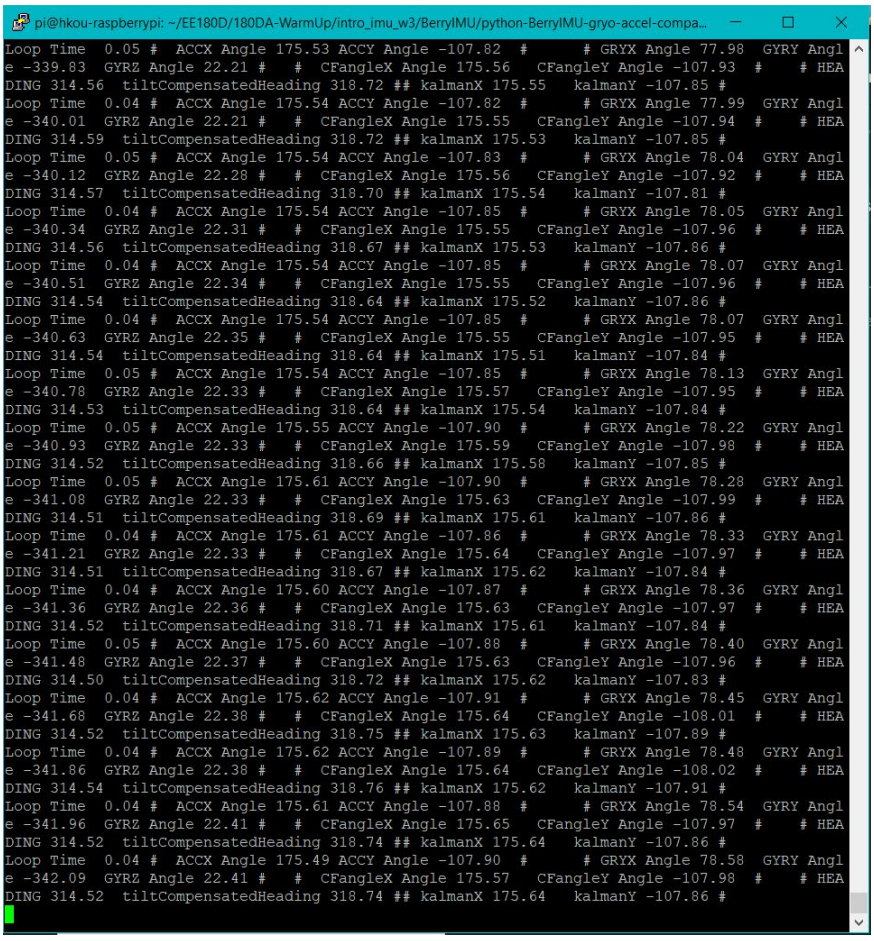
Henry Kou: 204921239, Team 6, EE180DA **Week 3 Lab Report**

1. **Action Items (plan)**
    a. Project proposal draft v 2 - **completed**
        i. Researched ideas from previous projects including GTUber.
        ii. Organized requirements and brainstormed ideas in doc: https://docs.google.com/document/d/14qEbNp-ccn-4xFTJozqWrSGkgyK1If69mKqUCWvCHLw/edit?usp=sharing
        iii. Proposal: https://docs.google.com/document/d/1FbrikDlhLAaNADgYI_8JAUBbm_Q2gItGKLAwzME5ZRE/edit?usp=sharing
        iv. Tutorial 3 Intro to IMU and Speech Processing

Installed necessary tools for I2C communication and configured proper files in the RPi to successfully interface with IMU. Obtained I2C detection with ssh connection, and display was identical to screenshot in tutorial. Therefore, my I2C setup on the RPi and physical wiring connections were correct

Results: IMU output constant stream



    v. Task 2: Write 2 gesture classifiers for IMU (upward lift, forward push) - **completed**

Experimenting with berryIMU.py, I recognized the output was dependent on some filtered IMU values. Therefore, some raw measurements were being processed. These included ACCx, ACCy, ACCz, GYRx_Angle, GYRy_Angle, etc.. The acceleration values were very useful as they had less drift than the rotational velocities from the gyroscope. Using a couple thresholding values, I could detect a change in acceleration towards a certain direction (upwards or forwards). I further lessened occurrence of false positives by detecting for change in acceleration over several timesteps. This models the physical motion of a push and avoids upwards bumps which are too quick to classify as a push. Below are the results of the output of the classifiers running in parallel.

Result: Upwards Lift with detected acceleration (m/ss)

```
Found BerryIMUv3 (LSM6DSL and LIS3MDL)
Upwards Lift Detected: 9.19339131608
Forward Push Detected: 0.88095351067
Forward Push Detected: 0.2331580877
```

Result: Forwards Push with detected acceleration (m/ss)

```
Found BerryIMUv3 (LSM6DSL and LIS3MDL)
Upwards Lift Detected: 10.8126168608
Upwards Lift Detected: 11.844424027
Upwards Lift Detected: 10.9109368345
Upwards Lift Detected: 11.6993731661
Upwards Lift Detected: 10.0206316404
Upwards Lift Detected: 11.2195961637
Upwards Lift Detected: 9.00277041768
Upwards Lift Detected: 11.7468478486
Upwards Lift Detected: 9.94392278598
Upwards Lift Detected: 11.1308959183
Upwards Lift Detected: 9.21661975489
Upwards Lift Detected: 9.40171102256
Upwards Lift Detected: 11.5405414335
Upwards Lift Detected: 10.9640203746
Upwards Lift Detected: 11.4548497734
Upwards Lift Detected: 10.7600785119
Upwards Lift Detected: 9.71889727237
Upwards Lift Detected: 10.1709271834
Upwards Lift Detected: 10.9830704858
Upwards Lift Detected: 10.5690125269
```

vi. Speech https://github.com/Uberi/speech_recognition

b. Installed required packages (pyaudio, speech_recognition) from the Python Audio Library repo speech recognition.
c. Ran '`python -m speech_recognition`' for audio up.
d. Said a couple of words, false positive phrases came up.
e. A future tuning possibility would be subtracting background noise and increasing sensitivity.
f. Results shown on the right.

```
(base) C:\Users\Henry Kou\Desktop\EE180DA\tutorial\1
n -m speech_recognition
A moment of silence, please...
Set minimum energy threshold to 124.19942015383936
Say something!
Got it! Now to recognize it...
You said hello hello today is Thursday
Say something!
Got it! Now to recognize it...
You said ejaculation
Say something!
Got it! Now to recognize it...
You said doesn't really work
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
Got it! Now to recognize it...
Oops! Didn't catch that
Say something!
```

2. **TODO Items:**
    a. Continue with finalizing proposal for our project
    b. Create more robust gesture detection compensating for Earth's gravitational acceleration and rotational velocity drift.
    c. Final midterm presentation for design project.
3. **Errors Encountered**
    a. When performing gesture classifiers for the IMU, I ran into some common IMU properties which created difficulties to trivially classify certain movements. This showed mainly in the forward push, as with the downward Earth acceleration of 9.8m/ss, any slight upwards tilt would render as a forward push. This nullified my algorithm of detecting changes in acceleration over a certain threshold.
    b. I also found another challenge when implementing gesture detection with the large drift rate of the IMU angular velocity values. Drifting at a rate of approximately 1 degree per second, I could not obtain a proper orientation for the IMU for a long period of time. Therefore if my classifier utilized orientation, the thresholds would have to dynamically adjust to the drift rate if my classifier wanted to continue accurately detect gestures for more than a couple seconds.
    c. For speech recognition on windows command line I ran into some issues with installing a module named pyaudio. This website helped: https://stackoverflow.com/questions/51992375/python-package-installation-issues-pyaudio-portaudio/52191687
    d.