Machine Learning 410

Introduction to Deep learning

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Why Deep Learning Is Exciting?

- Deep learning models have revolutionized many areas of machine intelligence
  - Speech recognition
  - Natural language processing
  - Image recognition
  - Handwriting recognition
  - etc., etc., …

- Deep learning models particularly effective for **unstructured data**

Why Deep Learning Is Exciting?

- Previously, models for unstructured data were highly specialized
  - Used complex **hand-engineered** features
  - Feature sets were very problem specific
  - Error rates stuck in the double digit precents
  - Feature sets could require a lifetime of work!

- Deep learning models provide a generalized approach to complex models for unstructured data
  - Deep learning models **learn features**
  - Error rates now routinely around 1% or less!

Why Deep Learning Now?

- Neural network models have been around for a long time
  - Deep learning models are based on neural networks
  - Early neural network models developed from the 1940s to 1960s
  - Early neural network models not that effective (Minsky and Papert, 1969)

- Very little research in 1970s

- Training deep NNs with backprobagation algorithm (Rummelhart et. al., 1986) sparked new interest
  - Early deep NNs proved hard to train
  - Limited computing capacity

Why Deep Learning Now?

- Continuing work on algorithms to overcome training problems in 1990s into 2000s

- Rania et. al. (2009), demonstrated that **Graphics Processing Units (GPUs)** could be effectively applied to training deep NNs
  - Removed a significant computational bottleneck
  - Combined with low cost cluster computing and large memory
 - Can train very large, or deep, models

Why Deep Learning Now?

- The current decade has seen an explosion in deep learning research
  - Deep learning approaches to many problems continue to appear

- Deep learning solutions are now routinely deployed on a large scale
  - Many powerful APIs in platforms like Azure
  - Open source pre-trained models
  - New solutions continue to appear

Why This Course?

- This course will give you the background to understand deep learning principles
    - Understand the theory behind common deep learning models
    - Know the pitfalls in training deep learning models

- You will gain hands-on experience with a variety of deep learning models

Why This Course?
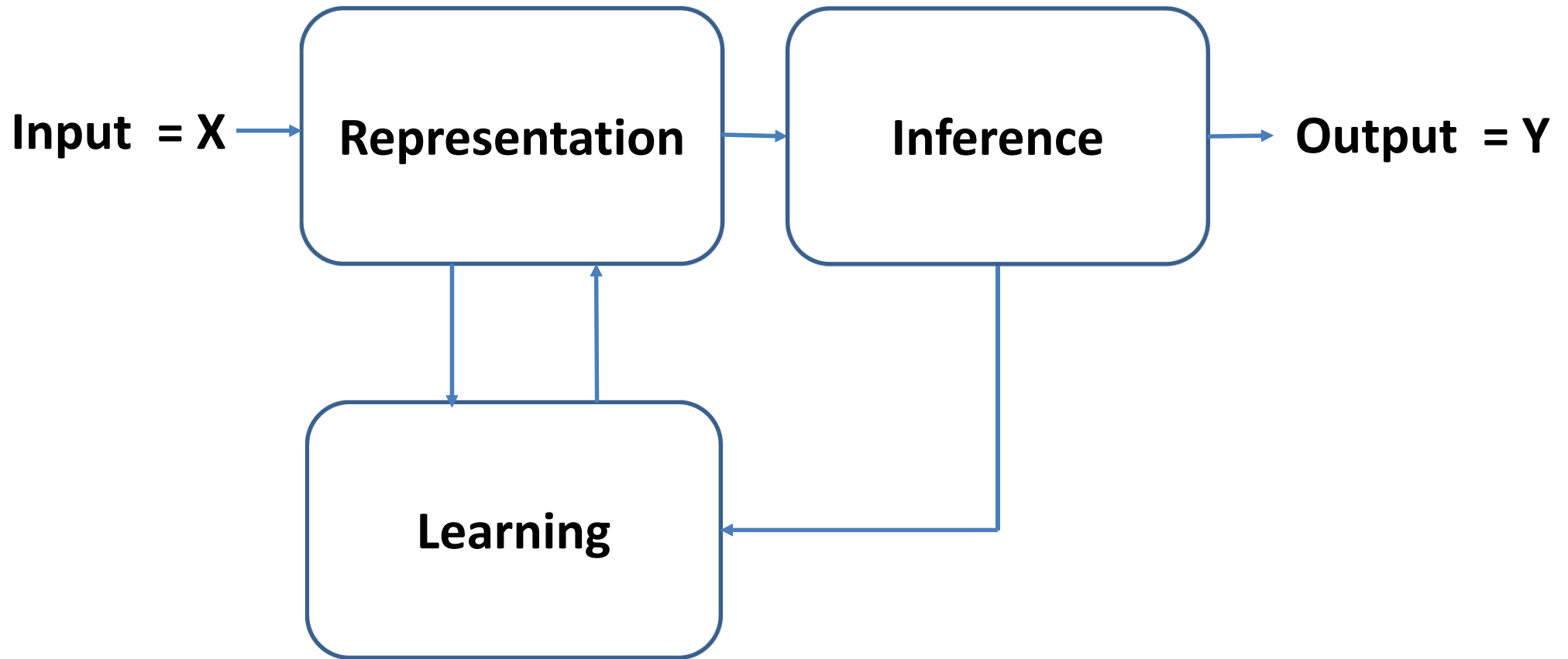
Why This Course?

Topics for this course

- Background review for deep learning and introduction to Keras

- Basic building blocks for deep NNs

- Regularization for training deep NNs

- Optimization for training deep NNs

- Convolutional NNs

- Recurrent NNs

About Your Instructor

- Principle Consultant at Quantia Analytics
- Instructor, Harvard Extension School, University of Washington
- MS and PhD in Geophysics from Princeton University
- Developed interest in NNs starting in 1980s
- Co-founded analytics businesses
- Worked in a number of areas:
  - Capital markets risk
  - Image analysis
  - Fraud detection
  - Forecasting
  - Failure prediction