520.440/640 Machine Intelligence on Embedded Systems

Laboratory Assignment #3

Cloud Based ML:

Collecting data, visualizing data, curating data, training model and

model exploration and optimization using EdgeImpulse.

Reading: Read EdgeImpulse An MLOps Platform for TinyML-Hymel-Reddi-2022.pdf available in ML Tools and Frameworks Resources/EdgeImpulse

Question #1 (4 points):
Follow the getting started tutorial in the following link:
https://studio.edgeimpulse.com/studio/194805
to run (i) continuous motion recognition (2pts) and (ii) responding to your voice (2 pts). Use the Arduino Nano 33 BLE Sense device as the hardware (you can also run the tutorials on your computer and or a mobile phone). – Please try to complete this in the lab -

Question #2 (2 points):
Perform the kitchen actions that you did in Lab 2 to collect data using EdgeImpulse, build a model and run inference on Arduino Nano 33 BLE Sense.

Question #2 (2 points):

Most AI/ML applications on embedded devices rely heavily on pre-processing steps that are necessary before using neural networks to perform the classification. EdgeImpulse using the build in EON compiler allows architecture exploration. For your action recognition task explore the tradeoffs in

- Neural Network model complexity (explore three different NN models)
- Use quantized (INT8) vs floating point (FP) and compare TensorFlowLite (TFLM) to EdgeImpulse (EON). Create a table like Table 4 in the paper showing the resources used (RAM and Flash) and Accuracy. There is no pre-processing in your case.

Question #4 (2 points):
One can add pre-processing to the action recognition models with data from the IMU. IMU data are often noisy so doing some filtering would help. Implement a filter of your choice to "clean" noisy data from the IMU. One can use a simple FIR filter or something more sophisticated such as a Kalman filter (you get extra two points if you implement a Kalman filter). See a simple discussion here https://www.planetanalog.com/kalman-or-fir-filter-for-my-imu/ . I have collected documentation and Arduino code for Kalman and Madgwick filters (the latter includes magnetic field sensor signal as well) under Laboratory Projects/Files/IMU Filtering.