

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Natural Language Processing

## Deep Learning — Units 5 & 6

Dr. Jon Krohn

[jon@untapt.com](mailto:jon@untapt.com)

Slides available at [jonkrohn.com/talks](http://jonkrohn.com/talks)

March 30th, 2019

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures



# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- **ReLU**
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- **ReLU**
- **cross-entropy**
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer



# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL

#### Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer



# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Take-Home Exercise: VGGNet

## Review

### DL for NLP

Intro

NLP Applications

Representations

### Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

### Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

### RNNs

Simple RNNs

LSTMs

### Parallel Nets

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

- ReLU
- cross-entropy
- epoch
- parameters
- hyperparams
- SGD
- learning rate
- batch size
- Adam
- dropout
- batchnorm
- input layer
- dense/FC layer
- convolutional
- max-pooling
- flatten
- softmax layer

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Two Core Concepts

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

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



# Two Core Concepts

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

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

# TML vs Deep Learning

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

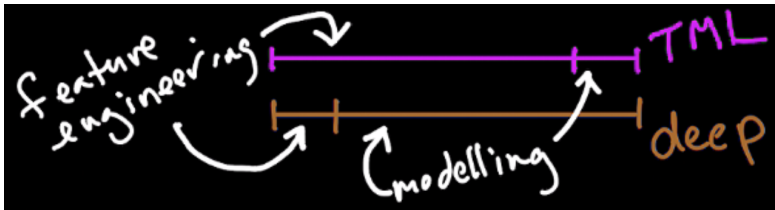
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets



# Two Core Concepts

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

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

# Two Core Concepts

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

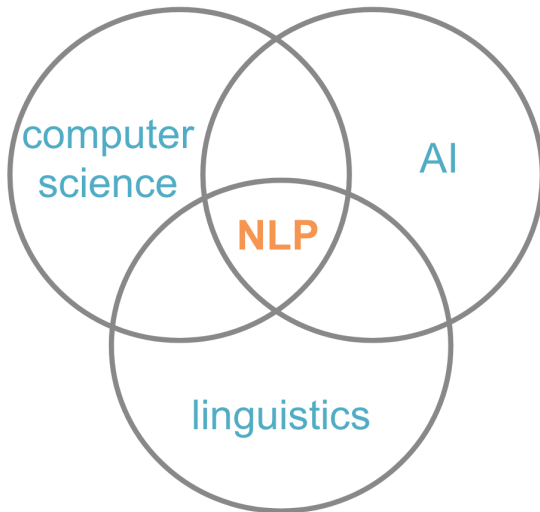
Simple RNNs

LSTMs

Parallel Nets

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

# Natural Language Processing



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Examples of NLP in Industry

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- **speech recognition (Echo, Siri, Cortana)**
- search (typed into omnibox, spoken)
- classifying documents
- language translation
- chatbots

# Examples of NLP in Industry

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- speech recognition (Echo, Siri, Cortana)
- search (typed into omnibox, spoken)
  - classifying documents
  - language translation
  - chatbots

# Examples of NLP in Industry

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- speech recognition (Echo, Siri, Cortana)
- search (typed into omnibox, spoken)
- classifying documents
- language translation
- chatbots



# Examples of NLP in Industry

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- speech recognition (Echo, Siri, Cortana)
- search (typed into omnibox, spoken)
- classifying documents
- language translation
- chatbots

# Examples of NLP in Industry

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- speech recognition (Echo, Siri, Cortana)
- search (typed into omnibox, spoken)
- classifying documents
- language translation
- chatbots

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications**
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

## Review

## DL for NLP

Intro

### NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL Data

Preprocessing

ROC Curve

Sentiment  
Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- **spell checking**
- synonym suggestions
- keyword search

## Review

## DL for NLP

Intro

### NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- spell checking
- synonym suggestions
- keyword search

## Review

## DL for NLP

Intro

### NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- spell checking
- synonym suggestions
- keyword search

Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space  
Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment  
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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

Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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



Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Intermediate

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

Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Complex

- machine translation
- question-answering
- chatbots

Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Complex

- machine translation
- question-answering
- chatbots

Review

DL for NLP

Intro

**NLP Applications**

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Complex

- machine translation
- question-answering
- chatbots

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets



## One-Hot Word Representations

<u>word</u>	The	cat	sat	on	the	mat.
the	1	0	0	0	1	0
cat	0	1	0	0	0	0
on	0	0	0	1	0	0
⋮						
⋮						
⋮						

Unique-words

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 **Word Vectors**
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space  
Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment  
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 **Word Vectors**
  - Vector-Space Embedding**
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space  
Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

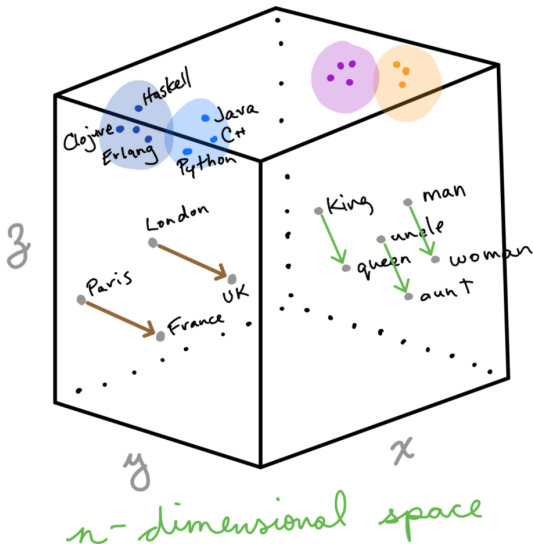
LSTMs

Parallel Nets

# JR Firth (1957)

“You shall know a word by the company it keeps”

# Vector Representations of Words



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Word Vector Arithmetic

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

$$V_{\text{king}} - V_{\text{man}} + V_{\text{woman}} = V_{?}$$

$$V_{\text{jeff\_bezos}} - V_{\text{amazon}} + V_{\text{facebook}} = V_{?}$$

$$V_{\text{windows}} - V_{\text{microsoft}} + V_{\text{google}} = V_{?}$$

$$V_{\text{cu}} - V_{\text{copper}} + V_{\text{gold}} = V_{?}$$

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space  
Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

[word2viz demo]

# Word Representations

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space  
Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

## One-Hot

lack nuance

handle new words poorly

subjective

laborious, manual taxonomies

word similarity ignored

unwieldy with large vocabulary

## Vector-Based

extremely **nuanced**

seamlessly incorporate **new words**

**driven by** natural language **data**

fully-**automatic**

**word similarity** = closeness in space

accommodate **large vocabularies**



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 **Word Vectors**
  - Vector-Space Embedding
  - word2vec**
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# JR Firth (1957)

“You shall know a word by the company it keeps”

# Word Representations

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

	<b>predicts</b>	<b>relative strengths</b>
<b>Skip-Gram (SG)</b>	context given target	<ul style="list-style-type: none"><li>● small data set</li><li>● rare words</li></ul>
<b>CBOW</b>	target given context	<ul style="list-style-type: none"><li>● many times faster</li><li>● slightly better for frequent words</li></ul>

# Evaluating Word Vectors

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

- 1 intrinsic
- 2 extrinsic

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Evaluating Word Vectors

- 1 intrinsic
- 2 extrinsic

# word2vec Hyperparameters

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

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

# word2vec Hyperparameters

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

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

# word2vec Hyperparameters

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

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



# word2vec Hyperparameters

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

**word2vec**

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

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

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 **Word Vectors**
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec**
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

**Creating Word  
Vectors**

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

[ *creating word vectors* notebook ]

# Outline

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data**
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Best Practices for Preprocessing NLP Data

[ *NL preprocessing best practices* notebook ]

# Outline

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

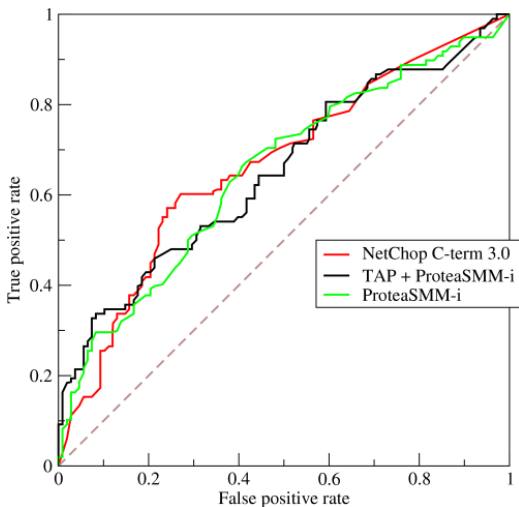
Simple RNNs

LSTMs

## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# The Area Under the ROC Curve



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

**ROC Curve**

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets



# Outline

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment  
Classification

## RNNs

Simple RNNs

LSTMs

## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification**
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# Dense Net Classification

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment  
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

[ *dense sentiment classifier* notebook ]

# ConvNet Classification

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment  
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

[ *convolutional sentiment classifier notebook* ]

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

# RNN Theory

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

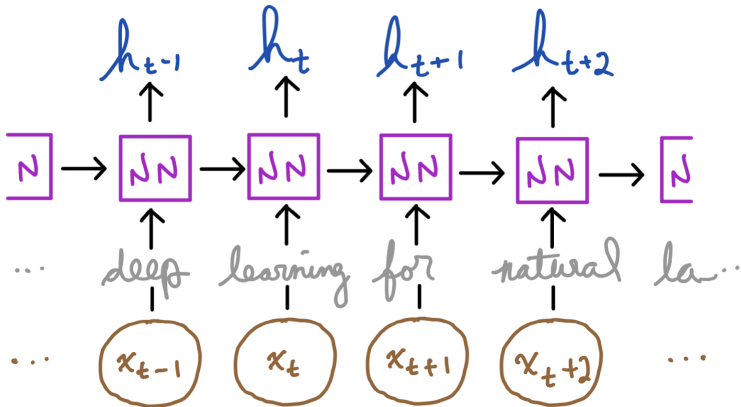
Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# RNNs in Practice

[ *rnn* notebook ]

# Outline

## Review

## DL for NLP

Intro

NLP Applications

Representations

## Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

## Modeling NL

### Data

Preprocessing

ROC Curve

Sentiment

Classification

## RNNs

Simple RNNs

LSTMs

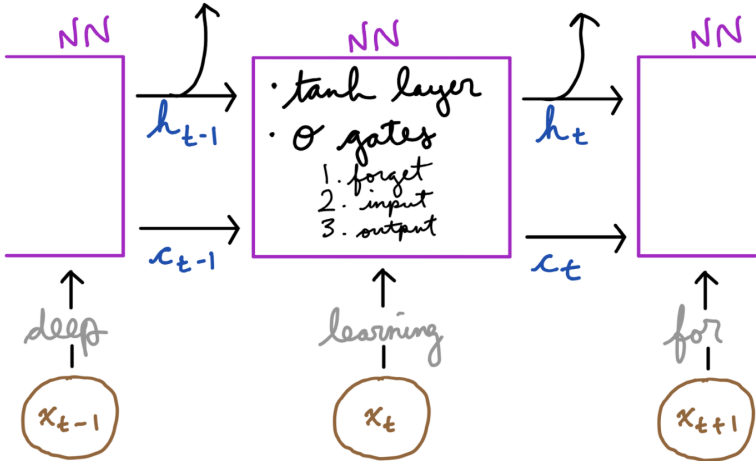
## Parallel Nets

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors with word2vec
- 4 Modeling Natural Language Data
  - Best Practices for Preprocessing NLP Data
  - The Area Under the ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures



# LSTM Theory

- Review
- DL for NLP
  - Intro
  - NLP Applications
  - Representations
- Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- Modeling NL Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- RNNs
  - Simple RNNs
  - LSTMs
- Parallel Nets



Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# LSTMs in Practice

[ *vanilla LSTM* and *GRU* notebooks ]

# Bi-Directional LSTMs

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

[ *Bi-LSTM* notebook ]

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Stacked LSTMs

[ *stacked LSTM* and *ye olde stackeroo* notebooks ]

# Outline

- 1 Review Take-Home Exercise
- 2 The Power and Elegance of Deep Learning for NLP
  - Introduction to DL for NLP
  - NLP Applications
  - Computational Representations of NL
- 3 Word Vectors
  - Vector-Space Embedding
  - word2vec
  - Creating Word Vectors
- 4 Modeling Natural Language Data
  - Preprocessing
  - ROC Curve
  - Sentiment Classification
- 5 Recurrent Neural Networks
  - Simple RNNs
  - LSTMs
- 6 Parallel Network Architectures

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL

Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Parallel Network Architectures

[ *multi-ConvNet* notebook ]

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

# Assessing Your Deep Learning Project III



# 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

### 3 “teamwork makes the dream work” (?)



# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)

# 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
- 3 “teamwork makes the dream work” (?)



# Up Next: TensorFlow

Review

DL for NLP

Intro

NLP Applications

Representations

Word Vectors

Vector-Space

Embedding

word2vec

Creating Word  
Vectors

Modeling NL  
Data

Preprocessing

ROC Curve

Sentiment

Classification

RNNs

Simple RNNs

LSTMs

Parallel Nets

