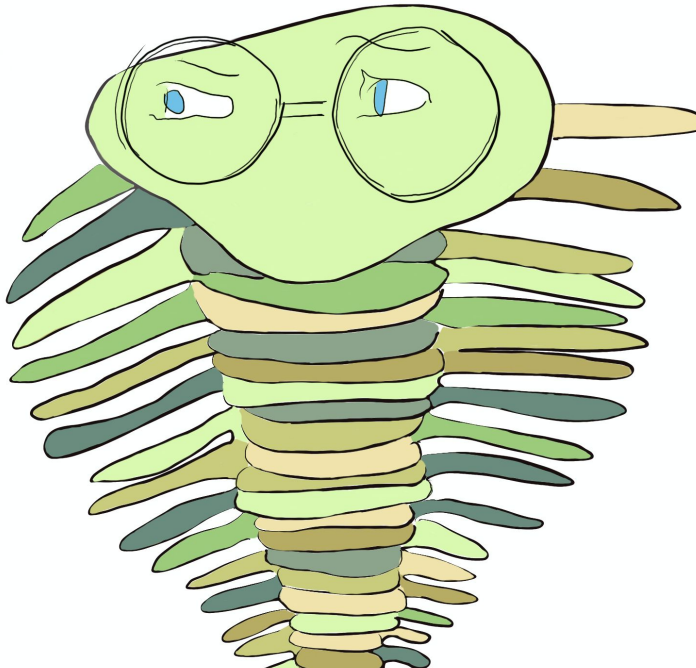
Deep Learning Model Architectures for **Natural Language Processing**

Powerful, Efficient Processing with Artificial Neural Networks

Jon Krohn, Ph.D.



jonkrohn.com/talks

github.com/jonkrohn/DLTFpT

Deep Learning for NLP

1. The Power and Elegance of Deep Learning for NLP
2. Modeling Natural Language Data
3. Recurrent and Advanced Neural Networks

Deep Learning for NLP

1. **The Power and Elegance of Deep Learning for NLP**
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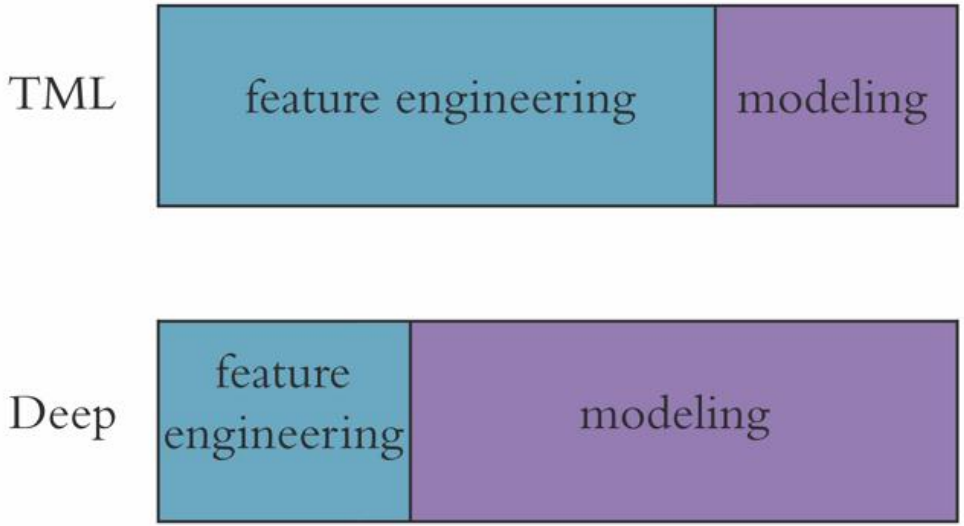
Two Core Concepts

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

Traditional ML vs Deep Learning



Two Core Concepts

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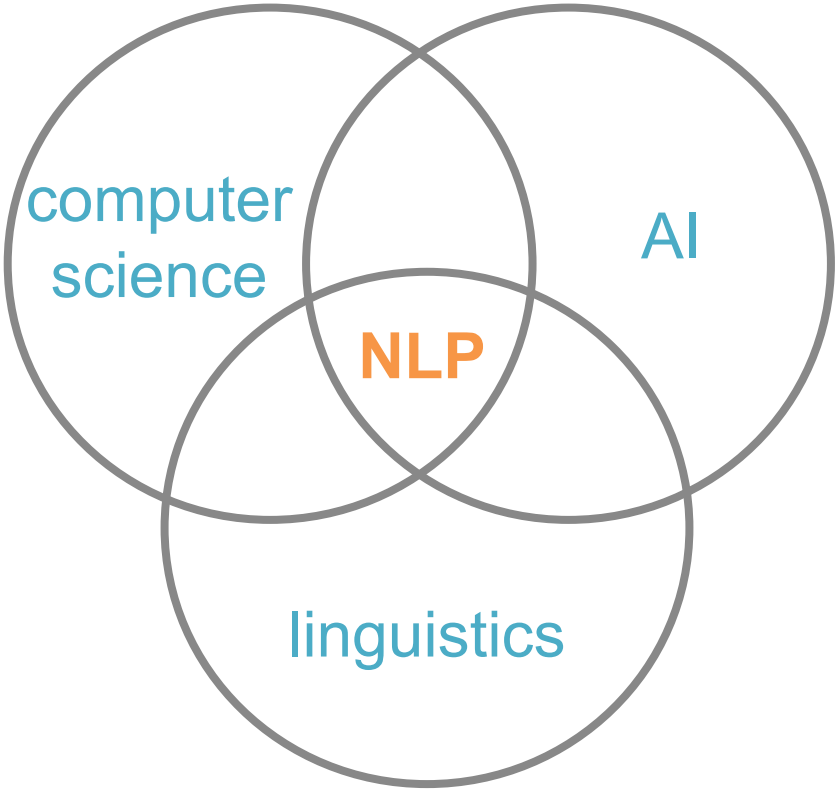
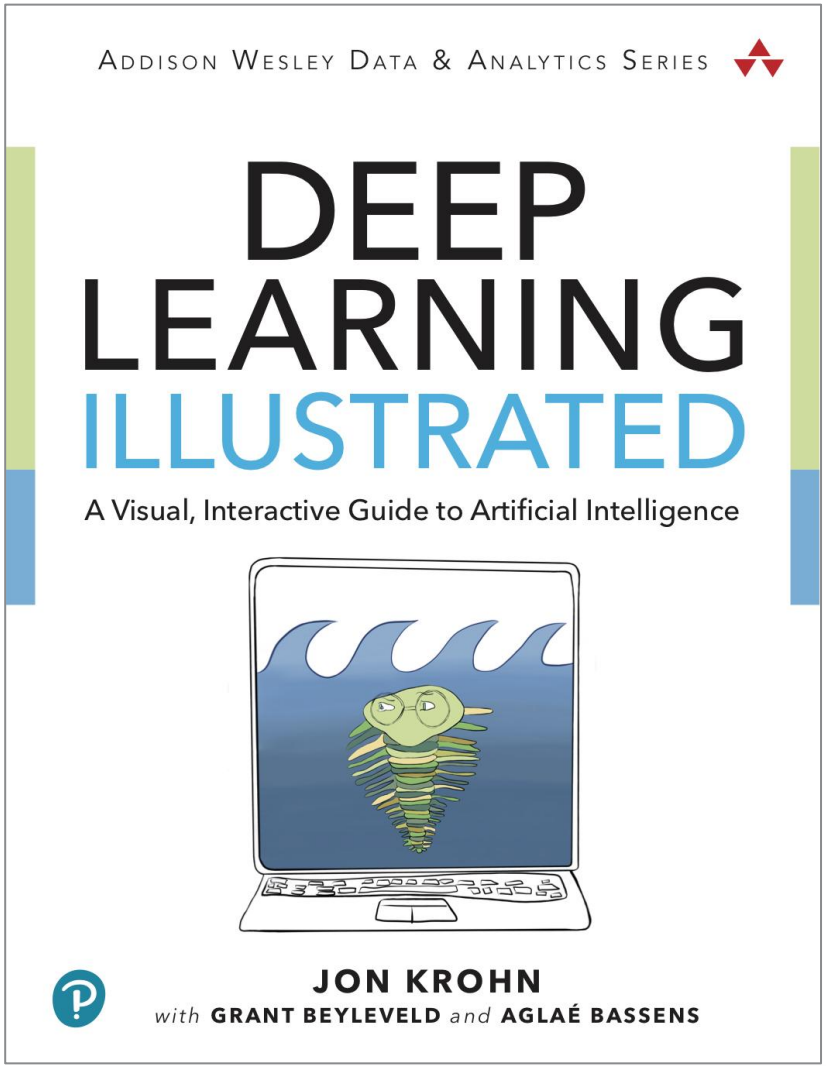
Natural Language Processing



Deep Learning for NLP

1. The Power and Elegance of Deep Learning for NLP
2. **Modeling Natural Language Data**
   - Document Classification with a Dense Net
   - Ditto with a ConvNet
3. Recurrent and Advanced Neural Networks



Deep Learning

Theory Assumed:

- **Artificial neurons**
- **Cost functions**
- **Stochastic gradient descent**
- **Dense and convolutional layers**
- **Pooling**
- **Dropout**

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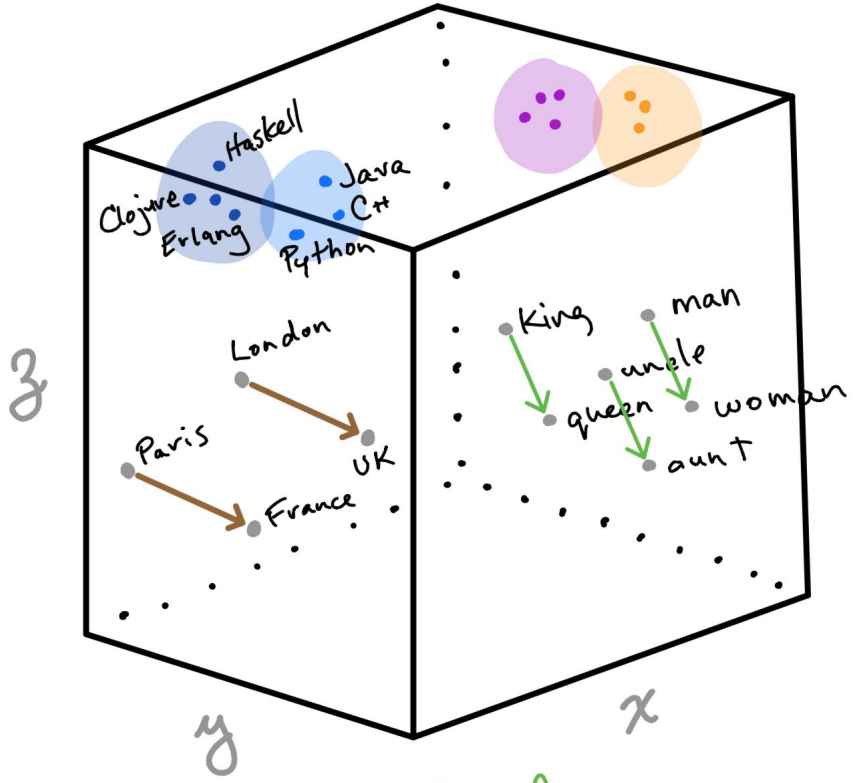
Vector Representations of Words



n-dimensional space

Word Vector Arithmetic

$$v_{\text{king}} - v_{\text{man}} + v_{\text{woman}} = v_{\text{queen}}$$

$$v_{\text{bezos}} - v_{\text{amazon}} + v_{\text{tesla}} = v_{\text{musk}}$$

$$v_{\text{windows}} - v_{\text{microsoft}} + v_{\text{google}} = v_{\text{android}}$$

$$v_{\text{cu}} - v_{\text{copper}} + v_{\text{gold}} = v_{\text{au}}$$

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3. **Recurrent and Advanced Neural Networks**
    - Recurrent Neural Networks
    - LSTMs
    - Bi-Directional LSTMs
    - Stacked LSTMs
    - Parallel Network Architectures
    - Transfer Learning in NLP

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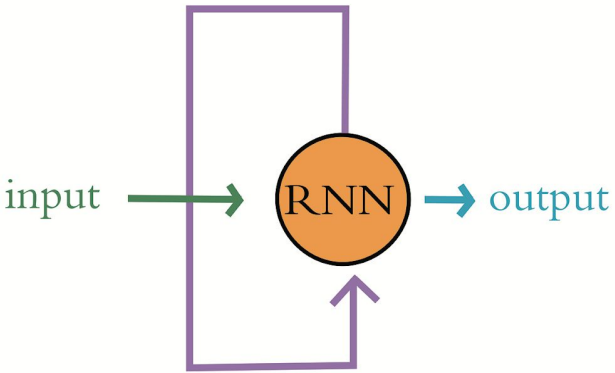
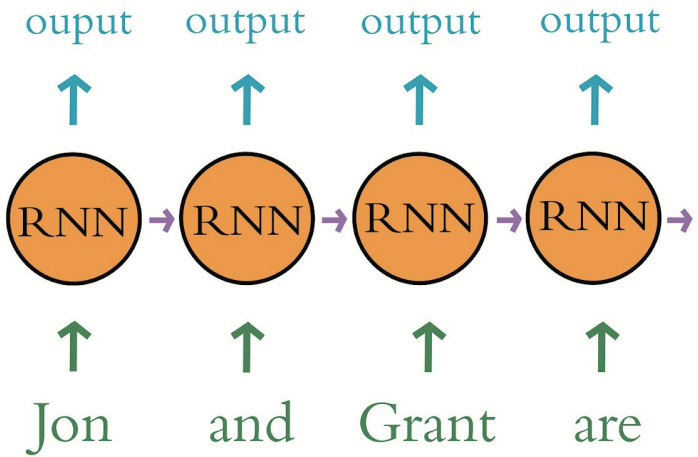
Recurrent Neural Network



RNN unpacked



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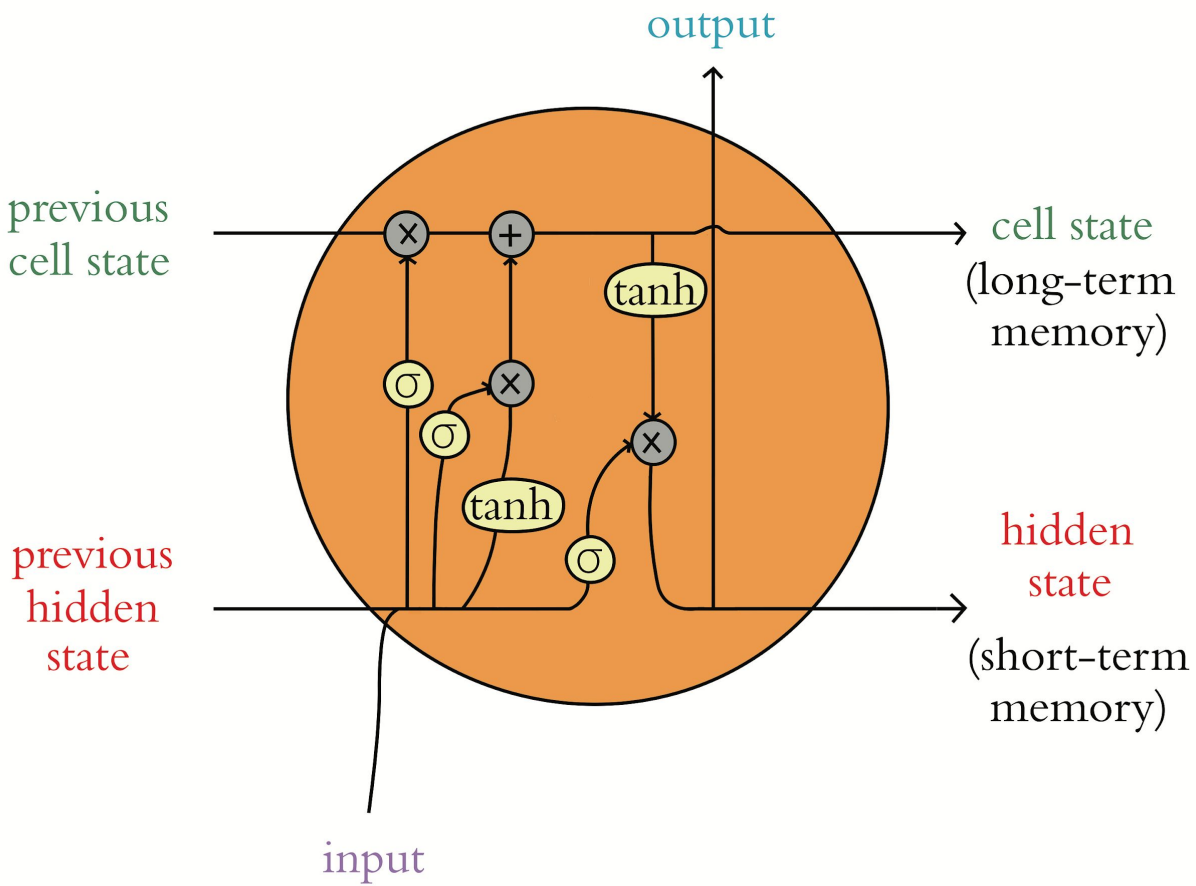
Long Short-Term Memory Unit



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Model	ROC AUC (%)
Dense	92.9
Convolutional	96.1
Simple RNN	84.9
LSTM	92.8
Bi-LSTM	93.5
Stacked Bi-LSTM	94.9
GRU	93.0
Conv-LSTM	94.5
Multi-ConvNet	96.2

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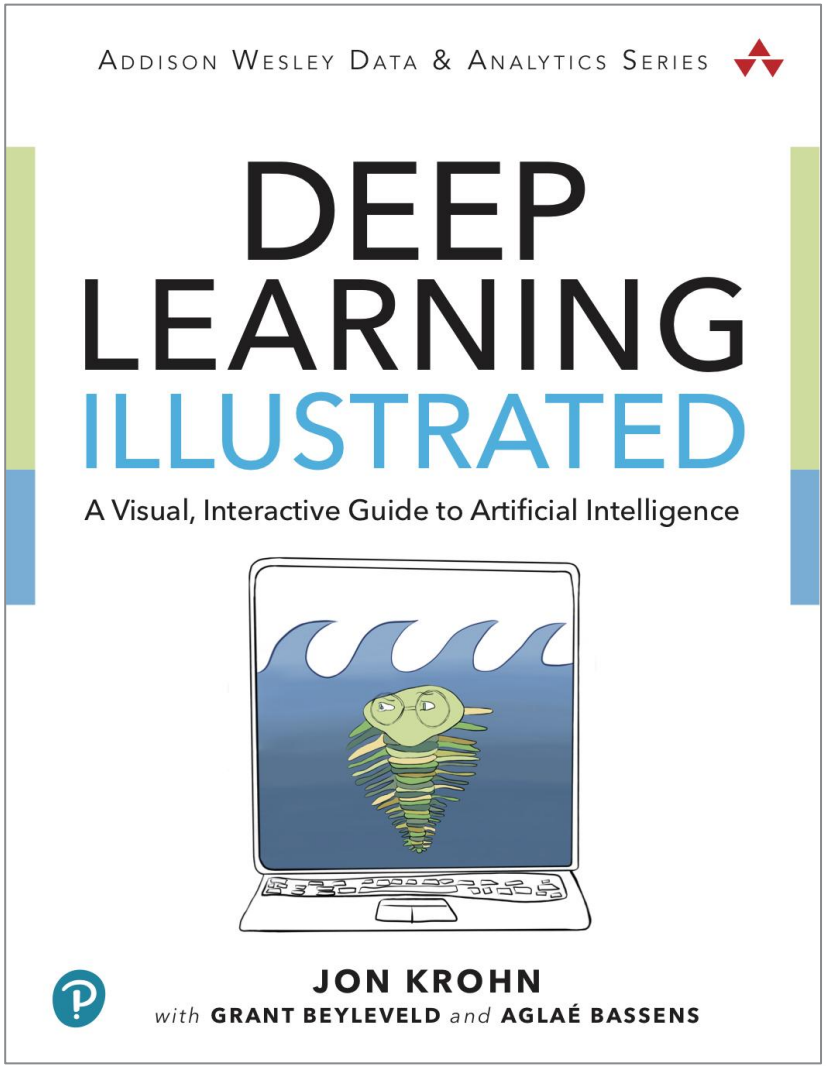
Transfer Learning in NLP

- ULMFiT
- ELMo
- BERT
  - RoBERTa
  - DistilBERT
- GPT-2: `talktotransformer.com`
- GPT-3
  - Absolutely massive
  - No transfer learning required for some tasks



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