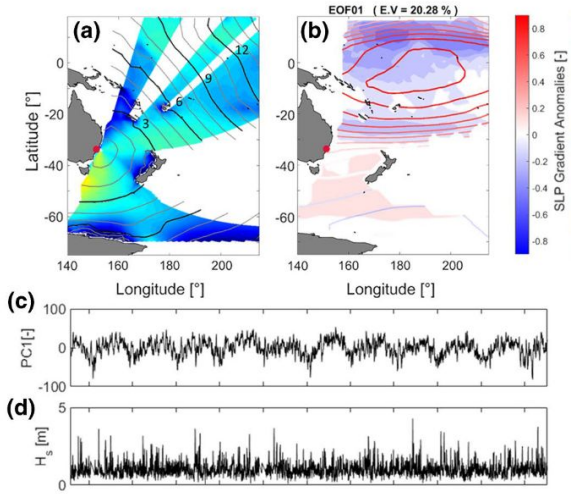
Hackathon SDD 2022

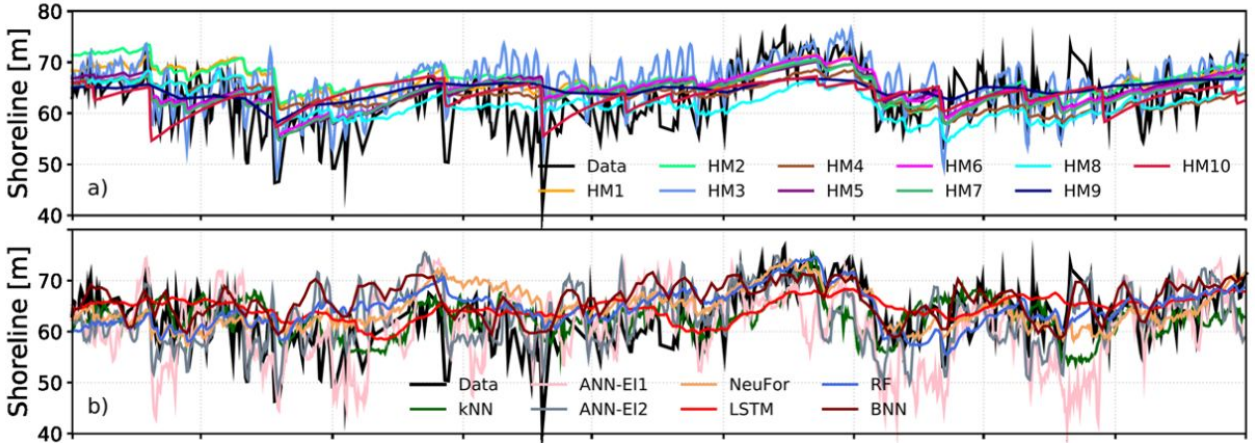
Subject 1: Shoreline Forecasting

Responsable : Grégoire Thoumyre, Mahmoud Al-Najar, Jennifer Montaño

The ability to track the evolution and development of the physical characteristics of coastal areas over time resulting from different natural forces is an important factor in coastal development, planning, risk mitigation, and overall coastal zone management. With changing water levels, global shorelines are changing more drastically than in the past. Predictive methods can help understand how global shorelines are changing.

In this topic, students will use **daily shoreline estimates** over many years to **predict large-scale changes to global coasts**. Features describing shoreline topography as well as wave information will be provided, with the goal of predicting shoreline change over a 3 month period.





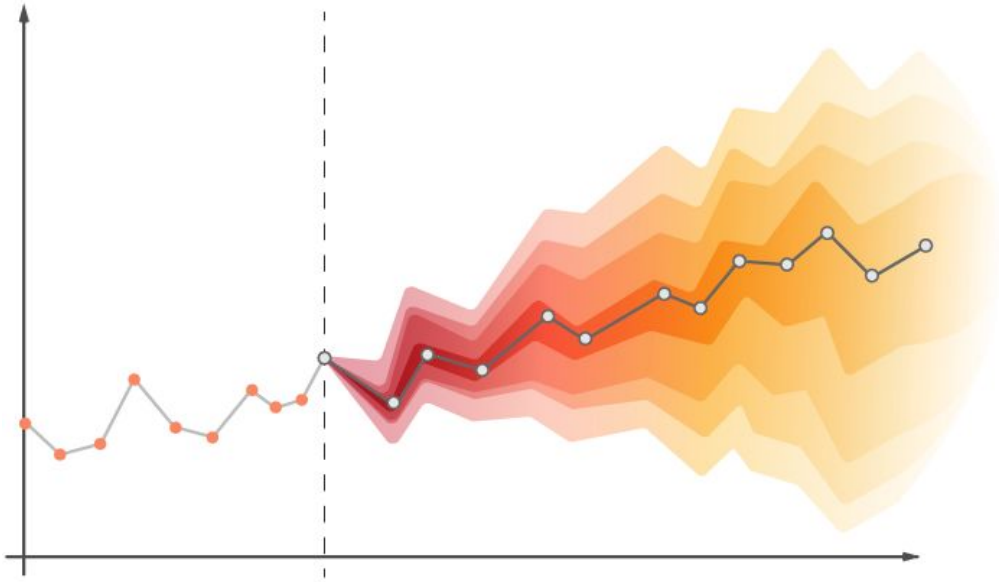
Subject 1 Teams

Subject 1 Results

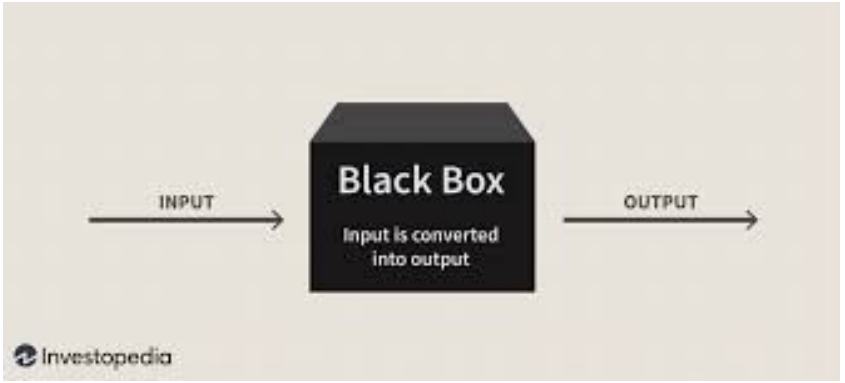
#	Team	Members	Score	Entries	Last	Code
1	**Tilted Towers**		5.85230	8	1s	
	Your Best Entry! Your most recent submission scored 5.85230, which is an improvement of your previous score of 57.48077. Great job!					**Tweet this**
2	happy_shockley		14.78541	9	12m	
3	gloomy_kare		61.16157	18	1s	

Deux sujets en 1 !

TIME SERIES
(time correlation)



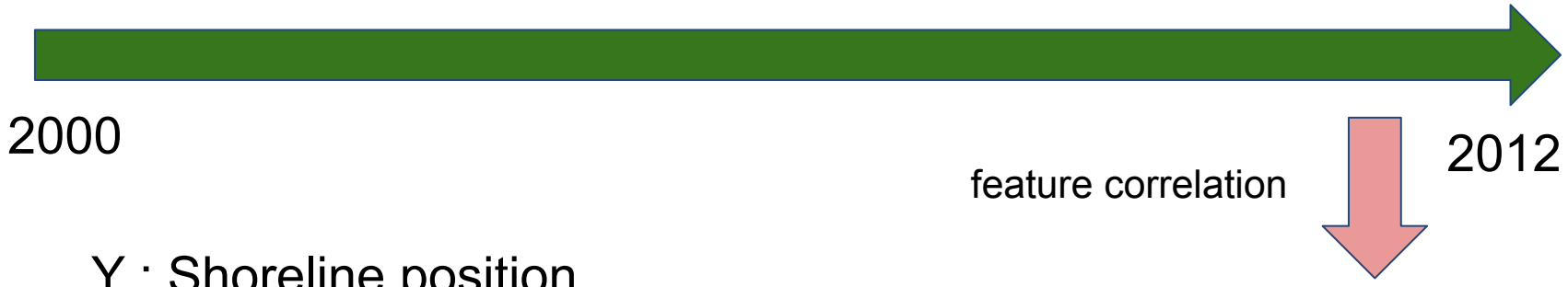
Classic supervised learning
(feature correlation)



Le probleme

Two DATASETS - 10.000 beaches
Time series of ~~ 45000 days

XX : Features



Y : Shoreline position

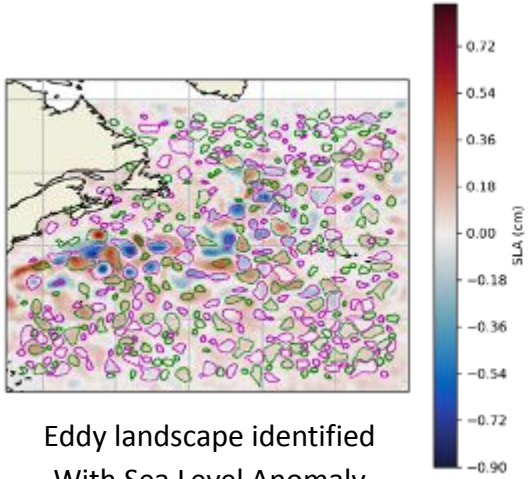
Nos differentes approches

Récapitulatif des résultats

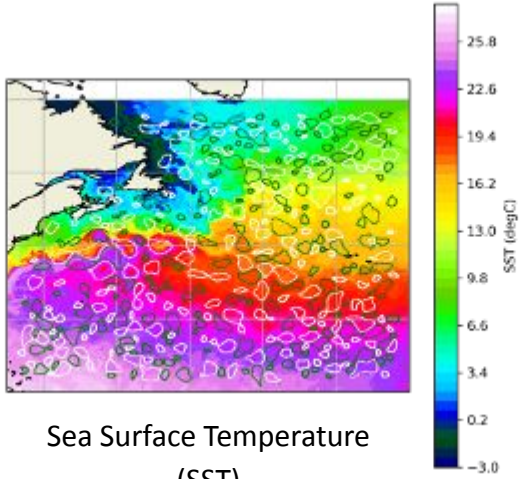
Naive	CNN	VIT	LSTM	Kmeans + LSTM	Naive fine tuné
~76	~58	57,48 !!!!	~73	~68	~59

Subject 2: Détection de

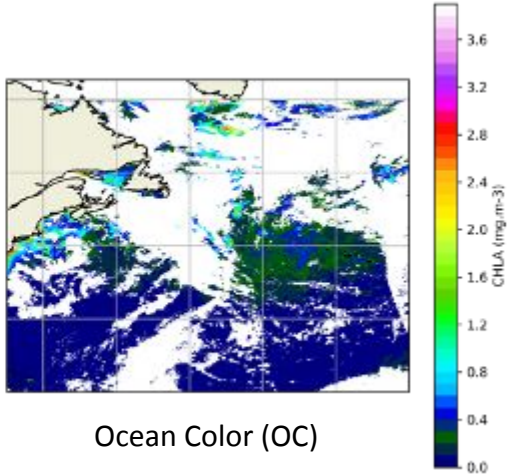
Responsable : Daria Botvynko, Simon Van Gennip



Eddy landscape identified
With Sea Level Anomaly



Sea Surface Temperature
(SST)



Ocean Color (OC)

MERCATOR OCEAN INTERNATIONAL

Oceanic Eddies are vortices of the order of ~10km in horizontal scale, whose signature is clearly visible in satellite products. Sea Level Anomalies (SLA) derived from altimetry is used for detecting such object (using numerical techniques), yet the horizontal and spatial resolution of the product limits the accuracy of detection. Eddy signature is also visible in other satellite-derived product such as Sea surface Temperature (SST) and Ocean Colour (OC) that do not suffer from such limitation (except for cloud coverage).

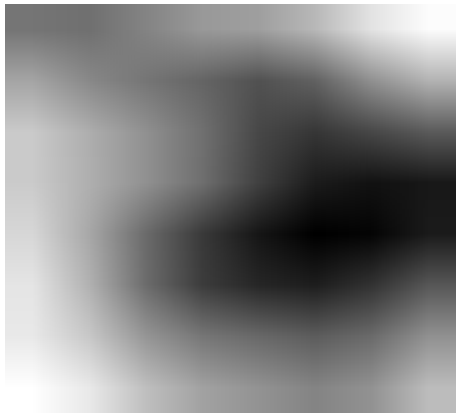
The objective here is to **develop a Deep Learning approach to identify eddies using SST and OC.** For this students will have a labelled eddy dataset consisting of SLA images (which have been used for the detection), and the corresponding SST and OC images wherein the eddy signature is also present.

Subject 2 Teams

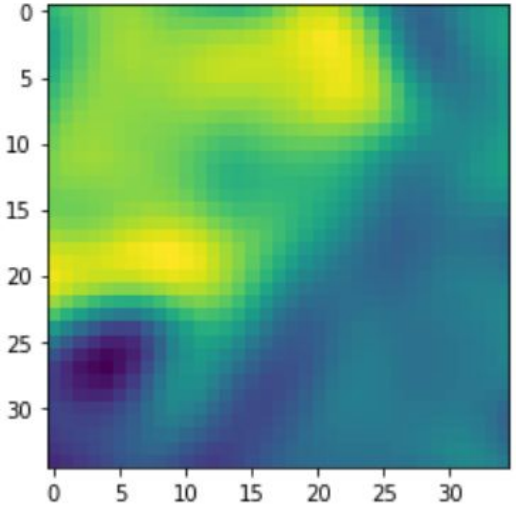
Subject 2 Results

#	Team	Members	Score	Entries	Last	Code
1	**Espadrilles argentées**		0.94711	1	1h	
	Your Best Entry! Your submission scored 0.94044, which is not an improvement of your previous score. Keep trying!					
2	insane_lamarr		0.87517	6	1h	
3	pensive_allen		0.83801	10	1h	
4	Les Albatros		0.80705	2	1d	

Problème 1 : Classification de cyclones et d'anticyclones



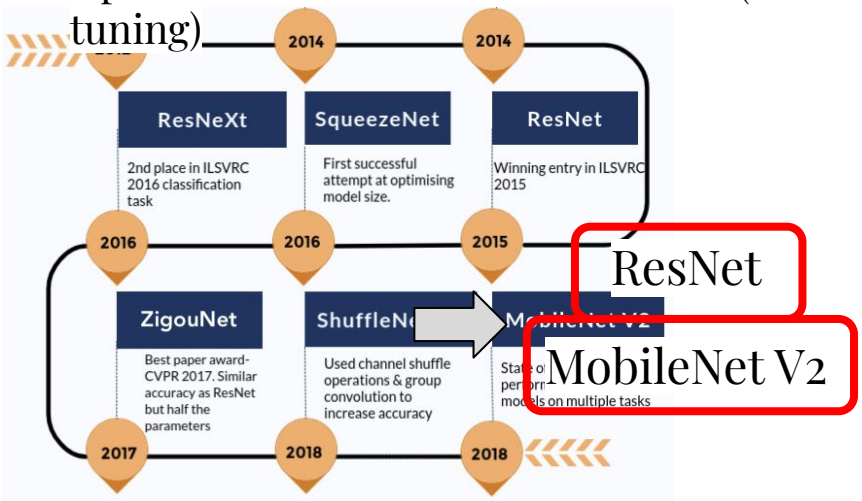
Niveau de la mer



Winning Team Slides

Problème 1 : Nos méthodes

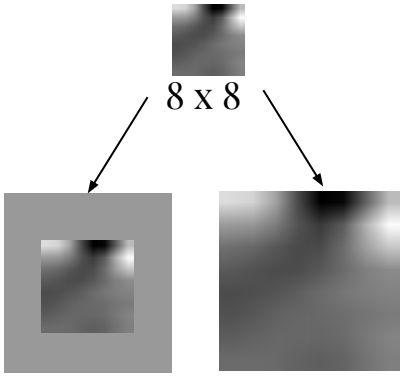
- Utilisation d'un modèle pré-entrainé de pytorch
- Optimisation des dernières couches (fine tuning)



Problème des images de dimensions différentes


48 x 48


40 x 40

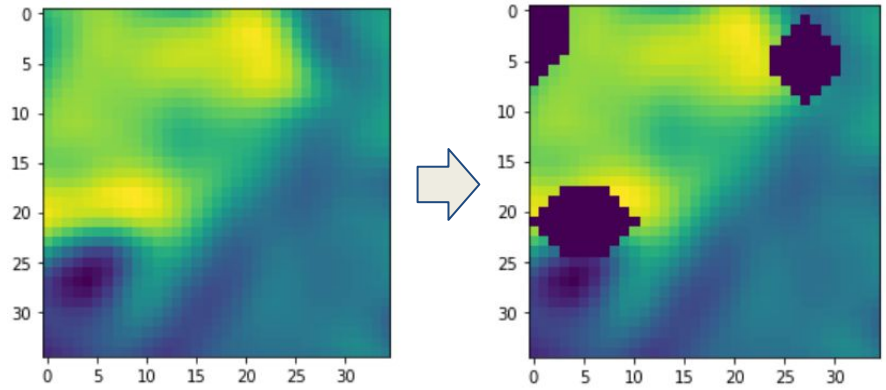


- Pooling
- Data augmentation

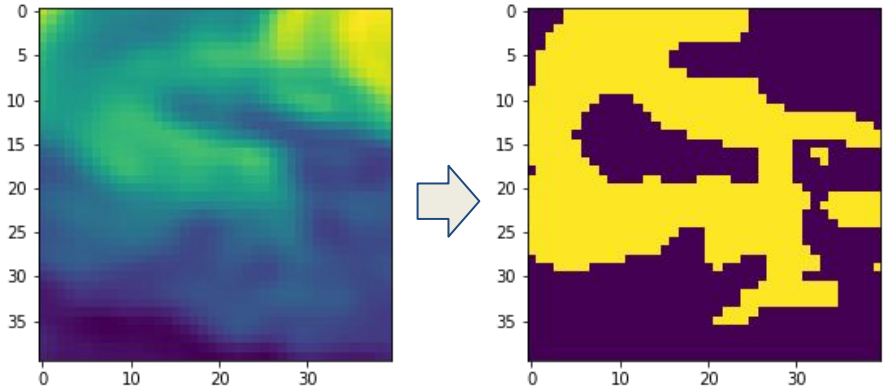
\+ bagging des 3 meilleurs méthodes

Problème 2 : Détection de la forme du tourbillon

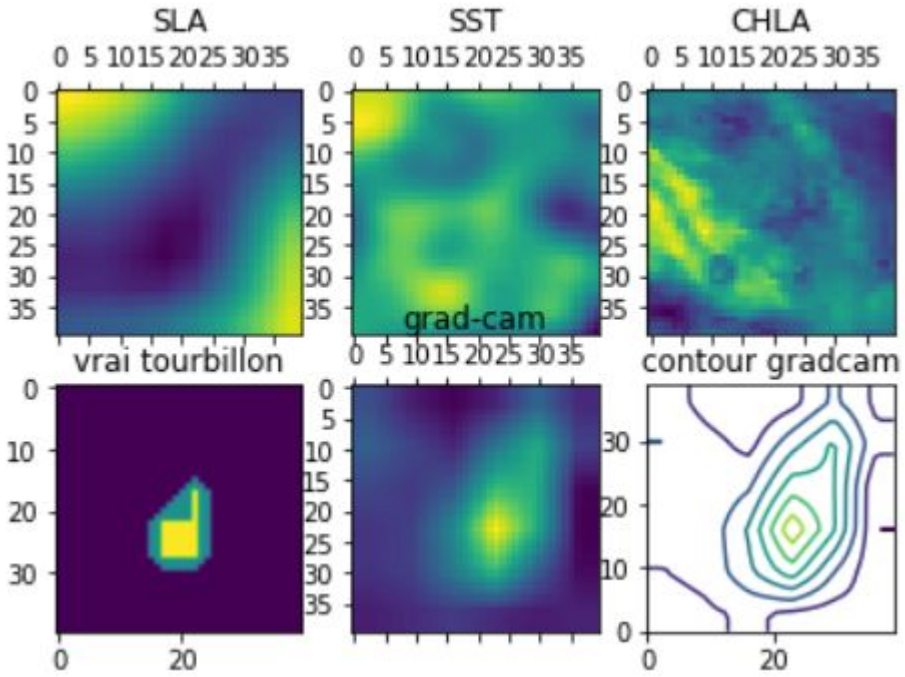
Convolution + détection de contour



One class SVM



Grad Cam



Subject 3: Daily Rainfall Forecasting

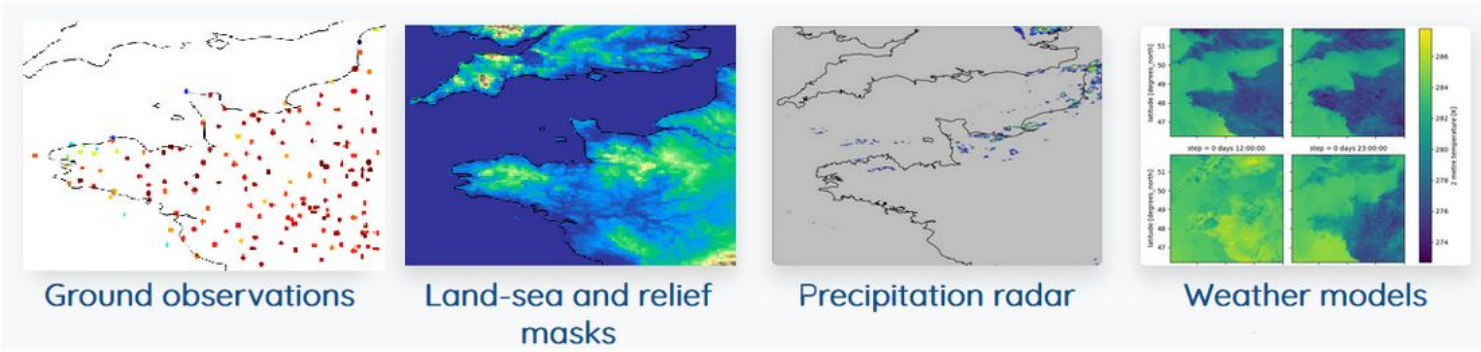
Responsable : Léa Berthomier, Brice Le Pape

Forecasting the daily rainfall can prevent you from coming back from work soaked from head to toe, but more importantly, it can help anticipating extreme events such as floods or hurricanes.

Your mission, should you choose to accept it, will be to forecast the rainfall over the next 24h using data from the previous day : ground observations (temperature, wind, pressure, rainfall…) and numerical weather forecasts from METEO-FRANCE. (These forecasts are based on the equations of the physics of the atmosphere).
You will have to learn from the past errors of the numerical weather models to forecast the rainfall on several ground stations.

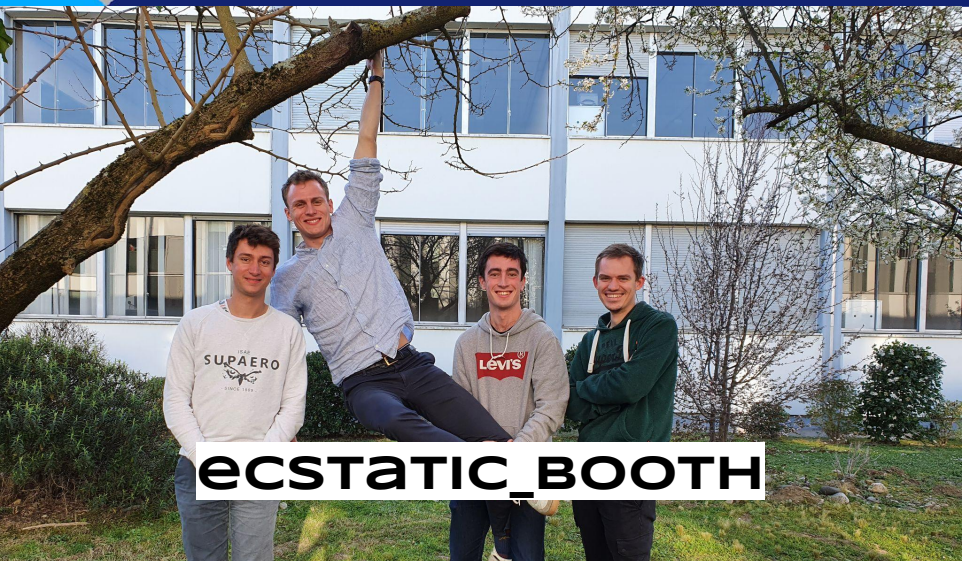
The data comes from MeteoNet, an open weather dataset for AI : https://www.kaggle.com/katerpillar/meteonet
It spans the North-West quarter of France from 2016 to 2019.

Content



METEO FRANCE

Subject 3 Teams



Subject 3 Results

#	△	Team	Members	Score	Entries	Last	Code
1	—	**Des 7A comme ça 👍**		27.33930	13	1h	
2	—	Hopeful feynman		30.33538	33	8m	
3	▲ 4	Hugo Bourdon		30.86529	1	10m	
4	—	sleepy_borg		31.43855	29	9m	
5	▼ 2	Ecstatic Booth		31.86625	28	15m	
6	▲ 2	Prediction = random()		34.50747	9	16h	
7	▼ 2	tonign		34.66995	16	12m	
8	▼ 2	Greygeese		34.66995	13	15m	

Winning Team Slides

Traitement des données :

- utilisation des moyennes et des observations sur les heures précédentes : features finalement peu pertinents par rapport aux prédictions d'AROME
- prédiction de l'erreur d'AROME plutot que du résultat de cumul : peu concluant

Approches testées et résultats :

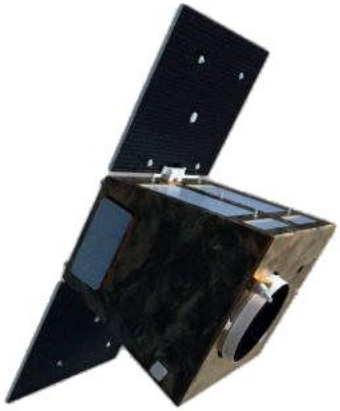
- Prévision d'aucune pluie + règles "à la main" : **27,5**
- Prévisions d'AROME + LGBM : **37**
- Prévisions d'AROME uniquement sur les jours de pluie avec RF : **38**
- Prévisions d'AROME seules : **39**
- Prévisions d'ARPEGE seules : **42**
- Prévisions d'AROME + observations + XGBoost : **51**

Subject 4: Orbit Propagation Modelling

Responsable : Quentin Rhone, Theo Nguyen, Jules-Edouard Denis

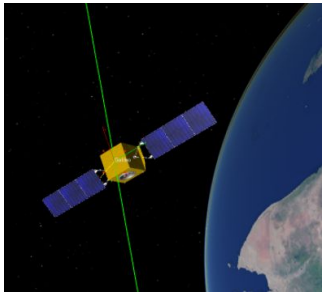
Orbit Propagation allows predicting satellites position and velocity. It is widely used for satellite operational activities like orbit determination, events prediction or collision avoidance management. It is for sure an old discipline but AI could be an interesting alternative in terms of accuracy and computational time. This innovative topic will bring us to test new ways to perform orbit propagation and could pave the way for future propagators.

Datasets are generated with current state-of-the-art propagators. It contains orbital data around CO3D satellite (Observation satellite for CNES to be launched in 2022) orbital regime. The students will deal with 2 different approaches and will need to develop accurate solutions for both problems to win the competition.



CO3D observation satellite orbital regime will be studied in this hackathon

- **Challenge 1**: build an AI propagator (analytical propagator forbidden!)
- **Challenge 2:** build an analytical propagator thanks to the learning of the error on the propagation due to the sun, moon, drag and solar activity.

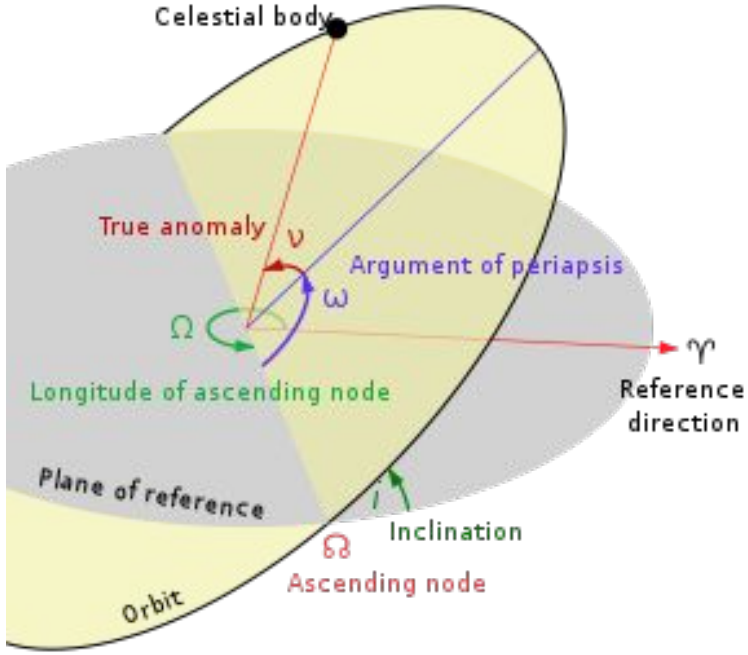


Orbit propagation is widely used for simulation as well as for operational problems and still needs to be improved

AIRBUS DEFENCE & SPACE

Subject 4 Teams

Winning Team Slides



Modelisation of the problem:

6 analytical (cartesian) variables per point

6 numerical (cartesian) variables per point

1 solar activity variable (3 levels of intensity)

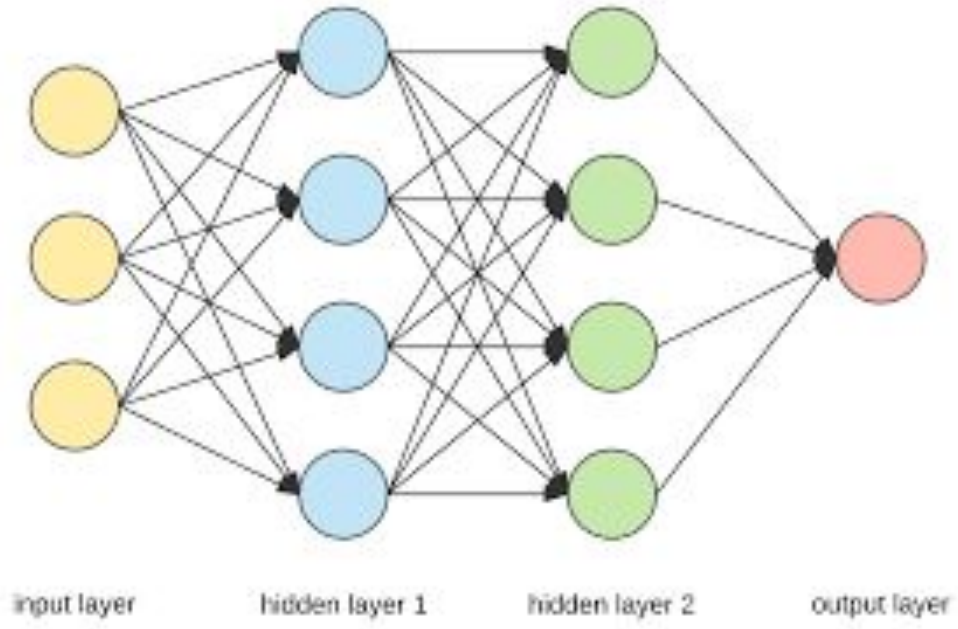
1 date variable (Normalized seconds)

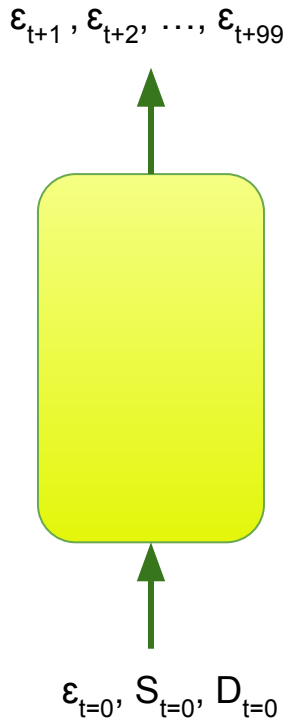
→ **6 errors per point**

NN input

Winning Team Slides

First approach - Simple MLP



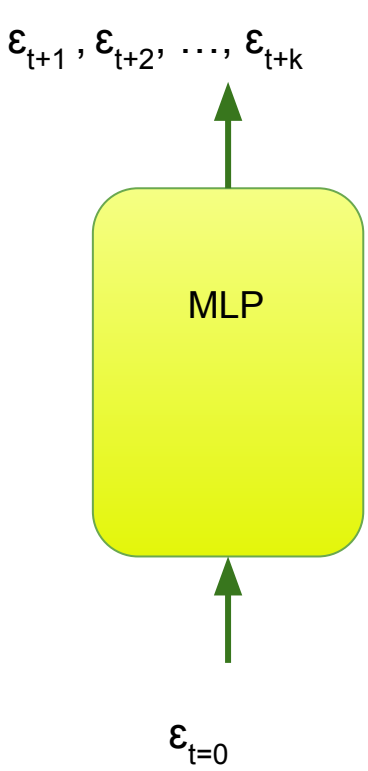


Y (Prediction of the other 99 points of the series)

X (First point of the series)

Winning Team Slides

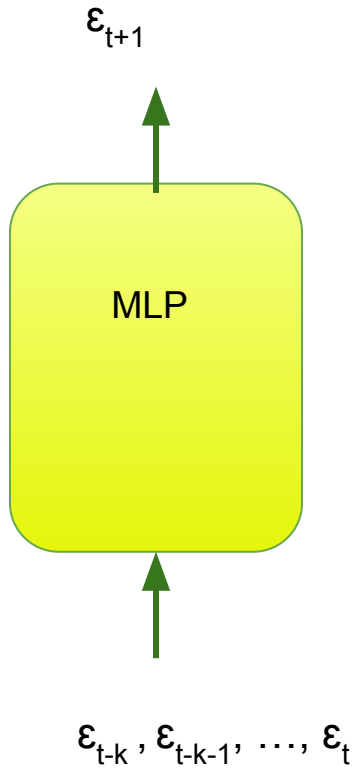
Second approach - Double MLP



The idea:

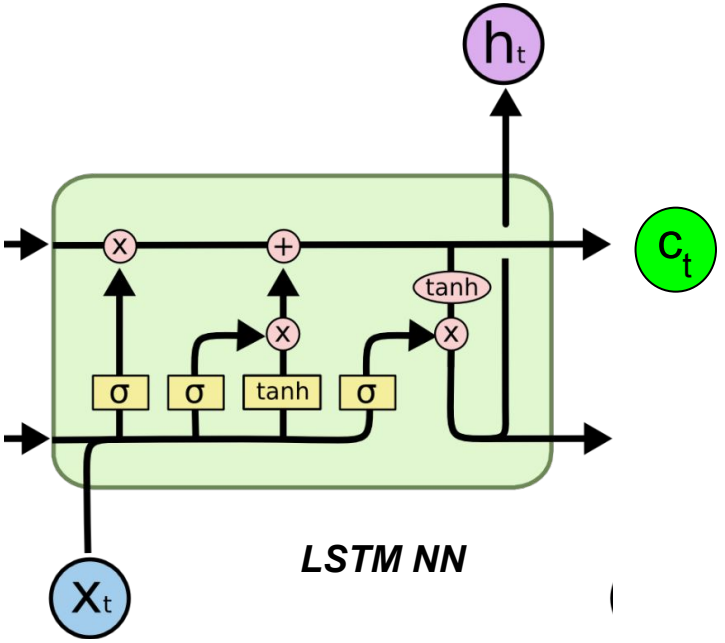
-Predict the first K points.

-Predict the rest of the series one by one



Winning Team Slides

Third approach - LSTM



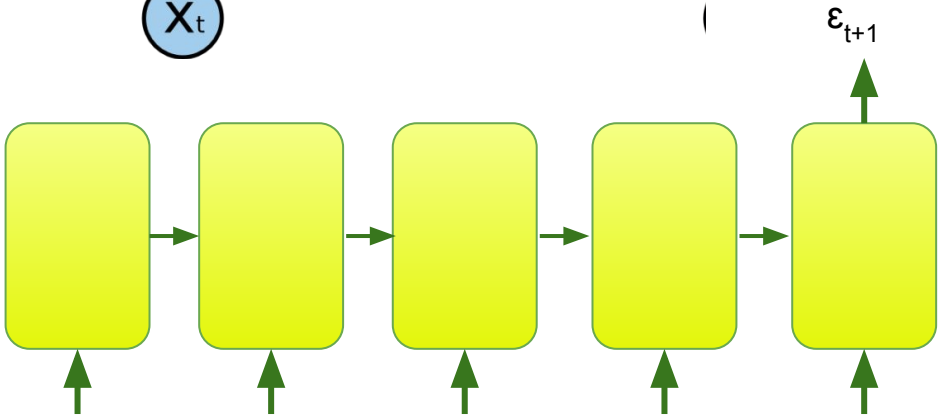
LSTM NN

MLP

$\varepsilon_{t+1}, \varepsilon_{t+2}, \ldots, \varepsilon_{t+k}$

Fully connected NN

$\varepsilon_{t=0}, S_{t=0}, D_{t=0}$



Winning Team Slides

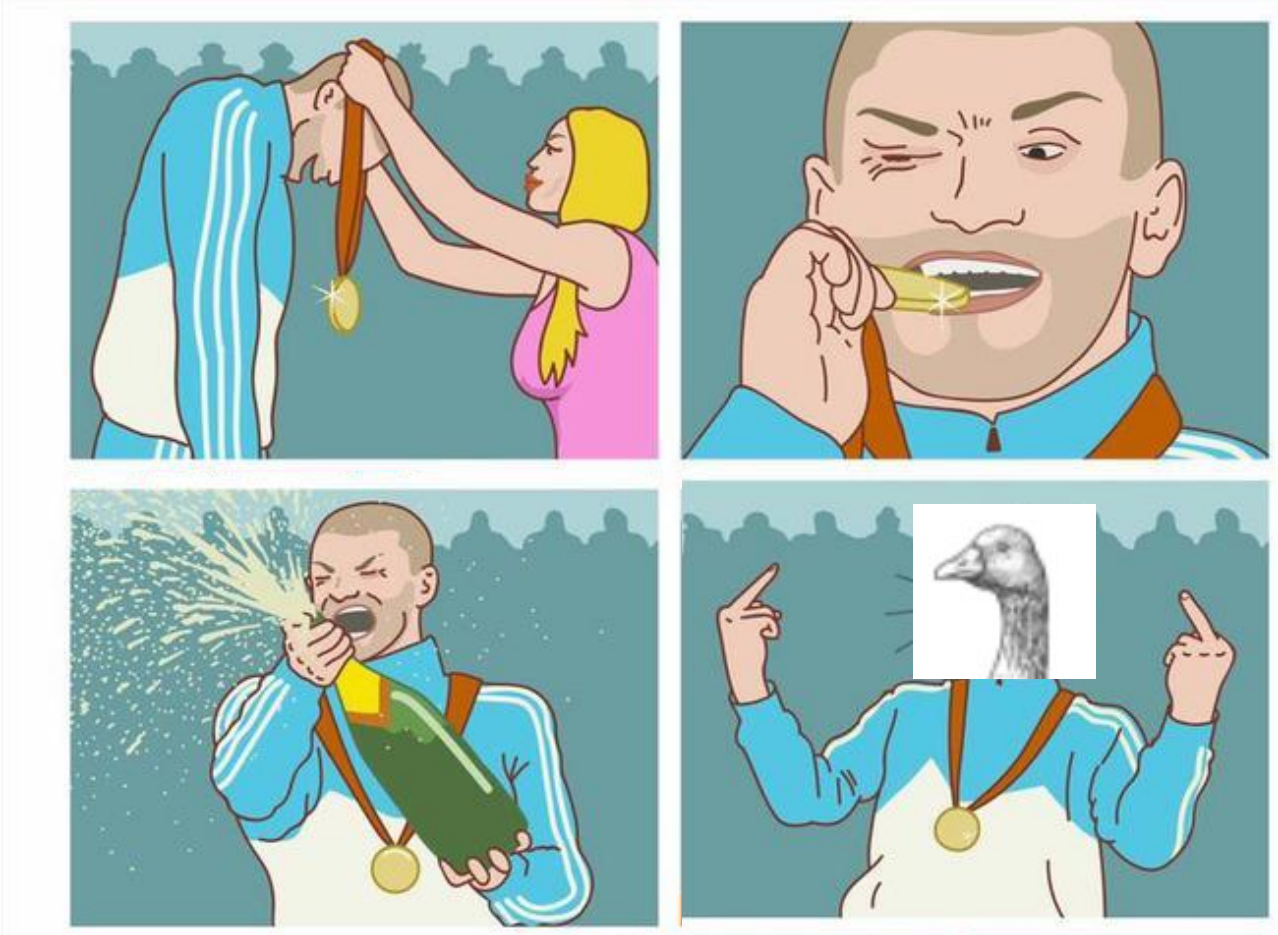
Which is the best approach?

LSTM?

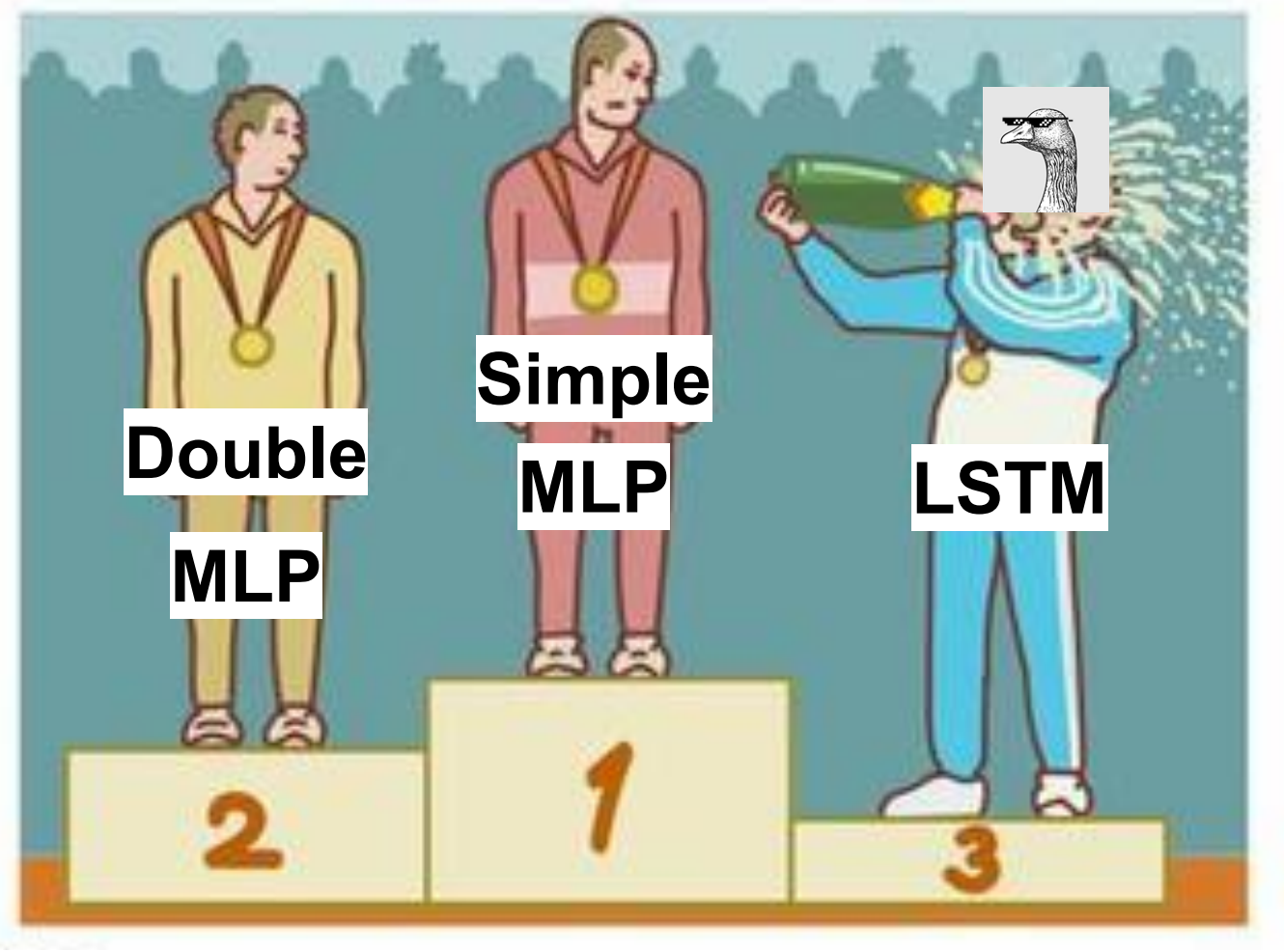
Winning Team Slides

Which is the best approach?

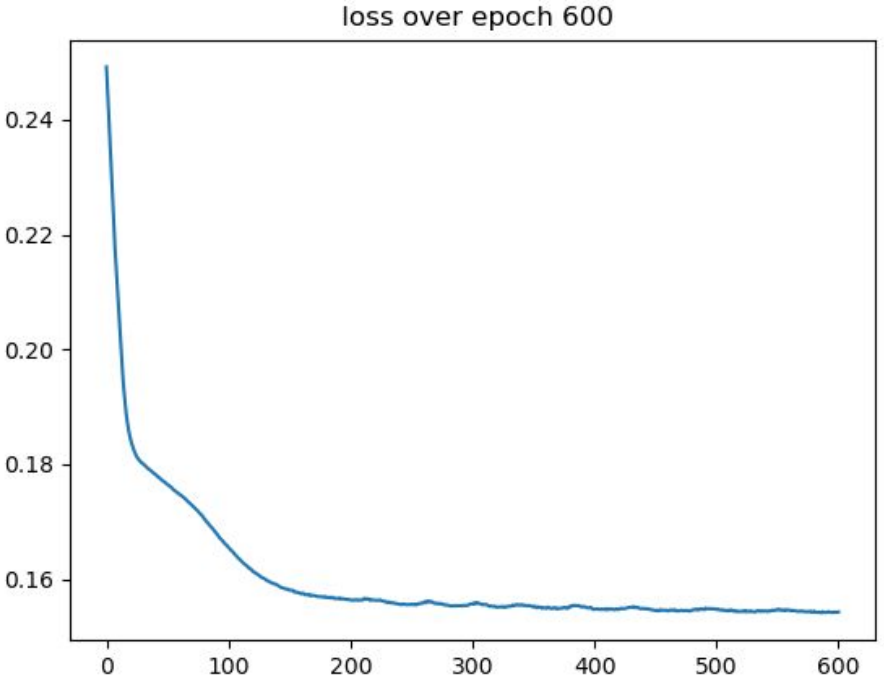
LSTM?

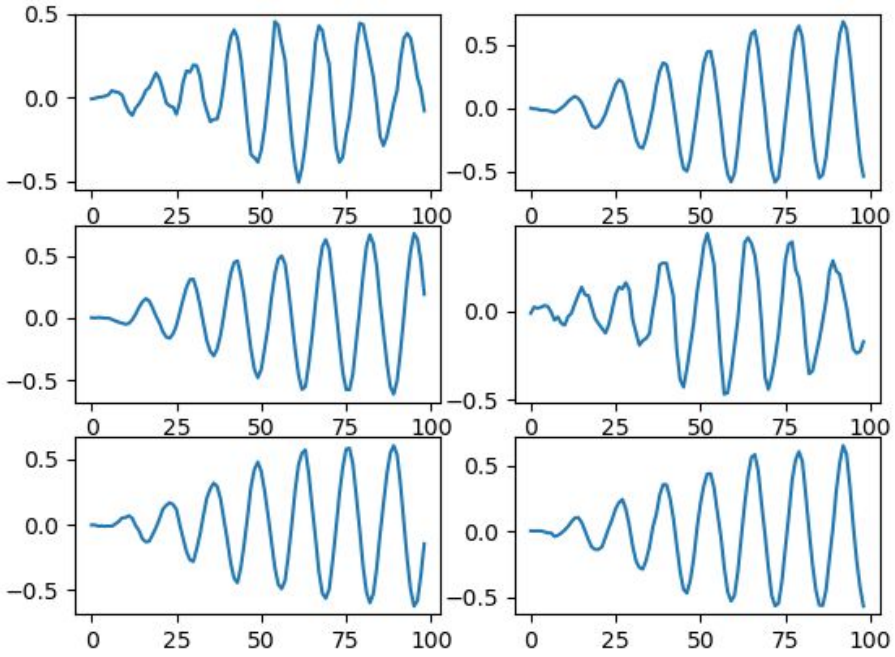


Winning Team Slides



Winning Team Slides





Error in the 6 predicted variables [x,y,z,dx,dy,dz]
for the 99 steps

Subject 4 Results

Score: **MAE** (Mean Absolute Error)

#	△	Team	Members	Score	Entries	Last	Code
1	—	**Wolsin Dinnes**		0.15399	27	18m	
2	—	Lucas G. Lima Lopes		0.15570	12	17m	
3	—	stoic_bhabha		0.18152	22	24m	
4	—	prickly_hodgkin		0.18266	36	4h	
		Simple_NN.csv		0.18868			