520.440/640 Machine Intelligence on Embedded Systems

Laboratory Assignment #2

Action Recognition on an Embedded Device:

Collecting data, visualizing data, curating data, training model and doing inference.

Reading: Chapters 11 and 12 in the TinyML book discuss the magic wand application and training new models. Please read through the chapters before attempting to do the lab work.

Question #1 (4 points):
Follow the tutorial in the following link:
https://docs.arduino.cc/tutorials/nano-33-ble-sense/get-started-with-machine-learning
to run (i) the speech recognition (2pts) and (ii) the gesture recognition (2 pts). These example involve models that have been trained already and are part of the Arduino library.

Question #2 (11 points + 1 point extra credit):
Continue the tutorial for gesture recognition beginning with the section header " Training a TensorFlow Lite Micro Model For Arduino" where now you will use your own model that is trained using data that you captured with your device.

(i) Select two gestures that are common in cooking, for example cutting a tomato or a zucchini, peeling a potato, pouring water in a pot, e.t.c. For the selected actions attach the nano-sense BLE to your hand and record several instances of the actions. Please also record the actions with your phone camera. Name your data files ActionName_YourLastNameFirstNameInitial.csv for example my peeling potato data would be: PeelingPotato_AndreouA.csv. Upload the collected data to the shared data directory. (2 pts)

(ii) Make sure you are capturing the data by visualizing the data in the Arduino device. Take a screen shot of your visualization window. (1 pt)

(iii) Train model in Tensorflow (2 pts)

(iv) Upload model to Arduino device and do inference on device displaying result on a screen. Record a video and device action recognition results. (1 pt)

(v) Extra credit for emoji designed for your actions. (1 pt).

(vi) Try increasing and decreasing the number of recordings per gesture, how does this impact performance? (1 pt)

(vii) Try to only use the accelerometer or gyroscope data (not both), how does this impact performance? (1 pt)

(viii) Tweak the model structure and parameters. Experiment with 2 different models. Can you get better results? (2 pts)

(ix) Can you reduce the size and still get "good" results (1 pt).

Do the experiments, capture results using your phone and write a one page report describing what you do and discuss your work and findings for question 1 sections (vi) to (ix).

Hints and Tips:

- The new Arduino IDE (version 2.x) seems to make it more difficult to copy and paste from the serial monitor than the old IDE (version 1.x) did. So for saving the CSV values you may want to run the code using the old version of the IDE to make things easier. I saw a student have

trouble selecting all the values to save because the IDE kept glitching and not allowing him to select all the data using the new IDE. It also seems that the old IDE lets you resize the serial plotter window, unlike the new IDE. That isn't necessary for this lab, but it might be something to keep in mind if you ever want to have that ability.