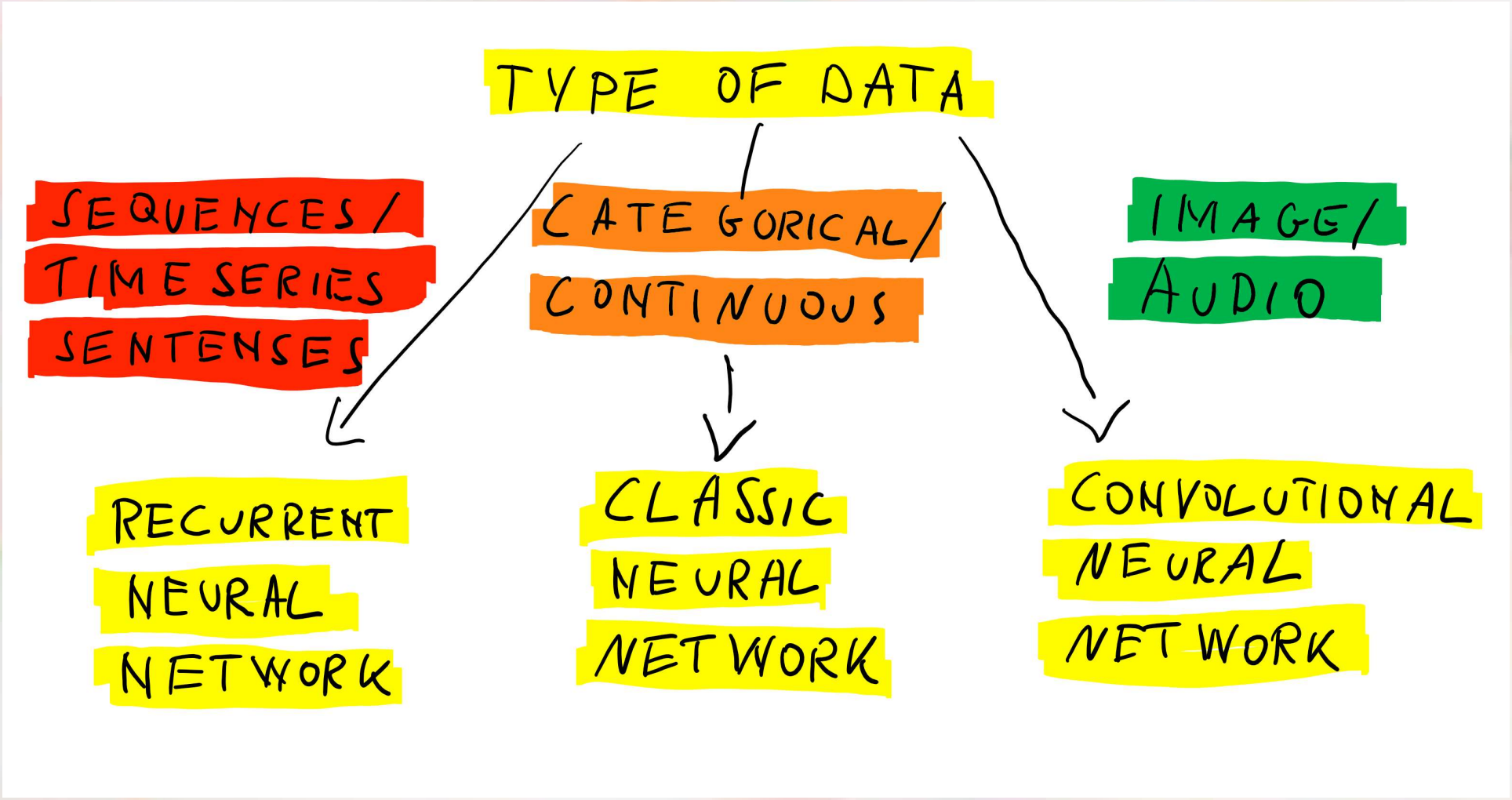
Recurrent Neural Networks: Simple RNNs

Oliver Zeigermann / @DJCordhose

https://djcordhose.github.io/ai/2018_rnn.html

Text and sequences are special



Simple RNNs

Recurrent Neural Networks

Challenge for traditional neural networks

How would you solve sequence to sequence translation?

Simple and theoretical example: addition digit by digit

```
 216
+648
 ===
 864
```

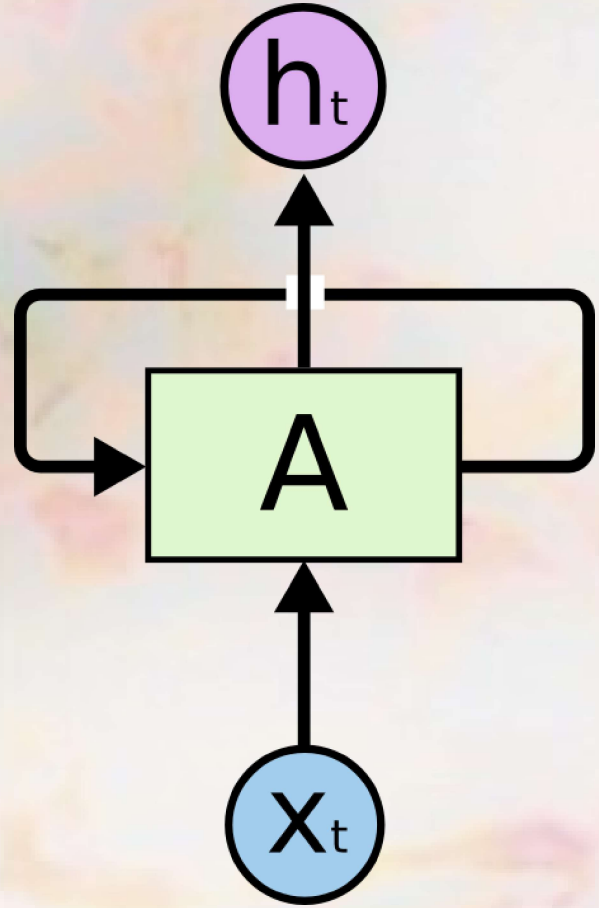
What is the challenge?

Motivation

Traditional Networks have no memory of previous events

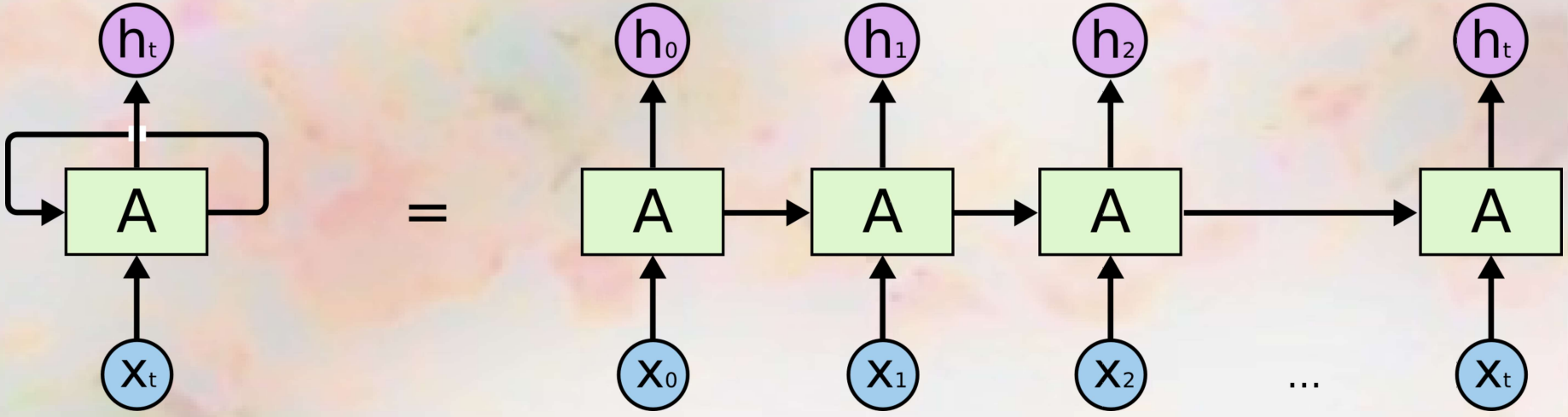
Number to Number enconding needs to factor in carry

Solution: RNNs - Networks with Loops



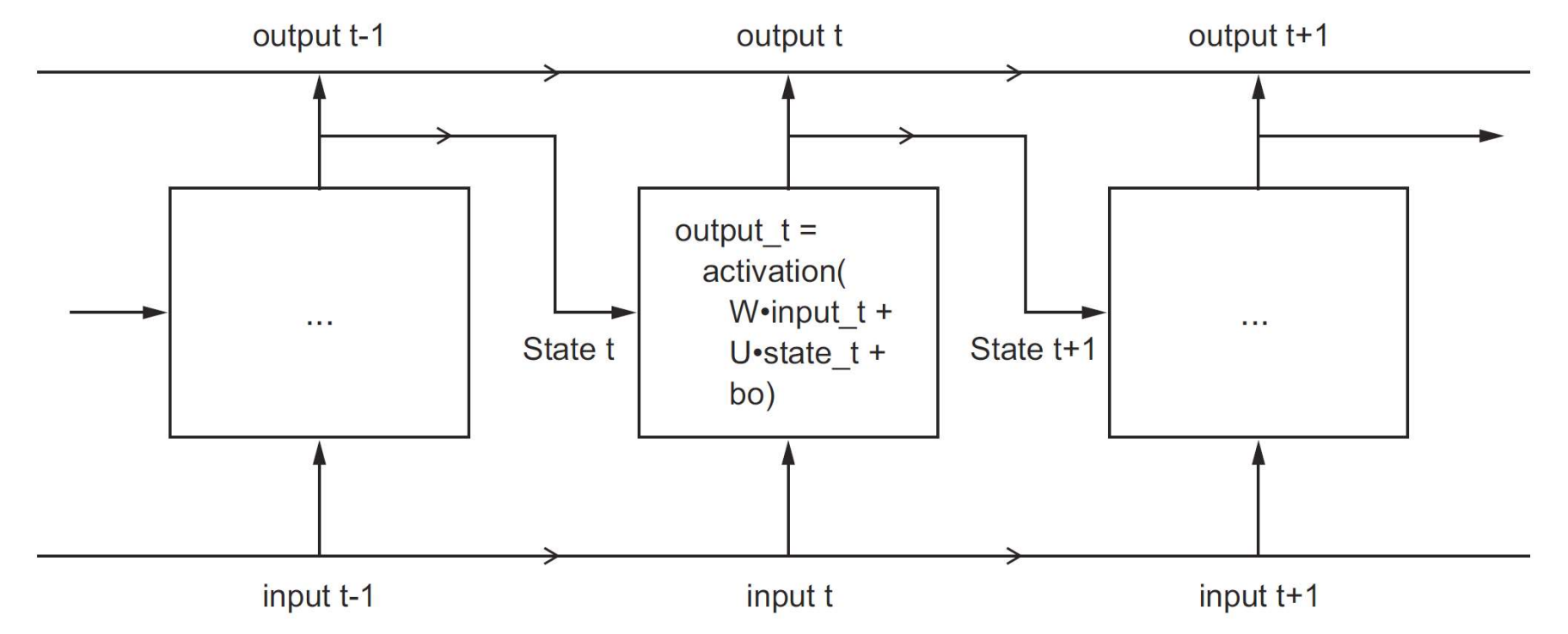
http://colah.github.io/posts/2015-08-Understanding-LSTMs/

Unrolling the loop



http://colah.github.io/posts/2015-08-Understanding-LSTMs/

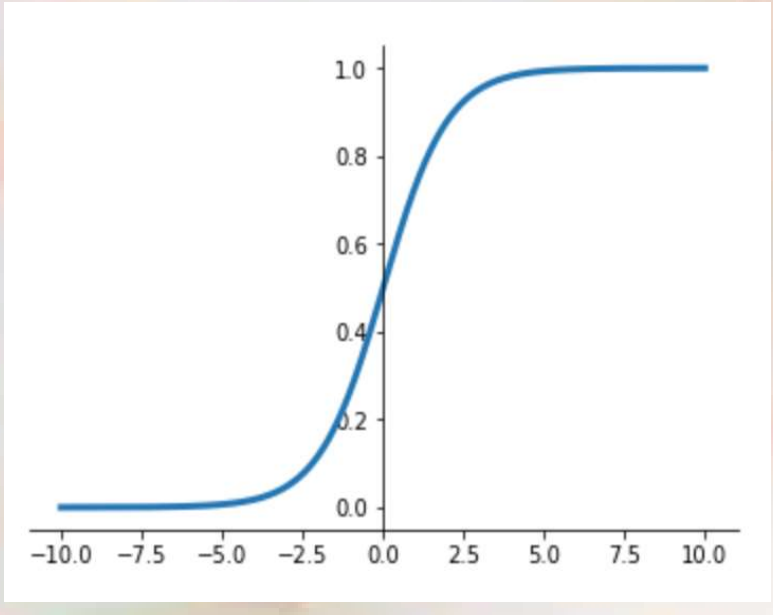
Simple RNN



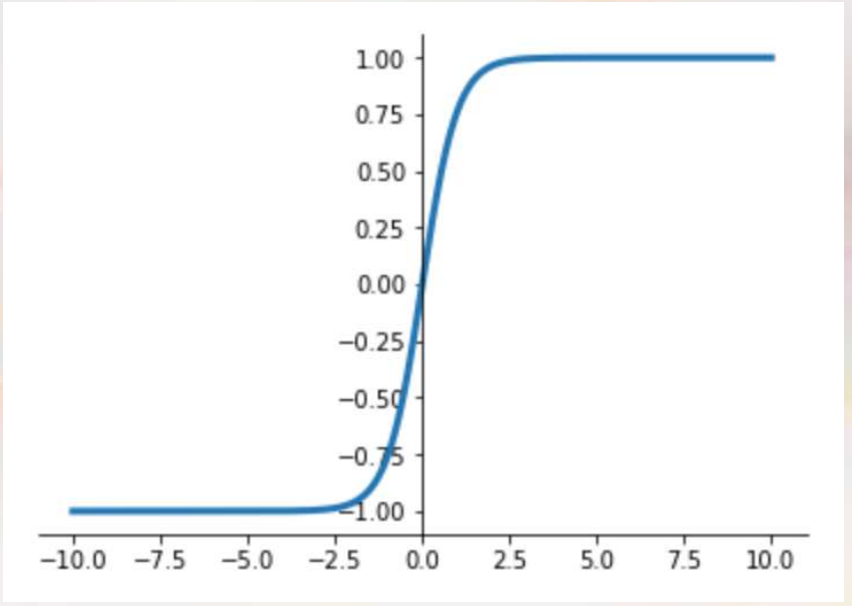
$$output_t = \tanh(W input_t + U output_{t-1} + b)$$

Deep Learning with Python, Chapter 6, François Chollet, Manning

Repetition Activation Functions



Sigmoid, floating from 0 to 1



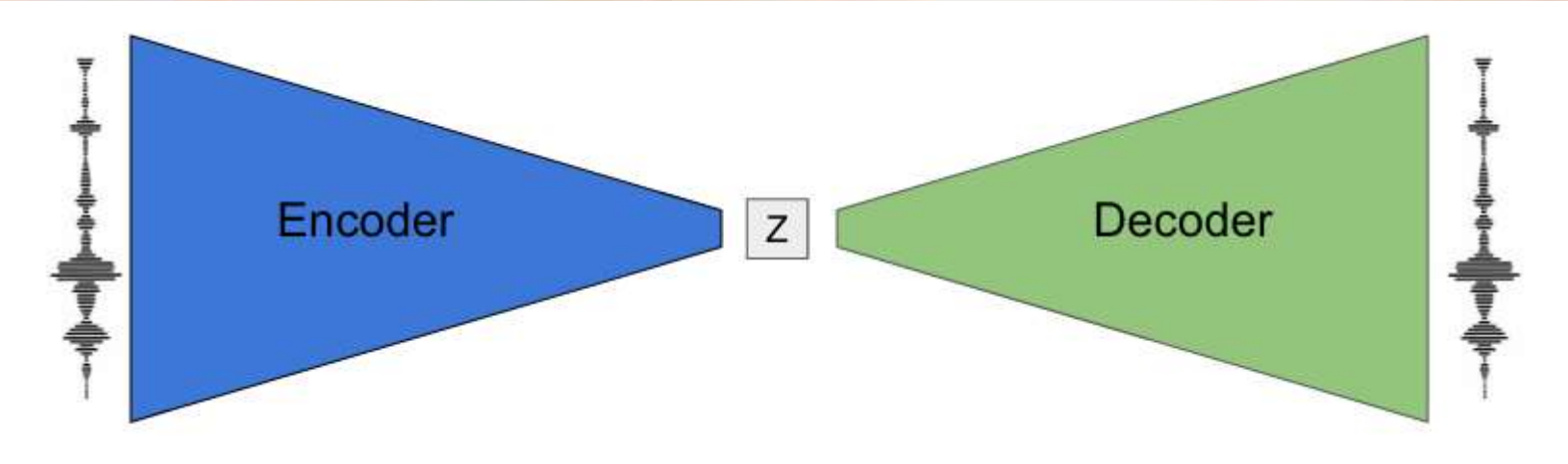
Tangens Hyperbolicus, floating from -1 to 1

https://notebooks.azure.com/djcordhose/libraries/buch/html/kap7-iris.ipynb

Perfect for sequences, lists, sentences

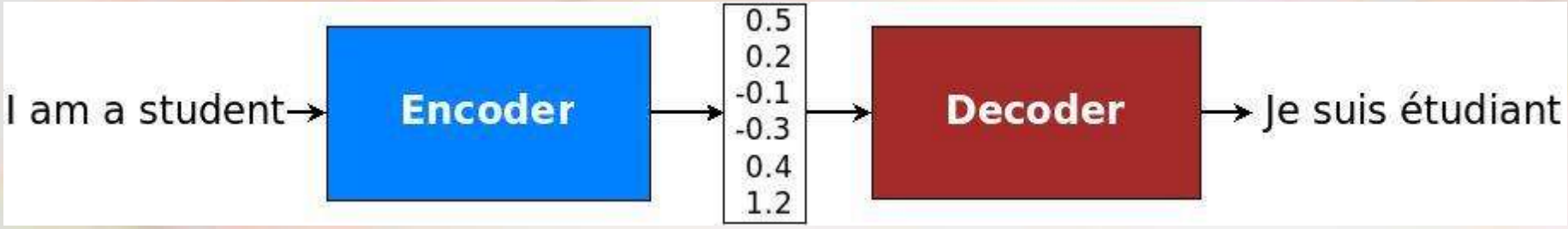
Generating musical sequences

Training a latent space and generating a new sequences



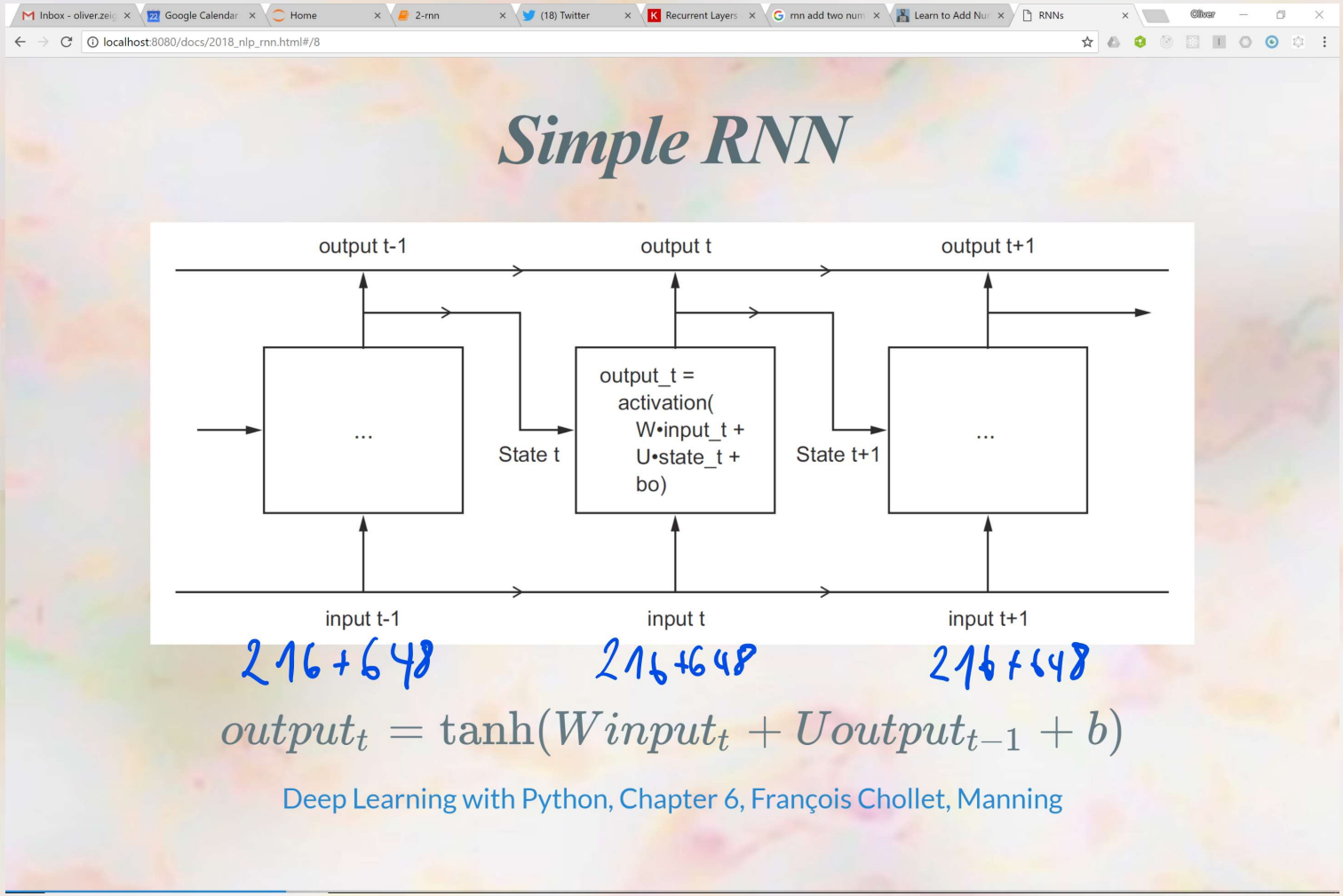
https://magenta.tensorflow.org/music-vae

Also perfect for natural language Sequence to Sequence translations

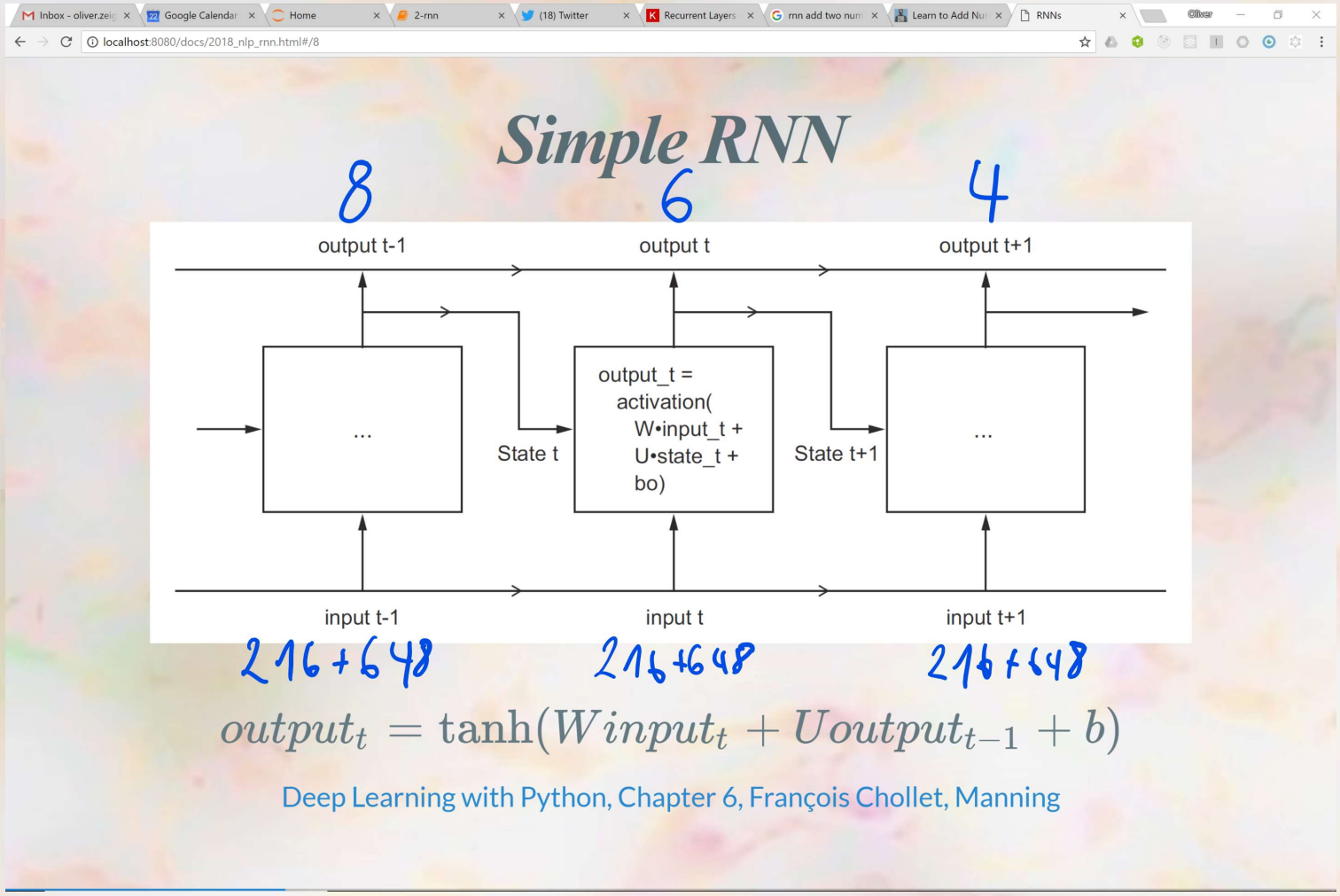


https://www.tensorflow.org/tutorials/seq2seq

Encoding addition as a Sequence to Sequence translation



Each time step generates a digit of the result



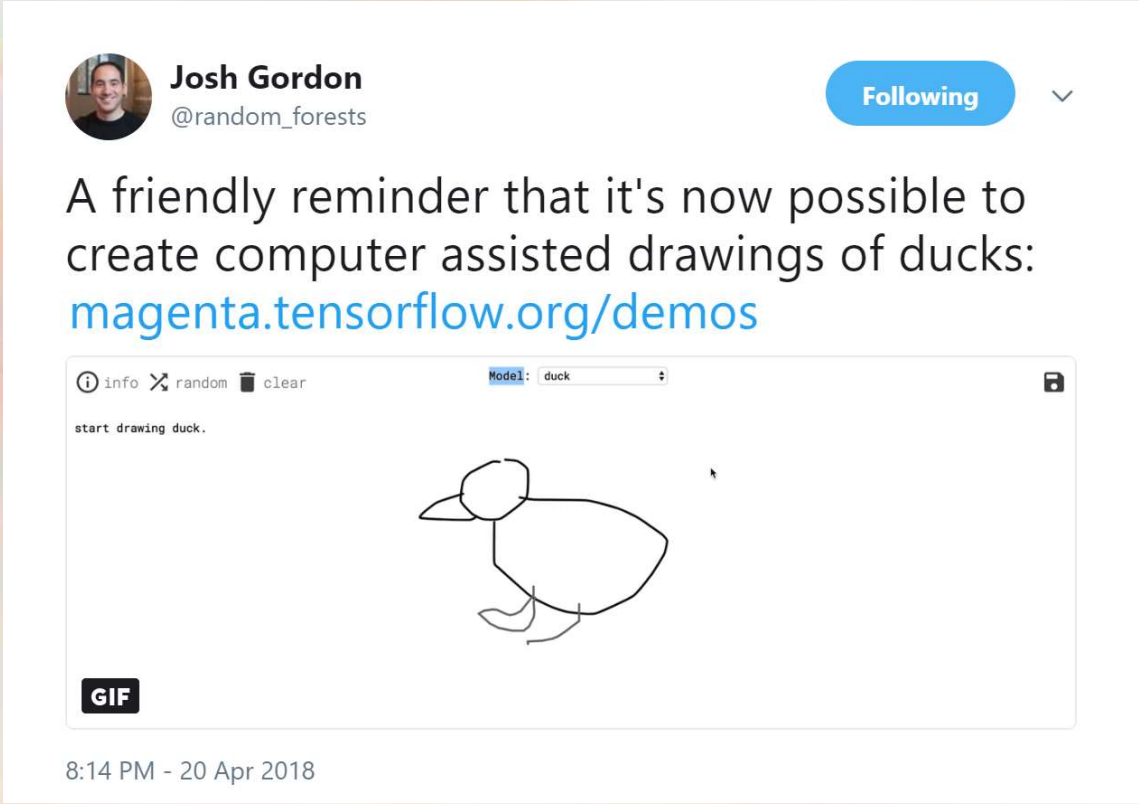
Seeing the network at work in a notebook

```
Input: "216+648"
Output: "864"
```

Padding is handled by using a repeated sentinel character (space)

Notebook:
https://colab.research.google.com/github/djcordhose/haw/blob/master/notebooks/nlp/rnn-add-example.ipynb
https://machinelearningmastery.com/learn-add-numbers-seq2seq-recurrent-neural-networks/

Example Application: Using sequences of events



https://twitter.com/random_forests/status/987394050914385927
https://magenta.tensorflow.org/assets/sketch_rnn_demo/index.html

Exercise: Think about more applications of Sequence to Sequence translations (or RNNs in general)

- Discuss with your neighbors
- 5 Minutes
- Share your ideas

More Applications

- ***Speech Recognition***: https://medium.com/@ageitgey/machine-learning-is-fun-part-6-how-to-do-speech-recognition-with-deep-learning-28293c162f7a
- ***Neural Machine Translation (seq2seq)***: https://blog.keras.io/a-ten-minute-introduction-to-sequence-to-sequence-learning-in-keras.html
- ***Sentiment Analysis***: https://medium.com/@alyafey22/sentiment-classification-from-keras-to-the-browser-7eda0d87cdc6
- ***Text / Source Code Generators***: http://karpathy.github.io/2015/05/21/rnn-effectiveness/