

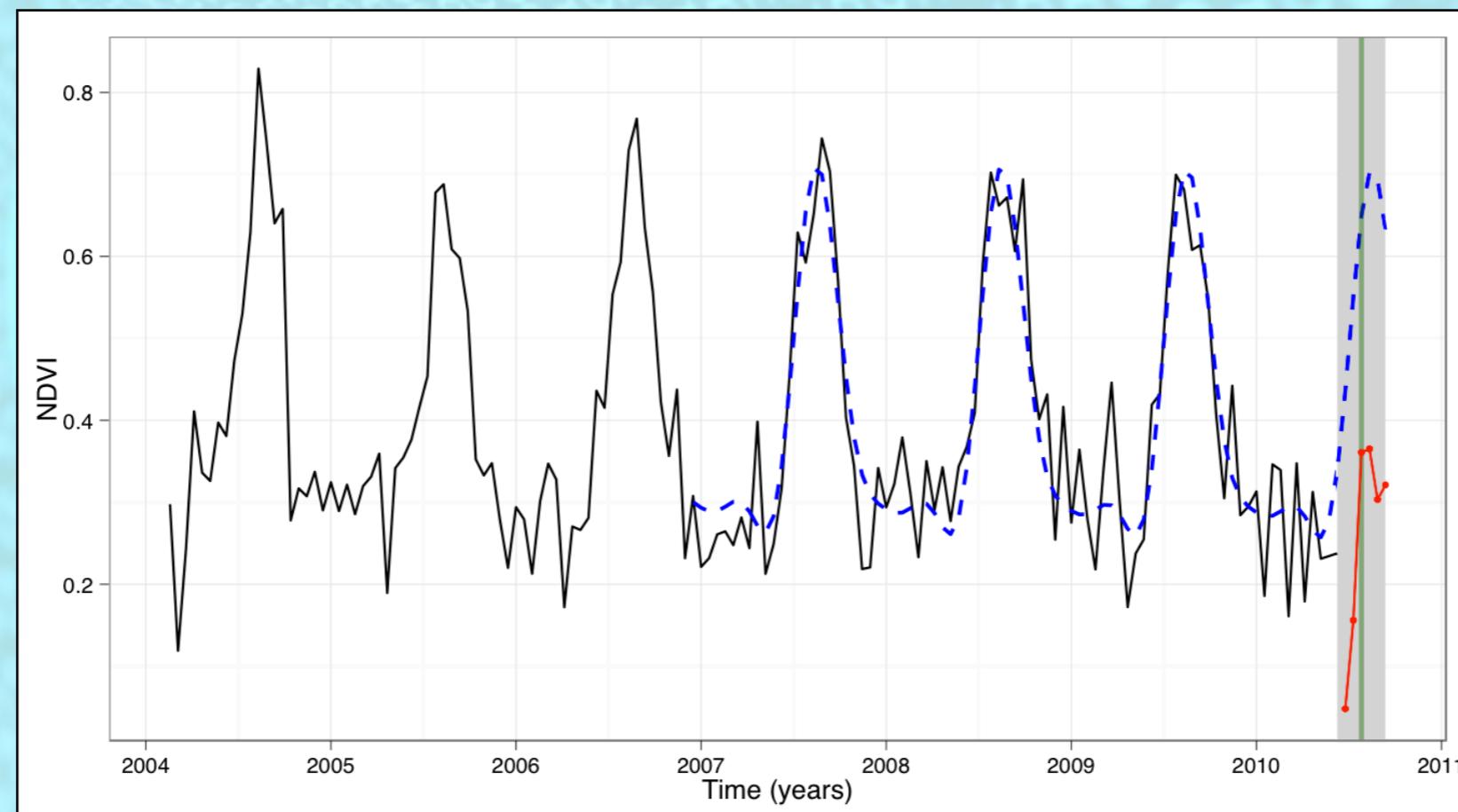


DATA Analysis con PYTHON



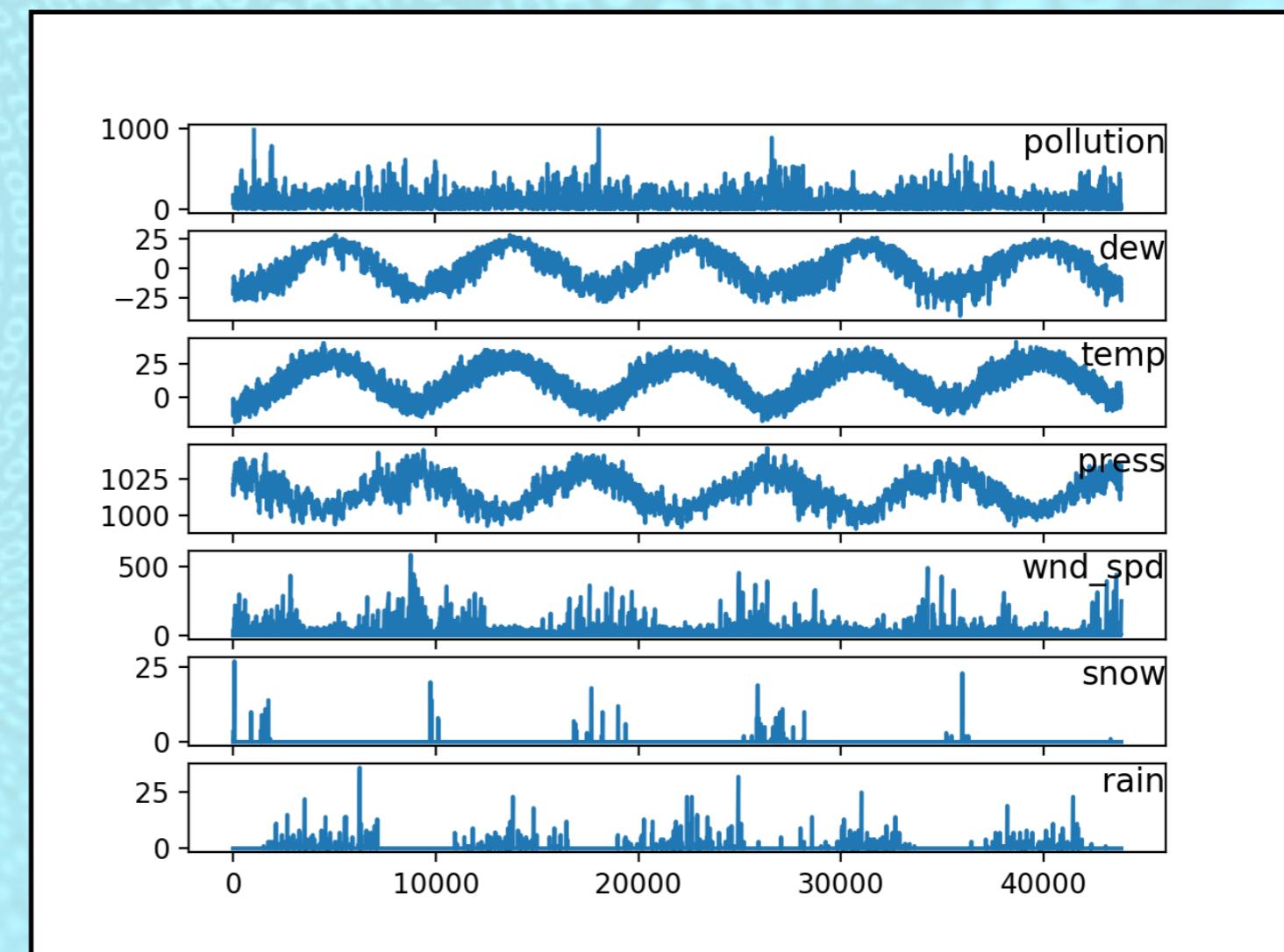
Temporal Series

$$x(t) = (x_1, x_2, x_3 \dots x_T) \quad t \in [1, T]$$



Monovariate

$$\bar{x}(t) = \begin{bmatrix} x_{11} & x_{12} & x_{13} & \dots & x_{1T} \\ x_{21} & x_{22} & x_{23} & \dots & x_{2T} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ x_{n1} & x_{n2} & x_{n3} & \dots & x_{nT} \end{bmatrix}$$



Multivariate

Complete analysis includes



Temporal series
analysis

Temporal series
Forecasting

Description
of the dataset

Making predictions

Classical statistics

Classical statistics
Machine learning

Complete analysis includes



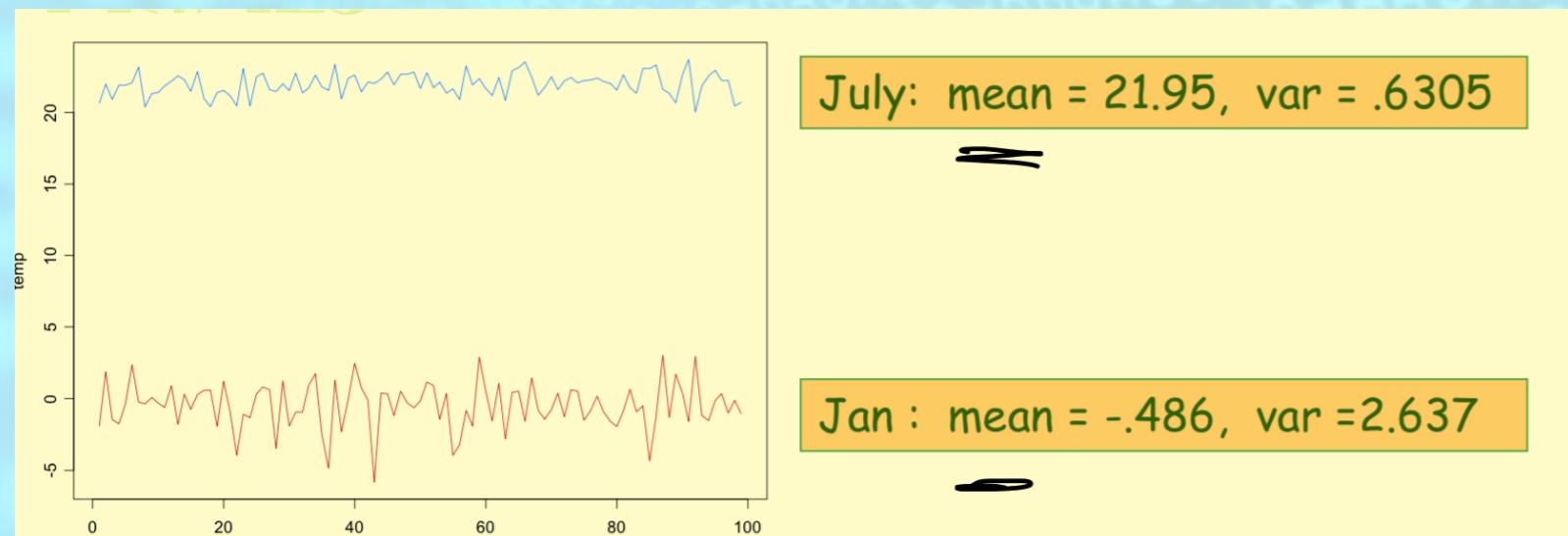
Temporal series
analysis

Temporal series
Forecasting

**Note that all the predictive models are
Purely statistic, i.e. not use the underlying
knowledge of the problem**

Temporal series analysis

Often decomposition of the series in
Constituent components

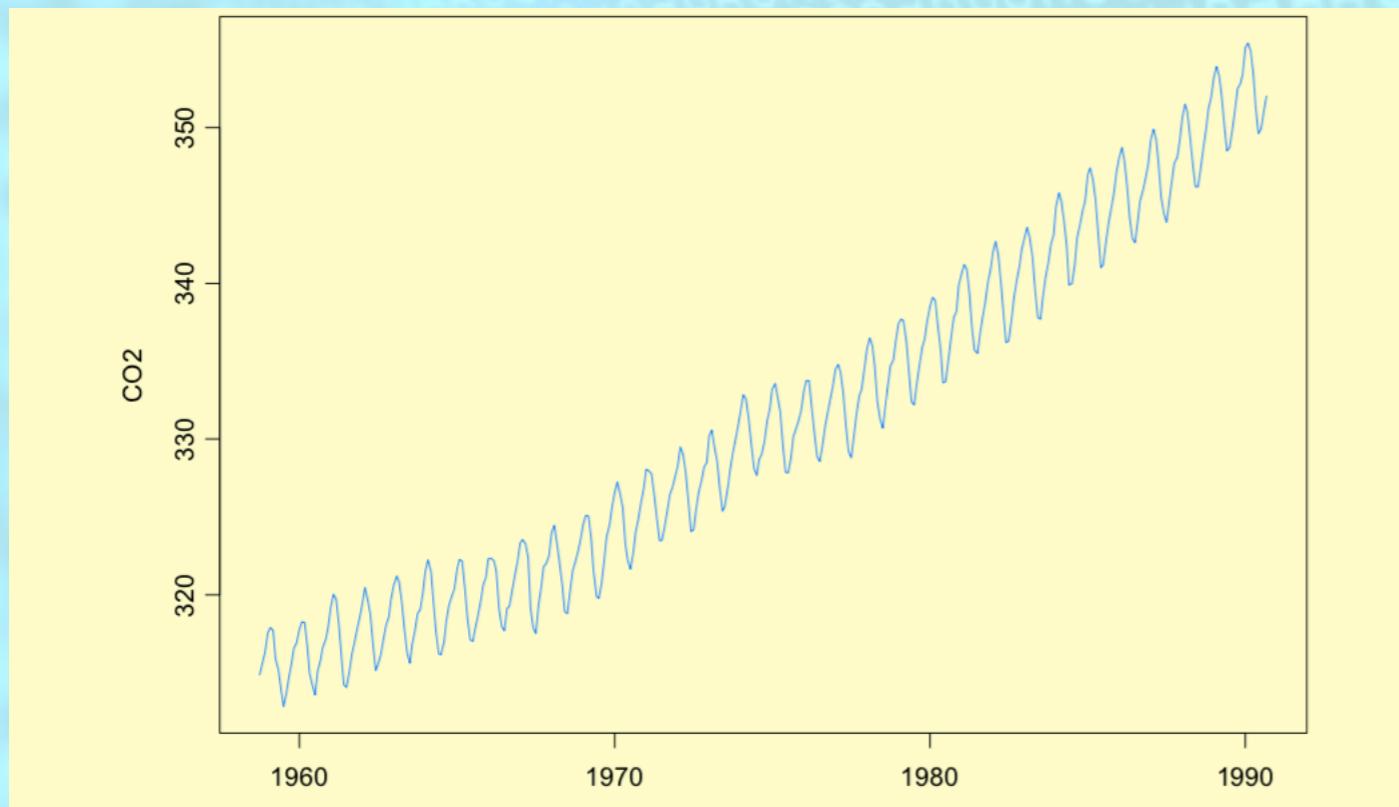


- **Level**

Baseline level of the TS

Temporal series analysis

Often decomposition of the series in
Constituent components

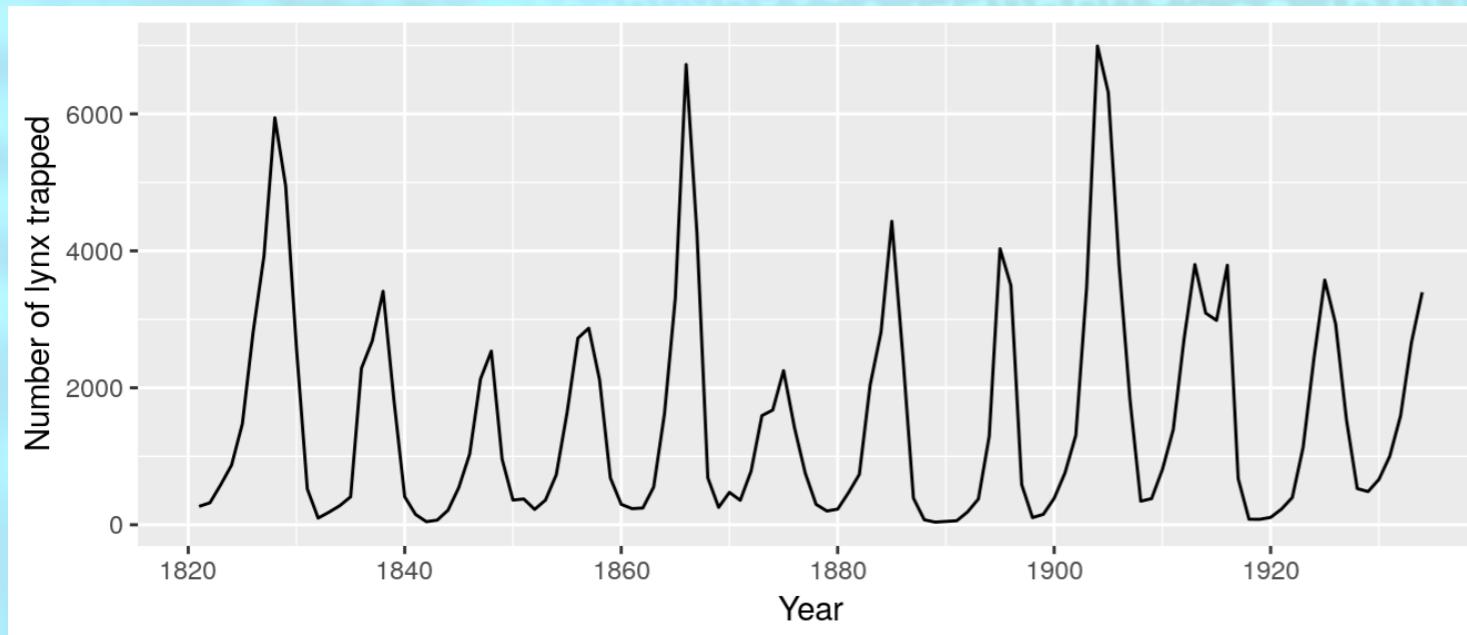


- **TREND**

Linear increase or decrease
Respect the level

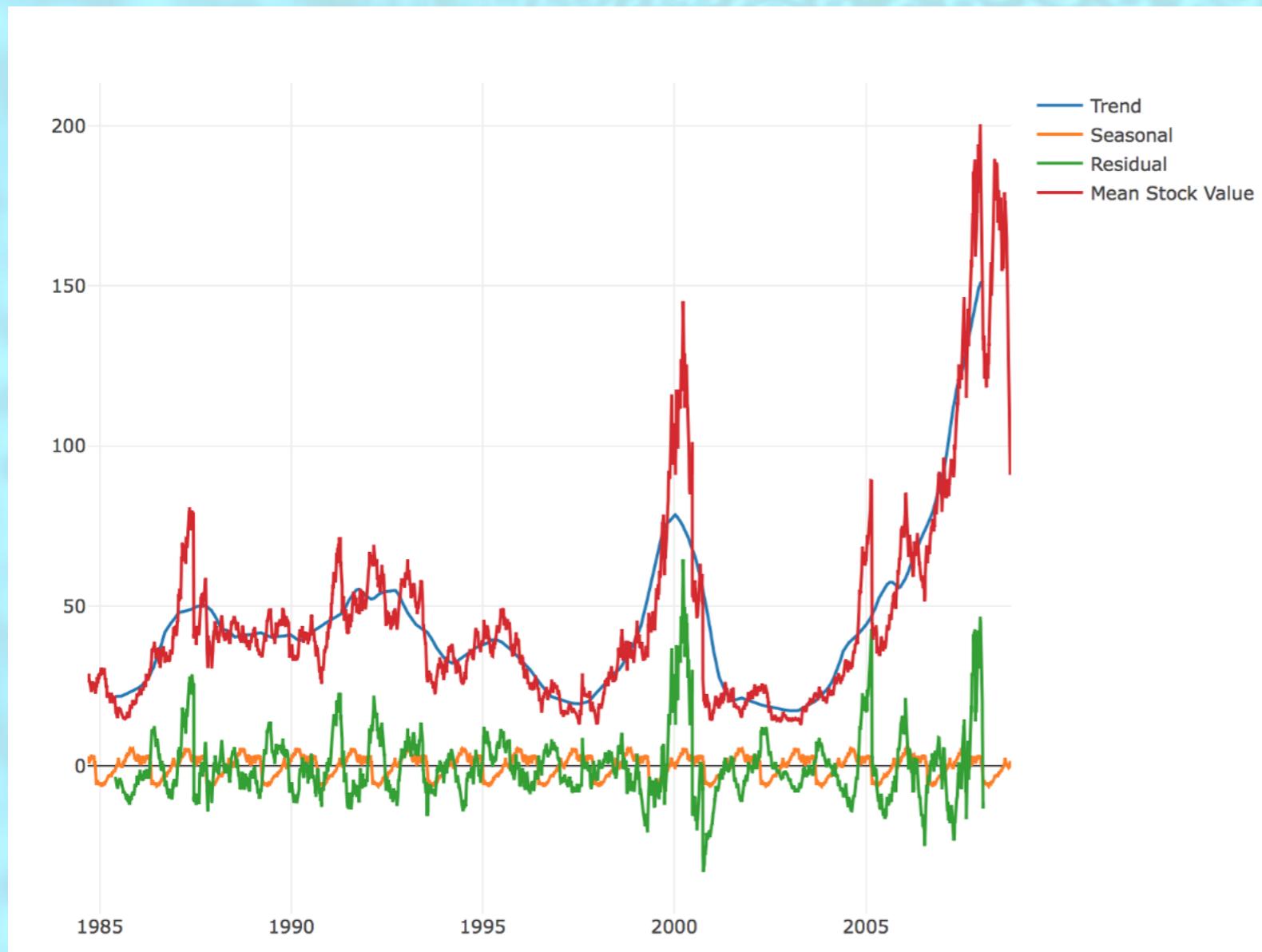
Temporal series analysis

Often decomposition of the series in
Constituent components



- **SEASONALITY**
Repeating patterns

Temporal series analysis



- Noise

Temporal series Forecasting

Linear auto-regressive models

AR

The linear autoregressive methods try to obtain the actual value as a linear combination of the previous

$$x_n = \alpha_1 x_1 + \alpha_2 x_2 + \dots$$



Parameters of the regression
(they can be calculated solving the
equations of Yule-Walker)

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(they can be calculated solving the
equations of Yule-Walker)

Intuition:
they are related to the autocorrelation of the model

The other autoregressive models are variations of AR, with inclusions of other elements.

For example:

ARMA

$$x_n = \alpha_1 x_{n-1} + \alpha_2 x_{n-2} + \dots + \beta_1 \eta_{n-1} + \beta_2 \eta_{n-2}$$

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ARMA

$$x_n = \alpha_1 x_{n-1} + \alpha_2 x_{n-2} + \dots + \beta_1 \eta_{n-1} + \beta_2 \eta_{n-2}$$

In all cases the ALL predict STATIONARY PROCESSES:

-mean

-variance

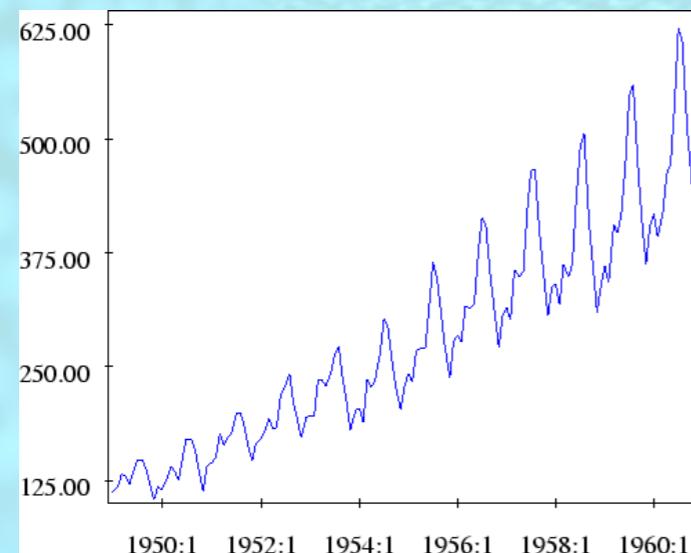
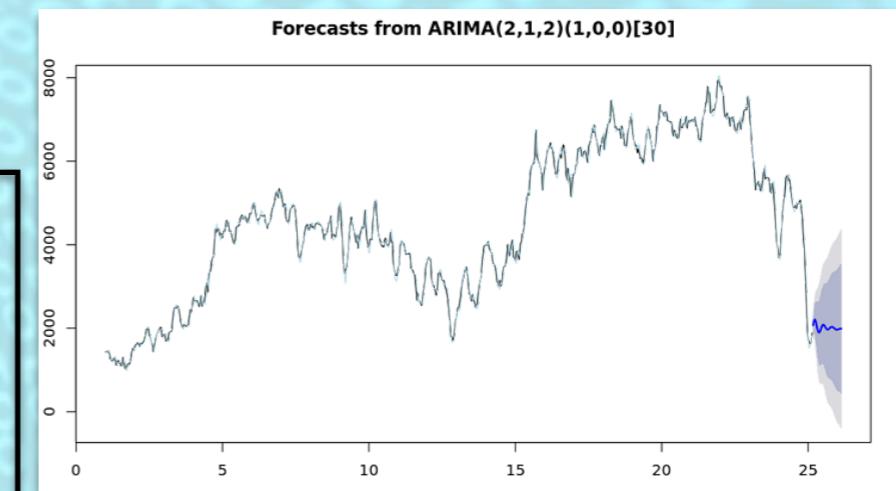
Are CONSTANT over time

However most of the processes are NOT STATIONARY

Non stationary models

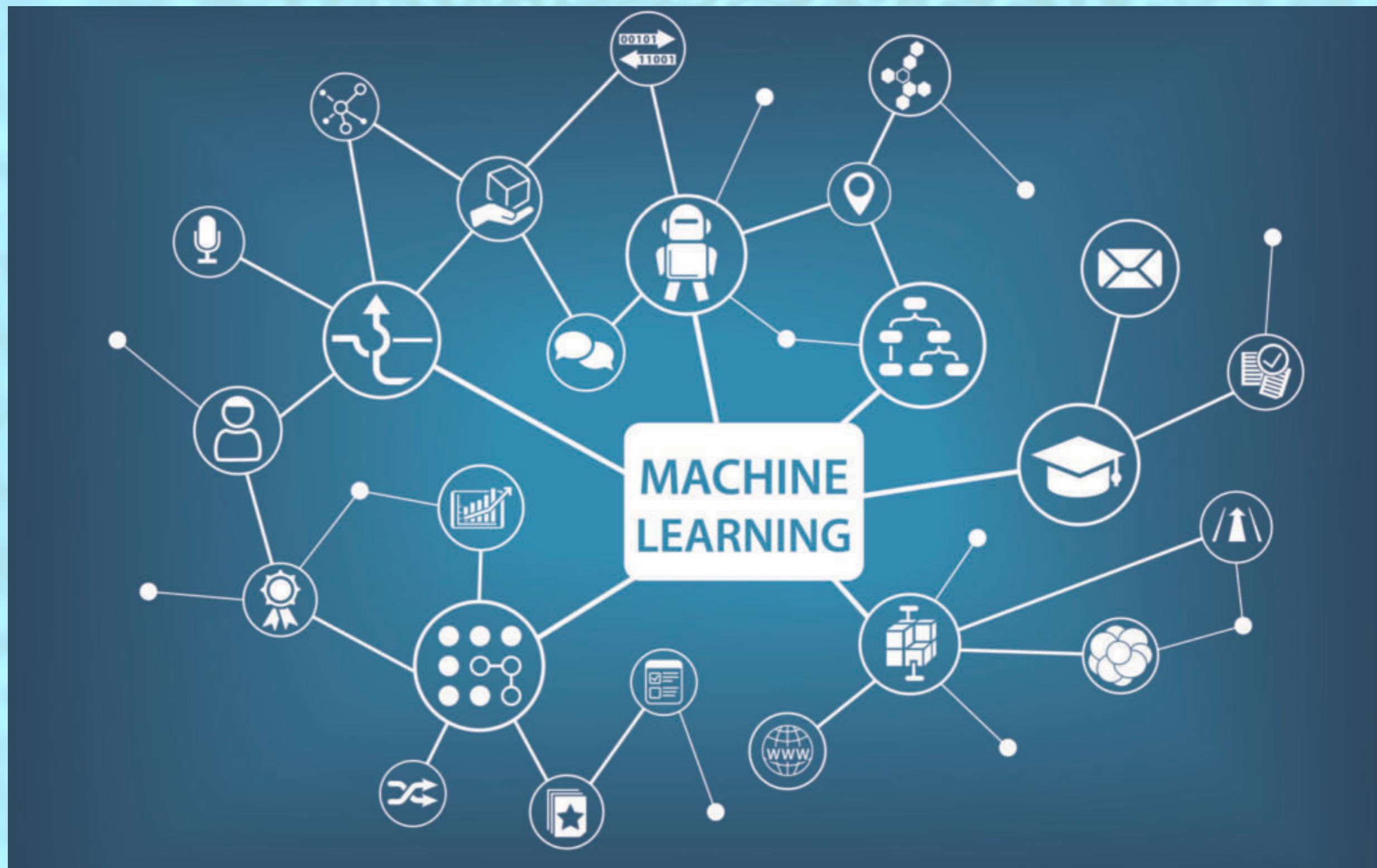
ARIMA

Allow to model processes that
are not stationary in the **MEAN**

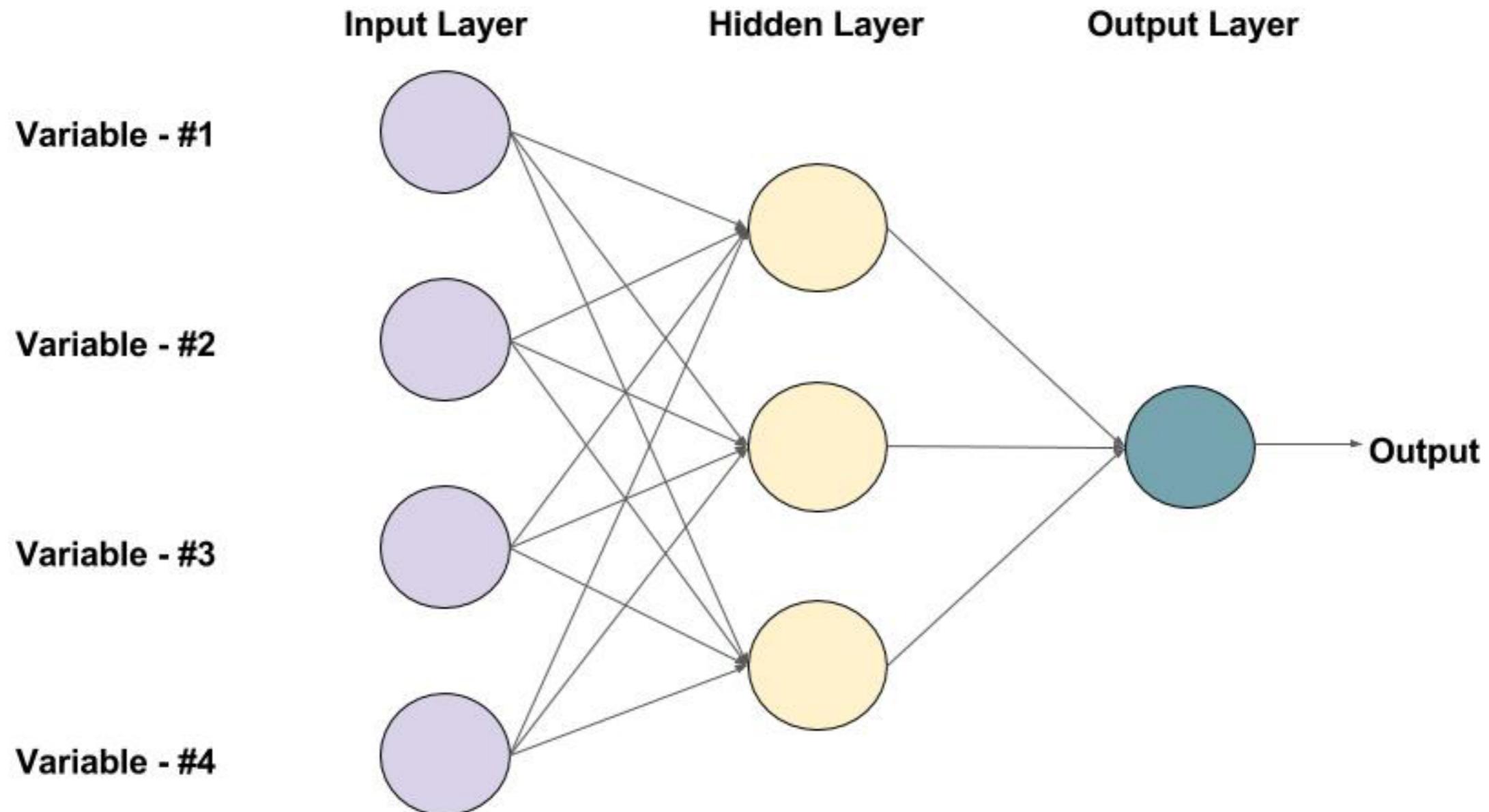


SARIMA

To treat series with
periodical components

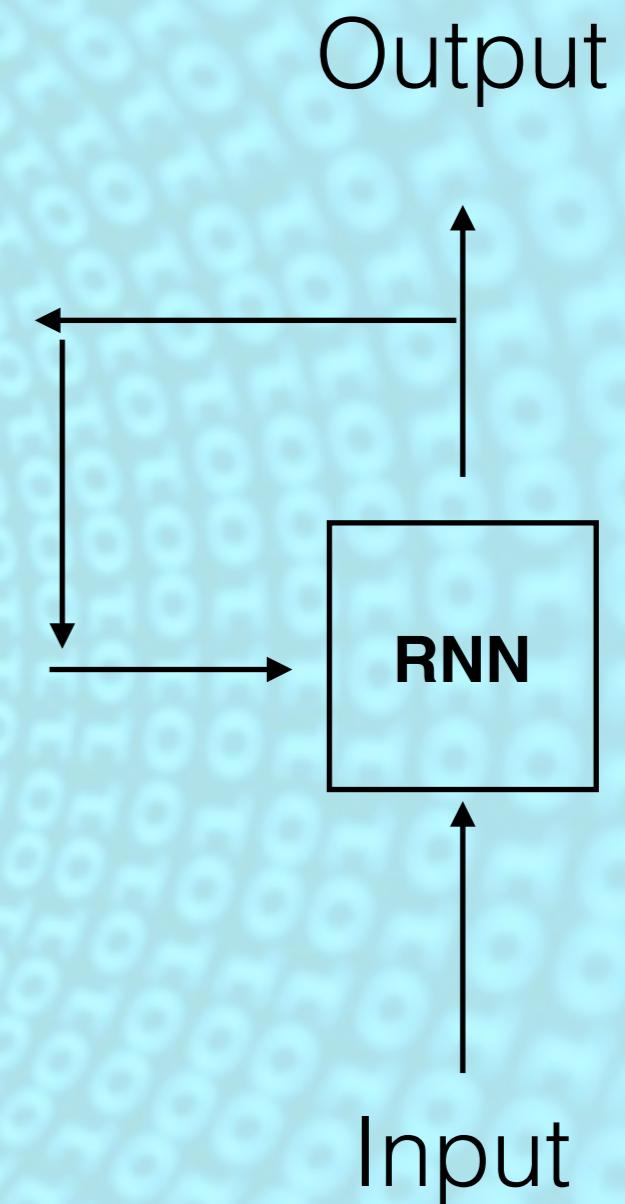
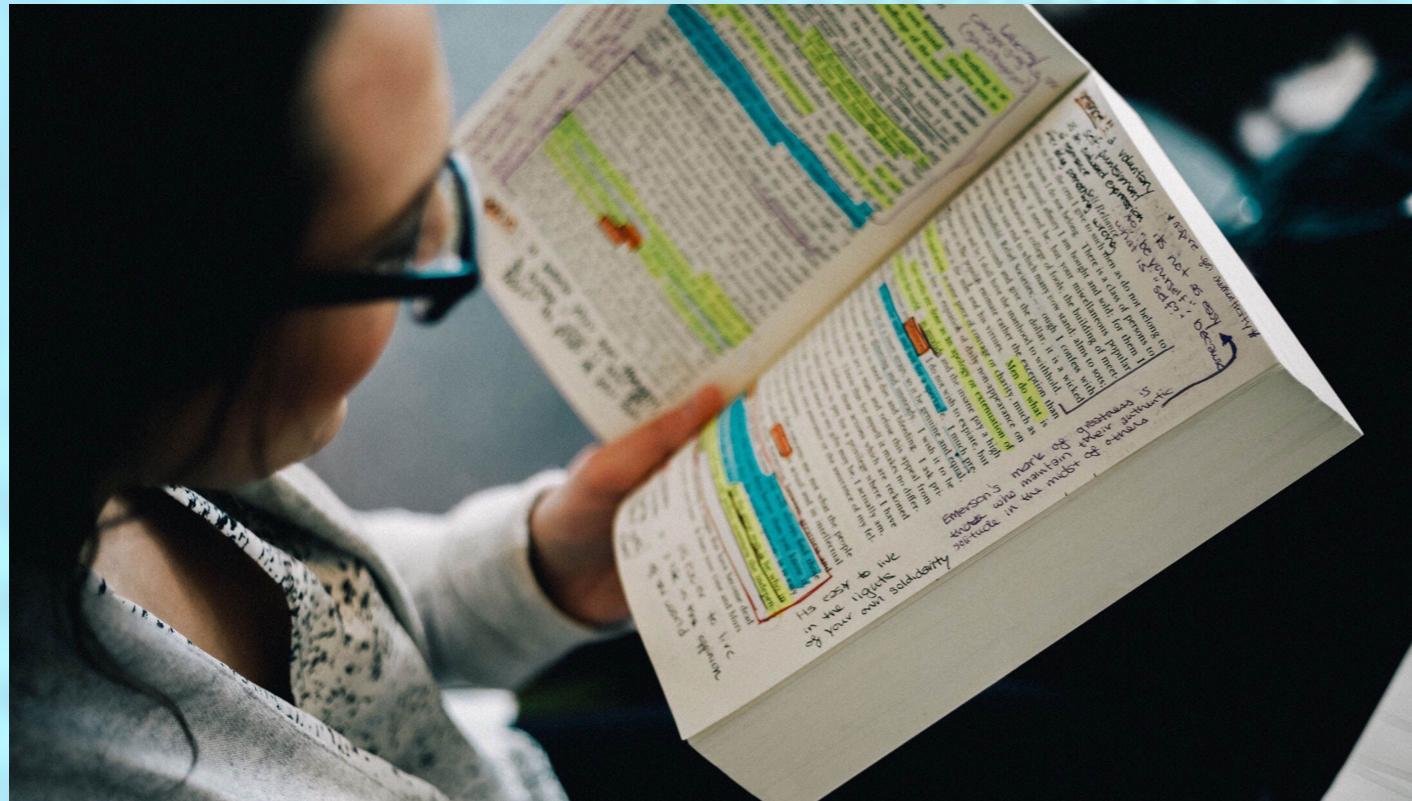


Feed forward NN

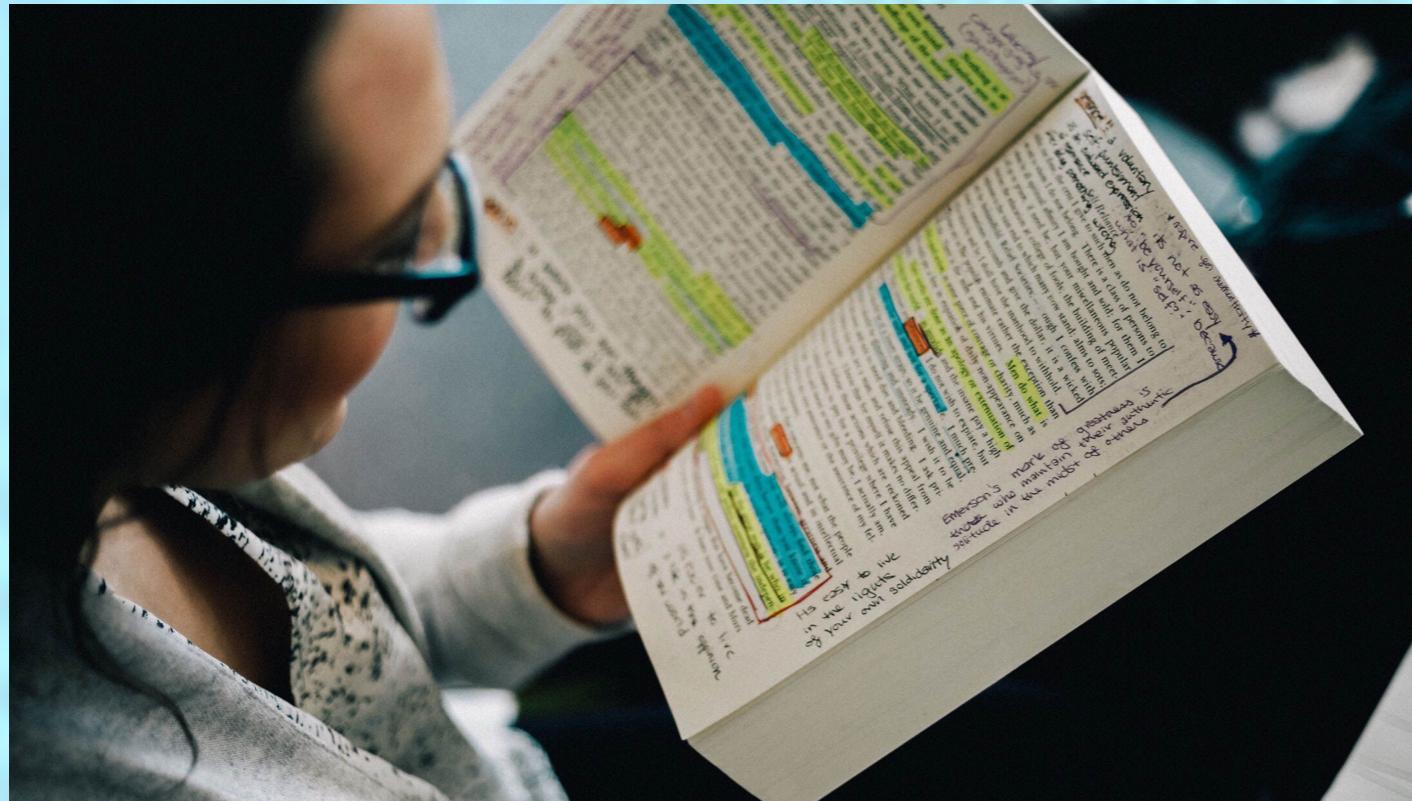


An example of a Feed-forward Neural Network with one hidden layer (with 3 neurons)

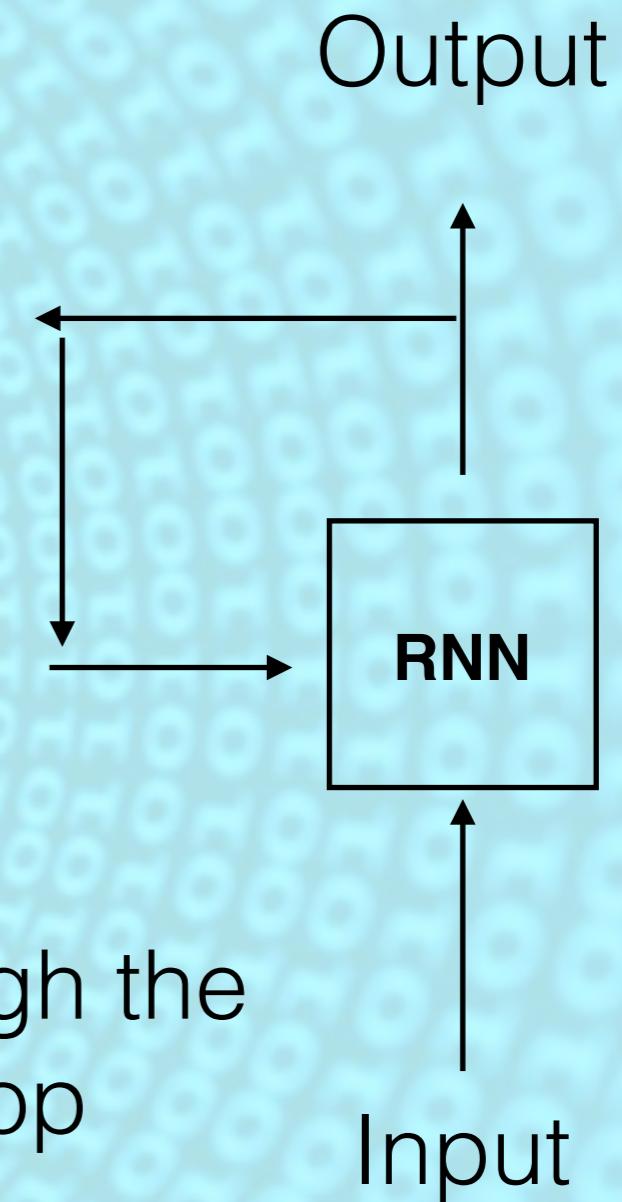
Recurrent Neural Networks



Recurrent Neural Networks

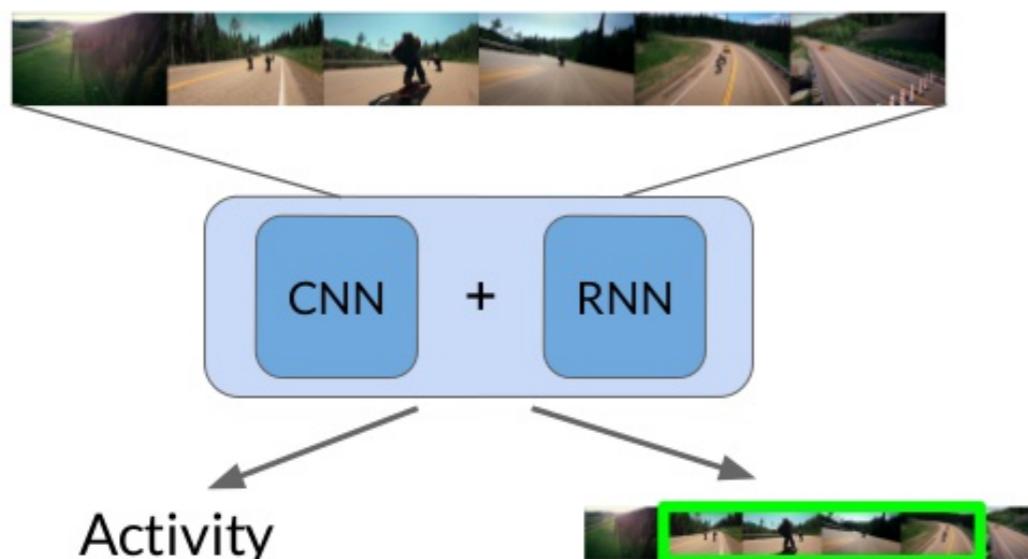


It processes sequences iterating through the sequence and having an internal loop keeping memory of all it learn

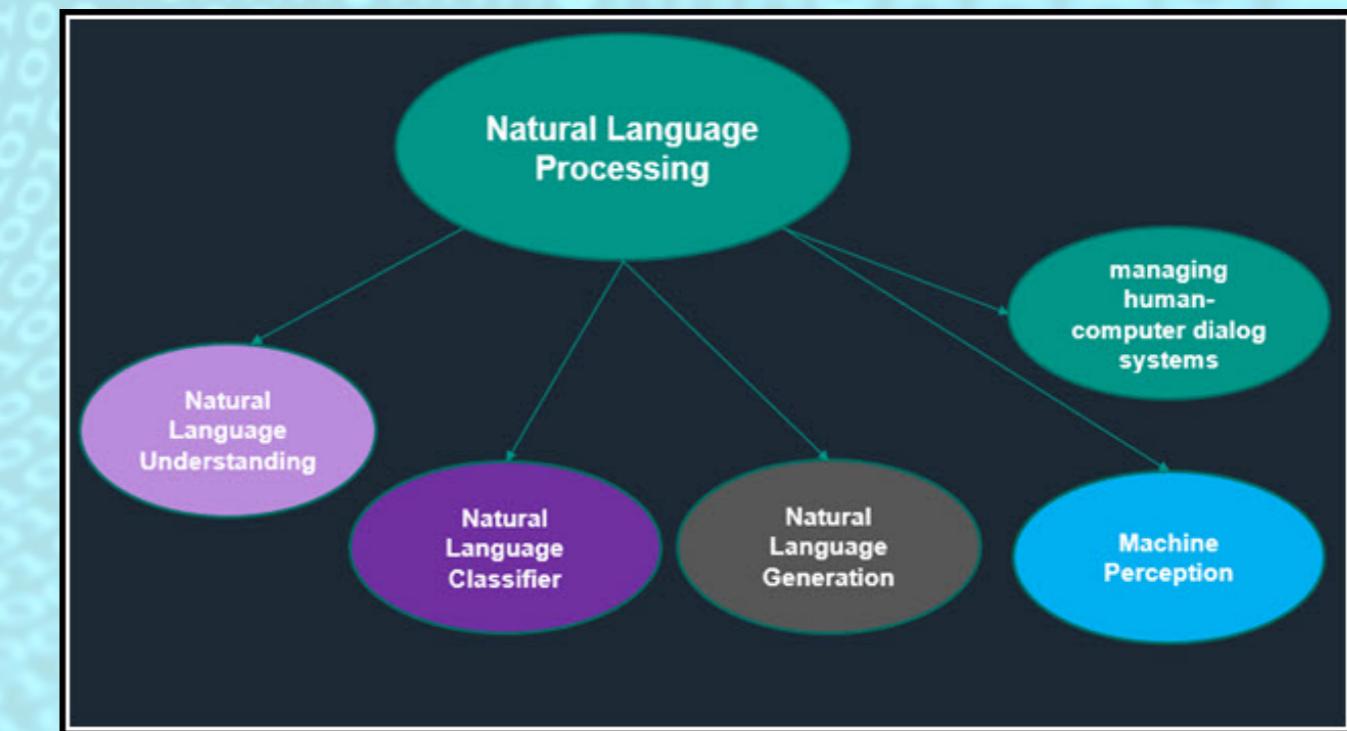
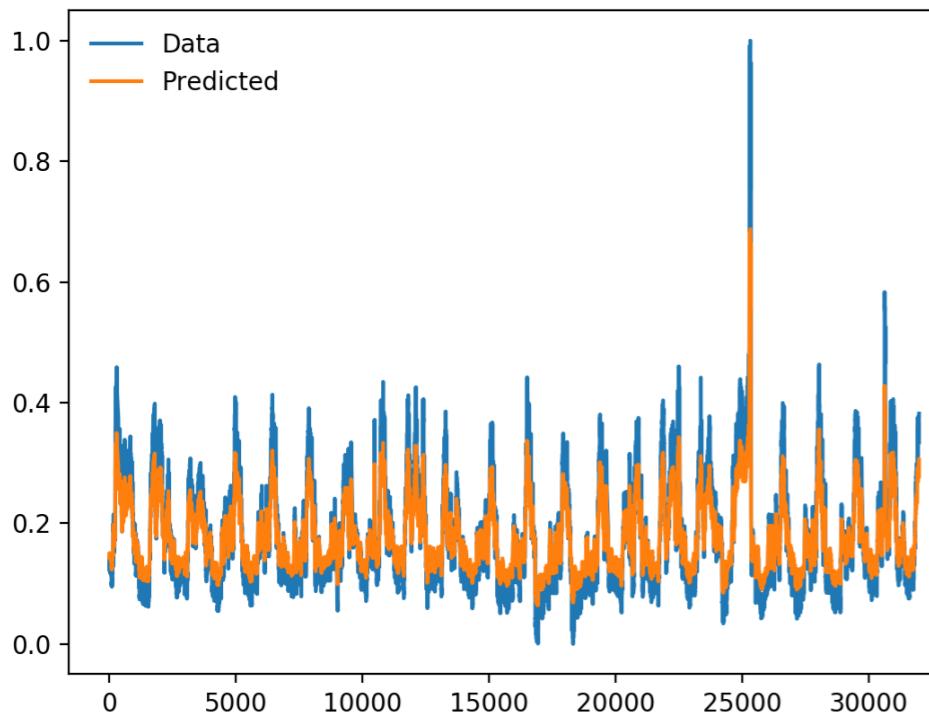


They take time and sequences into account

Temporal Activity Detection



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Recurrent NN suffer from short-term memory



If a sequence is long enough, they'll have a hard time carrying information from earlier time steps to later ones

Recurrent NN suffer from short-term memory



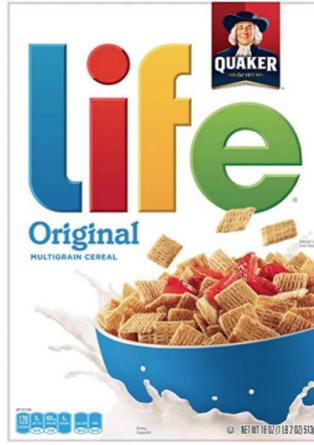
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Customers Review 2,491

 Thanos

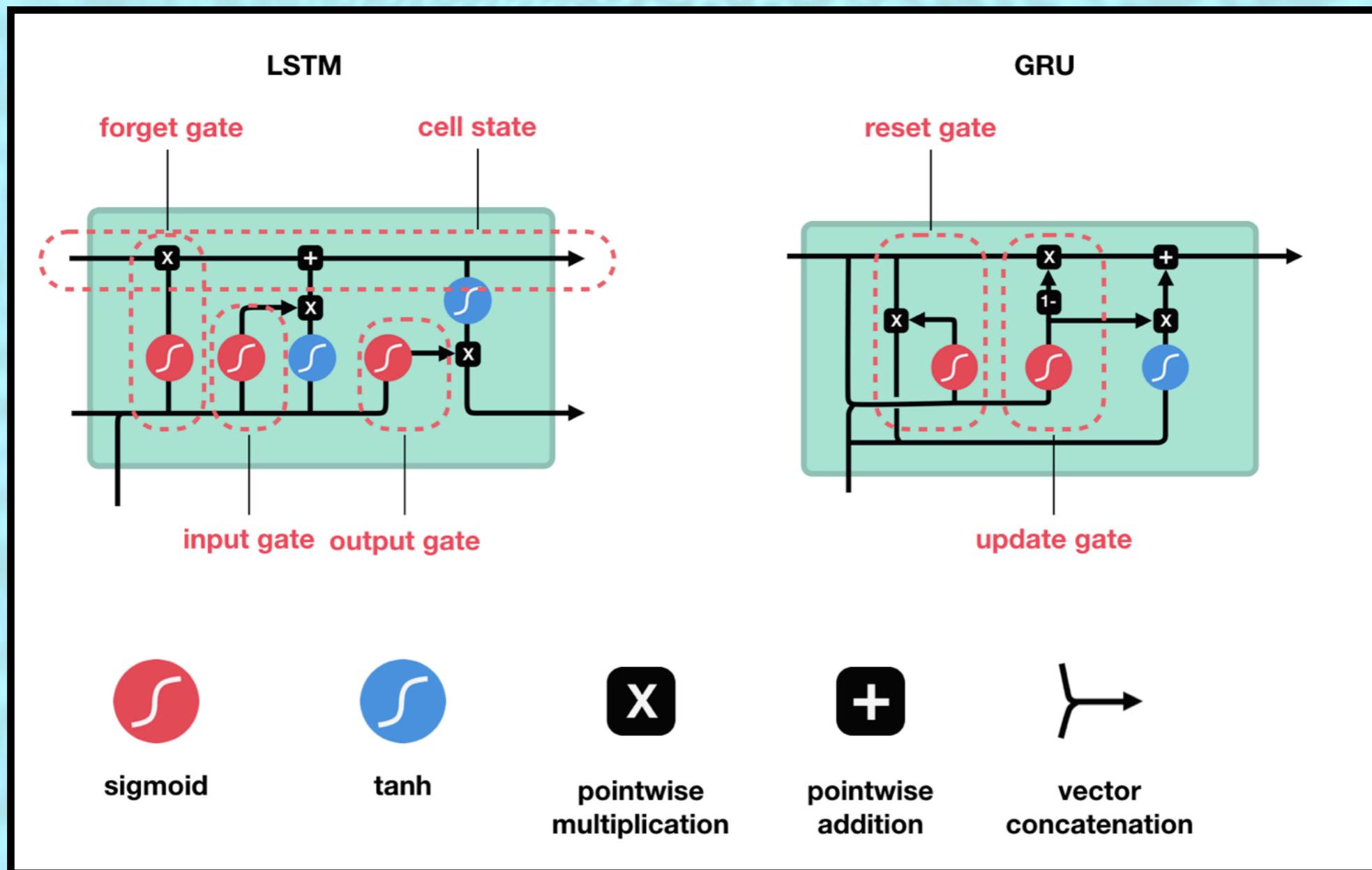
September 2018
Verified Purchase

Amazing! This box of cereal gave me a perfectly balanced breakfast, as all things should be. I only ate half of it but will definitely be buying again!


A Box of Cereal
\$3.99

LSTM = Long short-term memory

GRU = Gated Recurrent Unit



LSTM's and GRU's were created as the solution to short-term memory. They have internal mechanisms called gates that can regulate the flow of information.

LSTM = Long short-term memory

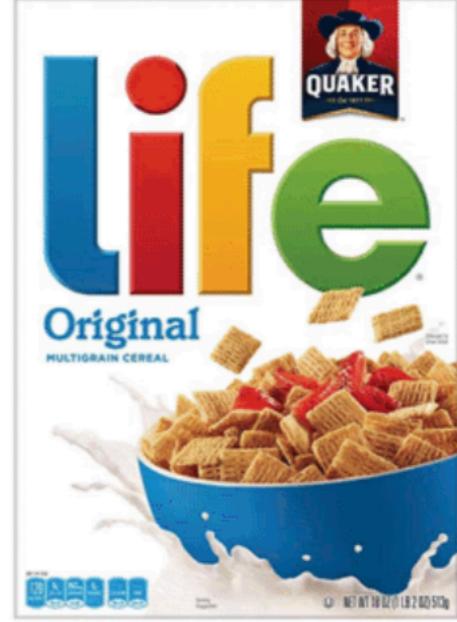
GRU = Gated Recurrent Unit

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