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AI IN THE MANUFACTURING INDUSTRY

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Manufacturing industries are transforming in the past few decades to satisfy the global expansion of product demands. Such transformations are becoming more relevant and essential to meet the flexible expectations of the customers. To enable a sustainable transformation, each process in the entire value chain has to be adapted based on the product needs, which can bring upon positive impact on their competitive global market. Due to proper utilisation of natural resources and massive labour force, an era of industrial revolutions has been inaugurated, to meet large production volumes. However, over a period, successive technological advancements enabled us to integrate electricity and electronic components to speed up the manufacturing processes along with much high precision. Now, it is time for a giant leap in recognising the fourth industrial revolution which is termed as “Industry 4.0” with much more sophisticated technologies. Industry 4.0 technology can be systematically incorporated into the industrial process chain to reap evolutionary digital transformation.

Often, the term “Industry 4.0” is interchangeably used with “Smart manufacturing” and “Industrial Internet of Things (IIoT)”. In bigger picture, all three concepts generally hold the same main functions, which include connectivity, data analytics, intelligent decision making, flexibility and adaptability. However, the differentiations can be derived based on their application and use cases. Nevertheless, Industry 4.0 focuses on establishing digital transformations which can enable manufacturing industries to achieve a connected ecosystem along with the smart decision making capabilities for their process chain. In essence, Industry 4.0 offers an efficient approach in interlinking hardware systems with digitalisation, thereby allowing better connectivity and real-time data analytics.

The power of AI

Digitalisation can be incorporated in each stage of the process chain which include but not limited to product design, production planning, manufacturing, and supply chain management. Integrating digitalisation can enable industries of all sizes to deploy existing and future technologies for more flexible, optimised, energy efficient, and automated solutions. This allows industries to properly utilise the full potential of Industry 4.0 and prepare for the next phase of their digital transformation journey.

As the real-time complex data analytics are becoming an integral part of the Internet of Things (IoT), it is inevitable to harness the power of Artificial Intelligence (AI) in understanding the sensor data, and to make smart decisions with minimal human intervention. AI integrated with IoT can offer local devices an ability to process time-sensitive data efficiently in terms of energy, rather than demanding centralised cloud computing technology.

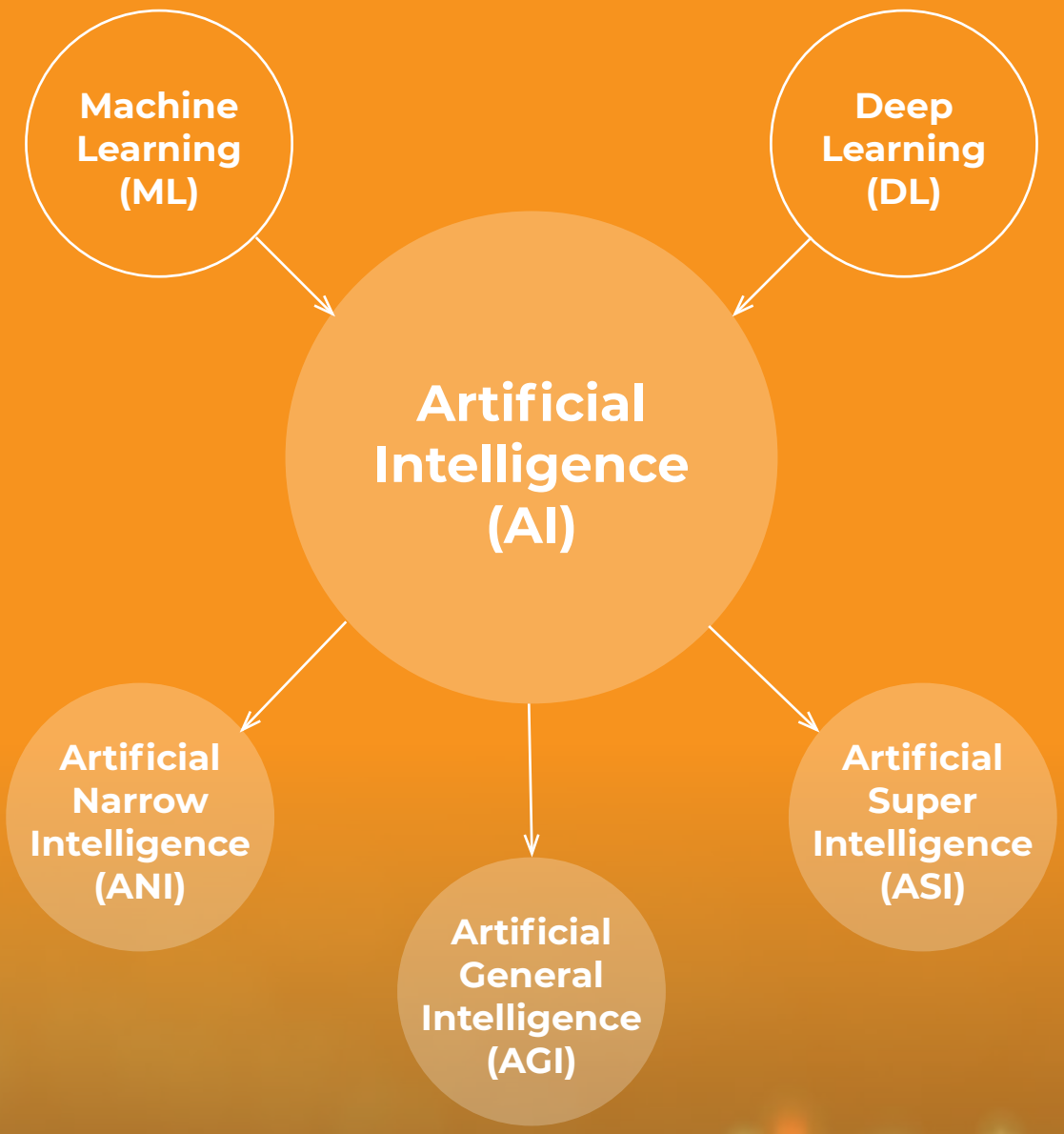
It is obvious that AI is engulfing us in this Industry 4.0 era. We are experiencing several articles with overwhelming information and opinions on AI. Because of the constant flow of information on AI, it is becoming increasingly difficult to pinpoint what exactly AI is all about.

AI typically covers concepts involving Machine Learning (ML) and Deep Learning (DL). It is very important to understand the difference between these terms and its associated applications. Proper understanding of these concepts can guide us in choosing an efficient approach suitable for a specific industrial problem.

ANI, AGI and ASI

AI can be termed in such a way that any intelligent system can identify efficient methods to solve a problem. This can be done by proper utilisation of sensor data, learning from experiences, and also by adjusting to new inputs. AI can be employed in applications requiring human-like intelligence in solving a problem and deliver solutions with minimal human interventions. Considering the application domain, hardware infrastructure and ability to perform a task, AI can be broadly classified as Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI).

ANI was carefully designed with a capacity to perform actions on a single specific task. Actions are performed by utilising necessary information from its pre-defined set of knowledge representations. Having proper knowledge representation, ANI has successfully demonstrated in outperforming human achievements for a given specific task. For example, beating humans in the game of chess, image classification, and virtual assistants like Siri, Alexa, etc. ANI also has a great potential in relieving humans from mundane tasks in industries. On the other hand, AGI refers to technology which can exhibit human-like intelligence and ASI refers to technology which can surpass human intelligence. Both AGI and ASI are still under scientific explorations and needs further advancements to realise their presence as a functional applications.


Machine Learning (ML)
Deep Learning (DL)
Artificial Intelligence (AI)
Artificial Narrow Intelligence (ANI)
Artificial General Intelligence (AGI)
Artificial Super Intelligence (ASI)

Based on the functions of ANI, it has a greater potential to be incorporated as an applicable solution for wide spectrum of industrial problems. ML being one among the beneficial applications of AI, has a capacity to identify patterns using statistical methods, which allows software systems to learn automatically from experiences without any preprograming to accomplish a specific task. However, ML typically requires human interventions to determine the hierarchy of features for a given set of structured inputs to make predictions. Based on the choice of ML algorithm, they may require a small to large set of data to extract relevant information about the process.

In contrast to ML, DL automates much of the feature extraction process thereby eliminating most of the human interventions. It also enables us to process large data coming from complex industrial applications. Deep learning concept is an evolved form of Artificial Neural Networks (ANN), which is inspired from neurons in the biological brain for processing information. The term “Deep” referred in DL technology is due to the stacking up of multi-layered neural network that consist of a large number of parameters. Input data (numbers) is processed through several layers of neurons called neural networks to predict and classify information. Based on the availability of labelled data, ML and DL technologies can be classified either as supervised, unsupervised, or reinforcement learning.

AI applications in manufacturing

Manufacturing industry whose journey is currently focused towards digital transformations can efficiently harness the power of AI to transform their process chain and increase productivity. One among the key requirements is to provide advanced data analytics, which can be possible with ML and DL technologies. Another application of AI in manufacturing industry is to enable smart maintenance, where ML algorithms can provide predictive maintenance analyses to determine the status of products and machinery. Such early detection can eliminate downtime and the Remaining Useful Life (RUL) of equipment can be efficiently extended.

In addition to smart maintenance, the quality of deliverable products can be drastically improved by identifying the potential defects beforehand which can tarnish business if unnoticed. For quality inspection processes, “Machine vision”, sometimes referred to as “Computer vision” integrated with deep learning technology can take the responsibility in classification and detection of defects. Vision guided data analytics can be integrated to a manufacturing process line where for example surface quality of a product is of utmost importance. Visual quality inspection is very helpful to manufacturers during the processing of goods which can relieve them from long hours of manual inspection and at the same time to maintain quality standards with high precision.

Large scale manufacturing industries have established steps to successfully incorporate AI to their process chains and continue to push their boundaries in improving productivity, product quality, and supply chain management. But when it comes to small scale industries, still the decisions are dicey to realise transformation in their manufacturing process, assisted by intelligent solutions. One brave step towards integrating AI can unleash the true potential of digital transformation in manufacturing industries of all sizes. Thanks to the power of AI, availability of resources, and competitive skills to make Industry 4.0 accessible to every industry.

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