Deep Learning

Lesson 9

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Lecture Overview

Conceptual overview of deep learning
How it works-When to use it?
Types of DNNs and frameworks
Deep Recurrent NNs
Deep Convolutional NNs
Use case

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Why is Deep Learning Suddenly So Popular?

DL models have been around for a long time

- Fukushima (1980) – Neo-Cognitron
- LeCun (1989) – Convolutional Neural Network

DL popularity grew recently due to:

- Availability of Big Data
- More powerful GPUs
- Runaway success in machine learning competitions

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Motivation: Why Go Deep

Deep representations may map more closely to the problem space

- –Allows for non-local generalization
- –Comprehensibility

Deep architectures can be representationally efficient for certain types of applications

- –Fewer computational units are required for similar or better capability

Multiple levels of latent variables allow combinatorial sharing of statistical strength

Deep architectures work well (vision, audio, NLP, etc.)

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Why are DNNs so Important?

Our brains are organized and operate in a very similar way

- Perception is represented at multiple levels of abstraction, where each level corresponds to a different area of cortex.

Humans often describe such concepts in hierarchical ways, with multiple levels of abstraction.

- The brain also appears to process information through multiple stages of transformation and representation.

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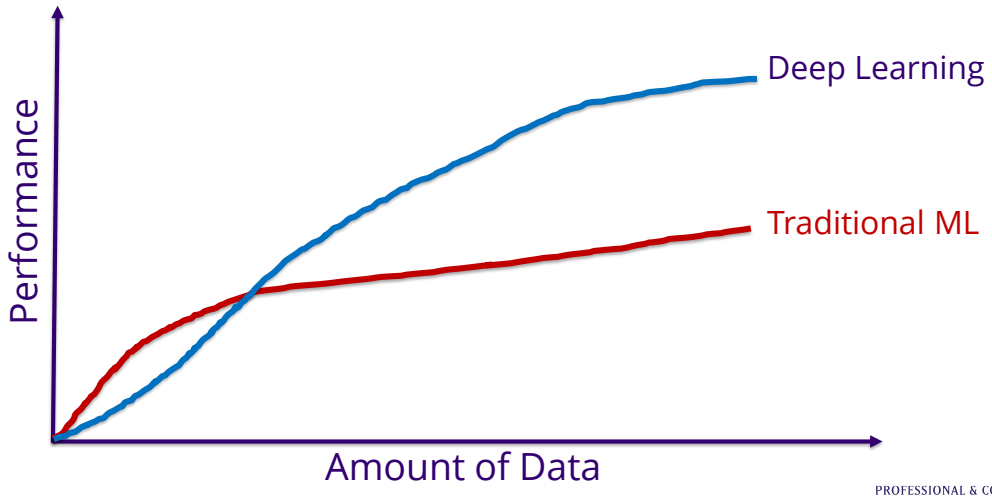
When to use deep learning



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Traditional Approach

Feature extractors, required:

- Expert knowledge
- Time-consuming hand-tuning
- In industrial applications, this is 70-80% of the time
- Sometimes are problem specific

But, what if we could learn feature extractors?

Microsoft

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Restricted Boltzmann Overview

- RB machines are useful for dimensionality reduction, classification, regression, collaborative filtering, feature learning and topic modeling
- An RB machine is a shallow, two-layer neural net (visible and hidden) which are the building blocks of deep-belief networks
- Differs from the neural networks:
  - Connections going both ways (forward *and* backward)
  - Activation function for each output node (as opposed to summing them)
  - Generative, as opposed to discriminative

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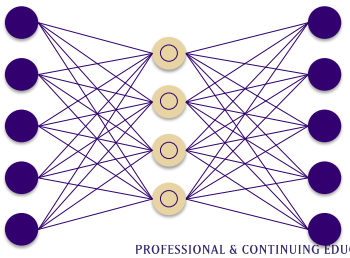
Autoencoders

- Symmetric neural network—where all output units are connected back to the input units
- The middle layer is a "compressed" representation of the data where latent features can be learnt
- It works similarly to PCA, except that it is able, depending on the depth and the activation function, to learn complex non-linear relationships between the input and output layers



Summary

- Conceptual overview of deep learning
  - What it is
  - Why it is important
  - When to use it
- We compared deep learning to traditional machine learning approaches
- Discussed two types of neural networks, used for latent feature identification