# Deep learning versus machine learning

Deep learning and machine learning are both subfields of artificial intelligence (AI) and are closely related but have distinct differences.

Machine learning (ML) refers to a set of algorithms and techniques that allow computers to learn from and make predictions or decisions based on data, without being explicitly programmed. ML algorithms can analyze and interpret patterns and relationships in data, enabling them to generalize from past experiences and make predictions or take actions on new, unseen data. Traditional machine learning algorithms include decision trees, support vector machines, and random forests, among others.

Deep learning, on the other hand, is a specific approach to machine learning that is based on artificial neural networks. Deep learning algorithms are designed to mimic the structure and function of the human brain by using interconnected layers of artificial neurons, known as artificial neural networks. These networks are capable of learning hierarchical representations of data, extracting complex features, and making highly accurate predictions or decisions. Deep learning algorithms, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have achieved remarkable success in various domains, including image and speech recognition, natural language processing, and autonomous driving.

In summary, the main differences between deep learning and machine learning are as follows:

1. Representation of data: Machine learning algorithms typically require handcrafted features or representations of data, whereas deep learning algorithms can learn hierarchical representations directly from raw data.
2. Complexity of models: Deep learning models are typically more complex, with multiple layers of interconnected neurons, allowing them to learn intricate patterns and relationships in data. Traditional machine learning models tend to be simpler and rely on explicitly defined features.
3. Performance: Deep learning algorithms have achieved state-of-the-art performance in several domains, particularly in areas such as image and speech recognition. Machine learning algorithms, while still powerful, may not match the performance of deep learning algorithms on complex tasks.
4. Training requirements: Deep learning algorithms often require large amounts of labeled data for training, as well as substantial computational resources. Machine learning algorithms can be trained with smaller datasets and require comparatively less computational power.

Overall, deep learning can be seen as a subset of machine learning that focuses on utilizing artificial neural networks to tackle complex problems and learn intricate representations from data. Machine learning, on the other hand, encompasses a broader range of algorithms and techniques that can be applied to various tasks, including those that do not require deep neural networks.

# Why feature engineering is not required in Deep learning

Certainly! In the context of machine learning and deep learning, the representation of data refers to how the input data is structured and transformed into a format that can be processed and analyzed by the algorithms.

In traditional machine learning, the process of data representation often involves manual feature engineering. This means that domain experts or data scientists carefully select and design relevant features or attributes that capture important information about the data. These features are derived from the original raw data and are typically based on prior knowledge and understanding of the problem domain. For example, if you're trying to build a spam email classifier, you might manually extract features like the presence of certain keywords, email length, or the number of exclamation marks in the subject line.

Once the features are extracted, they are used as input to the machine learning algorithm, which then learns patterns and relationships between these features and the target variable (e.g., whether an email is spam or not). The machine learning algorithm makes predictions or decisions based on these learned patterns.

In contrast, deep learning approaches, particularly with the use of artificial neural networks, aim to learn representations directly from the raw data, without explicit feature engineering. Instead of relying on handcrafted features, deep learning algorithms learn hierarchical representations of the data through multiple layers of artificial neurons. Each layer extracts progressively more abstract features, starting from low-level features (e.g., edges or textures in an image) and building up to high-level features (e.g., objects or shapes). The network learns these representations through a process called training, where the model adjusts the weights of its neurons to minimize the difference between its predictions and the ground truth labels.

This ability to automatically learn representations from data is one of the key advantages of deep learning. It eliminates the need for manual feature engineering, which can be time-consuming and relies on human expertise. Deep learning models can learn complex and intricate patterns directly from raw data, often leading to improved performance in tasks such as image and speech recognition, natural language processing, and other areas where the underlying data is high-dimensional and complex.

In summary, traditional machine learning relies on manually engineered features derived from the raw data, while deep learning algorithms learn representations directly from the raw data itself, allowing for more automated and higher-level feature extraction.