

Recurrent Neural Networks

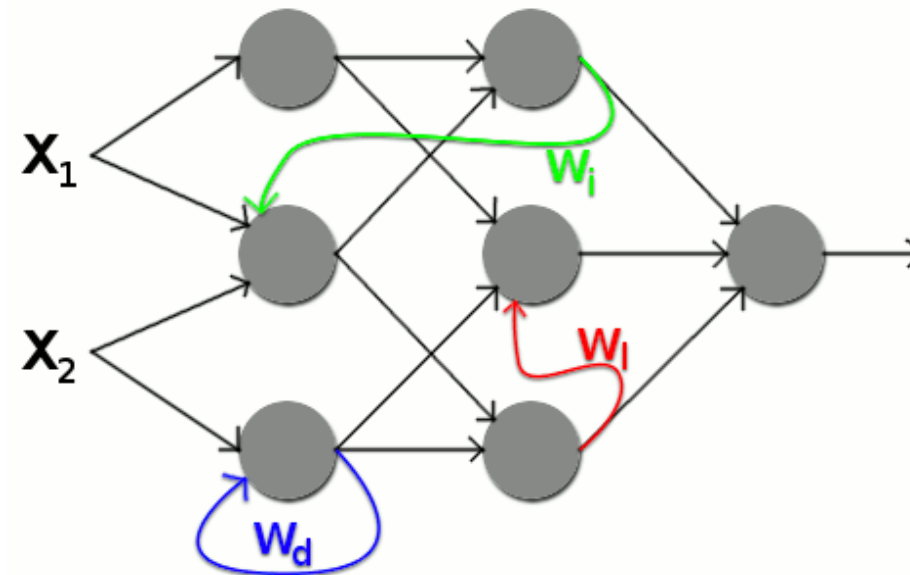
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Let's get started with Recurrent Neural Networks

Why?

So in the last lecture we've learned that a single layer feed forward neural network can represent any mathematical function. But we've briefly explained that training such a single hidden layer neural network is nearly impossible. At least with the tools and methods we have at the moment. If you give me a quantum computer and a bit of time I might come up with a better solution. So since training is a difficult task people came up with various different types of neural network layers and topologies and Recurrent Neural networks are one of them. So while feed forward neural networks are good at function learning, they fail often when it comes to sequence and time-series data like the data streams we obtain from IoT sensors for example.

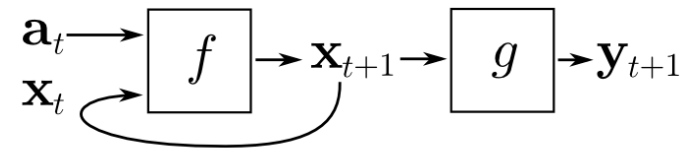
How?



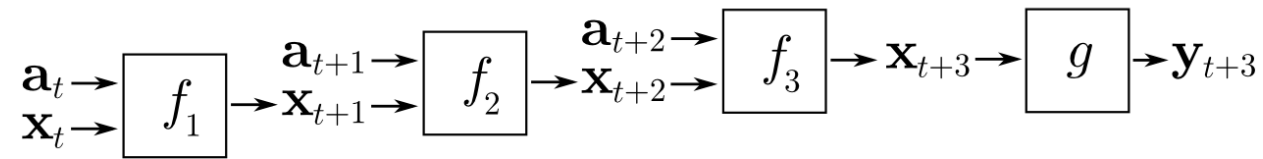
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Processing sequences and time series requires some sort of memory since dynamic temporal behaviour is also adding information to the whole picture. So by introducing loopback connections between neurons such a Recurrent Neural Network can remember past events.

How?



↓ unfold through time ↓



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Note that any Recurrent Neural Network can be unfolded through time into a Deep Feed Forward Neural Network. So again, this whole exercise is only there since training can be improved by changing the neural network topology from a single hidden layer feed forward network to something else.

Recursive

There exists an abundance of Recurrent Neural Network types...

Hopfield

Recursive

Hopfield

Fully recurrent

Recursive

Hopfield

Fully recurrent

Recursive

Elman network

Hopfield

Jordan network

Fully recurrent

Recursive

Elman network

Hopfield

Jordan network

Fully recurrent

Recursive

Elman network

Echo state

Hopfield

Neural history compressor

Jordan network

Fully recurrent

Recursive

Elman network

Echo state

LSTM

...but we will only concentrate on one...LSTM ... long short term memory networks. Those are so powerful and essential that we dedicate the next lecture entirely to LSTMs