

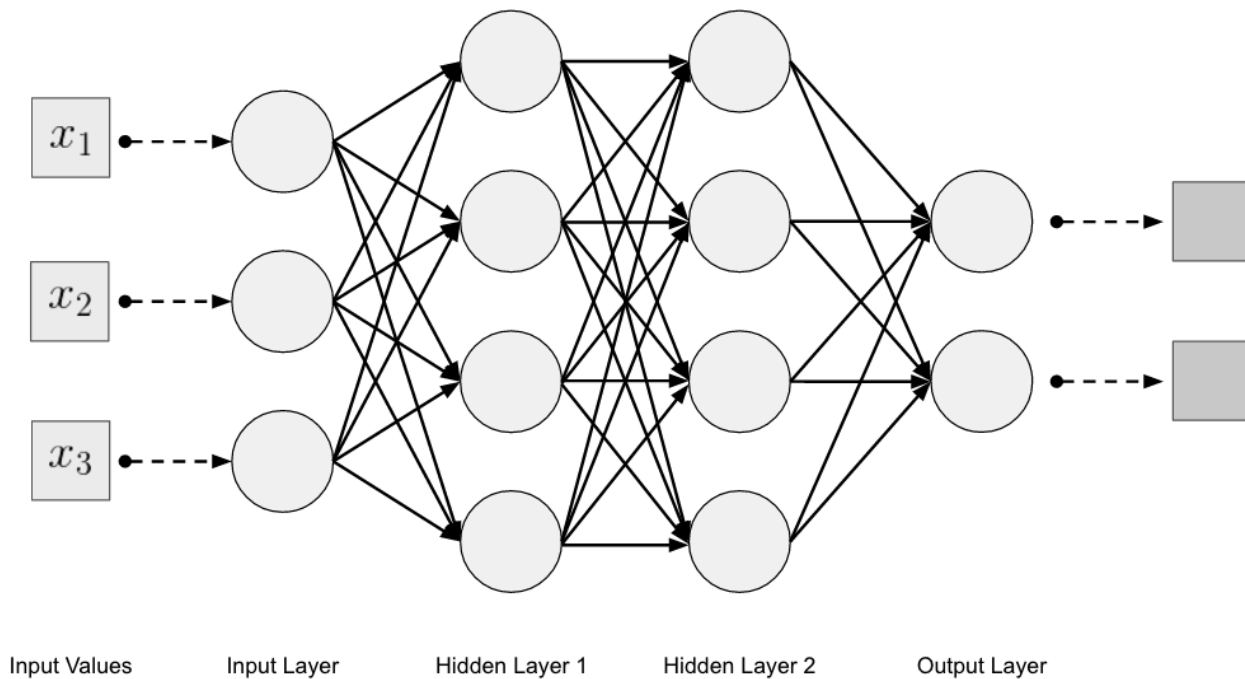
Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) Networks

Thomas Reske, AWS Solutions Architect

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Feedforward Nets



Sequences and Long-Term Dependency

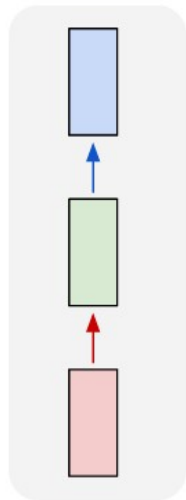
- I grew up in France. I speak fluent
- The Spanish King officially abdicated in ... of his ..., Felipe.
Felipe will be confirmed tomorrow as the new Spanish

Sequences and Long-Term Dependency

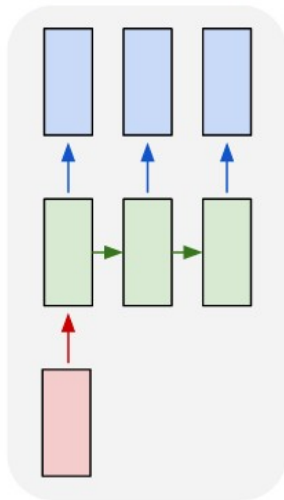
- I grew up in France. I speak fluent French.
- The Spanish King officially abdicated in favor of his son, Felipe. Felipe will be confirmed tomorrow as the new Spanish King.

Recurrent Neural Networks

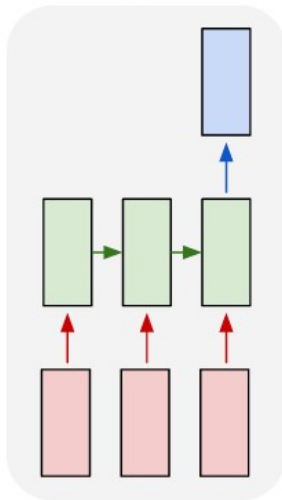
one to one



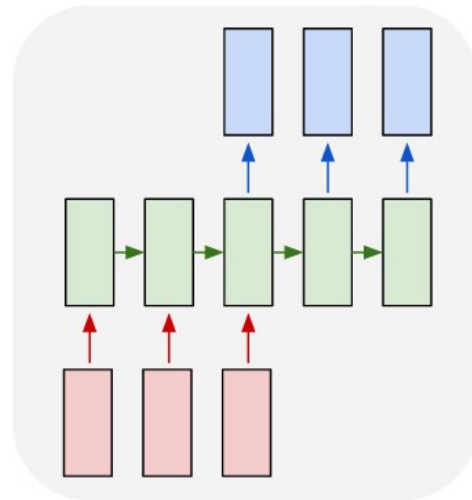
one to many



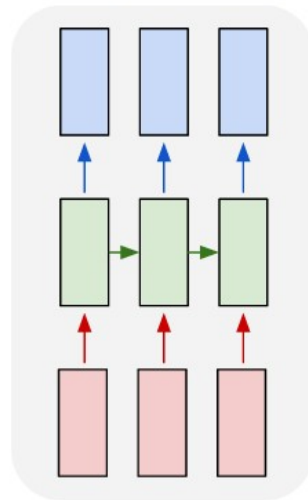
many to one



many to many



many to many

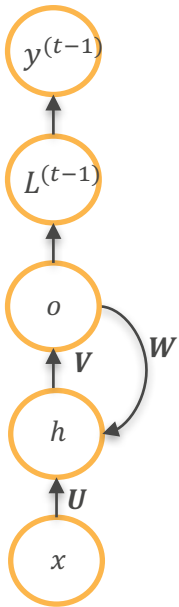


Andrej Karpathy, (2015), The Unreasonable Effectiveness of Recurrent Neural Networks.

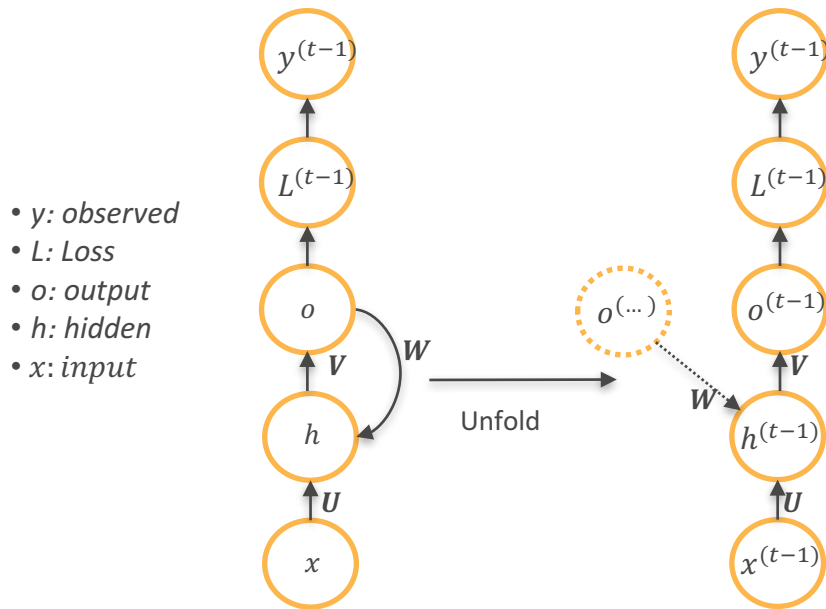
<http://karpathy.github.io/2015/05/21/rnn-effectiveness/>

Recurrent Neural Networks – Train in Time/Unfold

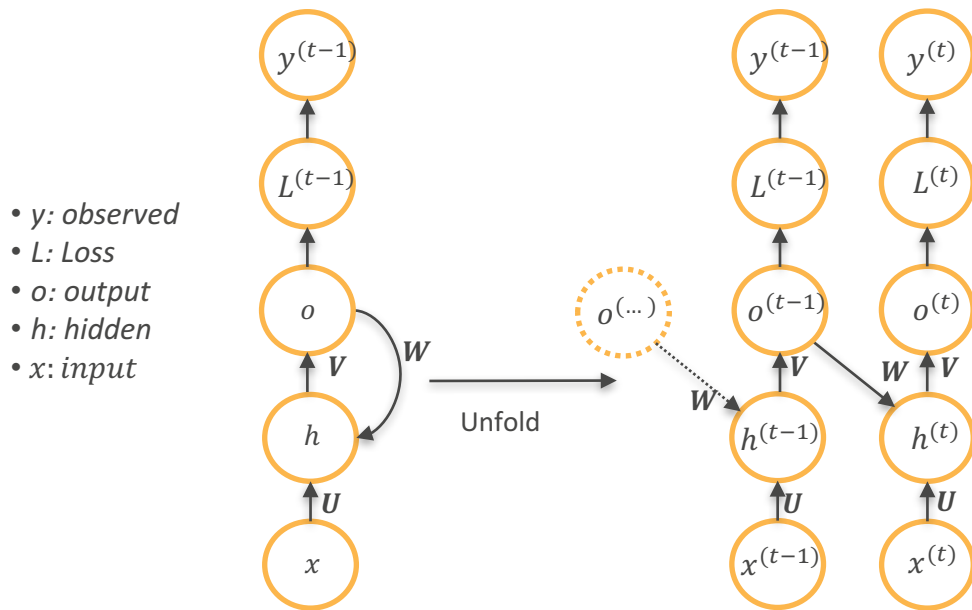
- y : observed
- L : Loss
- o : output
- h : hidden
- x : input



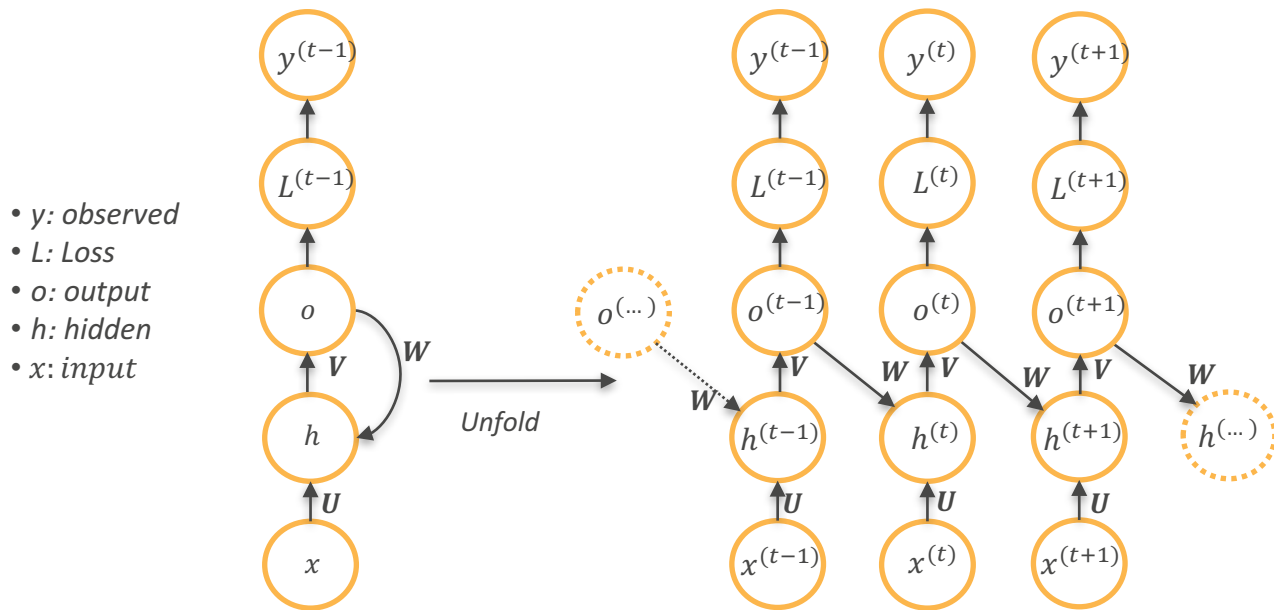
Recurrent Neural Networks – Train in Time/Unfold



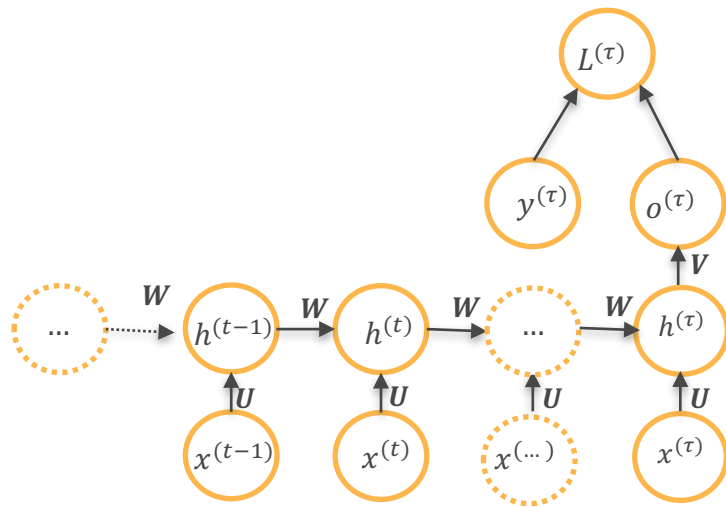
Recurrent Neural Networks – Train in Time/Unfold



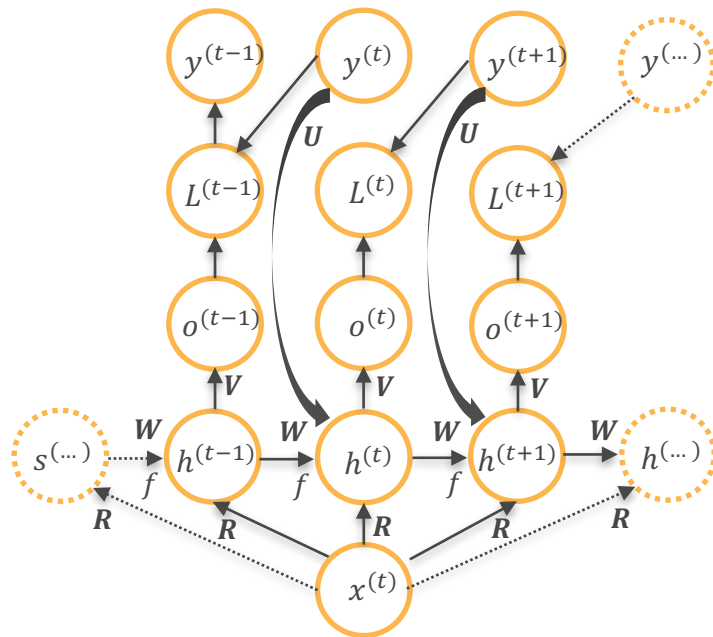
Recurrent Neural Networks – Train in Time/Unfold



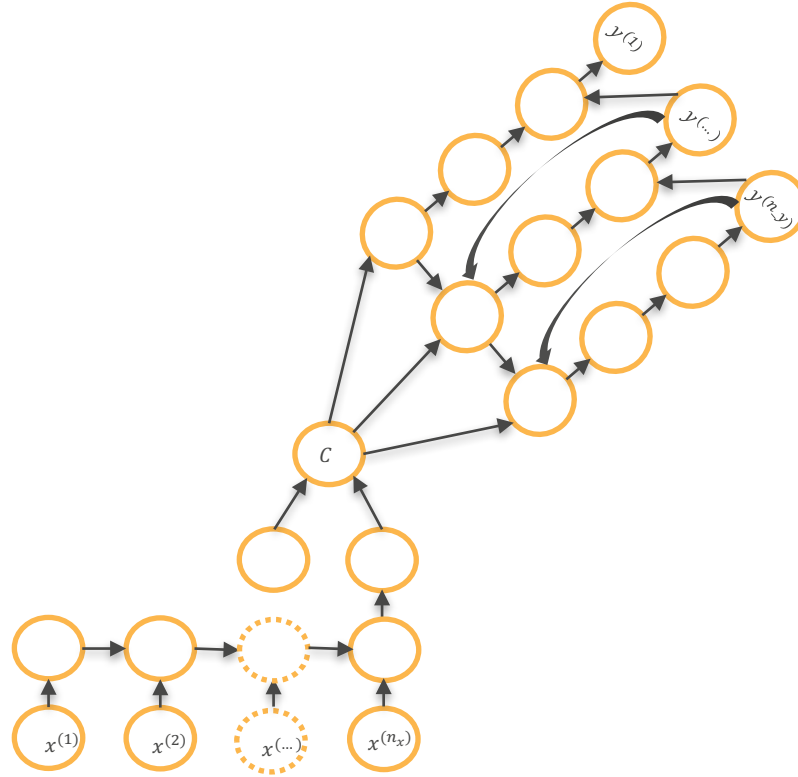
Many to One



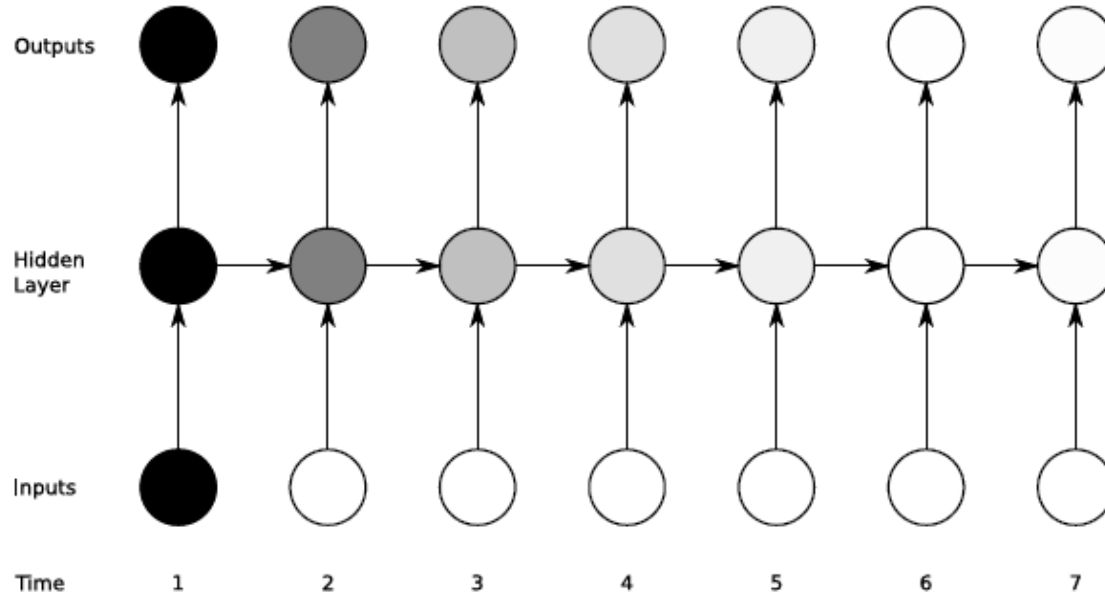
One to Many



Encode-Decoder / Sequence-to-Sequence

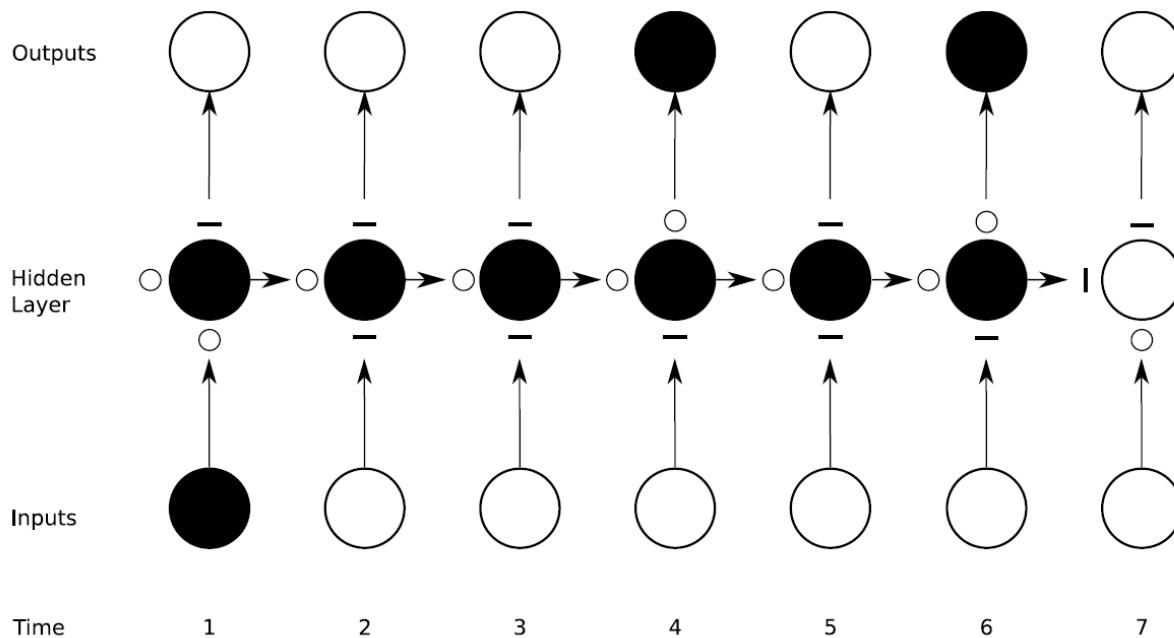


Challenge of Long-Term Dependencies



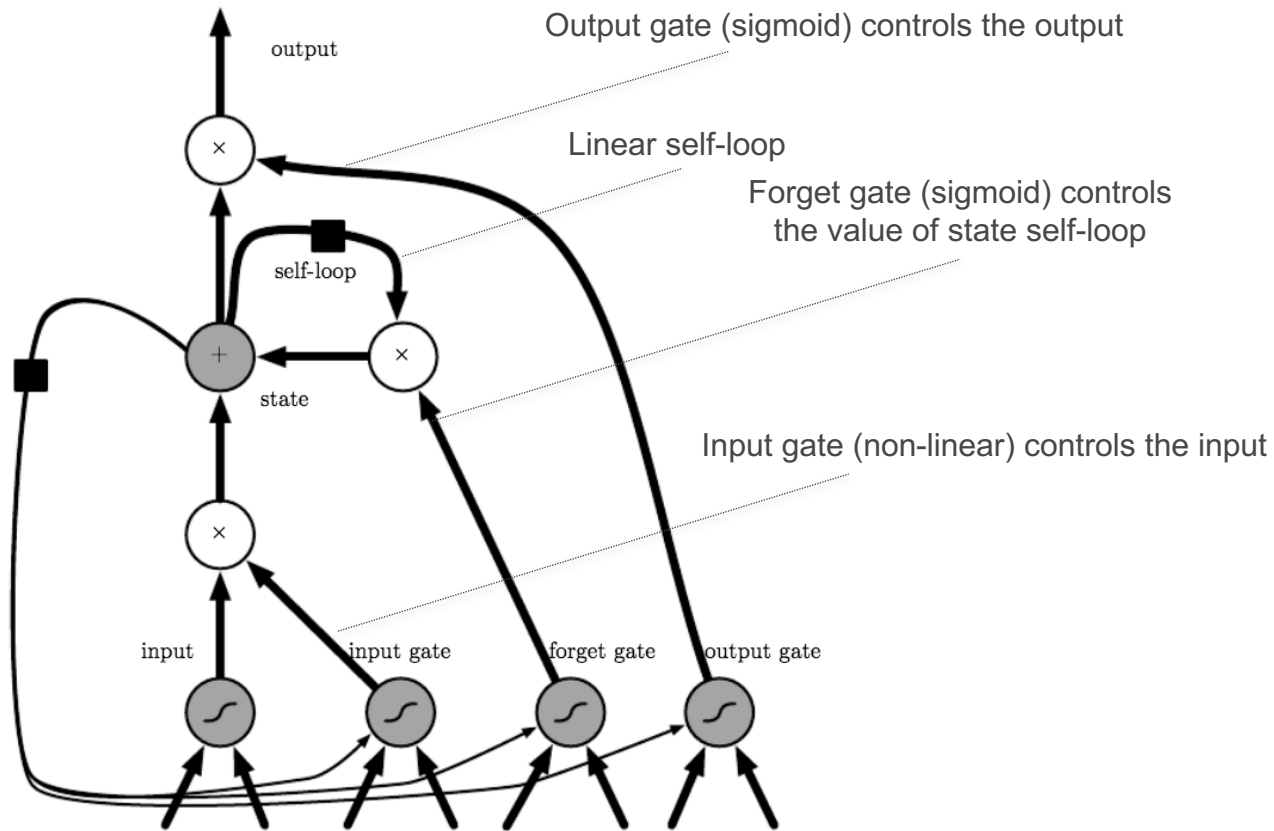
<http://prlab.tudelft.nl/sites/default/files/Introduction%20to%20RNN%20LSTM.pptx>

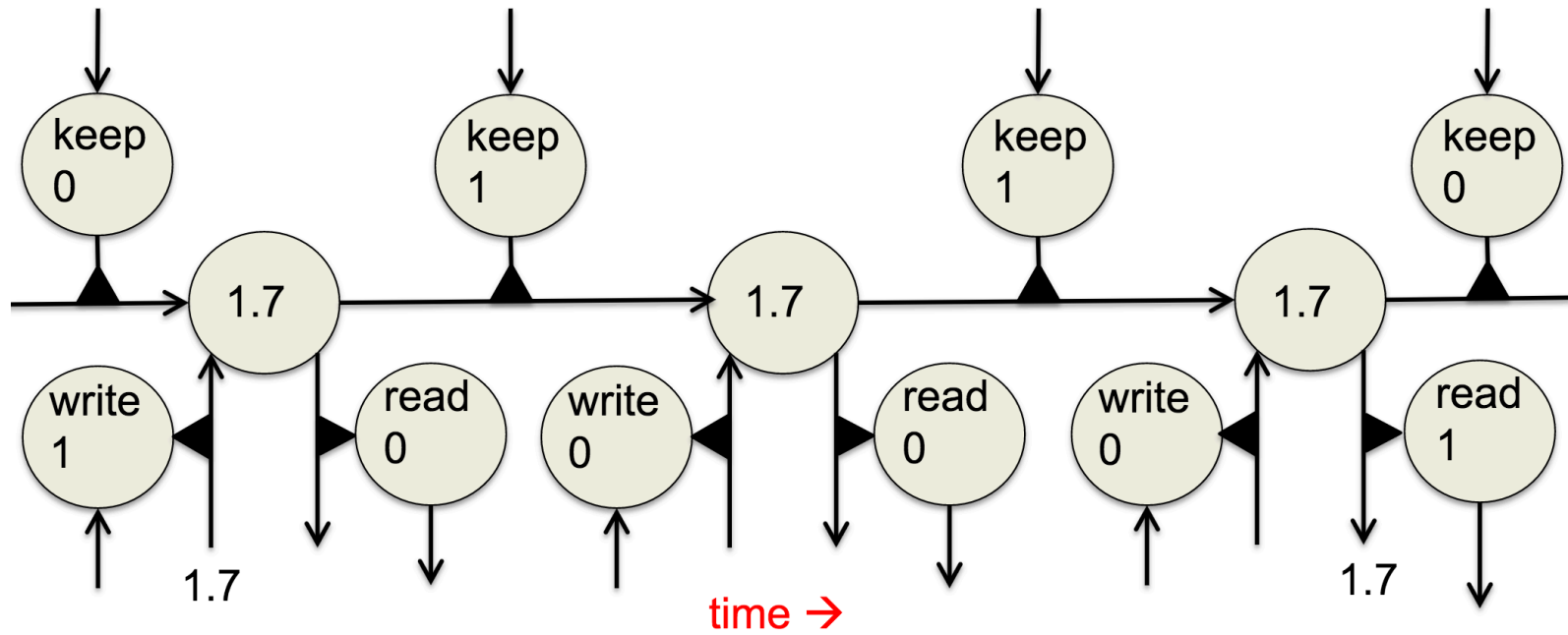
LSTM



<http://prlab.tudelft.nl/sites/default/files/Introduction%20to%20RNN%20LSTM.pptx>

LSTM





Handwriting Recognition by Alex Graves



<https://www.youtube.com/watch?v=mLxsbWAYlpw>

DEMO

<https://github.com/apache/incubator-mxnet/blob/master/example/rnn/old/char-rnn.ipynb>

Thank You