Performance Analysis of Different Time Series Classification Techniques

Demonstrated on the Lightning7 Dataset

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CS559 – Machine Learning Fundamentals and Applications

Outline

Topic

The Dataset

Weak Classifiers

Advanced Classifiers

Future Work

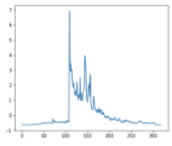
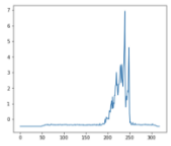
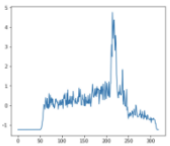
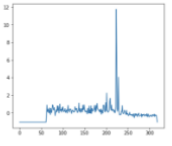
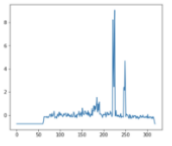
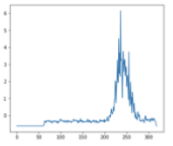
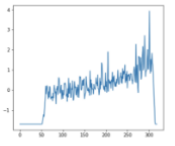
Lightning7

- The FORTE satellite detects transient electromagnetic events associated with lightning using a suite of optical and radio-frequency (RF) instruments.
- A Fourier transform is performed on the input data to produce a spectrogram.
- The spectrograms are then collapsed in frequency to produce a power density time series, which is then smoothed.

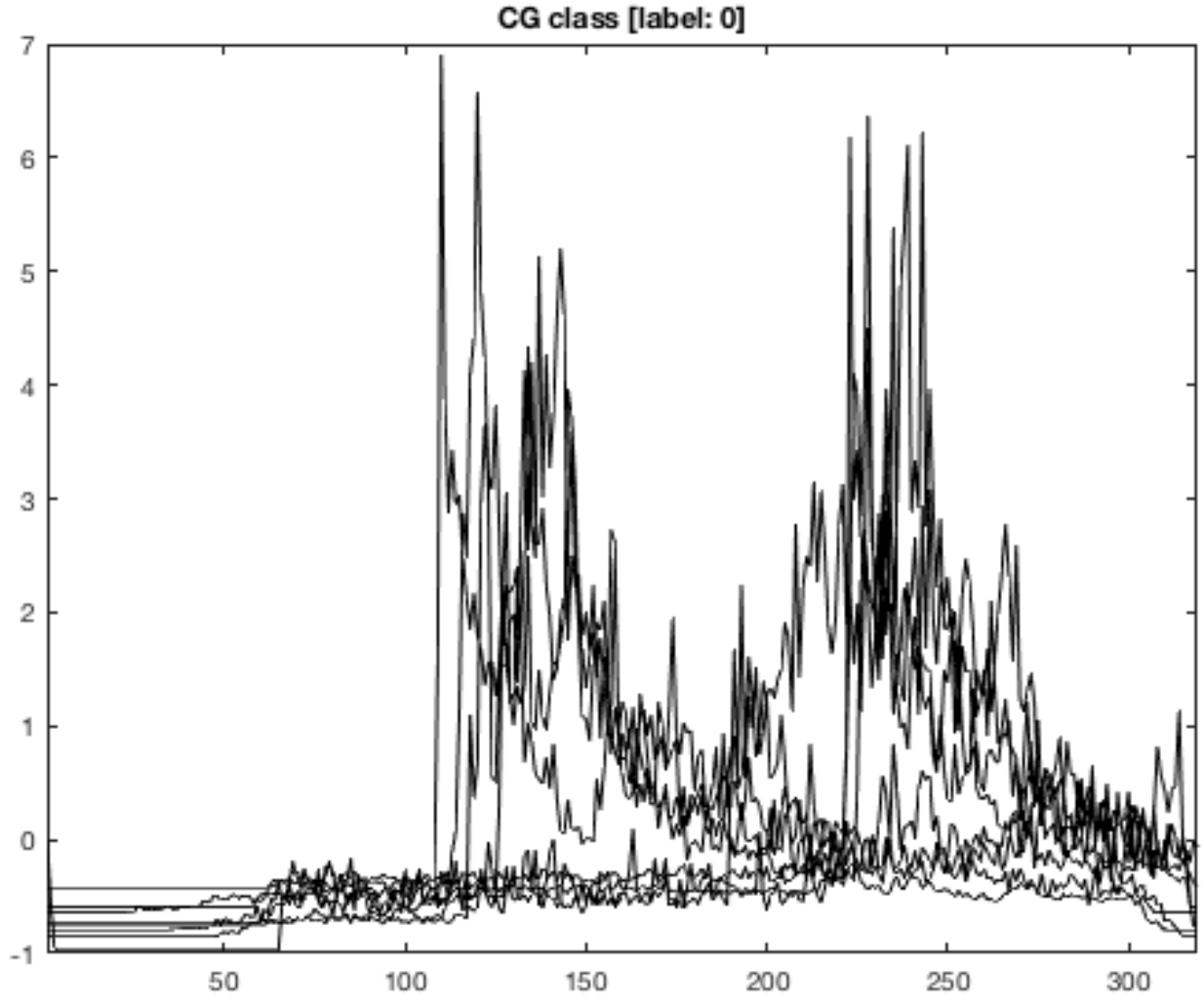
Classes

1. CG (Positive Initial Return Stroke)
2. IR (Negative Initial Return Strokes)
3. SR (Subsequent Negative Return Stroke)
4. I (Impulsive Event)
5. I2 (Impulsive Event Pair)
6. KM (Gradual Intra-Cloud Smoke)
7. O (Off-record) (special case)

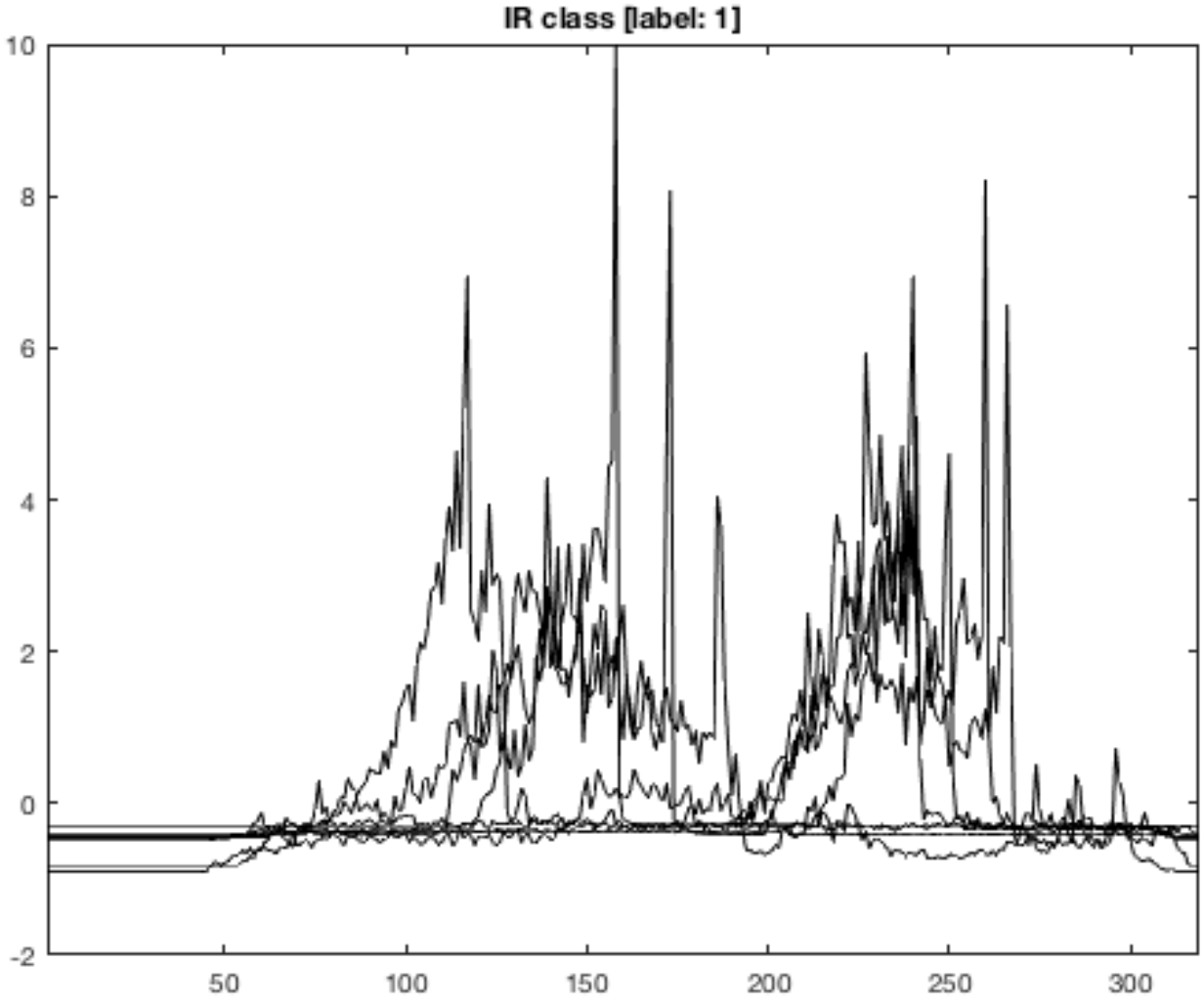
Visualization of Classes

Label	CG	IR	SR	I	I2	KM	O
Name	Positive Initial Return Stroke	Negative Initial Return Stroke	Subsequent Negative Return Stroke	Impulsive Event	Impulsive Event Pair	Gradual Intra-Cloud Stroke	Off-Record
# Samples	18	17	14	19	15	38	22
Ex. Time Series							

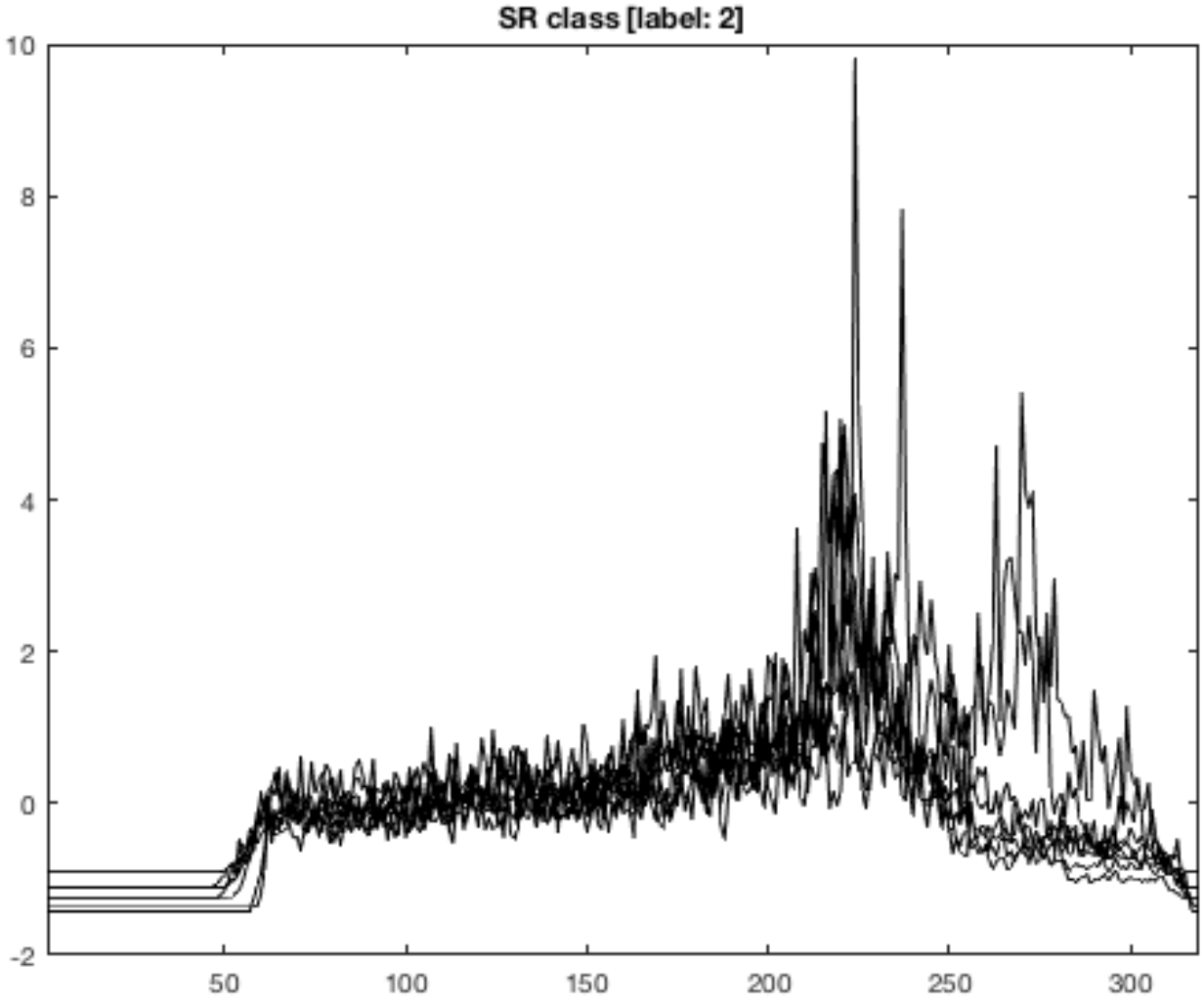
0. CG (Positive Initial Return Stroke)



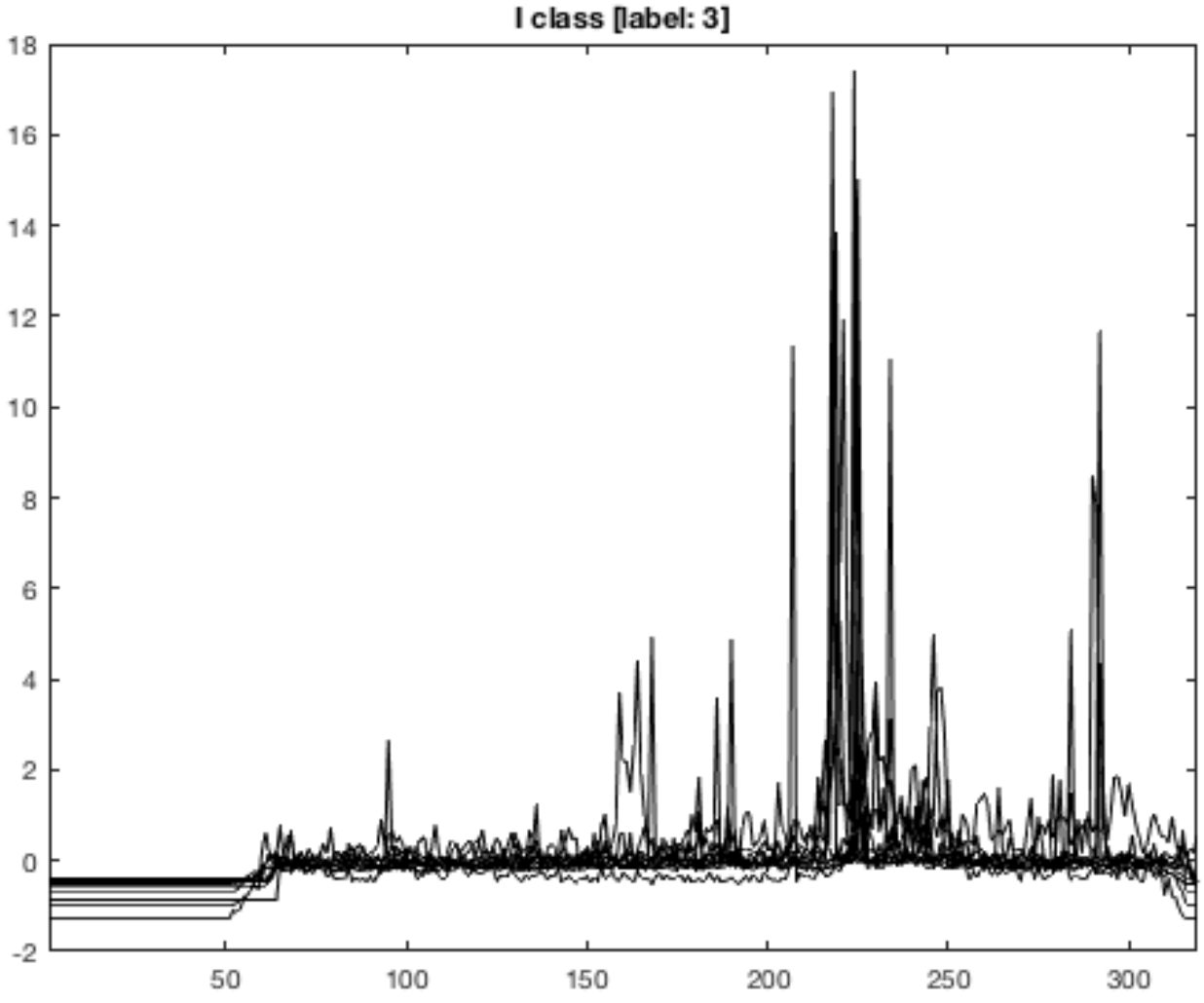
1. IR (Negative Initial Return Strokes)



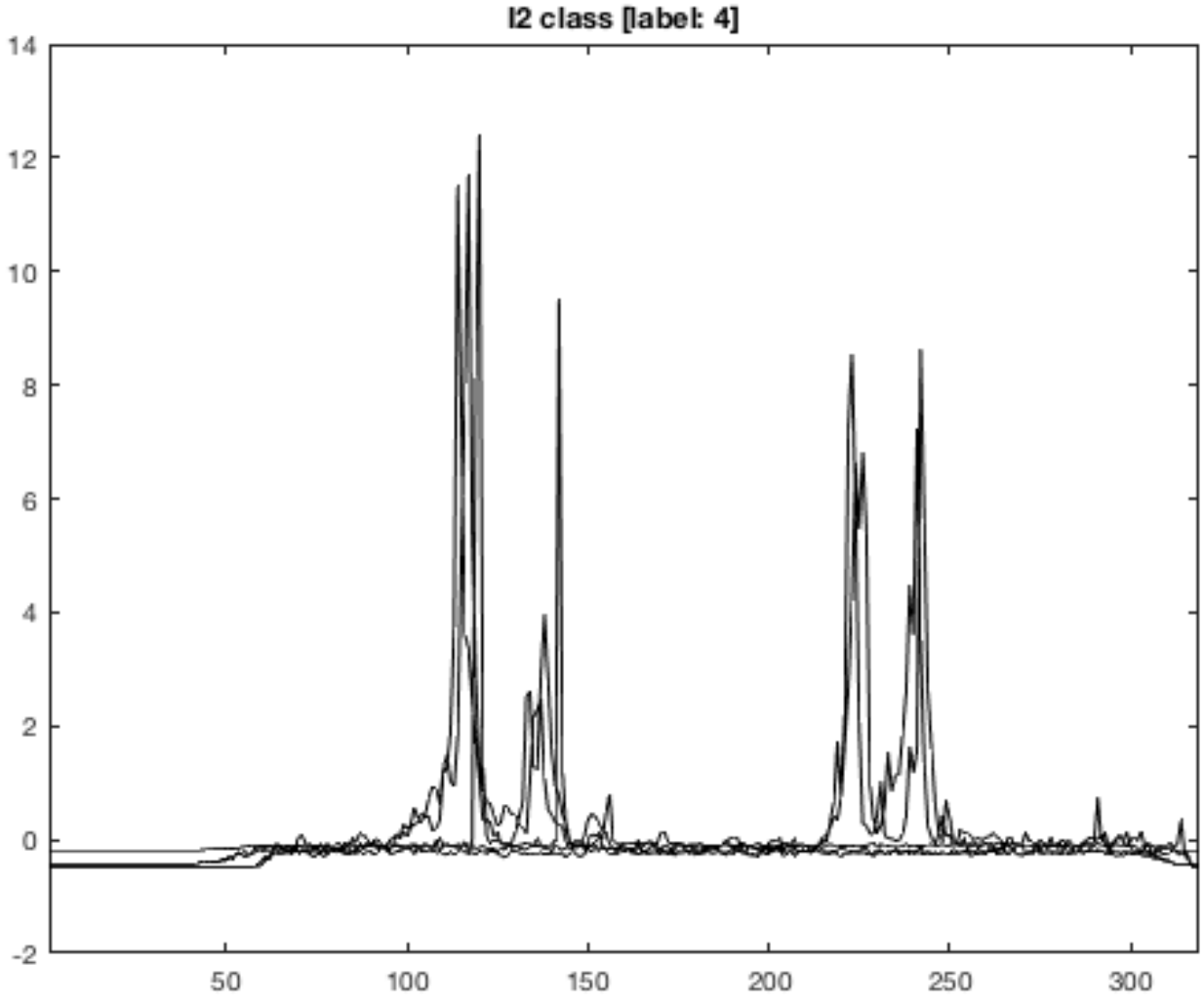
2. SR (Subsequent Negative Return Stroke)



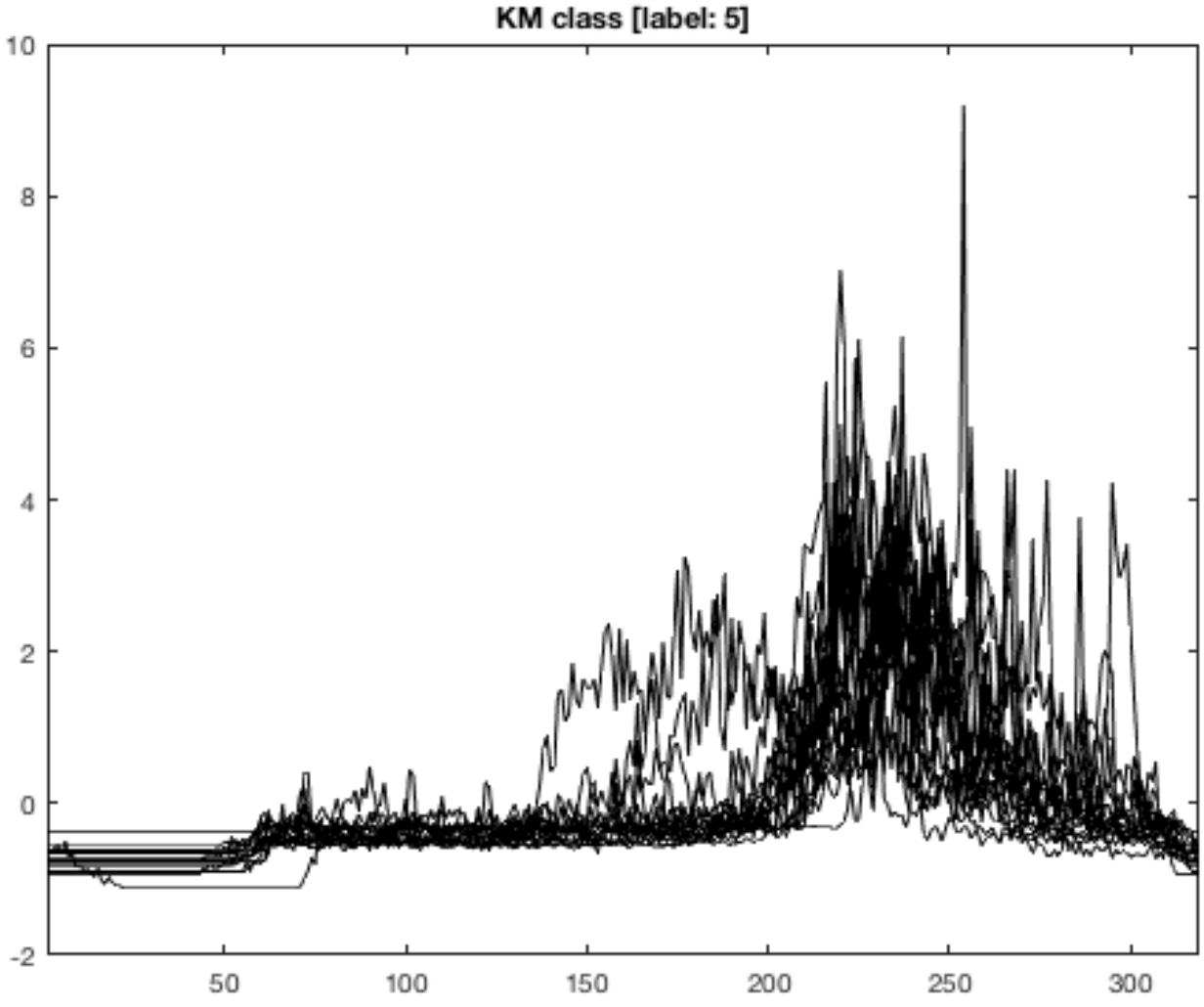
3. I (Impulsive Event)



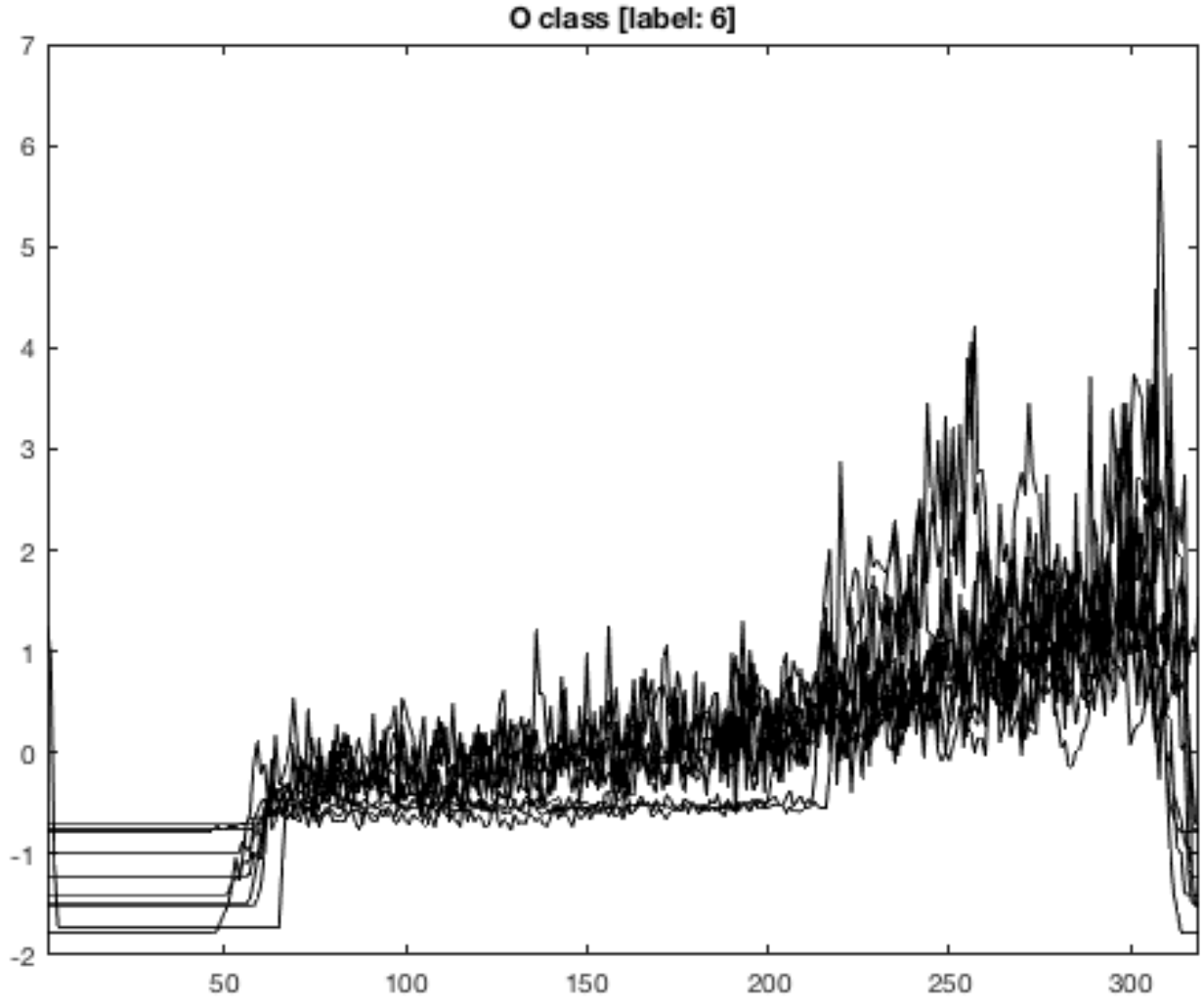
4. I2 (Impulsive Event Pair)



5. KM (Gradual Intra-Cloud Smoke)



6. O (Off-record) (special case)



The Problem

- Imbalanced data
- Unequal class representation
- Curse of dimensionality

Topic

Naive Bayes

- Essence of Naïve Bayes $\rightarrow$ Given multiple pieces of evidence, treat each piece as independent.
- $P(outcome|evidence) = \frac{P(likelihood\_of\_evidence)*(Prior)}{P(evidence)}$
- Our job is to look at the evidence, to consider how likely it is to be this class or that class, and assign a label to each entity.
- The class that has the highest probability is declared the "winner" and that class label gets assigned to that combination of evidences.
- Gaussian Naïve Bayes $\rightarrow$ assumes means within classes are normally distributed.
- With a (default) train-test split of 70-73, we achieved an accuracy of 0.573.

K-Nearest-Neighbors

Topic

SVM

CNN

RNN

Topic

Hyperparameter Tuning

Feature Preprocessing