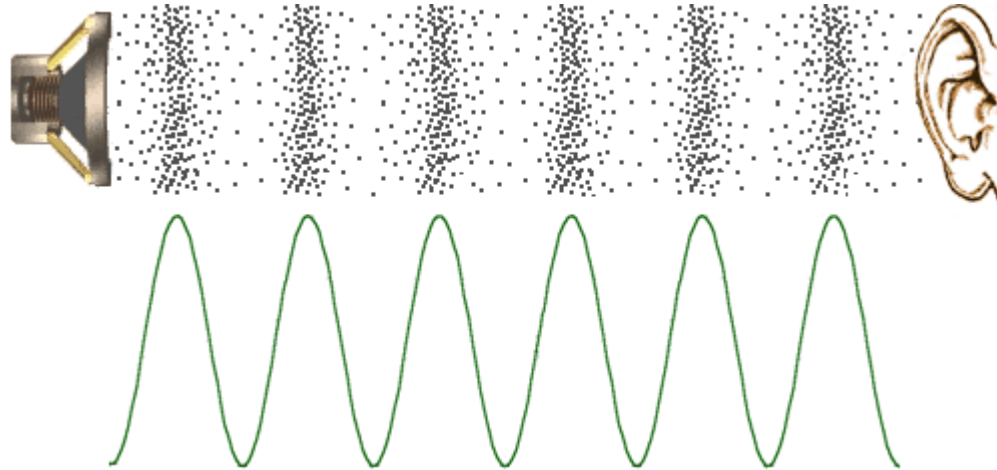


# Signals + Filtering

# What is sound?

- Sound and music contain pressure waves that propagate in air.



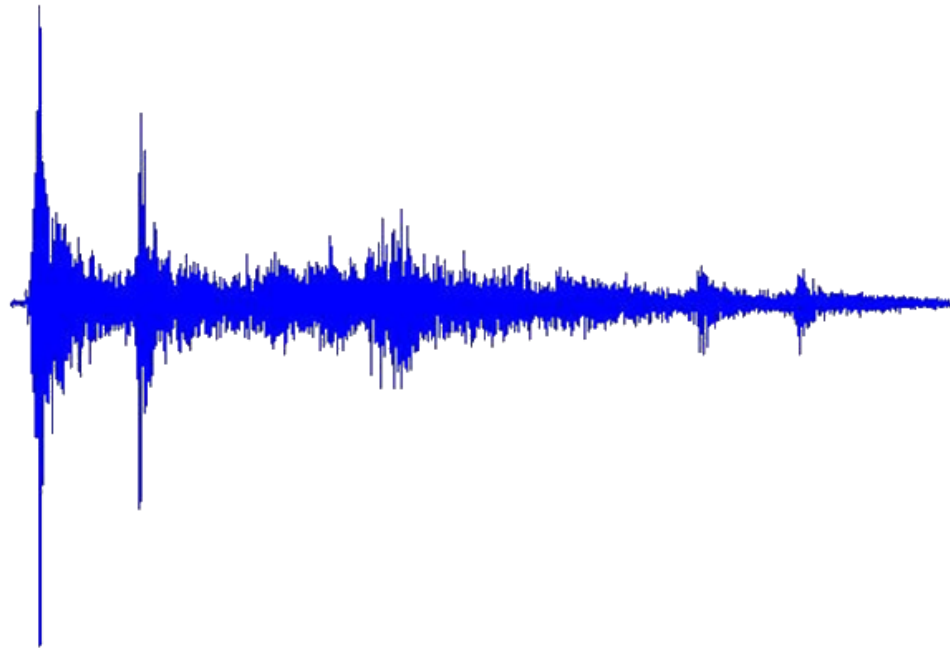
# Translation from Sound to Voltages

- Microphones are able to capture these waves, and convert them to electrical energy.



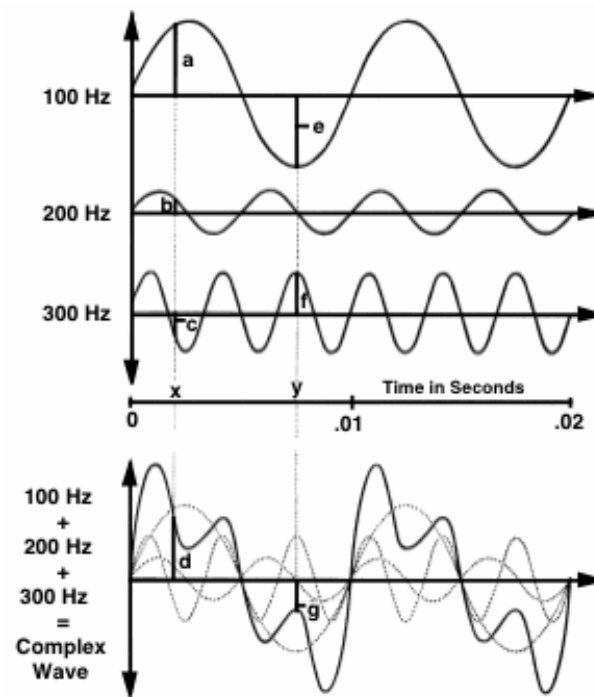
# What Does an Electric Signal Look Like?

- Fluctuations in voltages describe the characteristics of sound waves:
  - Loudness (Amplitude)
  - Timber (Frequency)



# Decomposition of Signals

- Signals (and sounds) are uniquely and simultaneously constructed of many periodic frequencies.



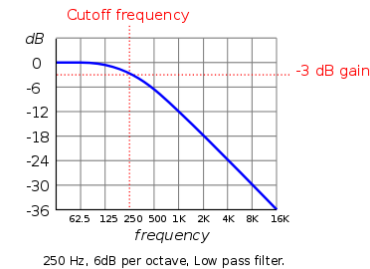
# Intro to Filtering

- Using **Electronic Filters**, we can modify the properties of sound:
  - Eg. An equalizer breaks down sounds into several frequency bands, and each band can be independently modified – for example, we can increase the bass of a song by amplifying its lower frequencies.

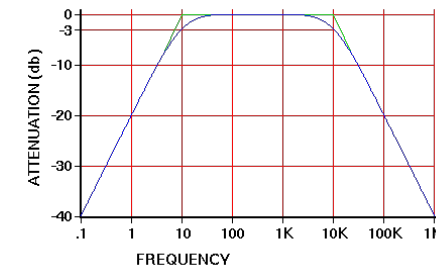
# More Filtering

- We can also use filters to solely capture some frequency bands:

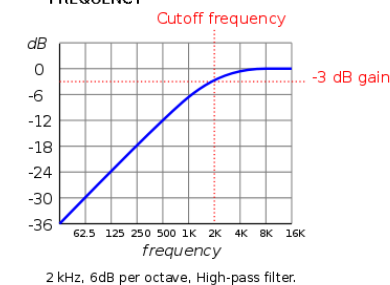
- **Low Pass Filter (LPF)** – Lets lower frequency signals through, removes higher frequency signals.



- **Band Pass Filter (BPF)** – Lets frequencies within a certain range through, removes all other frequencies.



- **High Pass Filter (HPF)** – Lets only higher frequency signals through, removes lower frequency signals.



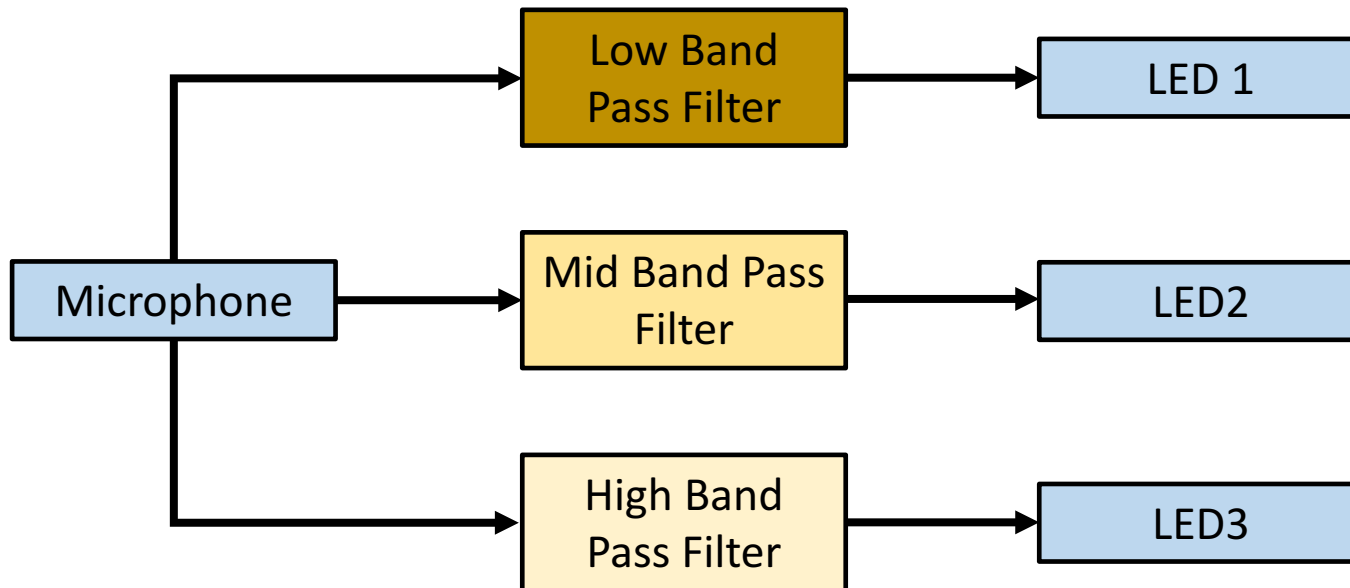
# Course Project

- The course project consists of 3 filters:
  - **Low Band Pass Filter**  
Captures: Bass Drums, Low Frequency Hums, Heavy Bass Tracks, etc.
  - **Mid Band Pass Filter**  
Captures: Vocals, Most Instruments and Sound Effects, etc.
  - **High Band Pass Filter**  
Captures: Hi-hats, Snare Drums, High Frequency String Instruments, etc.



# More on Course Project

- If the output from a filter exceeds a certain threshold amount, lights react by flashing.



# More on Course Project

- A microcontroller receives signals from each of the filters and controls how to make the lights flash and react.

