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Motivate

How it works

HOW to trail

Fast training

Questions

Neural machine translation Pydata2017 Amsterdam

Rob Romijnders

RomijndersRob@gmail.com robromijnders.github.io

April 9, 2017

Overview

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 $\mathsf{Motivat} \mathfrak{e}$

How it works
RNN
Seq2Seq

How to train
Word vectors
Fast training
Fast translation

Question

1 Motivate

- 2 How it works
 - RNN
 - Seq2Seq
- 3 How to train
 - Word vectors
 - Fast training
 - Fast translation
- 4 Questions

GMail reply

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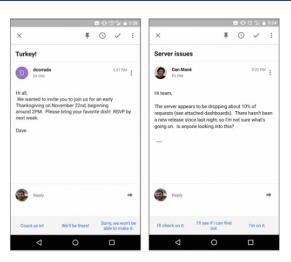


Photo: Greg Corrado, Google Research Blog

Apple siri

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Photo: cultofmac.com

Question Answering

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Question:

Attention Visualization











What is the pattern on the cat's fur on its tail?

Answer: stripes

the ball ?

Allswei . y

credits: NIPS slides, Richard Socher

Question answering

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Questio

■ Info: Mary Walked to the bathroom

■ Info: Sandra went to the garden

Info: Daniel went back to the garden

■ Info: Sandra took the milk there

Question: Where is the milk?

Answer: Garden

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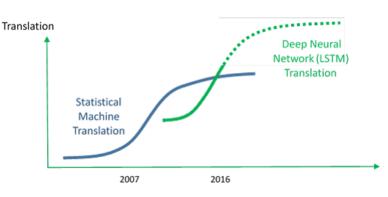
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credits: Microsoft research blog

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Input sentence:	Translation (PBMT):	Translation (GNMT):	Translation (human):
李克強此行將啟動中加 總理年度對話機制,與 加拿大總理杜魯多舉行 兩國總理首次年度對 話。	Li Keqiang premier added this line to start the annual dialogue mechanism with the Canadian Prime Minister Trudeau two prime ministers held its first annual session.	Li Keqiang will start the annual dialogue mechanism with Prime Minister Trudeau of Canada and hold the first annual dialogue between the two premiers.	Li Keqiang will initiate the annual dialogue mechanism between premiers of China and Canada during this visit, and hold the first annual dialogue with Premier Trudeau of Canada.

credits: Google research blog

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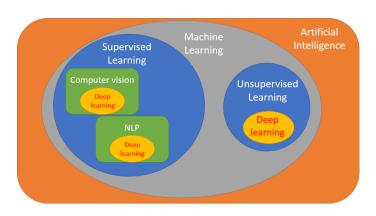
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How do RNN's work?

Credits for images to Andrej Karpathy

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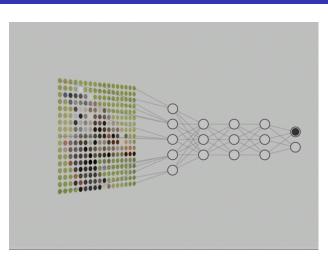
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credits: Blaise Aguera y Arcas

```
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```

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```
How it works
```

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Fast training

```
#FF
def step(x):
    h = np.tanh(np.dot(W1, x) + b1)
    y = np.dot(W2, h) + b2
    return y

y = step(x)
```

Word tagging

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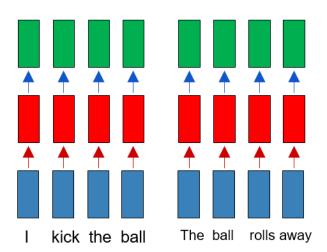
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Connect over time

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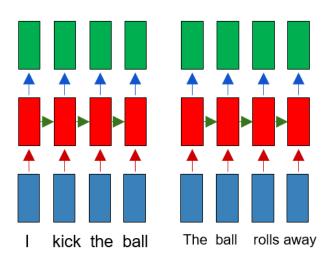
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RNN cell

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A

$$h = \phi(W_{xh}x)$$
 $y = \phi(W_{hy}h)$

$$h_t = \phi(W_{xh}x_t + W_{hh}h_{t-1}) \qquad y_t = \phi(W_{hy}h_t)$$

```
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```

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```
Question
```

```
#FF
def step(x):
    h = np.tanh(np.dot(W1, x) + b1)
    y = np.dot(W2, h) + b2
    return y

y = step(x)
```

```
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```
#FF
def step(x):
  h = np.tanh(np.dot(W1, x) + b1)
  y = np.dot(W2, h) + b2
  return y
#RNN
class RNN:
  def step(self, x):
    self.h = np.tanh(np.dot(W1, self.h)
          + np.dot(W2,x))
    y = np.dot(W3, self.h)
    return v
```

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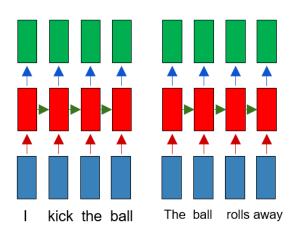
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RNN in 112 lines

Examples

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- Weather forecasting
- Detection of walk/run/stairs in smartphones
- Analyse stock markets and other financial markers
- Speech transcription

Tagging of clinical events

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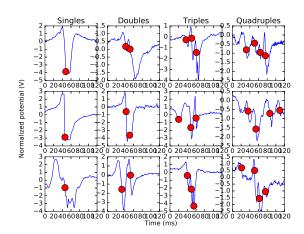
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Classification of fractionated electrograms in epicardial mappings using a recurrent neural network, R Romijnders et al.



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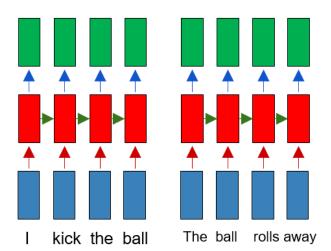
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Seq2Seq

Sequence 2 sequence

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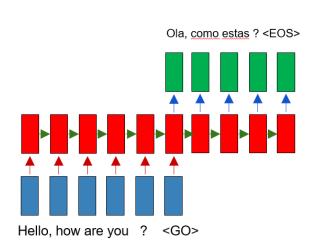
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Long sequence 2 long sequence

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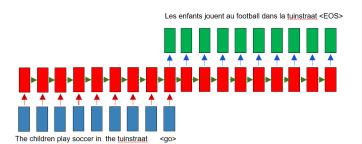
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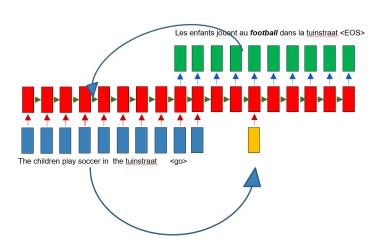
How it work

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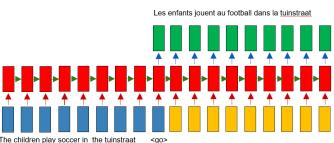
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Long sequence 2 long sequence

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Seq2Seq



Visualize attention

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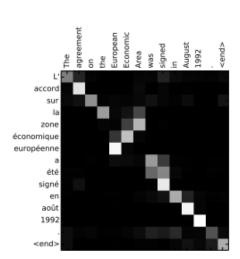
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Word vectors

- Training
 - Data parallelism
 - Model parallelism
- Fast translation

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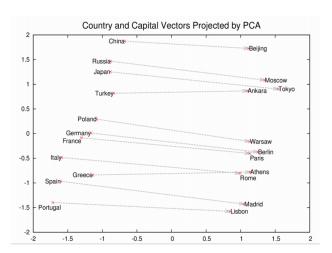
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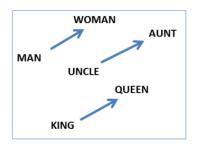
credits: deeplearning4j.org/word2vec

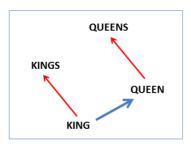
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(Mikolov et al., NAACL HLT, 2013)

Python implementation

Gradient Descent

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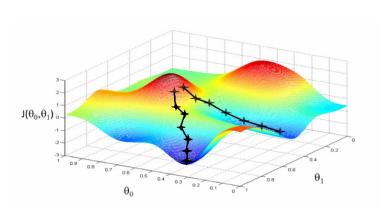
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Credits: ML blog Vasilis Vryniotis

Data parallelism

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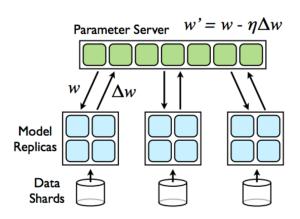
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Credits: arimo.com/machine-learning/deep-learning/2016/arimo-distributed-tensorflow-on-spark/

Model parallelism

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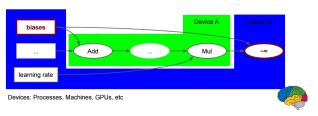
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Credits: slideshare Jeff Dean

Quantization

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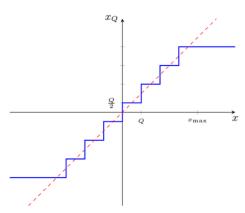
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Credits: Sascha Spors

Speed up

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Ouestions

	BLEU	Log Perplexity	Decoding time (s)
CPU	31.20	1.4553	1322
GPU	31.20	1.4553	3028
TPU	31.21	1.4626	384

Credits: Arxiv GNMT paper

Quantization

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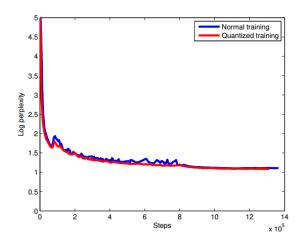
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Credits: Arxiv GNMT paper

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Conclusion

Further reading

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- GNMT paper and the blog
- The Unreasonable Effectiveness of Recurrent Neural Networks, Andrej Karpathy
- 3 Supervised sequence labelling with RNN, Alex Graves
- 4 robromijnders.github.io
- 5 Courses
 - Oxford Deep NLP
 - 2 Stanford DL for NLP