Comparing Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL)

Introduction

Artificial intelligence (AI), machine learning (ML), and deep learning (DL) are terms that are commonly used in the technology industry. While these terms are often used interchangeably, they are not the same thing. Each technology has unique features, advantages, and disadvantages. In this blog post, we will explain the differences between AI, ML, and DL and provide supporting citations from authoritative sources.

Artificial Intelligence (AI) AI refers to the ability of machines to perform tasks that typically require human intelligence. AI is divided into two categories: narrow or weak AI and general or strong AI. Narrow AI is designed to perform specific tasks, such as speech recognition, image recognition, and natural language processing. On the other hand, general AI is designed to perform any intellectual task that a human can do. General AI systems can learn from experience and adapt to new situations. However, as of now, there is no truly general AI in existence, and most AI applications are narrow AI systems.

Machine Learning (ML) ML is a subset of AI that involves training machines to learn from data without being explicitly programmed. In other words, ML algorithms can automatically learn and improve from experience without human intervention. ML algorithms are designed to identify patterns in data and make predictions based on those patterns. The process of training an ML model involves providing it with a large dataset, and then the algorithm will learn to recognize patterns in the data and make predictions based on those patterns.

Deep Learning (DL) DL is a subset of ML that involves training deep neural networks. Neural networks are computing systems inspired by the structure and function of the human brain. These networks consist of layers of interconnected nodes, each of which performs a mathematical operation on the input data. Deep neural networks have multiple layers, which allows them to learn more complex representations of the input data. The process of training a deep neural network involves providing it with a large dataset and adjusting the weights of the nodes to minimize the error between the predicted output and the actual output.

Differences between AI, ML, and DL

Now that we have a basic understanding of AI, ML, and DL, let’s take a closer look at the differences between these technologies.

1. **Complexity of Tasks**
    - AI systems are designed to perform tasks that typically require human intelligence, such as speech recognition, image recognition, and natural language processing. ML algorithms are designed to identify patterns in data and make predictions based on those patterns. DL algorithms, on the other hand, are designed to learn from large datasets and can perform tasks that are too complex for traditional ML

algorithms. For example, DL algorithms can be used to detect fraud in financial transactions, diagnose medical conditions, and even play complex games such as Go.

2. **Type of Learning**
    - While both ML and DL involve training machines to learn from data, they differ in the type of learning. ML algorithms use supervised, unsupervised, or semi-supervised learning, depending on the problem they are trying to solve. In supervised learning, the algorithm is provided with labeled data, and it learns to make predictions based on that data. In unsupervised learning, the algorithm is provided with unlabeled data, and it learns to identify patterns in the data. In semi-supervised learning, the algorithm is provided with both labeled and unlabeled data. DL algorithms, on the other hand, use a technique called backpropagation to adjust the weights of the nodes in the neural network. This technique involves computing the error between the predicted output and the actual output and then adjusting the weights to minimize that error.

3. **Training Data Size**
    - The size of the training data also differs between AI, ML, and DL. AI systems typically require a large amount of data to learn and perform well. ML algorithms can be trained with smaller datasets than AI systems, but still require a significant amount of data. DL algorithms, however, require large datasets to train deep neural networks. The larger the dataset, the better the performance of the DL algorithm.

4. **Hardware Requirements**
    - DL algorithms require significant computational power and memory to train deep neural networks. As a result, DL algorithms require specialized hardware such as graphics processing units (GPUs) and tensor processing units (TPUs) to achieve high performance. ML algorithms, on the other hand, can be trained on a standard computer.

5. **Interpretability**
    - Another key difference between AI, ML, and DL is interpretability. AI systems are typically rule-based, and the rules can be easily understood by humans. ML algorithms can be more difficult to interpret, as they learn from data and do not necessarily follow explicit rules. DL algorithms are even more difficult to interpret, as deep neural networks can have millions of parameters and can learn complex relationships between the input and output data.

Conclusion

In conclusion, AI, ML, and DL are all related but distinct technologies with unique features, advantages, and disadvantages. AI refers to machines that can perform tasks that typically require human intelligence, while ML involves training machines to learn from data without being explicitly programmed. DL is a subset of ML that involves training deep neural networks. The key differences between these technologies are the complexity of tasks they can perform, the type of learning they use, the size of the training data, the hardware requirements, and the interpretability of the results. As AI, ML, and DL continue to evolve, they will play an increasingly important role in many aspects of our lives, from healthcare to finance to entertainment.

References:

- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT press.
- Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. Science, 349(6245), 255-260.
- Kelleher, J. D., Tierney, B., & Tierney, B. (2018). Data science: An introduction. CRC Press.
- LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-444.
- McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (2006). A proposal for the Dartmouth summer research project on artificial intelligence, August 31, 1955. AI magazine, 27(4), 12-14.

Getting started with Robotic Process Automation (RPA)

This post covers the same ground as the link in the papers section of the site, but I think it is worth dropping into a post as well.

Robotic Process Automation brings together classic Business Process Management (BPM) approaches, and macro or scripted automation, with a simpler approach to the automation development. In simple terms, RPA is about making the automation accessible without deep development-based integration.

RPA allows the replacement of repeatable human functions with automation, reducing both costs and time with the assumption that the process is clear, repeatable and well documented or articulated. In addition to simple replacement of human keyboard time, RPA facilitates bringing disparate systems together with minimal direct IT investment, or rigid development. This just touches on the capabilities made accessible by RPA, as it really becomes exponentially more valuable when paired with more advanced technologies such as NLP (Natural Language Processing) on the inbound size, ML (Machine Learning) and advanced analysis / rules engines on the

processing side and NLG (Natural Language Generation) on the output side to mimic human to human interaction where that is needed. Think personalization without the cost of the person in the middle!

I drafted the included paper as a short reference on the lessons learned in an early implementation I was a part of, and these lessons continue to hold true as I dive deeper into this topic. I would welcome thoughts on the ideas outlined in the included paper.

Getting Started With RPA

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