Sensor Load Forecasting

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Introduction

In general, our project is there is a factory, and, in this factory, there is a sensor, and this sensor sends data to a control unit, and we need the control unit to be able to expect a sensor reading. Construct an algorithm for a sensor reports data to predict sensor will be able to read 48 data based on the last 336 readings to set the factory work. It means that this sensor will send a reading every half hour. Our problem is forecasting the values (time series) of the reading sensor. This problem was solved by one of the models called LSTM, which is one of the simplest models, and it is also one of the types of long-term memory in storing data, and also a type of recurrent neural network, which is the best in terms of memory.

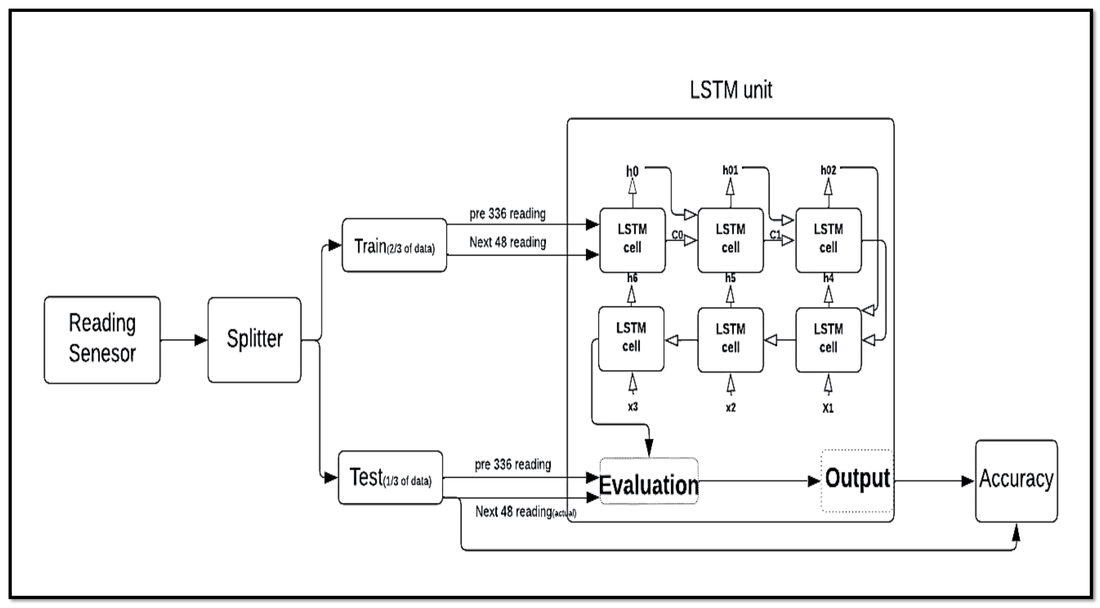

Chart 1. Flowchart of the system.

Methodology

First of all, split the data into 2/3 train and 1/3 test , train for the predicting unit and test for measuring the accuracy of the prediction model, by using two nested loops.

After splitting the data , now time to deliver the train data to the neural network, that will be used a long short temporal memory (LSTM) that depends on recurrent neural network :

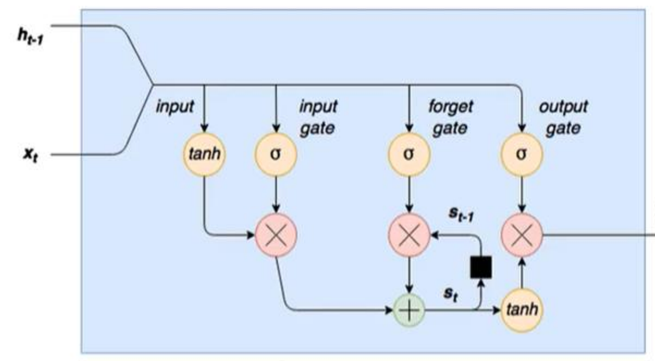

Figure 3. Glass box of LSTM cell.

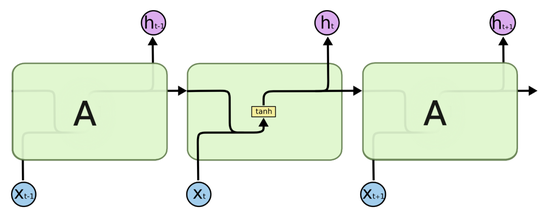

Figure 4. Chain of LSTM cells

From this glass box in figure 3 of LSTM that used two inputs First for previous input and other for current, both will pass it into two functions tanh and sigmoid
Tanh for ensuring the data are more consistent that represent all data between (-1 : 1) **,**, At the second stage take the results of tanh then decide which append it for the next layer or no , by using sigmoid activation function ,third stage is a forget gate at this part will decide if we want to save this data or forget it by adding the output from the previous phase and current weights , this process still a specific time (loop), finally at the output gate it decides which value will be performed by also using tanh.

$$sigmoid: \quad \sigma(x) = \frac{1}{1+e^{-x}}$$

$$tanh: \quad \tanh(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}}$$

Results

Taking the result from the model of neural network output , for each 336 inputs there are 48 predict output ,we take the average for each day :
So we notice from figure 5 at the percentage error is decreasing when the days move up according to the huge input of train and evaluation of the model, at table1 .

Day #	Actual data	predicted	Error %
1	0.32	0.48	50
14	0.43	0.5	16
199	0.72	0.76	6
2000	0.89	0.9	1
50k	0.92	0.83	10
100 k	0.64	0.62	3
120k	1.3	1.35	4
126,960	0.45	0.47	4

Table 1. The results of the LSTM model and accuracy.

Summary of LSTM model :		
Layer (type)	Output shape	Parameters#
Dense 11	336	113232
Dense 12	500	168500
Dense 13	1150	576150
Dense 14	700	805700
Dense 15	350	245350
Dense 16	48	16848
Total parameters:192,780 **Trainable parameters:192,780** **Non-trainable :0**		

Table 2. Summary of LSTM model.

At table give us a fine visualization of the model.

Potential

We know that , today the forecasting is very important for all life, like in a Stock market, Factories of the different application fields, artificial intelligence applications, football results, even your weight!

Build a specific program that works with different machine learning methods according to the need of used to forecasting.

The cost will be different according to the version of the program which means high accuracy results mean need a lot of programmer developers for the algorithm, but for public people, the version will be cheaper.

Conclusions and future work

After finishing from construct this model
By split and constructing the layers of the LSTM neural network , was not from the first time done ,actually, the prediction values were enhanced by many steps of review .

For future work, first of all, enhance the accuracy of the model by developing the algorithm , secondly perform this algorithm with other data types like for images and signals for prediction.

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References

1. Training and evaluation with the built-in methods | TensorFlow Core Organization
2. Time Series Forecasting with Neural Networks | The Code Forest Scientist website
3. (47) Deep Learning (in Arabic) - التعلم العميق او التعلم بعمق والذكاء الاصطناعي بالعربيYouTube
4. Tensorflow In Python - Python Guides organization