Identifying Known and Unknown Signals from the SETI Dataset

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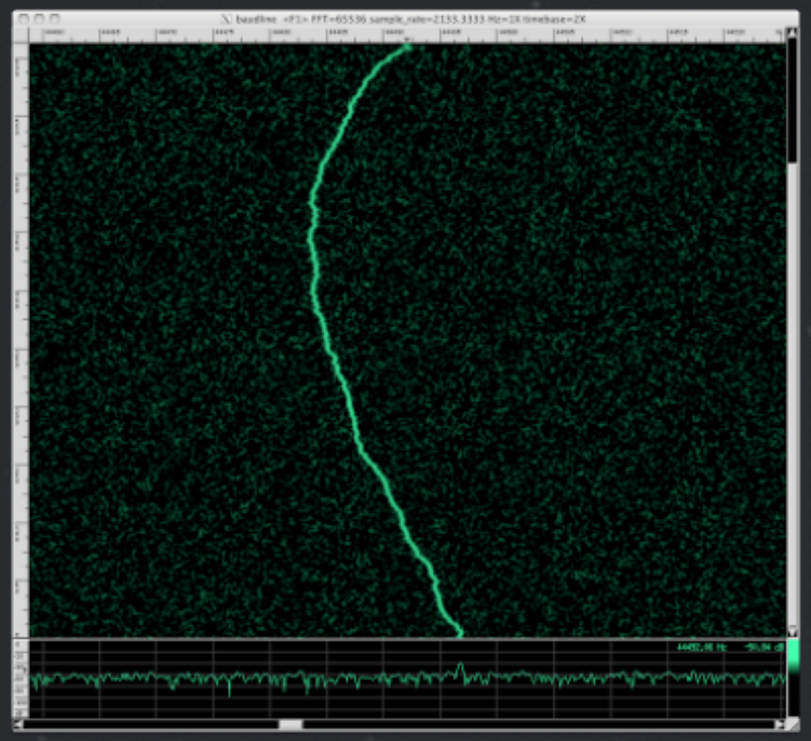
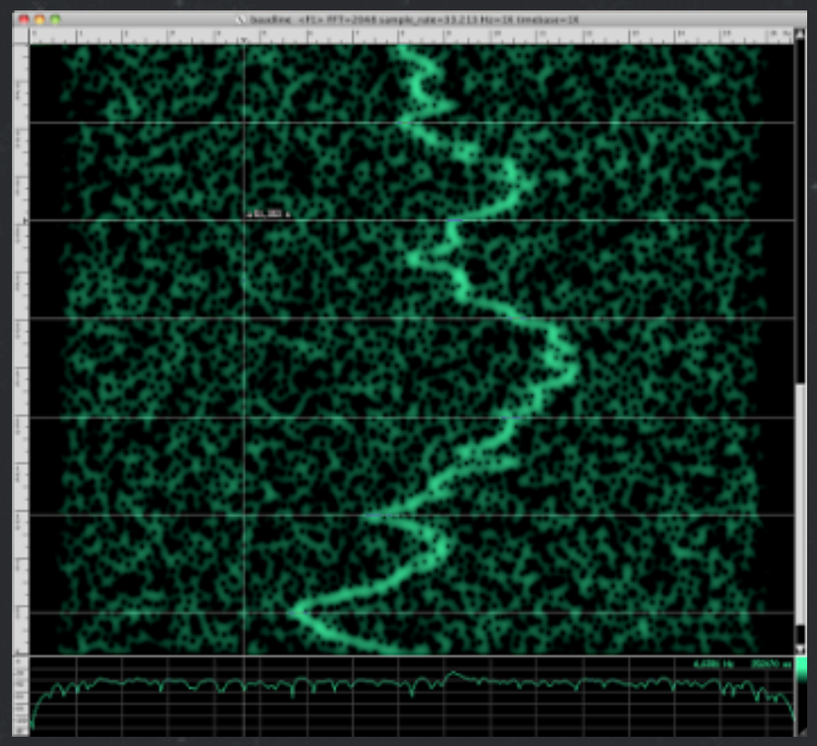
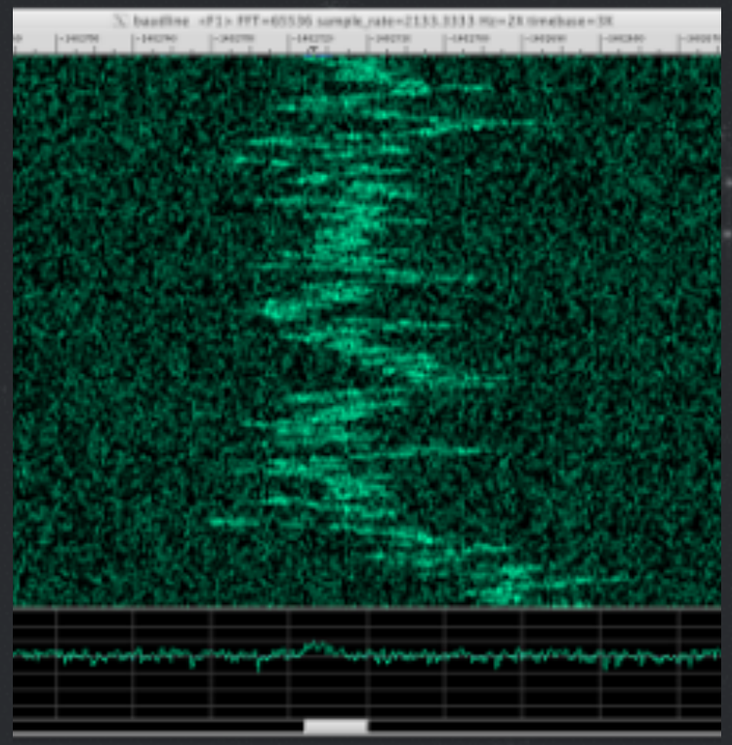
Dataset



Slow Modulation Squiggle



Classic Squiggle



Rapid Modulation Squiggle

>380,000 spectrogram images
833 hand-curated squiggle examples

Question 1: How can we use image processing to convert spectrogram waterfall plots into discrete time series data?

Question 2: How can we build a classifier to identify new “squiggle” signals from incoming spectrogram images?

Approach

1. Spectrogram conversion into discrete time series

2. Discrete Time Fourier Transform (DTFT) to decompose signals into component frequencies

3. Feature extraction using FT & non-FT data

4. Fit a classifier to separate squiggle v.s. non-squiggle

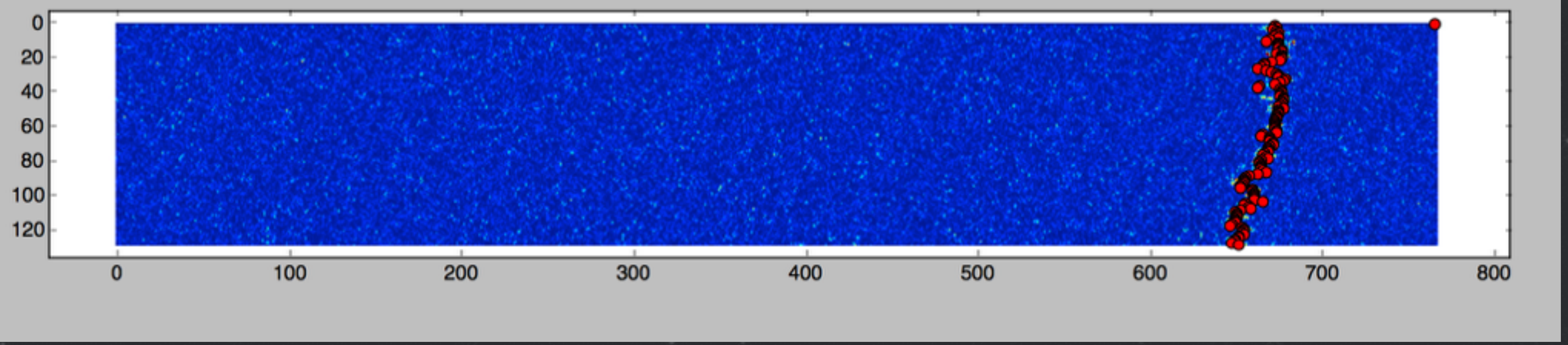
5. Unsupervised learning to identify squiggle subgroups

Progress

1. Explored generative models: Brownian motion with drift/noise, autoregressive

2. Derived dynamic programming algorithm & loss function for time series discretization.

3. Applied DTFT on squiggle and non-squiggle images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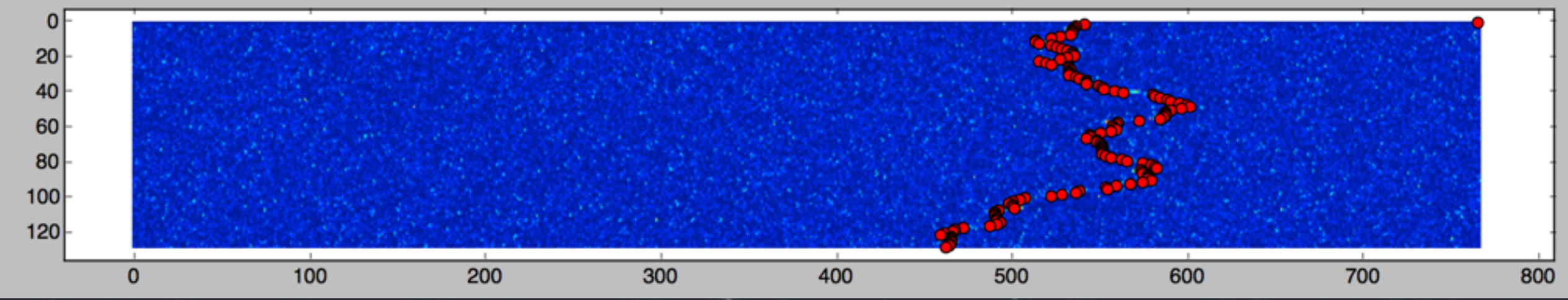
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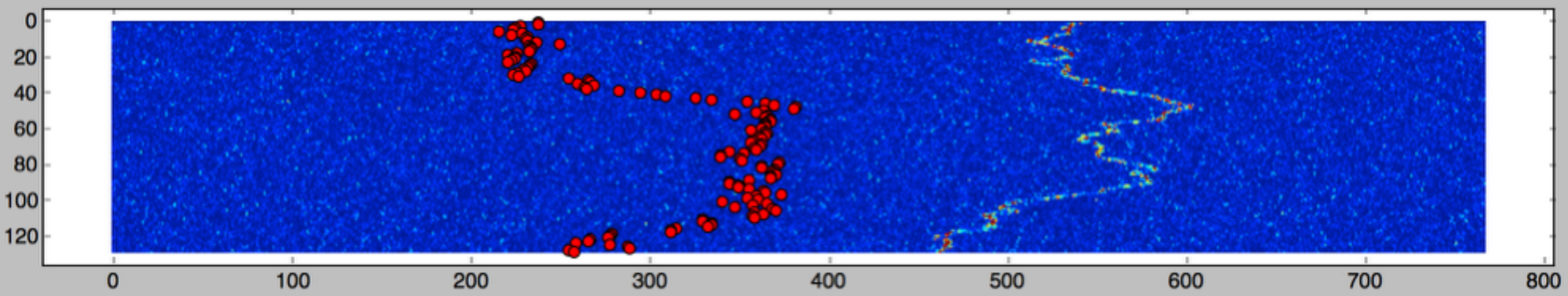
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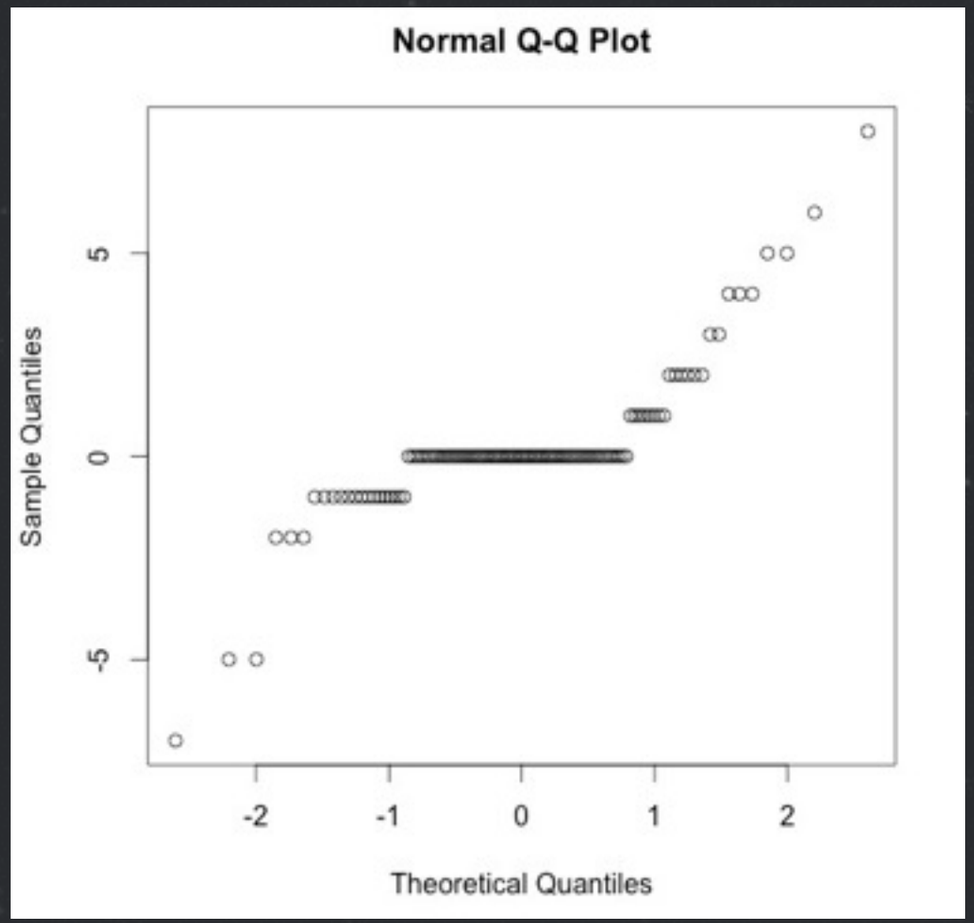
Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
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-2
-1
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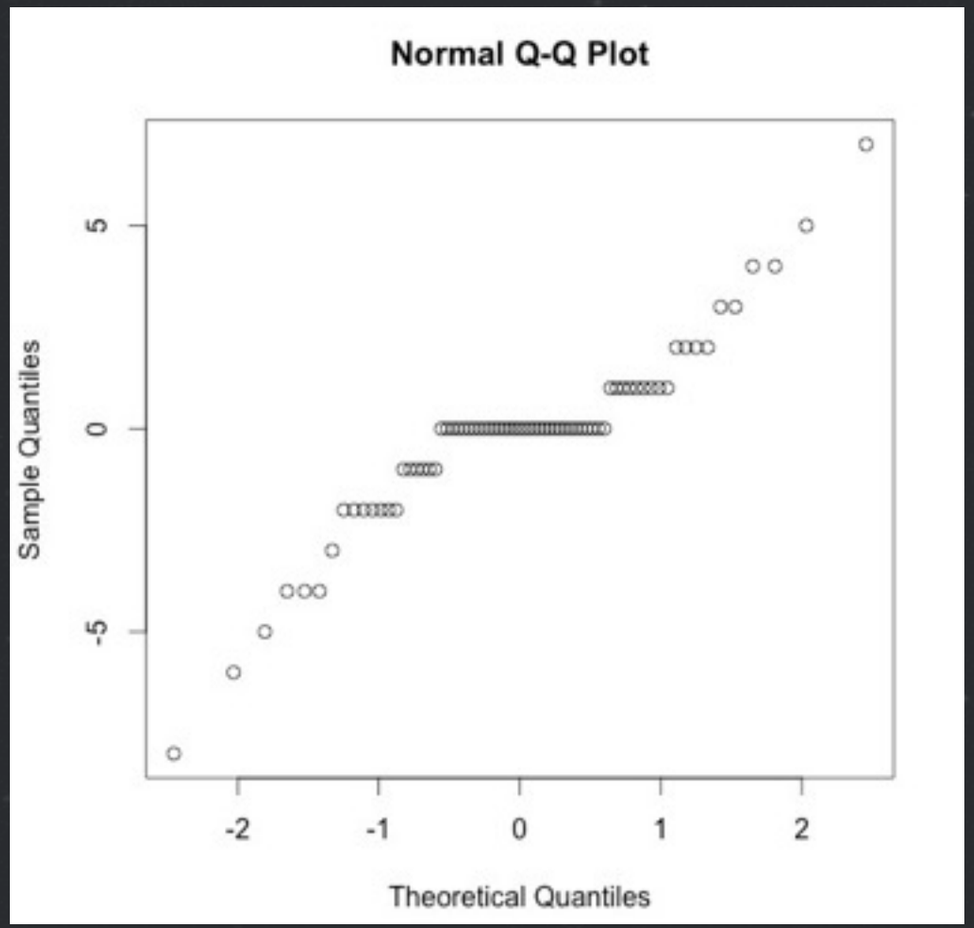
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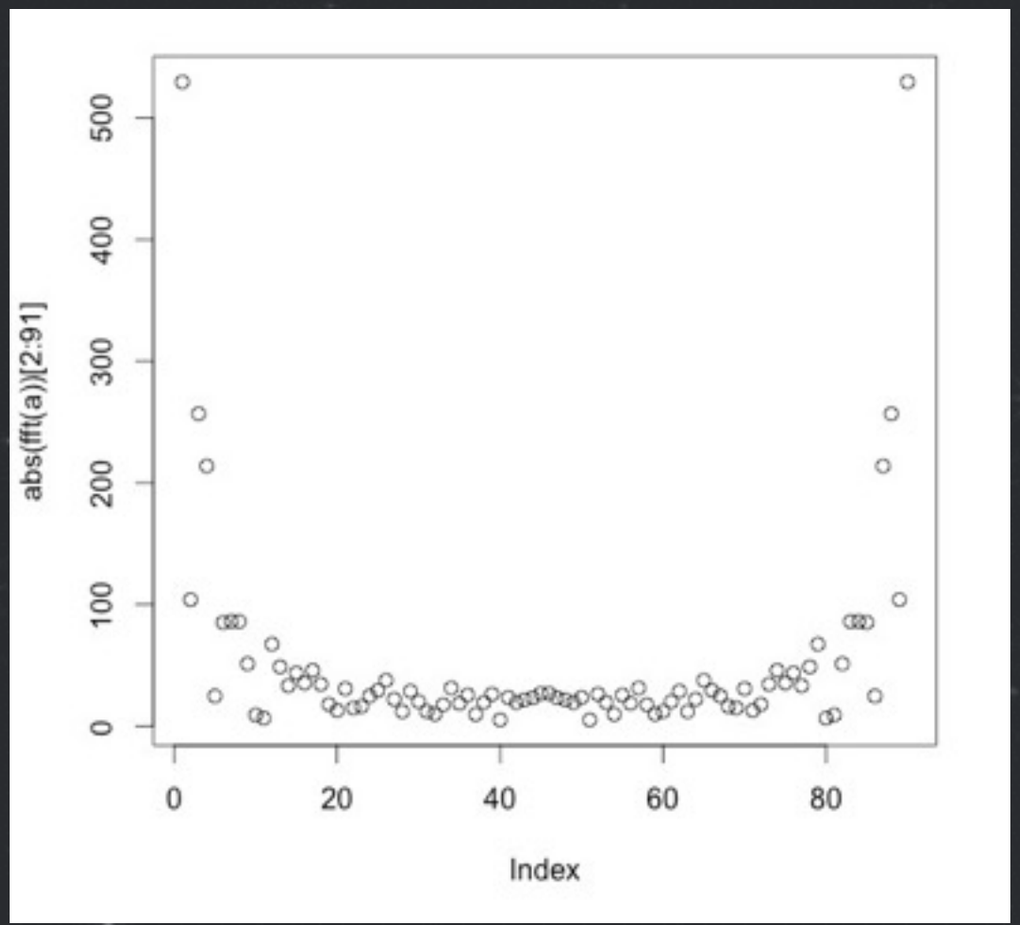
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Future Directions

1. Parallelize discretization algorithm

2. Feature Extraction: parameters of AR model, band intensity, etc.

3. Fit a classifier using logistic regression, linear discriminant analysis, etc. to separate squiggle & non-squiggle

4. Apply K-means, KNN, self-organizing maps, etc. to identify characteristic groups within squiggles