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# Natural Language Processing Deep Learning — Units 5 & 6

Dr. Jon Krohn
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Slides available at jonkrohn.com/talks

November 16th, 2019



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Talk through the purpose of every line in the [VGGNet notebook], including all of the following terms:

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# Two Core Concepts

- 1 Deep Learning
- 2 Natural Language Processing (NLP)



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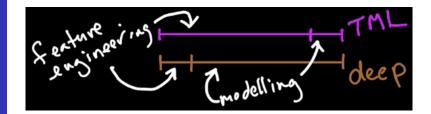
# Two Core Concepts

- Deep Learning
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# TML vs Deep Learning





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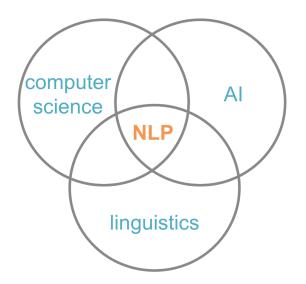
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## Natural Language Processing





- speech recognition (Echo, Siri, Cortana)



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- search (typed into omnibox, spoken)
- classifying documents
- language translation
- chatbots



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- spell checking
- synonym suggestions
- keyword search



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- synonym suggestions
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## Intermediate

## reading level

- extracting information
- predicting next words
- classification
- sequence generation
- time-series analysis



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# Complex

- machine translation
- question-answering
- chatbots



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## Complex

- machine translation
- question-answering
- chatbots



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# Complex

- machine translation
- question-answering
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# One-Hot Word Representations

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# JR Firth (1957)

"You shall know a word by the company it keeps"



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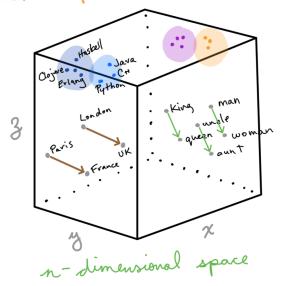
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$$V_{\text{king}} - V_{\text{man}} + V_{\text{woman}} = V_{?}$$
 $V_{\text{jeff\_bezos}} - V_{\text{amazon}} + V_{\text{facebook}} = V_{?}$ 
 $V_{\text{windows}} - V_{\text{microsoft}} + V_{\text{google}} = V_{?}$ 
 $V_{\text{cu}} - V_{\text{copper}} + V_{\text{gold}} = V_{?}$ 



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## Word Representations

### One-Hot

### **Vector-Based**

lack nuance

handle new words poorly

subjective

laborious, manual taxonomies

word similarity ignored

unwieldy with large vocabulary

extremely nuanced

seamlessly incorporate new words

driven by natural language data

fully-automatic

word similarity = closeness in space

accommodate large vocabularies



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# JR Firth (1957)

"You shall know a word by the company it keeps"



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word2vec

# Word Representations

predicts		relative strengths		
Skip-Gram (SG)	context given target	<ul><li>small data set</li><li>rare words</li></ul>		
CBOW	target given context	<ul> <li>many times faster</li> <li>slightly better for frequent words</li> </ul>		



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# **Evaluating Word Vectors**

- 1 intrinsic
- 2 extrinsic



### word2vec

# **Evaluating Word Vectors**

- intrinsic
- extrinsic



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## word2vec Hyperparameters

- 1 n dimensions
- 2 window size (SG ~10, CBOW ~5)
- 3 n iterations
- data set size



word2vec

# word2vec Hyperparameters

- n dimensions
- 2 window size (SG ~10, CBOW ~5)



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# word2vec Hyperparameters

- 1 n dimensions
- 2 window size (SG ~10, CBOW ~5)
- 3 *n* iterations
- data set size



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# word2vec Hyperparameters

- 1 n dimensions
- 2 window size (SG ~10, CBOW ~5)
- 3 *n* iterations
- 4 data set size



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# Transfer Learning

**Pre-Trained Word Vectors** 

- 1 word2vec: code.google.com/archive/p/word2vec
- 2 GloVe: nlp.stanford.edu/projects/glove
- 3 fastText: fasttext.cc (157 languages)
- 4 BERT: github.com/google-research/bert (hierarchical)



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# Transfer Learning

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[ creating word vectors notebook ]



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# Best Practices for Preprocessing NLP Data

[ NL preprocessing best practices notebook ]



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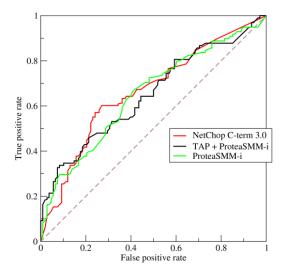
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# **Dense Net Classification**

[ dense sentiment classifier notebook ]



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# ConvNet Classification

[ convolutional sentiment classifier notebook ]



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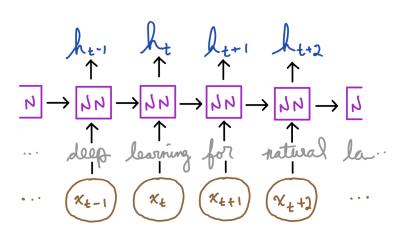
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# **RNNs** in Practice

[ rnn notebook ]



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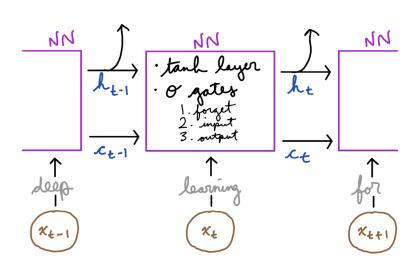
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# **LSTM Theory**

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# LSTMs in Practice

[ vanilla LSTM and GRU notebooks ]



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# **Bi-Directional LSTMs**

[ Bi-LSTM notebook ]



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# Stacked LSTMs

[ stacked LSTM and ye olde stackeroo notebooks ]



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[ multi-ConvNet notebook ]



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# Sequence Generation

[ Sequence Generation notebook ]



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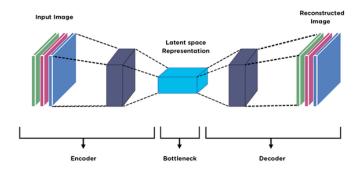
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# **Autoencoders and Attention**





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Seminal Models

- ULMFiT: universal language model fine-tuning
- ELMo: embeddings from language models
- BERT: bi-directional encoder representations from transformers (for long-range attention)
- smaller derivations of BERT, e.g., RoBERTa, DistilBERT
- GPT-2: generative pre-trained transformer 2



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# Financial Forecasting

See *Time Series Prediction* on my [resources page]



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# Assessing Your Deep Learning Project III





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# Assessing

- 1 split your data
  - training set (80% for optimizing parameters)
  - validation set (10% for hyperparameters)
  - test set (10% don't touch yet!)
- 2 build and assess architecture
  - · get above chance (simplifying problem, if necessary)
  - do existing performance benchmarks exist?
  - if not, use a simple architecture as benchmark
- 3 "teamwork makes the dream work" (?)



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- (?)
  \*teamwork makes the dream work



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# Assessing Your Deep Learning Project III

- 1 split your data
  - training set (80% for optimizing parameters)
  - validation set (10% for hyperparameters)
  - test set (10% don't touch yet!)
- 2 build and assess architecture
  - get above chance (simplifying problem, if necessary)
  - do existing performance benchmarks exist?
  - if not, use a simple architecture as benchmark
- (?)
  \*teamwork makes the dream work



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- 2 build and assess architecture
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  - do existing performance benchmarks exist?
  - if not, use a simple architecture as benchmark
- 3 "teamwork makes the dream work" (?)



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