Welcome

ENGR 3321: Introduction to Deep Learning for Robotics

Introduction

08/25/2025

Outline

- Course related information
- A Brief Introduction on Deep Learning

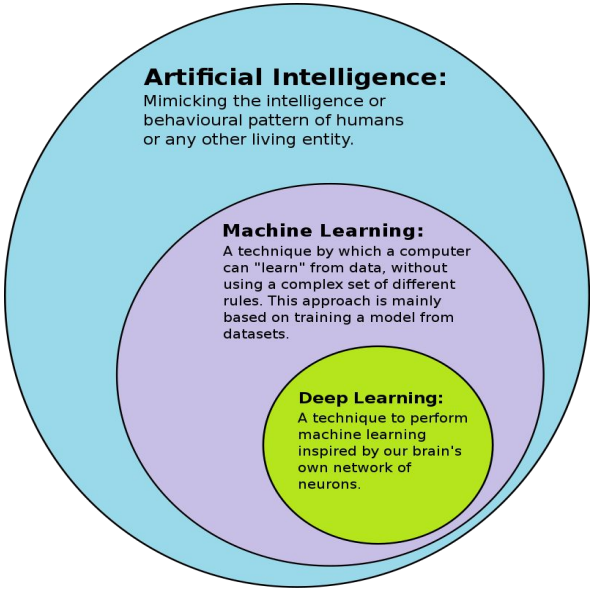
Course Information

- Classes: 01:00 PM - 02:15 PM, M/W @ LSC174
- Office Hour: 10:00 AM - 12:00 PM, Monday @ LSC110
- Slides & Assignments: https://linzhanguca.github.io/deep_learning-2025
- Announcements & Grades: Blackboard
- Homework: Github Classroom

Introduction to Deep Learning

What is Deep Learning

- Definition: Deep learning is a subset of machine learning that uses neural networks with many layers (hence "deep") to model complex patterns in data.



DL Applications

- Yolo
- Gemini
- AlphaFold
- Omniverse and Cosmos
- AgiBot-World

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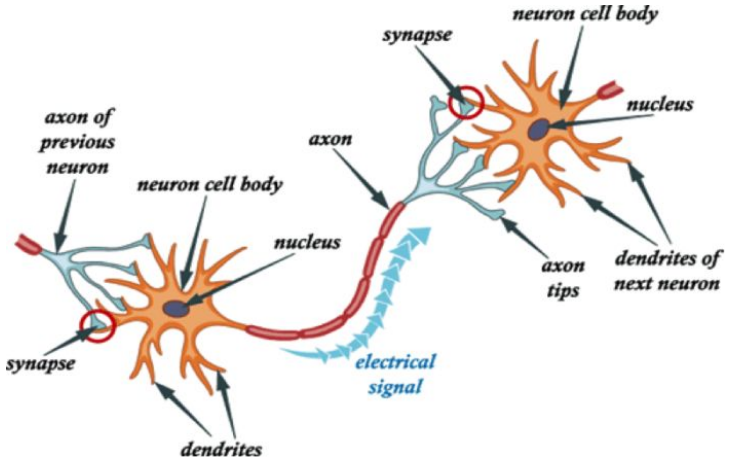
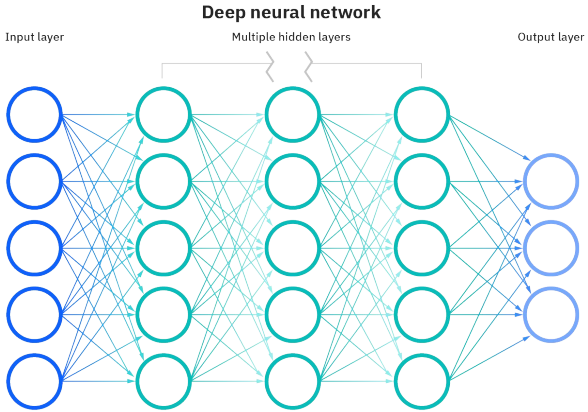
What is the general mechanism behind DL/AI models?

DL Inspiration





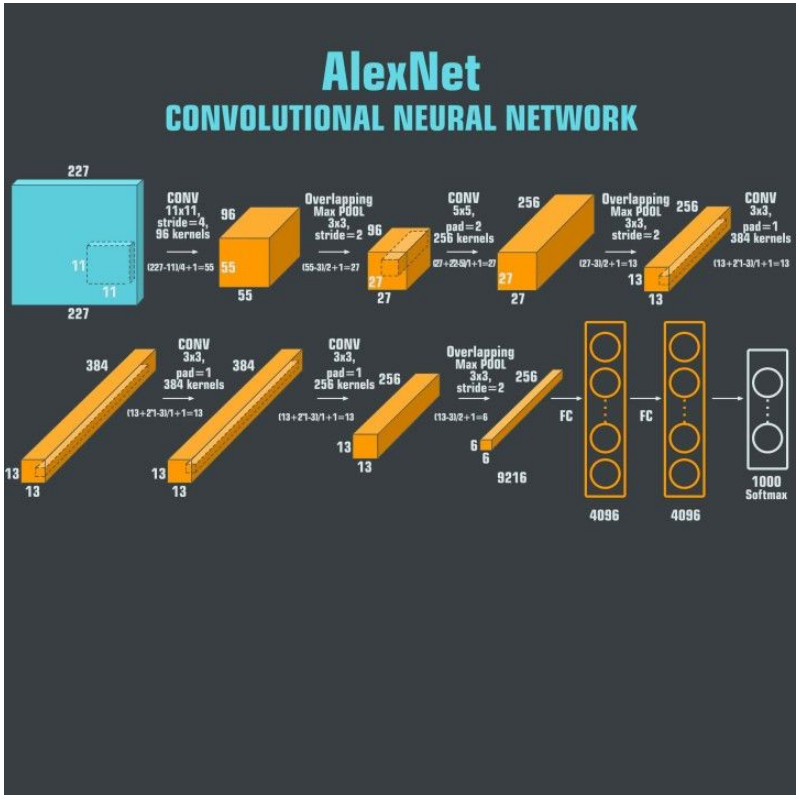
Perceptron

- Neural Network Concepts: In 1943 American neurophysiologist and cybernetician of the University of Illinois at Chicago Warren McCulloch and self-taught logician and cognitive psychologist Walter Pitts published “A Logical Calculus of the ideas Imminent in Nervous Activity”.
- Perceptron: In 1958 a research psychologist and project engineer at the Cornell Aeronautical Laboratory in Buffalo, New York, Frank Rosenblatt introduced the perceptron. It was one of the earliest neural network models, designed for binary classification tasks.

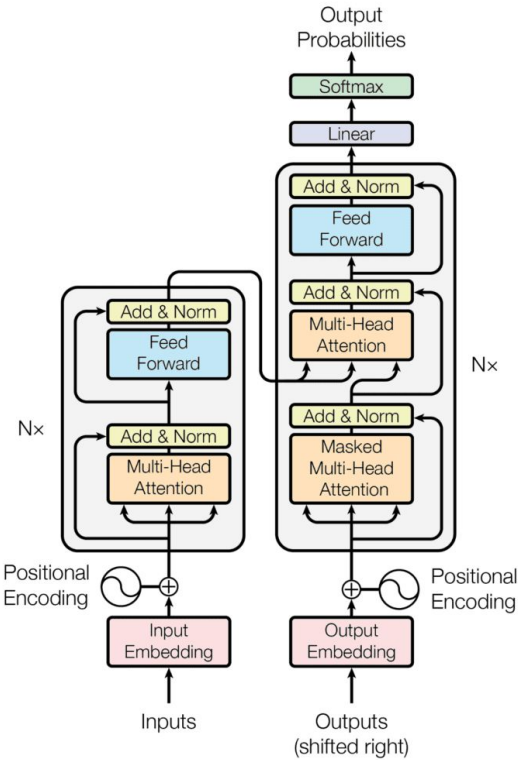
Winter of AI

- Challenges: Early neural networks faced significant limitations, such as the inability to solve non-linear problems, leading to decreased interest and funding in 1970s. This period is often referred to as the "AI Winter."
- Backpropagation: Geoffrey Hinton, David Rumelhart, and Ronald J. Williams published “Learning representations by back-propagating errors” in 1986. The backpropagation algorithm allowed for the training of multi-layer neural networks, revitalizing interest in neural networks.

Emergence of Deep Learning



Modern Era of Deep Learning



Why DL?

- Solves a lot of problems (almost anything).
- End-to-End process.
- Growing community and rich resources.
- Well-paid jobs.

Why not DL?

- Resources requirement
- Uncertainty
- Nasty data
- Explainability
- Ethics