08

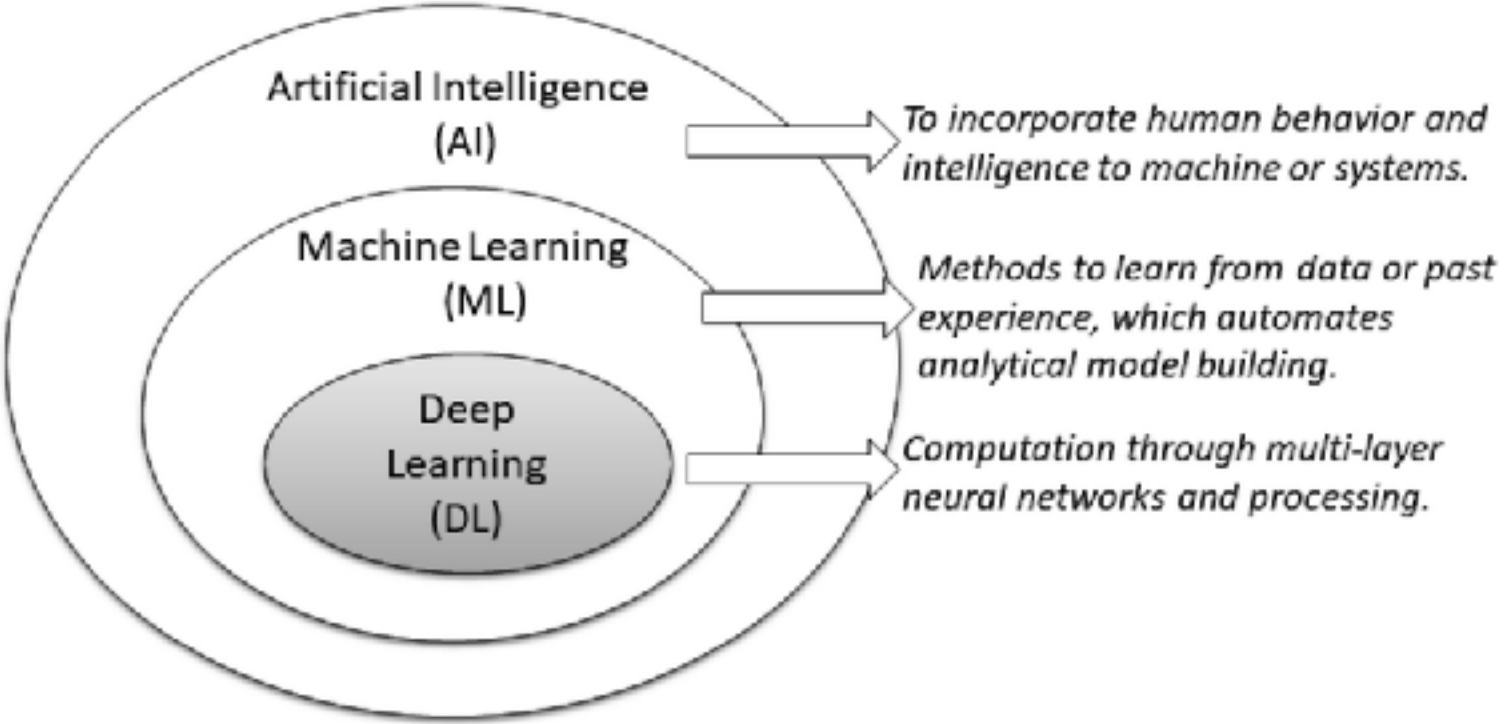
Introduction to Deep Learning

Time to go deeper

8.1
What is Deep **Learning?**

Understanding Deep Learning

- Deep Learning is a subset of Machine Learning, utilizing neural networks
- Neural Networks replace the mathematical models we learned previously
- Deep learning requires large volume of high-dimensional data


Artificial Intelligence
(AI)
Machine Learning
(ML)
Deep
Learning
(DL)
To incorporate human behavior and intelligence to machine or systems.
Methods to learn from data or past experience, which automates analytical model building.
Computation through multi-layer neural networks and processing.

Why bother with Deep Learning?

- Deep Learning can learn high-dimensional, unstructured data (images, texts, etc.)
- Deep learning excel in complex tasks requiring hierarchical feature learning

When to avoid Deep Learning

- When task is simple and structured enough for Machine Learning models
- When computational resources are minimal
- When model interpretation is required

8.2
Deep Learning **Applications.**

Places Deep Learning is being used today:

- **Image Recognition**: Automating the process of identifying and detecting objects in images and videos.
- **Natural Language Processing**: Understanding and generating human language, enabling applications such as chatbots and translation services.

Places Deep Learning is being used today:

- **Healthcare:** Assisting in diagnosis, personalized medicine, and drug discovery.
- **Autonomous Vehicles:** Enabling self-driving cars to navigate and understand their environment.
- **Finance:** Fraud detection, credit scoring, and algorithmic trading.

8.3
Neural Networks.

What are Neural Networks?

- Neural Networks are the backbone of Deep Learning
- These are mathematical model based on human brain structure
- At a high level these consists of:
  - Nodes/Neurons which host a value
  - Connections from one node to another

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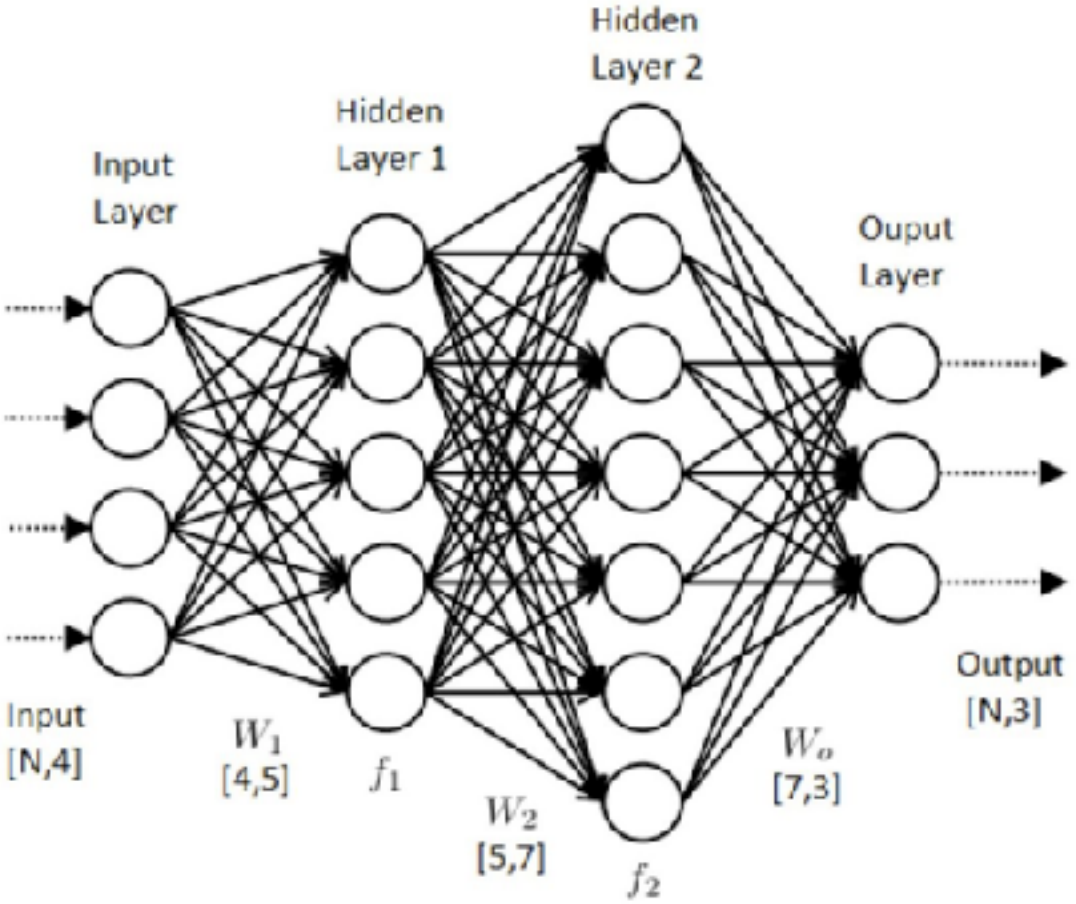
Basic Components of a Neural Network

- **Neurons**: Fundamental units of a neural network that receive input and pass the output to the next layer after computation.
- **Weights**: Parameters within the network that transform input data within the network's layers.
- **Biases**: Additional parameters that enable the model to adjust its output accordingly.
- **Activation Functions**: Determine if a neuron should be activated or not, influencing the model's output.


Hidden
Layer 2
Hidden
Layer 1
Input
Layer
Ouput
Layer
Output
[N,3]
Input
[N,4]
W_1
[4,5]
f_1
W_2
[5,7]
f_2
W_o
[7,3]

8.4
Machine Learning
or Deep Learning?

Issue 1

- **Problem Statement:** Companies are facing challenges in efficiently sorting through large volumes of customer reviews and feedback to identify areas of improvement and customer satisfaction.

- **Solution Label:** Natural Language Processing (Deep Learning)

Issue 2

- **Problem Statement:** Financial institutions need a robust method to predict credit default risks based on historical transaction data and customer profiles to minimize financial losses.

- **Solution Label:** Supervised Machine Learning

Issue 3

- **Problem Statement:** E-commerce platforms are struggling to provide personalized product recommendations to users, which is essential for enhancing user experience and boosting sales

- **Solution Label:** Collaborative Filtering (Machine Learning)

Issue 4

- **Problem Statement:** Manufacturers need an effective solution for detecting defects and anomalies in products on the production line to ensure quality and reduce waste

- **Solution Label:** Convolutional Neural Networks (Deep Learning)

Issue 5

- **Problem Statement:** Environmental scientists require an efficient method to predict air quality levels in urban areas based on various atmospheric and weather-related parameters to issue timely alerts

- **Solution Label:** Regression Analysis (Machine Learning)

To understand the math behind deep learning

- But what is a neural network? | Chapter 1, Deep learning
- Gradient descent, how neural networks learn | Chapter 2, Deep learning
- What is backpropagation really doing? | Chapter 3, Deep learning
- Backpropagation calculus | Chapter 4, Deep learning

END.