October 27, 2016

Rob Romijnders

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Questions

Recurrent Neural Networks
Data Science Amsterdam

Rob Romijnders

Eindhoven, University of Technology

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Overview

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GMail reply

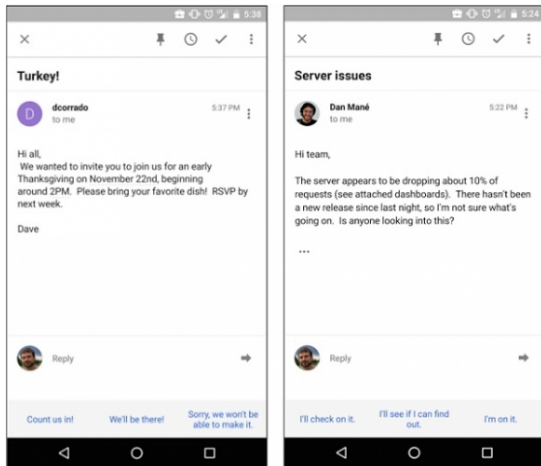October 27, 2016

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Figure: Photo: Greg Corrado, Google Research Blog

Figure: Photo: cultofmac.com

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Deep Learning Stock Volatility with Google Domestic Trends

Ruoxuan Xiong[1], Eric P. Nichols[2] and Yuan Shen[*3]

[1]Department of Management Science and Engineering, Stanford University

[2]Google Inc.

[3]Department of Physics, Stanford University

Generation

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Figure: Generating Sequences With Recurrent Neural Networks, Alex Graves
Music: github.com/hexahedria

Generation

THE MULTIVERSE —

Movie written by algorithm turns out to be hilarious and intense

For *Sunspring*'s exclusive debut on Ars, we talked to the filmmakers about collaborating with an AI.

ANNALEE NEWITZ - 6/9/2016, 12:30 PM

Sunspring, a short science fiction movie written entirely by AI, debuts exclusively on Ars today.

Figure: http://arstechnica.com/the-multiverse/2016/06/an-ai-wrote-this-movie-and-its-strangely-moving/

Deep learning

Deep learning

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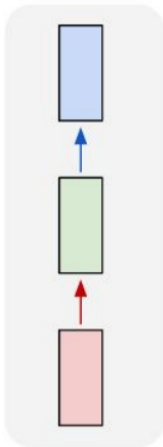
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Figure: cs231n, Andrej Karpathy

Deep learning

[1]Inception 5 (GoogLeNet)

Inception 7a

[1]Going Deeper with Convolutions, [C. Szegedy et al, CVPR 2015]

Deep learning

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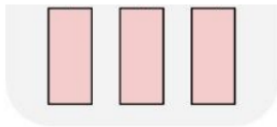Romijnders

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Figure: cs231n, Andrej Karpathy

Deep learning

Figure: cs231n, Andrej Karpathy

Deep learning

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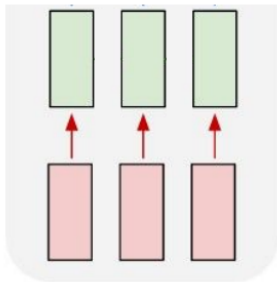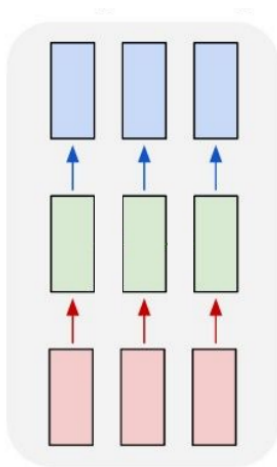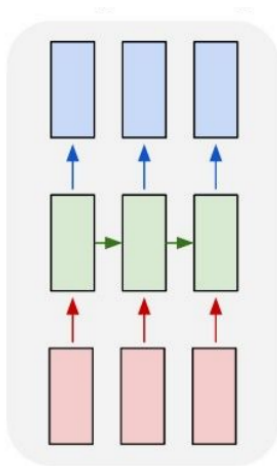Romijnders

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Figure: cs231n, Andrej Karpathy

RNN cell

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

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

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


class RNN:
  def step(self, x):
      self.h = np.tanh(np.dot(self.W_hh,self.h)
                + np.dot(self.W_xh,x))
      y = np.dot(self.W_hy, self.h)
      return y
```

Example

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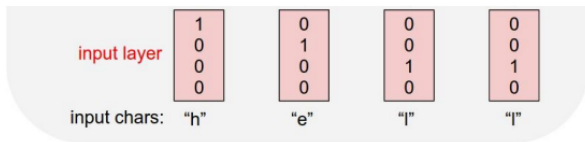Why

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Figure: cs231n, Andrej Karpathy

Example

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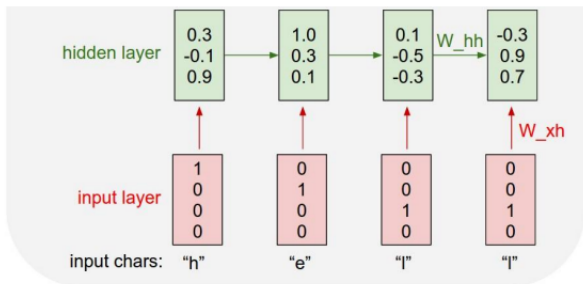
Questions

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

Figure: cs231n, Andrej Karpathy

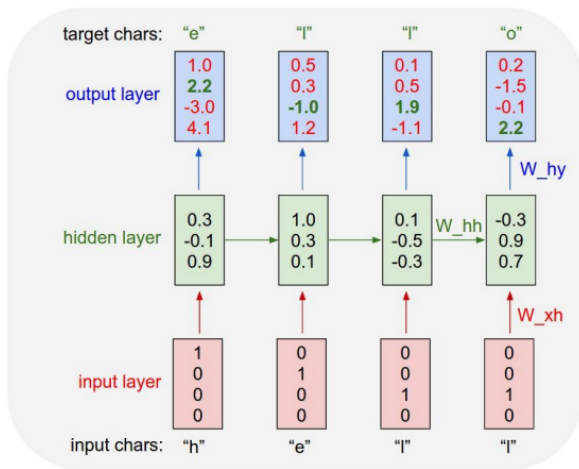October 27, 2016

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Figure: cs231n, Andrej Karpathy

Long Short-term memory

$$i_t = \sigma(W_{xi}x_t + W_{hi}h_{t-1} + b_i)$$

$$f_t = \sigma(W_{xf}x_t + W_{hf}h_{t-1} + b_f)$$

$$o_t = \sigma(W_{xo}x_t + W_{ho}h_{t-1} + b_o)$$

$$c_t = f_t c_{t-1} + i_t \tanh(W_{xc}x_t + W_{hc}h_{t-1} + b_c)$$

$$h_t = o_t \ \tanh(c_t)$$

LSTM

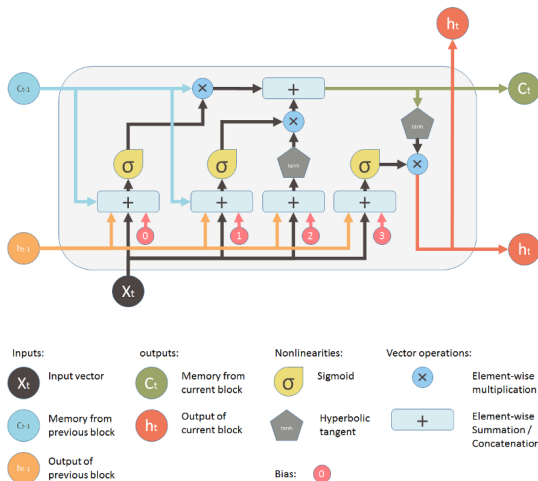October 27, 2016

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Figure: Diagram depicting LSTM block
Author: Shi Yan. Source: medium.com/@shiyan/

Architecture

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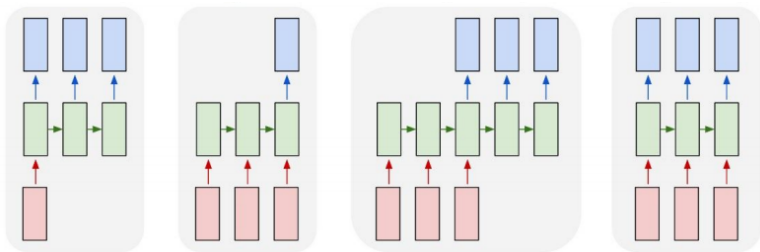
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Architecture

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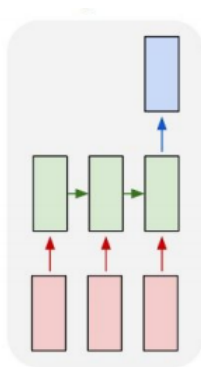2016

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Data

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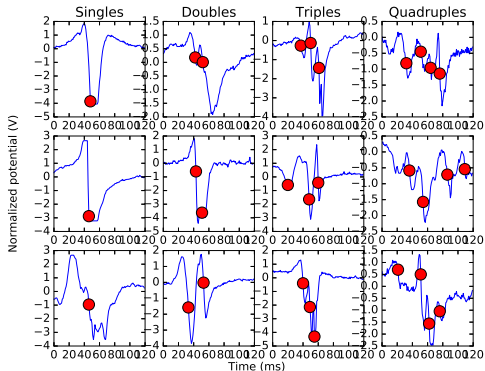Romijnders

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

Data

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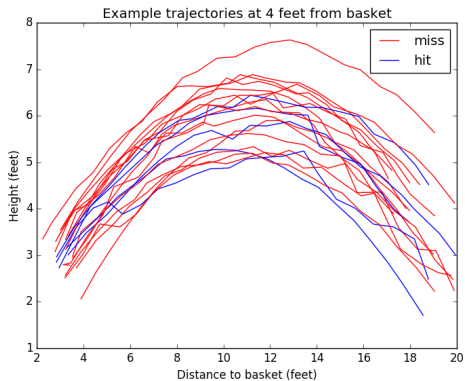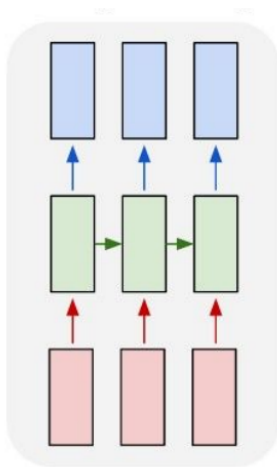Romijnders

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Figure: Applying Deep Learning to Basketball Trajectories, R Shah, R Romijnders

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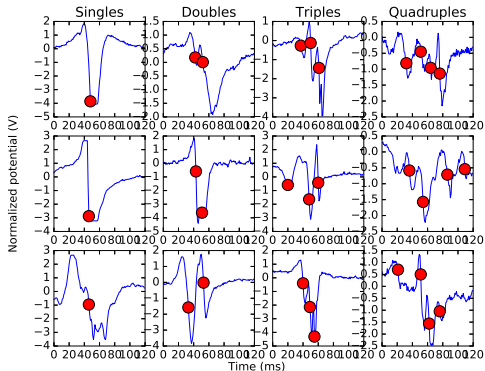Figure: cs231n, Andrej Karpathy

Data

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

Annotation

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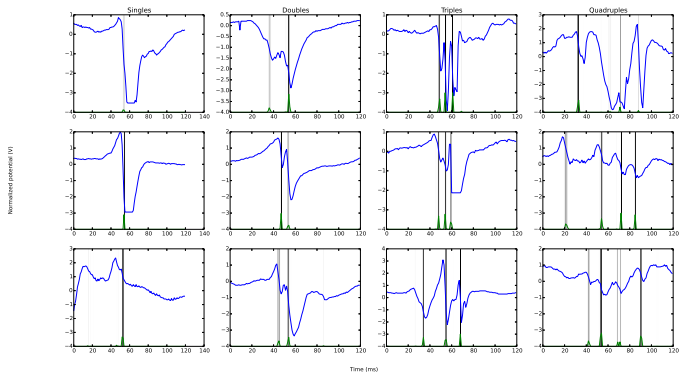2016

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

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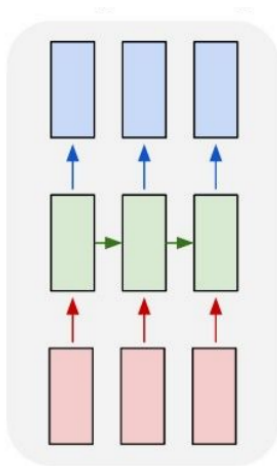Why

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Figure: cs231n, Andrej Karpathy

2D visualizations

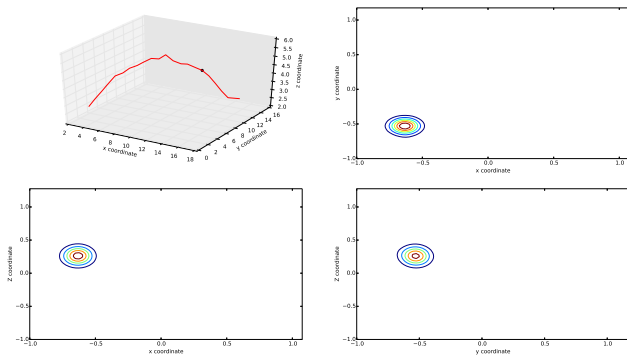October 27,
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Figure: Applying Deep Learning to Basketball Trajectories, R Shah, R Romijnders

Sample

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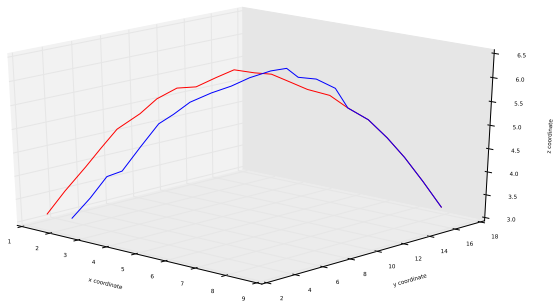2016

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Figure: Applying Deep Learning to Basketball Trajectories, R Shah, R Romijnders

Biased sample

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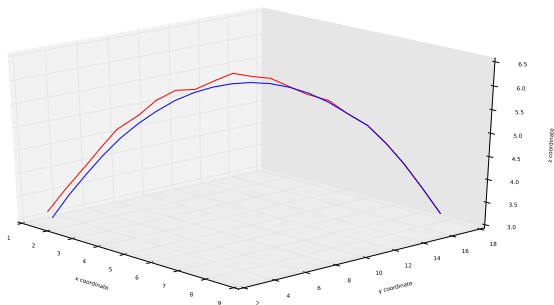Why

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Figure: Applying Deep Learning to Basketball Trajectories, R Shah, R Romijnders

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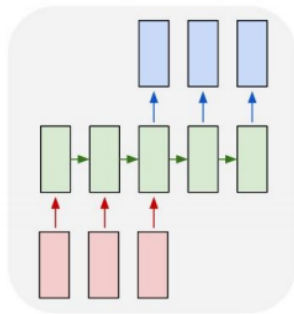Rob Romijnders

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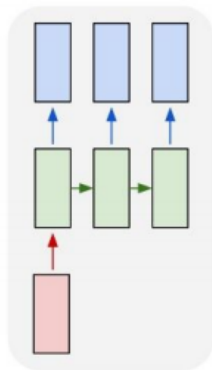Romijnders

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Captioning

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"man in black shirt is playing guitar."

"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."

"boy is doing backflip on wakeboard."

Figure: Deep Visual-Semantic Alignments for Generating Image Descriptions, Andrej Karpathy

Architecture

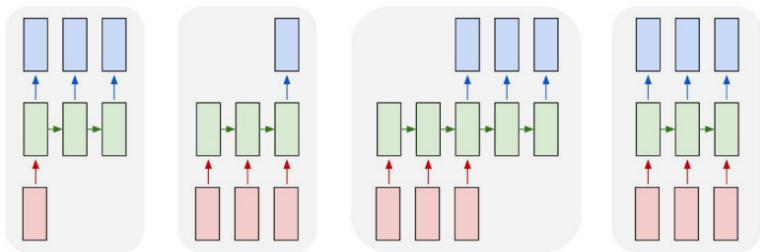October 27,
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Figure: cs231n, Andrej Karpathy

Questions

Further reading

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Questions

1. The Unreasonable Effectiveness of Recurrent Neural Networks, Andrej Karpathy
2. Supervised sequence labelling with RNN, Alex Graves
3. Generating Sequences with RNN, Alex Graves
4. robromijnders.github.io