Deep Learning

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Machines?

A machine is a device that uses energy to perform a specific task or set of tasks. Machines are typically designed to make work easier by converting one form of energy into another to accomplish a particular function. They can range from simple devices to complex systems, and they play a crucial role in various fields, including manufacturing, transportation, and communication.

- **Simple Lever**
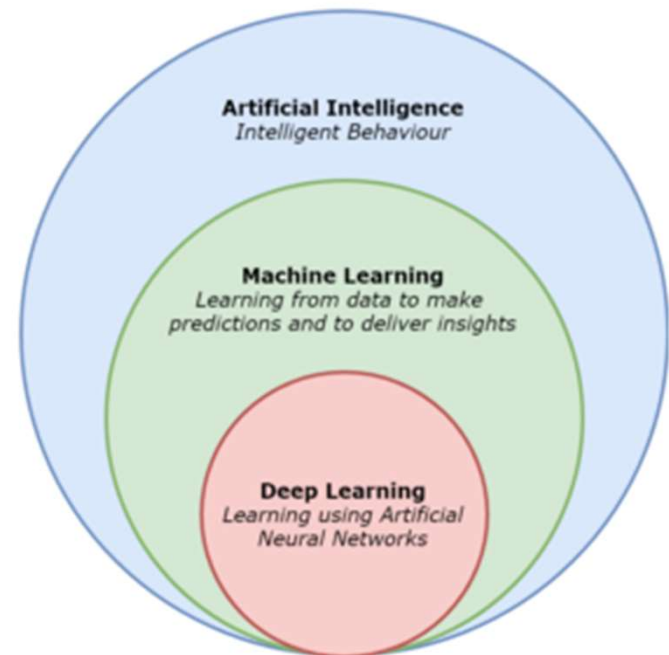- **Complex Machine – Automobile**
- **Computer**

Intelligent Machines ?

Intelligent machines refer to systems or devices that demonstrate the ability to perform tasks that typically require human intelligence.

These machines often leverage artificial intelligence (AI) technologies to mimic or replicate human cognitive functions such as:

- Learning
- problem-solving
- Perception
- language understanding
- decision-making

Artificial Intelligence
Intelligent Behaviour

Machine Learning
Learning from data to make predictions and to deliver insights

Deep Learning
Learning using Artificial Neural Networks

Different AI Systems:

Rule Based System

- A rule-based system, also known as a rule-based reasoning system or expert system, is a type of artificial intelligence (AI) system that uses a set of explicit rules to make decisions or solve problems within a specific domain.

- These systems are designed to emulate the decision-making process of a human expert in a particular field by encoding their knowledge into a set of rules.

Key Components of Rule Based System

Modularity

Knowledge Base

Inference Engine

Transparency

Facts or Data

If-Then Rules
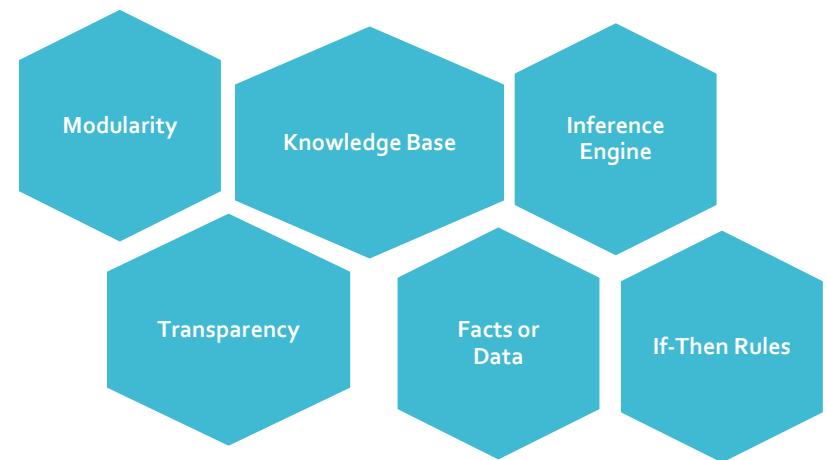
Rule –Based System

- Let's consider a simplified example of a rule-based system in the context of a smart home thermostat. The goal is to create a system that automatically adjusts the temperature based on specific rules related to user preferences, time of day, and current weather conditions.

Knowledge Base

The knowledge base contains a set of rules that dictate how the thermostat should behave.

Rule 1:

- If the current time is between 6:00 AM and 8:00 AM and the external temperature is below 65°F,

- Then set the thermostat to 70°F.

Rule 2:

- If the current time is between 8:00 AM and 5:00 PM and the external temperature is above 75°F,

- Then set the thermostat to 72°F.

Rule 3:

- If the user is at home and prefers a warmer temperature,

- Then set the thermostat to the user's preferred temperature.

Rule 4:

- If the user is away from home,

- Then set the thermostat to an energy-saving temperature (e.g., 60°F in winter, 80°F in summer).

Inference Engine

The rule engine processes these rules and makes decisions based on the current context, which includes the time of day, external temperature, user presence, and user preferences.

1. The system checks the time of day and external temperature.
   - If it's between 6:00 AM and 8:00 AM and the temperature is below 65°F, Rule 1 is triggered, setting the thermostat to 70°F.
   - If it's between 8:00 AM and 5:00 PM and the temperature is above 75°F, Rule 2 is triggered, setting the thermostat to 72°F.

2. The system checks if the user is at home and has specified a preferred temperature.
   - If the user is present, Rule 3 is triggered, setting the thermostat to the user's preferred temperature.

3. If the user is away, Rule 4 is triggered, setting the thermostat to the energy-saving temperature.

Different AI Systems:

Machine Learning

- Machine Learning (ML) is a subset of artificial intelligence (AI) that involves the development of algorithms and models that **enable computers to learn from data and improve their performance on a specific task without being explicitly programmed.**

- In other words, machine learning systems can recognize patterns, make predictions, or automate decision-making based on the information they acquire through training.

Example (House Price Prediction)


Housing price prediction

Let's consider a classic example of a supervised learning problem: predicting housing prices based on features such as square footage, number of bedrooms, and location.

1. Data Collection

2. Data Preprocessing

3. Feature Engineering: *Feature Selection, Feature Extraction, Feature Creation.*

4. Data Splitting

5. Model Selection

6. Model Training

7. Model Evaluation
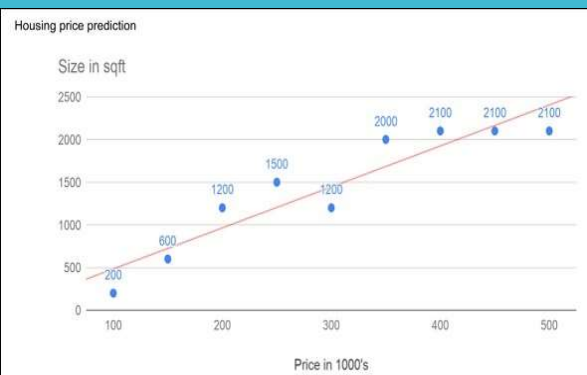
Deep Learning

- Deep Learning is a subfield of Artificial Intelligence and Machine Learning that is inspired by the structure of a human brain.

- Deep Learning algorithms attempt to draw similar conclusions as humans would by continually analyzing data with a given logical structure called Neural Network.
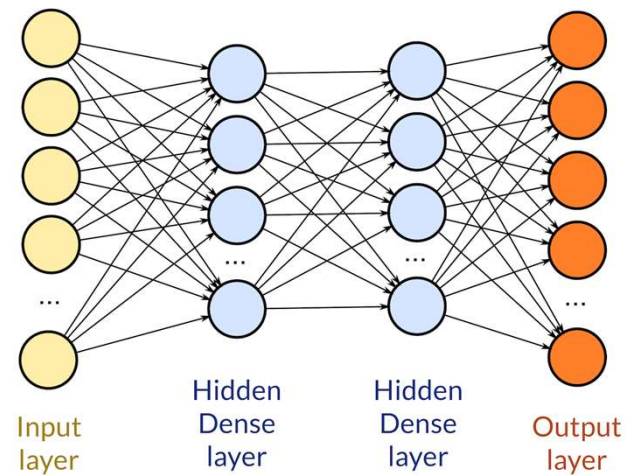
Why Deep Learning is getting so famous?

- **Applicability:** Computer Vision, Speech Recognition, Image Processing, Bioinformatics, Drug Design, etc.

- Performance
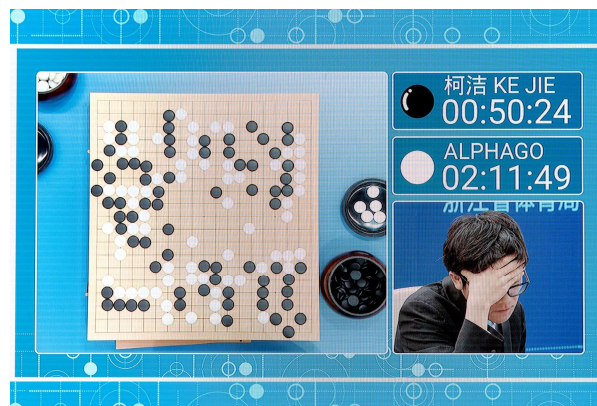
Microsoft Productivity Future Vision

Recommended Books

Textbooks

1. Goodfellow, Ian. "Deep learning." (2016).

2. Aggarwal, C. C. (2018). *Neural networks and deep learning* (Vol. 10, No. 978, p. 3). Cham: springer.

Reference Books

1. Gulli, A., & Pal, S. (2017). *Deep learning with Keras*. Packt Publishing Ltd.

2. Pointer, I. (2019). *Programming pytorch for deep learning: Creating and deploying deep learning applications*. O'Reilly Media.

3. Zaccone, G., & Karim, M. R. (2018). *Deep Learning with TensorFlow: Explore neural networks and build intelligent systems with Python*. Packt Publishing Ltd.