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Neural Network and Deep Learning Workshop

Spring 2020

Agenda

- Introduction to deep learning
- Basics of neural networks
- Gradient descent and loss functions in neural network
- Convoluted neural networks
- Tensor Flow: Deep learning example using Tensor Flow

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Deep Learning

- *Basic: Learning from examples or data representations*
- *Defined as ML technique that can ask a computer to filter inputs (observations in the form of images, text, audio, video, etc.) through layers > learn to predict or classify information*
- Deep learning algorithms seek to exploit the unknown structure in the input distribution in order to discover good representations

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Deep Learning

- Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks
- Deep learning has had an explosion of use since 2012 when it became computationally feasible to do very very deep neural network models

Source: www.PCMag.com

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Deep Learning Applications

- Social Network Analysis
- Movie Recommendations
- Automation in Vehicles and Driverless Cars
- Financial Fraud Detection
- Drug Discovery and Image Processing
  - Helping to tackle the vast amount of patient data (in the form of images) that needs to be processed, analyzed and used by hospitals, insurance companies and other industry players
  - Healthcare companies now have sophisticated tools which allow them to provide virtual healthcare assistance, recognize images on X-rays and scans for fast analysis, and complete medical coding and annotation quickly
- …

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Health Care Deep Learning World

- 300+ papers regarding deep learning and medical image analysis

"By 2025, AI systems could be involved in everything from population health management, to digital avatars capable of answering specific patient queries." — Harpreet Singh Buttar, analyst at Frost & Sullivan.

https://www.cbinsights.com/research/artificial-intelligence-startups-healthcare/

Deep Learning and Neurons

- When you hear the term deep learning, just think of a layers of neurons in our brain and mimic that for a machine

Source: www.medium.com

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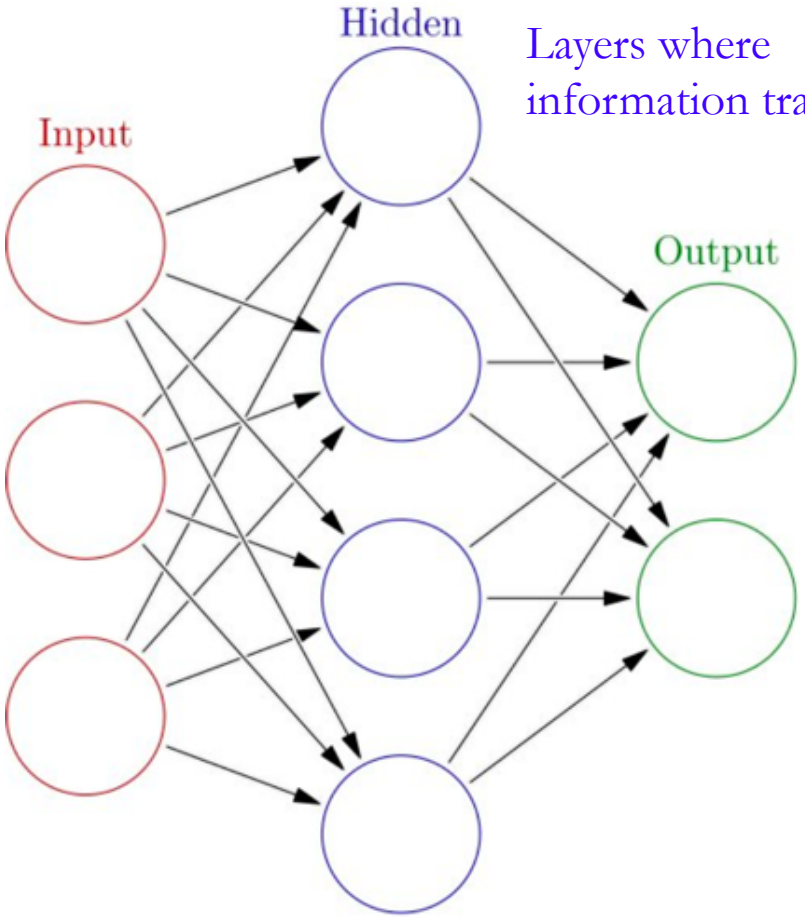
Neurons and Artificial Neural Network



Layers where information travels

What we already know

Our predictions

Artificial Neural Network

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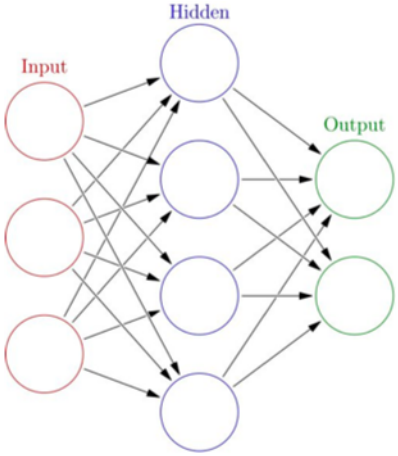
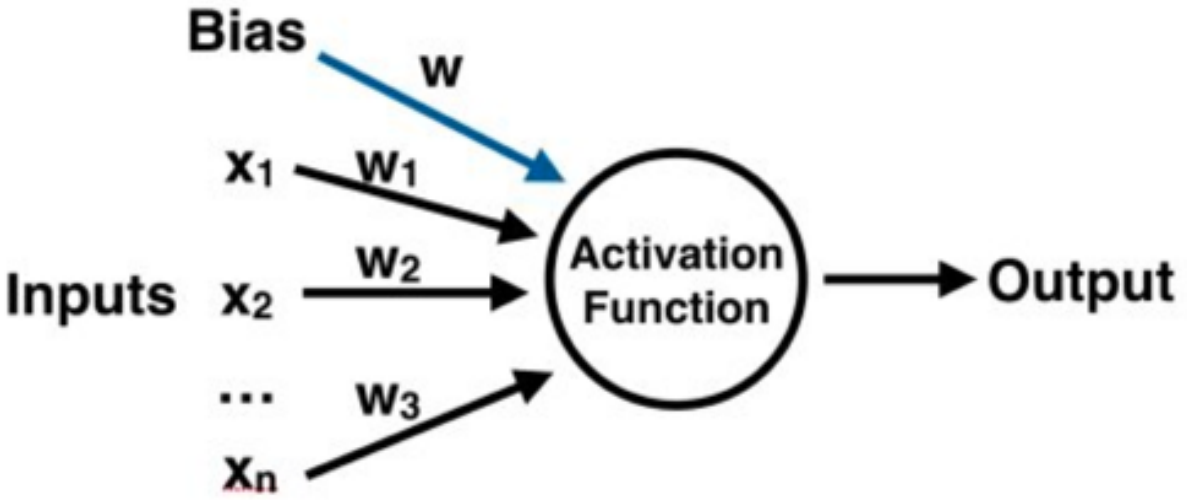
Deep Learning and Neurons





- Artificial neural networks learn by using weights
- By adjusting these weights, ANN decides what signal gets send/ pass along
- Next an activation function is applied to the neuron > so it understands if it needs to pass along a signal or not

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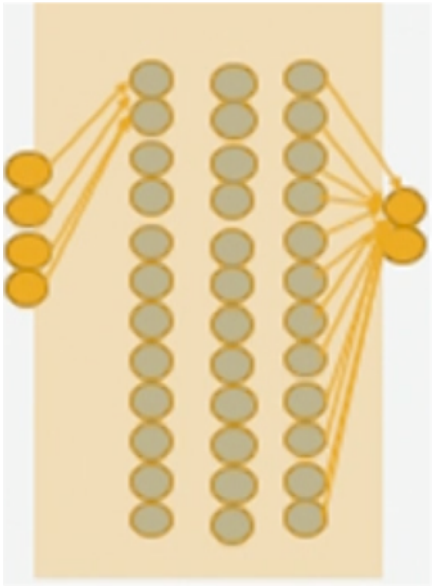
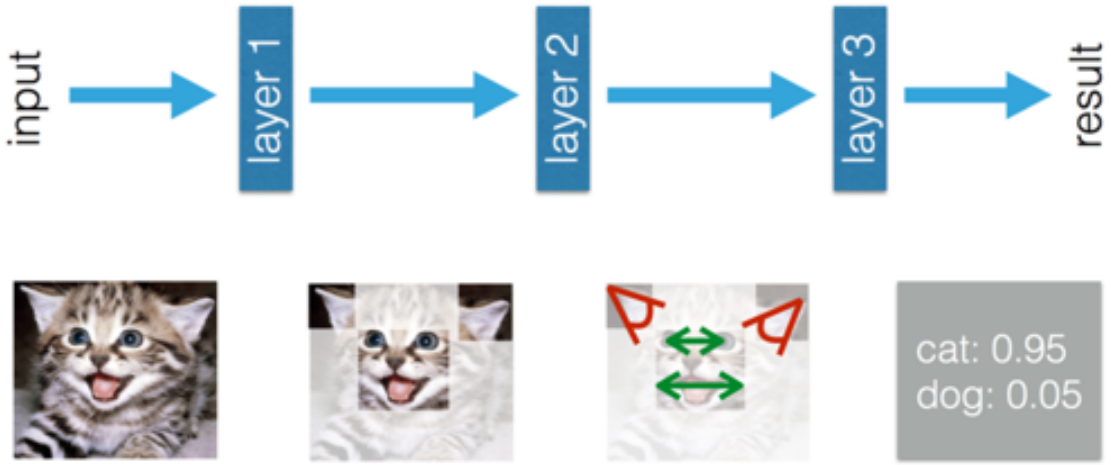
Deep Learning and Neural Network

- When you hear the term deep learning, just think of a large deep neural net

Deep= number of layers typically





Source: Data Science Stack Exchange

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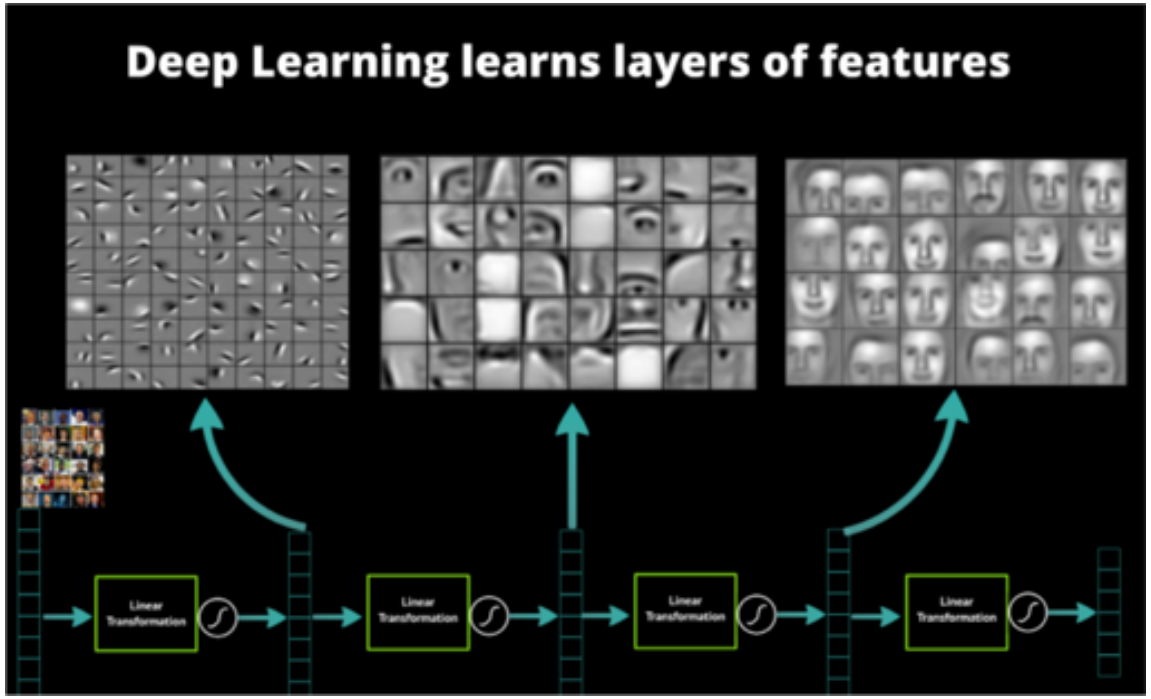
Why Deep Learning is in Fashion?

- Scalability: results better with more data, larger models
- Better technology and tools allow computational efficiency
- Feature Learning: automatic feature extraction from raw data



Source: Data Robot

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Deep Learning Models

- Supervised learning: Almost all the value today of deep learning is through supervised learning or learning from labeled data
- Have an outcome variable: Create an algorithm that supervises the training data and produces an inferred function to map new examples
- Example classification problems
  - Identifying stop signs, lane markers
  - Facial recognition
  - Classifying emails or texts (as spams)
  - Identifying speakers/persons through images, audio and video
  - Transcribing text to speech
  - Identifying sentiments
  - …

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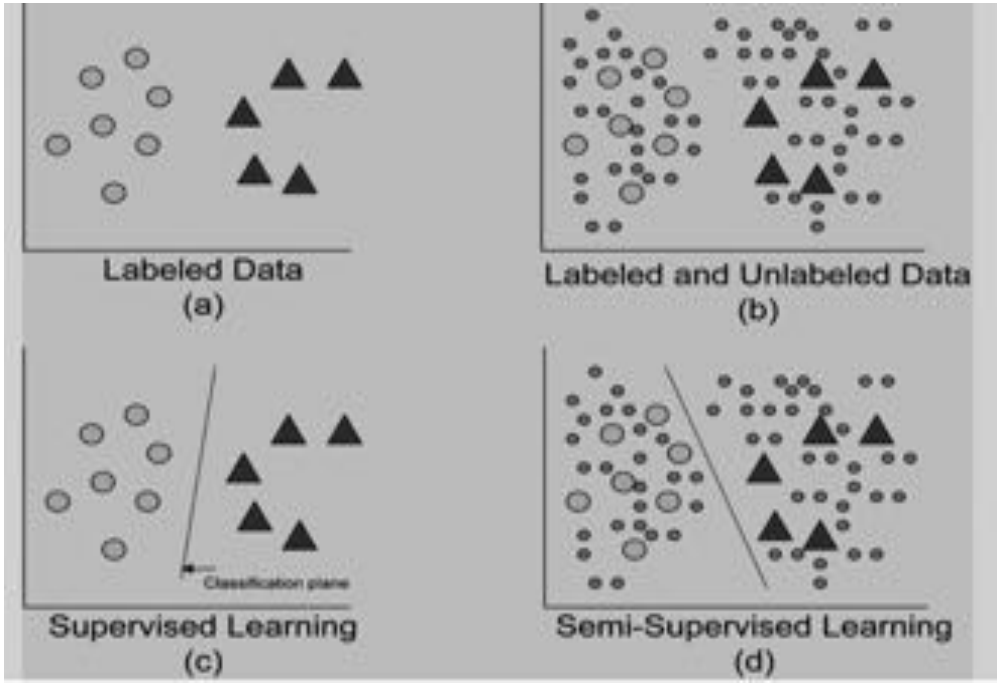
Deep Learning Models

- Semi-Supervised learning: combination of labeled information and those that you have learned (no labels that you observed without naming/counting them)
- Lot of unlabeled data and little labeled data



Source: Towards Data Science

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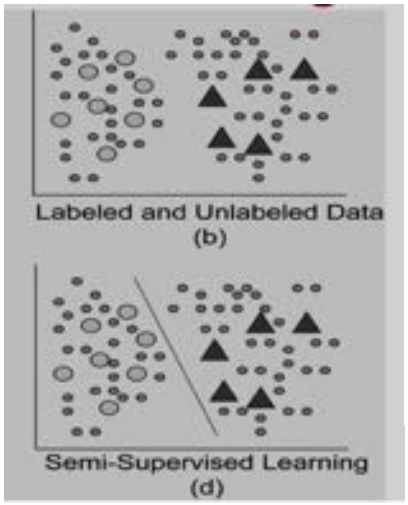
Deep Learning Models

- Semi-Supervised learning: combination of labeled information and unlabeled data



- Assumptions in semi-supervised models:
  - Points that are nearest neighbors share a label (continuity)
  - Data that are likely to form clusters share a label (clustering)
  - The data lie approximately on a manifold of lower dimension than the input space (manifold)

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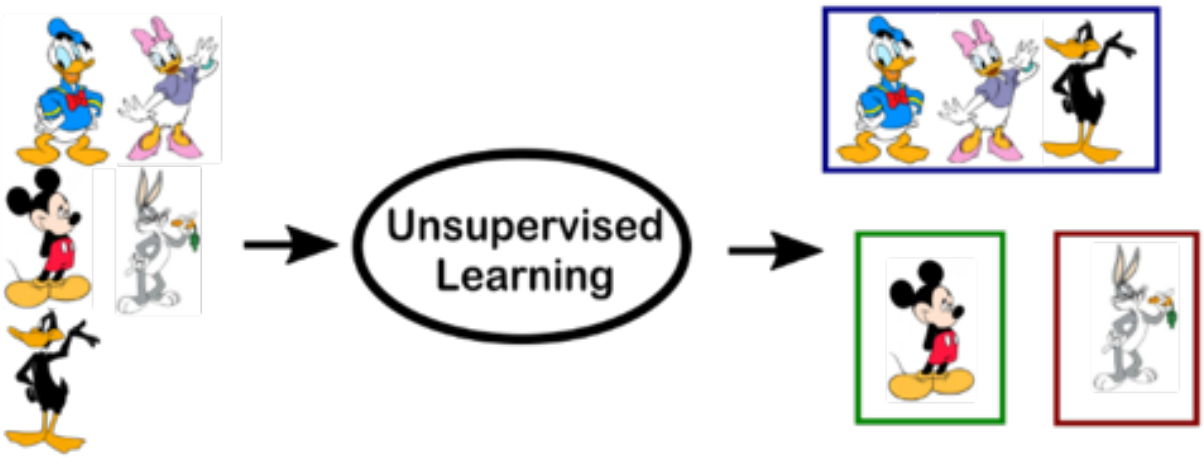
Deep Learning Models

- Unsupervised learning: learn relationships among elements of data and classifying the data (no labels)
- Methods: Algorithms that look for hidden structures, features and patterns in the data (e.g., clustering, anomaly detection)



Source: Kdnuggets.com

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Deep Learning Summary

- Deep Learning: Extract useful patterns from Data
- Approach: Neural Network + Optimization
- Tools: Python, Tensor Flow, Keras, others
- Challenges: Questions and data should be good
- Progress:

  Face recognition; Image classification; Speech recognition; Text-to-speech generation; handwriting transcription; machine translation; medical diagnosis; automated cars; digital assistants; social recommendations; digital marketing; gaming

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Thanks

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