Bluetooth Motion Capture App (Android - Java):

1. Requires that the phone has an already established bluetooth pairing/connection with the computer before operating the app
2. To open a connection between the two devices, tap the CONNECT button
    a. If successful, the computer will display a message that it has been connected to by the device
    b. If unsuccessful, tap the DISCONNECT button, verify that the device and the computer have already been paired and try again.
3. To begin broadcasting the device's motion data, tap the RECORD button.
4. The device should be orientated in the user's hand so that the screen of the device is parallel to and facing the ceiling.
5. The large NEW BEAT button is used for debugging purposes and serves no actual purpose in the actual operation of the project
6. When finished, tap the STOP and DISCONNECT button.

    NOTE: If the computer's python application is restarted, the connection must also be reconnected by tapping DISCONNECT then CONNECT.

Future Improvements:

- Improve UI of the app.
- Remove the NEW BEAT button in main version and maybe only keep it in the debug version if at all.

Neural Network Classifier (Computer - Python):

Available commands are:

- "bluetooth"
    - Debugging command that only runs the bluetooth portion of the program and does not run the classifier
- "generate"
    - Generates the training files for the neural network from a bluetooth device and stores the files in the "Generated Data" directory.
    - Requires the beat label (2beatNormal, 2beatStaccato, 2beatLegato, 3beatNormal, 3beatStaccato, 3beatLegato, 4beatNormal, 4beatStaccato, 4beatLegato), the name of the user recording the data, and the round of that

user's recording (this should be a different number each time so that in case there is a bad batch of data, it can easily be identified).

- "generateFromFile"
    - Generates the training files for the neural network from a round of raw data files currently found in "Recorded Data Archive\Gathered Data Split By Window Size\Collected Stream of Sensor Data 2.0" and stores the files in the "Generated Data" directory.
    - Selects the correct files to read from the given beat label, username and round number.
- "test"
    - Runs a 3 fold cross-validation on the neural network design and training files found in the "Training Data" directory.
- "train"
    - Trains the neural network model with the training files found in the "Training Data" directory.
    - NOTE: Currently the program requires an even amount of files for each label
- "run"
    - The main function to run the program.
    - After connecting to a bluetooth device and receiving a stream of motion data, the classifier then outputs which beat pattern the device is creating in real-time.
- "runFromFile"
    - Runs the main classifier on a round of raw data files rather than from a real-time bluetooth device.
- "viewGraph"
    - A debugging command that displays a graph of the given motion data file.
- "viewImage"
    - A debugging command that displays the image that the neural network sees as input for the given motion data file.
- "gatherRaw"
    - Records all motion data from a bluetooth device in large chunks and stores them in the "Generated Data" directory.
    - These files should be used as the source for generating training files from the "generateFromFile" command.
- "exit"
    - Terminates the program.

NOTES:

- After generating training files or raw data files, it is recommended to move them right away to a directory within "Recorded Data Archive" so that the files are sorted and not lost and are located in the proper directories for the program to use them in other commands.

- Sometimes the computer will continue to produce files after the bluetooth device has been disconnected so it is recommended to restart the shell to prevent any unnecessary additional files from being created.
- All 9 features are recorded (acceleration, gyroscope and rotation vectors), but only the acceleration and gyroscope data are used as inputs for the neural network.

Comments to Developer:

- The start/end of a beat pattern is currently being detected by the rotation vector around the x-axis. This method of detection has gone through many different attempts and could probably still be improved.
- The python code sometimes creates another thread for processes such as bluetooth which means that using a keyboard interrupt will only stop the main thread and not the other threads. To interrupt or terminate the program, close/restart the shell instead.
- In the final push to the git repository many of the old files were combined into a single file and the entire directory organization was cleaned up.

Future Improvements:

- Improve method of detection for the start/end of a beat pattern.
- Allow for the training of the model to use any number of training files rather than an equal number of files for each label
- When the device disconnects or reading file ends, go back to the main menu for the user to select another command.
- Allow user to specify the neural network parameters when generating the trained model rather than having them hard-coded.
- Automatically create new directories and sort generated files rather than having them all be generated into the same “Generated Data” directory and require manual transferring of files.
- Perhaps allow the user to specify the directories to run a command on rather than being hard-coded. If the above solution is made, this may be of little use and be more confusing for the user. (such as selecting the training file directory or which directory containing raw data to generate files from)