Data processing for IoT

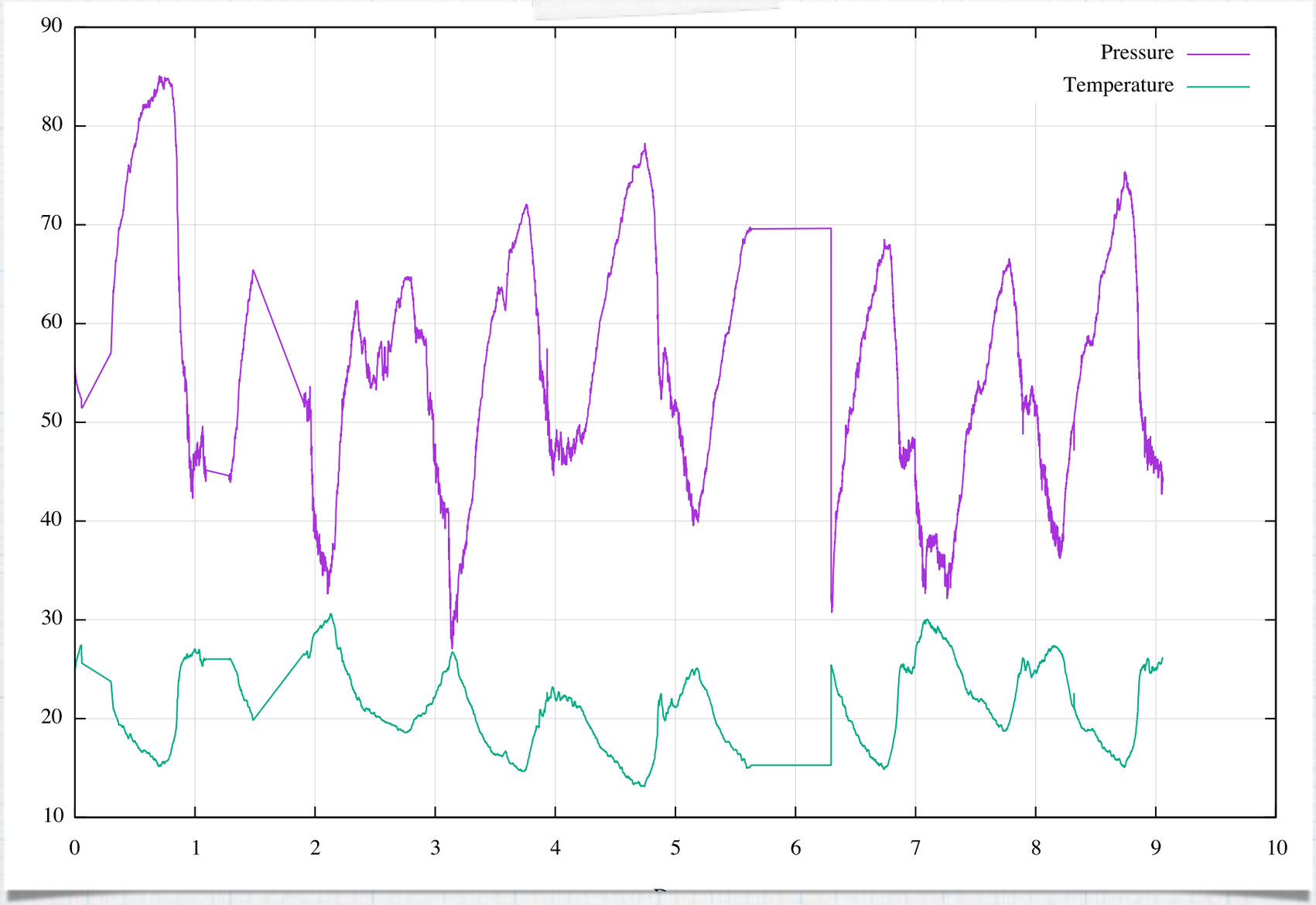
Sandor Markon
Kobe Institute of Computing

ICTP Workshop on Open Source Solutions for the Internet of Things, Jun 25-29, 2017

What to do with your data in the cloud?

* Data:
  capture - send - collect - now what???

* Convert "data" into "information"
* Convert "information" into "knowledge"
* Convert "knowledge" into "action"

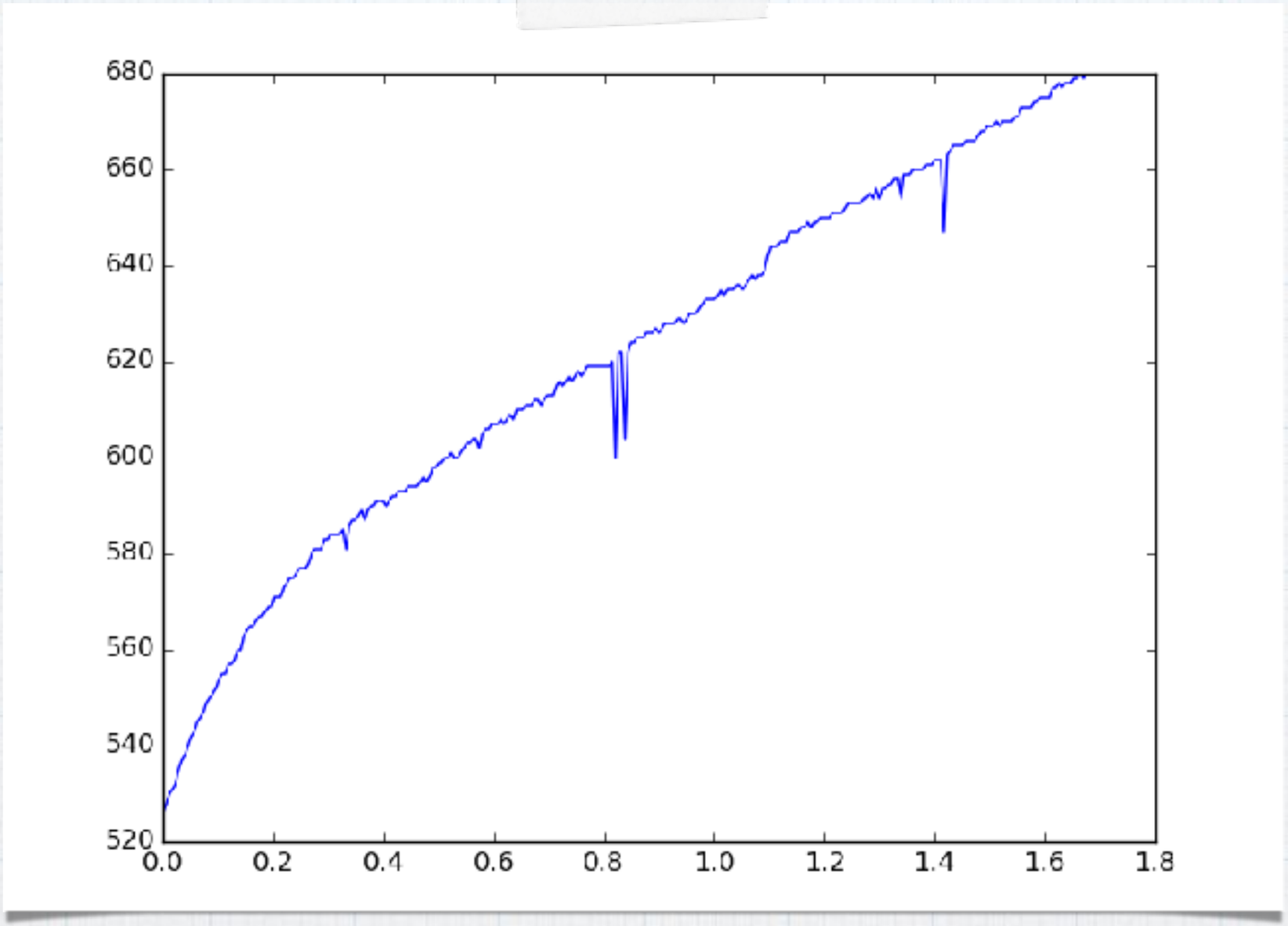


Temporal data

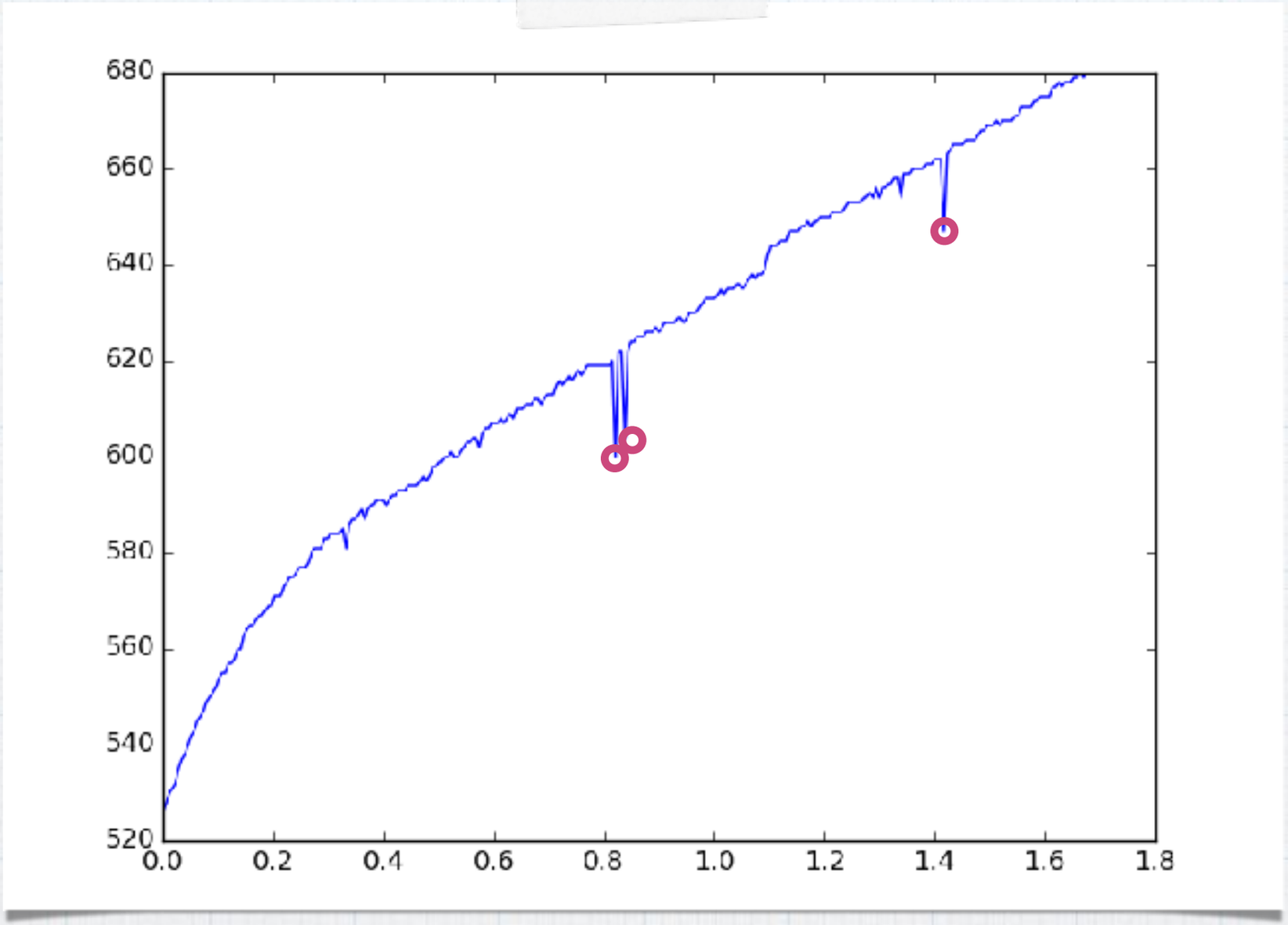
Time series: evidence of some process going on
Usual task: prediction

What to do with time series?

* Clean up the dirty data:
  noise
  outliers
  missing data
* Visualize it
* Predict the future



Data with outliers

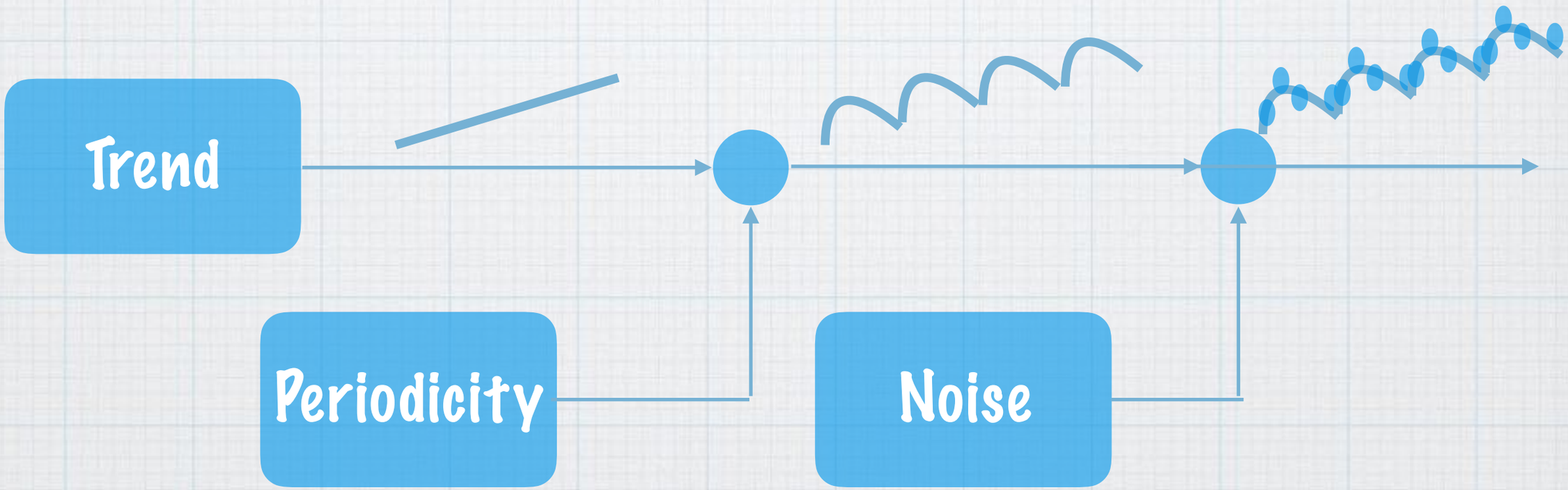


Data with outliers

The spikes are not real data

Why can we predict?

* Data is generated by some process
* Usual assumption: deterministic + noise



Time series in Python

* Numerics: numpy, scipy
* Plotting: matplotlib
* Time series: pandas
  http://pandas-docs.github.io/pandas-docs-travis/
* Prediction (statistical): pyflux
  http://www.pyflux.com
* Prediction (AI): FB Prophet
  https://arnesund.com/2017/02/26/using-facebook-prophet-forecasting-library-to-predict-the-weather/



Healthy



Diseased

Image data

Photos, videos: evidence of some status
Usual task: classification

Images + Python + AI

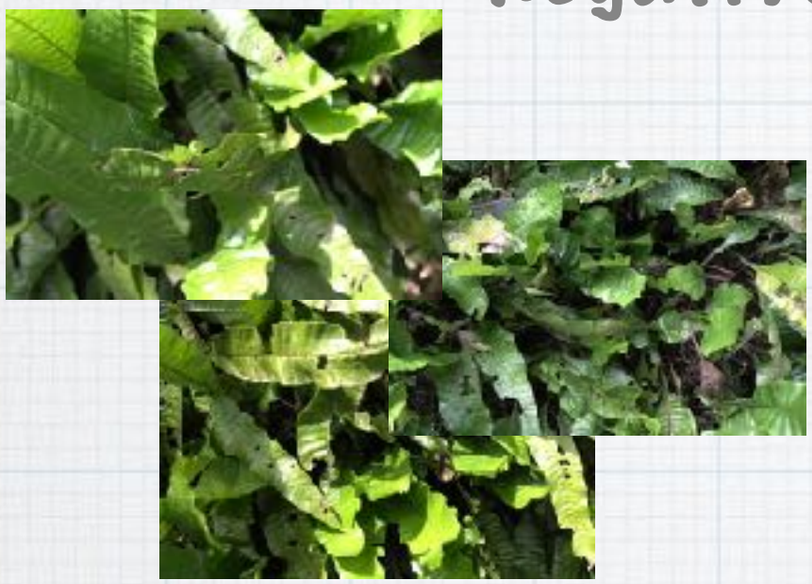
* Basics: OpenCV
* Image features: Mahotas
* Classification: milk

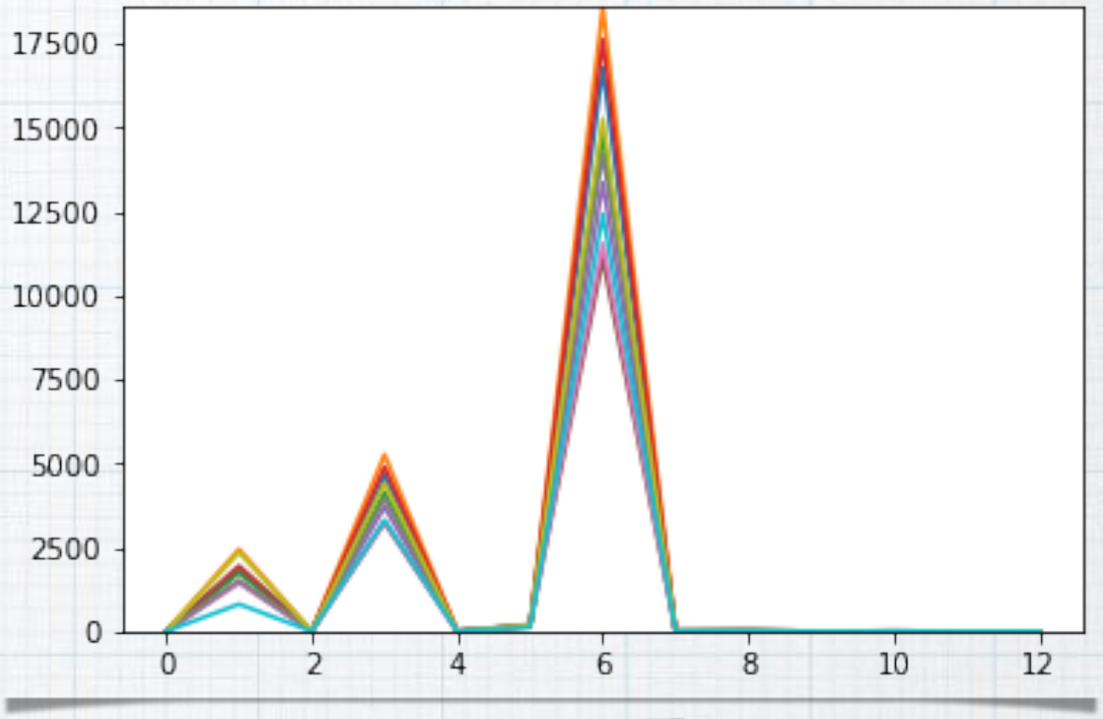
(or scikit-learn: http://scikit-learn.org/stable/)

Simple AI for images

* Generate numerical feature vectors
* Select part of the images as a training set:
  N_p positive samples
  N_n negative samples
* Train a classifier with the training set
* Test it with the rest of the data

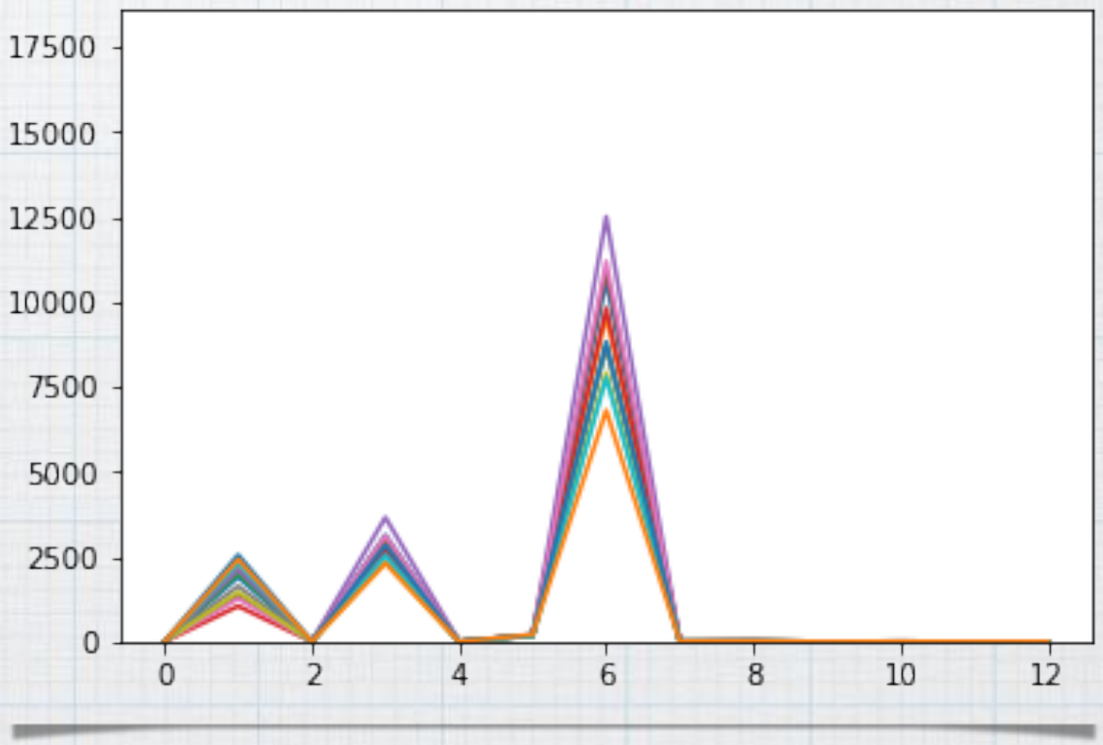
negatives



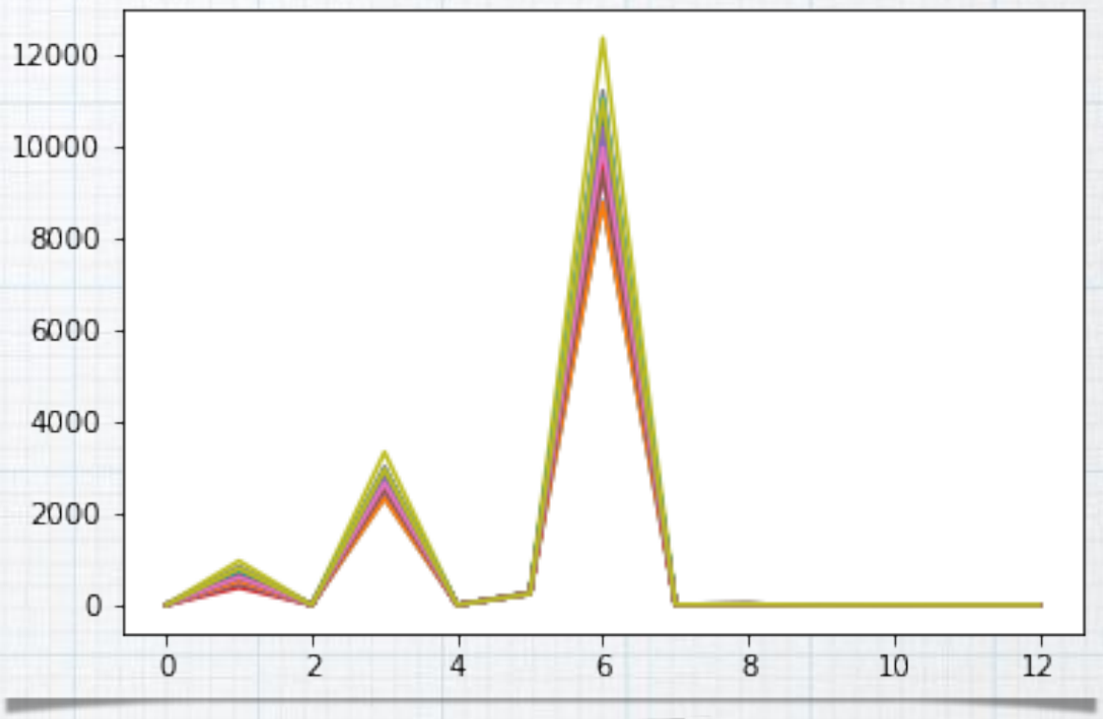


Features

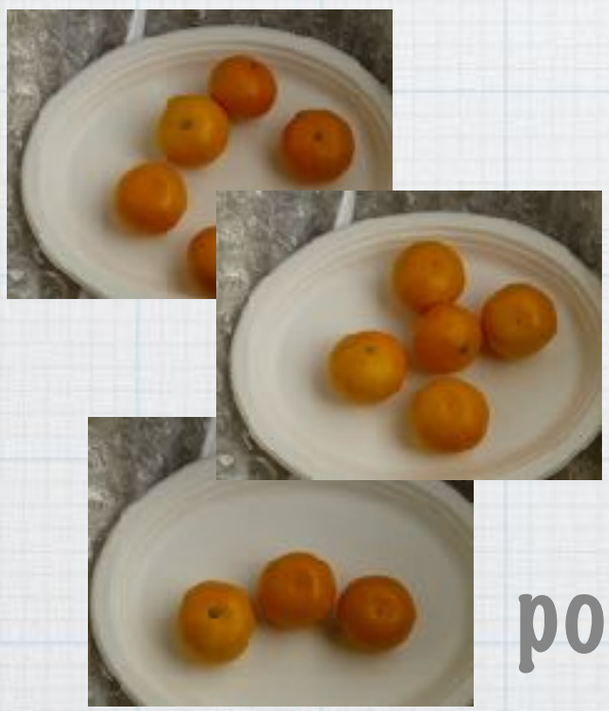
positives



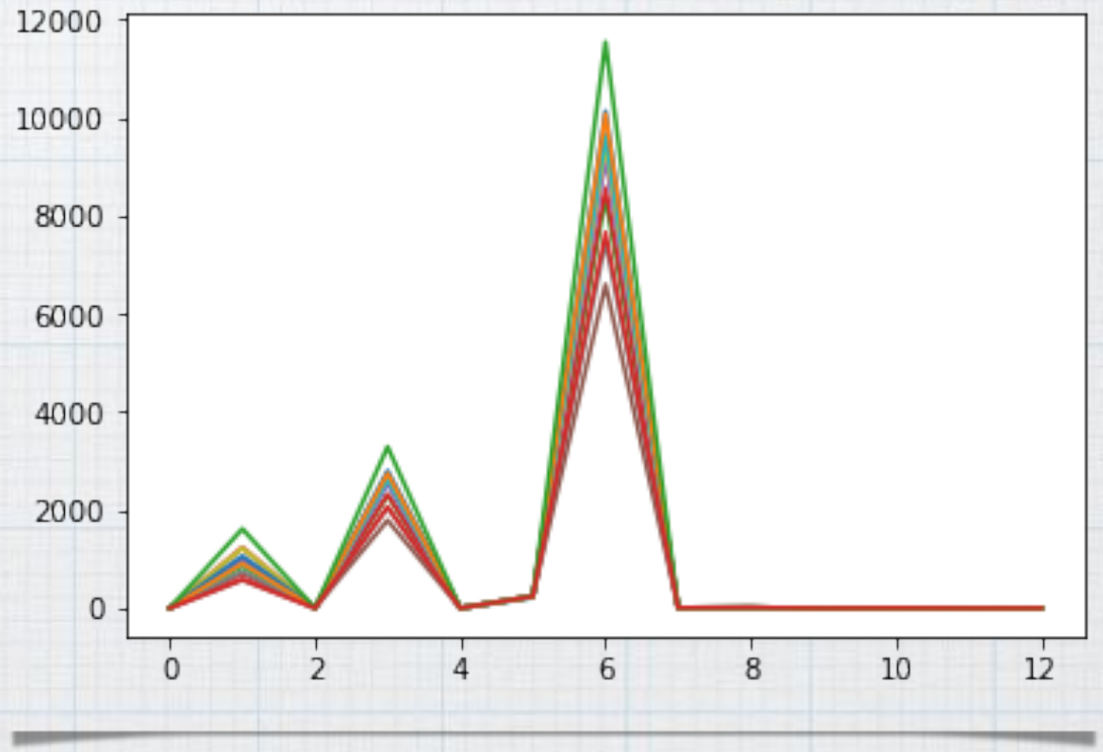
negatives



Features

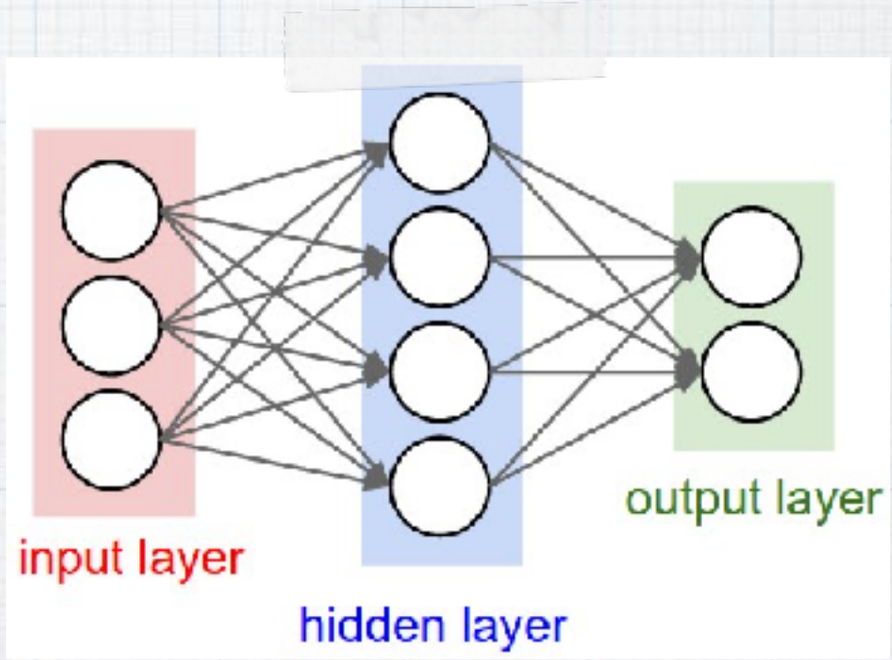


positives



Neural network

* Feed features to input layer
* Calculate hidden and output layer activations through connection weights
* Compare output with known correct output
* Adjust weights until output becomes correct for all input samples



Classification

* After training, the neural network classifies correctly the training samples
* Hopefully it will also correctly classify unknown data
* Some common problems (and many others...):
  * overfitting (can classify only the training set)
  * poor flexibility (too simple for the task)