AI Sense - Igor Isaev & Hazel Wat

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We are implementing machine learning for detecting different scents.

Supervised machine learning & Classification problem

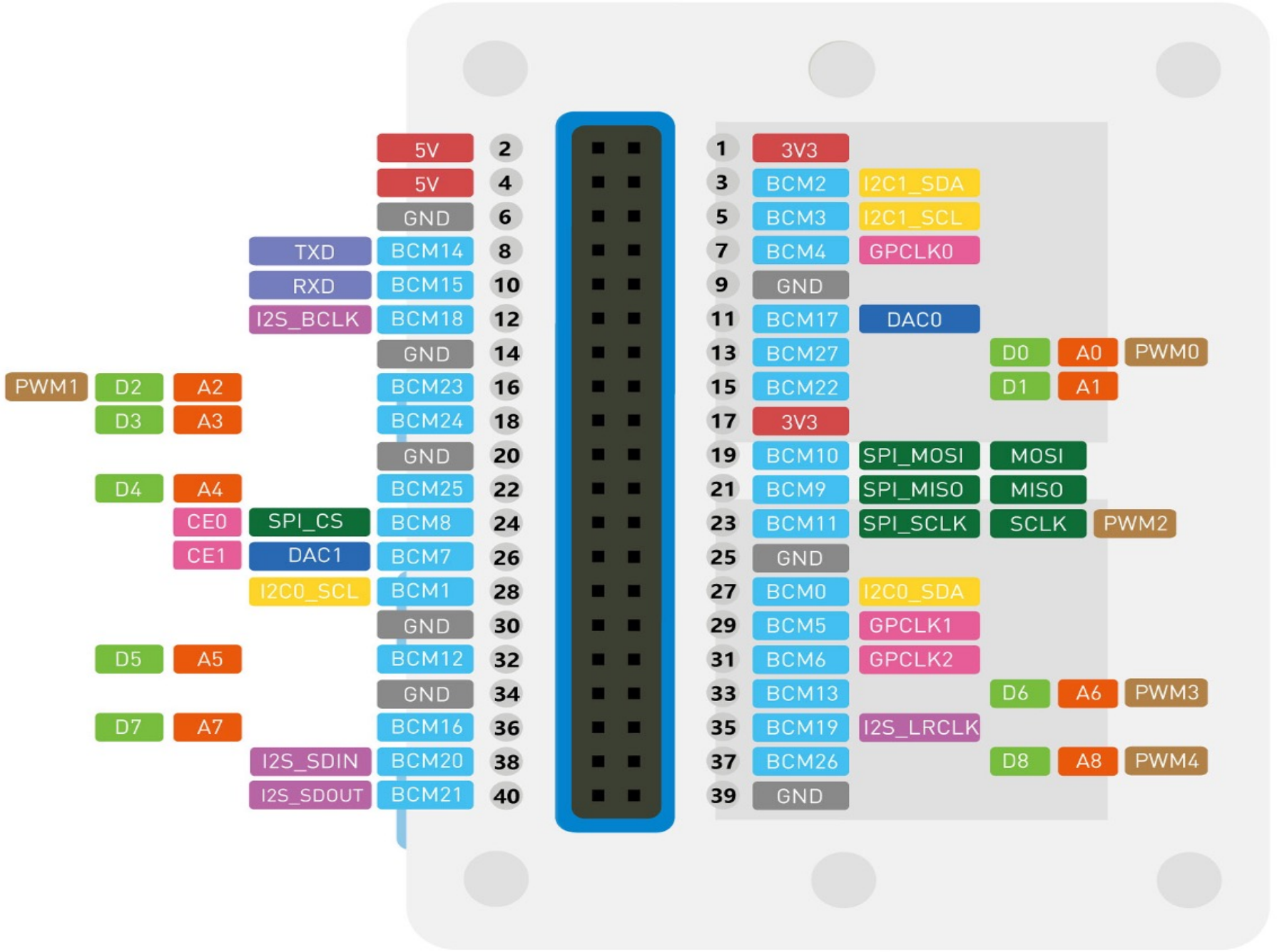
Following tasks are done:

- Data collection
- Data analyse and transformation
- Define number of classes to be predicted
- Defining the most suitable machine learning models
- Training
- Experiment
- Final prototype for common applications

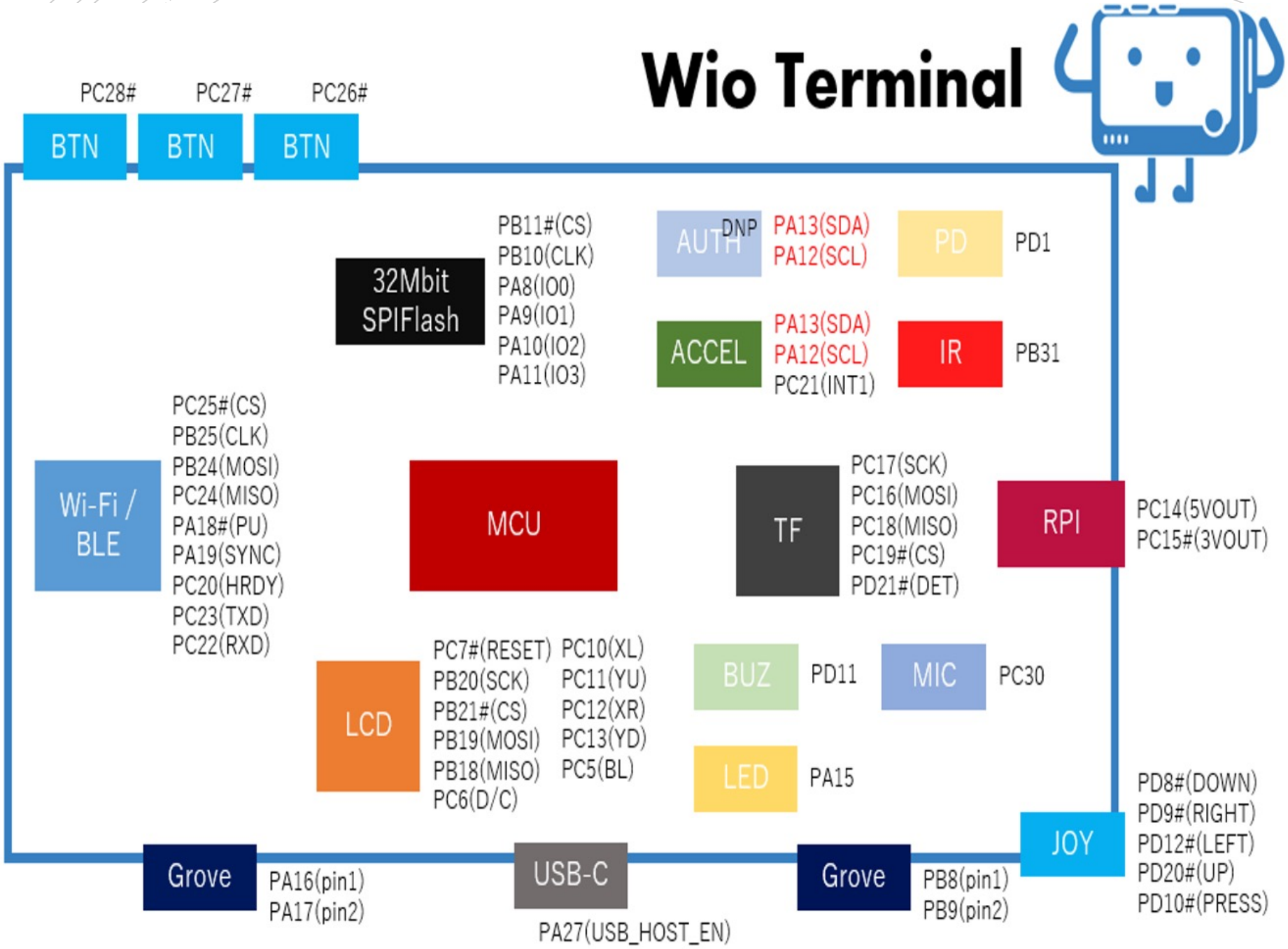
4 Elements to be collected:

- Nitrogen dioxide (NO_2)
- Ethyl alcohol (C_2H_5OH)
- Volatile organic compounds (VOCs)
- Carbon monoxide (CO)

Pinout Diagram



Pinout Overview



Possible use case:

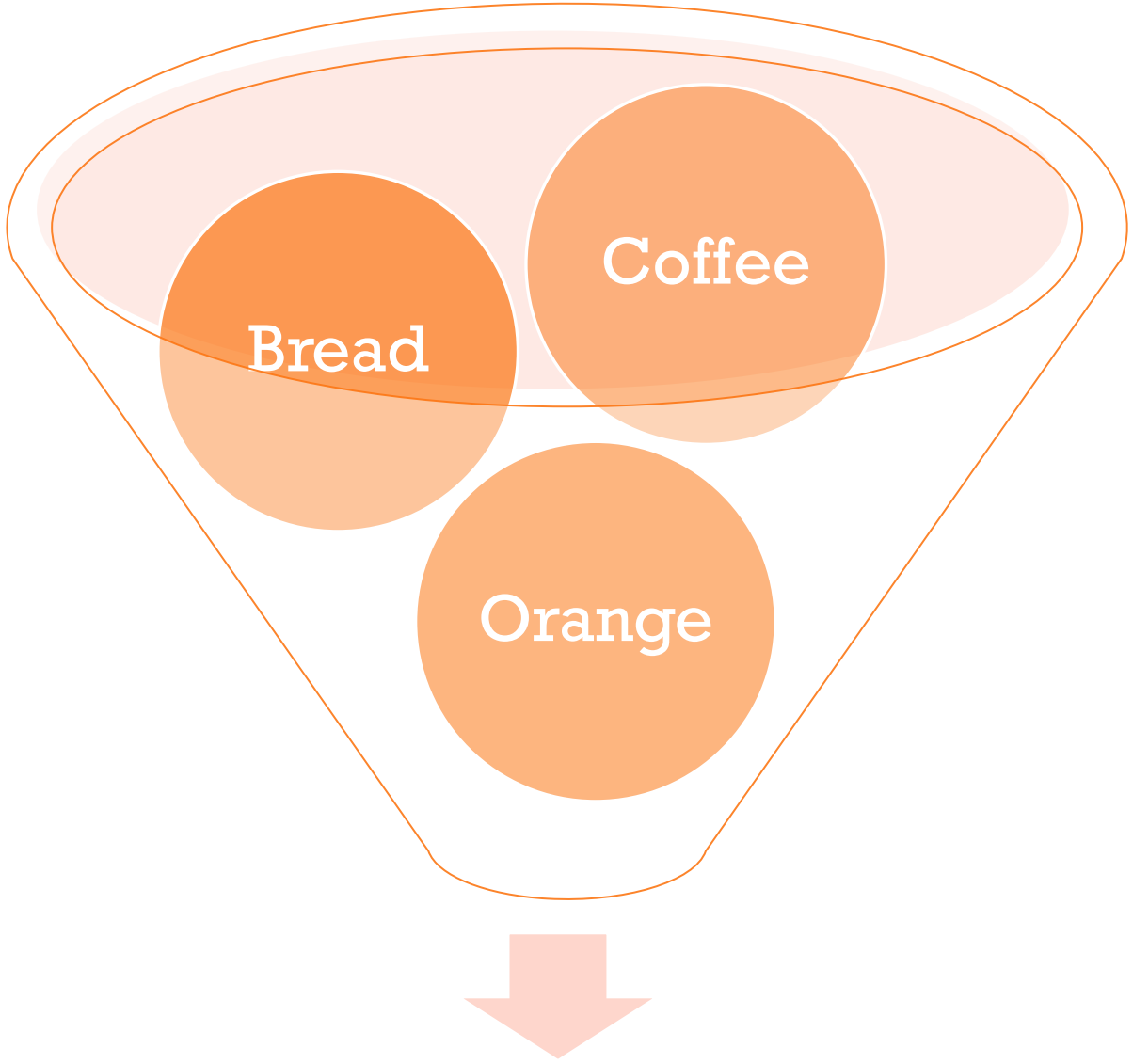
- Anosmia (loss of the sense of smell) is a "neglected disease" which concerns 2% of the global population. The number has significantly increased due to COVID.
- Smart Kitchen: Up to 50 Consumer Electronics & Home Appliance application. Products differentiations can be achieved by Smart-Phones' apps
- Health check: Morning: blow into the sensor (watch).
  - E.g. Your diabetic level is not so good today
  - E.g. Your oxygen level is not good. Pre-detect Pneumonia / Bronchitis
  - You are highly stressed
- Water cleanliness check: In Germany, Calcium (kalt) is built up on water from tap and if it is not filtered, it is accumulated and affects the taste of tea to be produced.

More possible use case:

- Cleaning company: Instead of having janitor that goes to clean the office area once per day regularly, he/she will clean unnecessarily. Clean the necessary area instead.
- Best Coffee: Helping coffee makers refine the perfect cup. Past difficulties: Extreme difficult to characterise coffee powder e.g. How to identify the qualify before it is brewed?
- Automobile: Sniffing out fuel leaks and engine problems in cars before it poses serious threat
- Spoiled food: A sensor in fridge, e.g. COVID patience who lost taste bud. Binding odor molecules to biosensors. e.g., bad smell, rotten food, spoiled milk
- Burger flipping robot - additional quality checking on top of AI technology

Procedure:

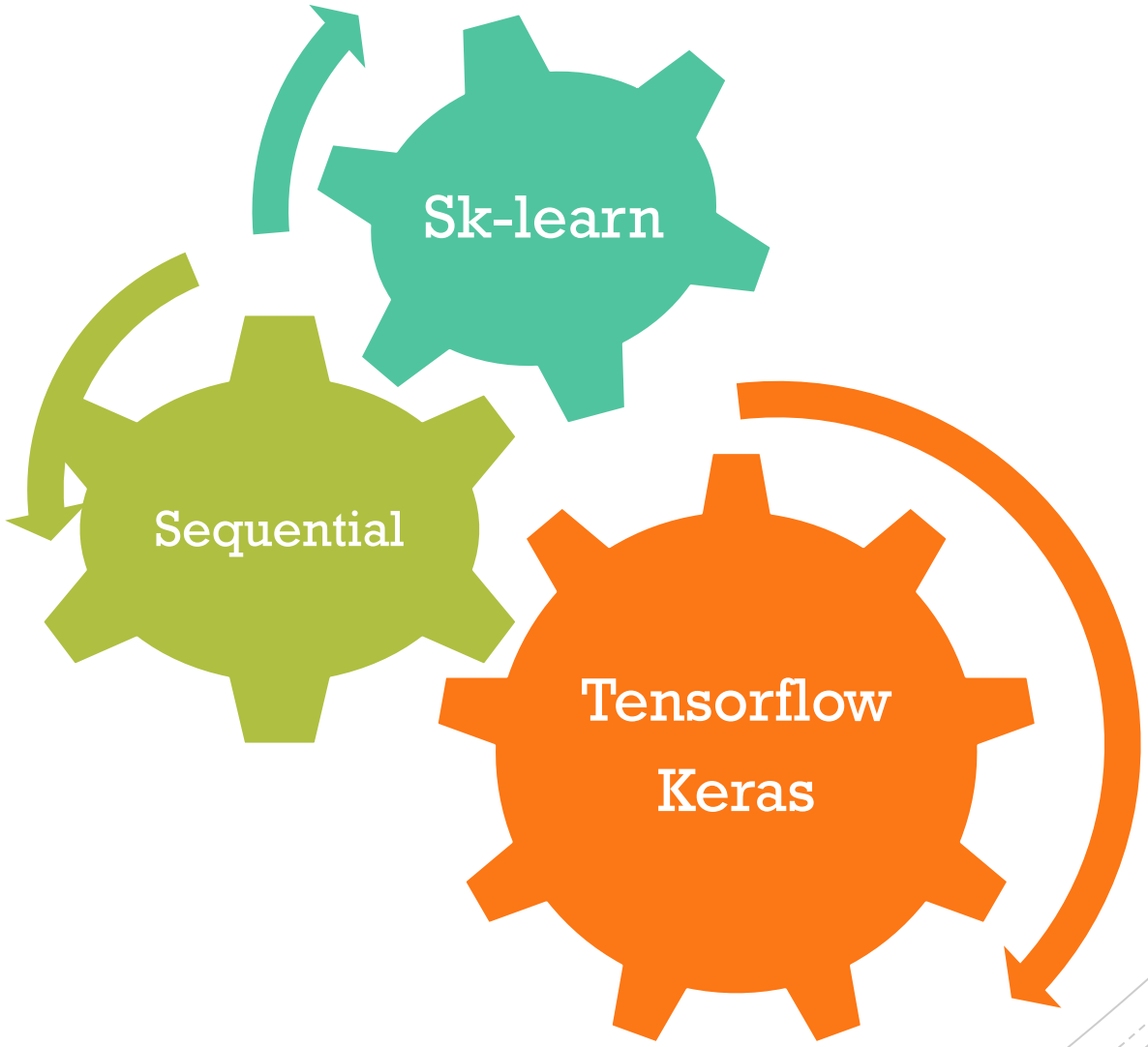
Acquiring data



Smelling mode

Design the model

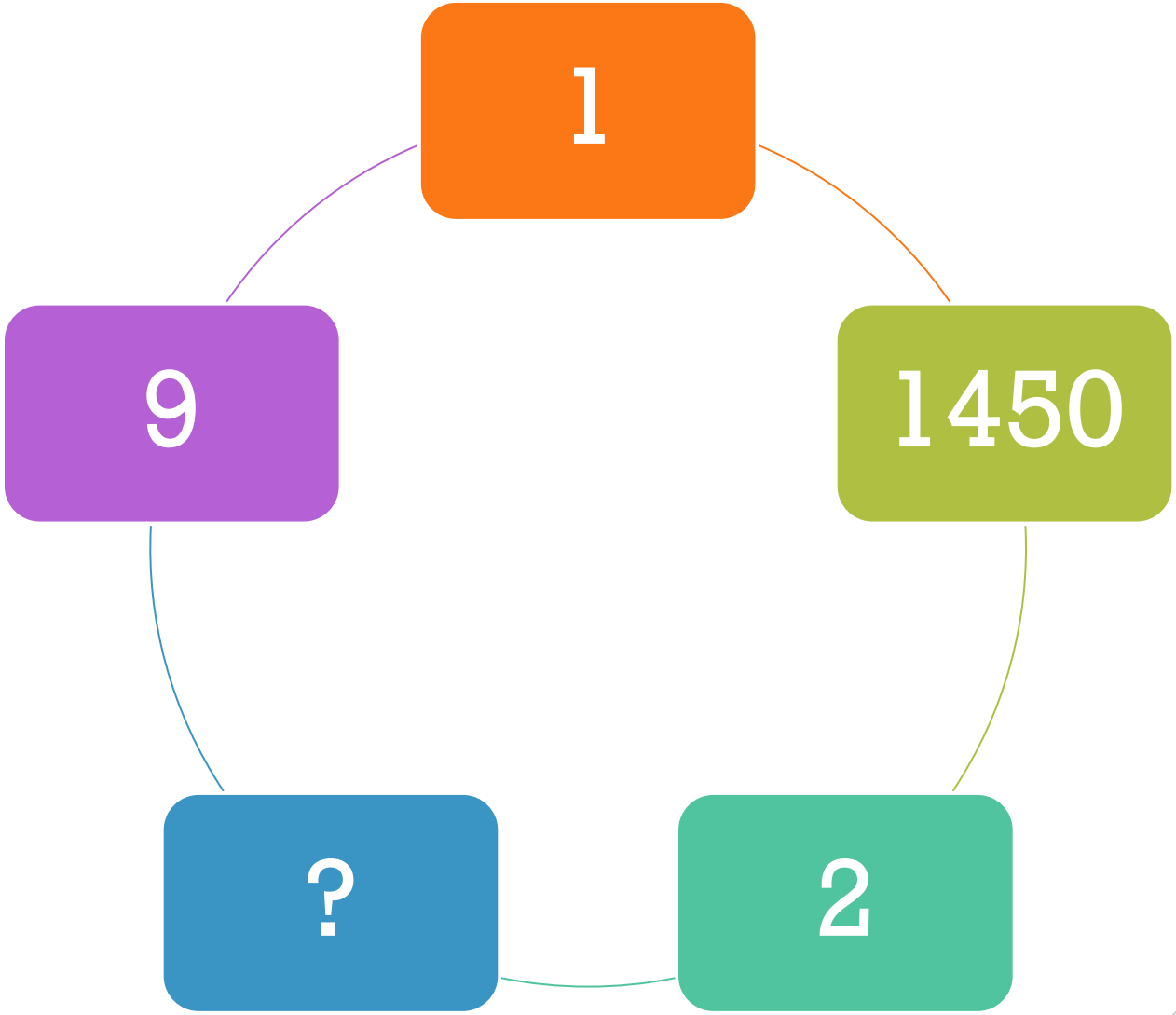
Teach the model to interpret unseen data, based on historical data. Use this to categorize new data



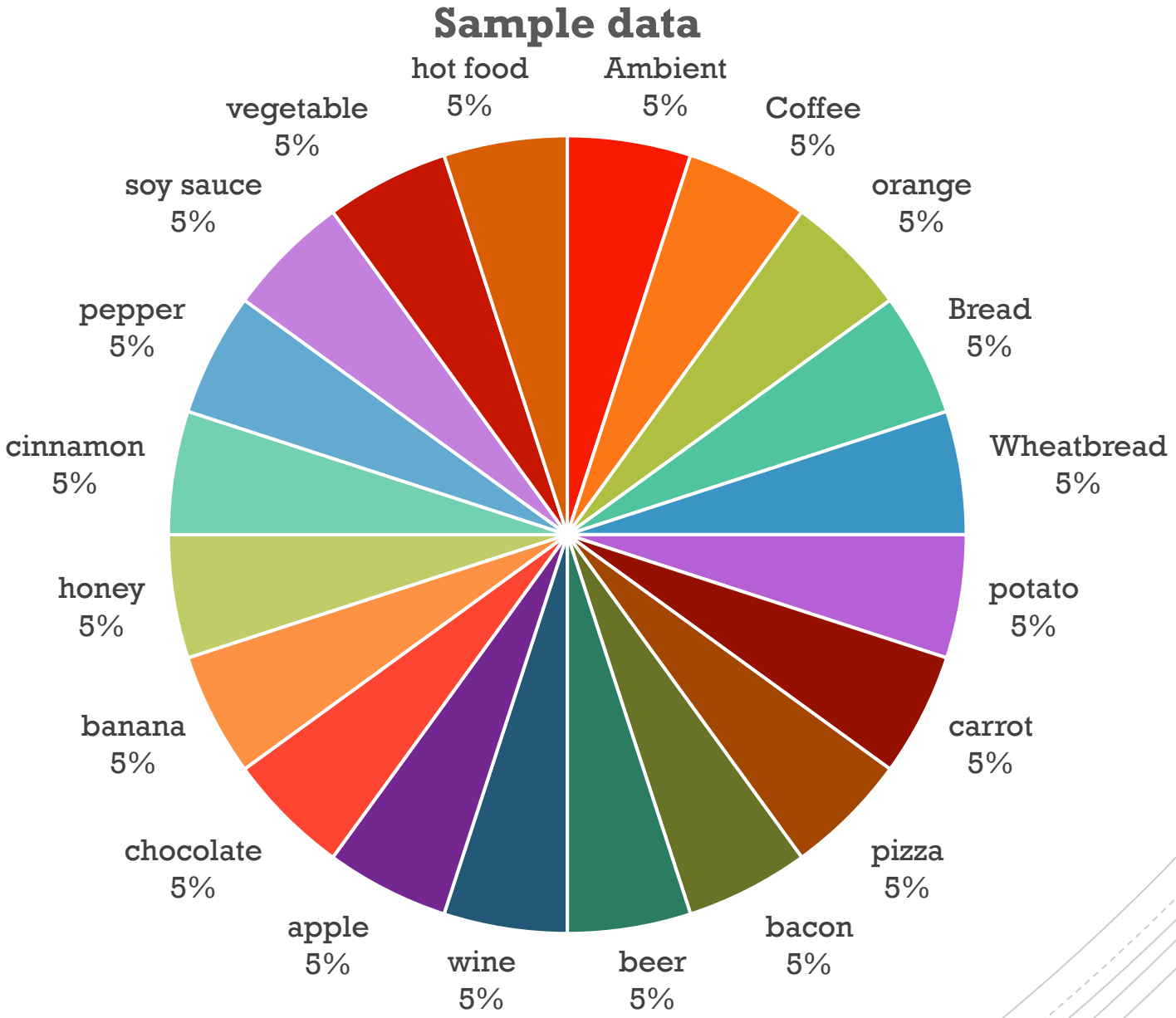
Deploy

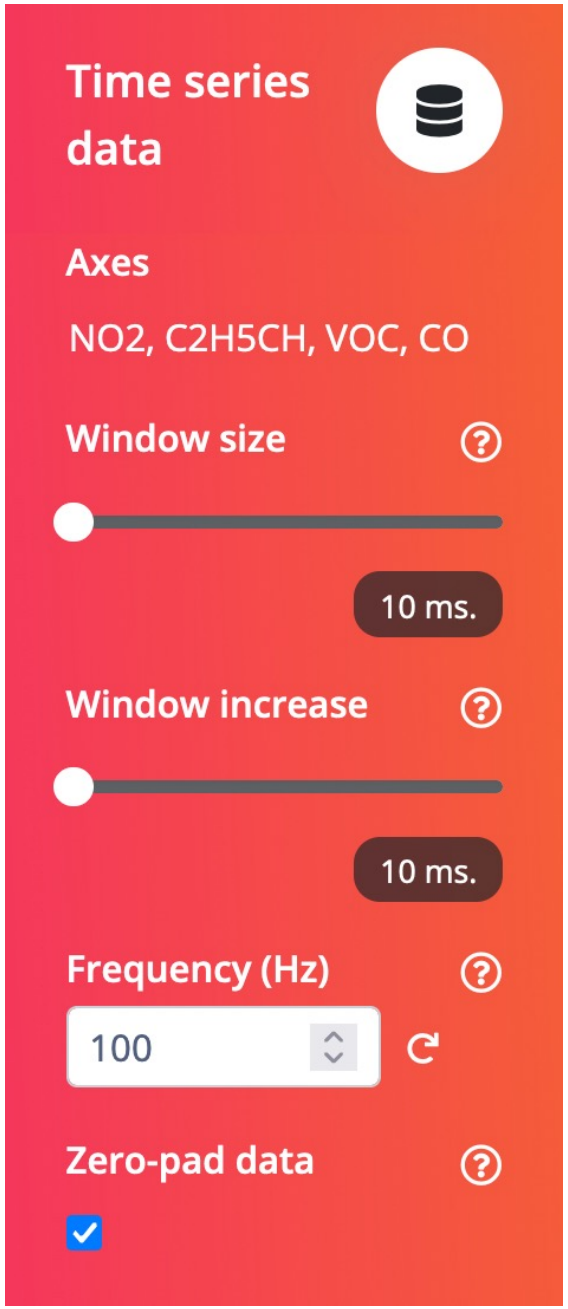
- Package from signal processing code to trained model, and deploy it.
  - low latency
  - without network connection.

Secret sauce

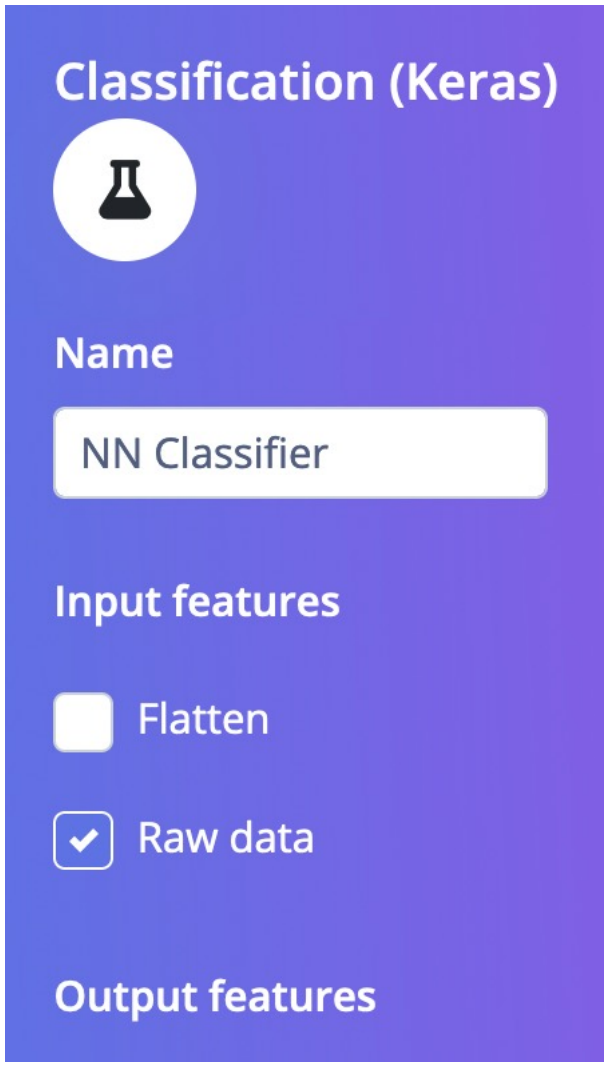


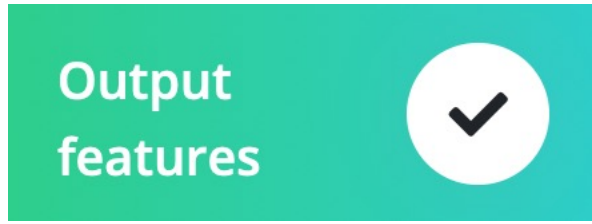
(to be revised)
Circle chart of the elements
- 30 classes




Time series data
Axes
NO2, C2H5CH, VOC, CO
Window size
10 ms.
Window increase
10 ms.
Frequency (Hz)
100
Zero-pad data


Flatten
Name
Flatten
Input axes
NO2
C2H5CH
VOC
CO


Classification (Keras)
Name
NN Classifier
Input features
Flatten
Raw data
Output features


Output features

Orange

982, 944, 961, 992

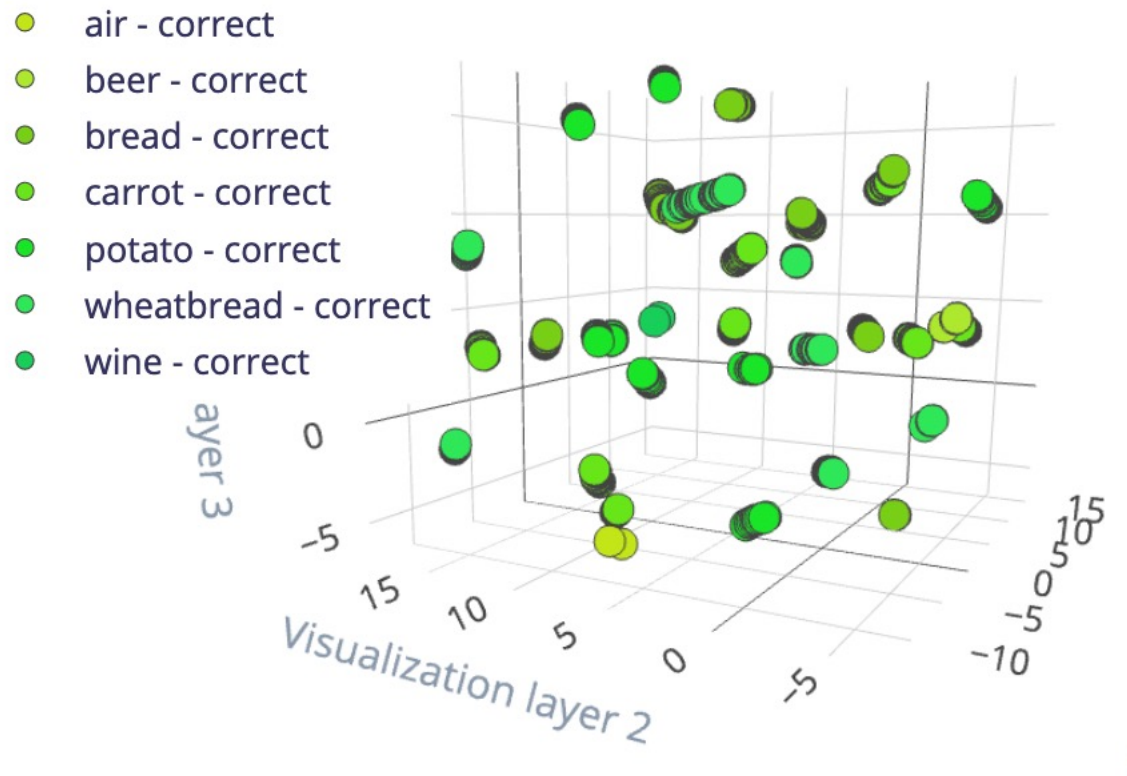
ACCURACY
99.2%

LOSS
0,03

Confusion matrix (validation set)

	AIR	BEER	BREAI	CARR	COFFI	ORAN	POTA	WHEA	WINE
AIR	100%	0%	0%	0%	0%	0%	0%	0%	0%
BEER	0%	100%	0%	0%	0%	0%	0%	0%	0%
BREA	0%	0%	100%	0%	0%	0%	0%	0%	0%
CARR	0%	0%	0%	100%	0%	0%	0%	0%	0%
COFF	0%	0%	0%	0%	100%	0%	0%	0%	0%
ORAN	0%	0%	0%	0%	0%	100%	0%	0%	0%
POTA	0%	0%	0%	0%	0%	0%	100%	0%	0%
WHEA	0%	0%	0%	0%	0%	0%	0%	100%	0%
WINE	0%	6.2%	0%	0%	0%	0%	0%	0%	93.8%
F1 SC	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	0.97

Feature explorer (full training set)




LIVE
DEMO

THANK YOU!