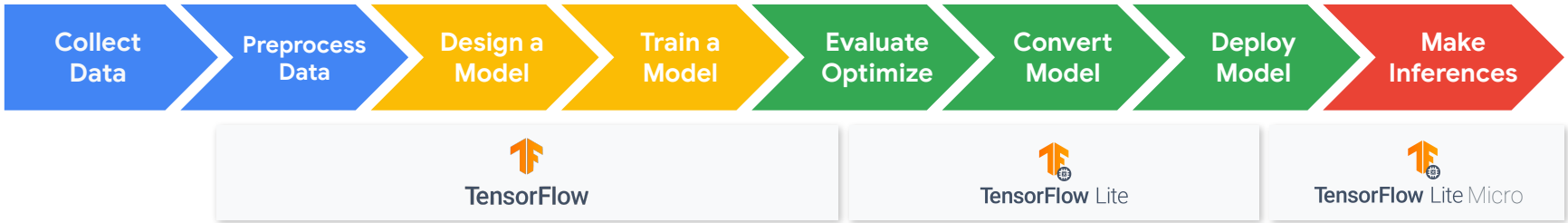
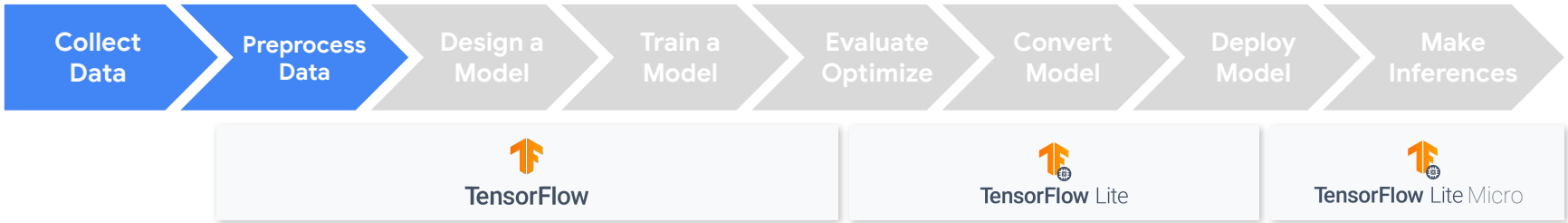
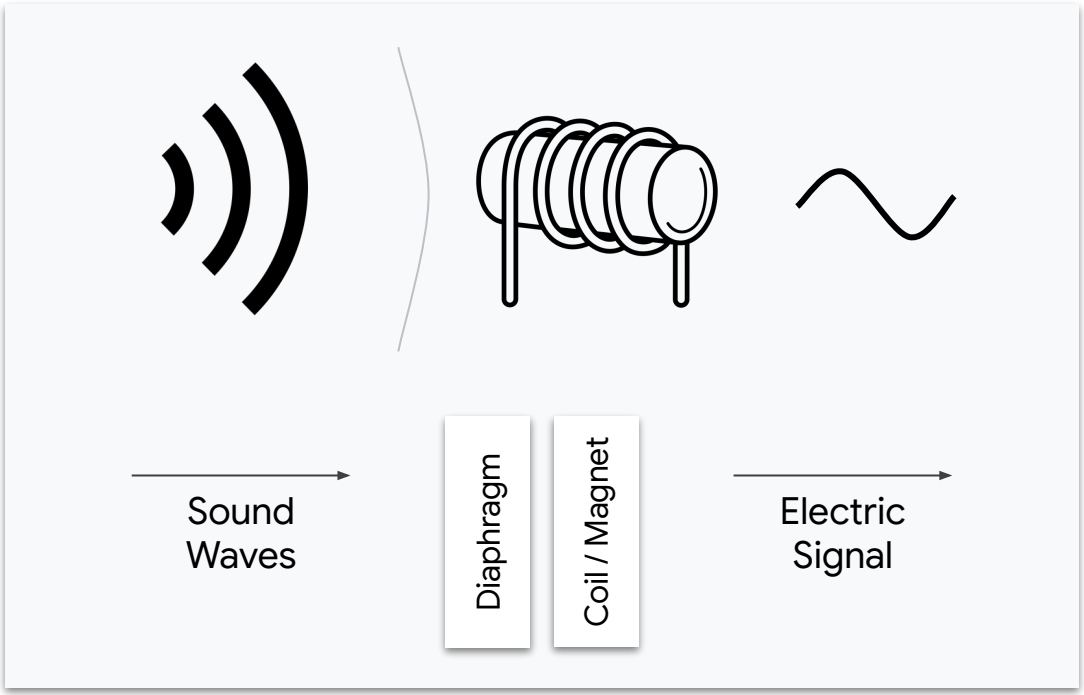
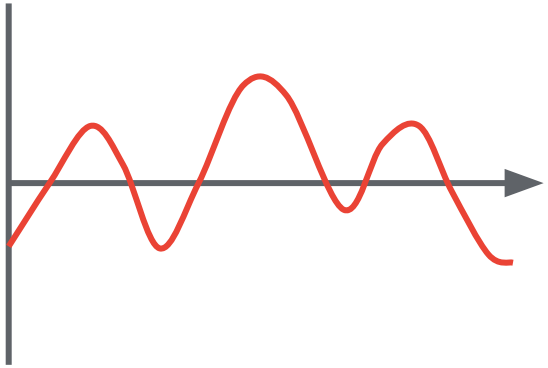
KWS Data Collection / Pre-Processing


Collect Data
Preprocess Data
Design a Model
Train a Model
Evaluate Optimize
Convert Model
Deploy Model
Make Inferences
TensorFlow
TensorFlow Lite
TensorFlow Lite Micro

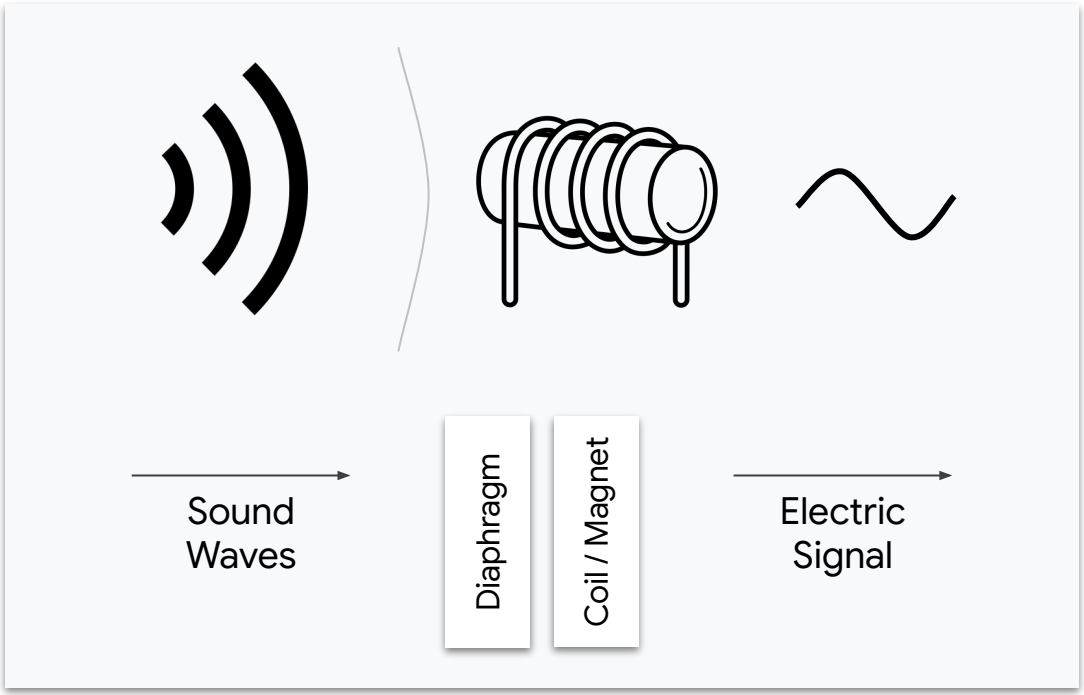

Collect Data
Preprocess Data
Design a Model
Train a Model
Evaluate Optimize
Convert Model
Deploy Model
Make Inferences
TensorFlow
TensorFlow Lite
TensorFlow Lite Micro

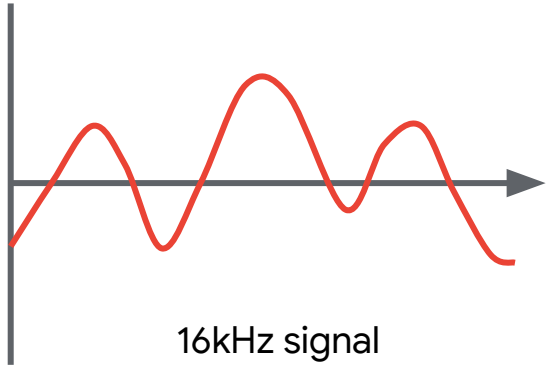
Sensor Data

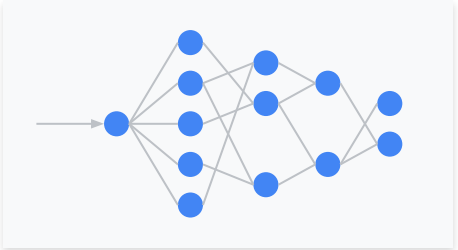




Sensor Data


Sound
Waves
Diaphragm
Coil / Magnet
Electric
Signal


16kHz signal



Sensor Data

- 16kHz signal, so that's **16000** samples (points / second)

16kHz signal

Sensor Data

- 16kHz signal, so that's **16000** samples (points / second)
- How do you feed ***all*** of that data into the network?

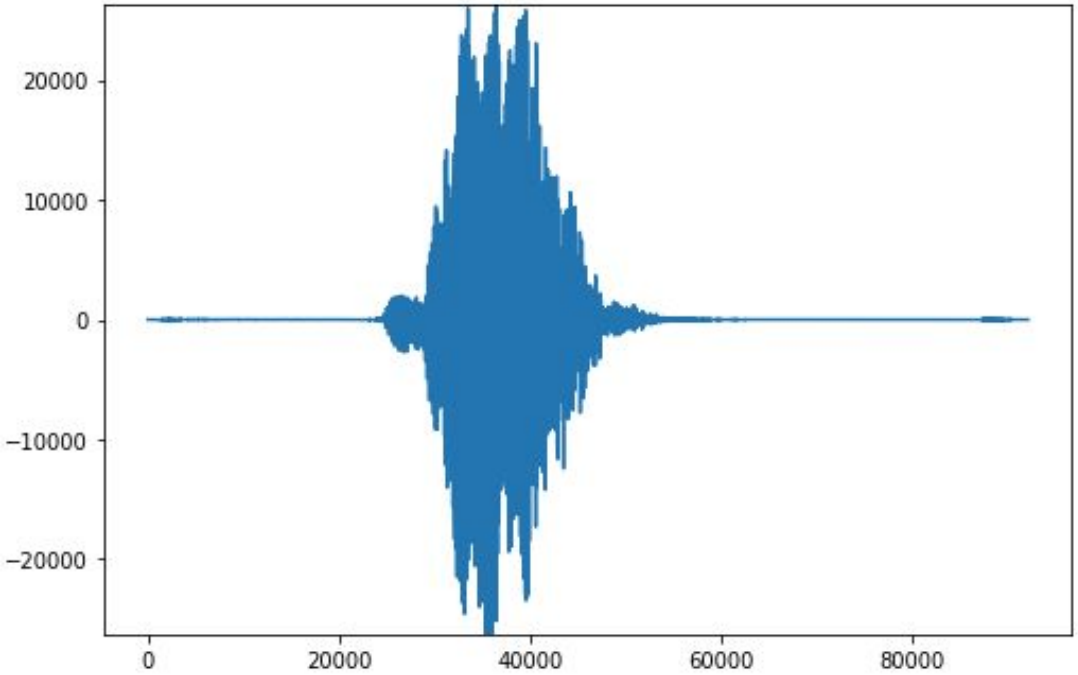
16kHz signal

Sensor Data

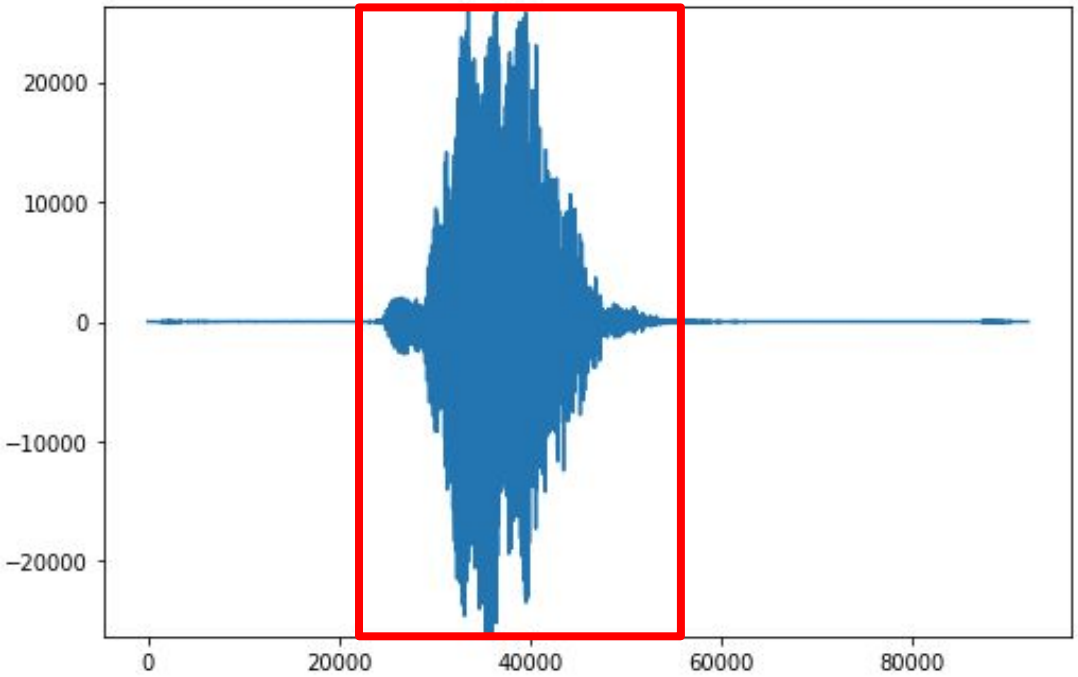
- 16kHz signal, so that's **16000** samples (points / second)
- How do you feed ***all*** of that data into the network?
- Need to **think creatively** about the input signal!

16kHz signal

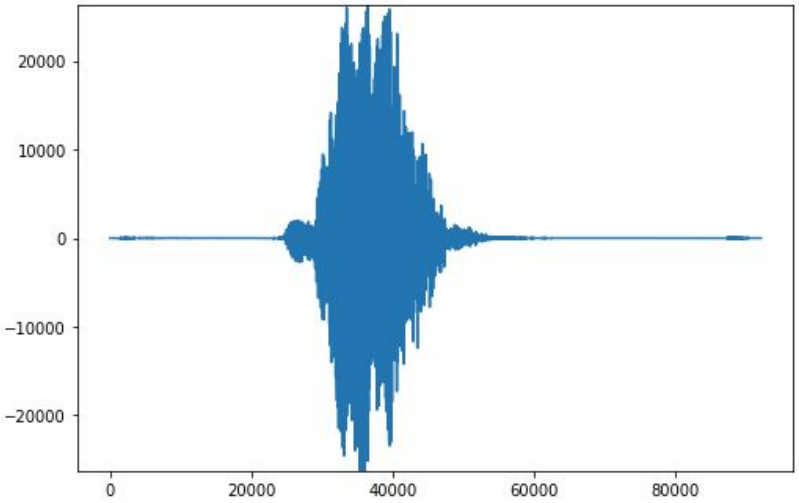
“No” *(spoken loudly)*



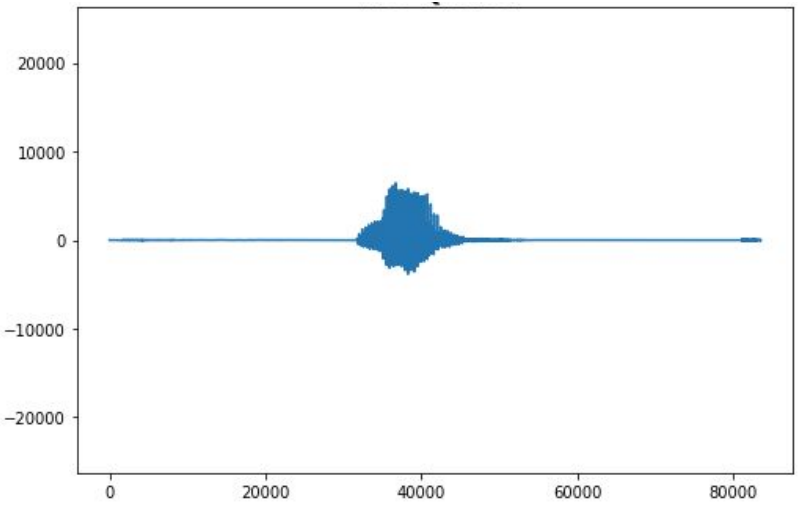
“No” *(spoken loudly)*



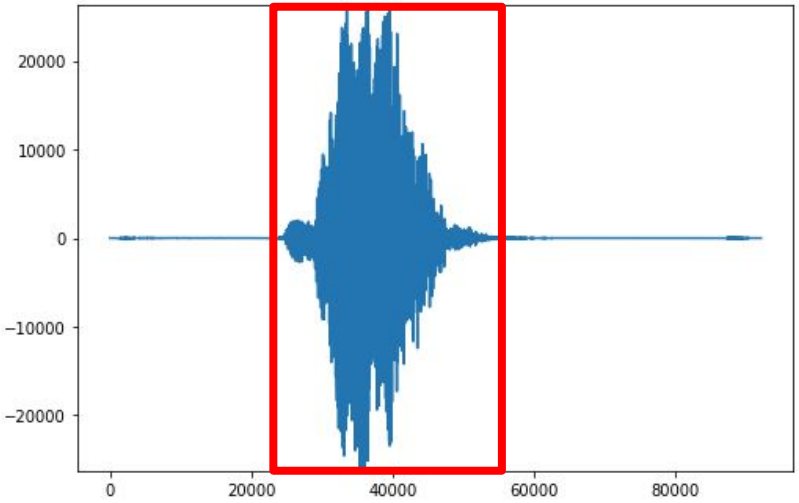
“No” *(spoken loudly)*



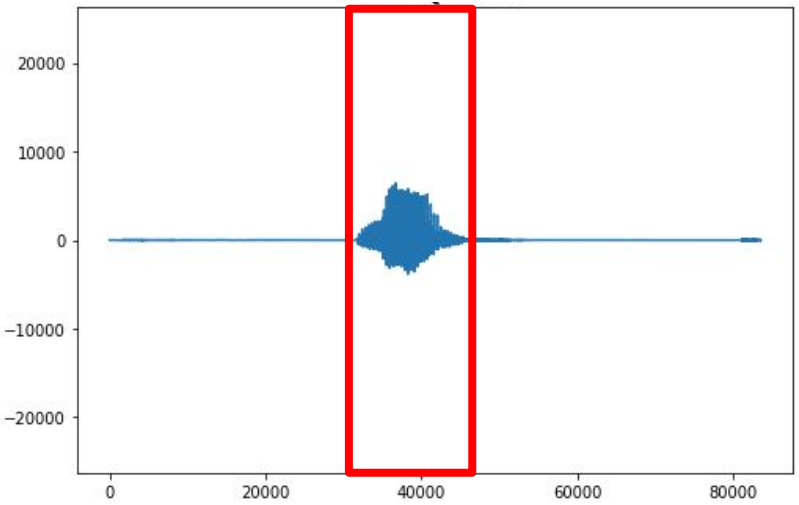
“No” *(spoken quietly)*



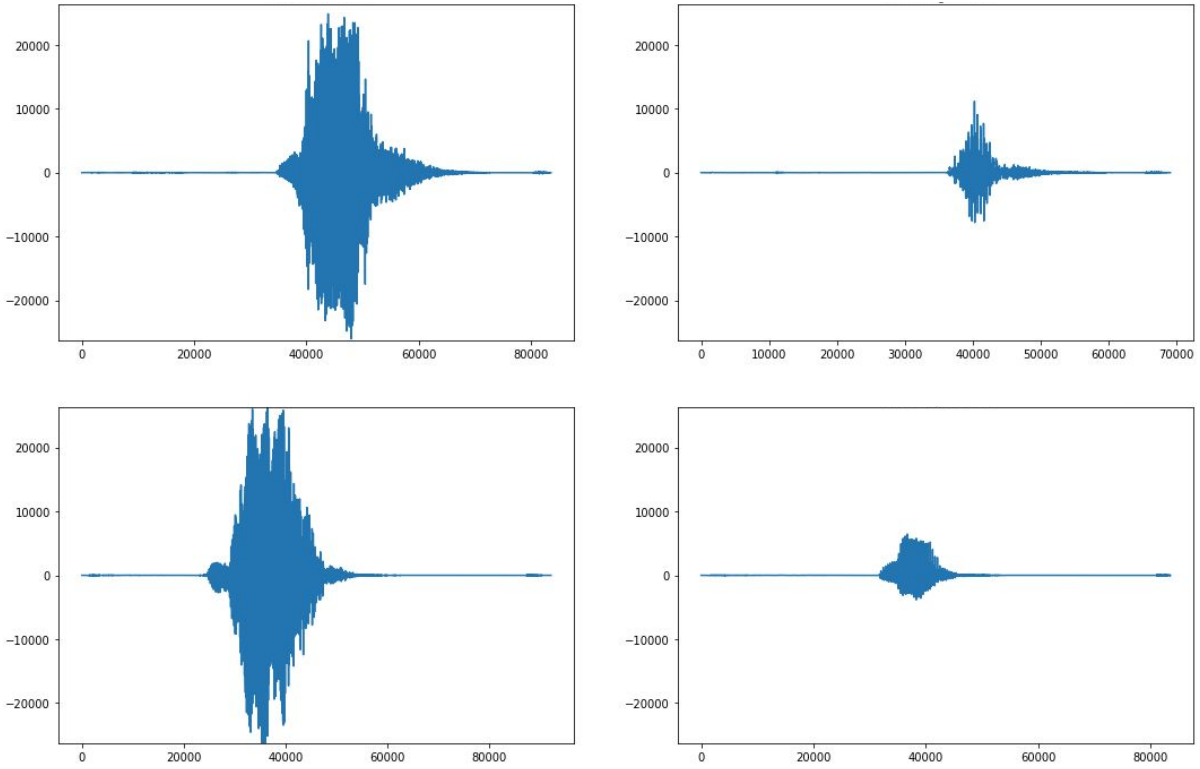
“No” *(spoken loudly)*



“No” *(spoken quietly)*



Guess!


20000
10000
0
−10000
−20000
0
20000
40000
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80000
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−10000
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10000
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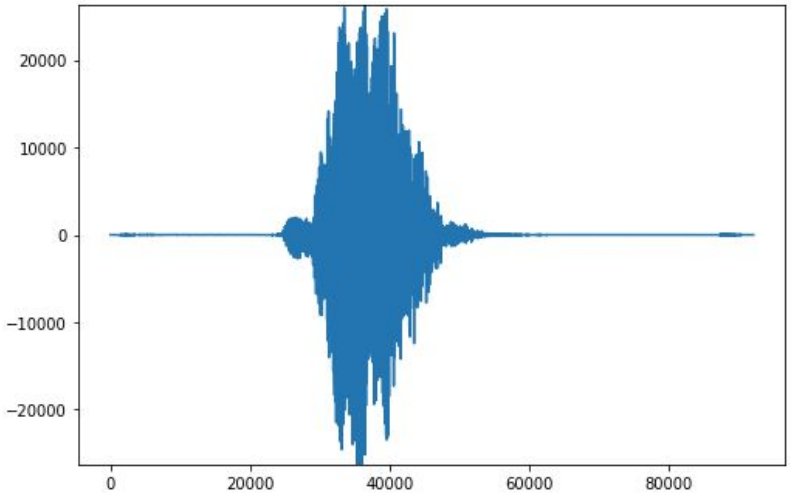
−20000
0
20000
40000
60000
80000
20000
10000
0
−10000
−20000
0
20000
40000
60000
80000

What are interesting **challenges**?

- It is a continuous signal, so **when does the word start**?

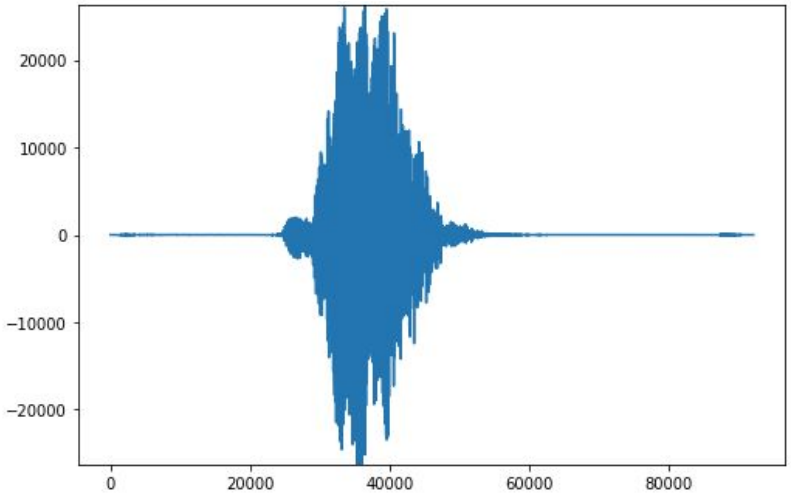
“No” *(spoken loudly)*



What are interesting **challenges**?

- It is a continuous signal, so **when does the word start**?
- How do you **“align”** on the starting point?

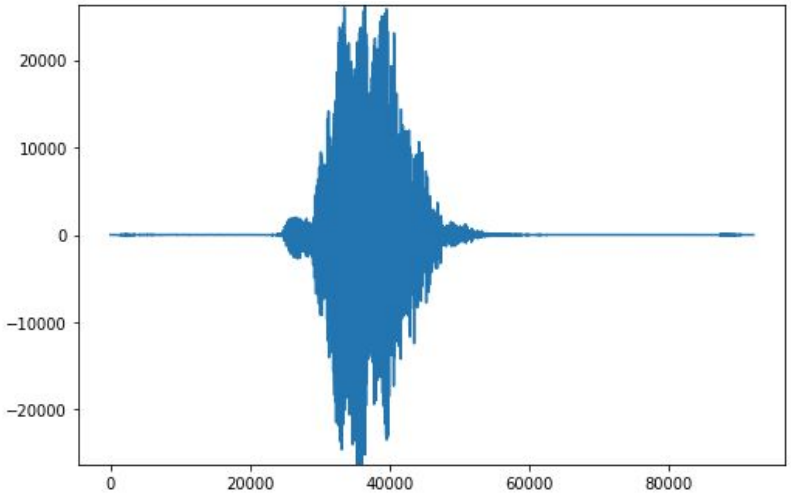
“No” *(spoken loudly)*



What are interesting **challenges**?

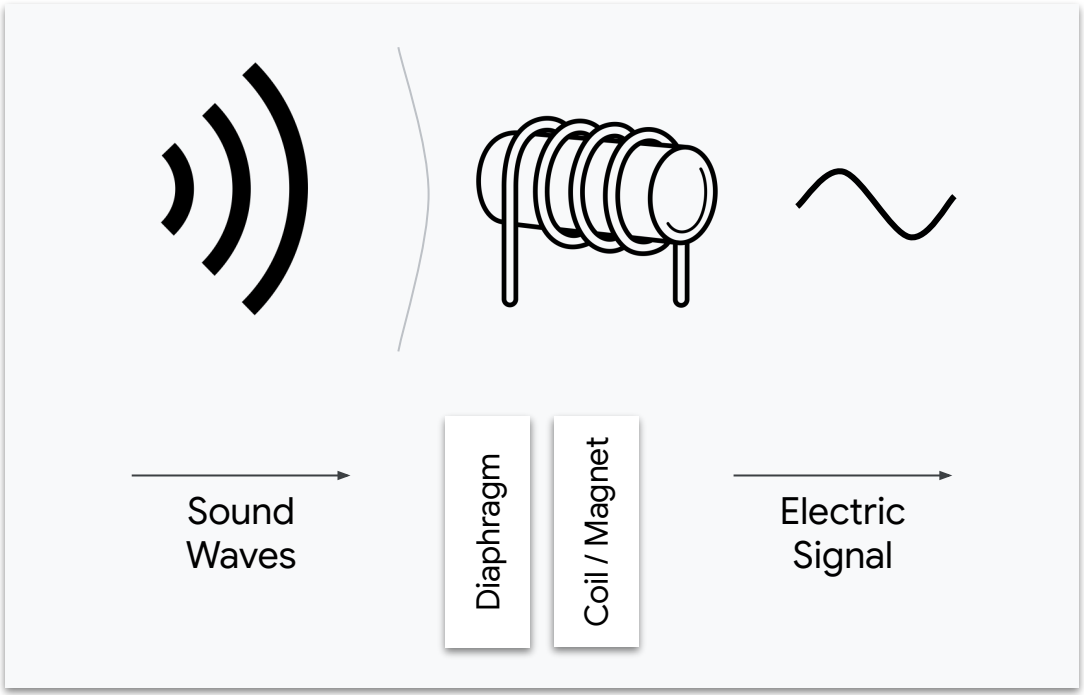
- It is a continuous signal, so **when does the word start**?
- How do you **“align”** on the starting point?
- How do we **extract the vital parts** of the signal that matter?

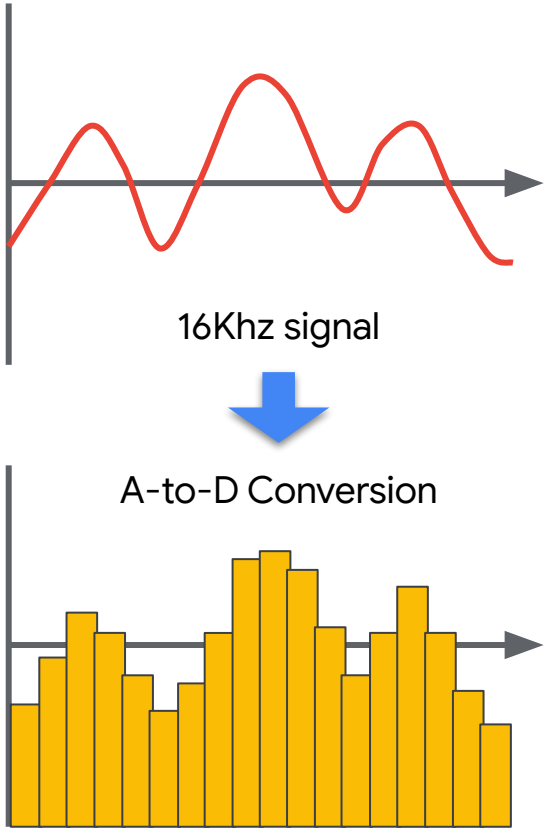
“No” *(spoken loudly)*



How can we ***differentiate*** the signals?

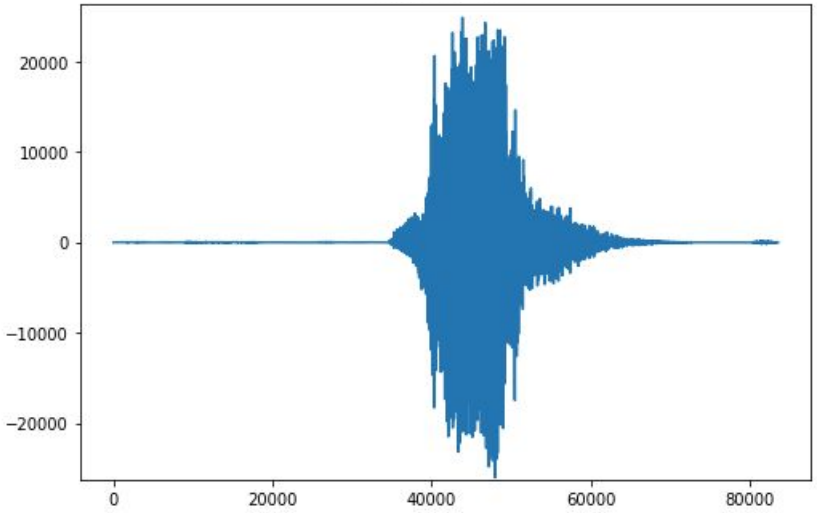
Sensor Data


Sound
Waves
Diaphragm
Coil / Magnet
Electric
Signal

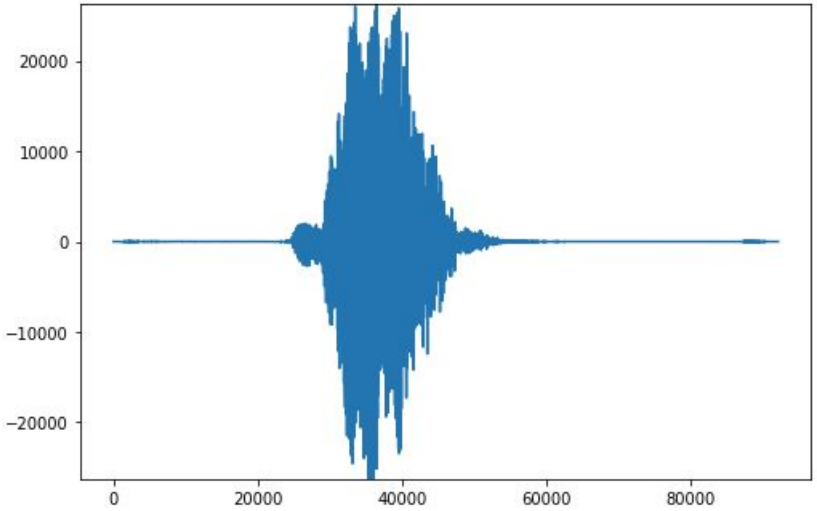

16Khz signal
A-to-D Conversion

Data **Preprocessing**

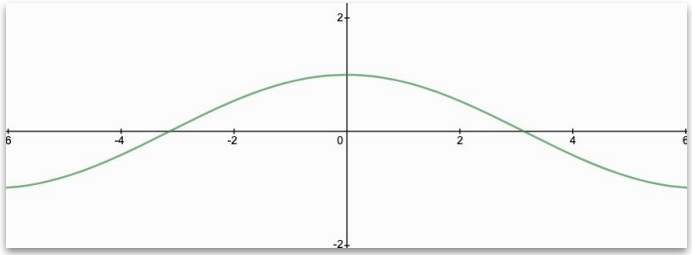
“No” *(spoken loudly)*



“No” *(spoken quietly)*



Signal **Components**?



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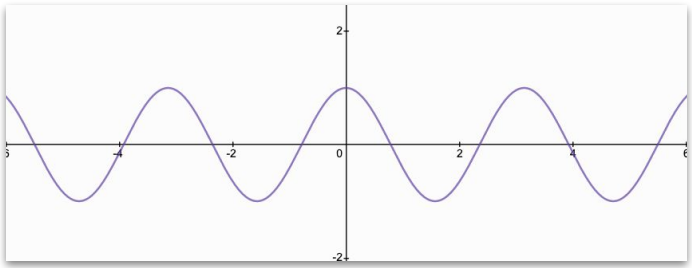

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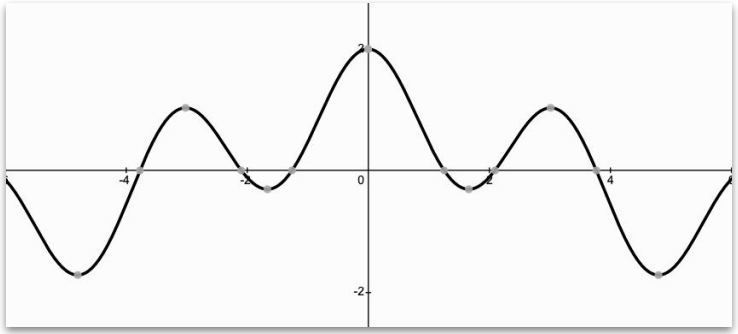


Signal **Components**?

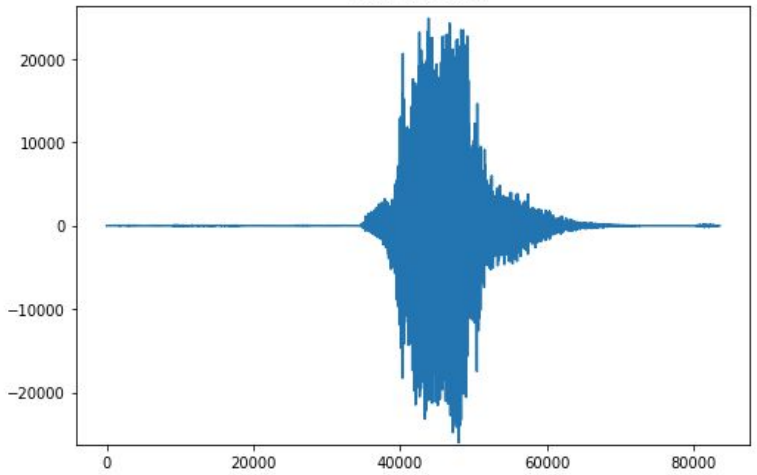
?

+

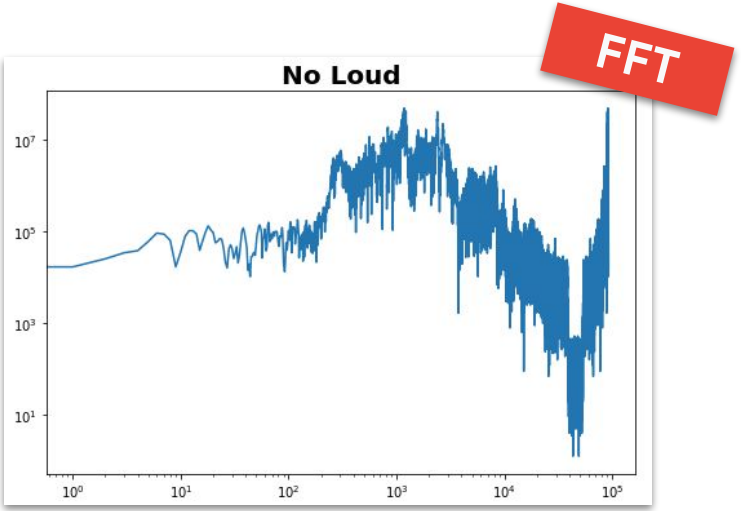
?

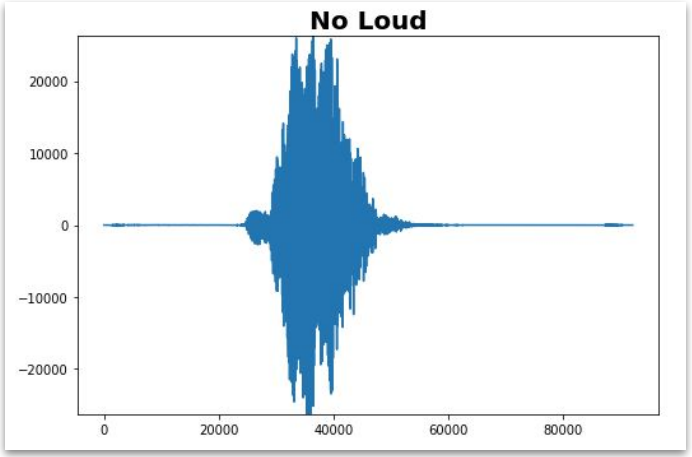
=

“No” *(spoken loudly)*



Signal **Components**?

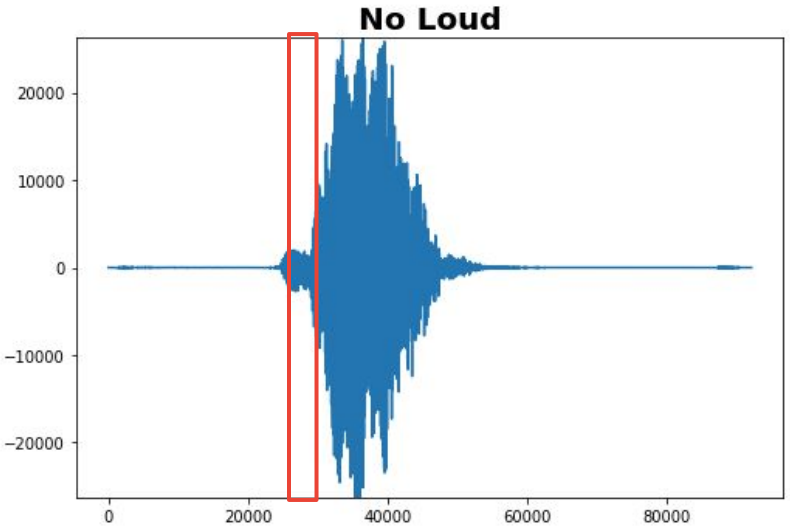




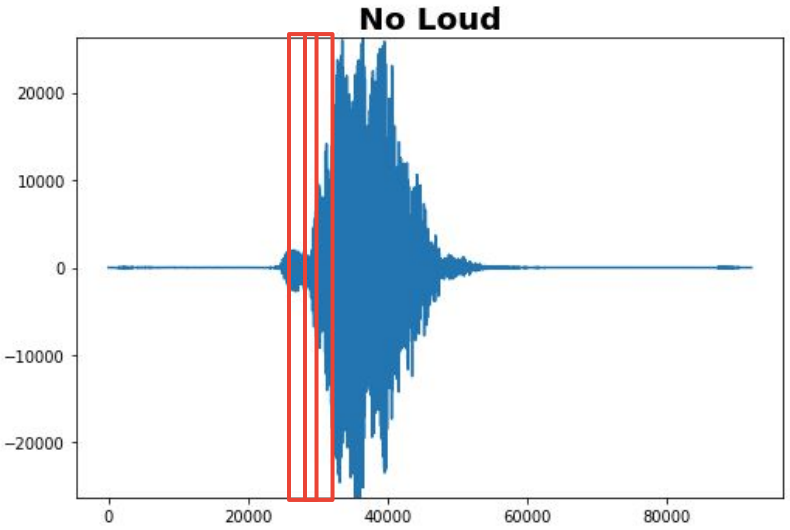
Frequency

Time

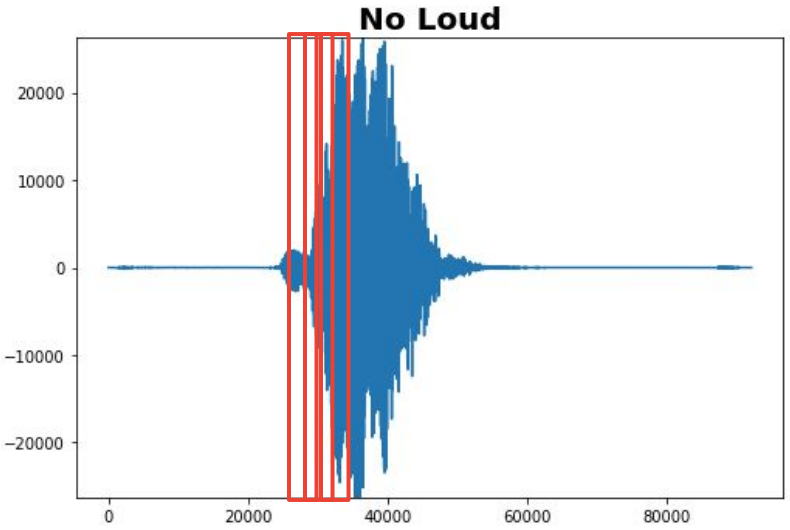
Data Preprocessing



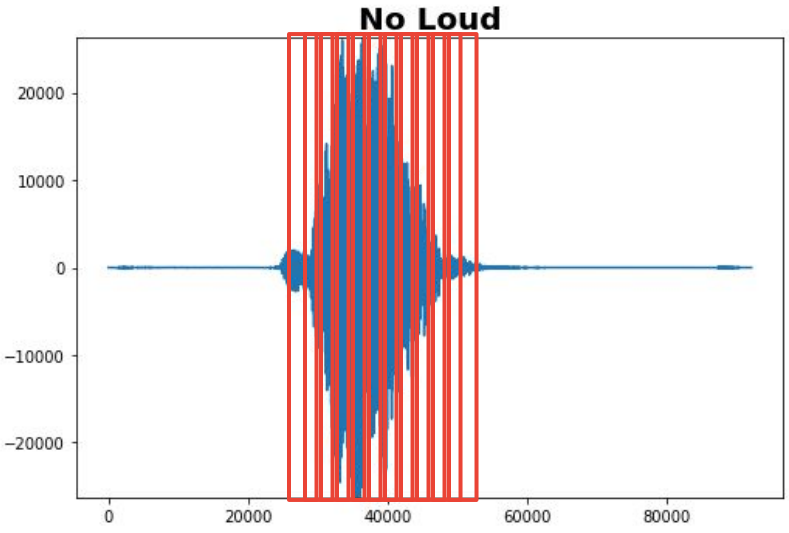
Data Preprocessing

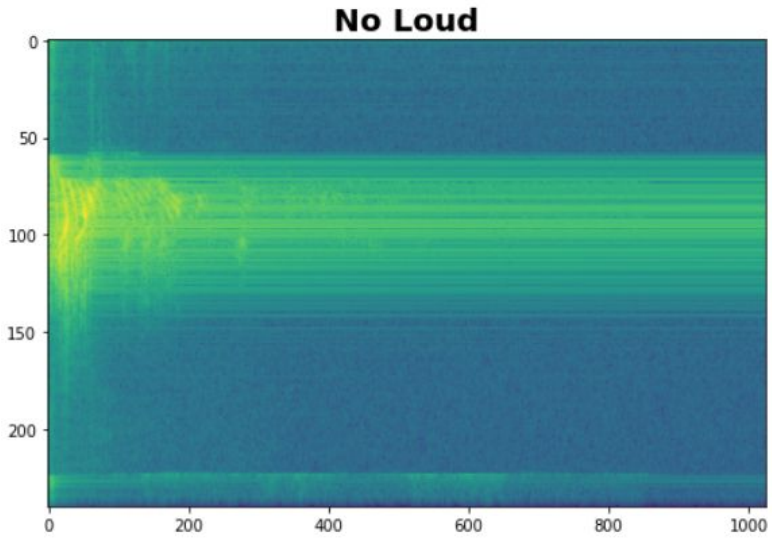


Data Preprocessing

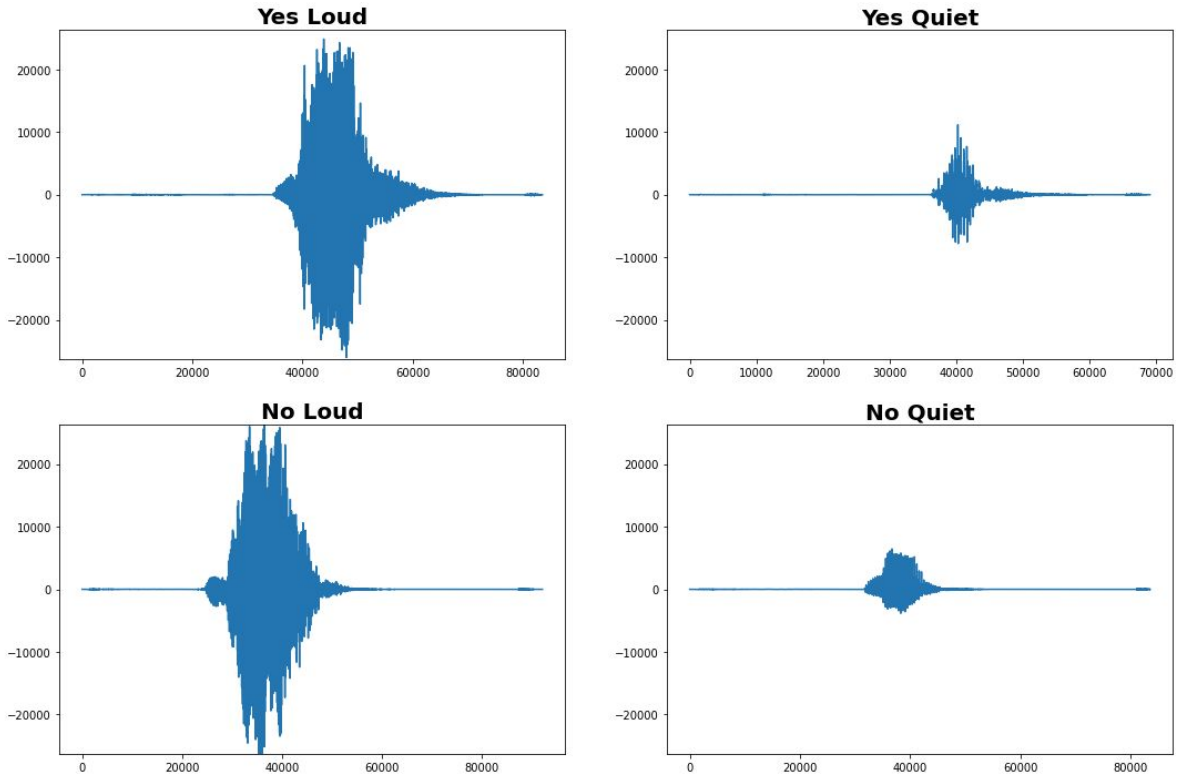


Data Preprocessing: **Spectrograms**

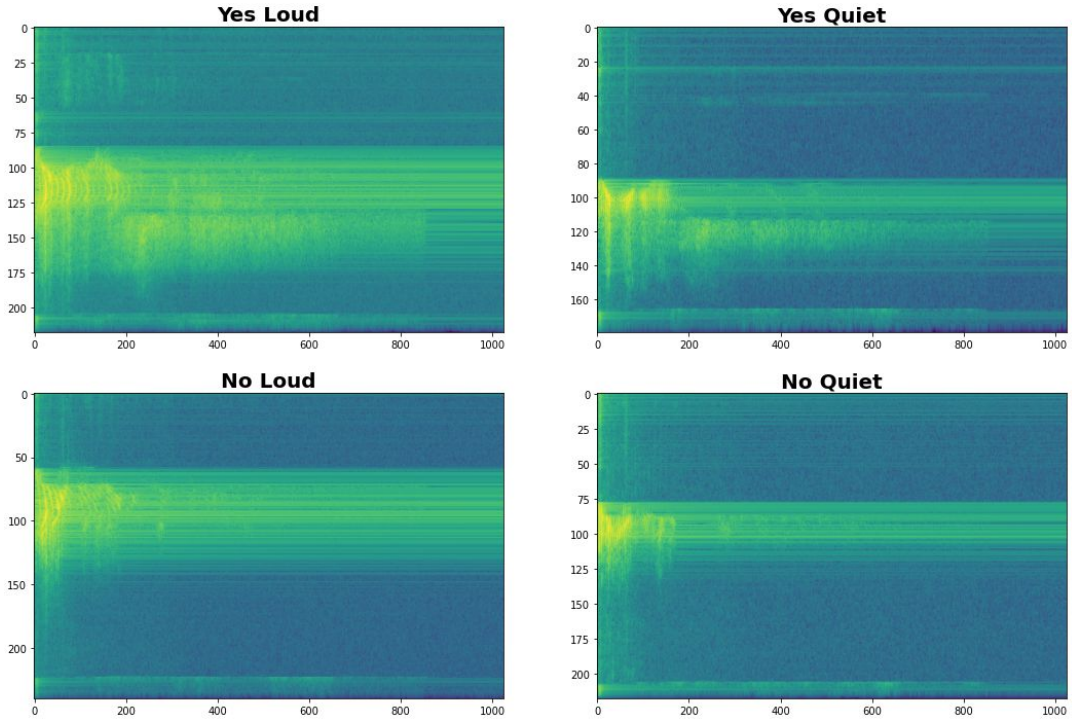




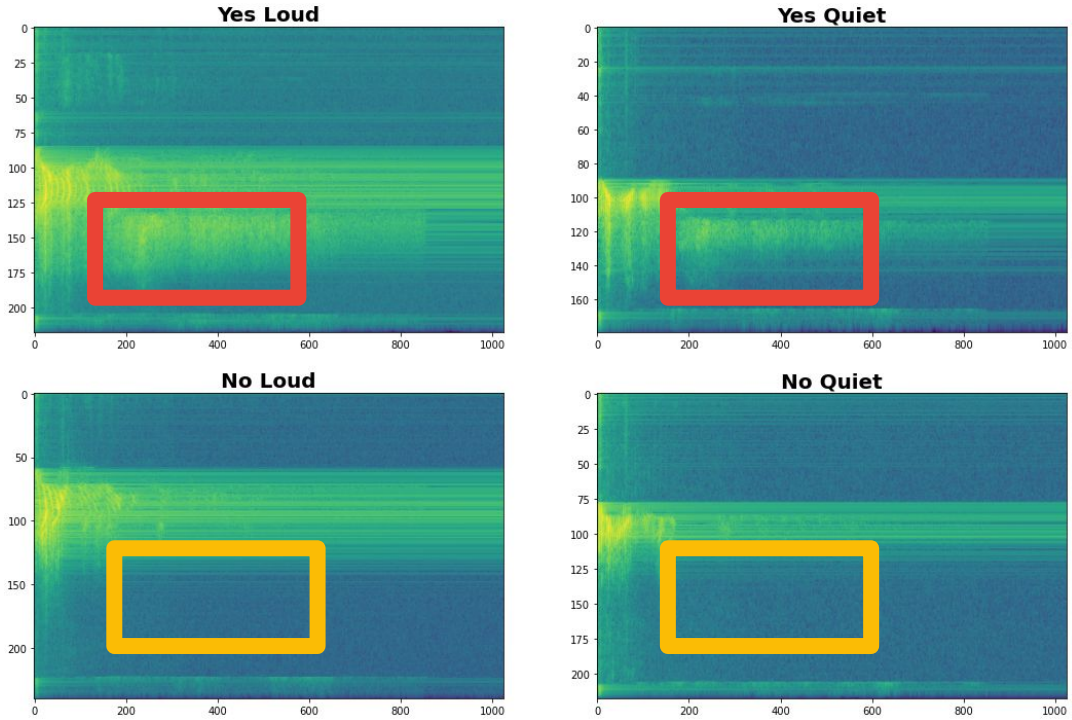
Data Preprocessing: **Spectrograms**



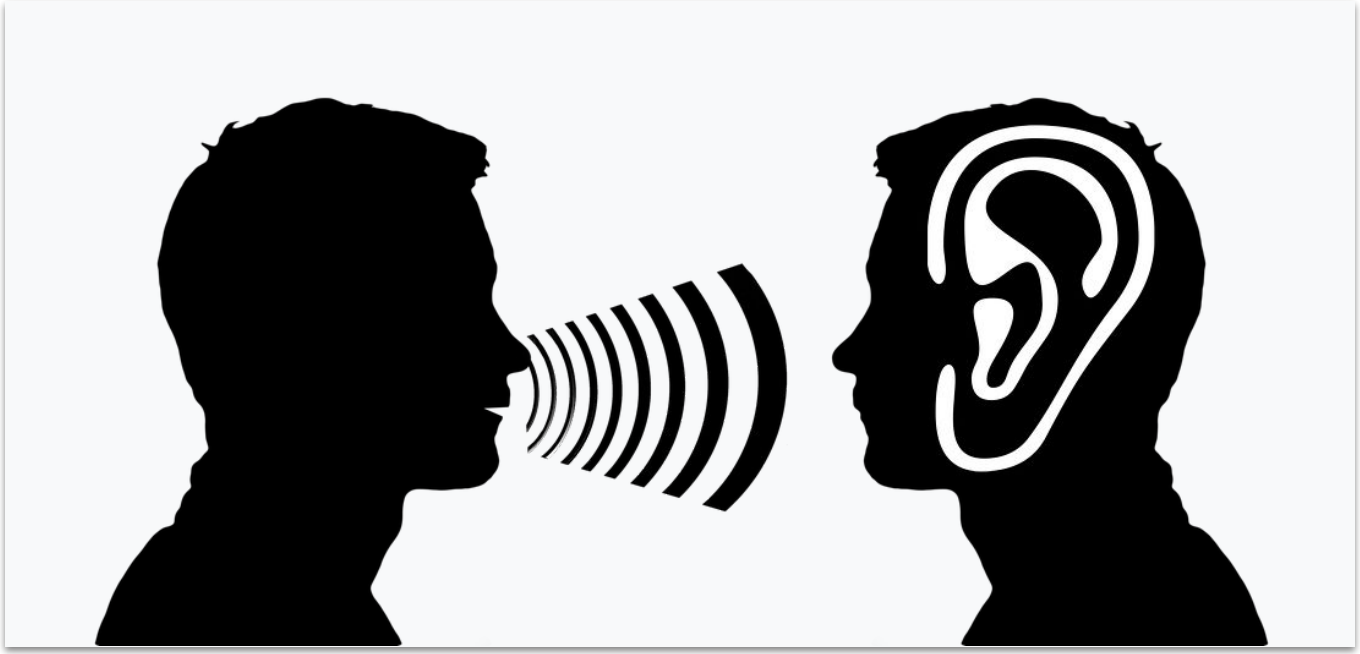
Data Preprocessing: **Spectrograms**



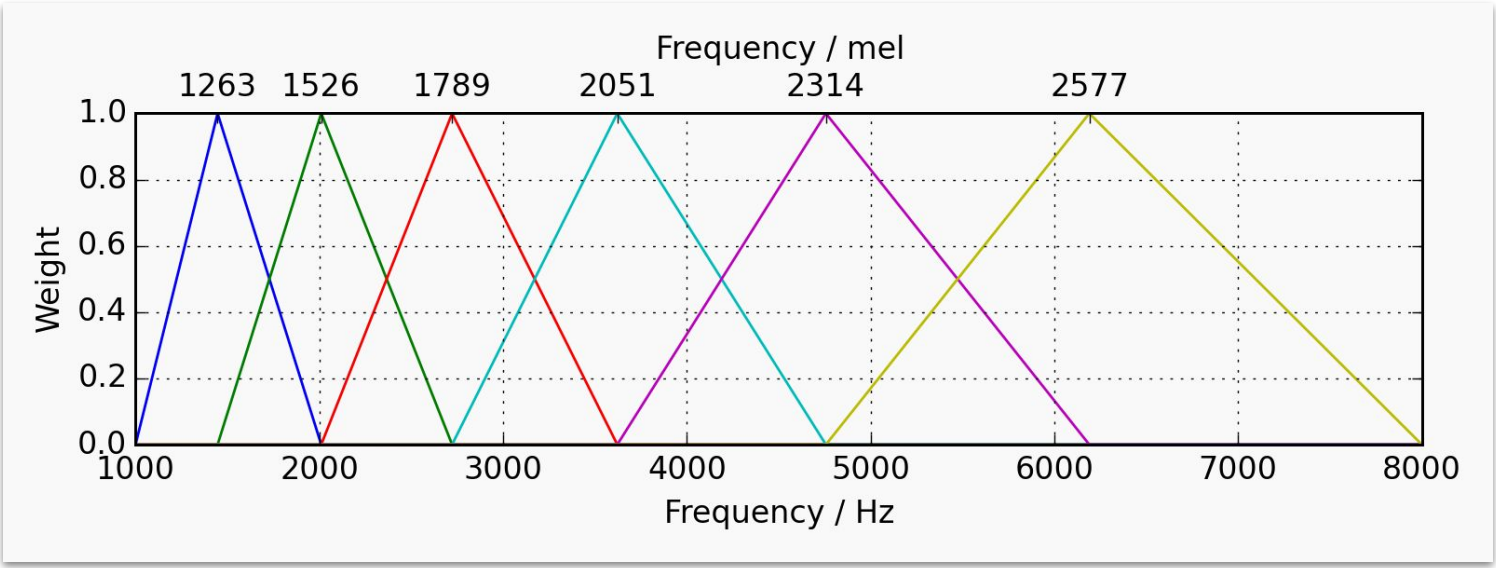
Data Preprocessing: **Spectrograms**



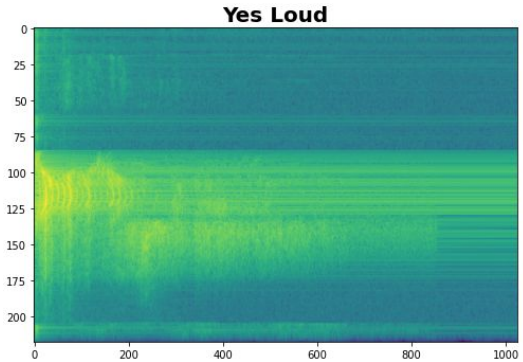
Can we find more ***salient*** features?

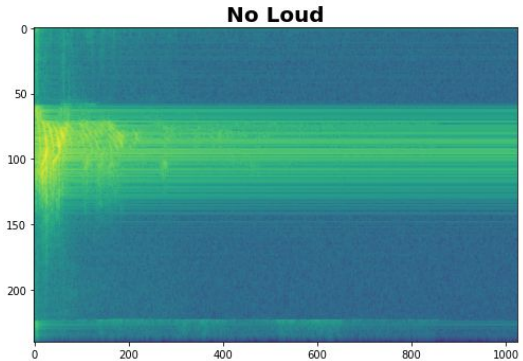


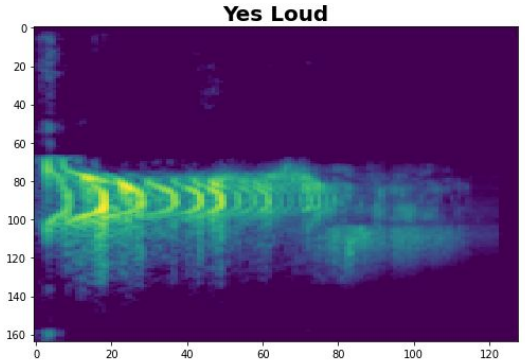
Mel Filterbanks

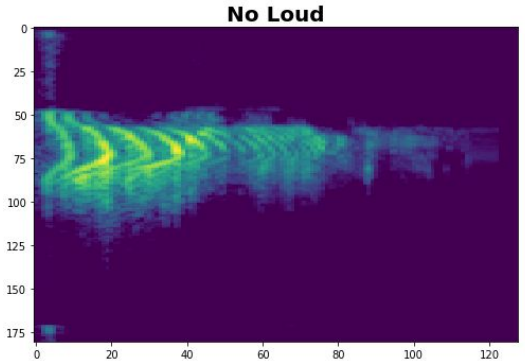


Spectrograms v. MFCCs









Additional **Feature Engineering**