Small Project:

ECG’s classifier

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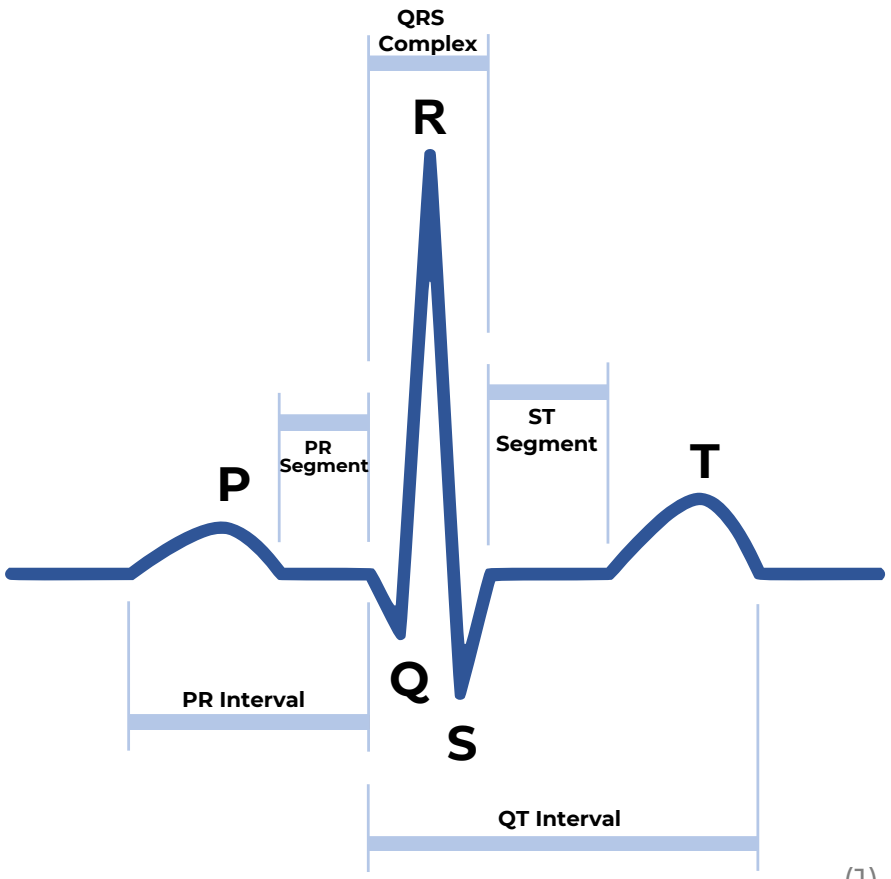
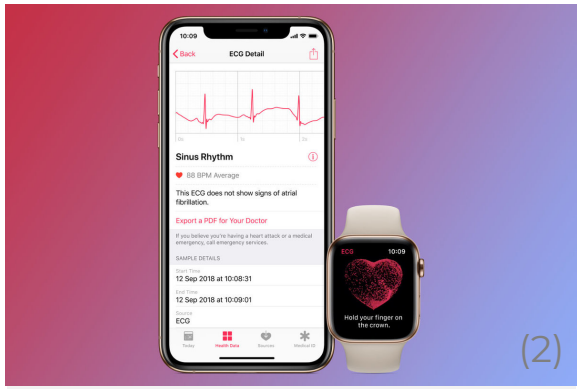
Introduction



(1)

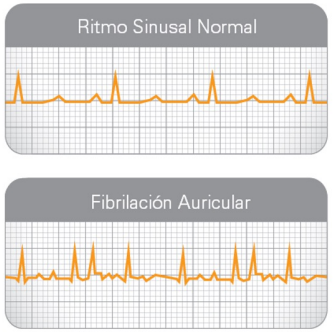
Characteristics ECG

- EASY DETECTION
- NON-INVASIVE
- CHEAP
- PORTABLE
- AUTOMATIC



(2)

Motivation
Diagnosis at early stages and monitorization of patients.



(3)

Atrial fibrilation
Difference in the distance between the peaks

Goal

1. Separate clean ECG from noisy ECG
2. Design and program R peak detector
3. Provide a classifier for the 4 classes

Signals and methods

1

8528 signals + Reference

- Different duration
- Classes of the signals

2

- Read the signals
- Programing algorithms

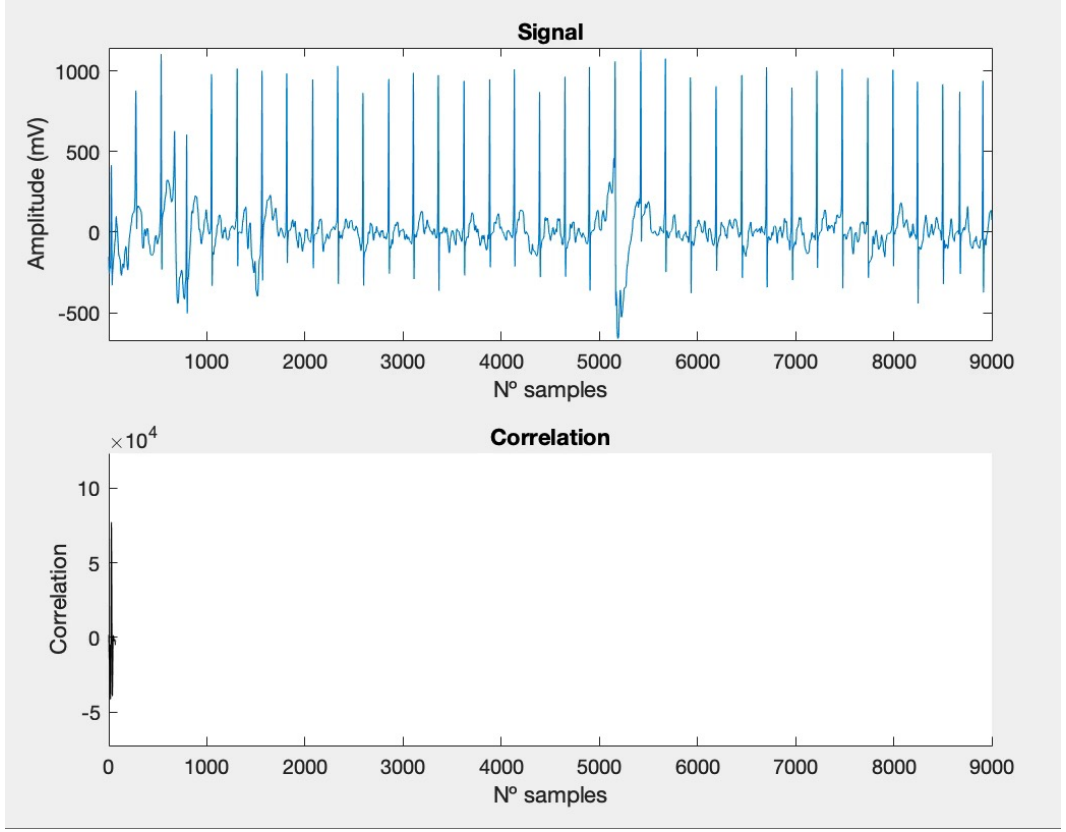
3

Output: results plotted

- Peaks detected
- Scatter plot
- Confusion matrix

Signals and methods

R peaks detector (Correlation)

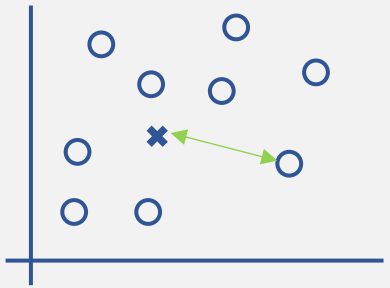


- **Sense of the signal** (depending on the derivative and a threshold)
- **Correlation** pattern
- Stablish of the threshold based on the standard deviation of the correlation.
- Output: location of the peaks and peaks distance

Signals and methods

Descriptors

POINCARÉ DISPERSION

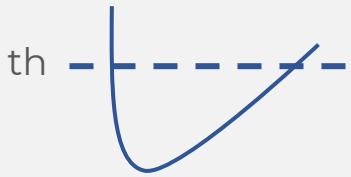


$$d = \sqrt{(x-\mu_x)^2+(y-\mu_y)^2}$$

Mean to eucladian distances to the mean.

COUNT ZER

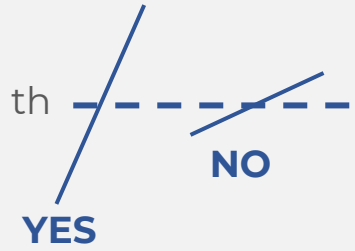
[300, 200, 200, 300]



Covariance with an arrytmic pattern. Values below a threshold.

COUNT DER

[300, 200, 200, 300]



Covariance with an arrytmic pattern. Derivates upper a threshold.

PEAKS FREQUENCY

Mean of the peaks distance

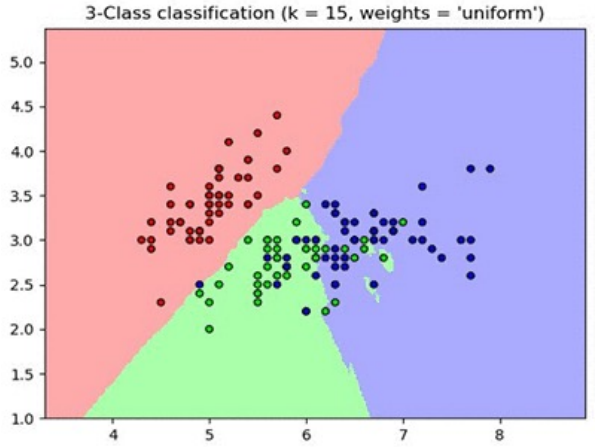
RMSSD

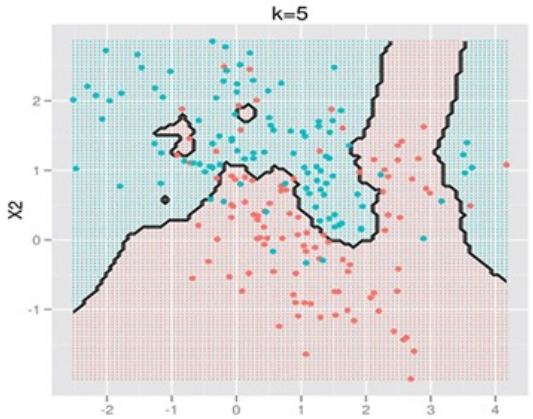
$$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i)^2}$$

Root mean square of the peaks distance.

Signals and methods

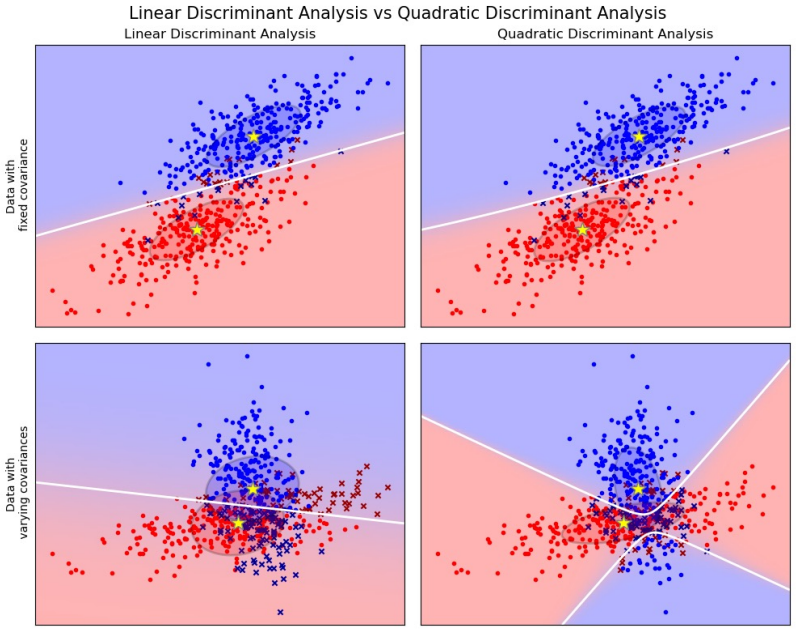
Descriptors





(4)

kNN (k-Nearest Neighbour)

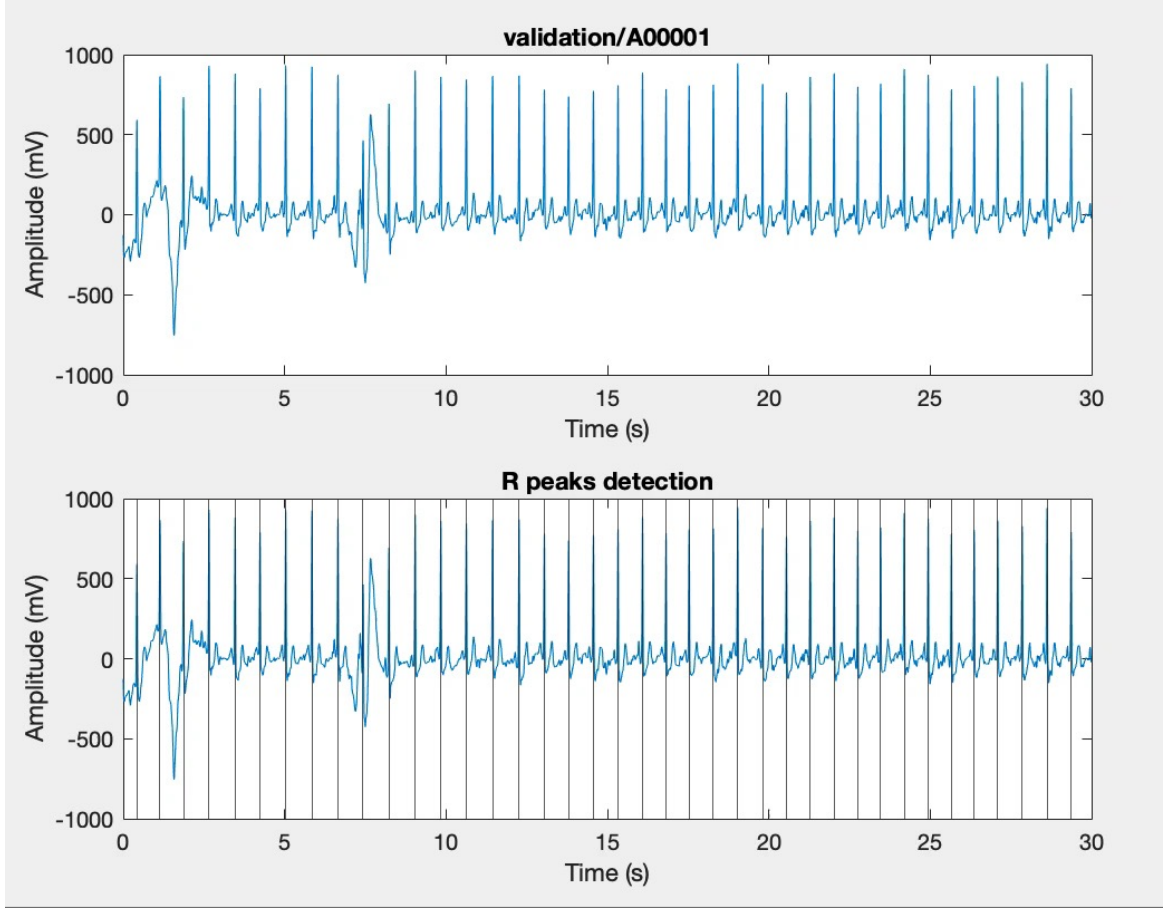


(5)

LDA (Linear Discriminant Analysis)

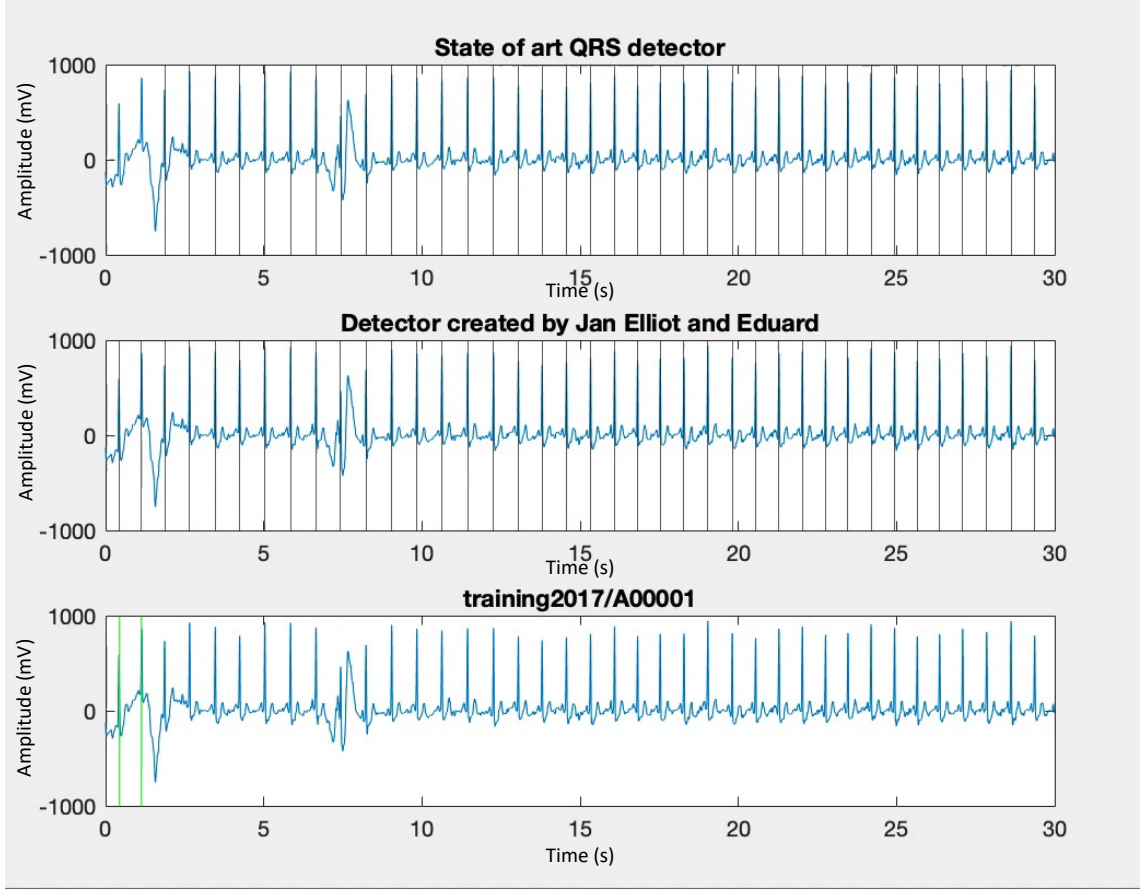
Results and discussion

R peaks detector



Results and discussion

Comparison with state of art QRS detector



- Not present in QRS detector
- Not present in our detector

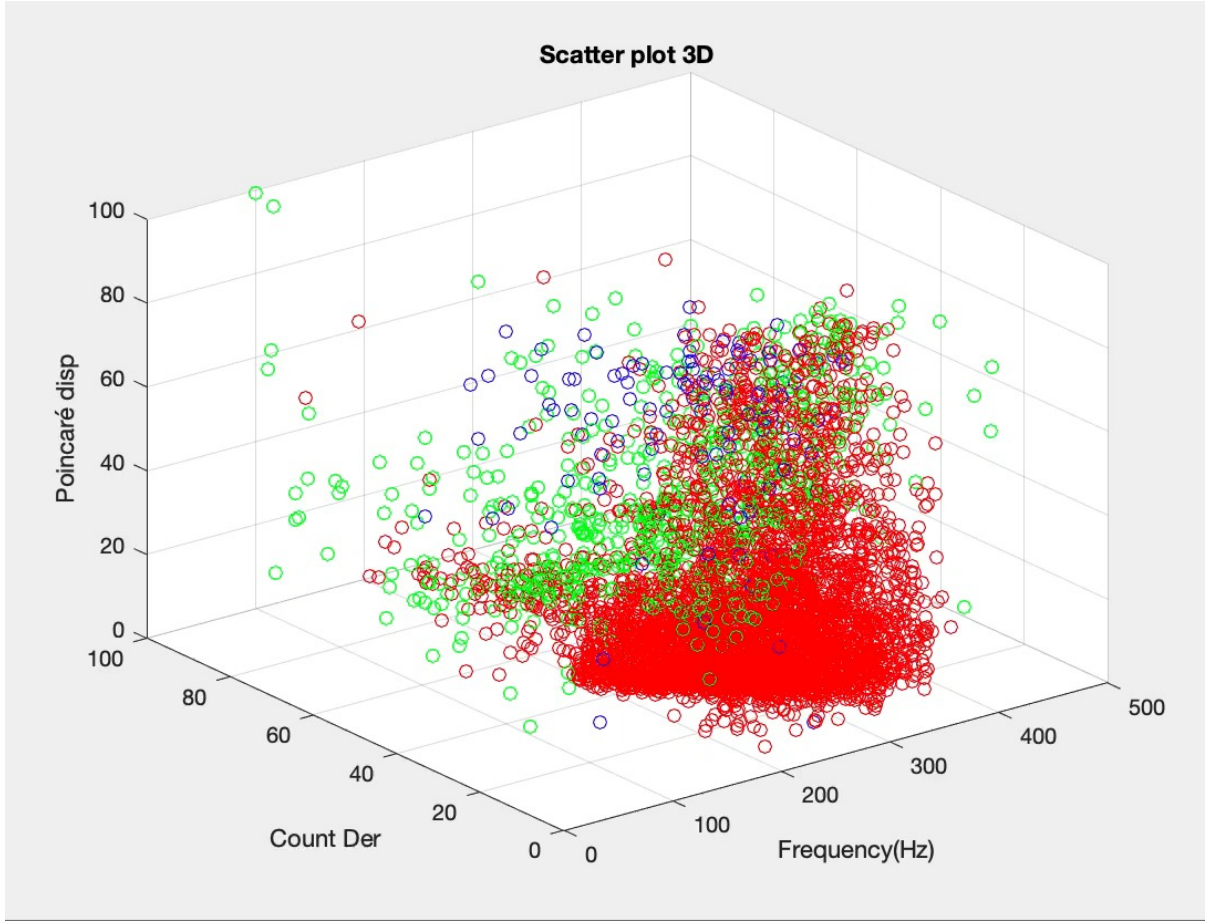
+3.5

MORE PEAKS

- Detection of more peaks in noise
- Detection of first peaks

Results and discussion

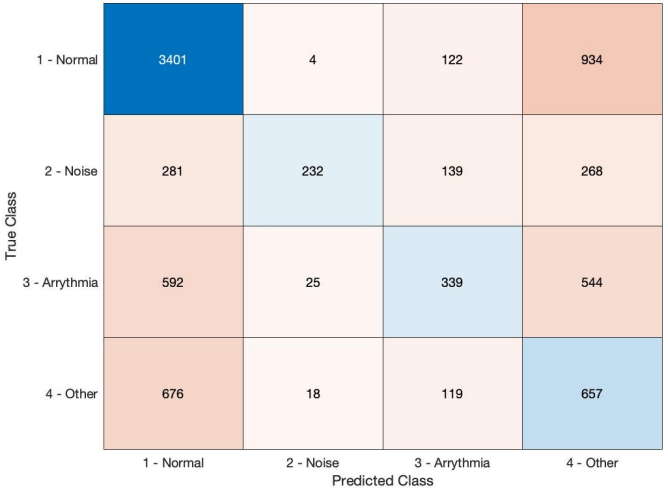
Classifier



55.4%

ACCURACY

Num_training = 200
K = 6
SD: 0.0125
Without other: 78%



0.5543 accuracy

Conclusion

- The algoritm needs to be improved
- Problems with ‘other’ class
- Daily problems of a data scientist
- New skills developed

Images

1) Colaboradores de los proyectos Wikimedia. “Síndrome de QT Corto.” *Wikipedia.org*, Wikimedia Foundation, Inc., 23 Apr. 2019, es.wikipedia.org/wiki/S%C3%ADndrome_de_QT_corto#/media/Archivo:SinusRhythmLabels.svg.

2) Pocket-lint. “Apple Watch ECG: ¿Qué Es y Cómo Se Configura?” Pocket-Lint, 16 Sept. 2020, www.pocket-lint.com/es-es/relojes-inteligentes/noticias/apple/145727-reloj-de-manzana-ekg-ecg.

3) “¿Qué Es La Fibrilación Auricular? | Mi Arritmia.” Getsmartaboutafib.net, getsmartaboutafib.net/es-419/publico-general/tengo-fibrilacion-auricular/que-es-la-fibrilacion-auricular.

4) “Amazon SageMaker Supports KNN Classification and Regression.” Amazon Web Services, 11 July 2018, aws.amazon.com/es/blogs/machine-learning/amazon-sagemaker-supports-knn-classification-and-regression/.

5) “1.2. Linear and Quadratic Discriminant Analysis — Scikit-Learn 0.23.2 Documentation.” Scikit-Learn.org, scikit-learn.org/stable/modules/lda_qda.html.