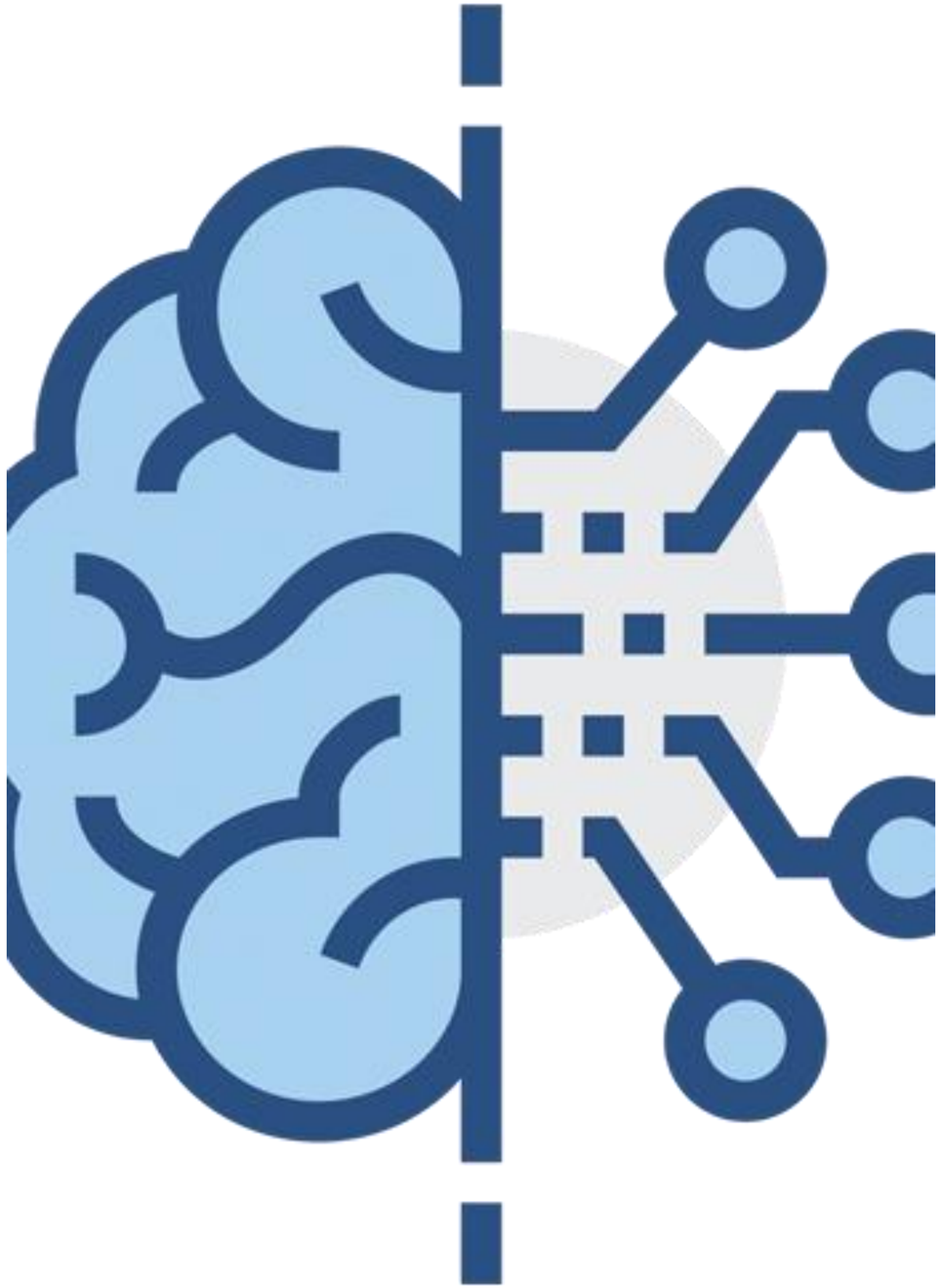


Weather Prediction Using Machine Learning Techniques

Athanasios Brianis

June 2019

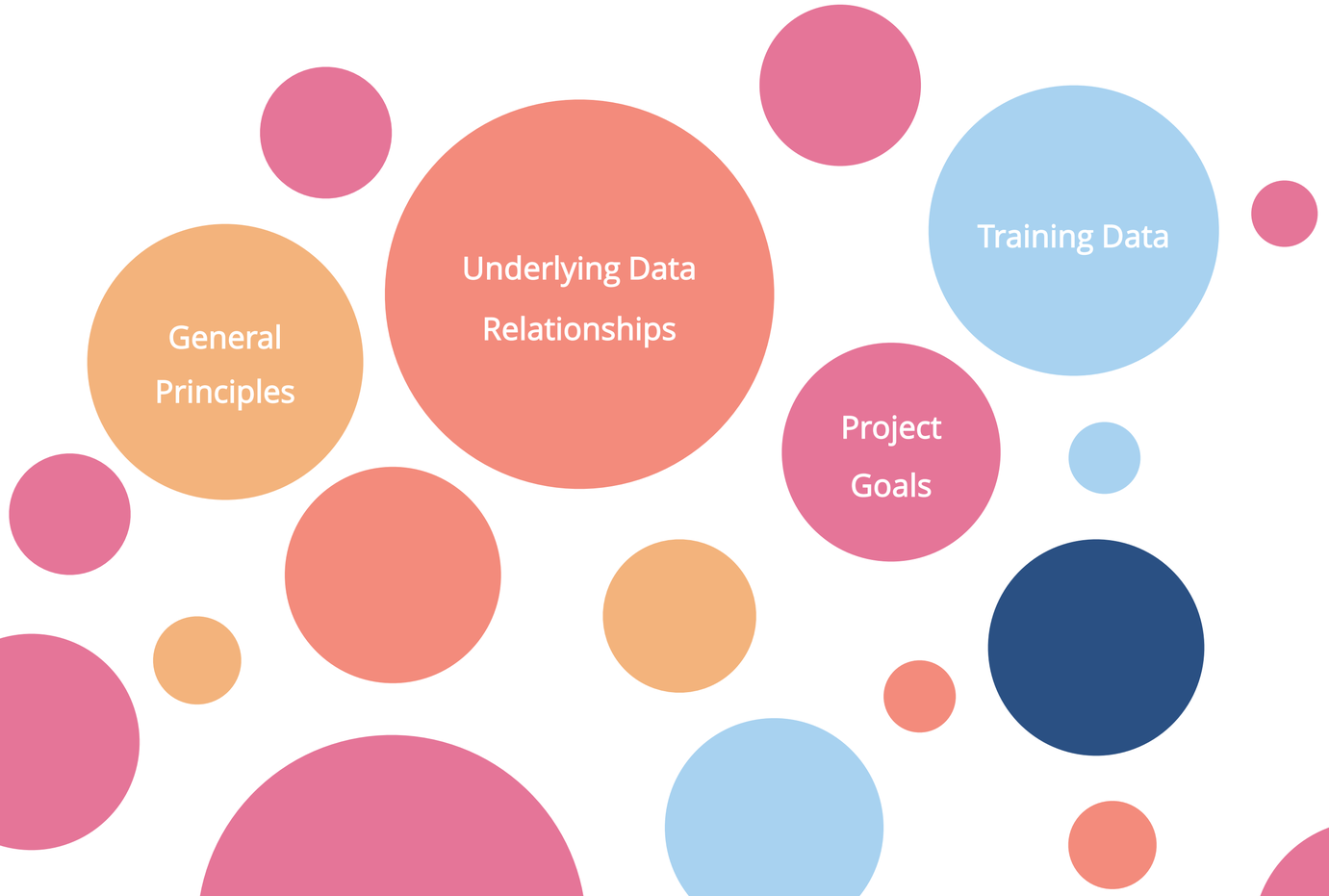
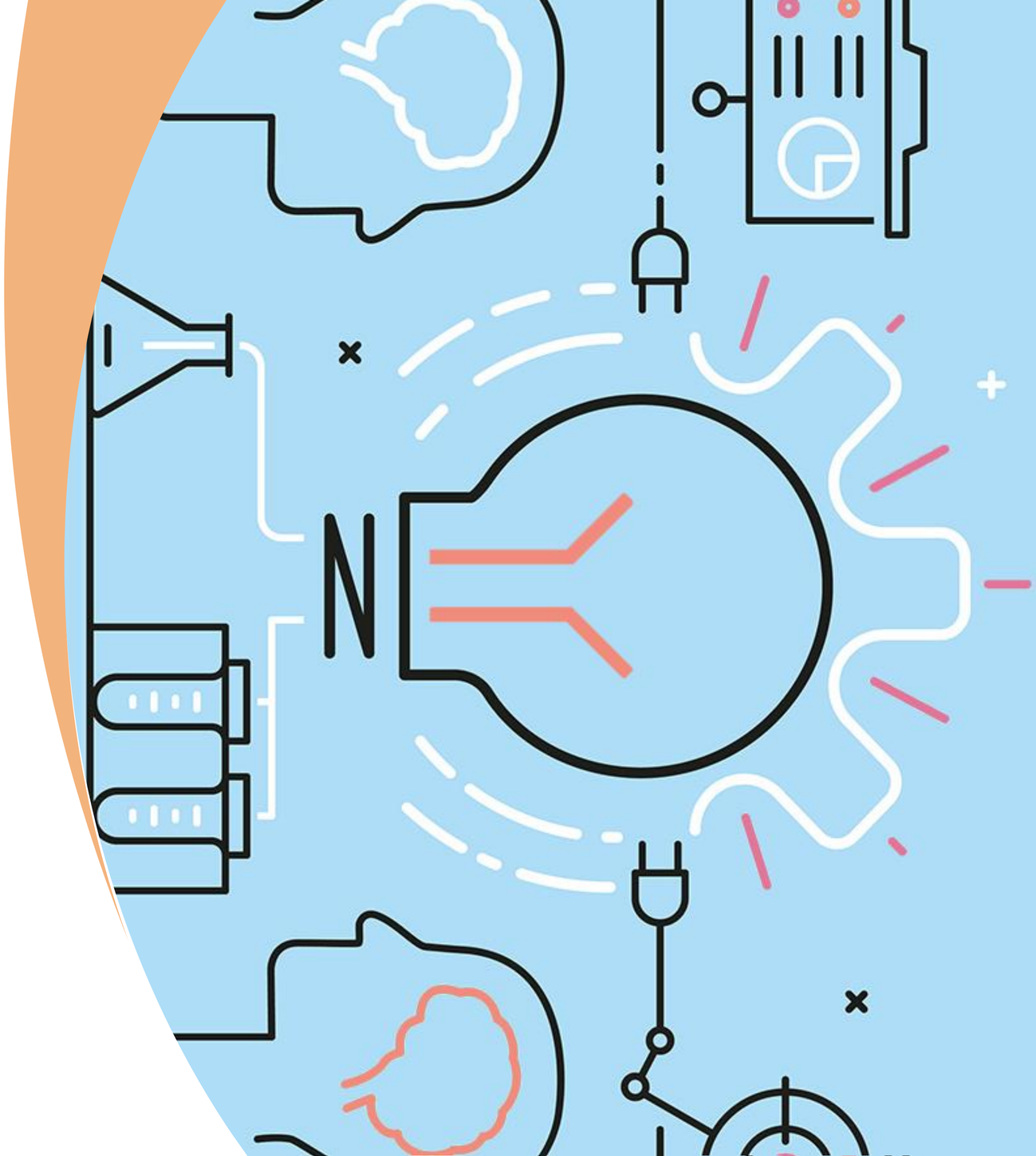


Table of Content

Machine Learning

Machine Learning Field of study that gives computers the ability to learn without being explicitly programmed (Arthur Samuel, 1959).

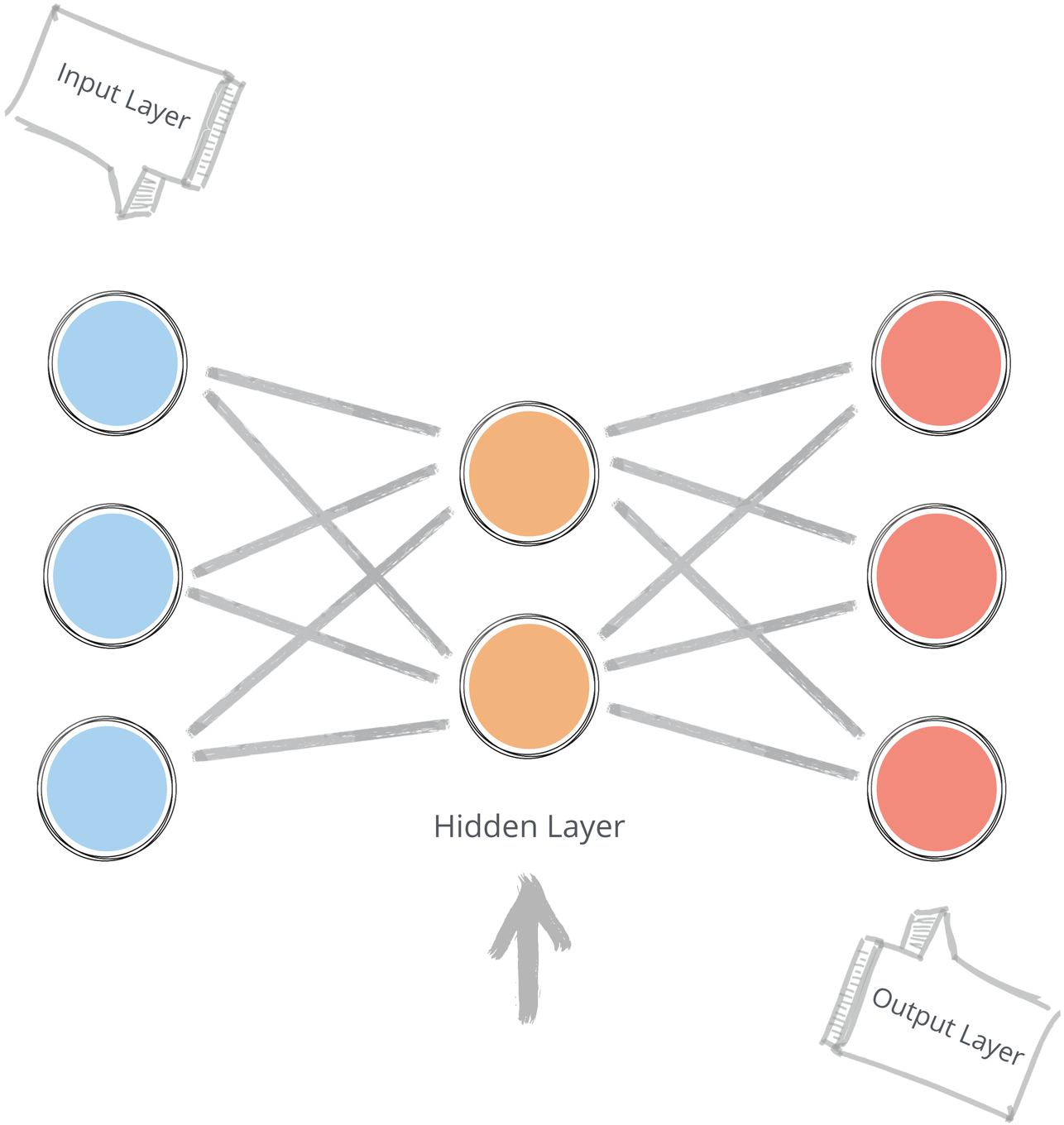


Neural Networks

Neural Network Inspired by the brain, interconnected network of processing elements called neurons.

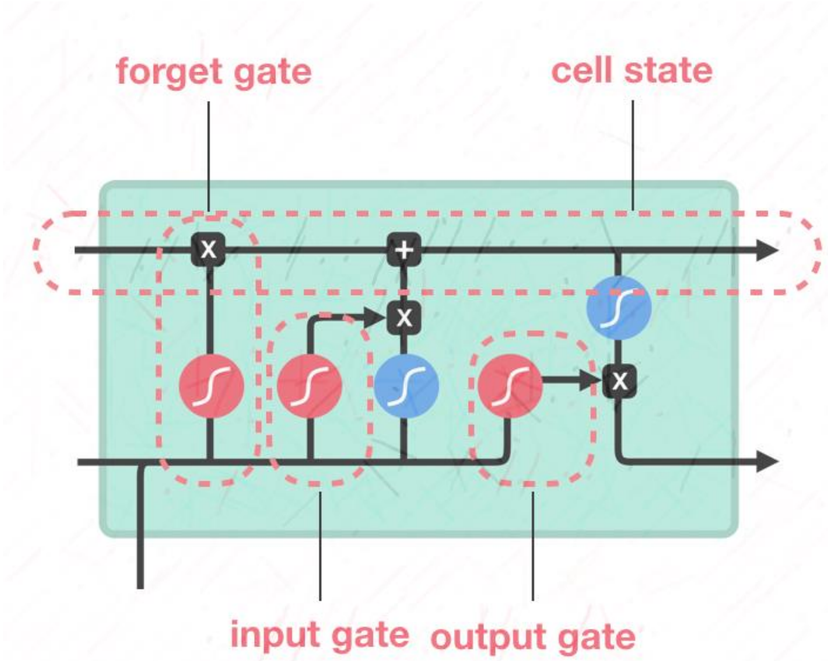
Neural Network Infrastructure

Simple NN

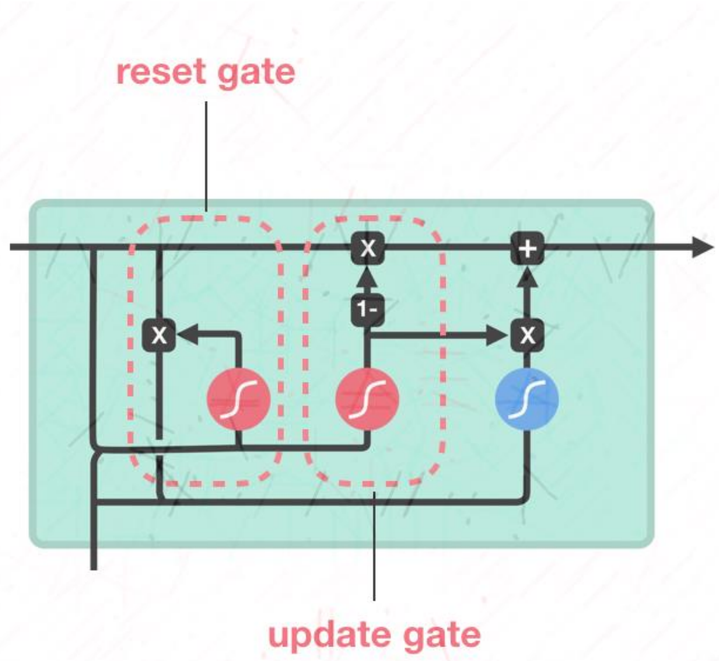


Neural Network Infrastructure

LSTM



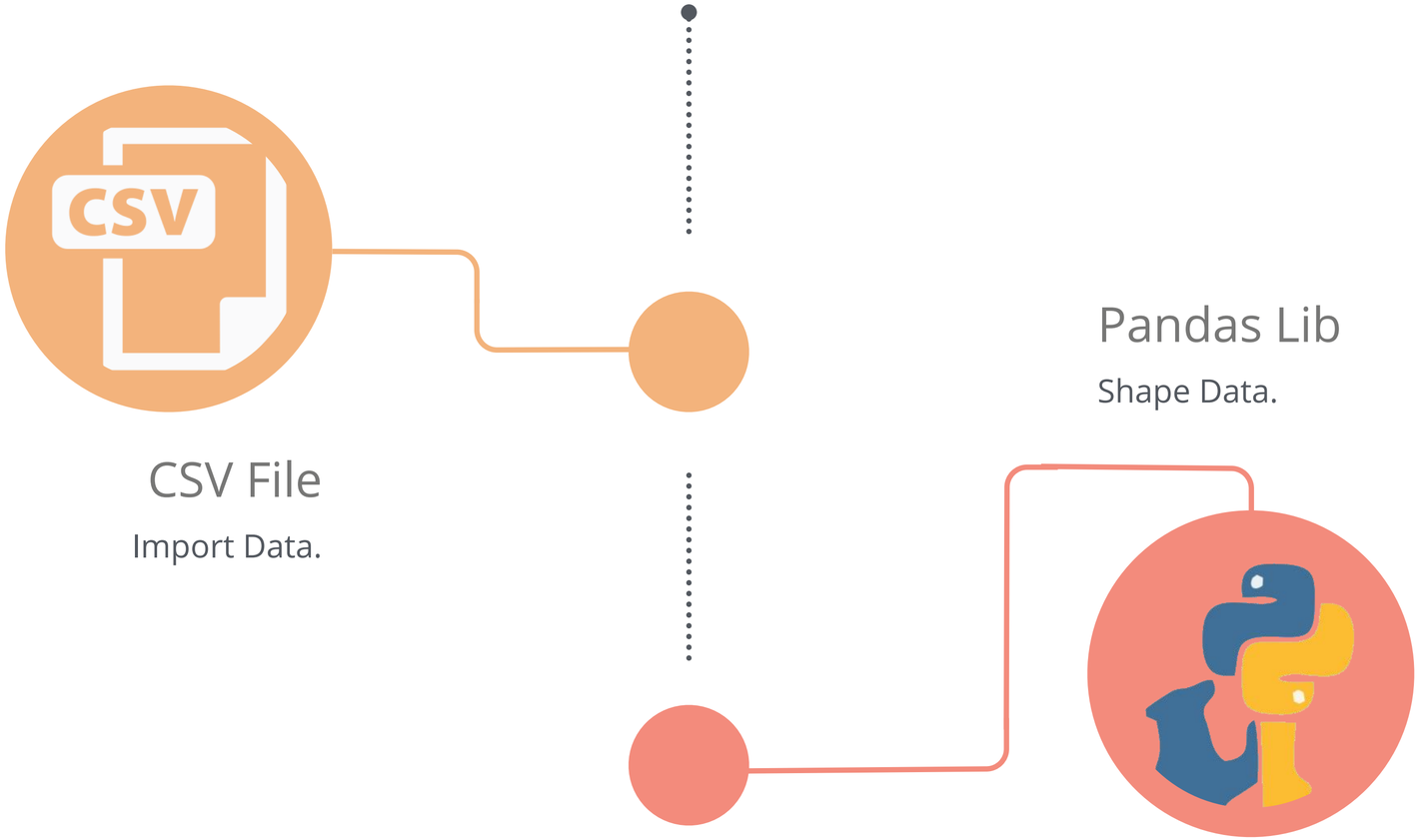
GRU



“Scope”

1. Using **Neural Network Models to predict the daily mean temperature** in Lamia Station, for the last 20 days of the year 2018.
2. Simple **NN, LSTM, GRU**
3. Accuracy, Performance

Scope • Flow Chart

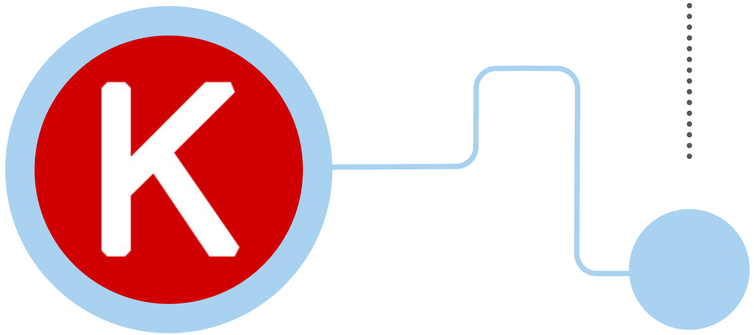


CSV File

Import Data.

Pandas Lib

Shape Data.

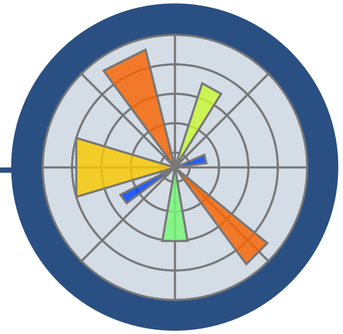


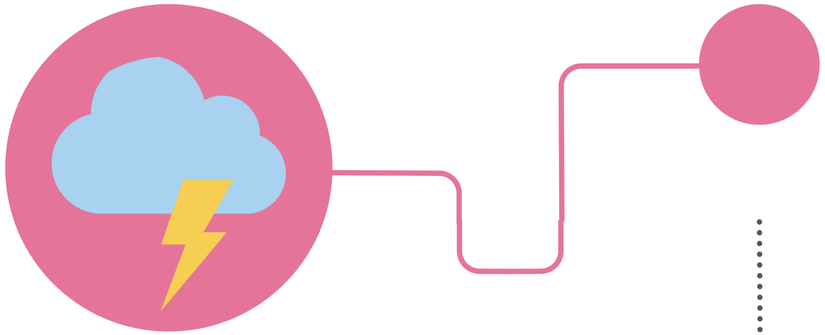
Keras Framework

Deploy Neural Networks.

MatPlot Lib

Plot Data.





Weather Prediction

Weather Data

Δεδομένα	Ακρίβεια - Μονάδα μέτρ.
Μέση θερμοκρασία	(.1 Fahrenheit)
Μέσο σημείο δρόσου	(.1 Fahrenheit)
Μέση πίεση στην επιφάνεια της θάλασ.	(.1 mb)
Μέση πίεση στην περιοχή του σταθμού	(.1 mb)
Μέση ορατότητα	(.1 miles)
Μέση ταχύτητα ανέμου	(.1 knots)
Μέση μέγιστη διατηρούμενη ταχ. ανέμου	(.1 knots)
Μέση μέγιστη ταχύτητα ριπών ανέμου	(.1 knots)
Μέση μέγιστη θερμοκρασία	(.1 Fahrenheit)
Μέση ελάχιστη θερμοκρασία	(.1 Fahrenheit)
Μέσο μεγεθος υετού	(.01 inches)
Μέση χιονόπτωση	(.1 inches)

```
STN---     WBAN    YEARMODA     TEMP   ...     MIN    PRCP   SNDP    FRSHTT
0  166750  99999   20180126     37.7   ...     27.7   0.00I  999.9        0
1  166750  99999   20180127     40.4   ...       30   0.00I  999.9        0
2  166750  99999   20180128     41.6   ...     30.2   0.00I  999.9        0
3  166750  99999   20180129     43.1   ...     29.5   0.00I  999.9        0
4  166750  99999   20180130     45.6   ...     31.1   0.00I  999.9        0
[5 rows x 22 columns]
```

```
STN---       WBAN    YEARMODA      TEMP   ...      MIN    PRCP   SNDP    FRSHTT
321  166750  99999   20181227      37.7   ...      30.9   0.00I  999.9        0
322  166750  99999   20181228      38.4   ...      28.9   0.00I  999.9        0
323  166750  99999   20181229      42.5   ...      29.5   0.00I  999.9        0
324  166750  99999   20181230      47.1   ...      39.4   0.00I  999.9        0
325  166750  99999   20181231      41.1   ...     37.6*   0.56F  999.9    10000
[5 rows x 22 columns]
```

N.O.A.A

325 days

Lamia Station 2018

12 Features

Weather Data

Δεδομένα	Ακρίβεια - Μονάδα μέτρ.
Μέση θερμοκρασία	(.1 Fahrenheit)
Μέσο σημείο δρόσου	(.1 Fahrenheit)
Μέση πίεση στην επιφάνεια της θάλασ.	(.1 mb)
Μέση πίεση στην περιοχή του σταθμού	(.1 mb)
~~Μέση ορατότητα~~	~~(.1 miles)~~
Μέση ταχύτητα ανέμου	(.1 knots)
Μέση μέγιστη διατηρούμενη ταχ. ανέμου	(.1 knots)
~~Μέση μέγιστη ταχύτητα ριπών ανέμου~~	~~(.1 knots)~~
Μέση μέγιστη θερμοκρασία	(.1 Fahrenheit)
Μέση ελάχιστη θερμοκρασία	(.1 Fahrenheit)
~~Μέσο μεγεθος υετού~~	~~(.01 inches)~~
~~Μέση χιονόπτωση~~	~~(.1 inches)~~

```
STN---     WBAN    YEARMODA     TEMP   ...     MIN    PRCP   SNDP    FRSHTT
0   166750  99999   20180126     37.7   ...    27.7   0.00I  999.9         0
1   166750  99999   20180127     40.4   ...      30   0.00I  999.9         0
2   166750  99999   20180128     41.6   ...    30.2   0.00I  999.9         0
3   166750  99999   20180129     43.1   ...    29.5   0.00I  999.9         0
4   166750  99999   20180130     45.6   ...    31.1   0.00I  999.9         0
[5 rows x 22 columns]
```

```
STN---       WBAN    YEARMODA      TEMP   ...     MIN    PRCP   SNDP    FRSHTT
321   166750  99999   20181227     37.7   ...    30.9   0.00I  999.9         0
322   166750  99999   20181228     38.4   ...    28.9   0.00I  999.9         0
323   166750  99999   20181229     42.5   ...    29.5   0.00I  999.9         0
324   166750  99999   20181230     47.1   ...    39.4   0.00I  999.9         0
325   166750  99999   20181231     41.1   ...   37.6*   0.56F  999.9     10000
[5 rows x 22 columns]
```

N.O.A.A

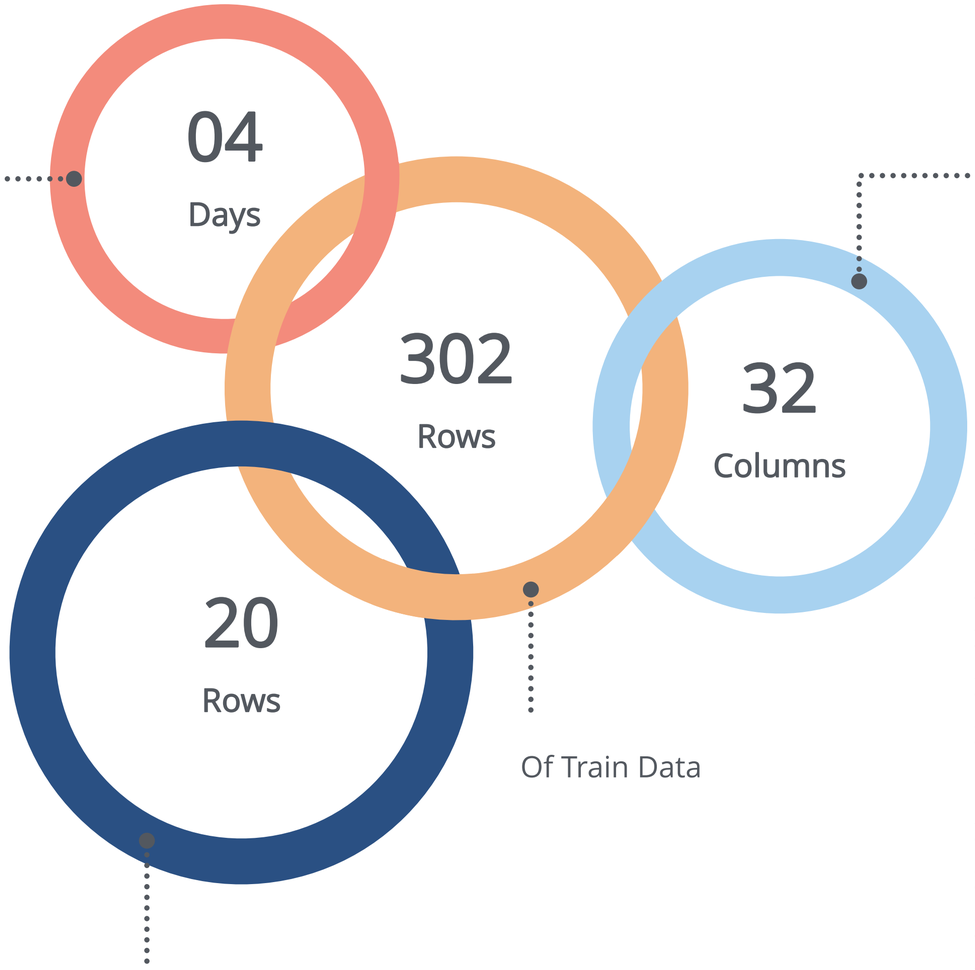
325 days

Lamia Station 2018

12 Features

Data Manipulation

Weather Data Values
5th Day Target
8 Features



Of Features Data

Of Train Data

Of Prediction Data (Temp)

	TEMP
306	39.7
307	39.9
308	45.8
309	49.4
310	52.1
...	...
321	37.7
322	38.4
323	42.5
324	47.1
325	41.1

Length: 20

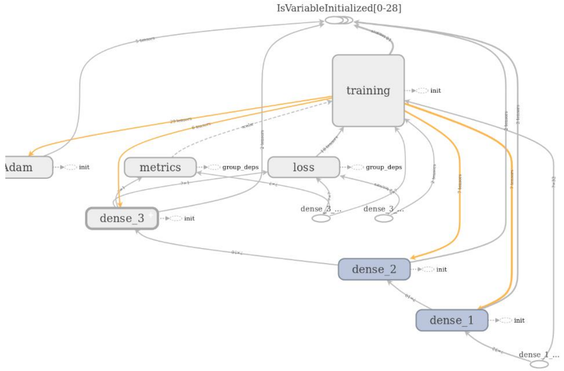
dtype: float64

	TEMP	DEWP	SLP	STP	WDSP	...	MAX3	MAX4	MIN2	MIN3	MIN4
302	42.0	35.2	1016.0	1014.6	3.1	...	60.4	52.5	41.0	44.1	38.7
303	54.7	41.1	1010.0	1008.6	8.1	...	52.5	57.0	44.1	38.7	32.5
304	51.8	39.0	1006.8	1005.5	7.7	...	57.0	42.8	38.7	32.5	32.4
305	44.3	32.0	1013.8	1012.5	5.9	...	42.8	49.8	32.5	32.4	41.5
306	39.7	28.8	1020.2	1018.8	4.4	...	49.8	54.7	32.4	41.5	47.1
...	...	...	...	...	...	...	...	...	...	...	...
317	48.4	39.0	1022.4	1021.0	2.6	...	49.3	48.0	34.7	43.3	32.5
318	47.8	40.8	1017.1	1015.7	2.3	...	48.0	53.8	43.3	32.5	30.9
319	45.7	37.5	1017.9	1016.6	8.8	...	53.8	55.2	32.5	30.9	28.9
320	38.0	22.0	1026.1	1024.7	7.6	...	55.2	60.1	30.9	28.9	29.5
321	37.7	26.1	1025.4	1024.0	6.3	...	60.1	57.2	28.9	29.5	39.4

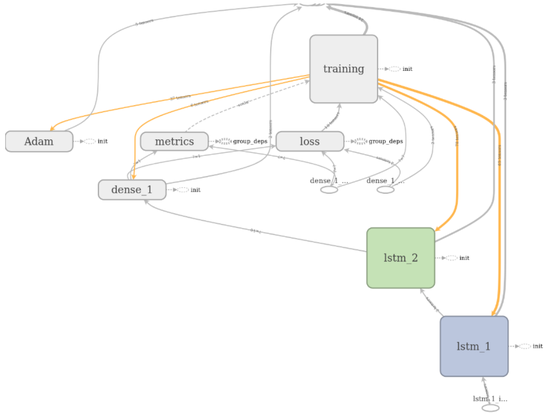
[20 rows x 32 columns]

Neural Networks Architecture

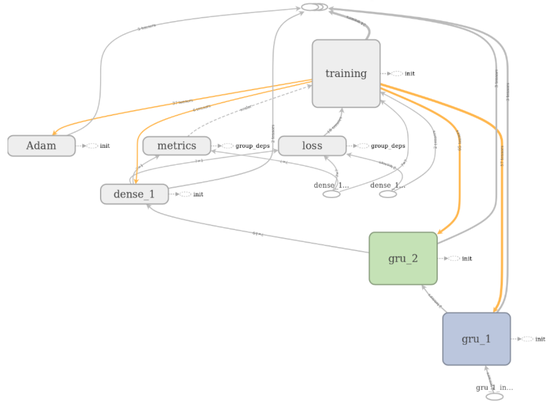
Simple NN



LSTM

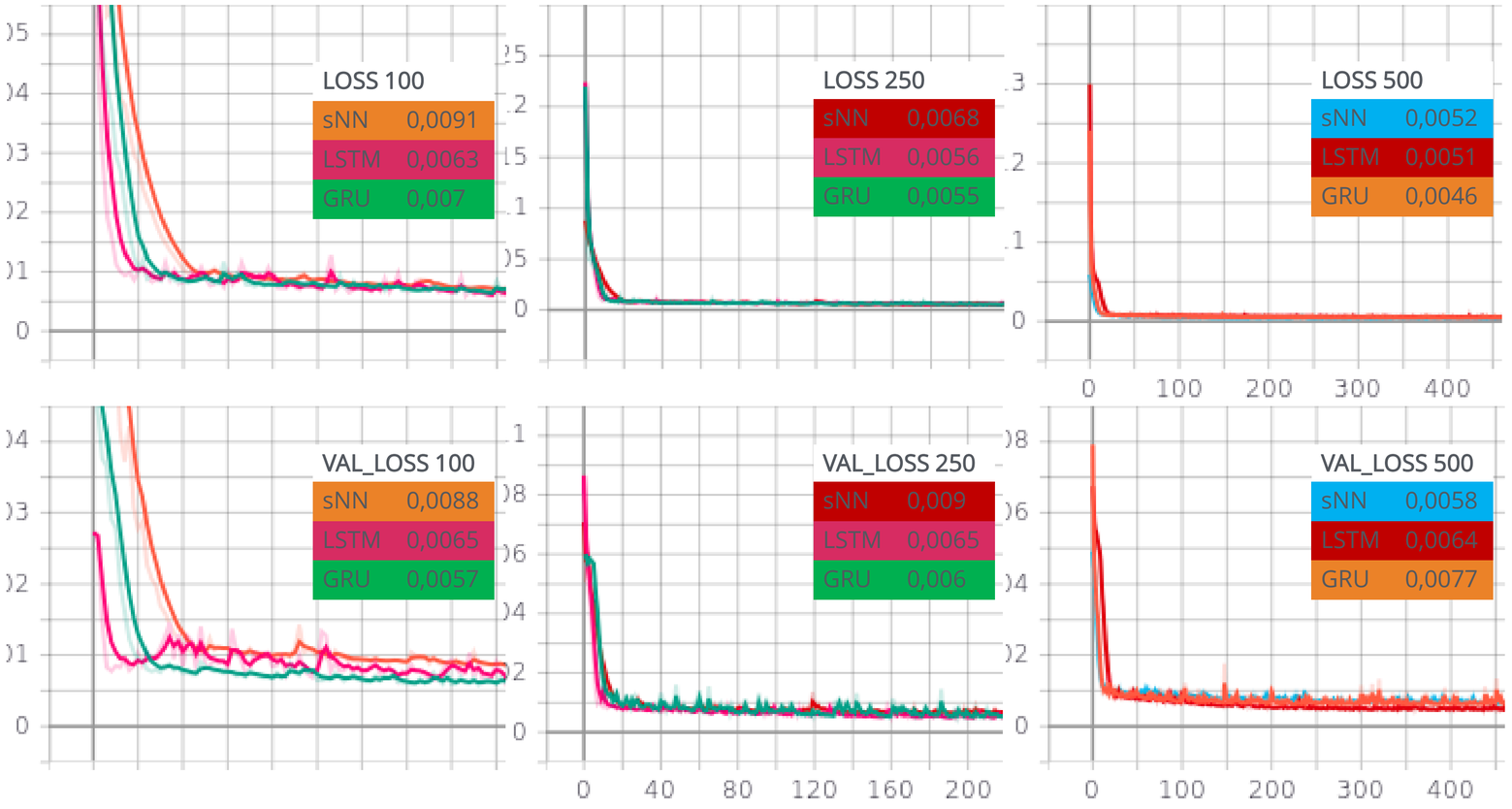


GRU



4 Layers | **1** Input Layer | **2** Hidden Layers ◦ **10** Nodes Each | **1** Output Layer ◦ **1** Node

Training



About The Graphs

Loss ◦ 100, 250, 500

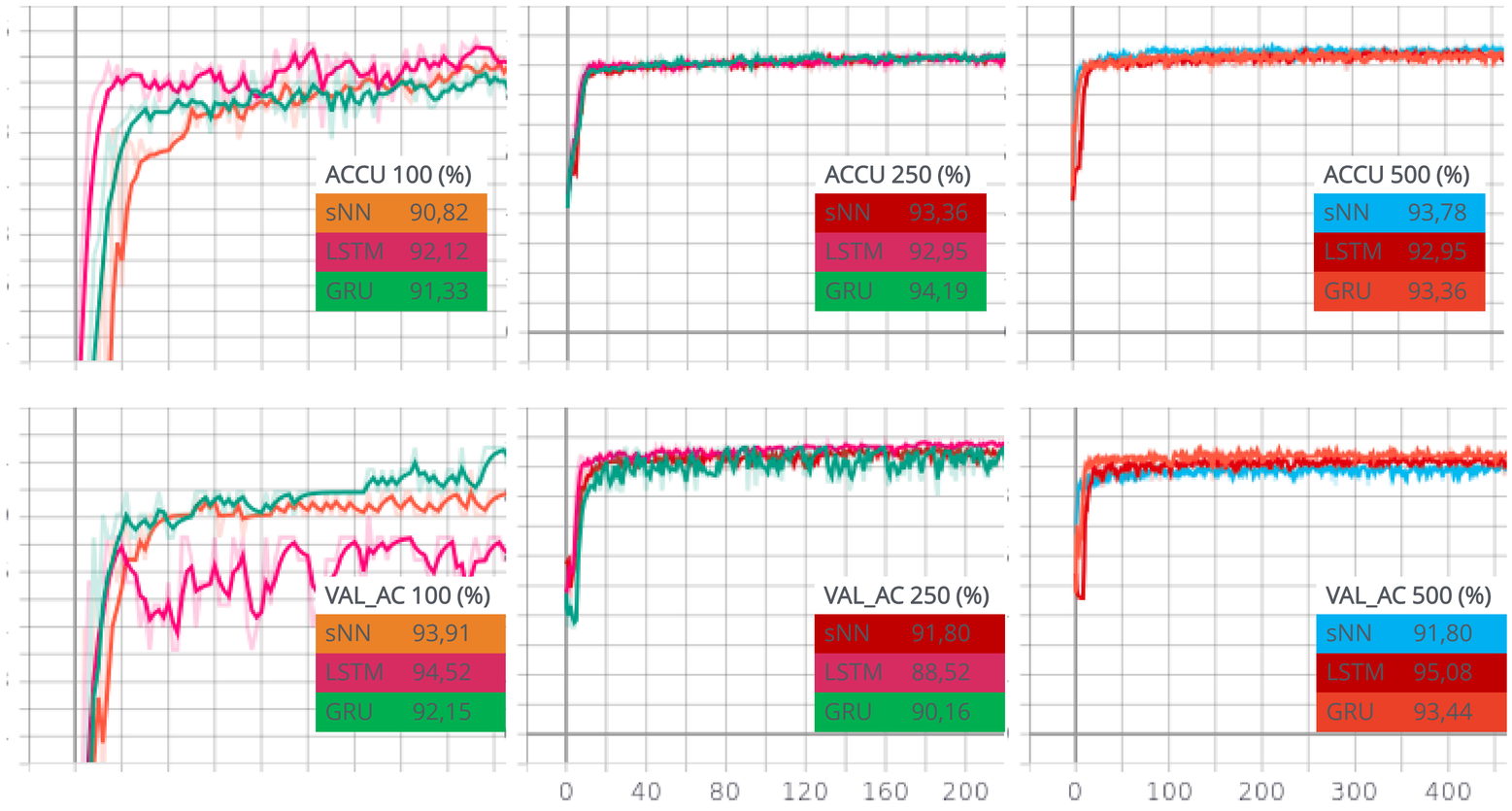
Loss • Mean Squared Error

Optimizer • Adam

Nb Batches • 50

Validation Loss ◦ 100, 250, 500

Training



About The Graphs

Soft Accuracy ◦ 100, 250, 500

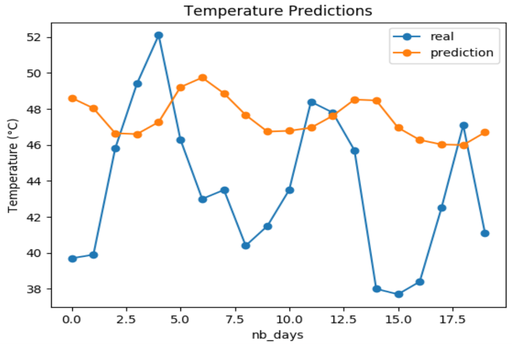
Algorithm accuracy • Soft Accuracy

Nb Batches • 50

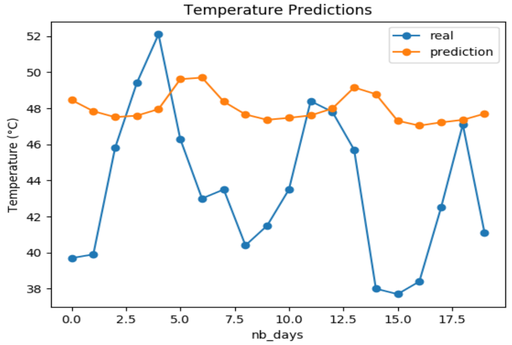
Validation Data • 20%

Validation Soft Accuracy ◦ 100, 250, 500

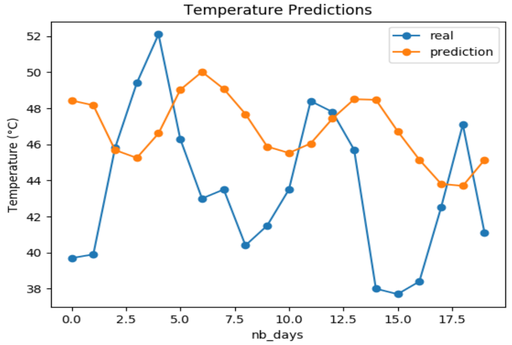
Predictions



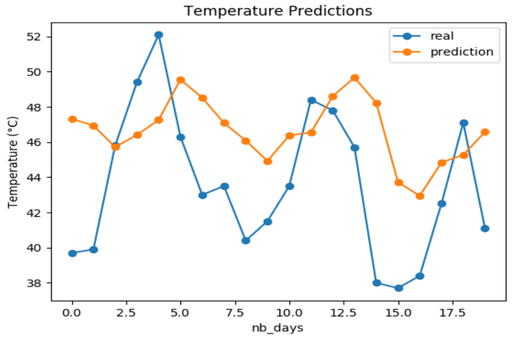
NN 100



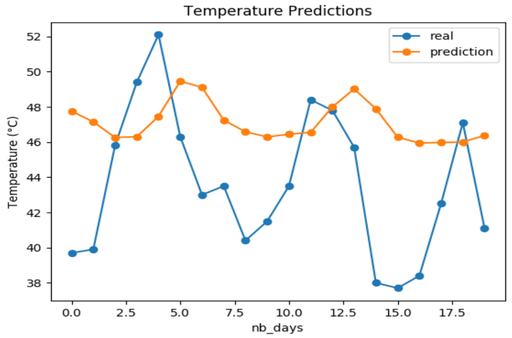
LSTM 100



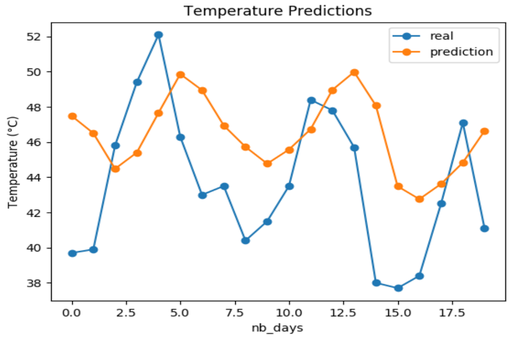
GRU 100



NN 250

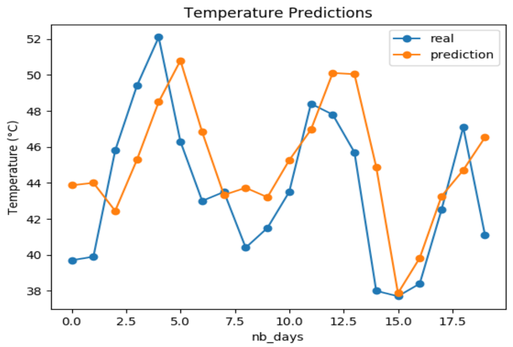


LSTM 250

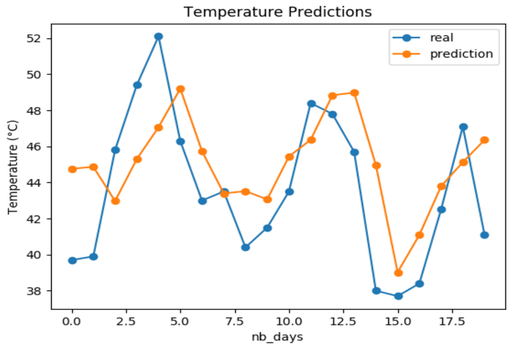


GRU 250

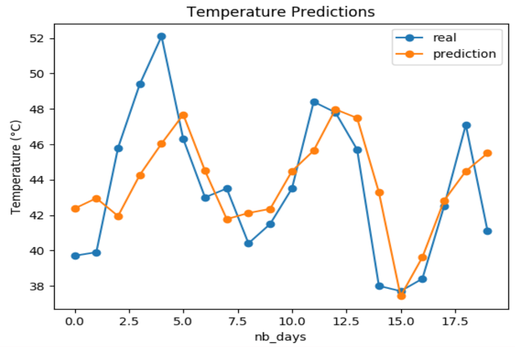
Predictions



NN 500



LSTM 500



GRU 500

PREDICTION MAE (°F)			
	100	250	500
SimpleNN	4,165	3,282	2,830
LSTM	4,560	3,825	3,622
GRU	4,100	3,525	3,149

Results

Simple NN

Have the best Accuracy, Performance, DT in the given case study.

LSTM ○ GRU

Despite LSTM, GRU ability to memorize time series data

Parameters

- sNN 451
- LSTM 2571
- GRU 1931

Temperature

2,8 - 4,6 °F ≈ (1 - 2 °C)

Thanks for your attention !

Do you have any questions?

https://github.com/brian13th

www.linkedin.com/in/athanasiosbrianis