Motivations:
Electronic synthesis is an incredibly unique field in that it is a creative endeavor driven by technological innovation. It is an opportunity for cultural and societal impact through clever design. The current synthesizer market is full of very expensive equipment with few economic options. Learning and playing synthesizers can also be abstract and confusing to those musicians without extensive knowledge of signal processing. Our goal for this project is to combat these problems with a synthesizer that is inexpensive, user-friendly, and versatile.

Specifications:
1. High quality audio
   Output as a line level signal
2. Full user control
   For parameters of each software block
3. Simple to use interface
   For users to pick up and play immediately
4. Depth of system design
   For a wide variety of musical sounds

Hardware Design:
- MIDI input comes from user keyboard
- DAC reads from 8 RPi GPIO pins
- 4th Order Butterworth Reconstruction Filter
- Variable Gain Amplifier provides gain from 0->1 for master volume control

Software Design:
- Coded in python on Raspberry Pi 3
- 555 Timer provides clock signal
- Waveform Generator resamples from 1024-point wavetables
- Reads from each potentiometer input before calculating next sample value
- ADSR timing based on keyboard input

Conclusion:
- Audio output achieved on 3.5mm cable
- Capable of producing notes in range of around 20Hz-3500Hz (~7.5 octaves)
- Major challenge in our system: tradeoff between sample output rate and required sample processing time

Future Work:
- Port to faster system/continue to optimize algorithms to be as time efficient as possible
- Design more software blocks for greater depth of synthesis
- Implement more features such as different input/output methods or a visual display