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.

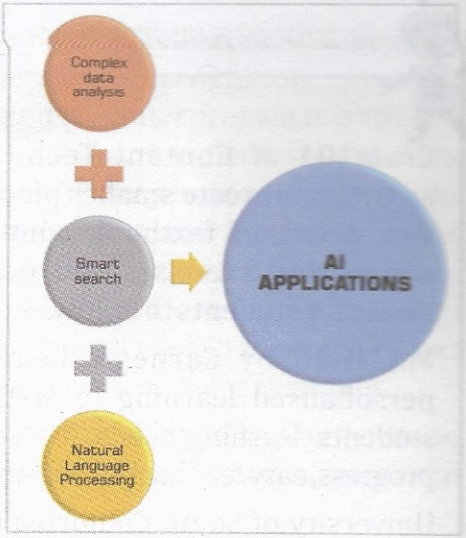
Let us look at some major areas where AI is playing a distinct role.

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.

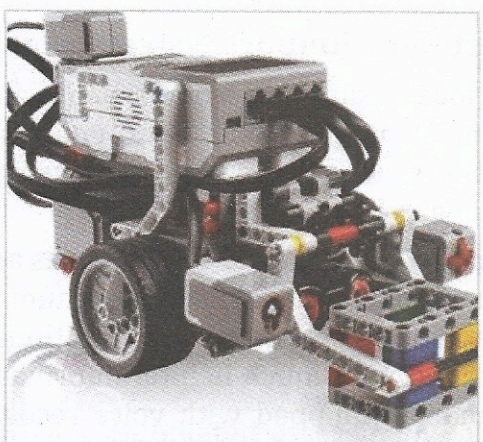
A machine can be developed with algorithms to learn ordinary tasks. Then this learning can be used to learn formal tasks and finally, machine can develop algorithms to perform expert level tasks.

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.

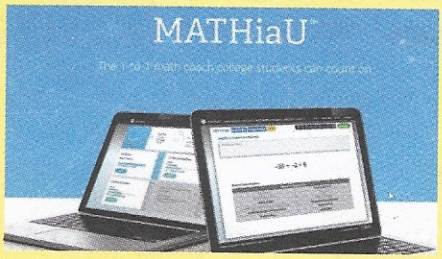


Lego EV3 Robot to learn robotics coding

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.

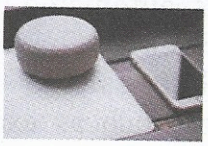
Integration of AI with other technologies such as Cloud can make smart education reach in remote areas.

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.

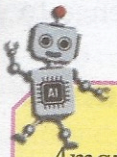
Robots: AI-driven autonomous, intelligent robots in public areas, homes, schools, industries, restaurants, hospitals etc. enhance public assistance and can minimize threat to human lives such as underground constructions, mining, oil-extraction, heavy-machines operations etc.

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.

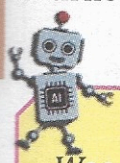
Social Media Platforms, News and Entertainment

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.

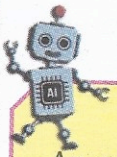
Public transport: AI systems can control city transport systems such as Metro rails, taxis and buses. Some common uses are: routing of vehicles, smart traffic control minimizing congestion, security and, disaster prevention, smart parking, crowd control and time management etc.

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).

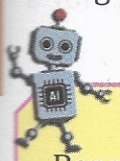
Robotics is the primary emerging field in this industry. Robotics will, then, pave the way of its applications in other industries. In 2017, more than 3000 robots have been purchased by Indian companies – automotive, hospital and defense as major players.

AI IN EDUCATION

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

Research and Development

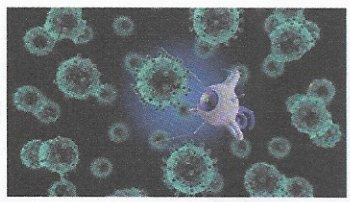
AI has tremendous potential to impact research and development in all the fields such as public health, automobile, environment & ecology, life sciences, education, defense, social crises – poverty, hunger, homelessness and crimes. There are many more such industries where AI-driven research can play 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.

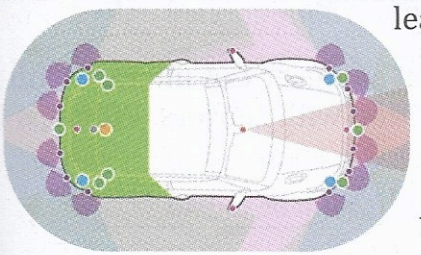
Other Potential-AI Applications



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.

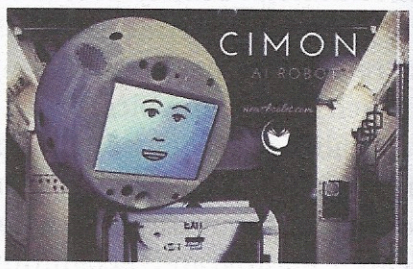
Photo-based search: This capability of AI is called Data Vision which will revolutionise E-Commerce, crime detection and research.

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.

Column A	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?**.