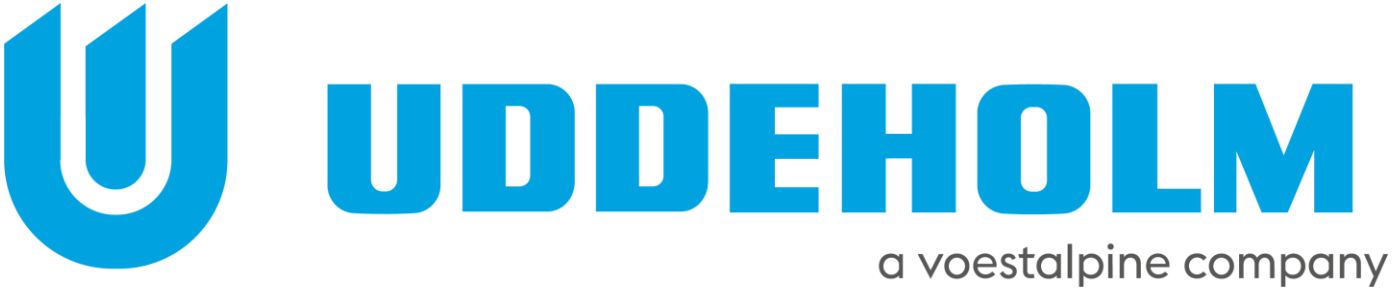

UDDEHOLM
a voestalpine company

#1 IN HIGH PERFORMANCE TOOL STEEL

HUMAN AI AT UDDEHOLM

INTRODUCTIONS

PERSONAL INTRODUCTION

- Erik Hallin – Gustavsfors, Sweden
- M.Sc. Informations System – Georgia State University
- Data Scientist at Uddeholm
  - Digitalization group
- Specializing in machine learning and statistical analysis
  - Predictive maintenance
  - Forecasting
  - Root cause analysis

UDDEHOLMS AB

- Founded in 1668 – located in Hagfors
- 3,000 employees worldwide
- World’s leading manufacturer of high performance steel
- Part of Voestalpine organisation

Industry 4.0 at Uddeholm

IIoT

Cloud Computing

Machine Learning

Robotics

Virtual/Augmented Reality

Additive Manufacturing

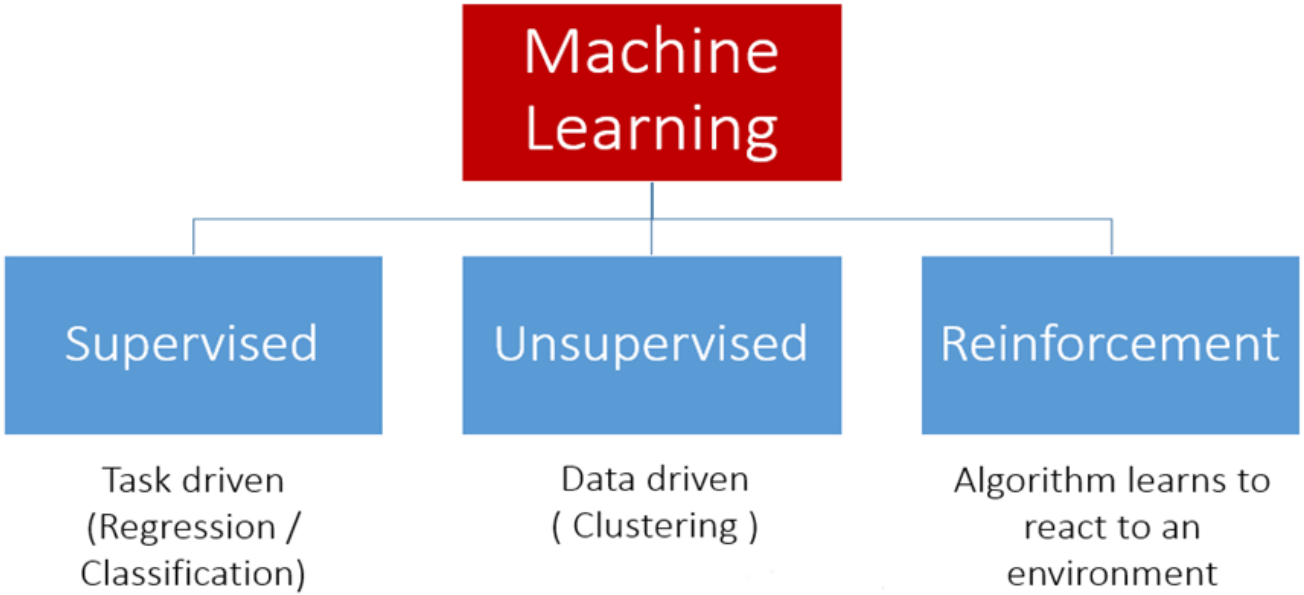
AI – MACHINE LEARNING

MACHINE LEARNING

Machine learning (ML) is a core branch of AI that aims to give computers the ability to learn without being explicitly programmed (Samuel, 2000).

TRADITIONAL PROGRAMMING VS. MACHINE LEARNING

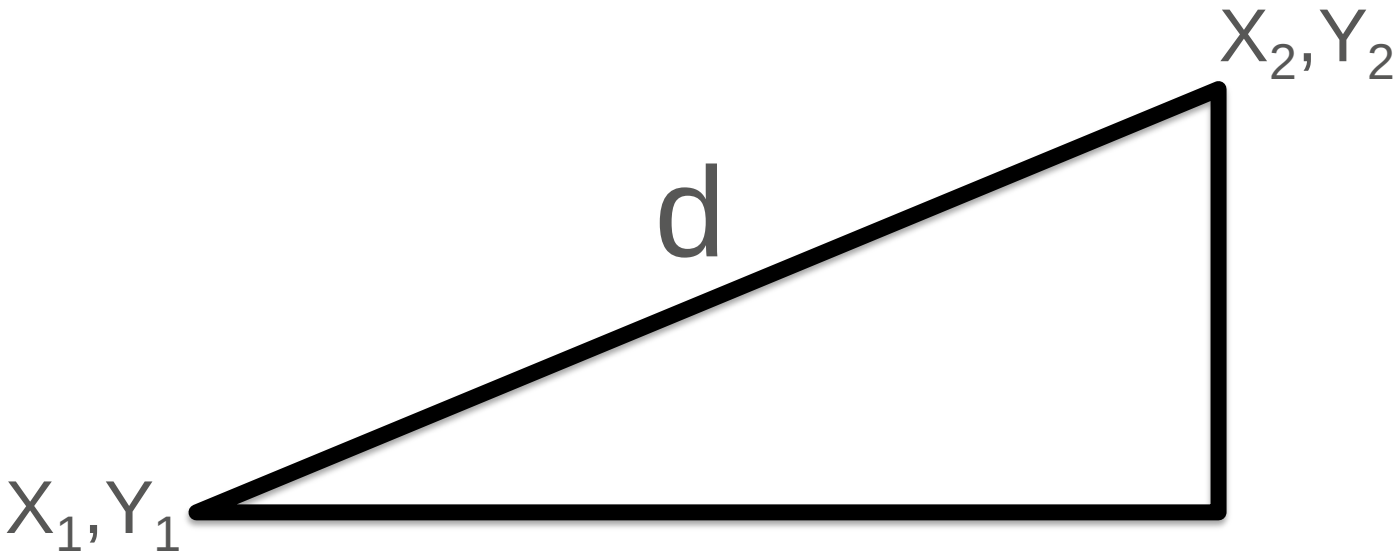
Types of Machine Learning



THE MOST BASIC MACHINE LEARNING ALGORITHMS

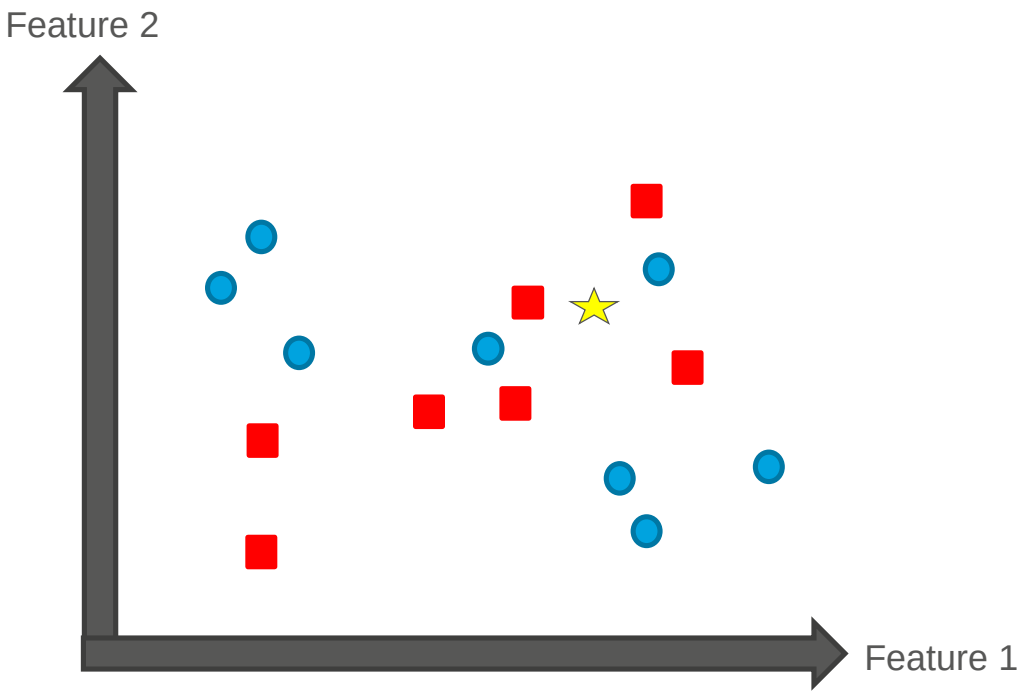
- K-Nearest Neighbor
- Linear Regression
- Logistic Regression
- Support Vector Machines
- CART (Classification And Regression Trees)
- Naive Bayes Classification
- Ensemble-Algorithms

EUCLIDEAN DISTANCE

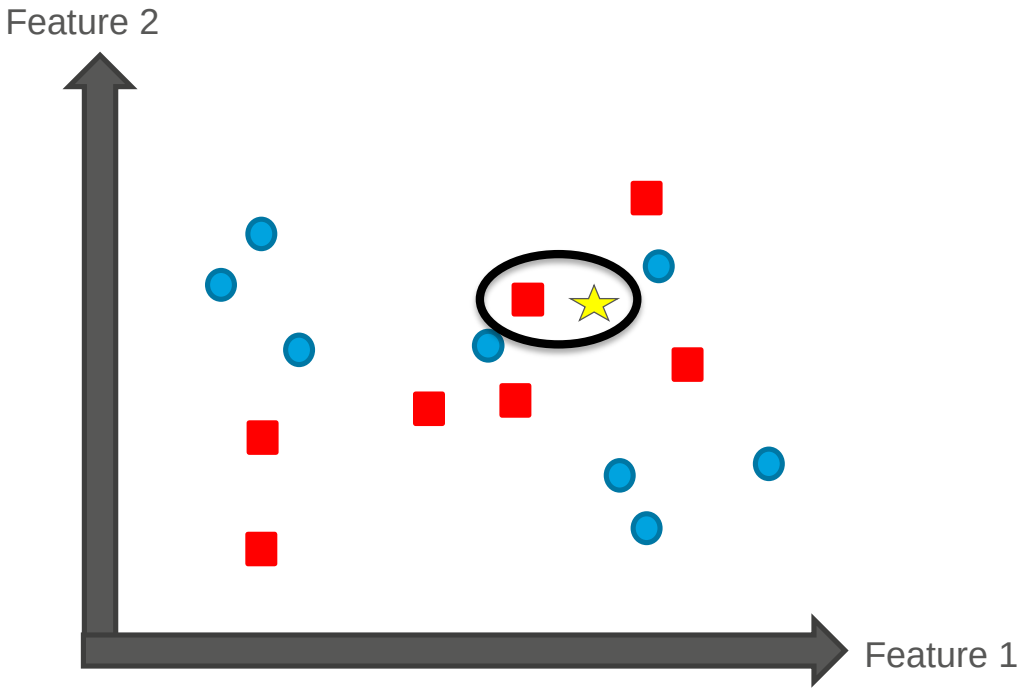


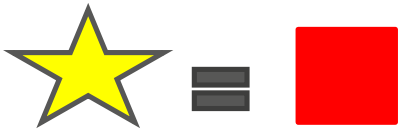
$$d = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2}$$

K-NEAREST NEIGHBOR



K-NEAREST NEIGHBOR

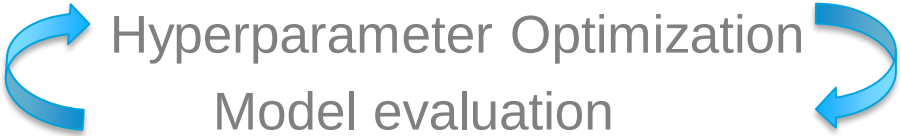




MACHINE LEARNING WORKFLOW

STEPS OF CREATING A ML-MODEL

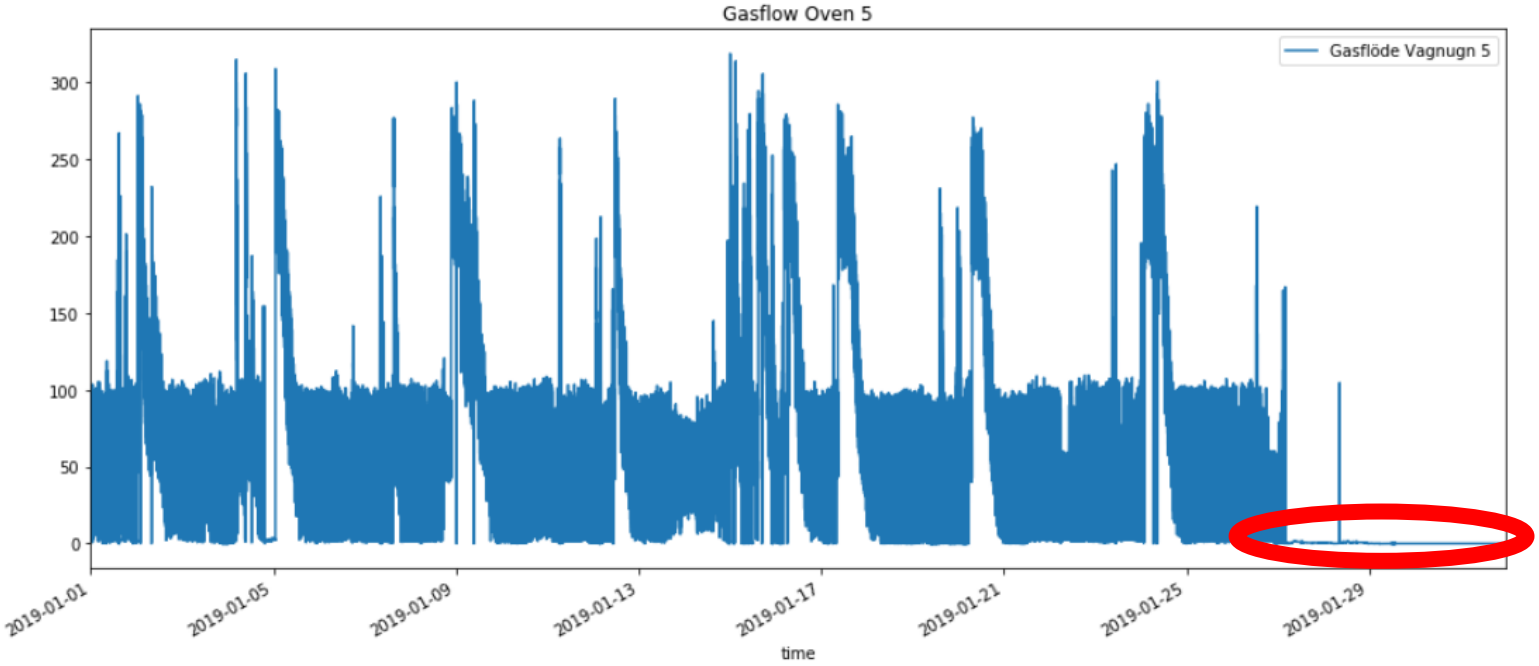
- Clean data
- Visualization
- Feature engineering
- Splitting data



CLEANING DATA

- Handling missing values
  - Replacing vs. removing
- Detecting and handling erroneous values
  - Outlier or error
- Dealing with categorical data and strings
  - Spelling, etc.

DATA VISUALIZATION



FEATURE ENGINEERING

ENGINEERING NEW FEATURES FROM EXISTING DATA TO BOOST THE PERFORMANCE OF A MACHINE LEARNING ALGORITHM

Original Data Table

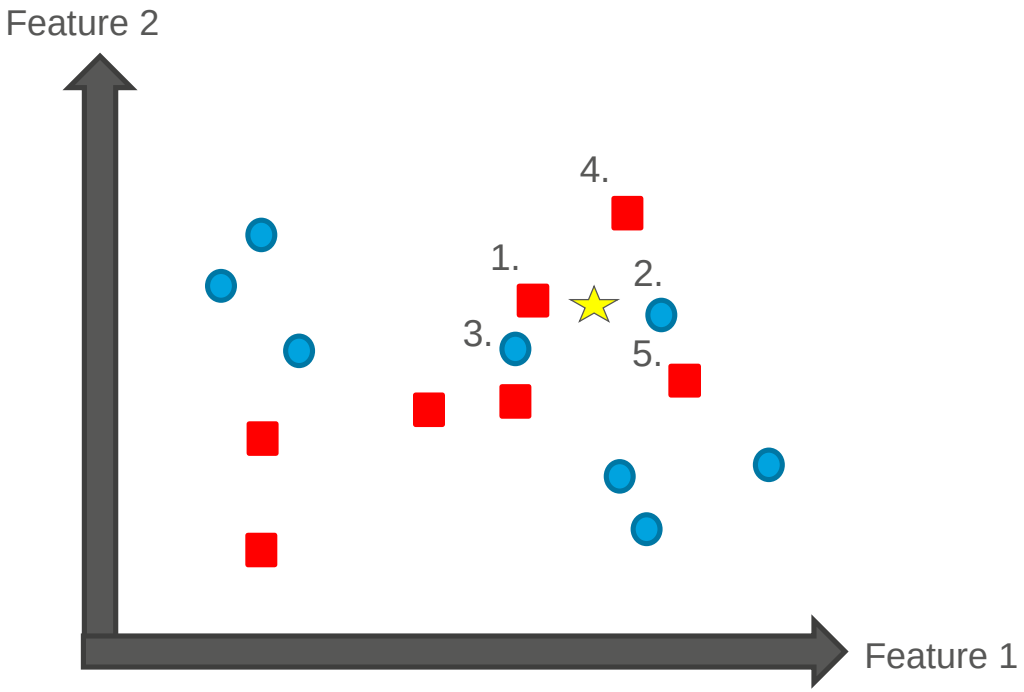
Datetime	Gasflow
2019-01-01 00:00:02	45.60490
2019-01-01 00:00:12	61.21000
2019-01-01 00:00:22	71.27930
2019-01-01 00:00:32	55.77920
2019-01-01 00:00:42	65.02780
2019-01-01 00:00:52	57.27110
2019-01-01 00:01:02	55.83460
2019-01-01 00:00:02	45.60490

Feature Engineered Table

Datetime	Gasflow	Ratio Difference
2019-01-01 00:00:02	45.6049	NaN
2019-01-01 00:00:12	61.2100	1.342180
2019-01-01 00:00:22	71.2793	1.164504
2019-01-01 00:00:32	55.7792	0.782544
2019-01-01 00:00:42	65.0278	1.165807
2019-01-01 00:00:52	57.2711	0.880717
2019-01-01 00:01:02	55.8346	0.974918

SPLITTING OUR DATA

HYPERPARAMETER OPTIMIZATION: KNN



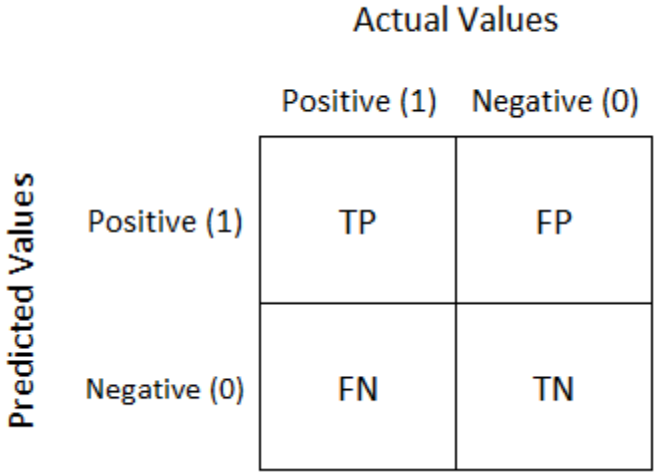
K	Prediction
1	■
2	■
3	●
4	■
5	■

Weighted voting?

MODEL EVALUATION

$$Accuracy = \frac{Total\ Correct\ Predictions}{Total\ Predictions}$$

MODEL EVALUATION CONT.



$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TP}{TP + FN}$$

UDDEHOLM
a voestalpine company

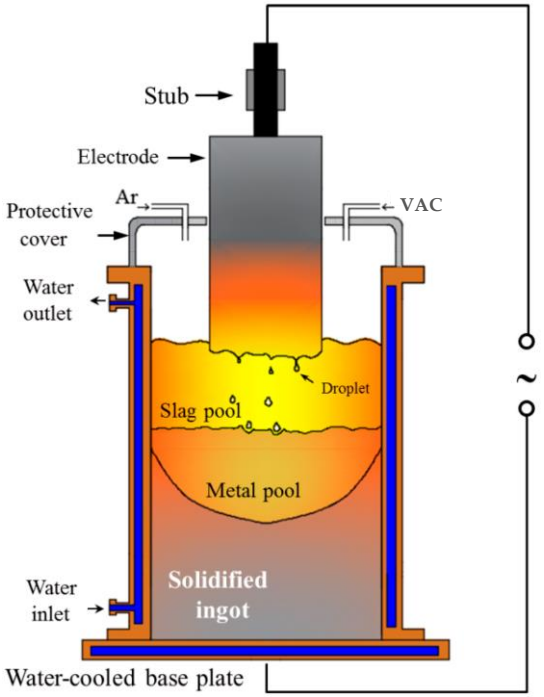
MACHINE LEARNING FRAMEWORKS

UDDEHOLM
a voestalpine company

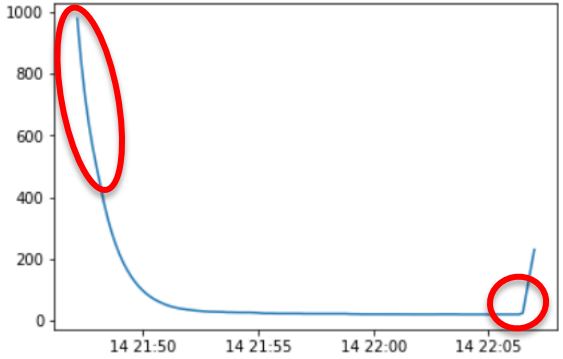
THE NEVER-ENDING BATTLE

USE CASES AT UDDEHOLM

BUSINESS CASE: ESR

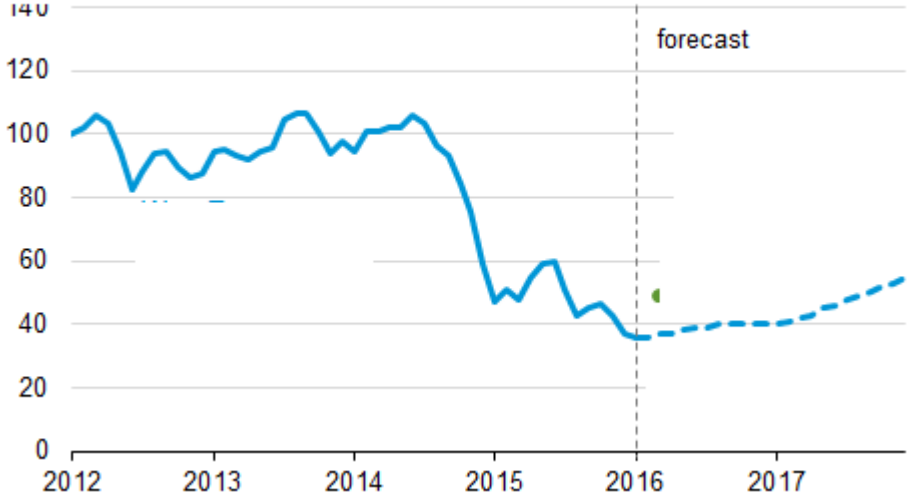


VACUUM PREDICTIONS

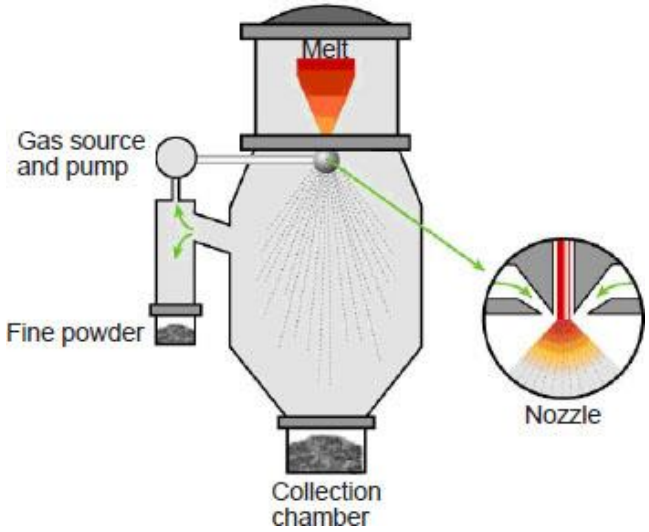


- Features extracted from curve's first 60sec
- Classification model using random forest classifier
  - Predicting above/under 20 mbar vacuum pressure within 20 min.

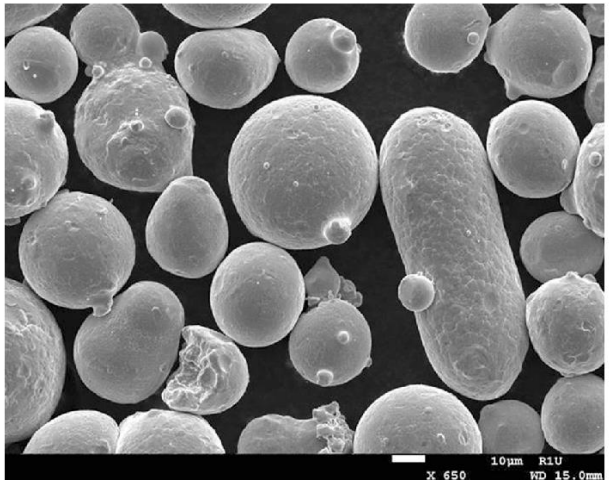
BUSINESS CASE: SALES FORECAST



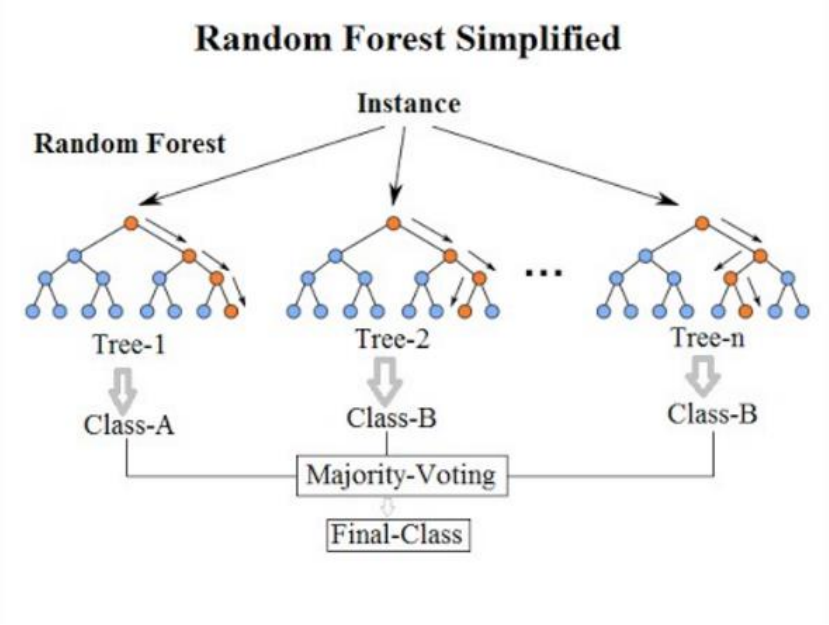
BUSINESS CASE: AM POWDER ANALYSIS

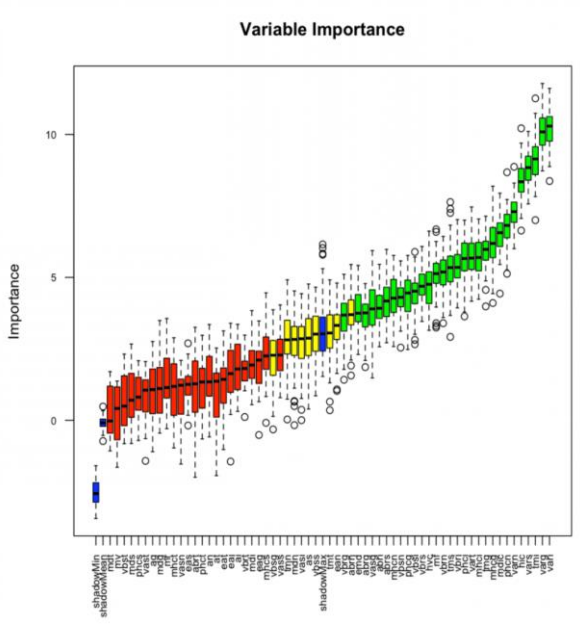


BUSINESS CASE: AM POWDER ANALYSIS



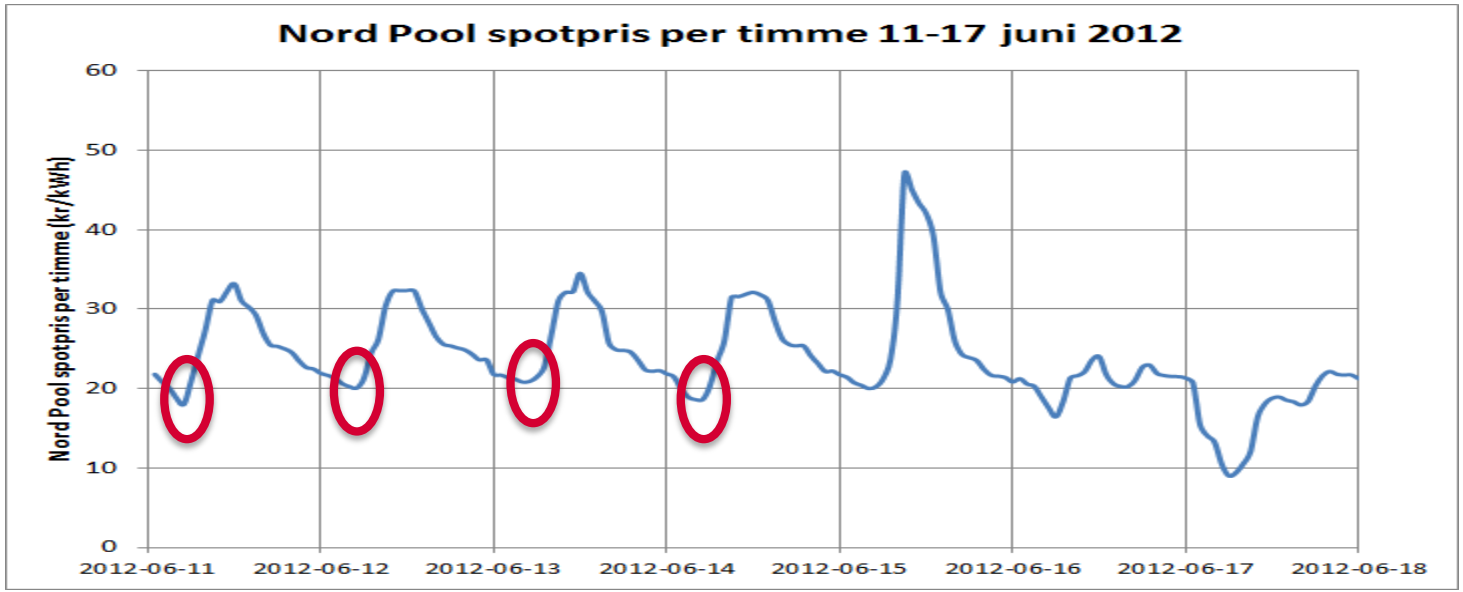
REVERSE ENGINEER MODEL



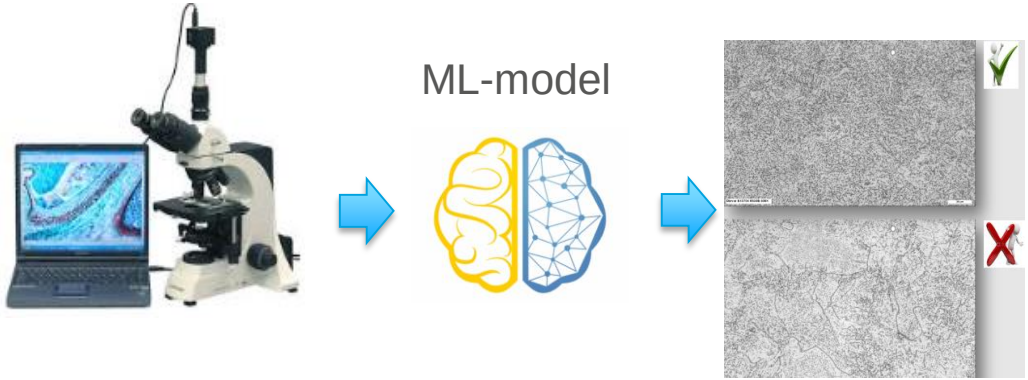


FUTURE PROJECTS

UPCOMING PROJECTS: ENERGY PRICE FORECASTS



UMPCOMING PROJECTS: MICROSCOPE IMAGERY CLASSIFICATION



UPCOMING PROJECTS: BUSINESS MODEL INNOVATION

QUESTIONS?