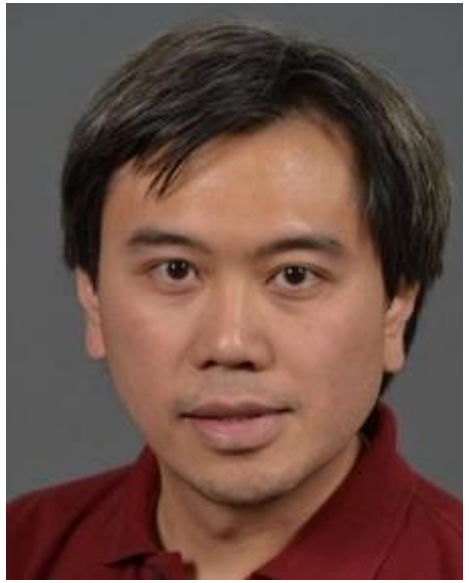


codestock

EDUCATE | INSPIRE | CONNECT

Developing Spidey Senses

Anomaly Detection for Javascript

RON DAGDAG

Spidey Sense?

- tingling sensation on the back of Peter Parker's skull

- ability to sense / react to danger

Uses

- Increases his ability to detect evil (and even clones)

- Helps him navigate if he is impaired (disoriented or unable to see/hear)

- Aids him in discovering secret passageways and find hidden/lost objects

- Helps fire his Web Shooters and swing instinctively

Real Spider Sense

“hyper-awareness”

long, thin hairs, *trichobothria*

- low-level vibrations through their web
- can detect the vibrations of faint sounds
- small insects moving up to 3 meters away

Any new web developers here?

Spidey Sense?

Gut feeling

Vibe

Feeling

Intuition

Discover Blind Spots

Learning from the past

Agenda

What is Anomaly Detection?

Time Series Anomaly Detection

Demo

Takeaways

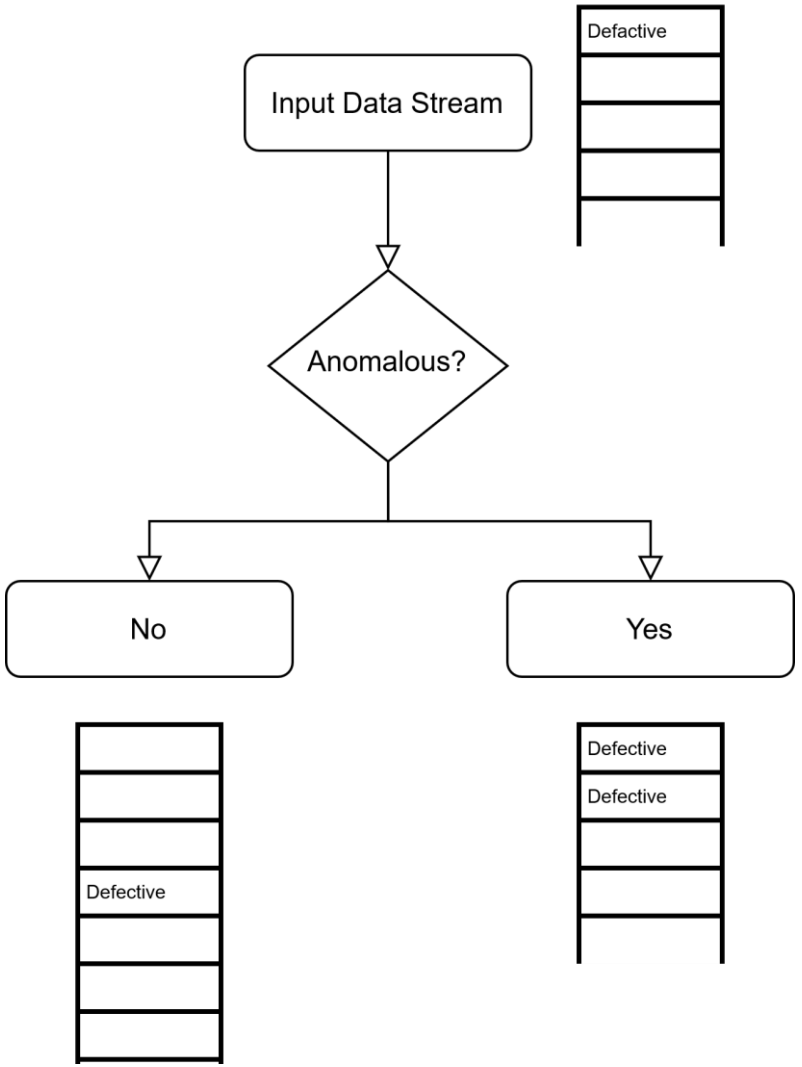
Anomaly Detection

Identifying unexpected items or events in data sets, which differ from the norm

An Outlier

Assumptions:

- Anomalies only occur very rarely in the data.
- Their features differ from the normal instances significantly.


Defactive
Input Data Stream
Anomalous?
No
Yes
Defective
Defective
Defective


Needle in a haystack
@RONDAGDAG

Methods

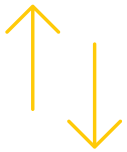
Rule-based Systems

Statistical Techniques

Machine Learning

Rule-based Systems

Specific Rules



Assign Threshold and limits

Experience of Industry Experts to detect “known anomalies”

Doesn’t Adapt as patterns change

Data Labeling

Statistical Techniques

flags the data points => deviate from common statistical properties
(mean, median, mode, quantiles)

a rolling average or a moving average

n-period simple moving average
"low pass filter.“ e.g. Kalman Filters

Histogram-based Outlier Detection (HBOS)

More Interpretable and sometimes more useful than ML methods

Machine Learning Methods

Supervised
(e.g. Decision Tree, SVM, LSTM Forecasting)

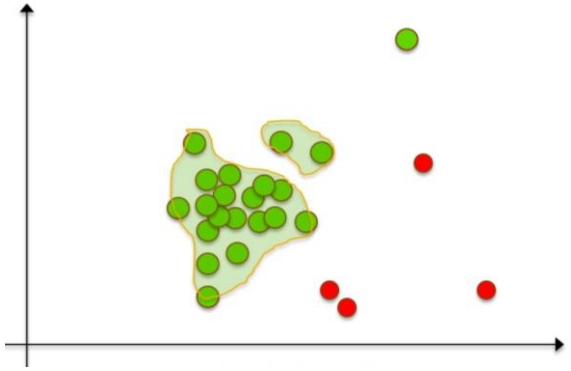
Unsupervised
(e.g. K-Means, Hierarchical Clustering, DBSCAN)

Self-Supervised
(e.g. LSTM Autoencoder)

Machine Learning

Density-Based Anomaly Detection

- based on the k-nearest neighbors algorithm.
- *Assumption:* Normal data points occur around a dense neighborhood and abnormalities are far away.



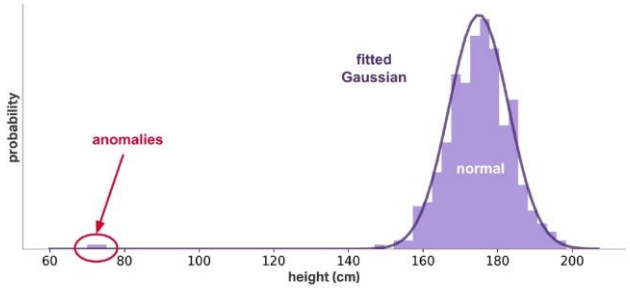
Clustering-Based Anomaly Detection

- *Assumption:* Data points that are similar tend to belong to clusters --> distance from local centroids.
- K-means

Machine Learning

Gaussian Distribution

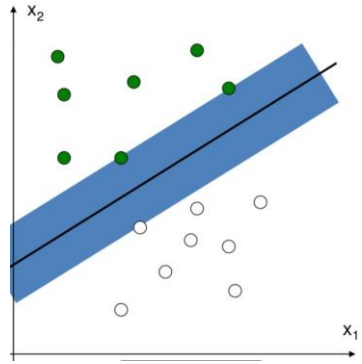
- Gaussian Distribution and given a new data-point,
- Compute the probability of the data-point
- If the probability is below a threshold => outlier or anomalous.



Machine Learning

Support Vector Machine-Based Anomaly Detection

- *OneClassSVM*
- *>100 features, aggressive boundary*
- find a function that is positive for regions with high density of points, and negative for small densities



PCA-Based Anomaly Detection

- analyzing available features to determine what constitutes a "normal" class
- applying distance metrics
- Fast training

Simple Anomaly Detection DEMO

Time Series Data

Series of data points indexed in time order

Examples:

- Logs
- Stock Market
- Sales Data
- Sensors
- Any data captured with Time Stamp

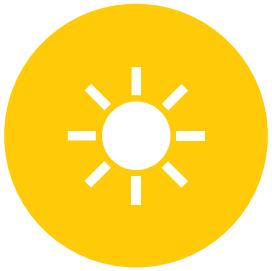
Internet of Broken Things

Time Series Anomaly Types

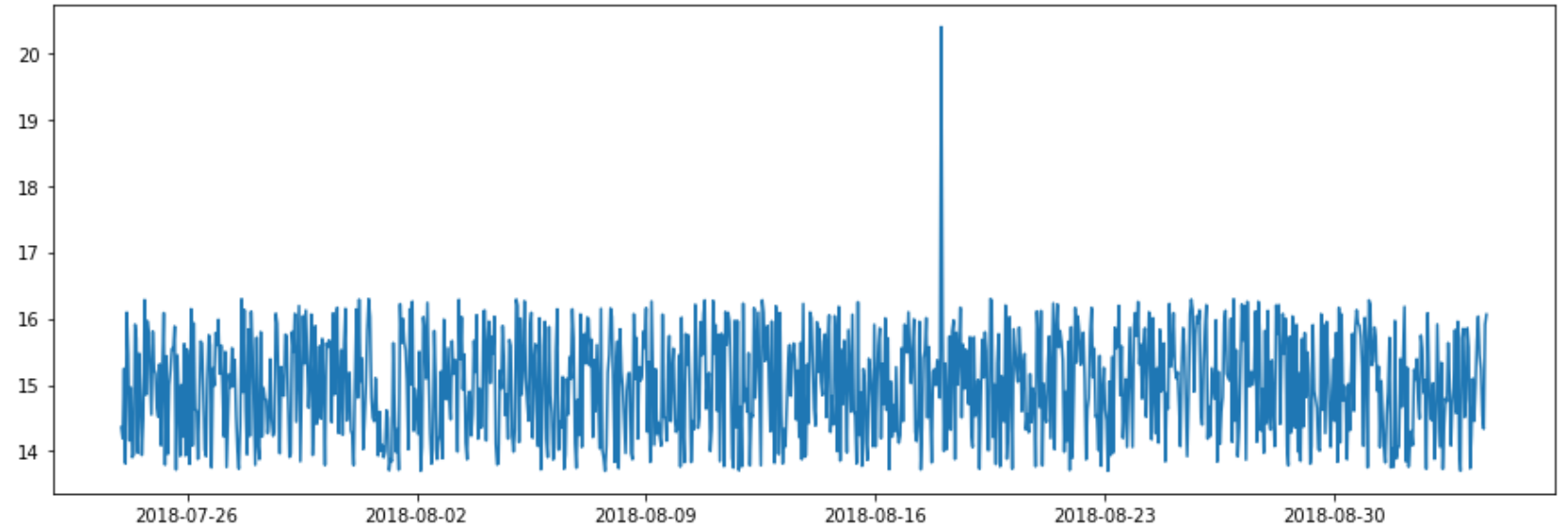
OUTLIER

SPIKE AND LEVEL SHIFT

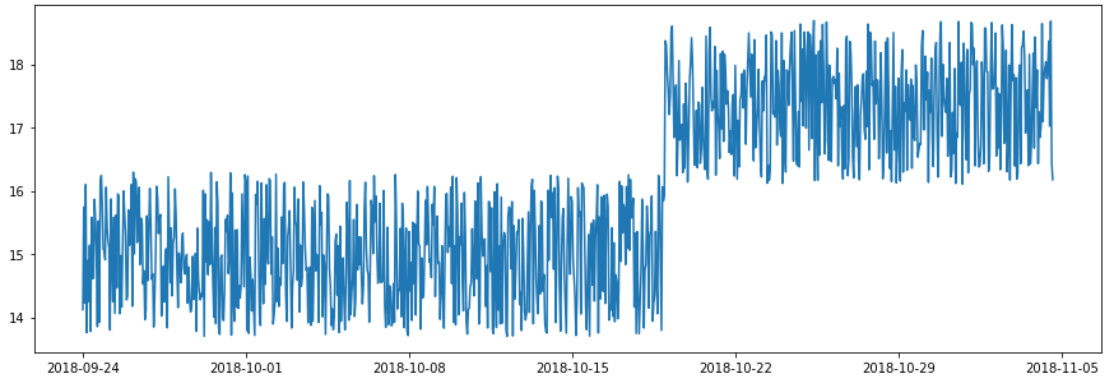
PATTERN CHANGE

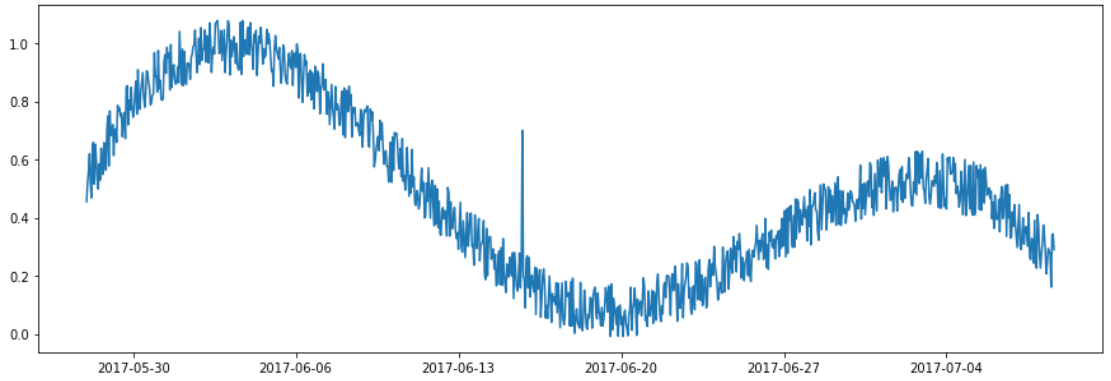


SEASONALITY

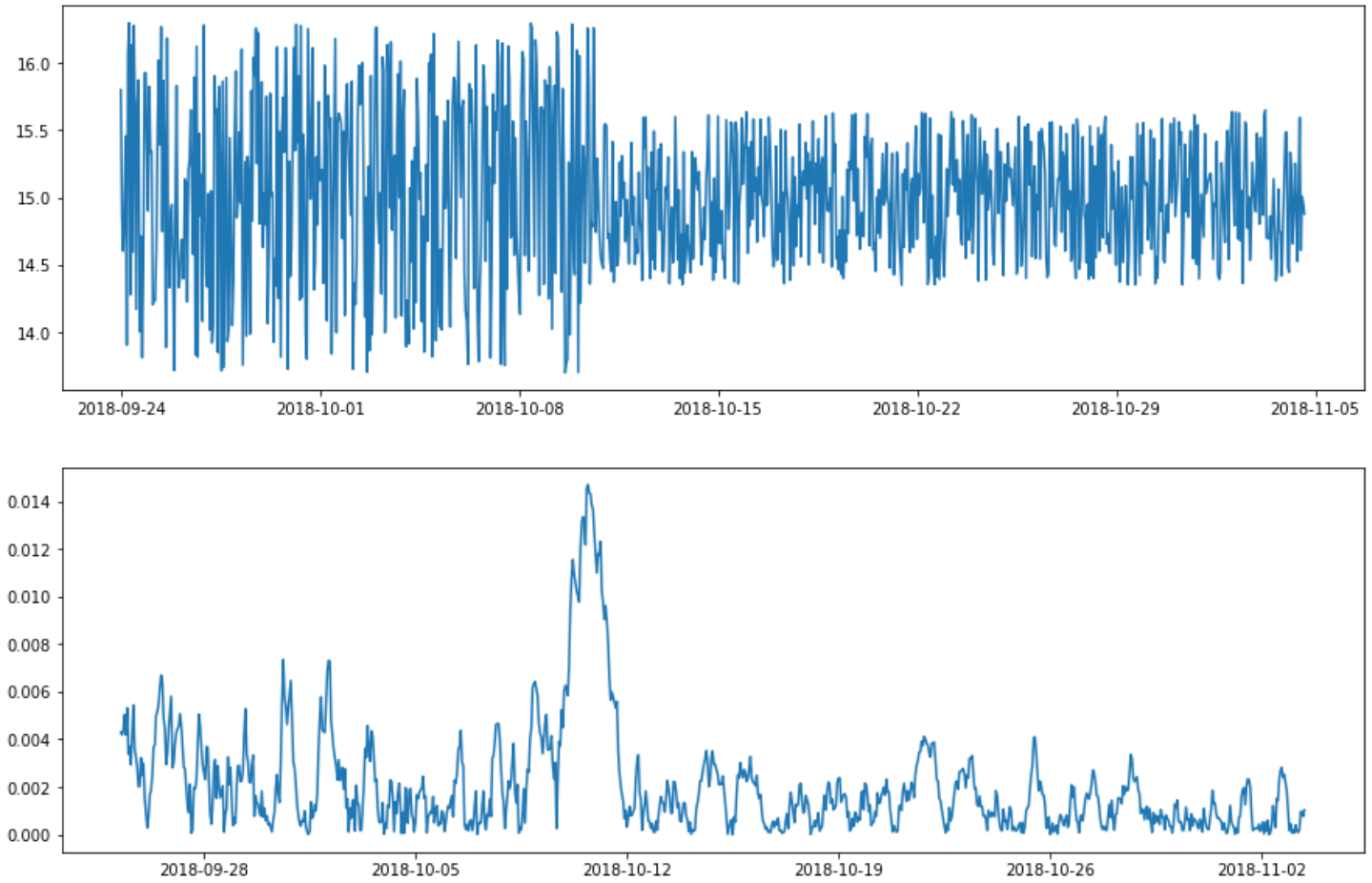

20
19
18
17
16
15
14
2018-07-26
2018-08-02
2018-08-09
2018-08-16
2018-08-23
2018-08-30

Outlier

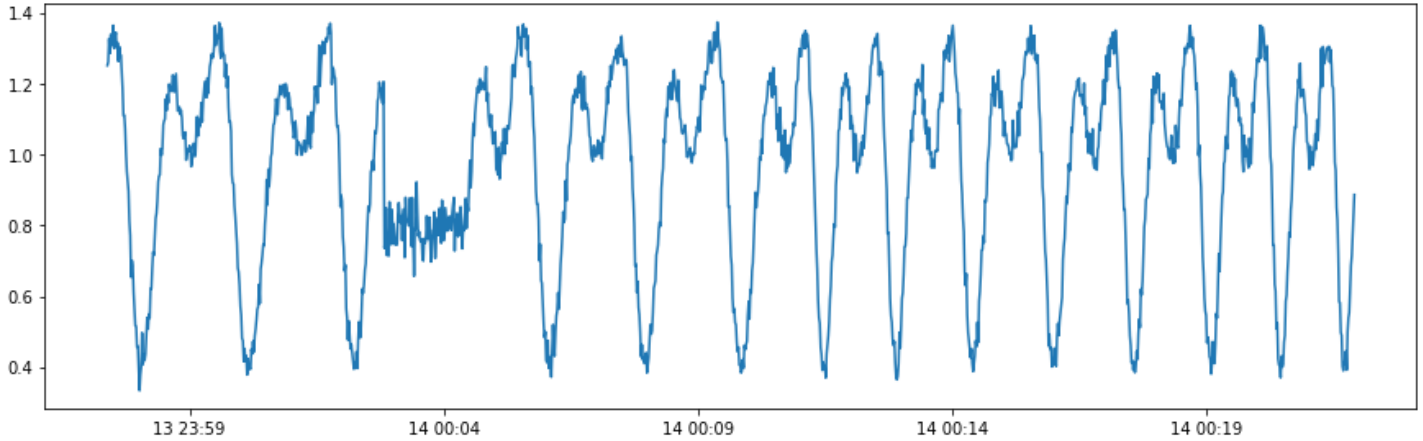


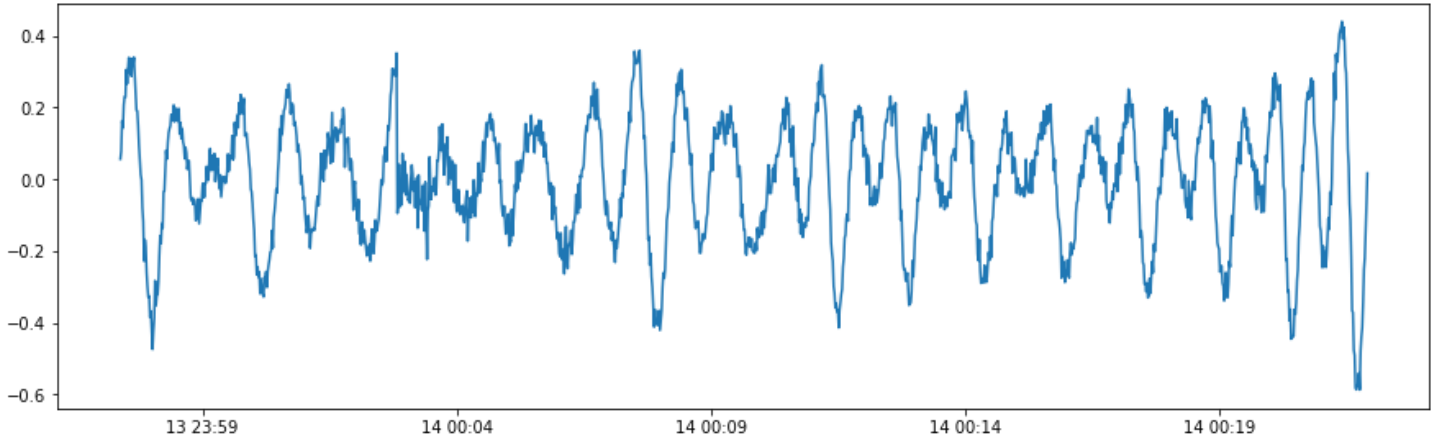


Spike and Level Shift



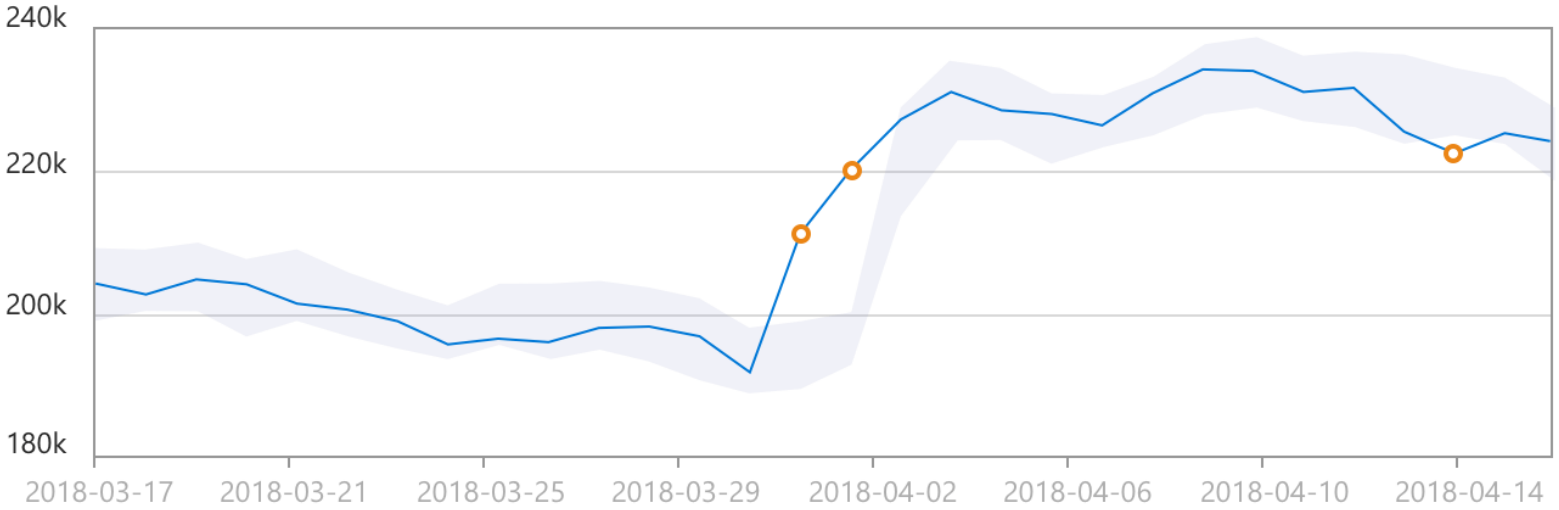
Pattern Change



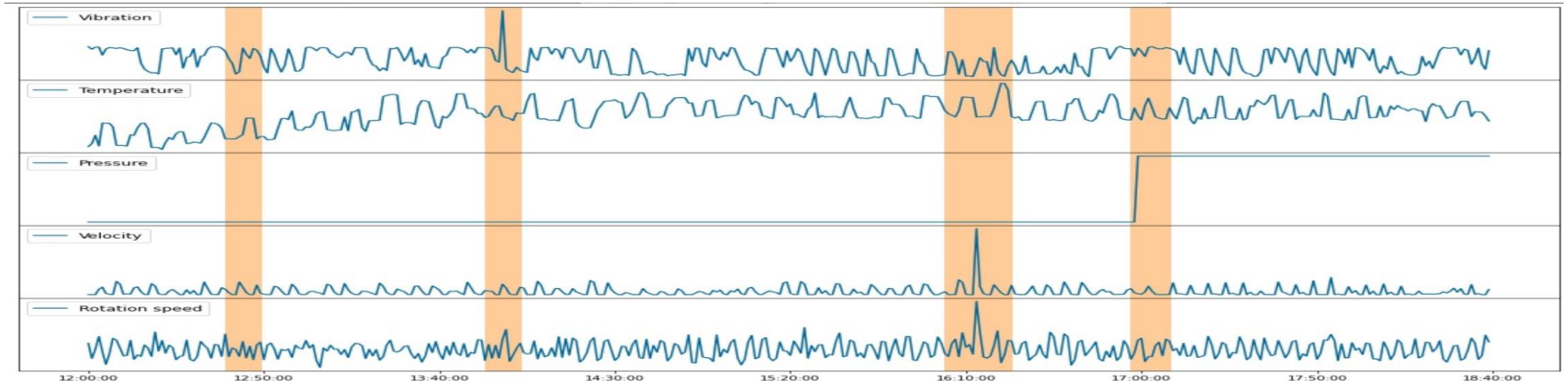


Seasonality

Univariate

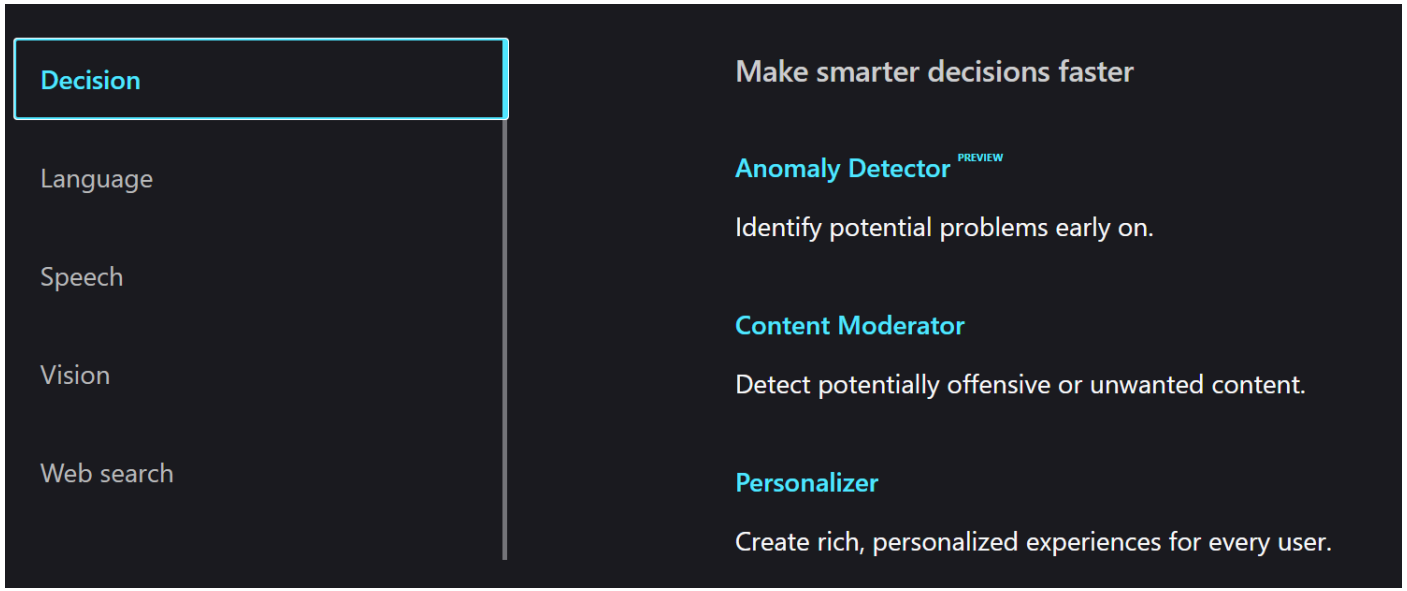


Multivariate



Azure Cognitive Services

- AI for every developer— w/o requirement ML expertise.
- Just an API call



Univariate Anomaly Detector Features

Detect anomalies as they occur in real-time.

Detect anomalies as a batch.

Automatically adapts and learns from new data

Fine Tune Sensitivity

Univariate Anomaly Detector Features

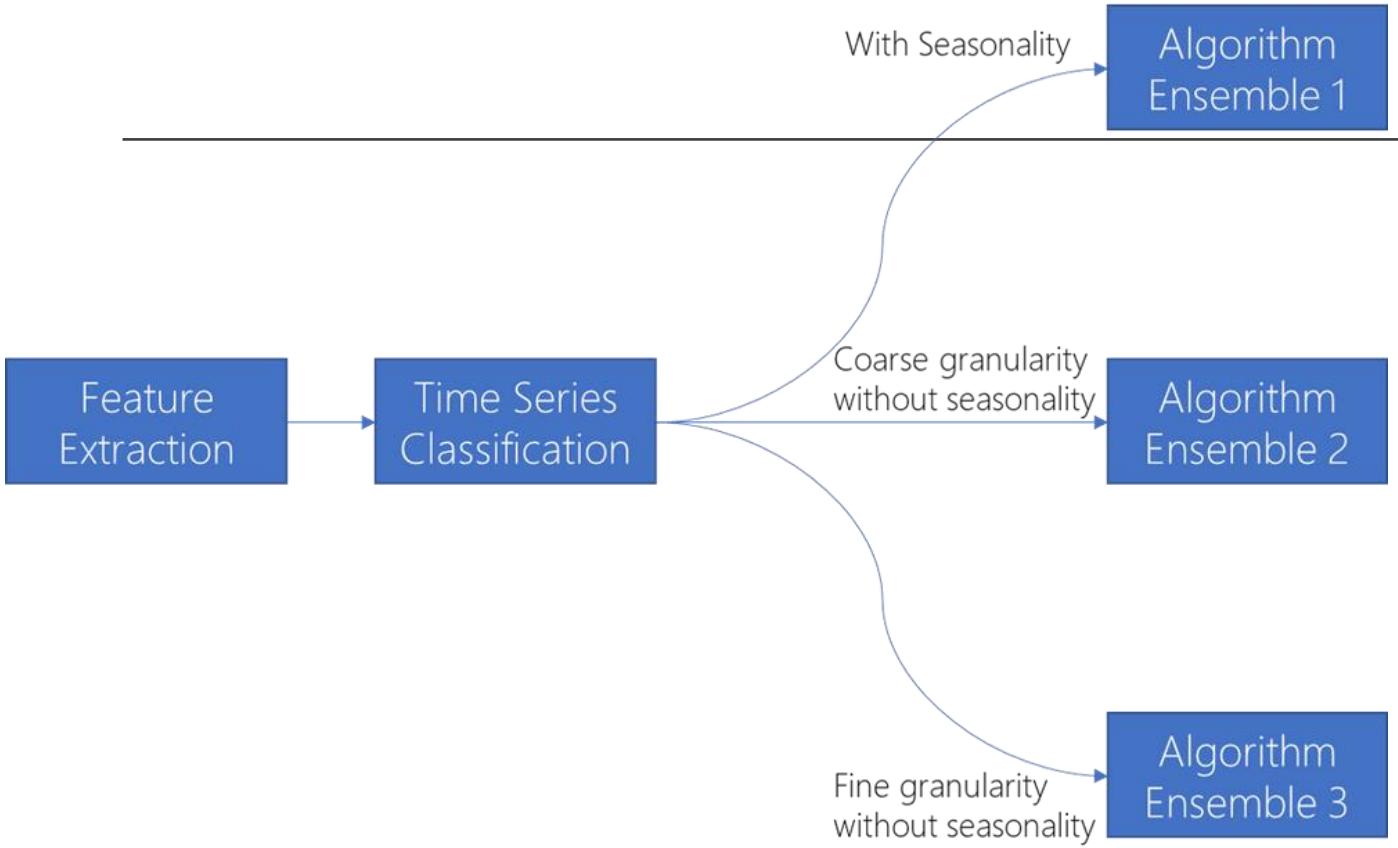
REST API

No machine learning expertise needed

Eliminate need for labeled training data

Automatically identify and apply best-fitting model

Gallery of Algorithms



Fourier Transformation

Extreme Studentized Deviate (ESD)

STL Decomposition

Dynamic Threshold

Z-score detector

SR-CNN

Limitations

Data Granularity – Daily, Hourly, Minutely, Monthly, Weekly, Yearly

Series Data Points – 12 to 8640 entries

JSON

```
{
    "granularity": "daily",
    "series": [
      {
        "timestamp": "2018-03-01T00:00:00Z",
        "value": 32858923
      },
      {
        "timestamp": "2018-03-02T00:00:00Z",
        "value": 29615278
      },
    ]
}
```

JSON

```
{
    "granularity" : "minutely",
    "customInterval" : 5
}
```

Calling the Anomaly Detector API

Client SDK

C#, Python, Node

REST API

Any language supporting HTTP calls

Anomaly Detector Demo

Where can you use this?

C#, Javascript, Python

Docker Containers

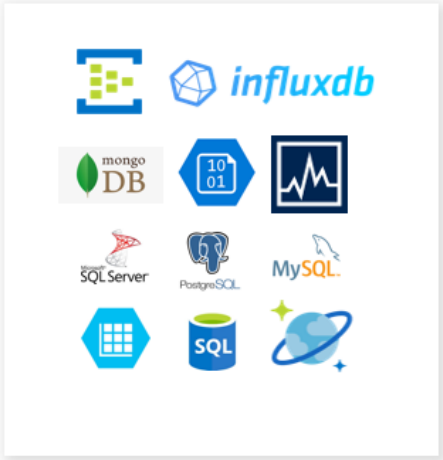
Power BI

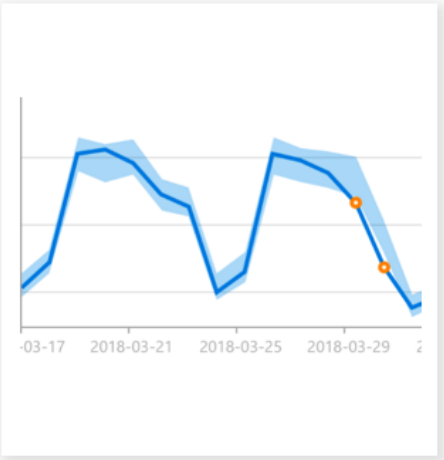
Azure Databricks for streaming data

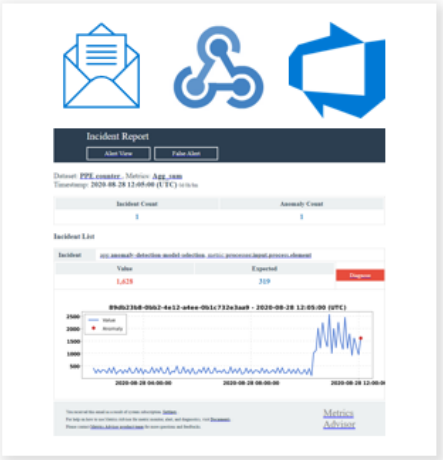
Metrics Advisor

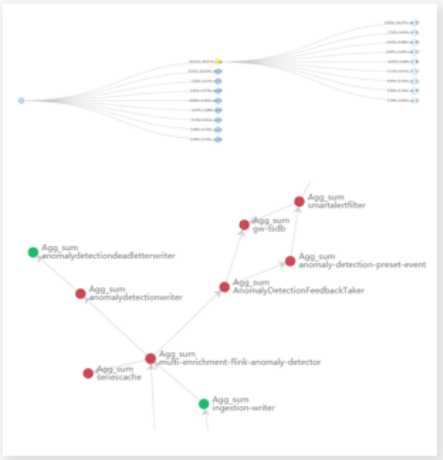
- Part of Azure Cognitive Services
- Performs data monitoring, anomaly detection in time series data
- Automates applying models
- Analyze multi-dimensional data from multiple data sources
- Identify and correlate anomalies
- Configure and fine-tune the anomaly detection model
- Diagnose anomalies and help with root cause analysis
- REST API and Web Portal

Collect time-series data → Detect anomalies → Send incident alerts → Analyze root cause









Multivariate Anomaly Detector Features

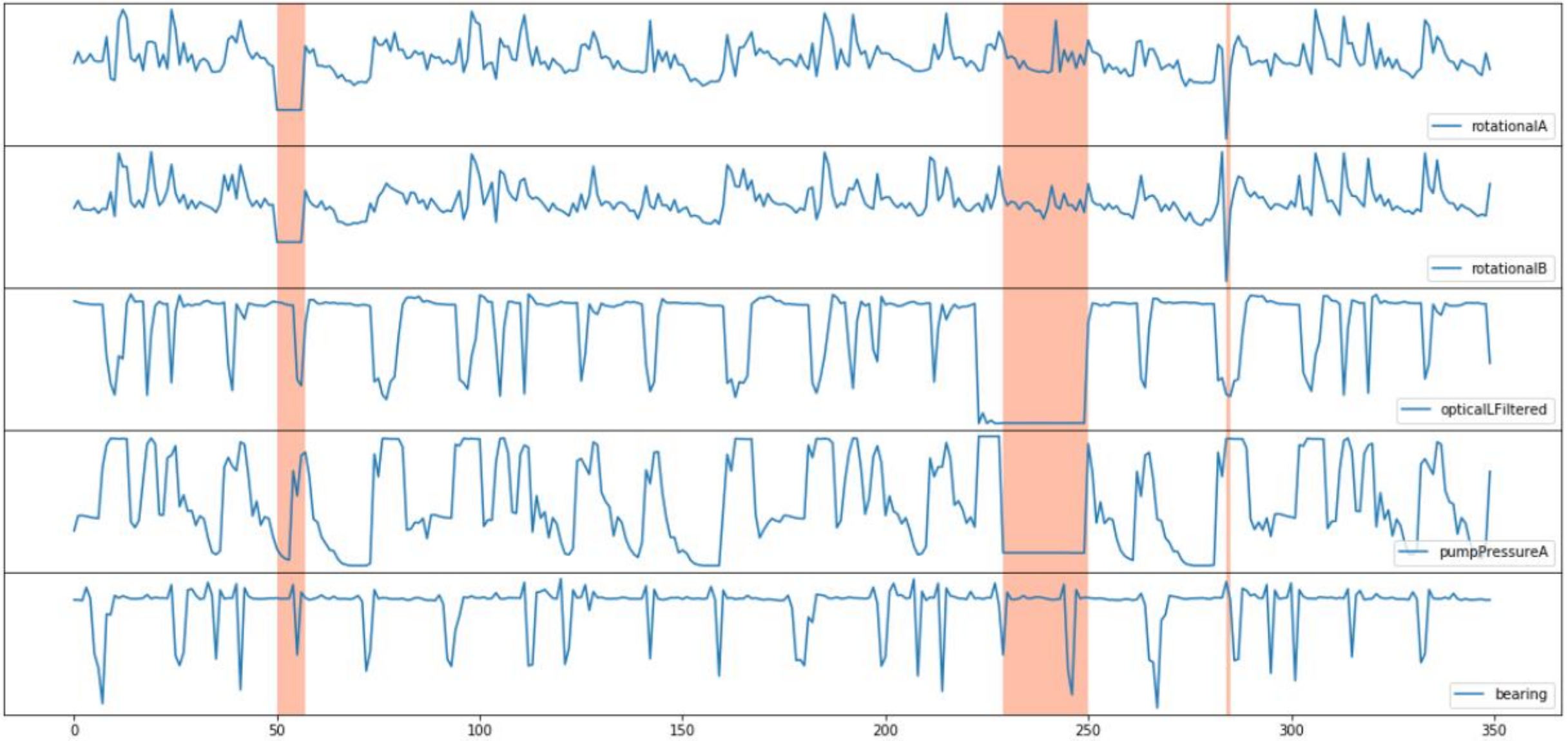
(in preview)

For detecting anomalies from groups of metrics

No need for ML knowledge or labeled data

up to 300 different signals

proactively protect your complex systems


rotationalA
rotationalB
opticalLFiltered
pumpPressureA
bearing
0
50
100
150
200
250
300
350

The best superpower you can give to your project is a “spidey-sense”.

https://github.com/rondagdag/spidey-sense-js

About Me

Ron Dagdag

- Lead Software Engineer / AI Edge Specialist
- 5th year Microsoft MVP awardee
- Personal Projects
  www.dagdag.net
- Email: ron@dagdag.net
  Twitter @rondagdag
- Connect me via Linked In
  www.linkedin.com/in/rondagdag/
- Thanks for geeking out with me about Spidey Senses and Anomaly Detection