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Machine Learning

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Lesson 6.2

RNN &

LSTM

Recurrent Neural Network

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- Because of their internal memory, RNNs can remember important things about the input they received

- This allows them to be very precise in predicting what's coming next.

Recurrent Neural Network

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- This is why they're the preferred algorithm for sequential data like time series, speech, text, financial data, audio, video, weather and much more.

- Recurrent neural networks can form a much deeper understanding of a sequence and its context compared to other algorithms.

RNN vs Feedforward NN

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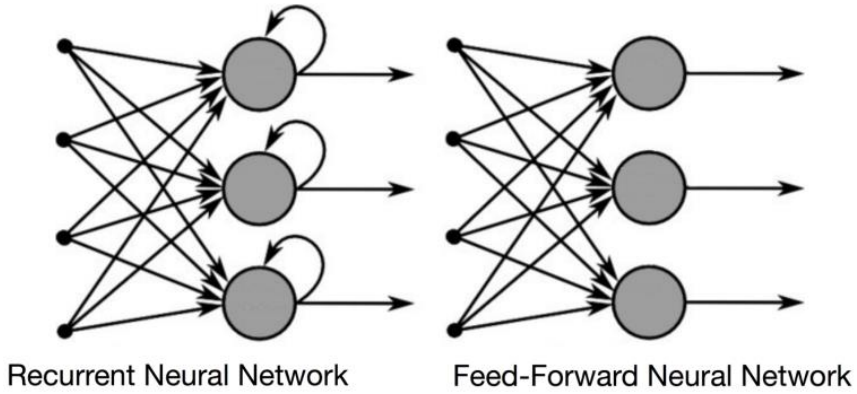
- In a feed-forward neural network, the information only moves in one direction — from the input layer, through the hidden layers, to the output layer.

- The information moves straight through the network.



Recurrent Neural Network Feed-Forward Neural Network

RNN vs Feedforward NN

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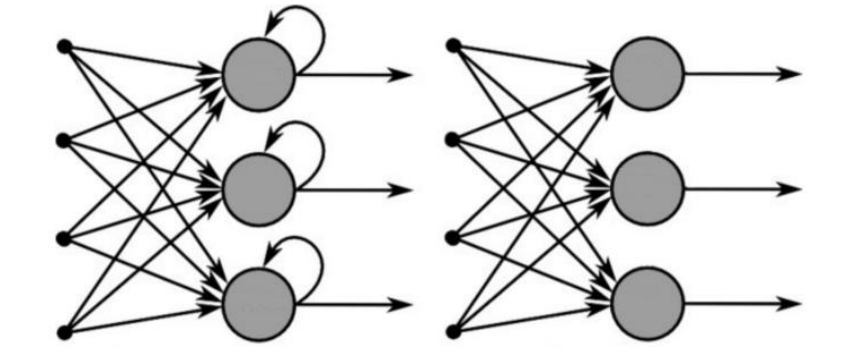
- Feed-forward neural networks have no memory of the input they receive and are bad at predicting what's coming next.
- Because a feed-forward network only considers the current input, it has no notion of order in time.
- It simply can't remember anything about what happened in the past except its training.



RNN vs Feedforward NN

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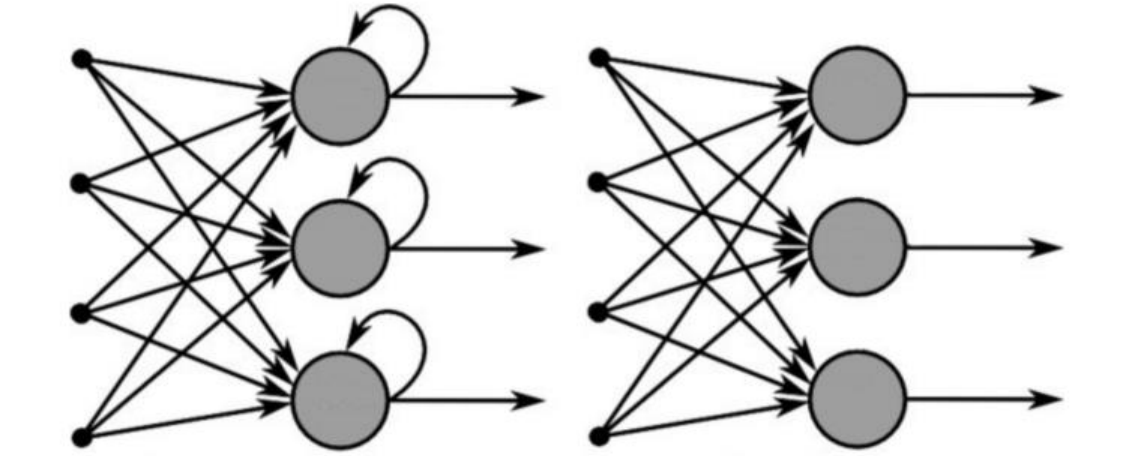
- In a RNN the information cycles through a loop.
- When it makes a decision, it considers the current input and also what it has learned from the inputs it received previously.



Recurrent Neural Network

Feed-Forward Neural Network

RNN

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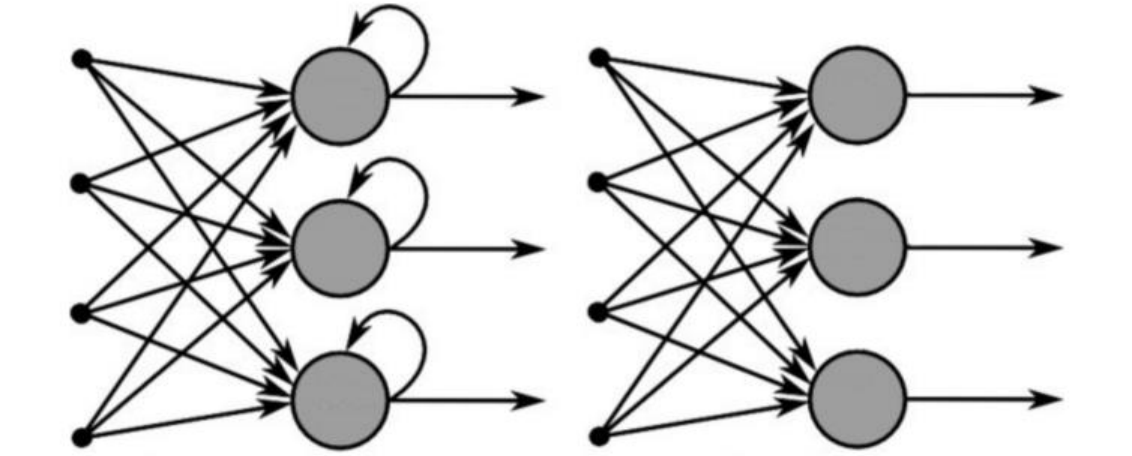
- A usual RNN has a short-term memory.
- In combination with a LSTM they also have a long-term memory.



Recurrent Neural Network

Feed-Forward Neural Network

RNN

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- A feed-forward neural network assigns, like all other deep learning algorithms, a weight matrix to its inputs and then produces the output.
- Note that RNNs apply weights to the current and also to the previous input.
- Furthermore, a recurrent neural network will also tweak the weights for both gradient descent and backpropagation through time.

LSTM

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- Long short-term memory (LSTM) networks are an extension of RNN that extend the memory.
- LSTM are used as the building blocks for the layers of a RNN. LSTMs assign data “weights” which helps RNNs to either let new information in, forget information or give it importance enough to impact the output.
- Therefore, it is well suited to learn from important experiences that have very long time lags in between

LSTM

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- The units of an LSTM are used as building units for the layers of a RNN, often called an LSTM network.
- LSTMs enable RNNs to remember inputs over a long period of time. This is because LSTMs contain information in a memory, much like the memory of a computer.
- The LSTM can read, write and delete information from its memory.

LSTM

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- This memory can be seen as a gated cell, with gated meaning the cell decides whether or not to store or delete information (i.e., if it opens the gates or not), based on the importance it assigns to the information.

- The assigning of importance happens through weights, which are also learned by the algorithm. This simply means that it learns over time what information is important and what is not.

LSTM

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- In a long short-term memory cell you have three gates: input, forget and output gate.
- These gates determine whether or not to let new input in (input gate), delete the information because it isn’t important (forget gate), or let it impact the output at the current timestep (output gate).
- Below is an illustration of a LSTM with its three gates:

LSTM

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