Deep Learning

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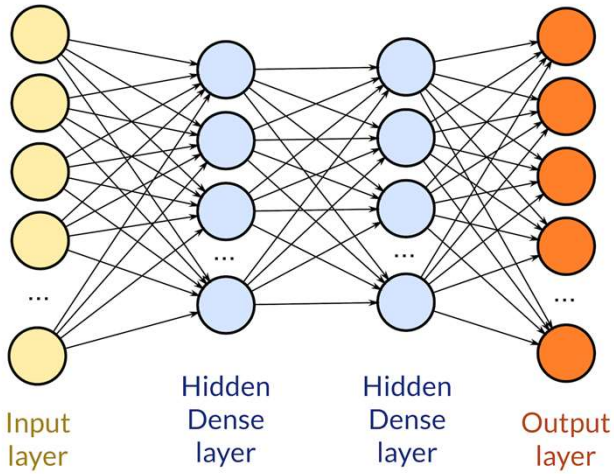
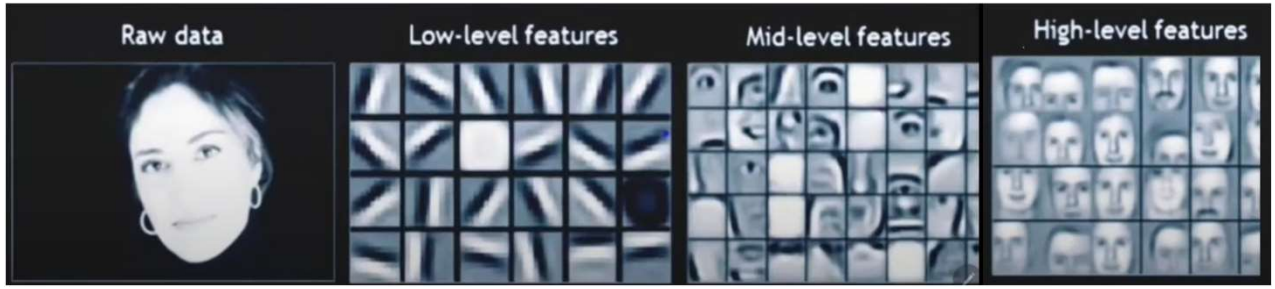
Deep Learning

- Machine Learning is based on Statistical structure.
- 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.



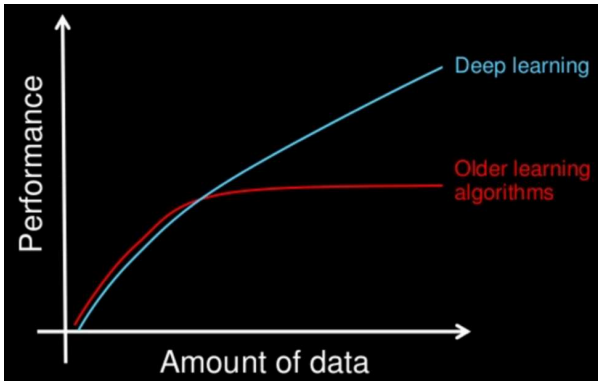
Why Deep Learning is getting so famous?

- Deep Learning is a part of a broader family of machine learning methods based on artificial neural networks with **representation learning**.
- Representation Learning - a.k.a feature learning – is a set of technique that allows a system to automatically discover the representations needed for feature detection or classification from raw data.
- *In DL – Feature Engineering is not necessary.*
- **Applicability:** Computer Vision, Speech Recognition, Image Processing, Bioinformatics, Drug Design, etc.
- Performance



Deep Learning vs Machine Learning

- Data Dependency
- Hardware Dependency
- Training Time
- Feature Selection

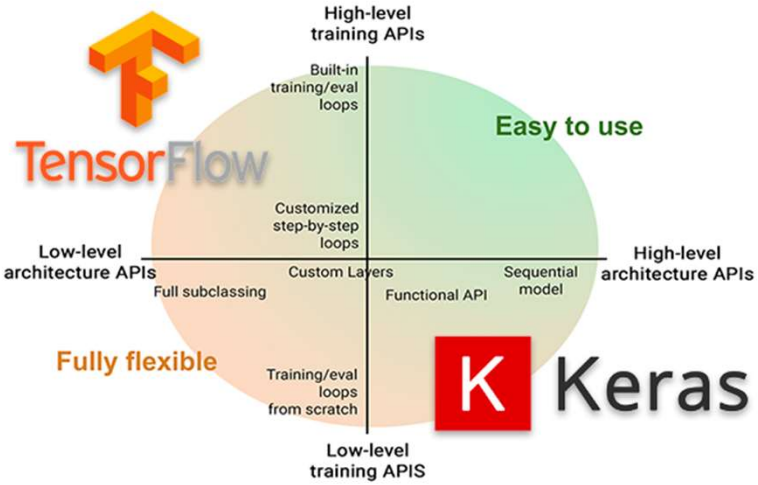


Eg: In Resume based prediction: Features such as 10^{th} percentage, 12^{th} percentage, No. of achievements, No. of courses, etc.

- Interpretability

Why Now?

- Public Available Datasets:
  - Image
  - Video
  - Text
  - Audio
- Hardware Cost Reducing
- Availability of different Frameworks:
  - TensorFlow - Google
  - PyTorch – Facebook
  - Keras
- Deep Learning Architectures

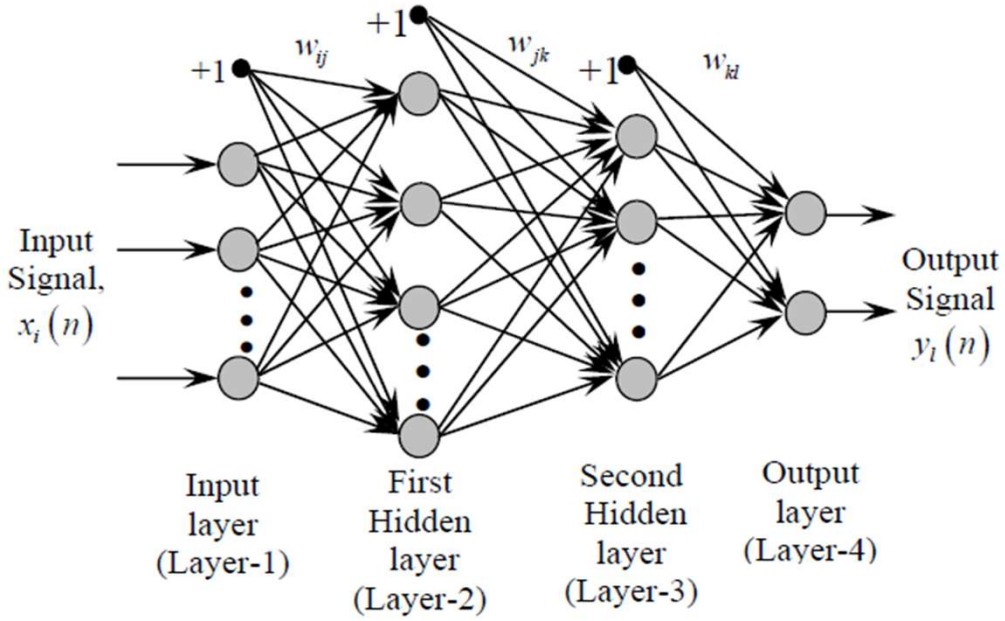


State-of-the-art Architectures

- Image Classification: ResNET
- Text Classification: BERT
- Image Segmentation: WNet
- Image Translation: Pix2Pix
- Object Detection: YoLo
- Speech Generation: WaveNET

Types of Neural Network

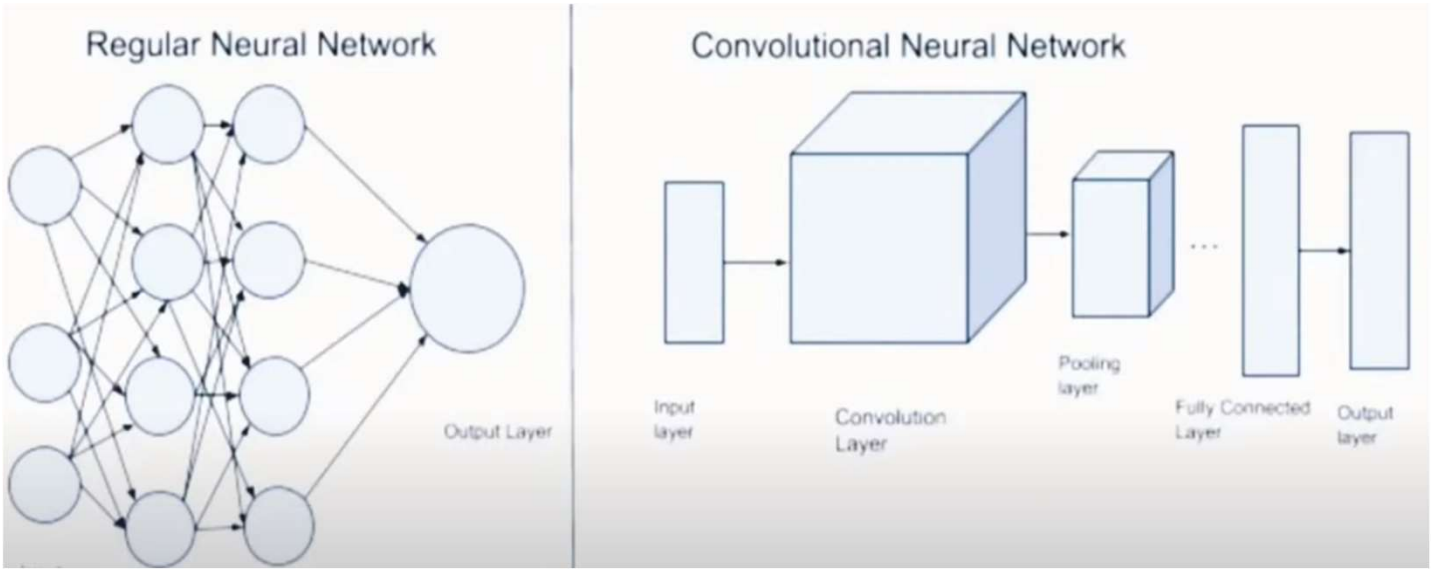
1. Multilayer Perceptron



-> Works best in supervised problems

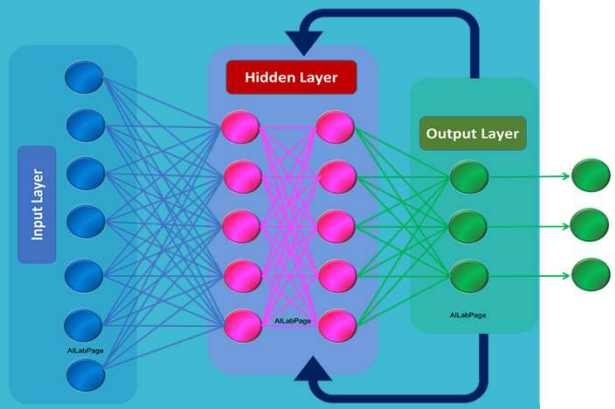
Types of Neural Network

1. Multilayer Perceptron
2. Convolutional Neural Network

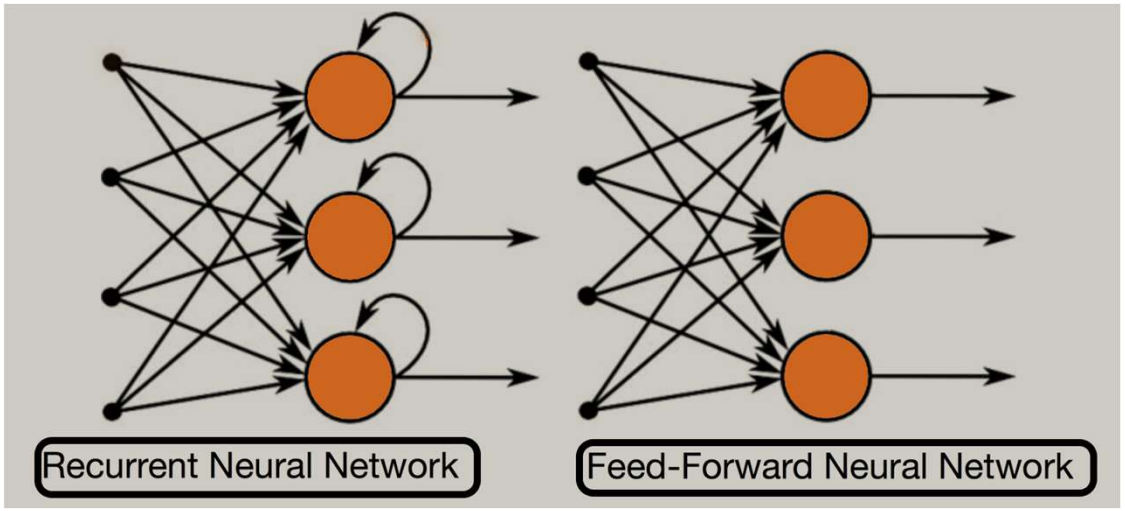


-> Works best with image and video processing

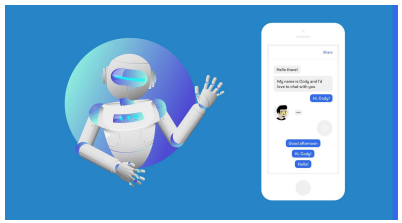
Types of Neural Network



1. Multilayer Perceptron
2. Convolutional Neural Network
3. Recurrent Neural Network: Eg: LSTM

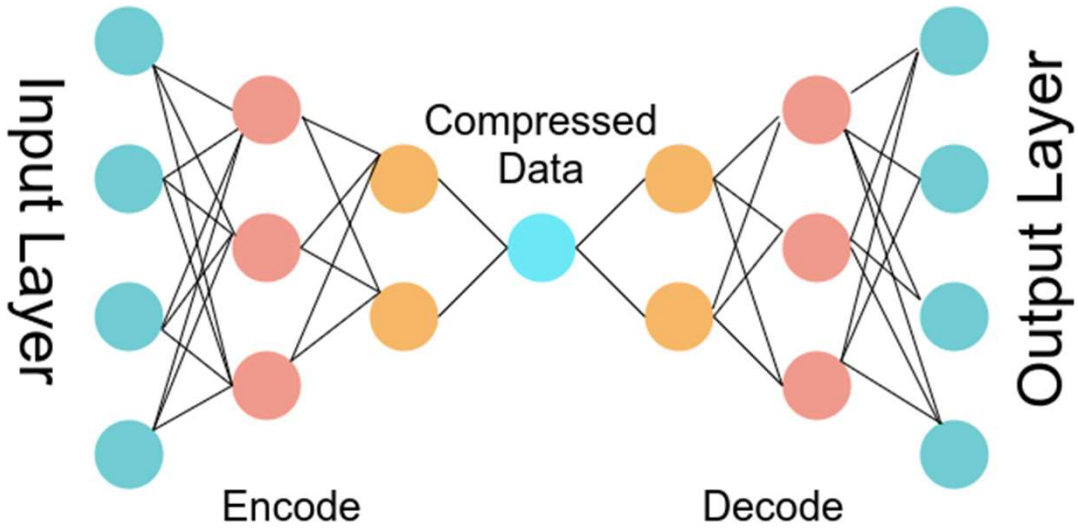


-> Works best with NLP applications



Types of Neural Network

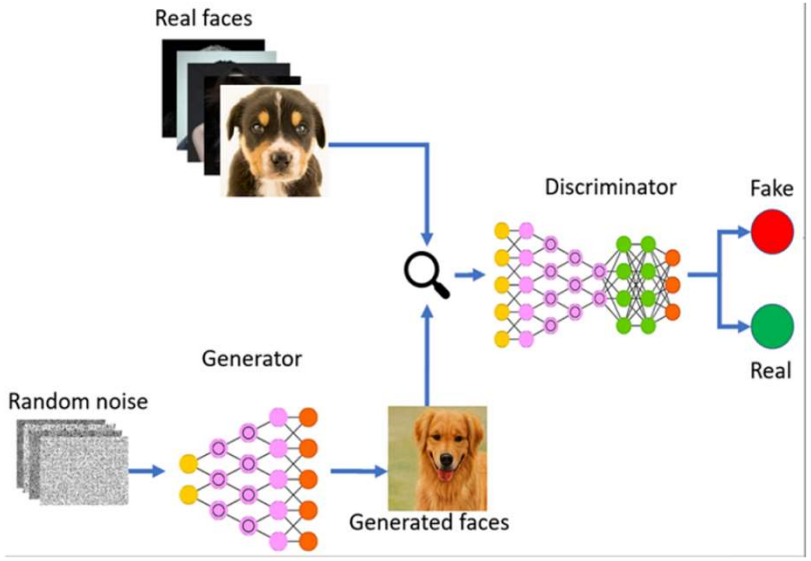
1. Multilayer Perceptron
2. Convolutional Neural Network
3. Recurrent Neural Network
4. Autoencoders



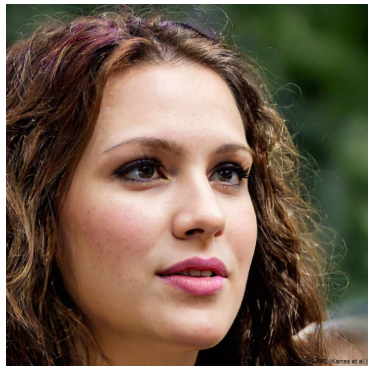
-> Works best with image compressions or regeneration of inputs

Types of Neural Network

1. Multilayer Perceptron
2. Convolutional Neural Network
3. Recurrent Neural Network
4. Autoencoders
5. GAN (Generative Adversarial Network): Can generate hand written texts, images, stories, music, videos, etc.



-> Works best generating texts and images



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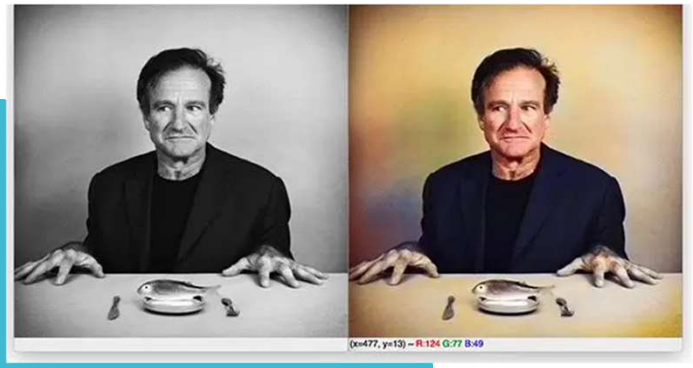
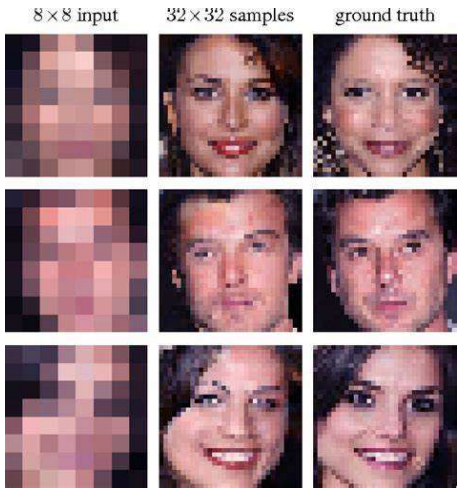
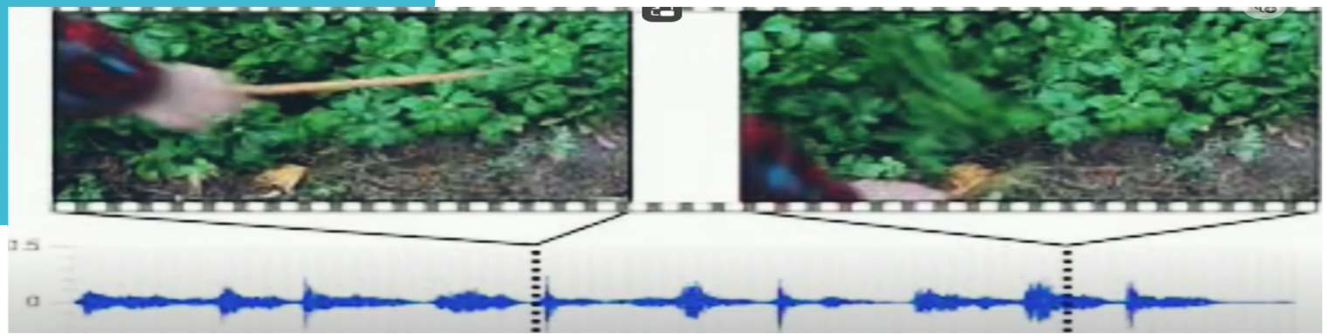
Applications Eg:







History of Deep Learning

- **1943:** Warren McCulloch and Walter Pitts propose the first artificial neuron model, laying the foundation for neural network research. 1957: Frank Rosenblatt introduces the perceptron, a type of neural network capable of learning through a single layer.
- **1969-1970:** Marvin Minsky and Seymour Papert publish "Perceptrons," highlighting limitations and challenges of single-layer perceptrons, dampening interest in neural networks.
- **1986:** Geoffrey Hinton, David Rumelhart, and Ronald Williams publish the "Parallel Distributed Processing" book, reviving interest in neural networks and introducing backpropagation for training multi-layer perceptrons.
- **1990s:** Neural networks gain popularity in various applications, but face limitations in training deep architectures due to the vanishing gradient problem.
- **2006:** Geoffrey Hinton, along with Simon Osindero and Yee-Whye Teh, introduces the concept of unsupervised pre-training, a breakthrough for training deep neural networks.
- **2012:** The ImageNet competition is won by a deep convolutional neural network (CNN) developed by Alex Krizhevsky, marking the beginning of the deep learning revolution in computer vision.
- **2014:** Google acquires DeepMind, an AI company founded by Demis Hassabis, Shane Legg, and Mustafa Suleyman, known for its work in deep learning and reinforcement learning.
- **2015:** Generative adversarial networks (GANs) are introduced by Ian Goodfellow and his colleagues, enabling the generation of realistic synthetic data.
- **2016:** AlphaGo, developed by DeepMind, defeats world champion Go player Lee Sedol, showcasing the power of deep learning in mastering complex games.
- **2017:** Transfer learning gains prominence, allowing pre-trained models to be adapted to new tasks with limited data.
- **2018:** OpenAI introduces GPT (Generative Pre-trained Transformer), a language model based on transformers, capable of understanding and generating human-like text.
- **2019:** BERT (Bidirectional Encoder Representations from Transformers) by Google demonstrates the effectiveness of pre-trained language models in various natural language processing tasks.
- **2020s:** Continued advancements in deep learning, including large language models, reinforcement learning breakthroughs, and applications in diverse fields such as healthcare, finance, and autonomous systems.