Recurrent Neural Network

IS THIS A GOOD IDEA FOR TIME SERIES FORECASTING?

Outline

Defining time series forecasting and discuss contemporary practice

Define Recurrent Neural Networks (including LSTMs)

Discuss the general findings on the applicability of RNNs to time series

Set the challenge for you!

Time series forecasting

A time series is a sequence of data in which temporal ordering of the data is a crucial element

- Temporal rearranging leads to meaningless gibberish

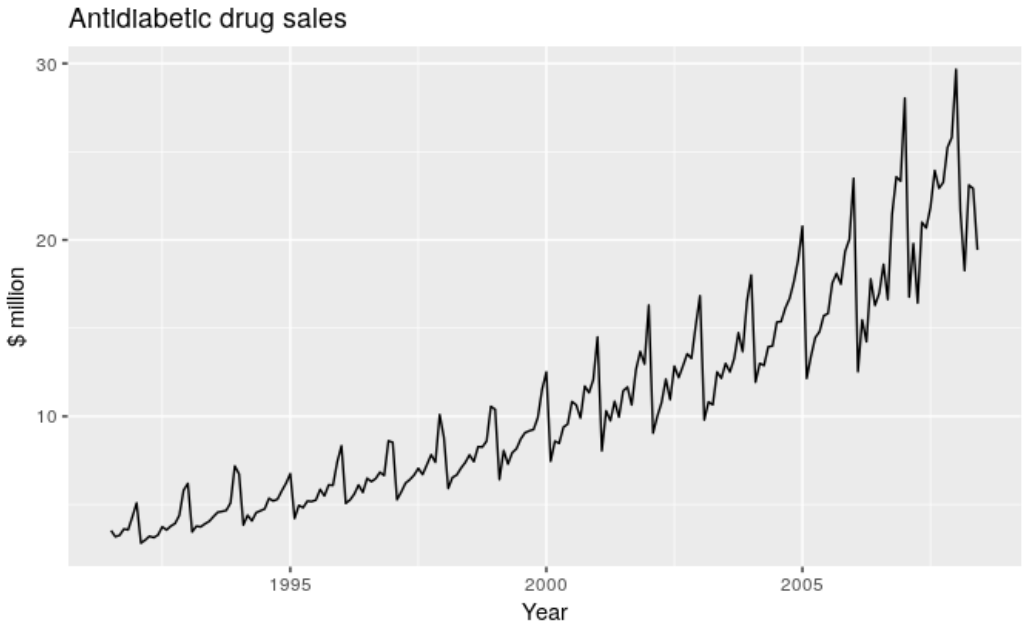
Time series data typically exhibits patterns that can be classified as:

- Trend
- Cycle
- Irregular

Classic time series analysis involves decomposing the data into these categories

Methods employed are:

- Box-Jenkins' ARIMA, UCM
- Multivariate VARIMAX



Source: Hyndman, R.J., & Athanasopoulos, G. (2018) Forecasting: principles and practice, 2nd edition, OTexts: Melbourne, Australia. OTexts.com/fpp2. Accessed 19/2/2019.

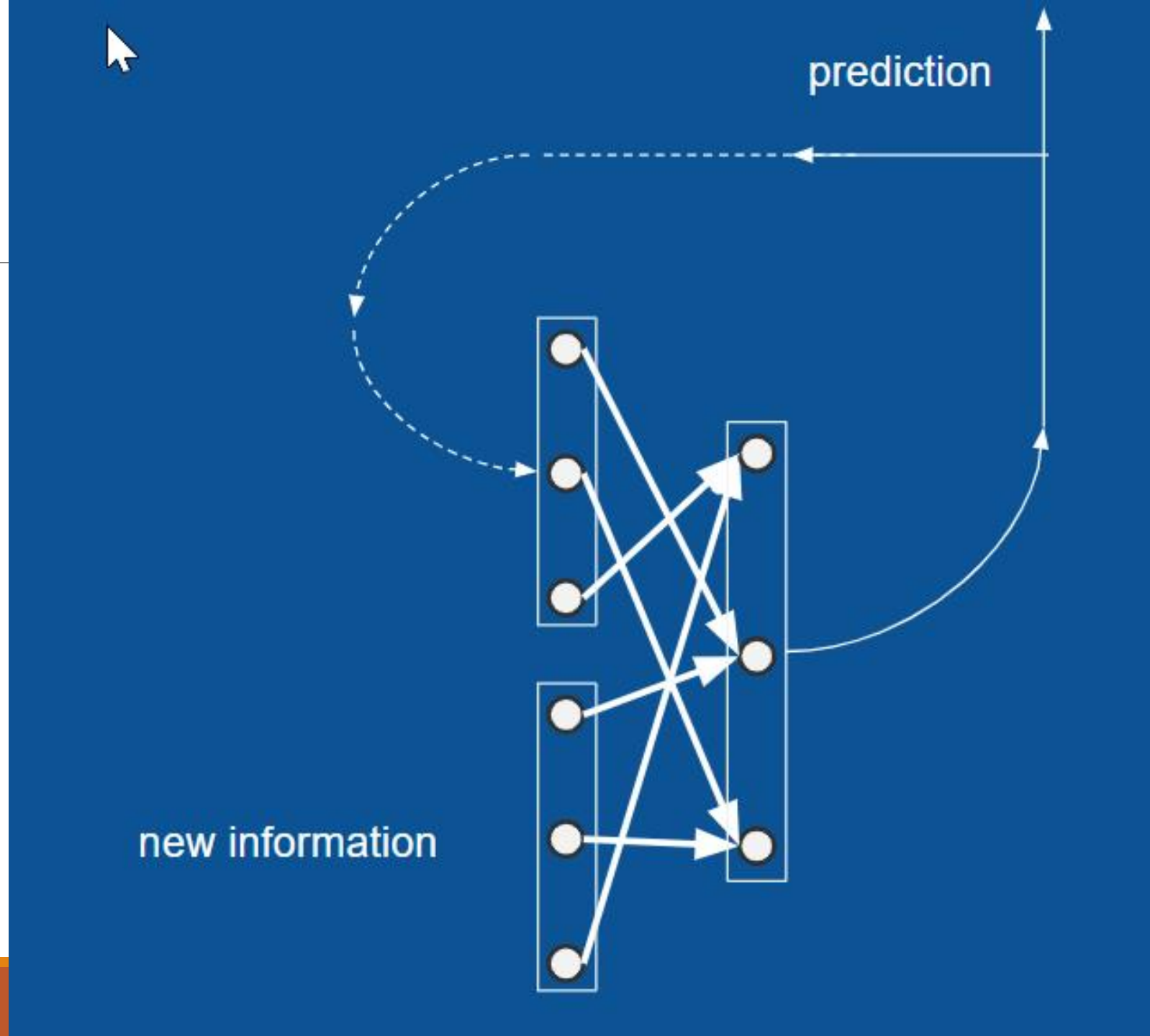
What is a recurrent neural network?

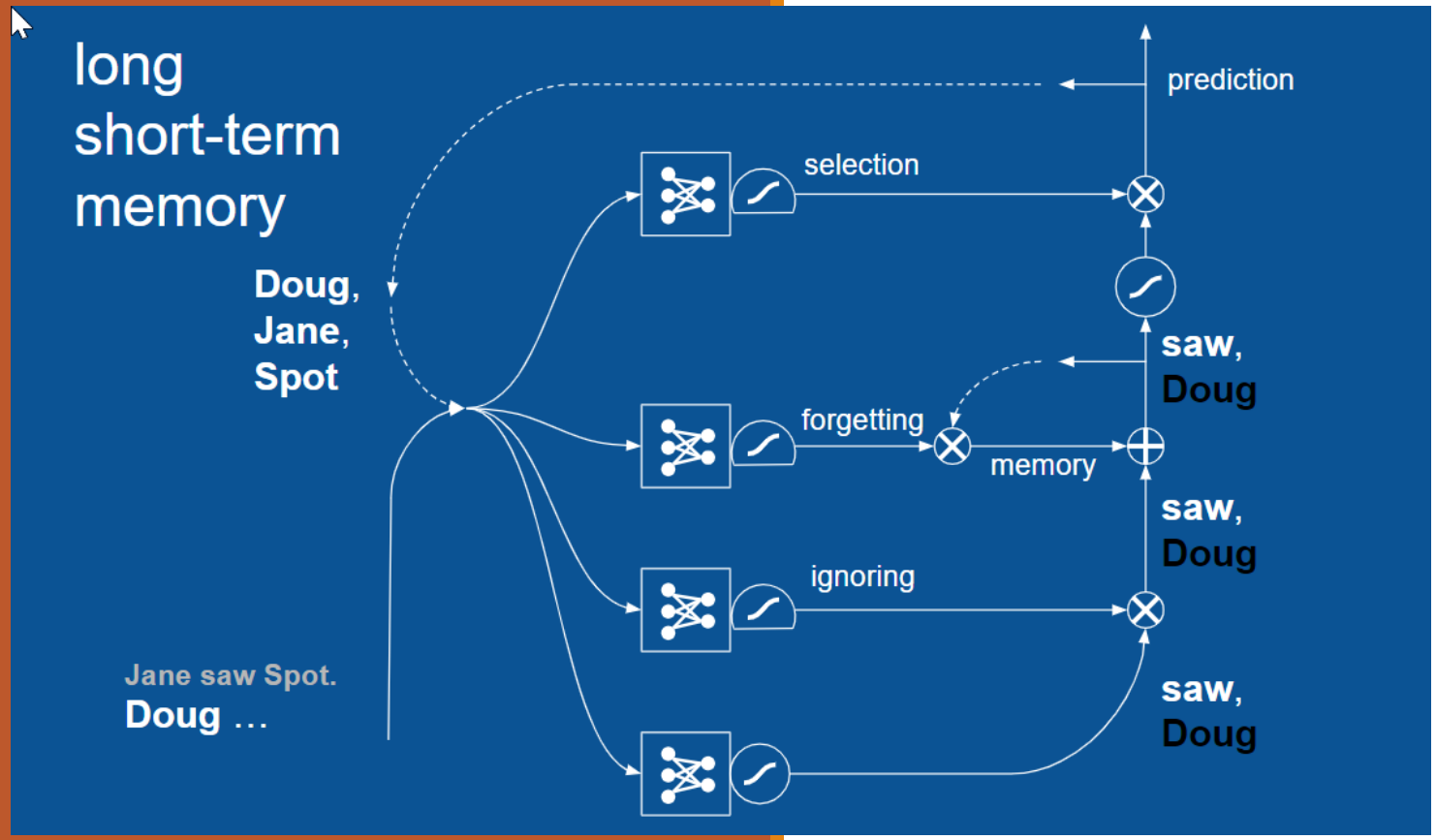
"A **recurrent neural network** (**RNN**) is a class of artificial neural network where connections between nodes form a directed graph along a temporal sequence. This allows it to exhibit temporal dynamic behavior."

Sources:

Wikipedia, Recurrent neural network. Accessed 19/2/2019

Brandon Rohrer, How LSTM and RNNs work, https://docs.google.com/presentation/d/1hqYB3LRwg_-ntptHxH18W1ax9kBwkaZ1Pa_s3L7R-2Y/edit#slide=id.g22a7e7fc5b_0_282. Accessed 19/2/2019





A more sophisticated version

- https://docs.google.com/presentation/d/1hqYB3LRwg_-ntptHxH18W1ax9kBwkaZ1Pa_s3L7R-2Y/edit#slide=id.g22a7e7fc5b_0_282

What are RNNs good for?

"There's something magical about Recurrent Neural Networks (RNNs). I still remember when I trained my first recurrent network for Image Captioning. Within a few dozen minutes of training my first baby model (with rather arbitrarily-chosen hyperparameters) started to generate very nice looking descriptions of images that were on the edge of making sense."

Source: Andrej Karpathy, The Unreasonable Effectiveness of Recurrent Neural Networks, May 21, 2015; http://karpathy.github.io/2015/05/21/rnn-effectiveness/. Accessed 19/2/2019

Applications:

- Text data
- Speech data
- Classification prediction problems
- Regression prediction problems
- Generative models

Are RNNs good for time series forecasting?

STATE SPACE MODELS VERSUS RNNS

LSTM models perform worse than custom-tailored SSM models in non-stationary scenarios.

PMCMC outperforms LSTM in all scenarios given the custom-tailored SSM parameters. Bootstrap filtering struggles more with estimating the state in non-stationary scenarios as noise increases, but still perform better than LSTM.

Source: Lene Finsveen (June 18, 2018). Time-series predictions with Recurrent Neural Networks; https://brage.bibsys.no/xmlui/bitstream/handle/11250/2563516/19906_FULLTEXT.pdf?sequence=1&isAllowed=y. Accessed 19/2/2019

ARIMA VERSUS RNNS

RNNs generally perform relatively poorly

Some exotic architectures have been shown to deliver better results than ARIMA.

But they have taken months of work to achieve that outcome.

Check out this paper for details: https://github.com/shellshock1911/Sky-Cast-Capstone/blob/master/final_report.pdf

How to develop RNNs

One way to learn how to apply LSTMs is to work through this book:

Time Series Prediction with LSTM Recurrent Neural Networks in Python with Keras

By Jason Brownlee

https://machinelearningmastery.com/time-series-prediction-lstm-recurrent-neural-networks-python-keras/

My challenge to you

Develop an LSTM using Standardised Western Power Zone Substation Load Data

Web link to the data: https://eudm.csiro.au/assets/a0f615ec-d3d3-4e24-970a-72548effc060

Western Power will soon advertise a job opportunity in the Forecasting & Modelling team.

A compelling demonstration of your abilities would help get you shortlisted for an interview