# ASPIS – PART II
# MACHINE LEARNIG

VIERA KREŠŇÁKOVÁ

ŠIMON MACKOVJAK, PETER BUTKA, MATEJ VARGA, SAMUEL AMRICH, SILVIA KOSTÁROVÁ, ADRIÁN KUNDRÁT

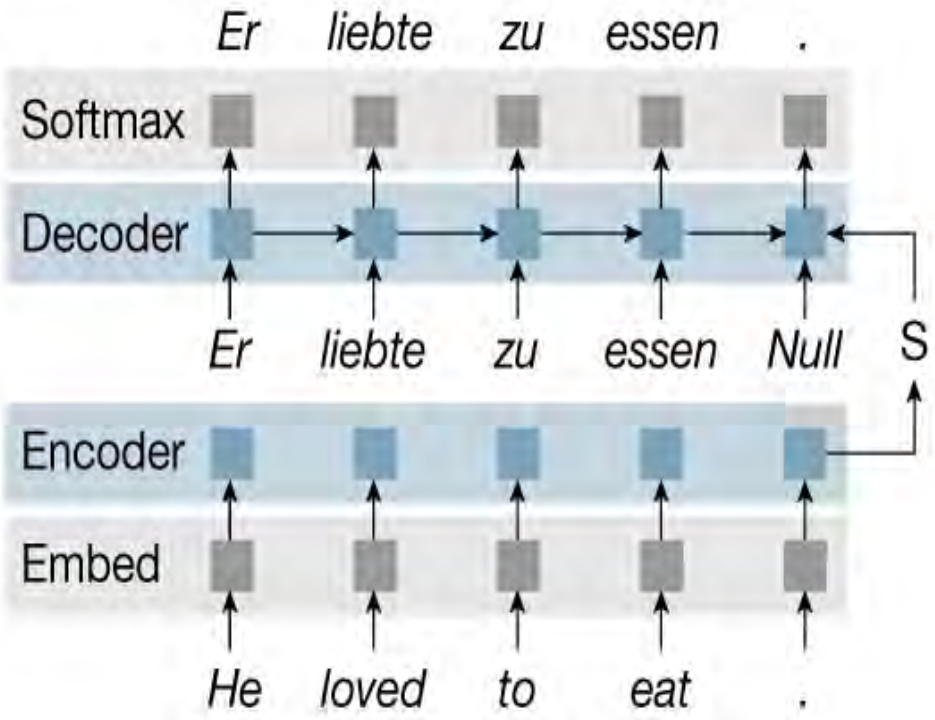
# MACHINE LEARNING APPLICATION

**Machine learning tasks**

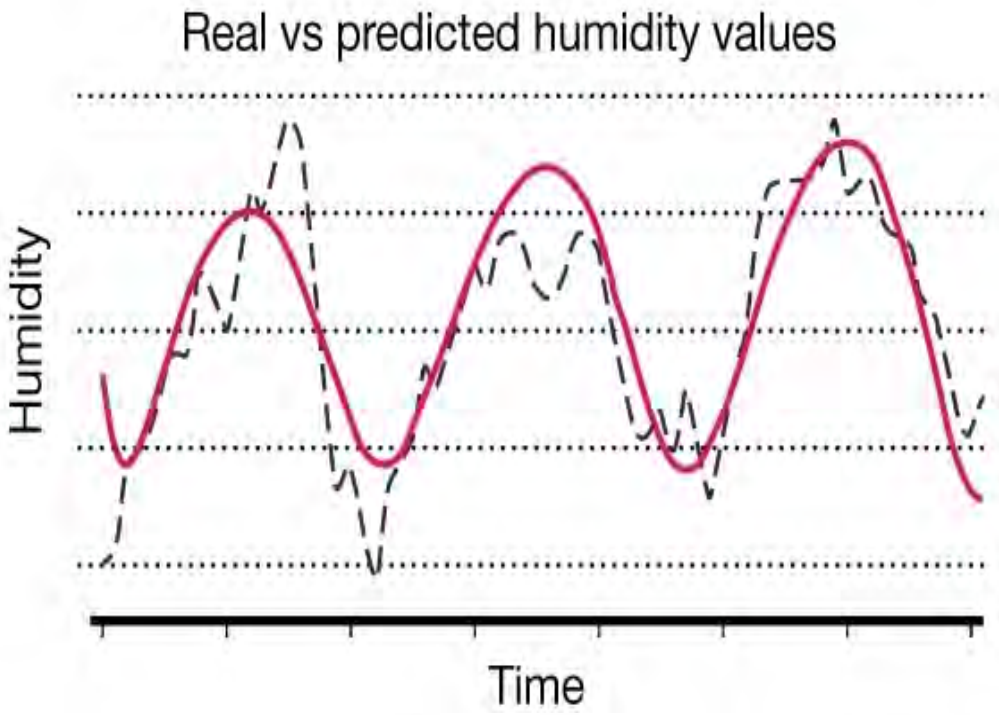
**Earth science tasks**

d

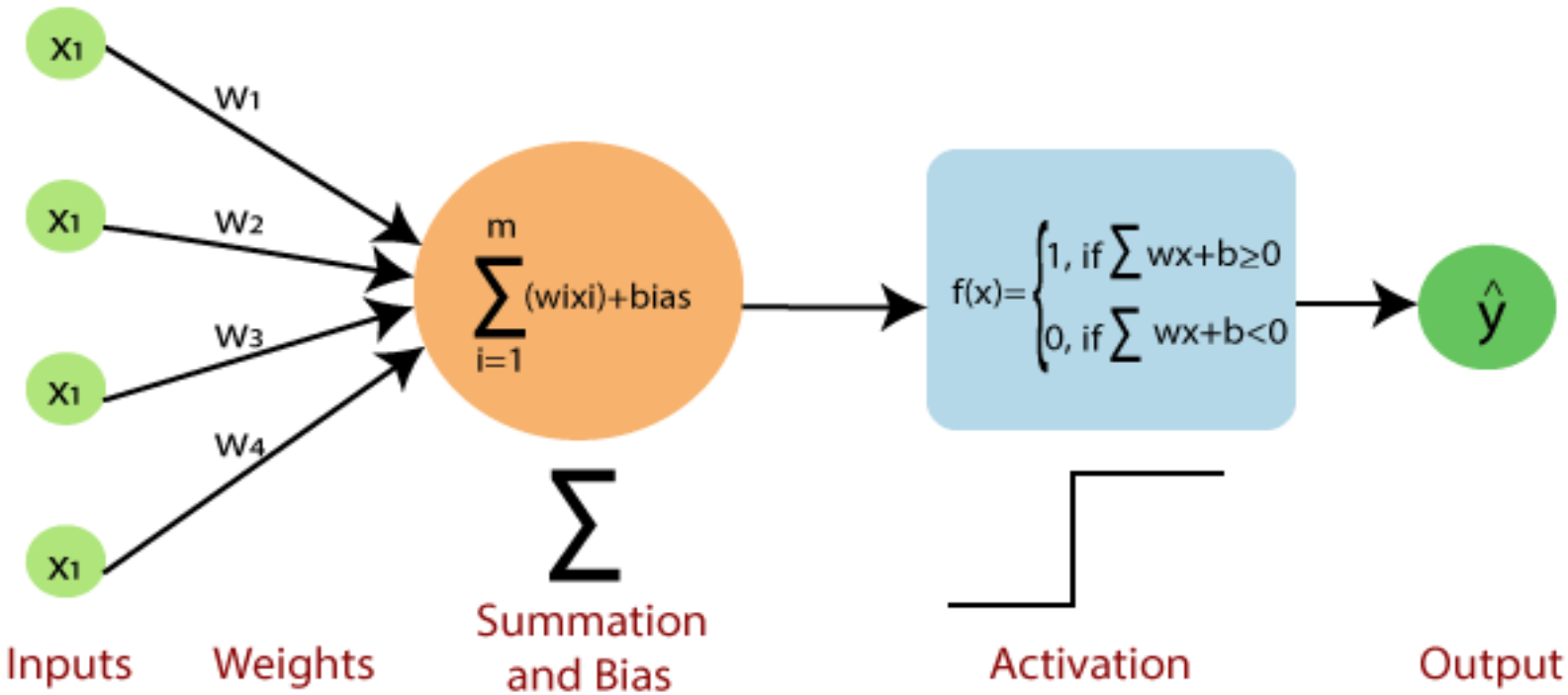
**Language translation**



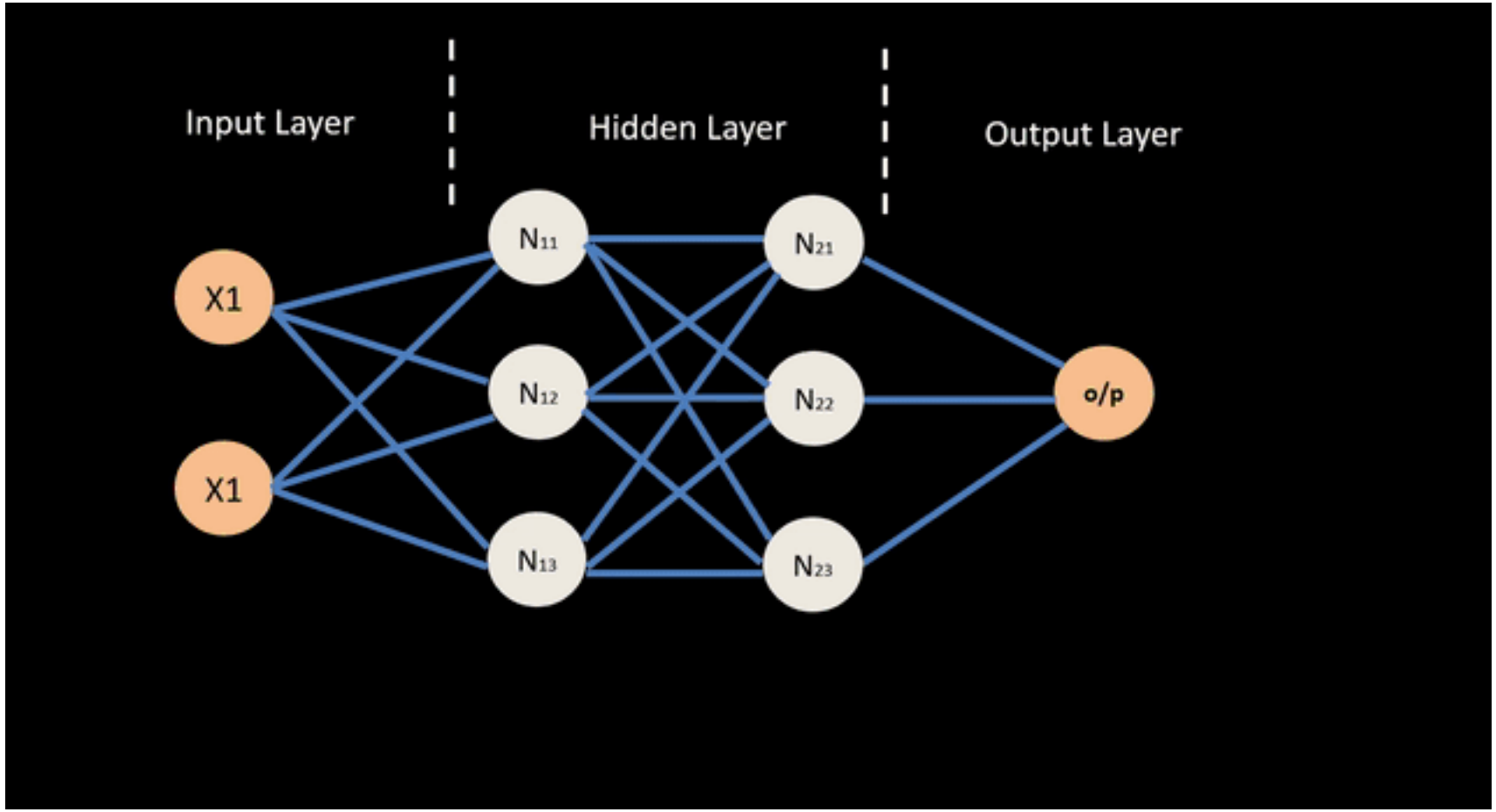

**Dynamic time series modelling**



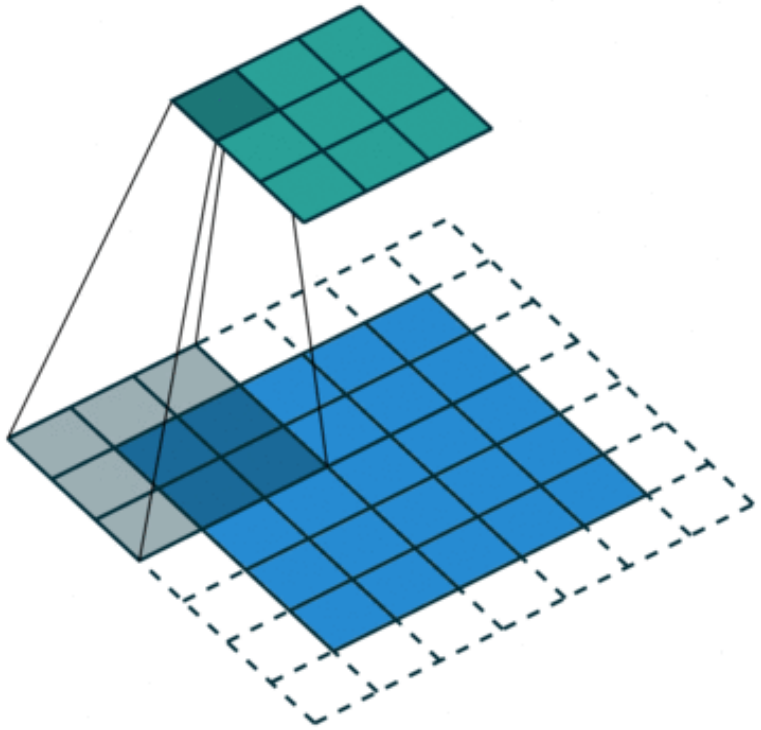
# PERCEPTRON


x1
x1
x1
x1
w1
w2
w3
w4
m
∑ (wixi)+bias
i=1
f(x)= 1, if ∑ wx+b≥0
0, if ∑ wx+b<0
ŷ
Inputs
Weights
Summation and Bias
Activation
Output

# BACKPROPAGATION



# 2D CONVOLUTIONAL NEURAL NETWORK



| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 105 | 102 | 100 | 97 | 96 | |
| 0 | 103 | 99 | 103 | 101 | 102 | 1( |
| 0 | 101 | 98 | 104 | 102 | 100 | 1 |
| 0 | 99 | 101 | 106 | 104 | 99 | |
| 0 | 104 | 104 | 104 | 100 | 98 | 1 |

Image Matrix

Kernel Matrix

| | | |
|---|---|---|
| 0 | -1 | 0 |
| -1 | 5 | -1 |
| 0 | -1 | 0 |

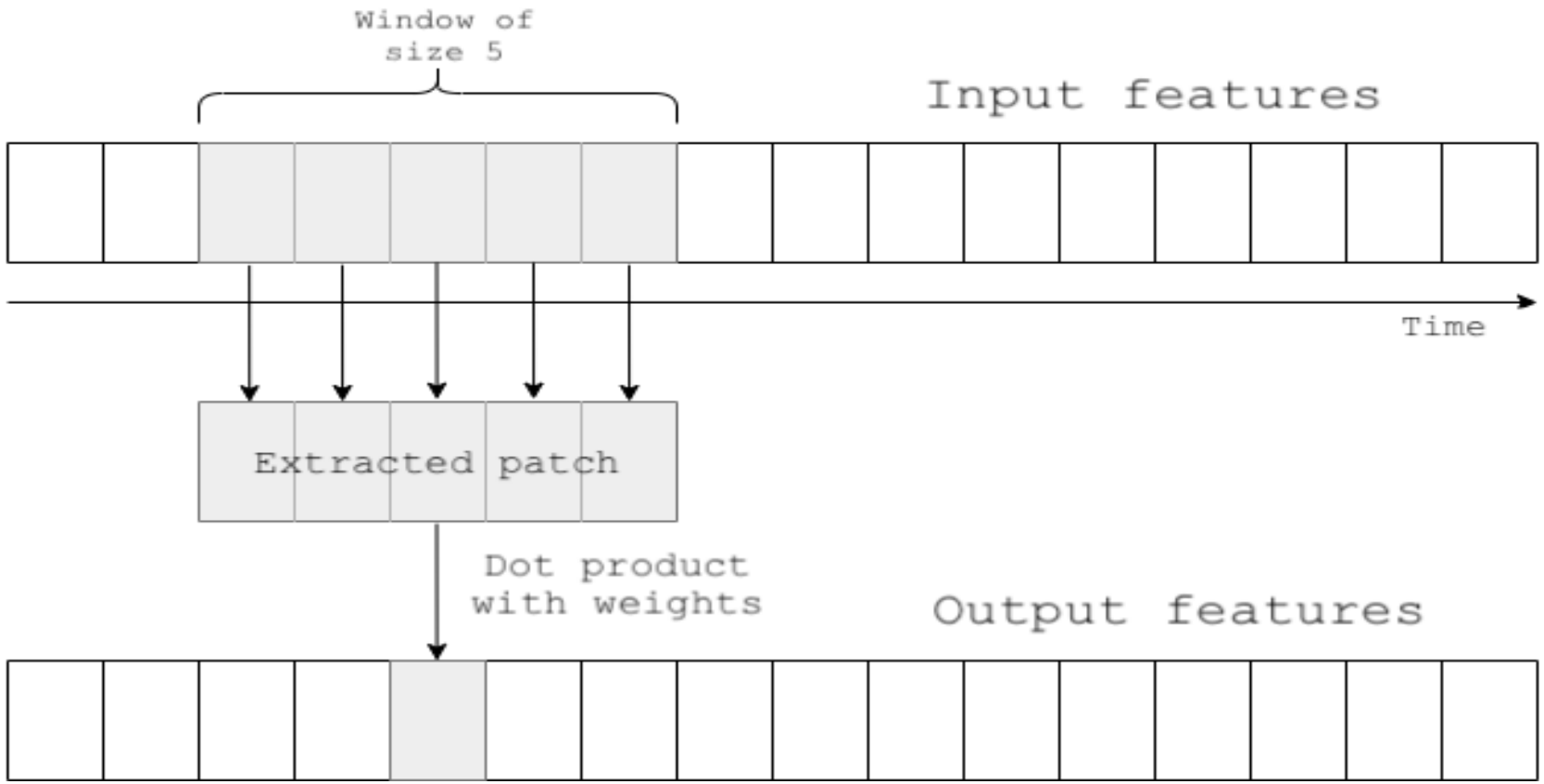
$$0*0+0*-1+0*0$$
$$+0*-1+105*5+102*-1$$
$$+0*0+103*-1+99*0 = 320$$

| | | | | |
|---|---|---|---|---|
| 320 | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

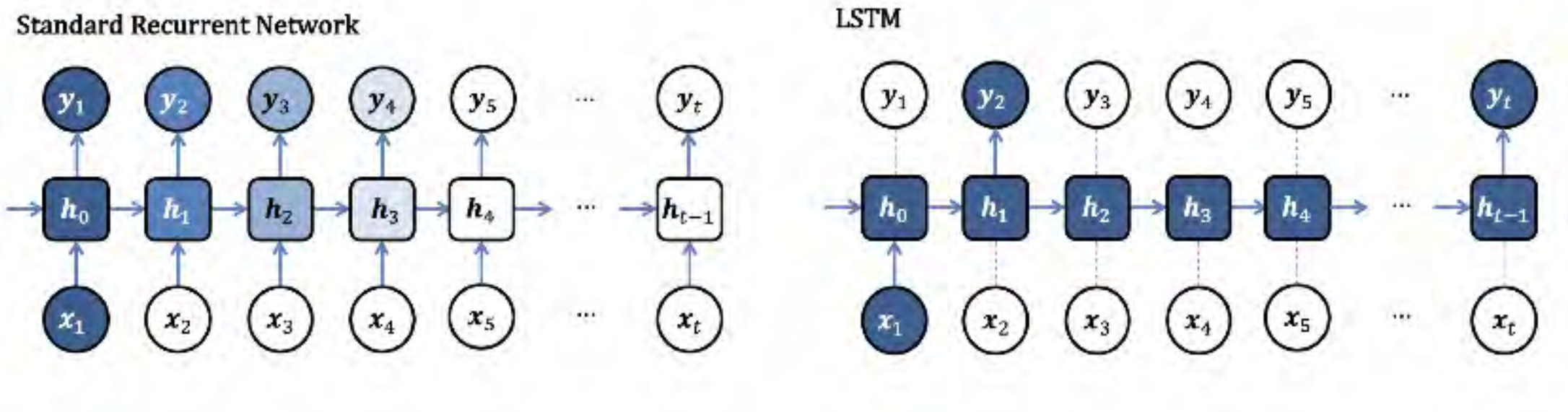
Output Matrix

**Convolution with horizontal and vertical strides = 2**

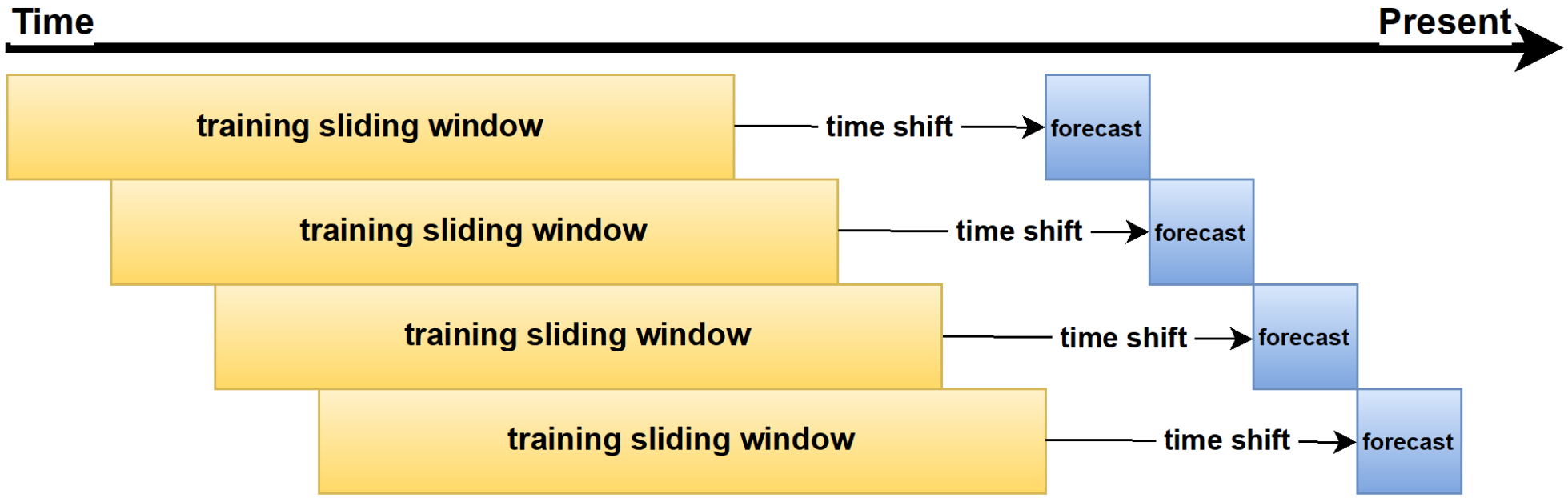
# 1D CONVOLUTIONAL NEURAL NETWORK



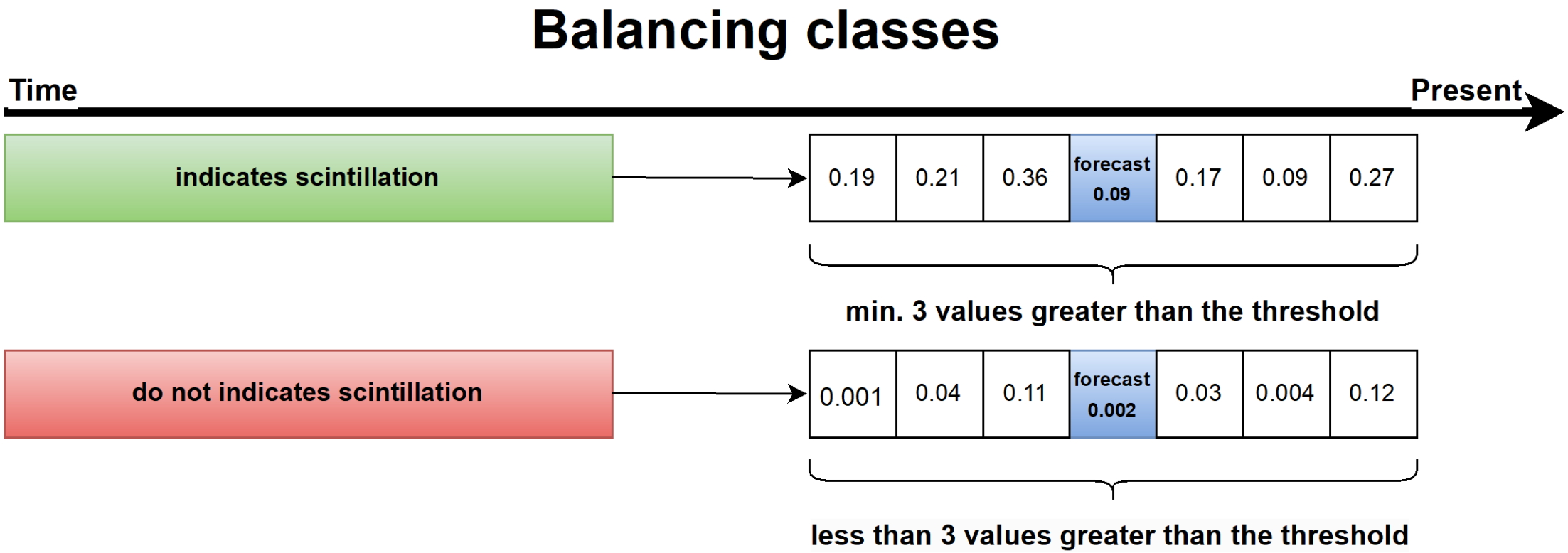
# RECCURENT NEURAL NETWORK



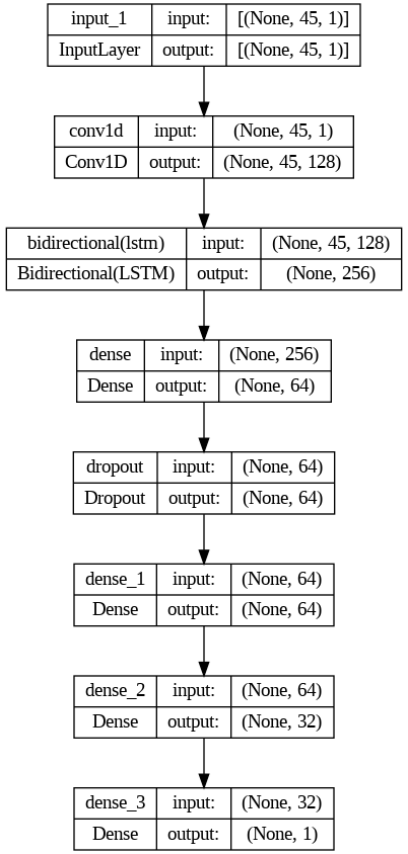
# DATA PREPARATION

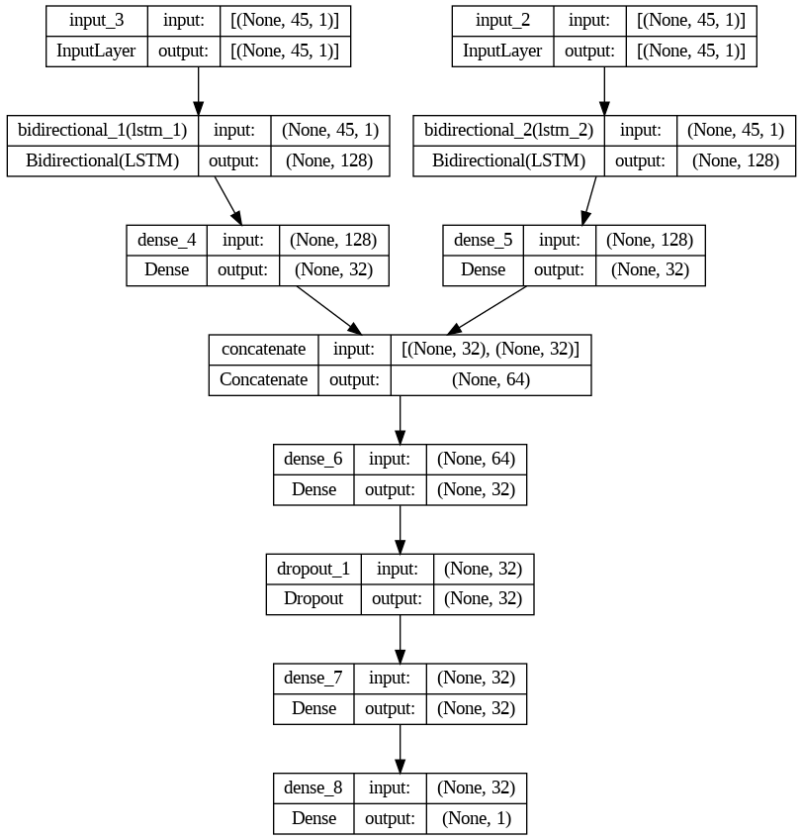


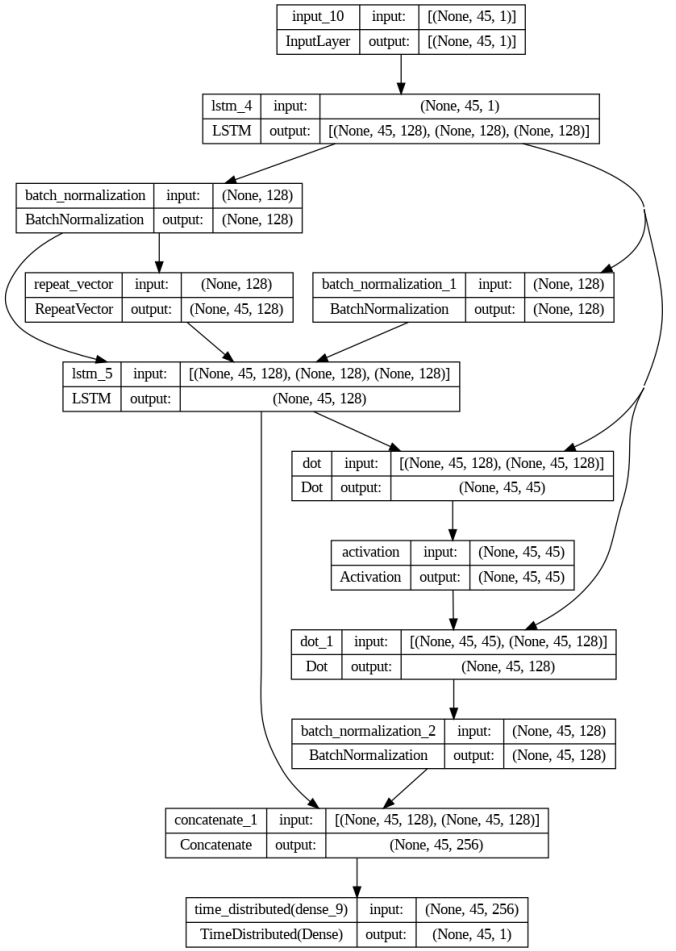
# DATA PREPARATION



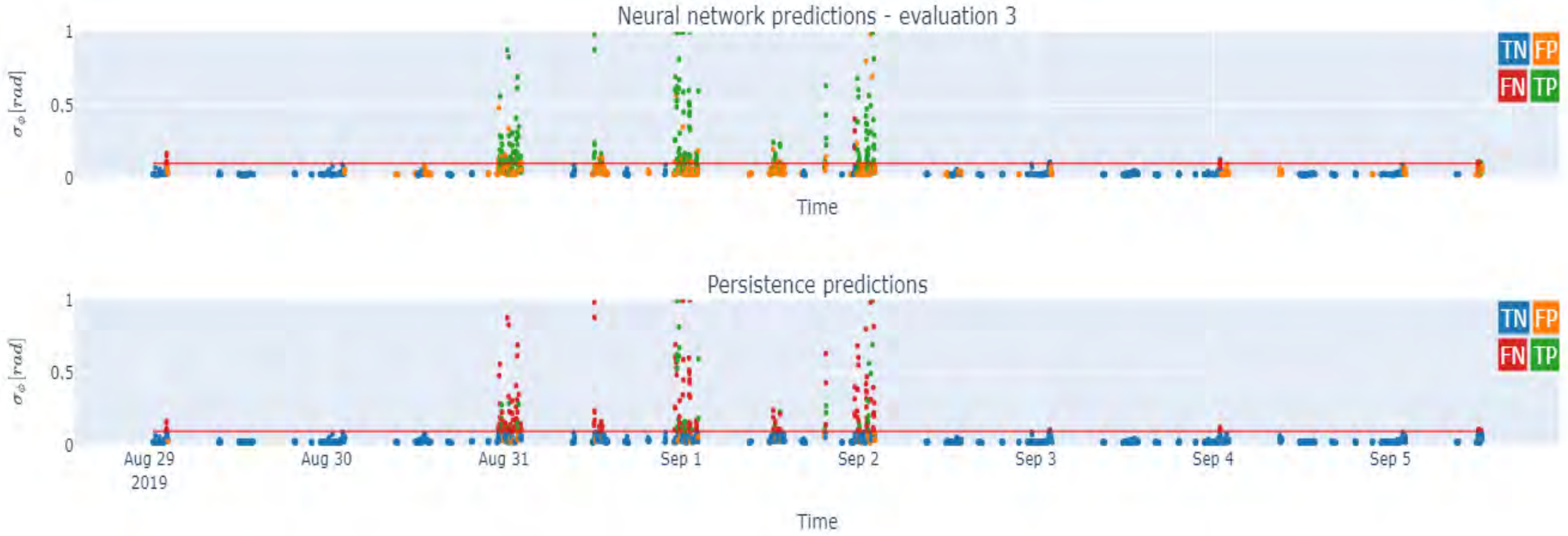
# ABSOLUTELY UNINTERESTING MODELS ARCHITECTURE



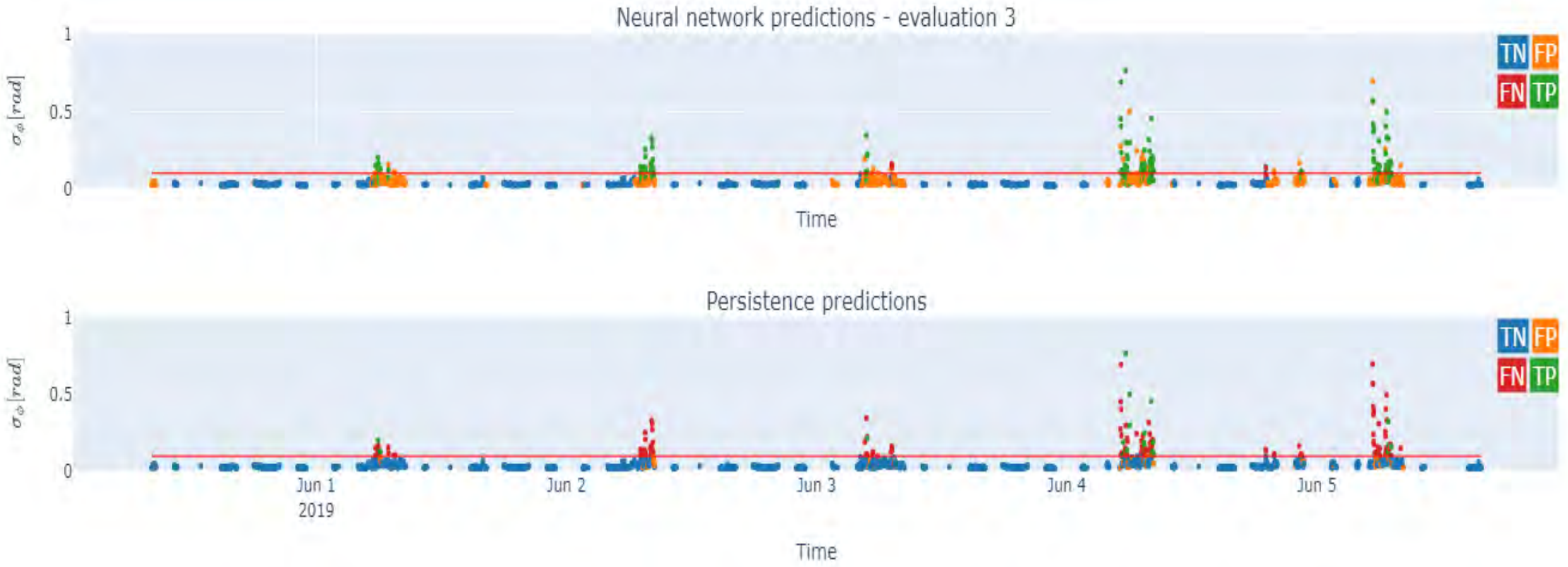



# ABSOLUTELY INTERESTING RESULTS



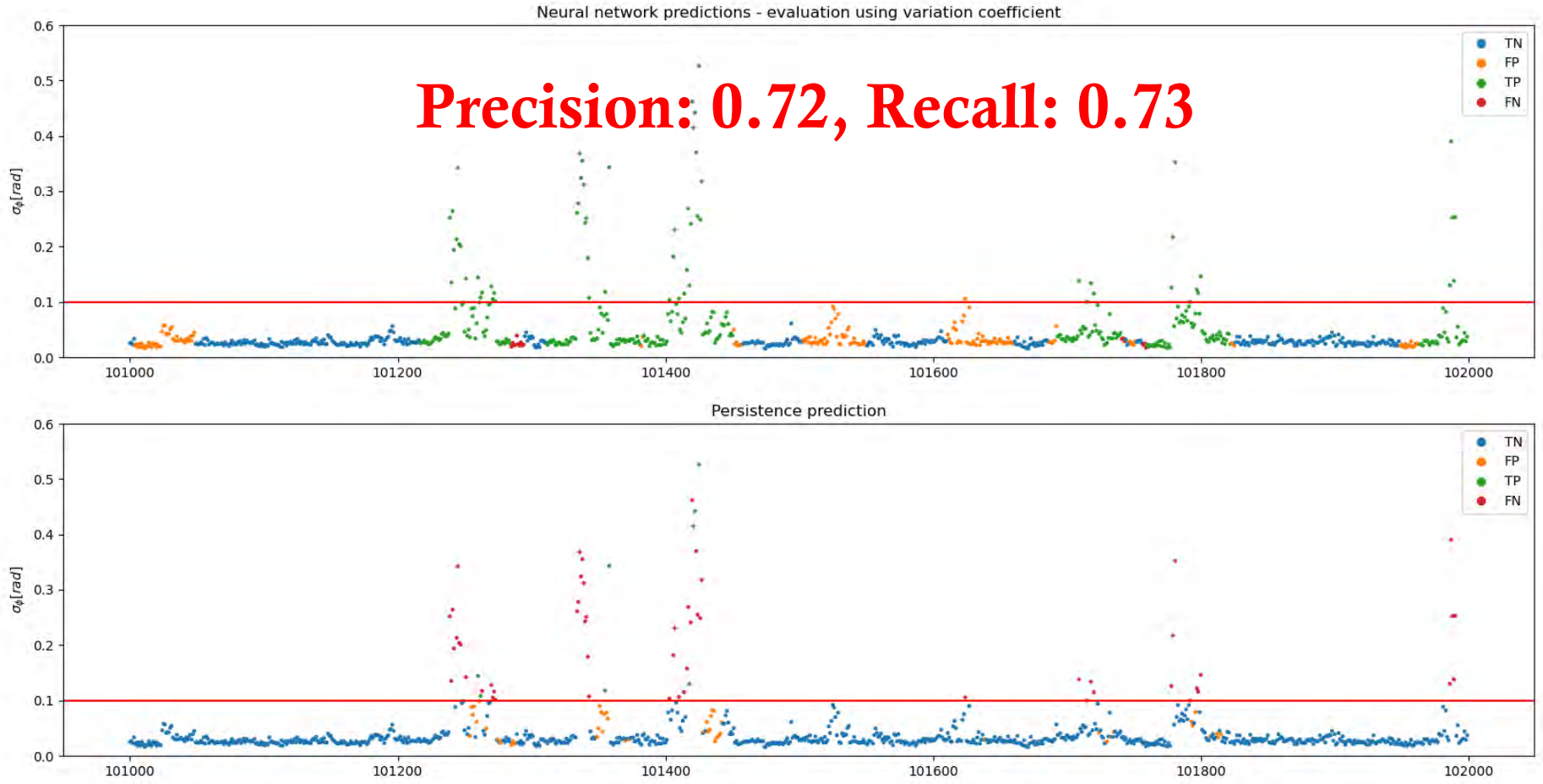
# ABSOLUTELY INTERESTING RESULTS



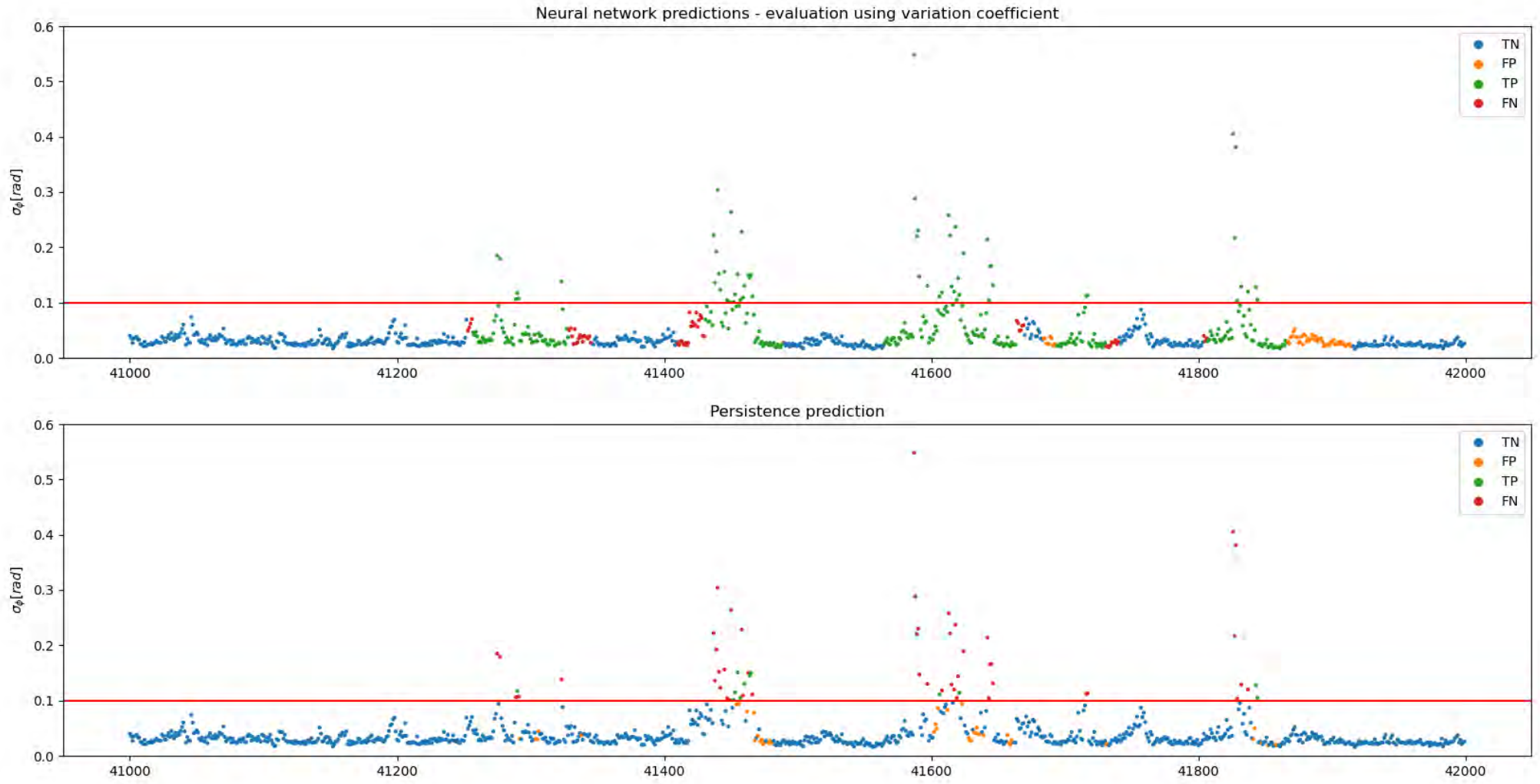
# QUANTITATIVE EVALUATION

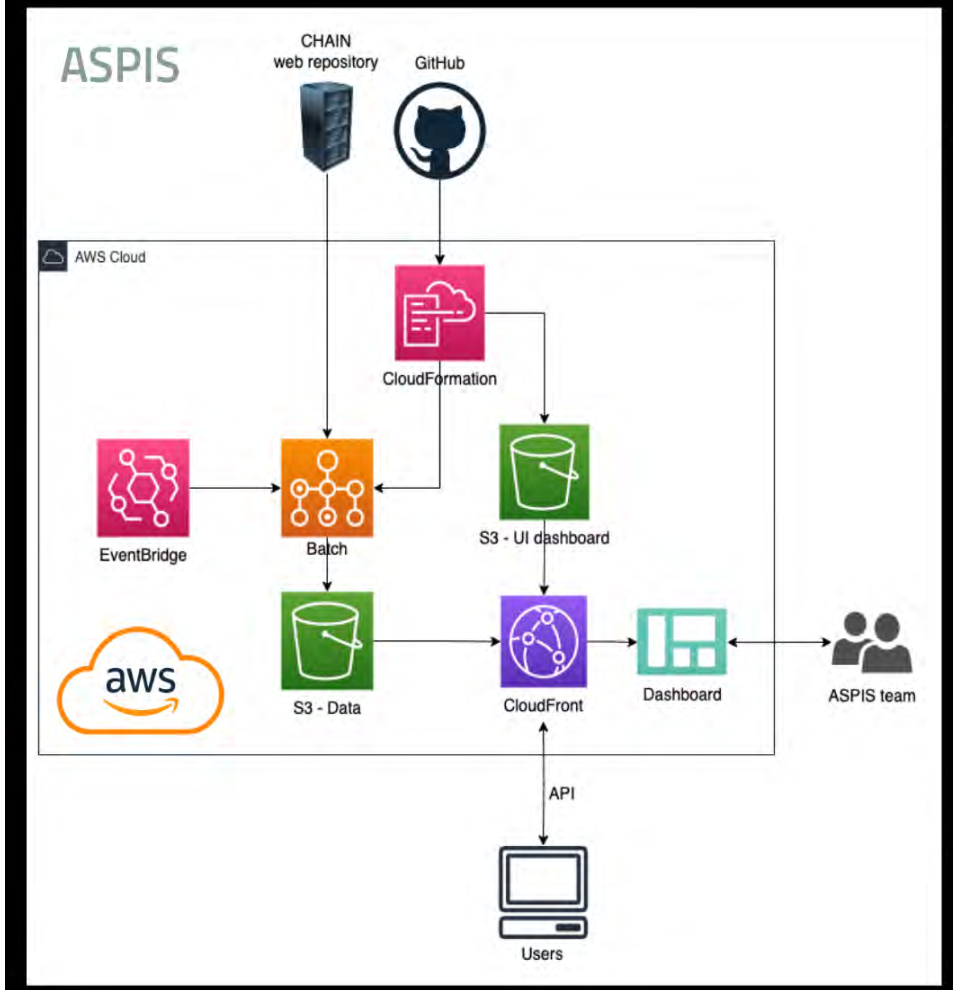
| Model | Precision | Recall | F1 Score | AUC-ROC | AUC-PR | TSS |
|---|---|---|---|---|---|---|
| Persistence | 0.12 | 0.12 | 0.12 | 0.70 | 0.13 | 0.11 |
| 15 min forecasting | 0.12 | **0.87** | 0.22 | 0.93 | 0.50 | **0.80** |
| +Ap index | 0.10 | **0.91** | 0.18 | 0.96 | 0.51 | **0.82** |

# NEW IMPROVEMENT



# Precision: 0.72, Recall: 0.73

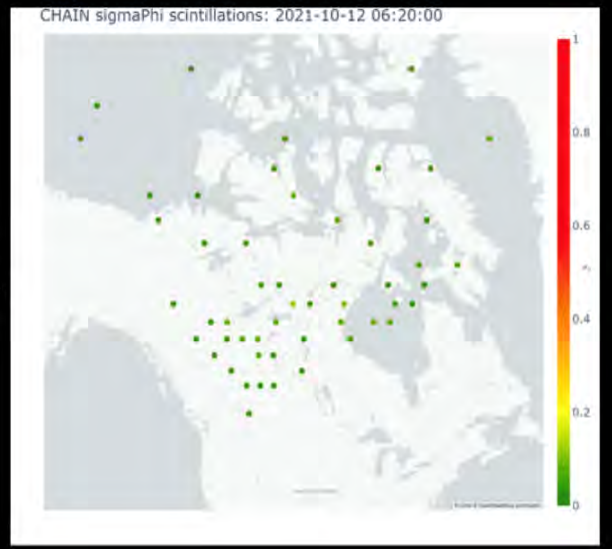




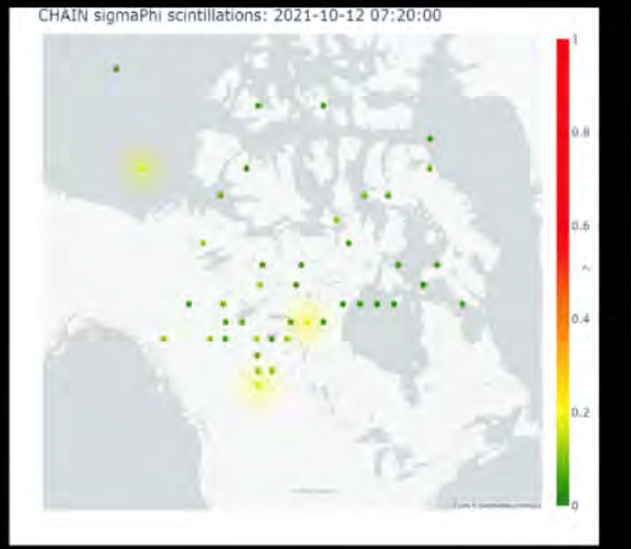

```
2184,194460, 12,      628,301, 14,38.6, 0.393, 0.117, 0.056, 0.063, 0.069, 0.071, 0.072, -1.197, 0.572, 18.435, 0.026, 24.632,-0.062, 20.158,-0.035,
2184,194460, 22,      628, 80, 36,42.2, 0.128, 0.078, 0.036, 0.039, 0.040, 0.040, 0.040, -1.989, 0.241, 14.603,-0.033, 13.832, 0.001, 14.060, 0.009,
2184,194460, 19,      628,218, 58,47.2, 0.046, 0.044, 0.020, 0.028, 0.031, 0.032, 0.032, -3.824, 0.076,  8.584,-0.029, 10.412, 0.004, 14.238,-0.024,
2184,194460, 14,      628,156, 27,42.6, 0.110, 0.074, 0.028, 0.035, 0.039, 0.039, 0.039, -5.340, 0.179,  7.333, 0.228,  3.373, 0.447,  6.534, 0.212,
2184,194460, 24,      628,277, 36,43.3, 0.082, 0.069, 0.032, 0.034, 0.036, 0.037, 0.037, -3.521, 0.175, 12.113, 0.009, 14.940, 0.009, 16.026,-0.020,
2184,194460, 21,      628, 56, 21,39.9, 0.143, 0.101, 0.038, 0.043, 0.047, 0.047, 0.047, -3.599, 0.245, 11.442, 0.021, 13.888, 0.017, 12.917, 0.011,
2184,194460, 32,      628,  5, 25,42.8, 0.138, 0.072, 0.032, 0.038, 0.044, 0.044, 0.044, -1.319, 0.262, 15.800,-0.023, 17.551, 0.001, 16.847, 0.010,
2184,194460,  3,      628,107, 27,41.6, 0.127, 0.083, 0.036, 0.047, 0.050, 0.051, 0.051, -2.703, 0.289, 21.540,-0.021, 15.124, 0.011, 12.316, 0.009,
2184,194460, 17,      628,156, 67,48.0, 0.042, 0.040, 0.019, 0.026, 0.029, 0.029, 0.029, -3.409, 0.082, 14.551, 0.007, 14.189, 0.029, 13.133, 0.012,
2184,194460,  1,      628, 69, 41,44.3, 0.181, 0.061, 0.033, 0.039, 0.042, 0.043, 0.044, -2.244, 0.175,  9.649, 0.036, 13.809, 0.041, 12.838,-0.042,
2184,194460,  6,      628,198, 15,37.3, 0.427, 0.137, 0.077, 0.132, 0.143, 0.149, 0.156, -1.020, 0.665, 27.580,-0.040, 22.744,-0.077, 15.204,-0.109,
2184,194520, 12,      628,301, 15,38.3, 0.481, 0.122, 0.052, 0.056, 0.061, 0.062, 0.063, -1.673, 0.637, 32.609,-0.007, 25.793, 0.018,  8.848, 0.042,
2184,194520, 22,      628, 80, 36,43.0, 0.105, 0.070, 0.033, 0.036, 0.038, 0.038, 0.038, -1.758, 0.208, 15.421,-0.024, 12.442, 0.003, 13.822,-0.018,
2184,194520, 19,      628,217, 58,46.9, 0.050, 0.045, 0.021, 0.026, 0.028, 0.028, 0.028, -3.790, 0.109, 17.637, 0.054, 20.122,-0.010, 21.540,-0.042,
2184,194520, 14,      628,156, 27,42.7, 0.146, 0.074, 0.030, 0.034, 0.037, 0.037, 0.037, -4.798, 0.250,  9.380, 0.117,  7.191, 0.097,  8.914, 0.507,
2184,194520, 24,      628,277, 35,42.8, 0.086, 0.073, 0.033, 0.037, 0.038, 0.039, 0.039, -3.428, 0.175, 15.416, 0.022, 16.502, 0.017, 14.179, 0.036,
2184,194520, 21,      628, 56, 21,40.0, 0.140, 0.100, 0.038, 0.043, 0.048, 0.049, 0.049, -3.563, 0.246, 14.507,-0.013, 13.622, 0.042, 10.023,-0.033,
2184,194520, 32,      628,  5, 25,43.1, 0.151, 0.070, 0.030, 0.035, 0.041, 0.042, 0.042, -1.374, 0.332, 25.119, 0.006, 14.048, 0.020, 14.724, 0.011,
2184,194520,  3,      628,106, 27,40.7, 0.135, 0.092, 0.040, 0.050, 0.055, 0.056, 0.056, -2.764, 0.293, 10.859,-0.015, 14.829, 0.011, 19.979,-0.022,
2184,194520, 17,      628,155, 67,48.2, 0.048, 0.039, 0.019, 0.023, 0.025, 0.026, 0.026, -3.337, 0.087, 13.771, 0.098, 14.751, 0.053, 12.847,-0.043,
```

## Ionospheric scintillations (sigma_phi)

**Nowcast**
2021-10-12 06:20




**Forecast**
2021-10-12 07:20



# How to use our REST API

| GET | https://aspis.services/api/{type}/{year}/{month}/{day}{hour}/{file} |
|---|---|

| | |
|---|---|
| {type} | nowcast I forecast |
| {year}/{month}/{day}{hour} | YYYY/MM/DD/HH |
| {file} | averaged.json I raw.json |

# Example:

| GET | https://aspis.services/api/nowcast/2023/06/0708/averaged.json |
|---|---|
| Response<br><br>status code: 200 | {<br>"dataSource": "CHAIN",<br>"timeUtc": "2023-06-07T08:00:00",<br>"binValues": [<br>{<br>"binId": 13254,<br>"sigmaPhi": 0.024<br>},<br>{<br>"binId": 13256,<br>"sigmaPhi": 0.032<br>},<br>{ |


THANKS FOR YOUR ATTENTION
QUESTIONS ?

# Disclaimer

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*ESA disclaimer: The view expressed herein can in no way be taken to reflect the official opinion of the European Space Agency.*