc.; and problems related with environment – global warming, pollutions, draught etc. demand the analysis of huge data-sets which is now possible by training the AI algorithms to show us patterns and trends to make strategies to address these problems more effectively.

Enriching human life: Smart homes, schools, hospitals, cities and infrastructure powered by Internet of Things (IoT) and Machine Learning add value to life making the places livable, workable and sustainable. AI offers potential to augment the capabilities of humans in fields like healthcare, efficient distribution systems for facilities and services.

Working towards equity: Bringing AI and big data together can help explore efficient ways to bridge the gap between the haves and have-nots. AI can help promote and sustain equal treatment of all classes of society by creating innovative means and solutions which were not possible earlier.

Easing conflicts and uplifting harmony: Data is the new currency of the world. Countries who know to acquire their data, model it well and use it with AI ethically will prosper but no country can prosper alone today. AI has the potential to shape the world economy in such a way that instead of resorting for war and other nefarious means, countries will opt for resolving conflicts, iron-out differences and practice harmony to grow together.

Giving back to mother earth: AI-powered data handling, predictions and systems can act as a vehicle to bring us to green economy faster. Better societies, sustainable means of living and improved quality of agriculture can help in arresting the ill-effects of pollution, global warming, climate change and other issues related with environment abuse.

Ethical Challenges with AI

Despite promising good influence of AI on humans and environment, the big question is – how it must happen? How do we ensure that the new power in our hands would be used really in an ethical way?

What are the gray areas which we need to identify and make provisions to handle them carefully to ensure ethical AI?

Accountability: Who will be held responsible if AI does not bring desired results or turns out to be harmful in different ways? How the accountability of a learning machine would be set? Can an autonomous vehicle be blamed if it runs over a pedestrian around the corner during an early foggy morning? Who is to blame – owner of the vehicle, developer of the AI system, manufacturer or the victim? System and policies need to be in place to determine accountability for every possible scenario.

Transparency and bias: An AI-powered system with learning algorithm will be able to decide a course of action for a task out of many alternatives. How will it be determined that its choice was ethically right? In a recruitment process, an AI-machine, shortlisting candidates on the basis of their personality traits will perform the selections judicially is to be ensured by the developers of the system. Machine will mimic what it will learn from the data given to it. The accuracy, versatility and richness of that data needs certain data-quality checks. A biased AI system can unfairly discriminate or produce discriminatory results. Eliminating candidates during job-selection who did not have "preferable" qualifications/ skill just because the data used to train it did not have a single case of that "preferred" qualification/skill. This is another example of bias by AI system.

- **Pre-existing biases:** Our current systems already have biases up to some extent which come from our societies over several years. For example, if police had not registered complaints of a particular segment of society and this data-set trains an AI system then it will tend to give lower priority index to such cases as they appeared very less in number in past while actually, they should be treated with equality.
- **Technical biases:** Such biases may creep into the system consciously or unconsciously by the flaw of logic. A reservation system may tend to slow down due to higher number of requests from a particular region thereby making everyone wait longer than usual to book a seat or an AI-system failing to recognise the desired object in an image and rejecting it just because data-set used to train it had no sufficient details for that kind of object.
- **Emergent biases:** These biases occur when system comes in use. For example, a user interface system for fixing doctor's appointment is too difficult to use by physically challenged persons or senior citizens. Another example could be a learning system that does not allow student to move to next level until previous module is completed successfully thereby discouraging an average student.

Better and efficient testing system need to be introduced in the design and development life cycle to detect and filter biases. Diverse and huge data-sets with variably rich values should be prepared to train AI-systems. The data acquiring and modelling process need to have sufficient quality checks.

Security and Privacy: Will it be difficult in future to predict up to what extent an AI system would learn and become a threat instead of utility? Think of an AI-system that could devise ways to hack into user accounts after getting trained with the rich data-sets. Possibilities are there. AI integrated with IoT needs care as it is deployed for domestic and public security. Possibilities of false alarms, auto-locking due to logic malfunction, blockage of access to a vital service (e.g. ambulance) due to machine flaw are very much there. Issues related with cybersecurity, cyberbullying and data-theft need to be

addressed with different perspectives.

Compromise with individual privacy in the name of data-acquisition, surveillance and a check on right to liberty, data protection breach and copyright breach are certain issues which need to be ethically balanced while developing AI systems. For example, how an AI system be assessed for plagiarism which generates articles and writes books after reading thousands of similar articles and books?

Decision making, common sense and human values: Harms caused due to unjust decisions, uncalled for actions and lack of decision-making capability in a learning machine may create more problems than the solution it provides. How can we be sure that an AI-system showing trends that help government devise upliftment policy for drought-prone areas is efficient enough to reflect all possible angles in the data-view? Another example is of a sinking ship, where on AI system locks the door preventing water to flood the rooms while the other system tends to open the same doors due to rising smoke. How AI-systems will imitate common sense and take care of human dignity and values.

ACTIVITY: AI OR NO AI?

This activity should be done in groups of 4 or 5. Some teams will be speaking in favour of AI and rest against it with reference to the selected application area from those listed here.

- Healthcare
- Security and privacy
- Education and training
- Transport and Logistics
- Entertainment and media
- Services

Ethical Framework for AI Development

Forums such as AI4People and organisations such as Institute of Electrical and Electronics Engineers (IEEE) which are dedicated to technical advancements with social benefits have already been working on AI ethics.

An ethically aligned design for AI addresses following principles:

- Human rights – AI systems should respect, promote and protect human rights.
- Well-being – AI developers should be responsible to keep human well being in central focus for a successful AI system.
- Rights related to Data – People should have rights and means to control and share their data. Right to individual identity of anyone should not be breached.
- Effectiveness – AI system should be robust and not prone to hacks and crashes.
- Transparency – The working and data processing functionalities of AI systems should be discoverable and investigable as and when required.
- Accountability – AI system should have a base of rational guidelines governing its working and decision-making.
- Awareness of misuse – Provisions must be there to prevent AI -system from misuse.

- Competence – The AI developers should possess right and sufficient knowledge and skills required to develop intended AI system.

The above principles have been collected from standards.ieee.org.

https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/ead1e.pdf?utm_medium=undefined&utm_source=undefined&utm_campaign=undefined&utm_content=undefined&utm_term=undefined

Policy Framework for Good AI

Government's world over are working in devising effective AI policies that govern the AI revolution in their countries in order to ensure benefits and minimize risks to society, economy and environment.

A possible policy framework outline is given here:

1. Existing human rights policies need revision and any new policies need inclusion of ways to protect privacy, dignity and freedom of people and to check that these human right principles are not compromised. This will ensure trust among people for the emerging AI technologies.
2. AI should target growth of gross domestic product (GDP) as one if its development principle since it is directly related to the overall growth of people and nation.
3. Detailed policies and means are needed to develop that ensures that people have access to their data and that their privacy is not compromised, their data is secured and they are able to share and own their data autonomously.
4. Benchmarks and testing systems should be devised to ensure the effectiveness of the AI systems in terms of performance, robustness, security, data quality, human resource deployment of systems and their future upgrades.
5. The AI systems should be transparent so that they could be easily tested, measured for performance and investigated for diagnosing and fixing faults and to investigate data-sets.
6. Laws to ensure responsibility, liability of and for the AI systems especially when a system malfunctions, breaches human rights or causes more harm than the intended benefits.
7. New guidelines to be created to decide who should be the stakeholders in an AI system and its ecosystem.
8. AI system developers should ensure that chances of system misuse are minimized or completely checked. Ensure that users are aware of its misuse, consequences and issues and are able to use the system safely.
9. Policies and guidelines for developers to specify who should be able to use the system or how the system should be used. Also, how to incorporate safety features to ensure that system does not crash, malfunctions or goes down if someone uses it incompetently.

The Economics of AI

AI will be used both in enhancing existing systems and to build new systems from scratch. The economics of AI involves two broad questions to be answered:

1. What value will it add or benefit will it bring to all stakeholders?
2. What will be the expenses for intended value addition.

AI is no cheaper proposition. It needs high level of expertise in every phase of development,

sophisticated tools and software, state-of-the-art hardware and other infrastructure, immense amount of data for machine training, training of personnel, costs involved in system development and project management.

If the sum of all value additions and revenues seems to exceed remarkably the sum of all the above expenses then AI alternative is worth giving a try.

Generally, AI cannot be taken up like the development of a customized software application for any business or general software applications for industries. AI products are available in the form of an entire ecosystem comprising of various hardware and software technologies from which customers can be helped to pick their business solution.

Organisations like Google, Amazon, Microsoft etc. have developed a diverse, general ecosystems for AI available in the form of Cloud computing. Depending on the client company's requirements, the tools, equipment and storage services are customized, consultation and support services are provided for the deployment of the system and project management approach is followed to integrate the AI system with company's existing system, collect and model data for machine learning and train the human resource and customers (if required) to be able to work with AI system.

The costs are involved at customization level considering the requirements of the client company. The benefit of this approach is that the cost for standard development of AI system is saved. Most expenses occur in integration of existing AI technology with client's system. The core technology remains unchanged. By the help of software interfaces, programming interfaces and other integration techniques AI is introduced in the existing system.

For example, to use a chatbot, a bank does not change the way it functions or replaces any major software components already in use. This saves a lot of cost.

Another example of economical AI implementation is NLP based assistant (Alexa, Siri etc.). They can be easily integrated with existing customer support services. The basic algorithms of language processing remain the same. They are just being reused. AI solutions are basically reusable components which can be deployed for various requirements with customisation costs.

LEARNING POINTS

- The principles and morals that govern someone's behaviour is referred to as ethics.
- Ethical principles serve as a guideline to distinguish between wrong and right while making decisions or doing something.
- Traditional programming is different from AI Systems development in approach, technology and expertise.
- An ethical AI system must be developed around the ethical guidelines of a society or people it is going to influence.
- Ethical issues with AI are accountability, transparency and bias, security and privacy, human rights and values.
- An ethically aligned policy design for AI is a must.
- Efficient AI policies ensure benefits and minimize risks to society, economy and environment.
- The major capabilities of AI are processing immense data-sets, Computer Vision, NLP, ANN and Robotics
- AI has potential to influence job roles in almost every industry.

KEYWORDS

- **Ethics:** A set of governing morals and principles.
- **Augmented system:** A system that learns from its interaction with humans (or other machines).
- **Bias:** Discriminate on certain basis or being unfair.
- **Gross Development Product (GDP):** A widely accepted parameter to assess a country's economic growth.
- **Customised:** Having features suitable to particular requirements of a customer.
- **State-of-the-art:** Newest, very recent.

CONCEPTUAL SKILLS ASSESSMENT

A. Choose the correct answer.

1. Ethical principles serve as a guideline to distinguish between _____ and _____.
   a. Pass, fail
   b. wrong, right
   c. success, failure
   d. Any of these
2. The _____ and service providers of AI bear the responsibility of its negative aspects.
   a. Developers
   b. Users
   c. Investigators
   d. All of these
3. AI can help us reveal facts and information locked in immense _____.
   a. Server
   b. Database
   c. Data
   d. Algorithm
4. Data is the new _____ of the world.
   a. Threat
   b. Buzzword
   c. Slogan
   d. Currency
5. Ecosystems for AI are available in the form of _____ computing.
   a. Data
   b. Cloud
   c. Python
   d. Machine

B. Categorise the following statements into *Traditional Computing* and *AI Development.*

1. The program is based on a finalized algorithm which is fixed for one or more versions of the program.
2. Data is needed for two purposes broadly: i. to train the machine and ii. To analyse.
3. Data is unstructured with several variables needed to train the system.
4. Targets to add efficiency and intelligence to existing and future systems.
5. Requires training from fundamentals of computing. Does not require prior programming knowledge.

6. Requires good knowledge of programming, database systems and other related technologies.
7. Forms a vast field of computer science and computer applications.
8. Integrates computer science, data science, statistics, math, research and business intelligence.
9. Deals with a limited size of data. Bulk data is processed in batches.
10. Deals with complex, dynamically changing and growing immense amount of data collectively called Big Data.

C. Answer the following questions.

1. What do you mean by ethics? Explain briefly why ethics is important with AI development?
2. List any 5 differences in traditional programming and AI development.
3. List any 5 ethical characteristics of good AI.
4. Briefly explain transparency and bias issue related with AI.
5. List any 4 major ethical challenges related to AI.
6. List any 4 Ethical framework principles for AI.
7. In a brief paragraph, explain how a policy framework for good AI will help in establishing ethical AI.

LIFE SKILLS ASSESSMENT

Information Highway – *Self-paced Learning, thinking skills, creativity*

- *https://iopscience.iop.org/article/10.1088/1757-899X/392/6/062188/pdf*
- *https://www.wired.co.uk/article/artificial-intelligence-ethical-framework*
- *https://standards.ieee.org/industry-connections/ec/autonomous-systems.html*

Experiential Learning – *Teamwork, communication, presentation, critical thinking, decision making, problem solving, leadership*

Visit the following link and create a write-up or 5 slide presentation on Top Ethical Considerations with AI.

https://www.logikk.com/articles/8-ethical-questions-in-artificial-intelligence/

AI PROJECT

Train A Computer

This project will give you a simple experience of how machine algorithms are trained with data and how they perform the desired task based on the training. This is called supervised machine laearning since you are telling the machine what it is supposed to do with the data.

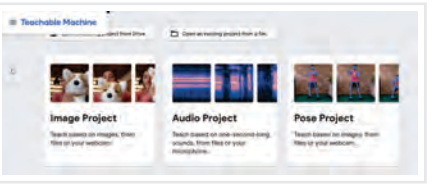
In Teachable machine project, we are takin up image project to train the machine algorithm in identifying some image. After training, the machine will be able to identify and match the image shown through the web cam if a match is really found.

A. PREPARING AND UPLOADING THE DATA

Follow the steps given in the sections below:

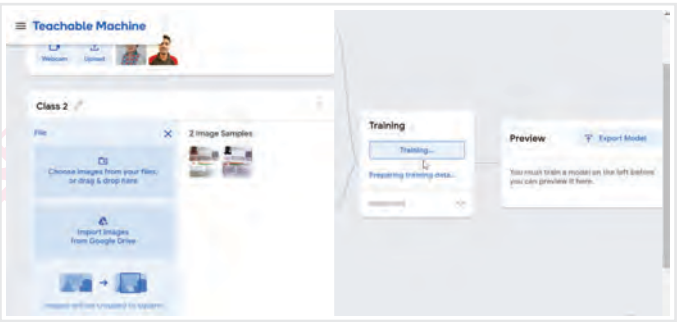
Arrange a dozen of images of which 4 should be yours and rest of other people. Then upload the images following the steps given here.

1. Visit https://teachablemachine.withgoogle.com/ and click on **Get Started.**
2. Click on **Image Project**
3. Upload 6 images in each class (Class 1 and Class 2) one-by-one by clicking **Upload button.**

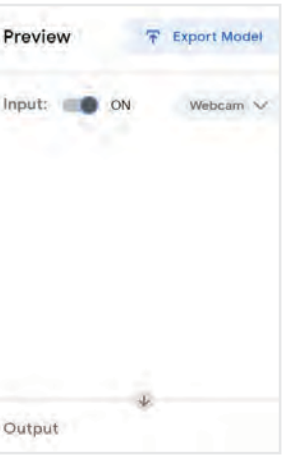


B. TRAIN THE ALGORITHM

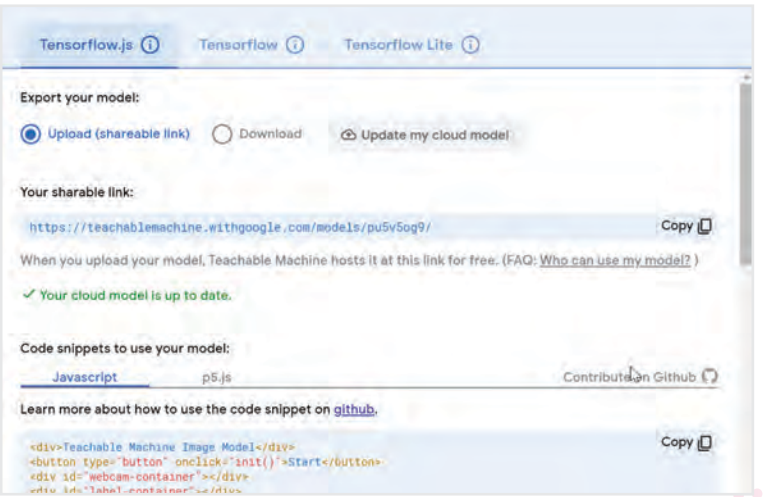
1. When all the images are uploaded, click on **Train Model** button. It will take a while to train the algorithm with the uploaded images.



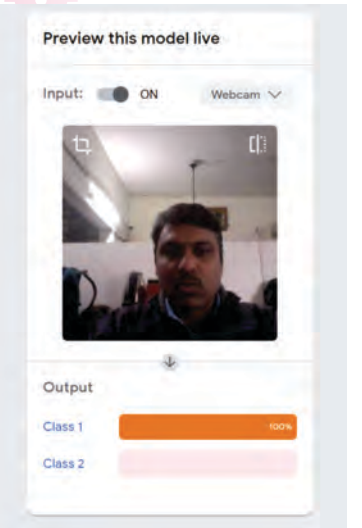
C. EXPORT AND TEST YOUR MODEL



1. After training, click on **Export Model** button.
2. In the popup, Click on **Update my cloud model**. A link to your teachable machine will be created.
3. Copy this link and paste it in new browser window to test.



Note: During the test, webcam should be on and working. The machine algorithm will try to recognise your face with the trained data and tell you how much percentage your face match was found. Also, try any other different printed image in front of web cam or ask a friend to show his/her face in the web cam. See if algorithm is able to tell that the match was not found.



WAY AHEAD

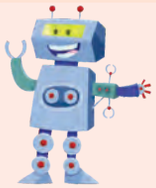
Similarly, try out **Audio project** and **Pose projects** also. Have fun!

INFORMATION SEARCH AND ANALYSIS SKILLS PROJECT

Visit any 10 (or more) of the following URLs and prepare a project report or presentation on AI-powered real-life applications covering the following:

- Details and features of AI application/tool
- Profile of the developer company
- Impact of AI application/tool

- https://builtin.com/artificial-intelligence/examples-ai-in-industry
- https://www.irobot.com/
- https://www.dw.com/en/saudi-arabia-grants-citizenship-to-robot-sophia/a-41150856
- https://www.youtube.com/watch?v=SraNMzbi_G4
- https://heyolly.com/
- https://builtin.com/artificial-intelligence/robotics-ai-companies
- https://learn.g2.com/ai-in-healthcare
- https://www.pathai.com/
- https://pager.com/
- https://www.atomwise.com/
- https://blogs.nvidia.com/blog/2018/02/26/ai-radiology-machine-learning-global-impact-awards/
- https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare
- https://www.betterment.com/
- https://www.alpha-sense.com/
- https://builtin.com/artificial-intelligence/ai-finance-banking-applications-companies
- https://econsultancy.com/blog/67894-what-are-chatbots-and-why-should-marketers-care/
- https://www.theverge.com/2018/5/10/17340004/google-ai-maps-news-secret-weapon-remaking-old-apps-products-io-2018
- https://www.washingtonpost.com/technology/2018/07/17/facebook-boosting-artificial-intelligence-research-says-its-not-going-fast-enough/
- https://www.bernardmarr.com/default.asp?contentID=1373
- https://www.technologyreview.com/s/609319/slack-hopes-its-ai-will-keep-you-from-hating-slack/
- https://medium.com/@bitrewards/ai-and-e-commerce-how-artificial-intelligence-is-revolutionizing-the-sector-9fb9f0a50591
- https://en.wikipedia.org/wiki/Amazon_Alexa
- https://www.wired.com/story/amazon-artificial-intelligence-flywheel/
- https://contentmarketinginstitute.com/2017/08/marketers-use-artificial-intelligence/
- https://www.twiggle.com/why-twiggle



My Dream Book of ARTIFICIAL INTELLIGENCE

CBSE CODE 417

Class VIII

Artificial Intelligence is the fuel of the future. Its subsets – Machine Learning, Deep Learning and regression have the power to revolutionalise the way industries function. It is also going to influence economic growth and social development.

My Dream Book of Artificial Intelligence series is developed for classes VI and VII to introduce the children with the basics of artificial intelligence in an exciting way through lots of fun and engaging activities. The purpose of this course is to engage young minds to prepare easily to learn emerging technology as they grow and move to higher classes. The series is designed considering the recommendations done by CBSE to integrate AI at different levels. This short course can be taken up by the students to prepare for a different line of career in future.

This series is an extension to the endeavours by CBSE in creating the ecosystem for skill-based education under National Skills Qualifications Framework propounded by Ministry of Skill Development and Entrepreneurship.

My Dream Book of Artificial Intelligence series is the most suitable series for teachers as well as the students who see AI is a vehicle to great career prospects. This series enables the young learners to understand AI in easy and interesting form through activities, mini projects, games, online assignments and classroom interactions. Following are the series highlights:

- **Objective:** Preparing young minds to explore about AI, its applications and related technologies in easiest possible way.
- **Skill development:** Developing skills like problem understanding, creative thinking, critical analysis and problem solving.
- **Challenge-based activities:** Engage students in solving puzzles and accomplish tasks to explore understanding about human intelligence and machine intelligence.
- **Mini Projects:** Small, workable projects to assimilate learnt concepts easily.
- **Fun Facts:** Keep the interest of the learners in the lesson and rouses curiosity to learn more.
- **Game Development with Python Turtle:** Inculcates programming and logical techniques through simple game.

Edusoft Smart App download requisites

- A smart phone with authentic Google Play Store account.
- An Internet connection - preferably 3G or higher.

Steps to download the Edusoft Smart App

1. Download the Edusoft Smart App from the Google Play Store and install on your phone.
2. Tap on Edusoft Smart App after installation.
3. Tap on **Add-on** button and scan the **QR Code** on this page.
4. Once the book downloads, tap on the book's name and immerse in an amazing digital experience.

Note: *After download, the book can be used offline also.*

"Is artificial intelligence less than our intelligence?"

— Spike Jonze aka Adam Spiegel (American filmmaker)

Skill India कौशल भारत-कुशल भारत

स्वच्छ भारत एक कदम स्वच्छता की ओर

Digital India Power To Empower

VOCAL FOR LOCAL

Edusoft IT Solutions Pvt. Ltd.

Regd. Office : KD-231, Pitampura, Delhi- 110034

Ph.: +91-11-27043431, +91-9136792617

Email: info@eduitspl.com, **Website:** www.eduitspl.com

Printed at : Kaveri Print Process Pvt. Ltd., Sec-65, Noida.

ISBN: 978-81-944640-0-6

MRP: ₹288/-