

April 9, 2017

Rob
Romijnders

Motivate

How it works

RNN

Seq2Seq

How to train

Word vectors

Fast training

Fast translation

Questions

Neural machine translation

Pydata2017 Amsterdam

Rob Romijnders

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Overview

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- RNN
- Seq2Seq

3 How to train

- Word vectors
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- Fast translation

4 Questions

GMail reply

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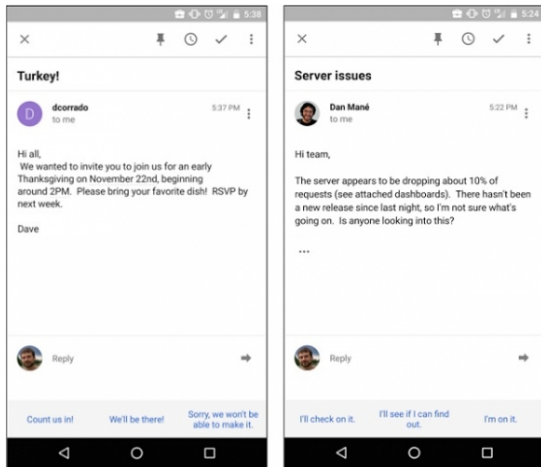


Photo: Greg Corrado, Google Research Blog

Apple siri

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Siri



Photo: cultofmac.com

Question Answering

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Attention Visualization

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What is this sculpture made out of ?



Answer: **metal**



What color are the bananas ?



Answer: **green**



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



Answer: **stripes**



Did the player hit the ball ?



Answer: **yes**

credits: NIPS slides, Richard Socher

Question answering

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- 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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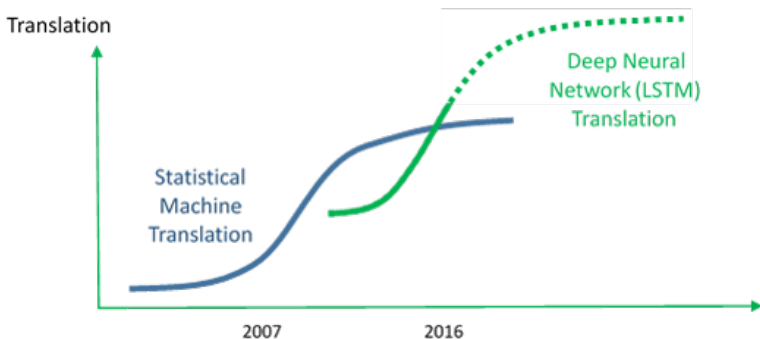
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credits: Microsoft research blog

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<i>Input sentence:</i>	<i>Translation (PBMT):</i>	<i>Translation (GNMT):</i>	<i>Translation (human):</i>
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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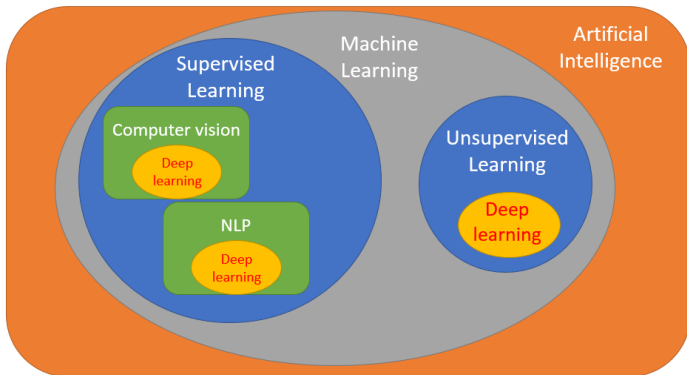
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How do RNN's work?

Credits for images to Andrej Karpathy

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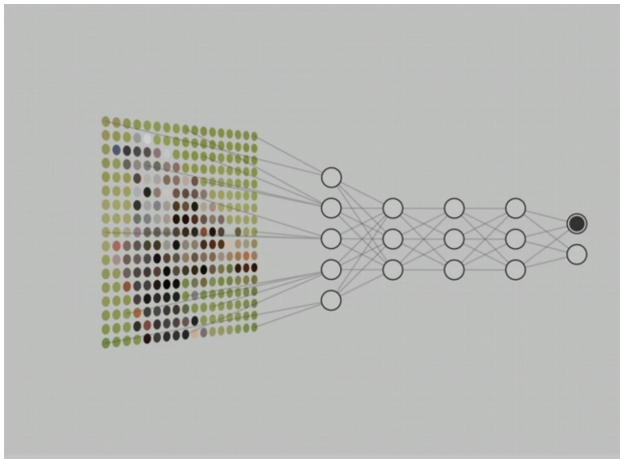
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credits: Blaise Aguera y Arcas

Python code

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Questions

#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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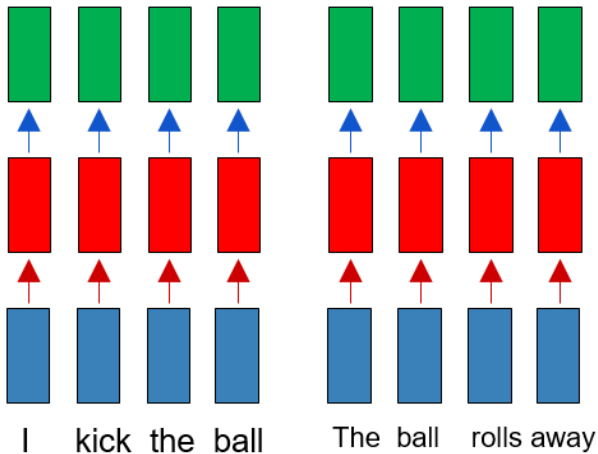
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Connect over time

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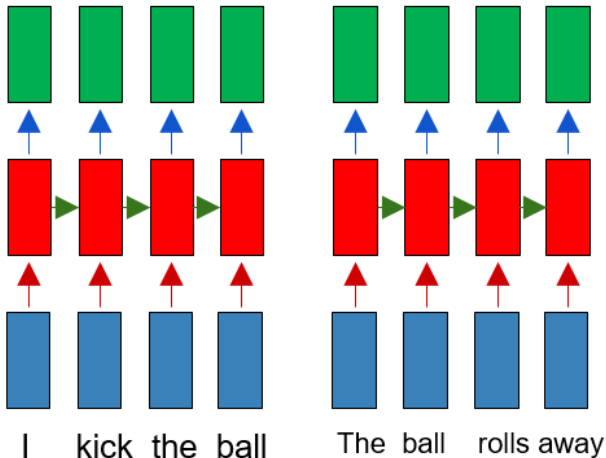
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RNN cell

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Questions

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

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

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

$$y_t = \phi(W_{hy}h_t)$$

Python code

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y = step(x)
```


Python code

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```
# RNN
rnn = RNN()
y = rnn.step(x)

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 y
```

Python code

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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 y
```

Word tagging

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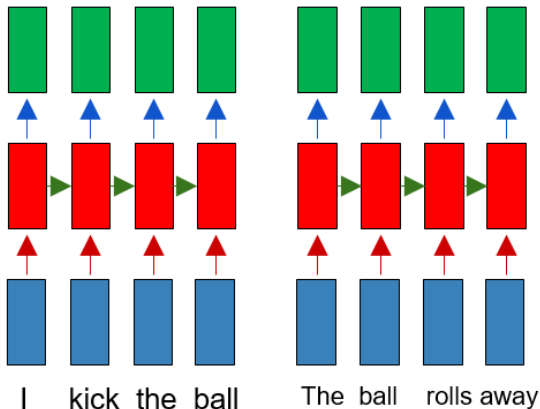
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RNN in 112 lines

Examples

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Questions

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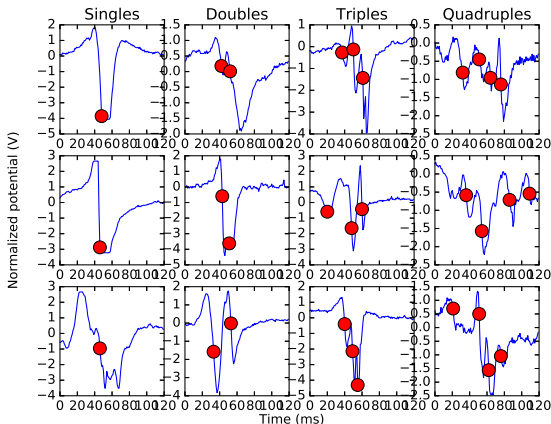
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Classification of fractionated electrograms in epicardial mappings using a recurrent neural network, R Romijnders et al.

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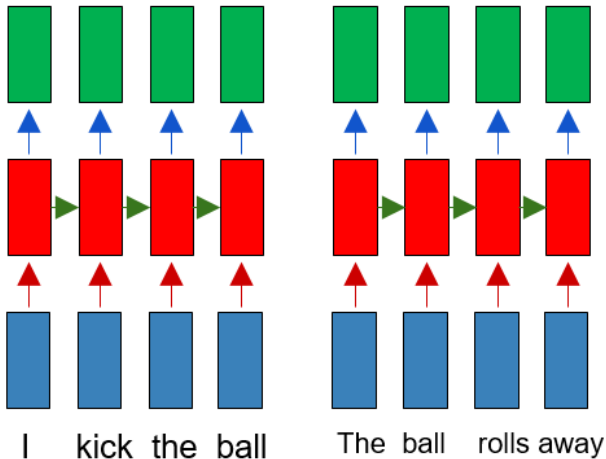
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Seq2Seq

Sequence 2 sequence

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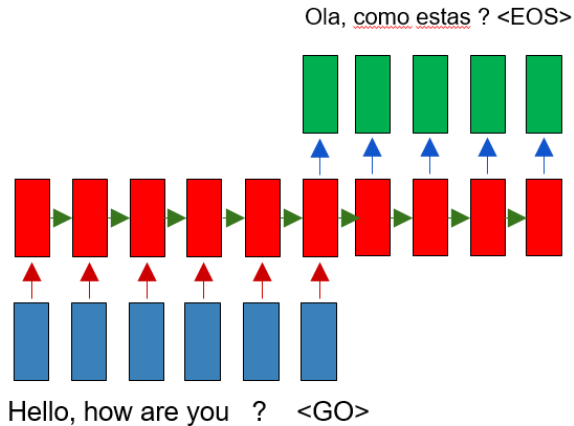
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Long sequence 2 long sequence

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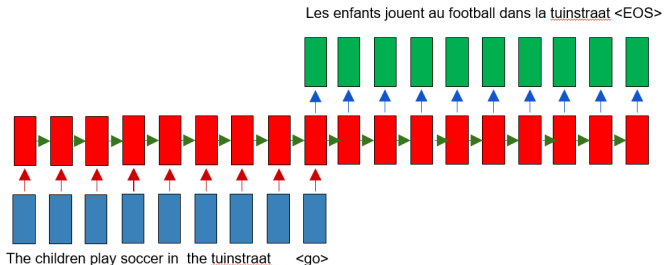
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Long sequence 2 long sequence

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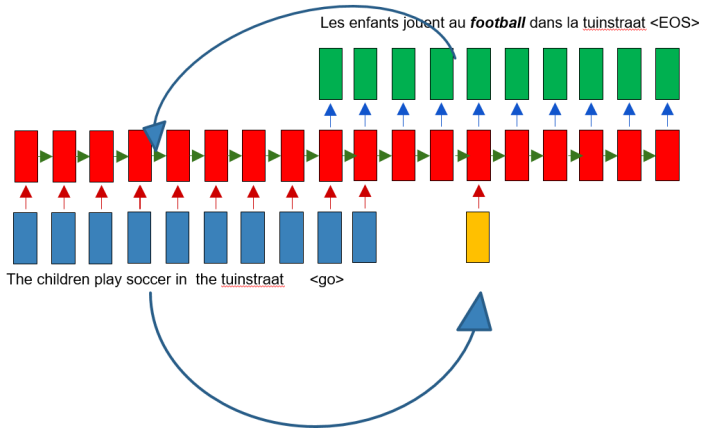
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Long sequence 2 long sequence

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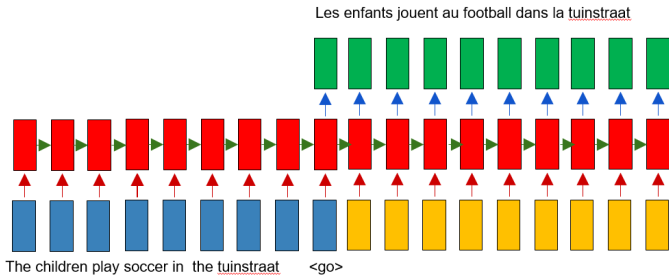
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Visualize attention

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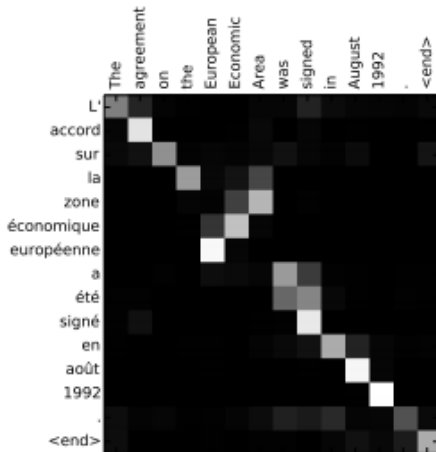
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How to train

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Questions

- Word vectors
- Training
 - Data parallelism
 - Model parallelism
- Fast translation

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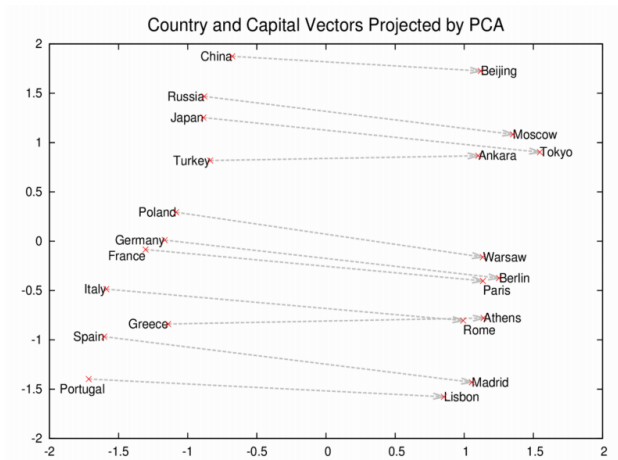
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credits: deeplearning4j.org/word2vec

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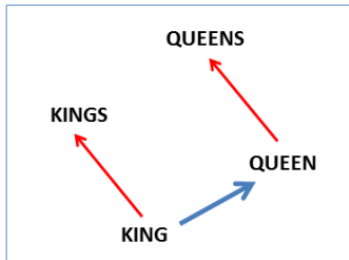
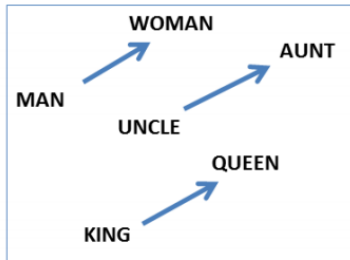
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(Mikolov et al., NAACL HLT, 2013)

Python implementation

Gradient Descent

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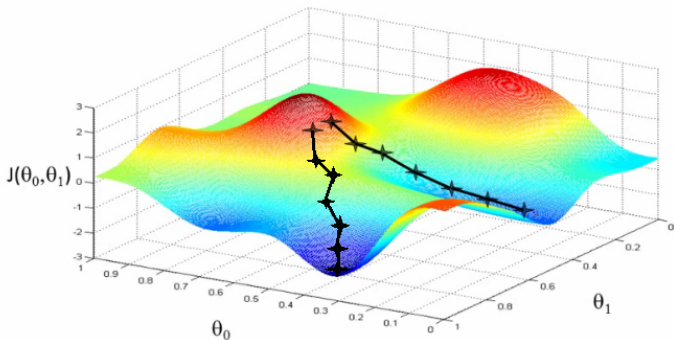
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Credits: ML blog Vasilis Vryniotis

Data parallelism

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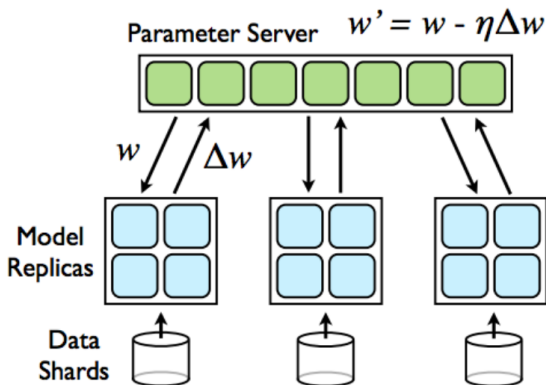
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Credits: arimo.com/machine-learning/deep-learning/2016/arimo-distributed-tensorflow-on-spark/

Model parallelism

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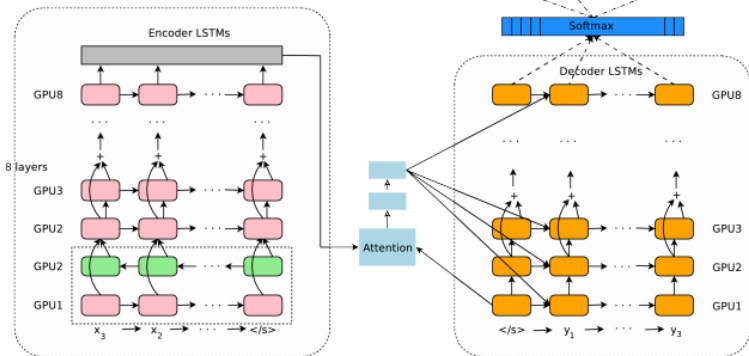
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Credits: Arxiv GNMT paper

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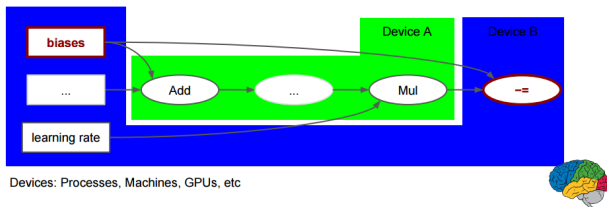
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Credits: slideshare Jeff Dean

Quantization

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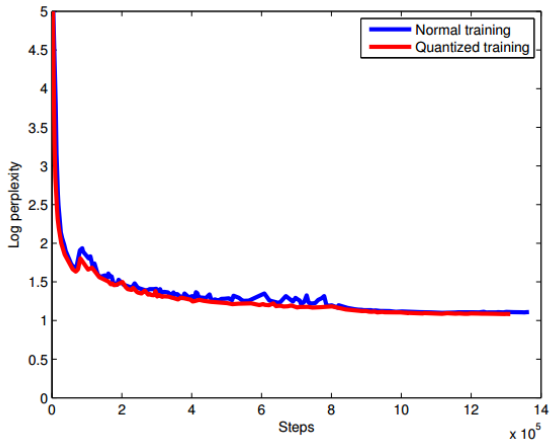
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Credits: Arxiv GNMT paper

Quantization

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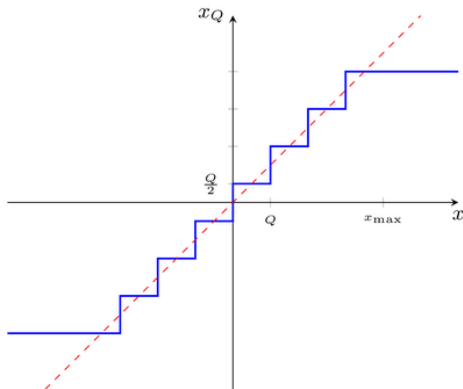
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Credits: Sascha Spors

Speed up

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	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

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Further reading

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Questions

- 1 GNMT paper and the blog
- 2 The Unreasonable Effectiveness of Recurrent Neural Networks, Andrej Karpathy
- 3 Supervised sequence labelling with RNN, Alex Graves
- 4 [robromijnders.github.io](https://github.com/robromijnders)
- 5 Courses
 - 1 Oxford Deep NLP
 - 2 Stanford DL for NLP (CS224D)

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Questions

■ WORD PIECES

- **Word:** Jet makers feud over seat width with big orders at stake
- **Wordpieces:** _J et _makers _fe ud _over _seat _width _with _big _orders _at _stake

■ CHARACTER BASED

- **Word** Miki
- **Tokens** (b)M (m)i (m)k (e)i.