# **Part I**

## The fundamental aspects of AI:

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|  | **AI** | **Machine Learning** | **Deep Learning** |
| Definition | A broad term of creating intelligent systems that can mimic human intelligence and can reason, learn, and act autonomously | A subset of AI that focus on algorithms and models which training from data and make predictions without explicit programming. | A subset of ML that focuses on building neural networks which can have many layers and make predictions based on it. Neural networks are inspired from human brain. Deep learning can deal with any type of data, and it gives good result in dealing with images and videos. |
| applications | Robots, autonomous cars | Fraud detection, spam filtering | Image classification, speech recognition |

* Definition of Artificial Intelligence:

Artificial Intelligence is the science of give the ability to machines to perform and do tasks that require human intelligence, like learning, problem solving, and decision-making. As it is through this field that it is possible to create systems capable of learning, thinking, solving problems, and making decisions, and this is done by combining computer science, mathematics and cognitive science.

The invention of the foundations of artificial intelligence (AI) was in the 1940s. In 1956, the phrase "artificial intelligence" was first used, which sparked the emergence of the subject as an area of study. Between the 1950s and 1970s, considerable advancements were made in the development of chatbots and human-like robots. Due to lack of financing and lackluster interest, there were two "AI winters" in the late 1970s to early 1980s and the late 1980s to early 1990s. In the 1980s, the advent of expert systems sparked a resurgence in interest in AI studies. Artificial intelligence has advanced significantly since the 1990s in many fields.

Modern artificial intelligence systems are developing due to advancements in computing power, storage capacity, and machine learning techniques. In addition to overcoming the drawbacks of earlier computers, AI systems have improved in effectiveness and efficiency. The field has advanced due to the growing availability of data and our ability to learn from it. A bright future is indicated by the sizeable investments that major corporations are making in AI research and development.

* The important features of big data:

Big data is the data that is too large or complex that traditional data processing applications (tools and techniques) is insufficient to deal with. Big data has become a significant component of many businesses and industries. Big data has 5 V’s as features:

* Volume: Big data, which can be petabytes or even exabytes in size, is the term used to describe the vast amount of data that is generated and collected. For instance, the amount of data on any given social media network in a single day can reach terabytes.
* Velocity: refers to the rate at which data is produced and gathered; big data is produced in real time or very close to real time. For instance, the sensors in autonomous vehicles can produce hundreds of megabytes of data per second.
* Variety: is used to describe the range of data that can be collected, including structured, semi-structured, and unstructured data.
  + Structured data is information that has been arranged in a certain fashion, such as tables (rows and columns), making it simpler for computers to process.
  + Semi-structured data is unorganized data that contains some organization, such as labels and tags. Although more difficult for a computer to process than unstructured data.
  + Unstructured data is a data that is not organized or have any structure. This type of data is the most difficult for computer to process.
* Veracity: refers to the quality of the data, there are many factors that can affect the quality of the data such as:
  + Accuracy: the accuracy of the data can affect the results of the analysis; any error can decrease the accuracy of the data.
  + Completeness: incomplete data can lead to inaccurate results, missing values and values duplication can affect the completeness.
  + Reliability: data should be reliable as it will lead to reliable results, data can be unreliable if it was collected from untrusted sources.
  + Consistency: data should be constant as it will increase the ability to identify trends, make comparisons and provide accurate conclusions. Data can inconsistent if it was collected from different sources.
* Value: it refers to the data ability to provide insights and drive the decision-making process, can be measured by many factors such as how much this data will increase revenue or decrease cost or even increase customer satisfaction.

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| features | Traditional data | New type data |
| Volume | Small | Large |
| Velocity | Collected and stored at lower rate | Much faster rate as it often generated from sensors and social media |
| Variety | Homogenous, it contains a single type of data | Heterogenous, it contains a multiple types of data |
| Veracity | Well structured, reliable | Varies in terms of quality, needs to be pre-processed and cleaned |

## The difference between weak AI and strong AI:

Weak AI: also known as narrow AI or artificial narrow intelligence. It is AI systems that are built to perform specific duties or deal with specific problems within a limited and specific domain. These systems lack general cognitive abilities and are concentrated on solving a specific set of problems. Weak AI is built to mimic human intelligence in a limited context but lacks true consciousness or self-awareness. Weak AI examples such as virtual assistants (Amazon’s Alexa, Apple’s Siri), recommendation systems, spam filtering programs, chess-playing programs.

Strong AI: also known as artificial general intelligence AGI or human-level AI, is the term used to describe AI systems that have general cognitive abilities equivalent to human intelligence. Strong AI is dedicated to understanding, learn, and apply knowledge across a variety of tasks and domains, displaying an intelligence on par with that of humans. while true strong AI does not yet exist, but advances in self-driving cars, chatbots, and medical diagnosis systems are significant steps in that direction. These examples show the intelligence, adaptability, and human-like interaction which move us a step closer to the ideal of powerful AI.

## Some of the areas of applications of AI systems used to solve real-world problems:

AI is highly significant in the manufacturing sector for streamlining processes and increasing productivity. Production lines have been revolutionized by AI-powered robots and automation systems, which have raised productivity and improved quality control. Predictive maintenance employs AI algorithms, enabling proactive equipment servicing to reduce downtime. AI systems also help with supply chain management, optimizing logistics and inventory levels for greater cost efficiency.

The banking industry benefits from AI's fraud detection and prevention abilities. Large amounts of transaction data are analysed by AI algorithms, which highlight suspicious patterns and possible fraud. Moreover, AI-powered chatbots offer personalized customer service, responding to inquiries and assisting users with banking procedures.

AI is also used in other industries, including smart cities, agriculture, autonomous vehicles, and cybersecurity. AI is used by self-driving cars to safely perceive and navigate their surroundings. AI algorithms improve cybersecurity measures by quickly identifying and preventing threats. AI systems in agriculture keep track of crop health, improve irrigation, and forecast crop yields. To increase sustainability and raise quality of life, smart cities use AI for waste management, traffic optimization, and energy optimization.

## The advantages and disadvantages of using AI in one of the areas of applications I mentioned in the previous point:

The selected AI system is in the manufacturing sector.

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| **Advantages** | **Disadvantages** |
| Increased Efficiency: improve productivity, streamline operations, and optimize production procedures. | Initial Investment and Implementation Challenges: significant initial costs associated with implementing AI, as well as challenges with integration. |
| Quality Enhancement: guarantee improved quality control and lower the possibility of defective products. | increase risks: AI systems pose risks of experiencing hardware breakdowns, software bugs, and cyberattacks. |
| Predictive maintenance: reduces breakdowns by identifying potential problems and forecasting the need for maintenance through AI-based systems. | Ethical Concerns: The use of AI brings up issues with data privacy, transparency, and algorithm biases. |
| Reduce costs: AI automates processes, improves resource allocation, and lowers labour and maintenance expenses. |  |

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## The security and ethical issues in your selected AI system:

* Safety risks: AI-controlled equipment and robots must obey strict safety regulations to avoid mistakes and guarantee the safety of human operators.
* Threats to cybersecurity: AI systems are vulnerable to data breaches, hacking, and other malicious attacks, which might put at risk the safety and security of manufacturing operations.
* Accountability and Liability: the accountability and liability in case of mistakes, mistakes, or harmful effects brought by AI systems presents challenging ethical and legal issues.
* Ethical Data Use: In order to protect individual privacy rights and prevent from using data in unethical ways, manufacturers must ensure consent, ethical data sourcing, and responsible data use.

## Analysis of the technical challenges in your selected AI system:

* collecting high quality data: For precise AI decision-making, manufacturing data must be complete and clean.
* Scalability: In order to provide real-time insights and predictions, AI systems must be able to handle large volumes of manufacturing data.
* Real-time processing: To enable rapid responses and enhance production procedures, AI systems must process data quickly and effectively.
* Integration: There are technical challenges involved in integrating AI systems with current manufacturing machinery and systems.
* Robustness: To handle unexpected occurrences and mistakes, AI manufacturing systems need to be fault-tolerant and resilient.

## Implications of ethical and technical issues to both users and the organization:

* Job displacement: The adoption of automation and AI in the manufacturing sector may result in job losses and have an impact on workers' livelihoods, raising moral concerns regarding social injustice and economic disparities.
* A focus on transparency and accountability in AI systems used in manufacturing is required by ethical considerations, ensuring that decisions and actions are explicable and adhere to moral and legal guidelines.
* The cooperation between users, organizations, and regulatory bodies is required to develop industry-wide standards for ethical AI utilization in the manufacturing sector.
* The performance and dependability of AI systems in manufacturing processes can be improved by addressing technical issues through extensive testing, ongoing monitoring, and staff training.

## References

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