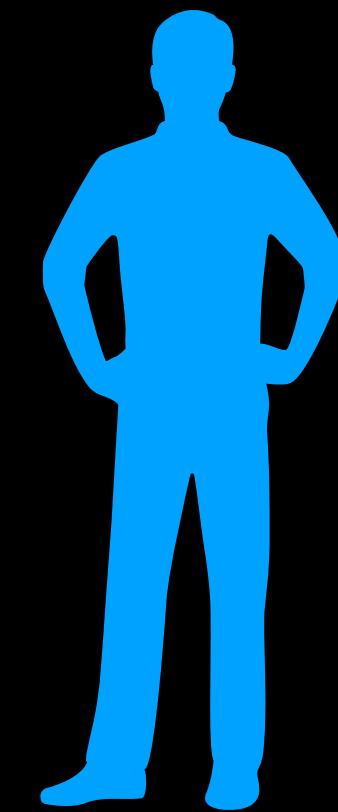




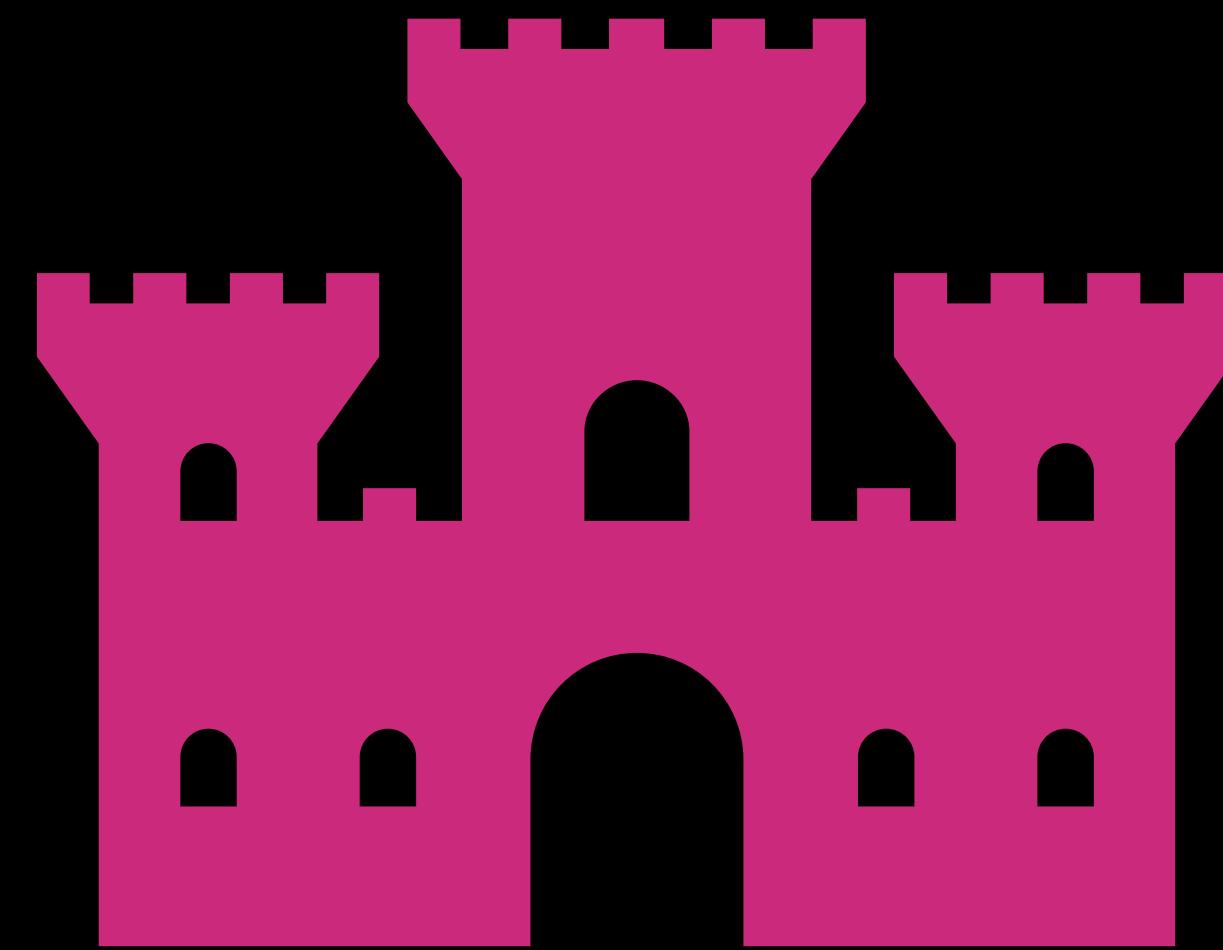
DATA MASTERS
Predictive
Maintenance

PREDICTIVE MAINTENANCE

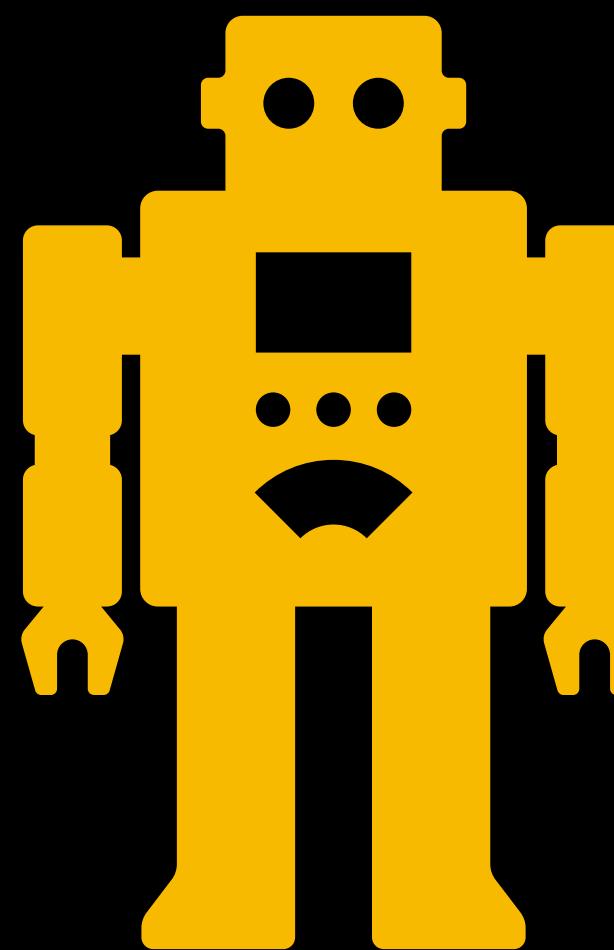
Why?



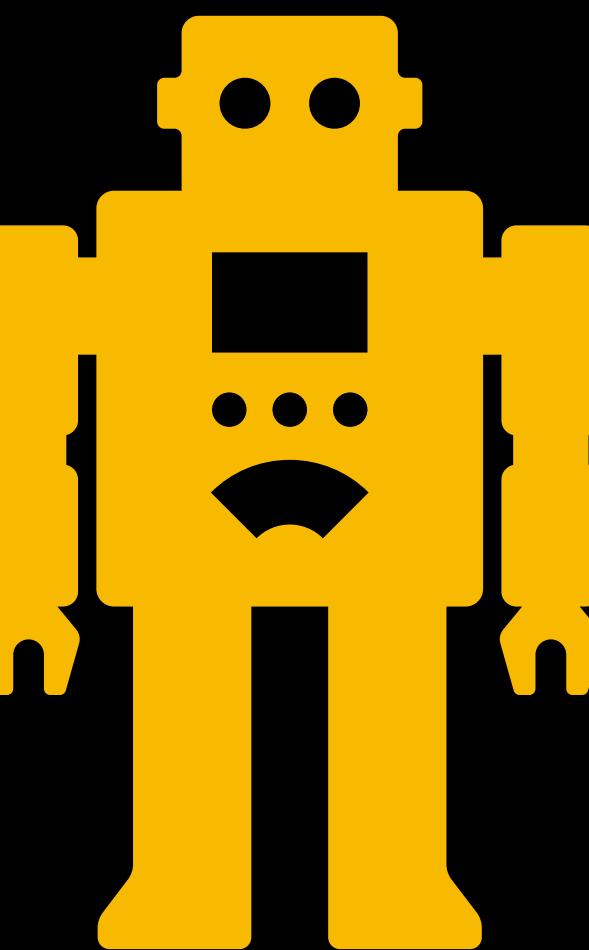
Mate



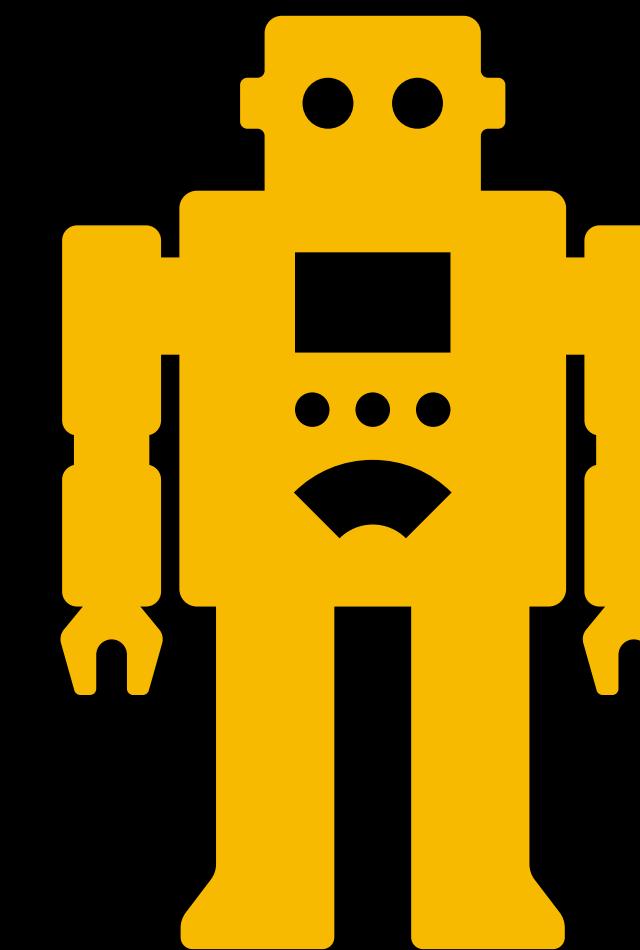
Warehouse



Forklift 1



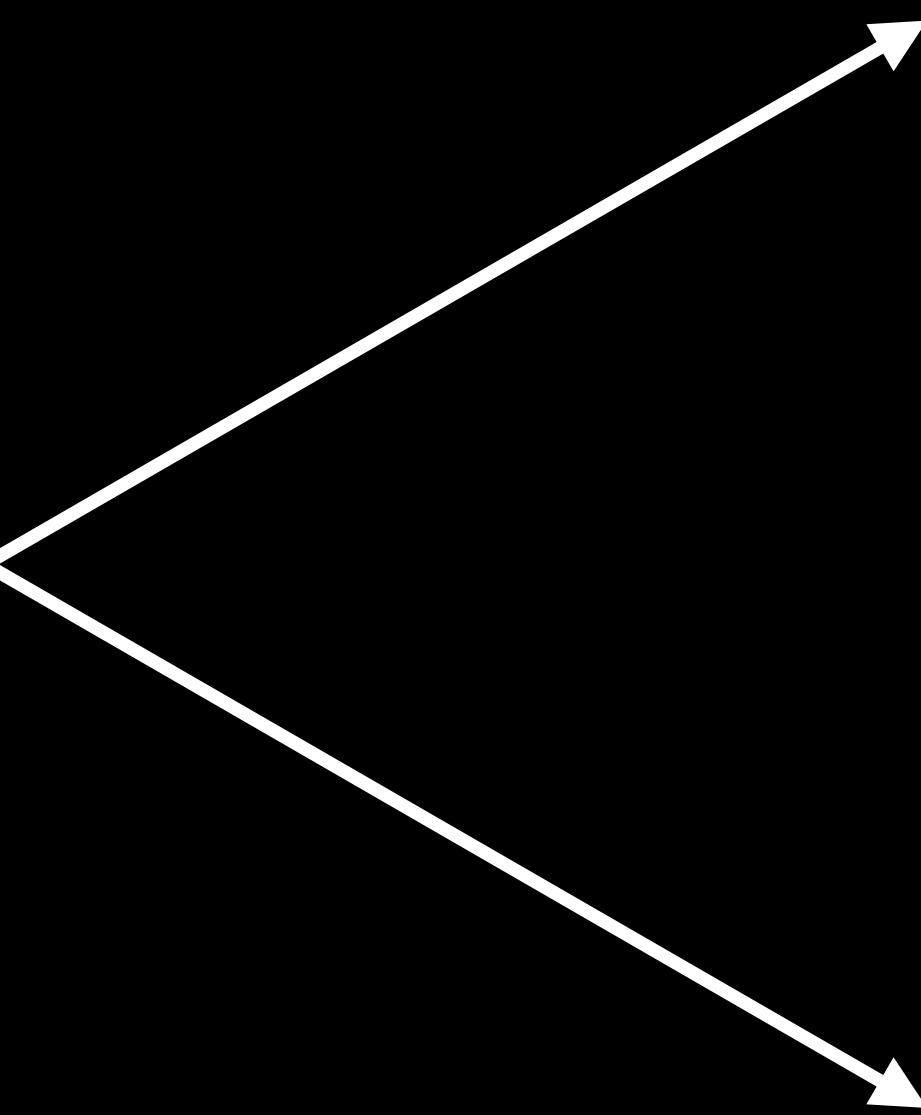
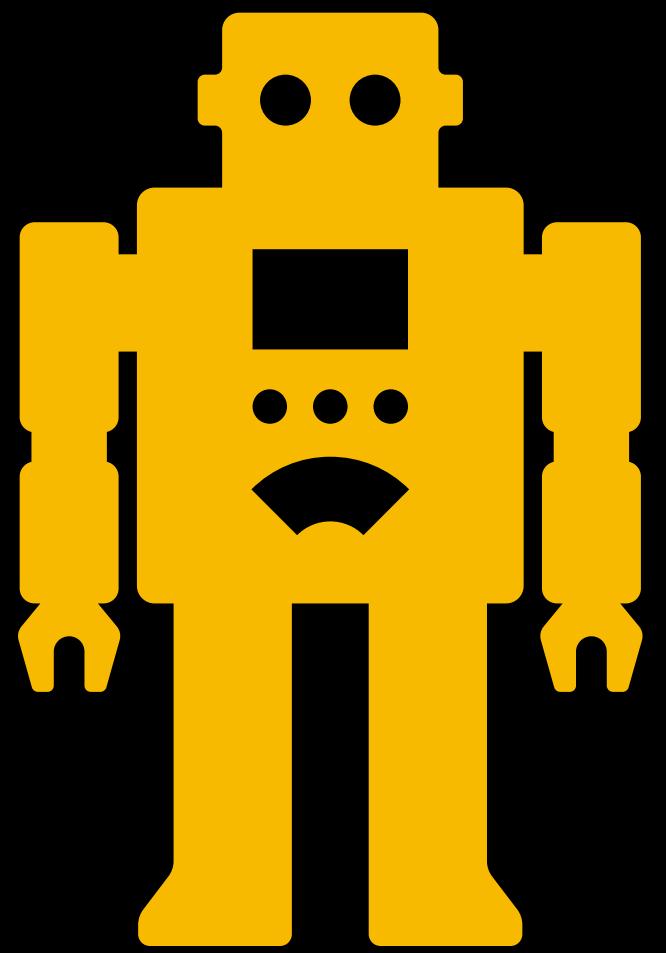
Forklift 2



Forklift 3

PREDICTIVE MAINTENANCE

Why?



SERVICE

Too late
- machine broke



SERVICE

Too early
- machine was fine

PREDICTIVE MAINTENANCE

Why?

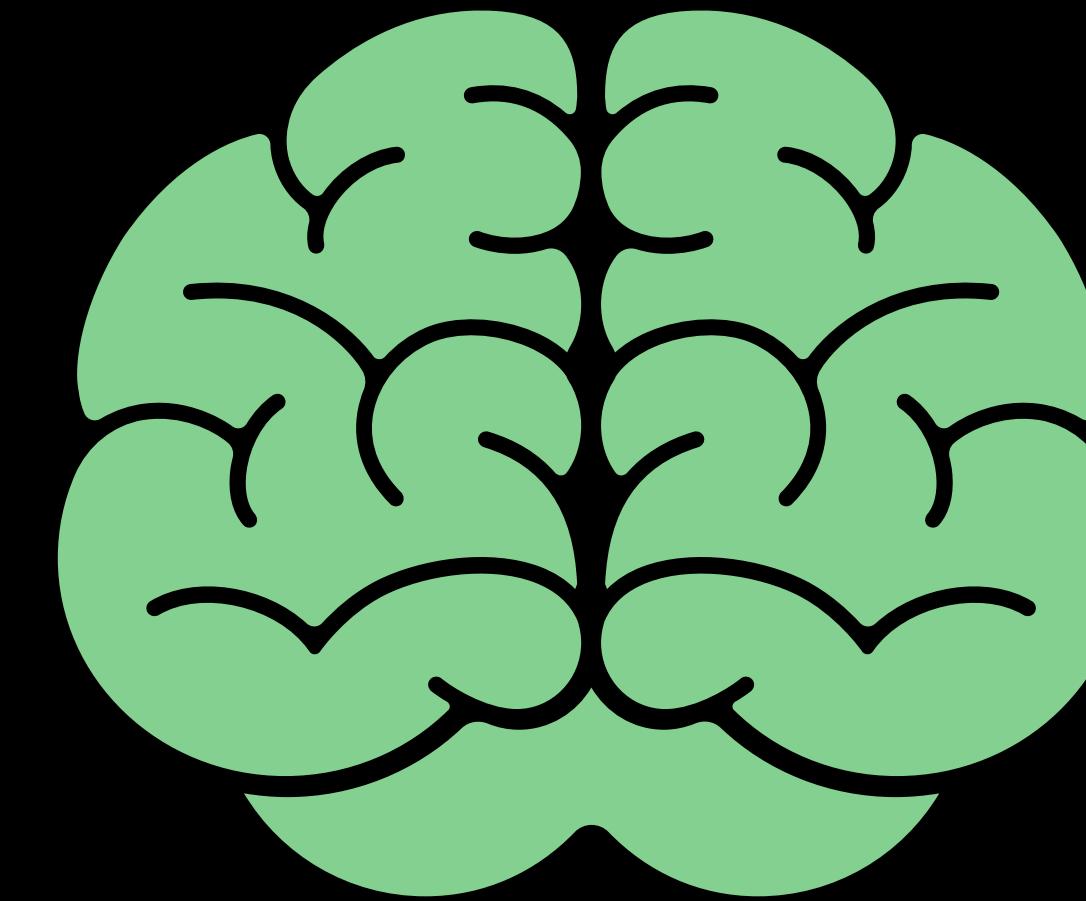
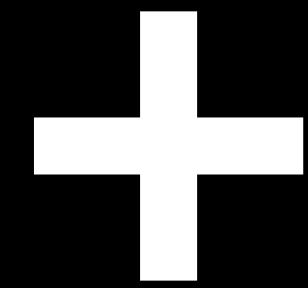
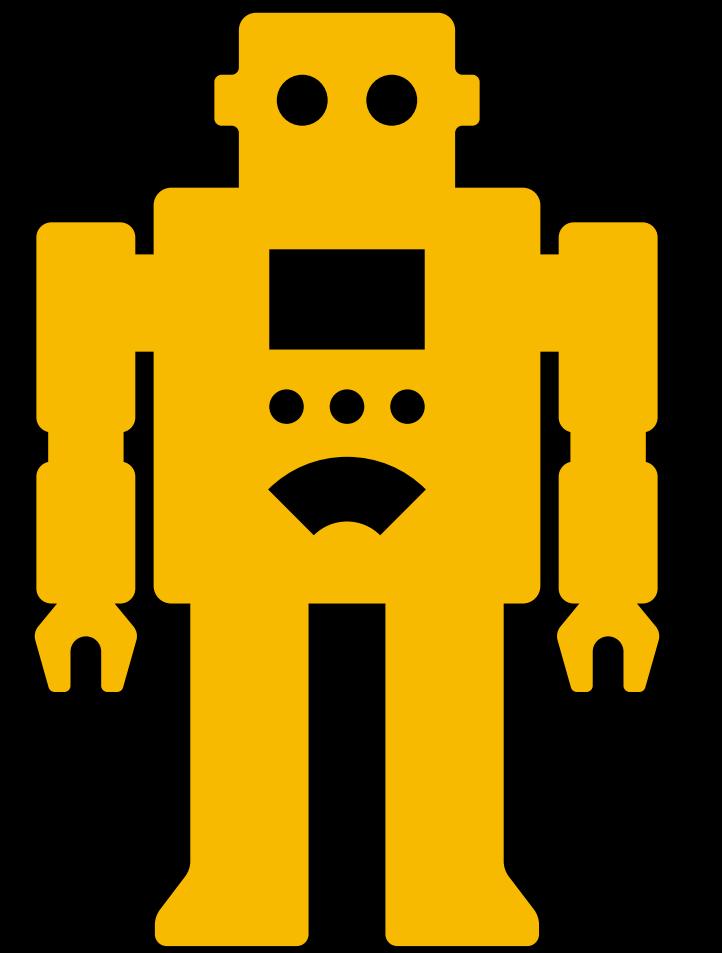


EITHER WAY
Costly
- unnecessary
expenses



PREDICTIVE MAINTENANCE

Idea



SENSORS

Measurements

- have several sensors measure vibrations on the key components of the forklift
- model which analyzes the data and tells us when the forklift needs to go into service

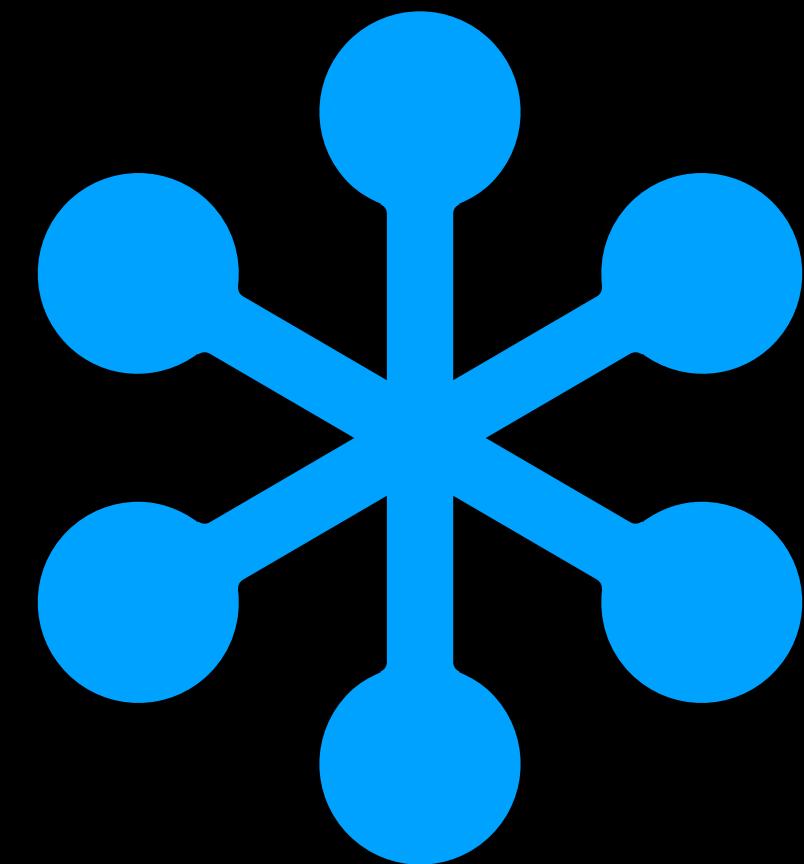
PREDICTIVE MAINTENANCE

Procedure



STEP #1

Data analysis



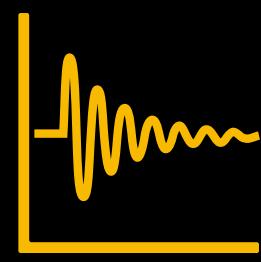
STEP #2

Modeling



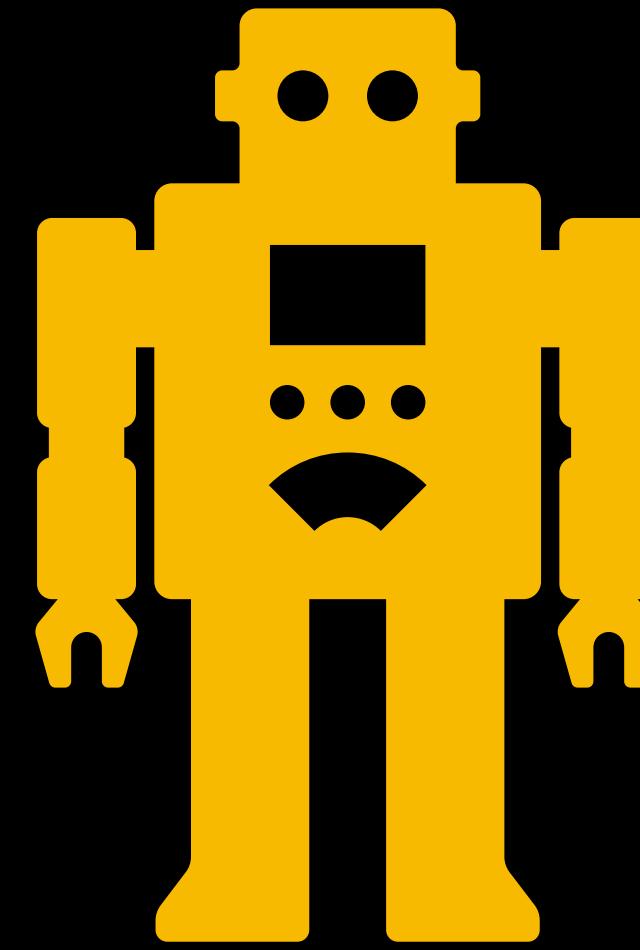
STEP #3

Evaluation



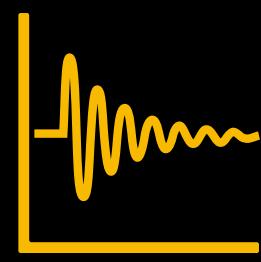
PREDICTIVE MAINTENANCE

Overview



SENSORS

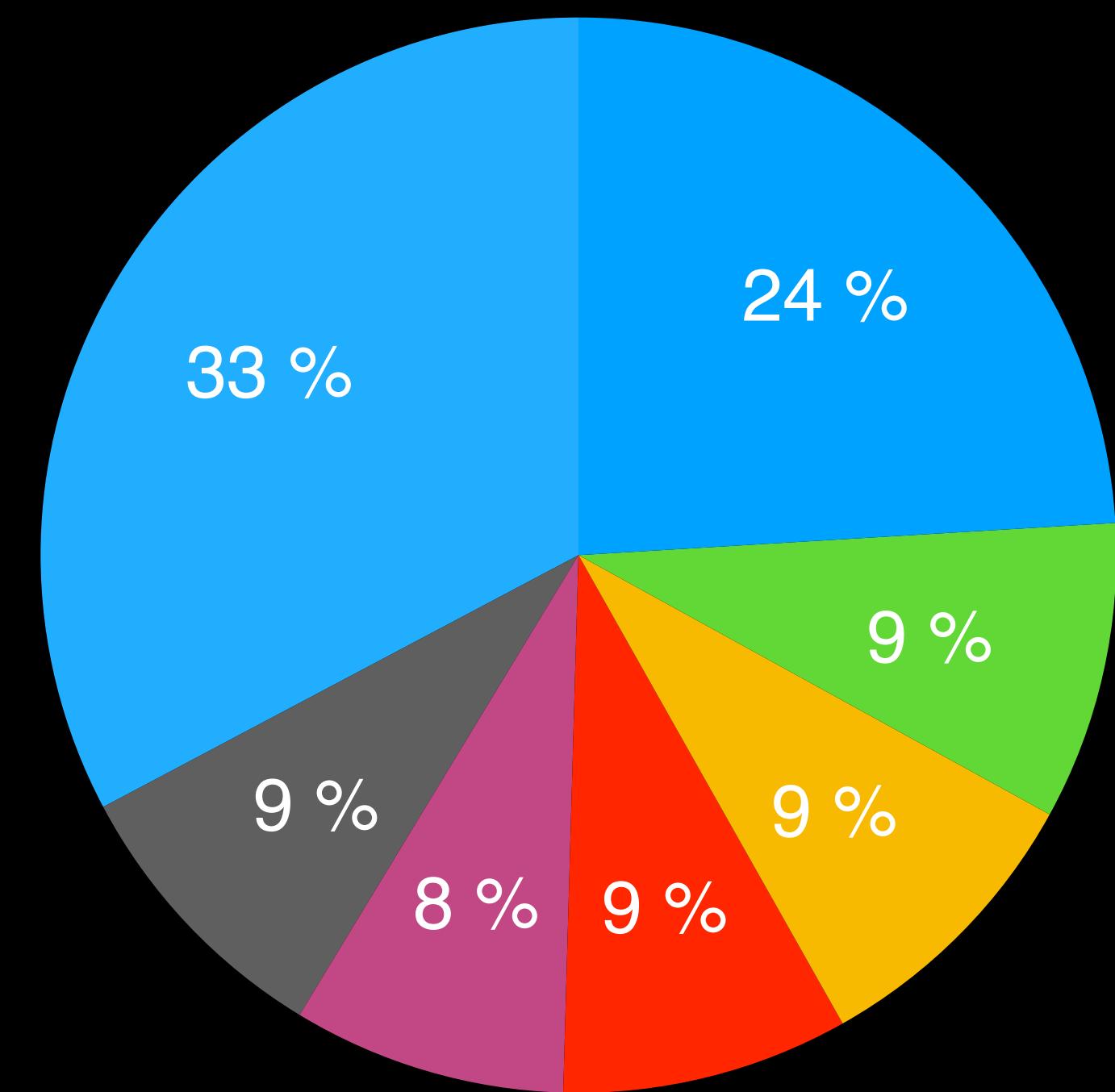
- Lifting motor
- Lifting gear
- Drive motor
- Drive gear
- Drive wheel
- Idle wheel

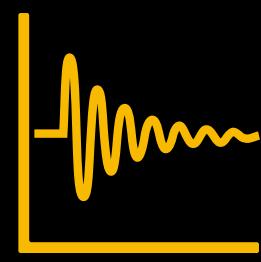


PREDICTIVE MAINTENANCE

Distribution of data points

● FL01 ● FL02 ● FL03 ● FL04 ● FL05
● FL06 ● FL07

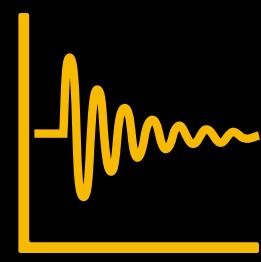




PREDICTIVE MAINTENANCE

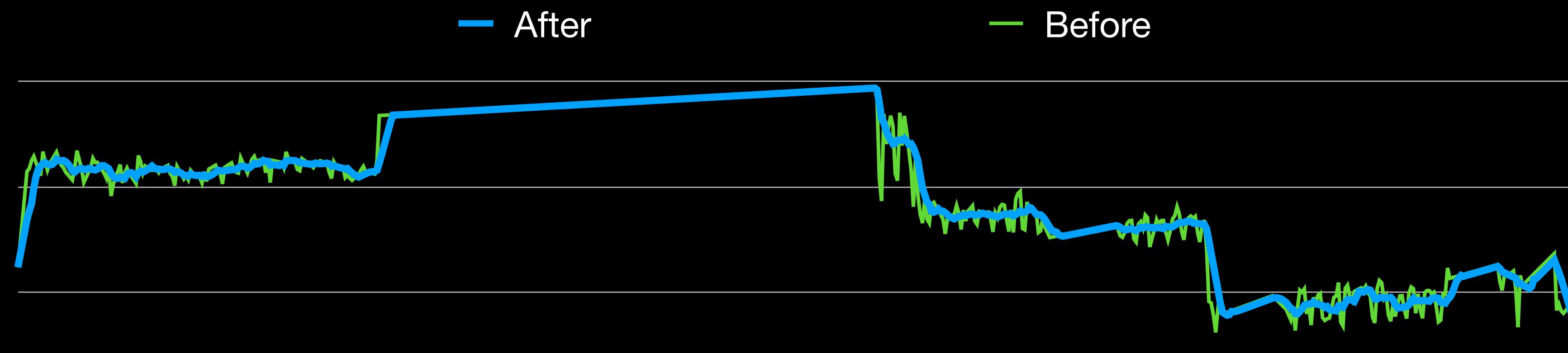
FL01 sensor graph





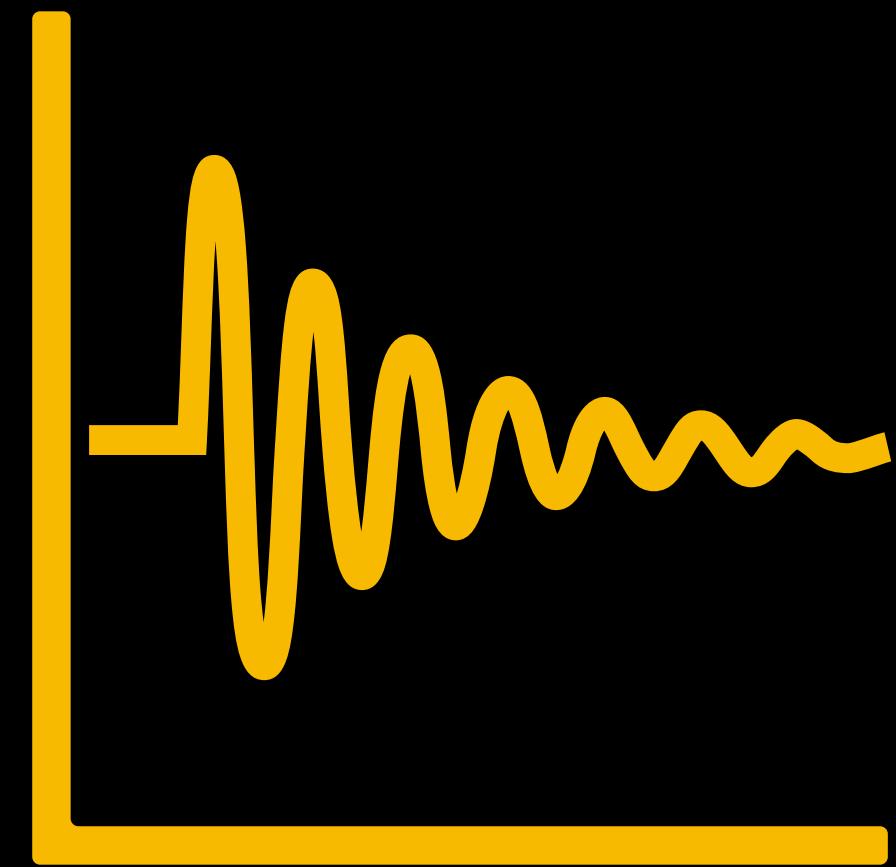
PREDICTIVE MAINTENANCE

Rolling mean transformation



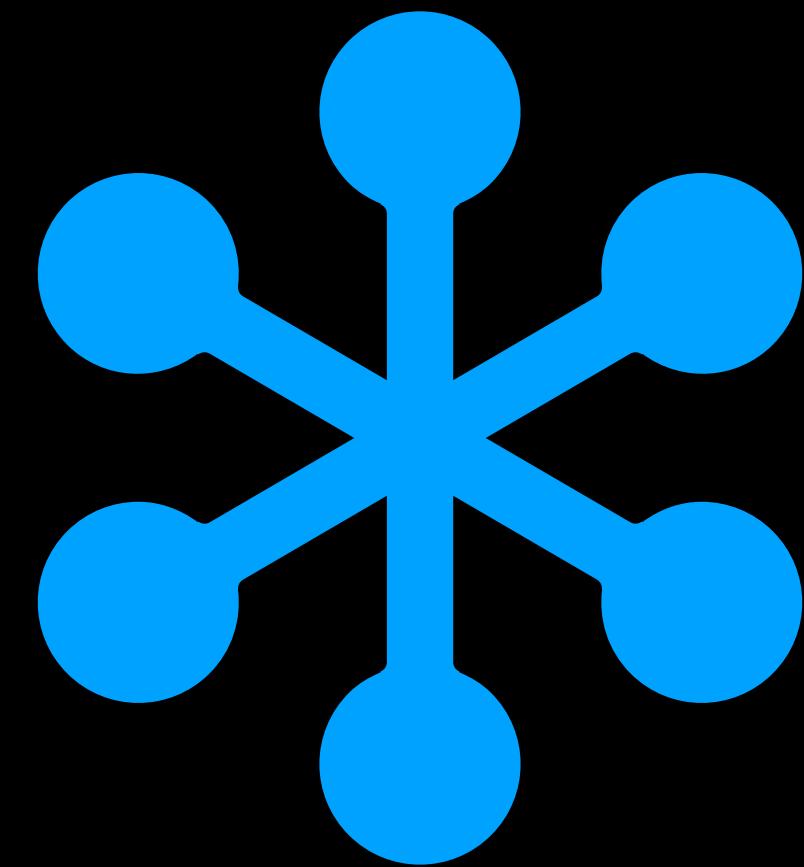
PREDICTIVE MAINTENANCE

Procedure



STEP #1

Data analysis



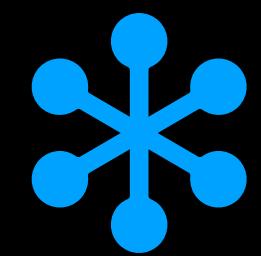
STEP #2

Modeling

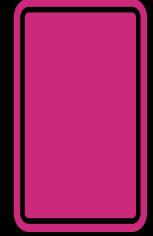


STEP #3

Evaluation



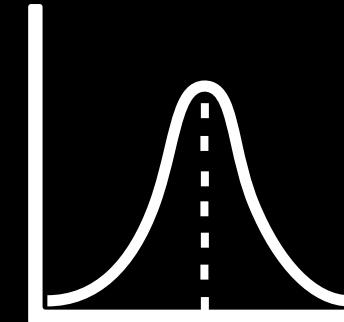
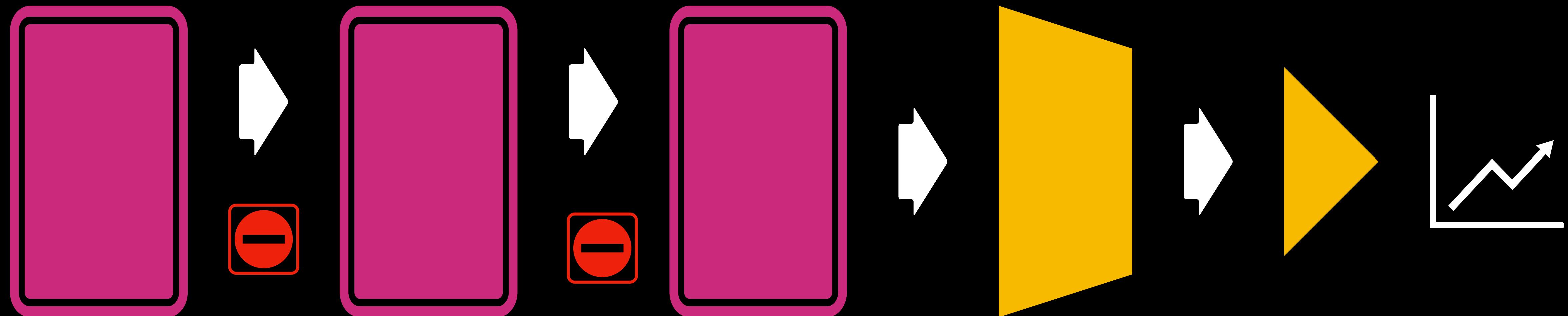
PREDICTIVE MAINTENANCE RNN



DROPOUT

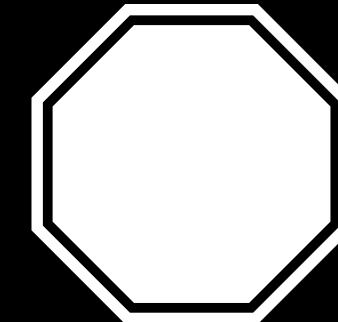
LSTM

DENSE



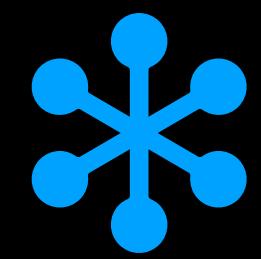
LOSS FUNCTION

Mean squared error



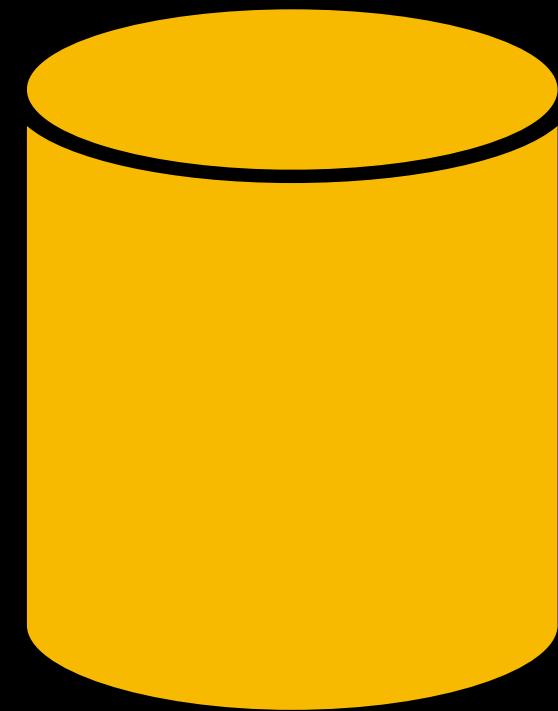
OPTIMIZER

Adam



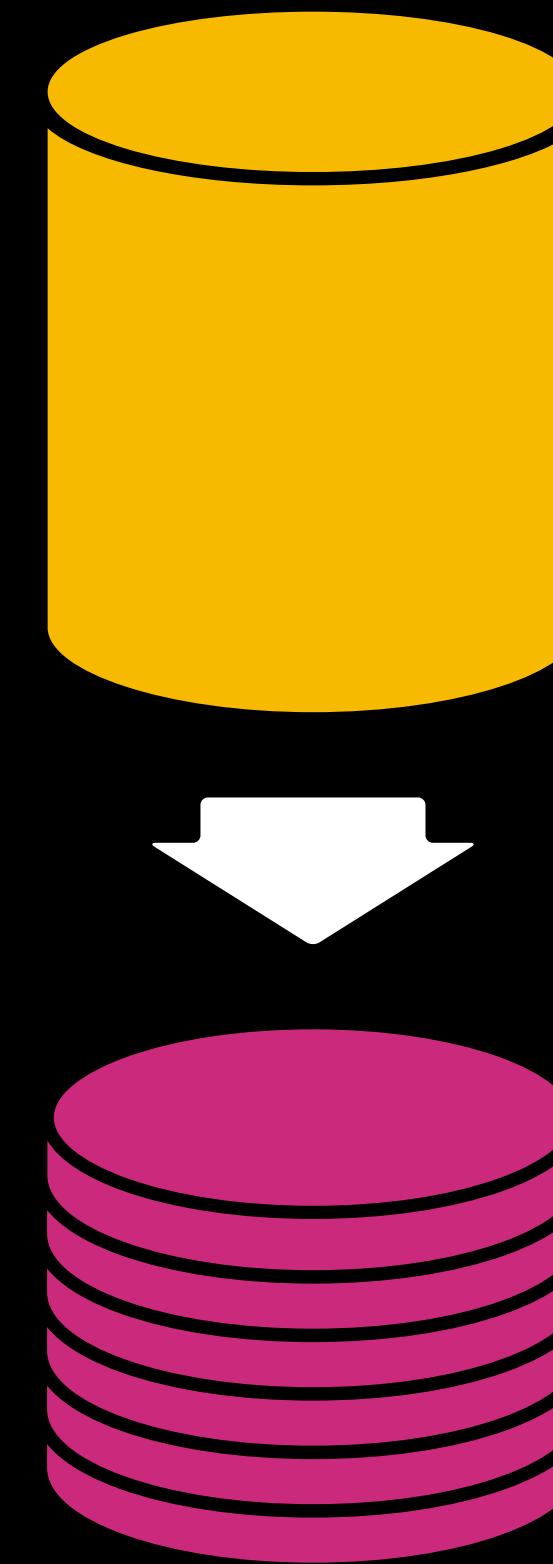
PREDICTIVE MAINTENANCE

Training paths



PATH #1

Per machine training

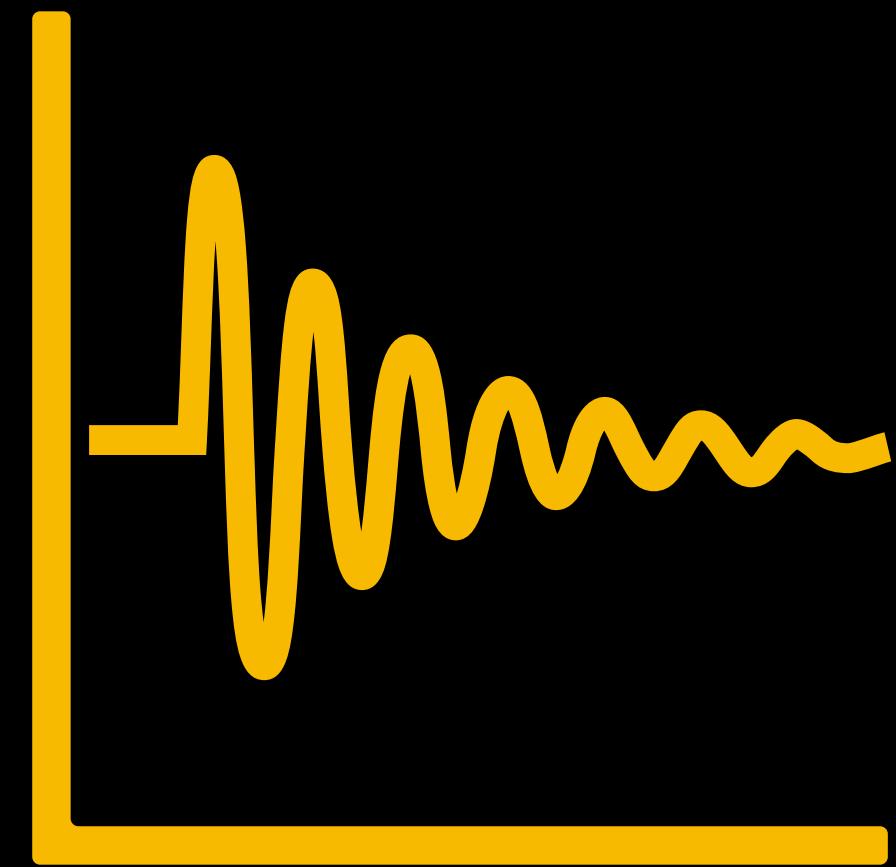


PATH #2

Transfer learning

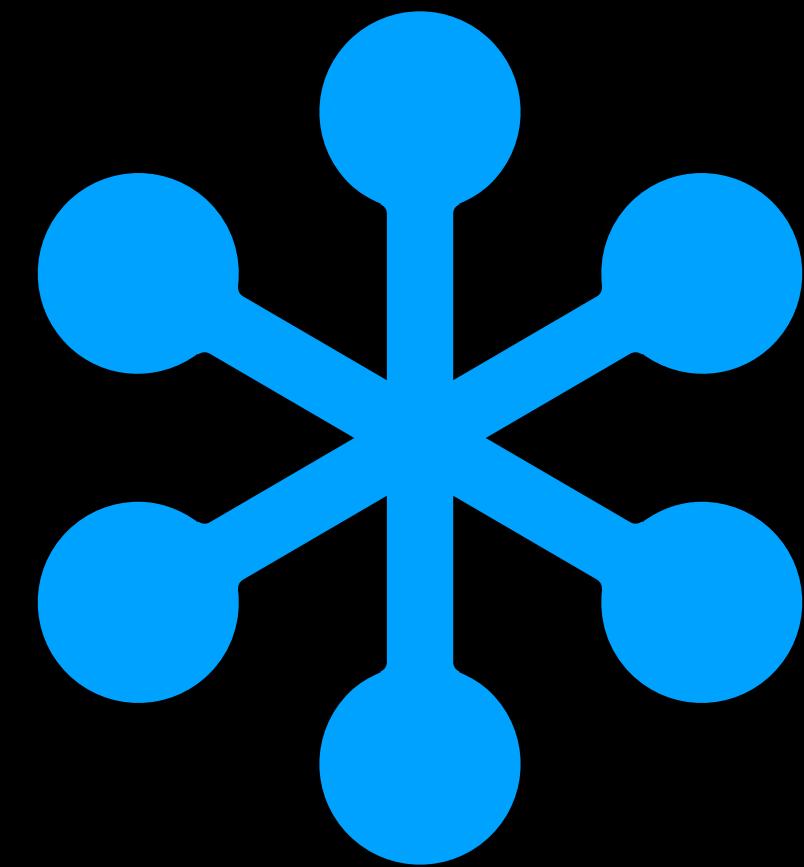
PREDICTIVE MAINTENANCE

Procedure



STEP #1

Data analysis



STEP #2

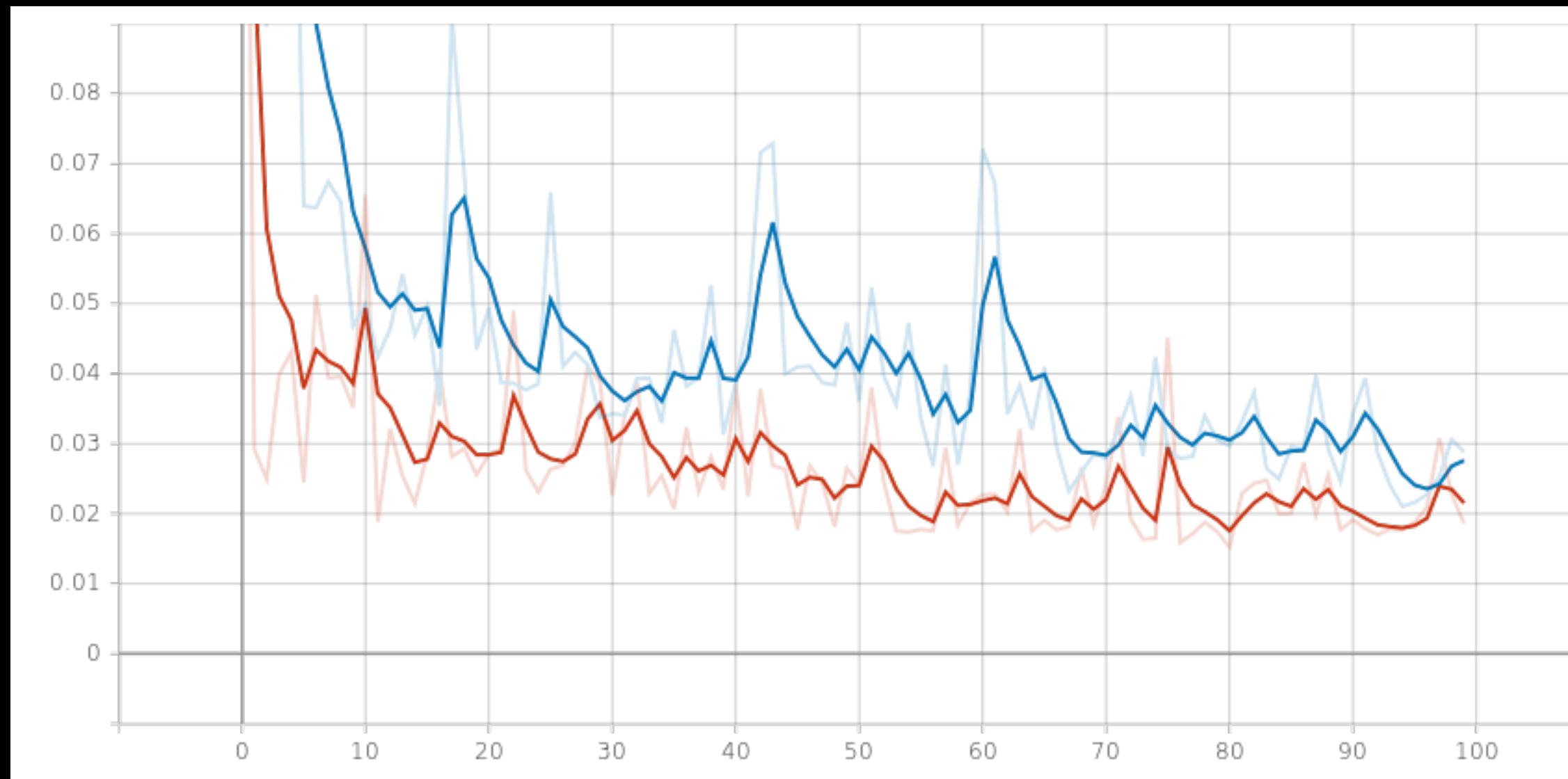
Modeling



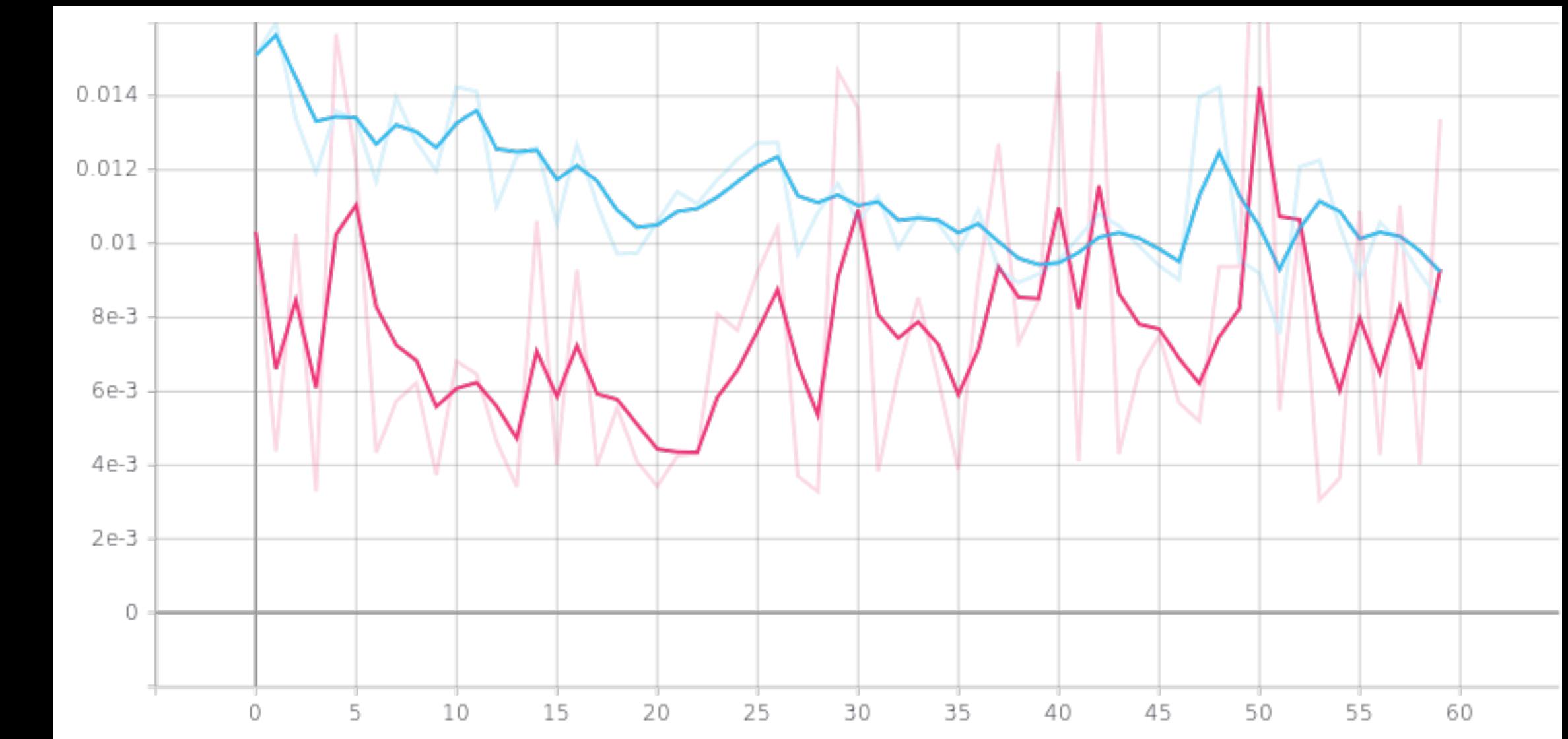
STEP #3

Evaluation

PREDICTIVE MAINTENANCE Performance



PATH #1
Per machine training

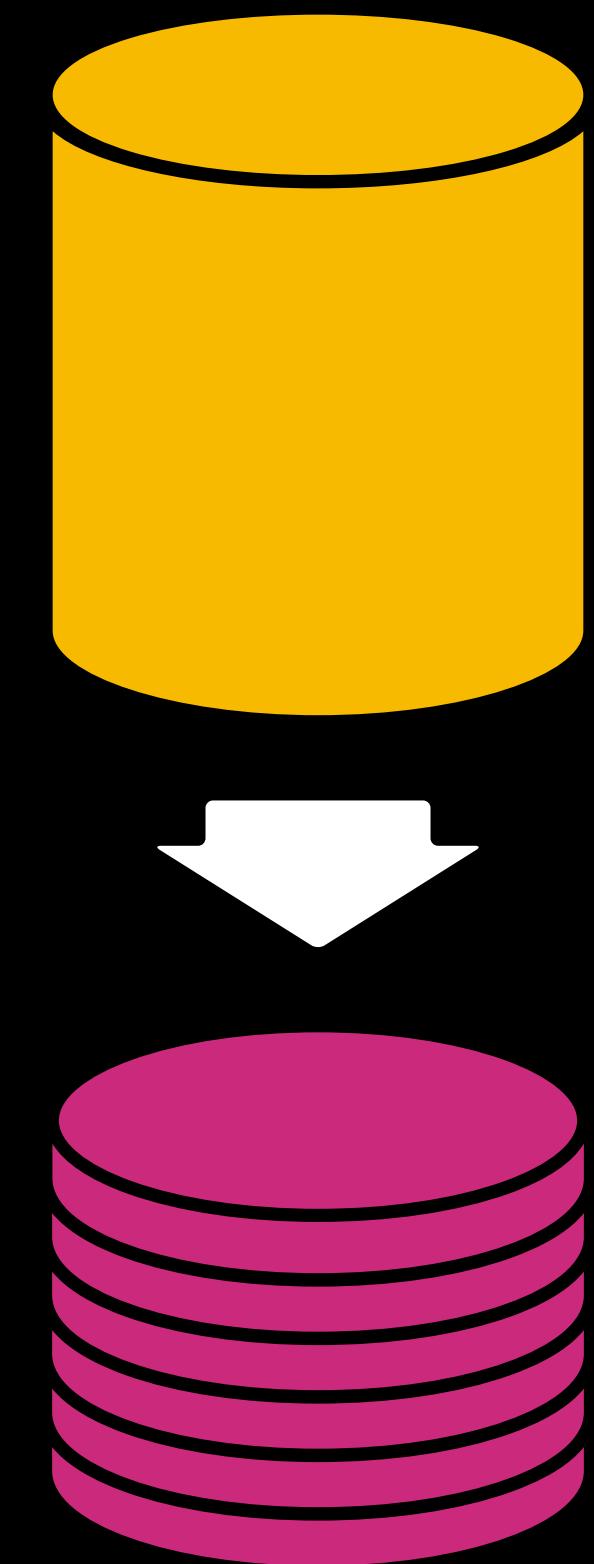


PATH #2
Transfer learning



PREDICTIVE MAINTENANCE

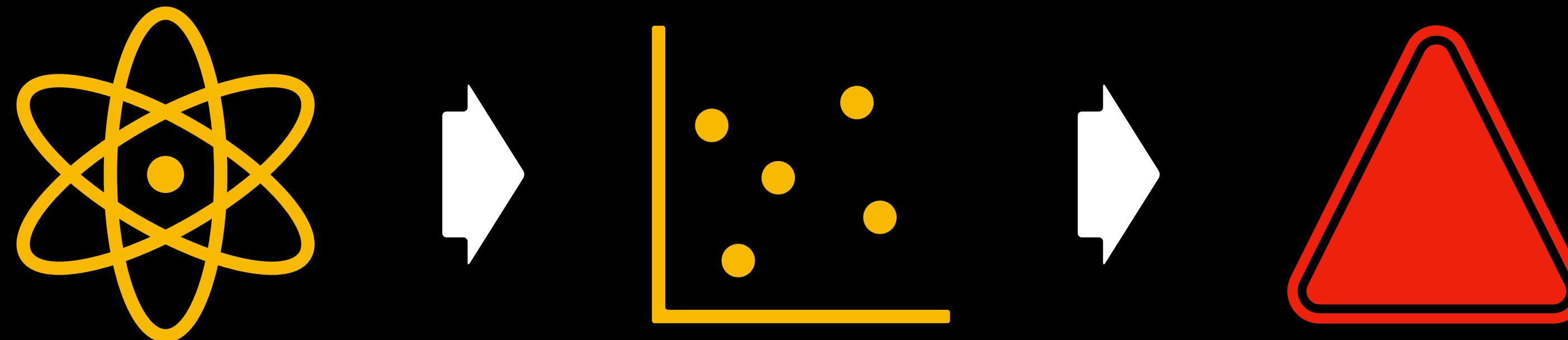
Approved model



PATH #2

Transfer learning

✓ PREDICTIVE MAINTENANCE Deployment



DEPLOYMENT

The prediction error is above threshold:

- **something is not behaving correctly**

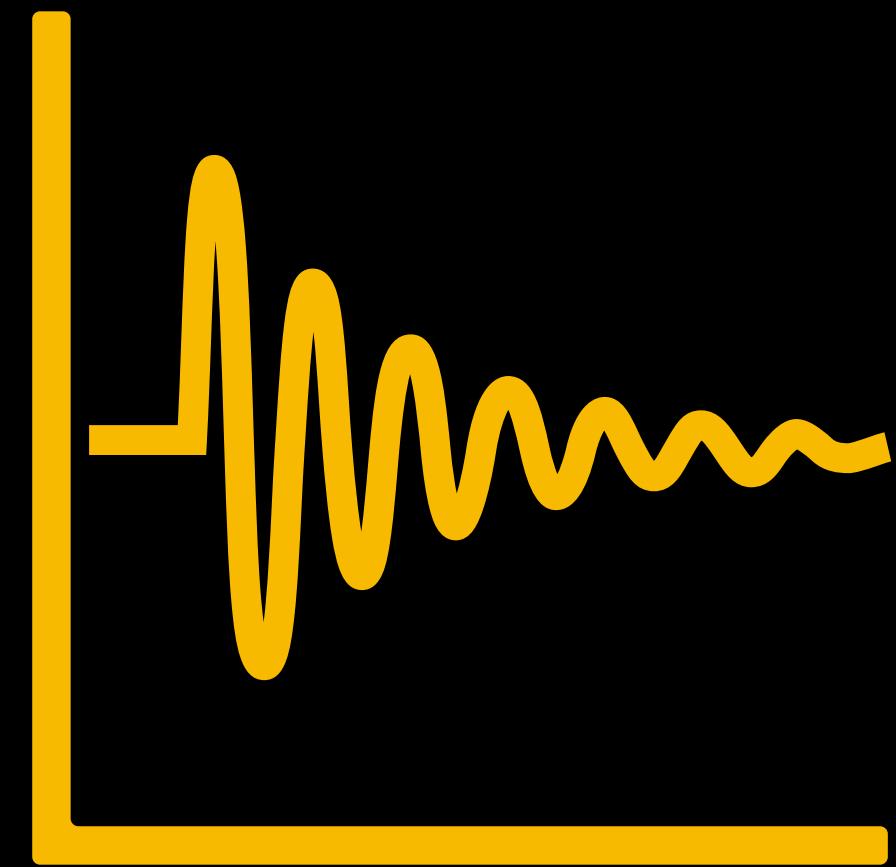
 PREDICTIVE MAINTENANCE
Deployment



TENSORFLOW LITE
Easy deployment on
IoT & Edge devices

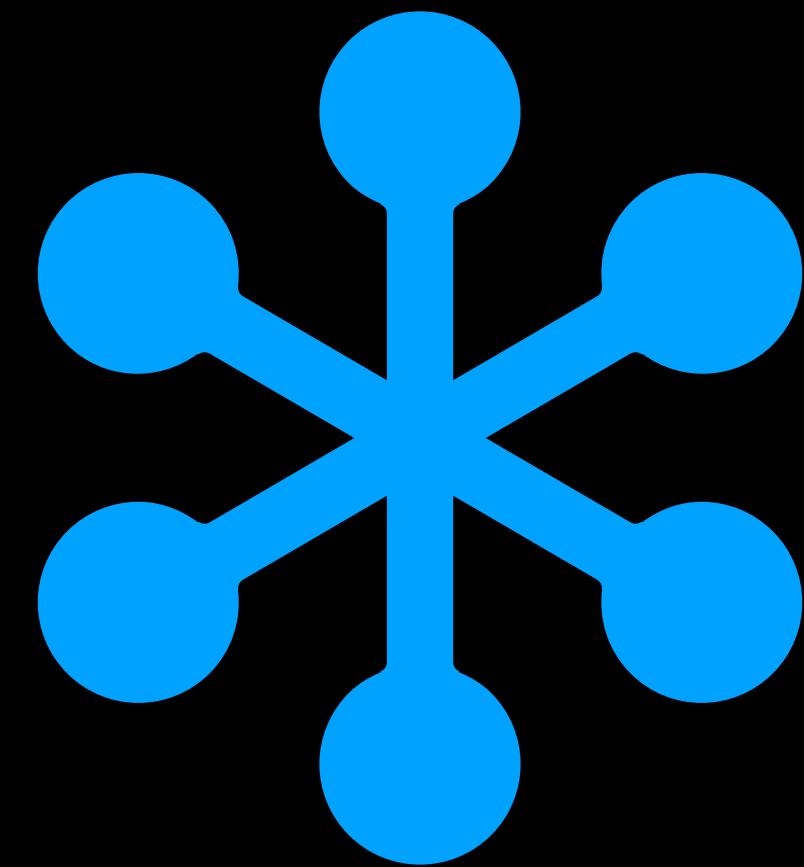
PREDICTIVE MAINTENANCE

Procedure



STEP #1

Data analysis



STEP #2

Modeling



STEP #3

Evaluation

“The alternative [to thinking ahead] would be to think backwards
... and that's just remembering.”

—Sheldon, the theoretical physicist on **The Big Bang Theory**

