Assignment 4: Practical Introduction to CNN on an Android App using TensorFlow Lite.
## Custom Gesture Recognition App

Part3: Define your own gesture – steps for re-train model and generate a new *tflite* model for your App.

Purpose: In my Android App, I want to add a new additional gesture like "clockwise-square", I should hold the phone **horizontally, parallel to the ground**, and perform the "clockwise-square" movement in that position (moving the phone to right, then move down, then move to left, then move up back to the origin to perform the wing).

1. Record new data. capture the data, and save it to *complete_data* to feed the model during training

Firstly, Do the clockwise-square movement, I need to use the *TYPE_ACCELEROMETER* sensor to record the XYZ axis data of "clockwise-square" movement. And then use the similar method from *FileReadWriteDemo* to save accelerometer data in a phone internal file and write these set of data to the *complete_data* file in data folder.
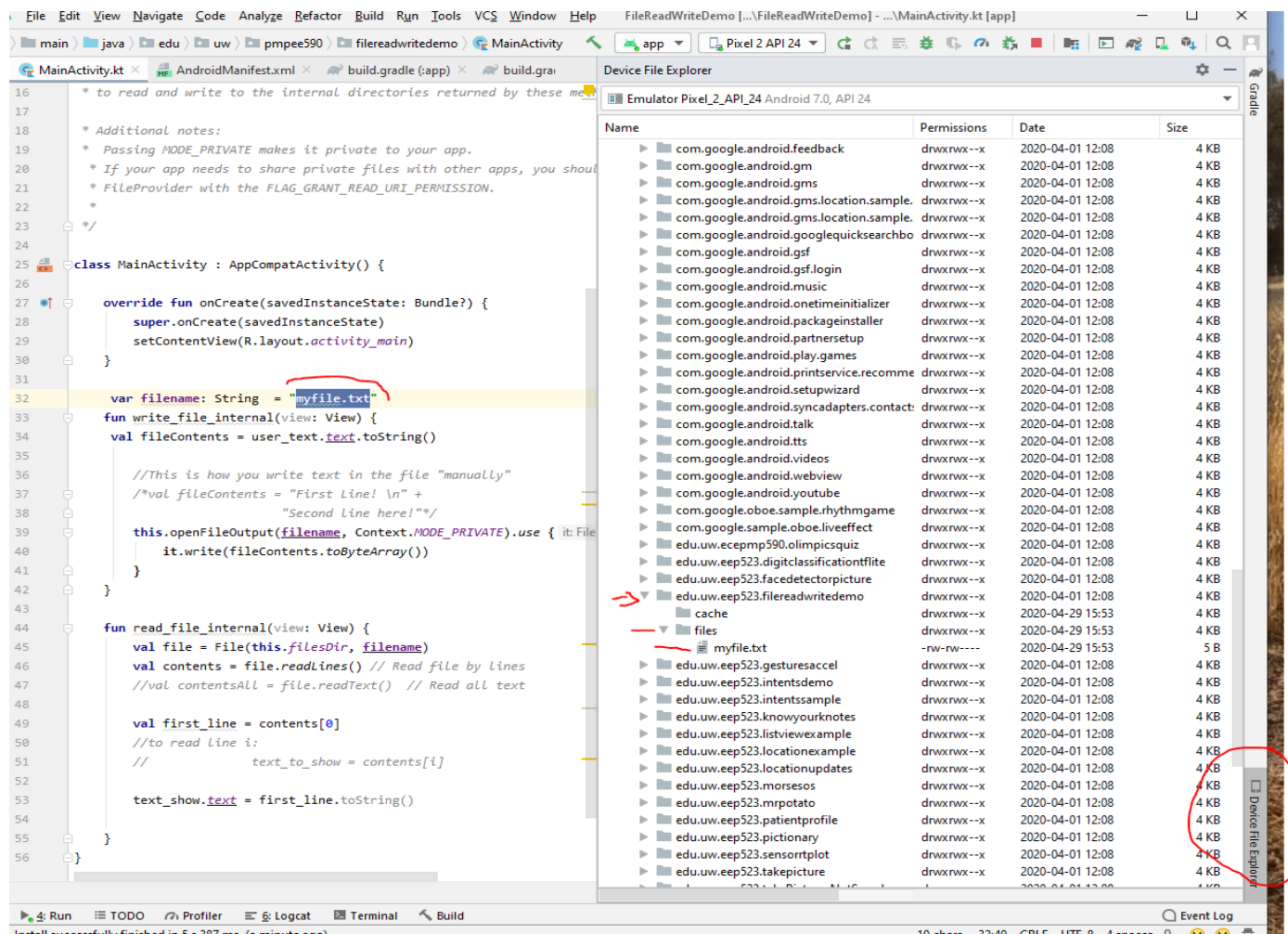
The original dataset(complete_data file):

```
1    {"gesture": "wing", "accel_xyz": [[818.0, -217.0, 581.0], [832.0, -227.0, 575.0], [836.0, -274.0, 604.0], [835.0, -294
2    {"gesture": "wing", "accel_xyz": [[829.0, -69.0, 525.0], [755.0, -138.0, 121.0], [604.0, 134.0, 418.0], [561.0, -86.0,
3    {"gesture": "wing", "accel_xyz": [[886.0, -157.0, 620.0], [908.0, -201.0, 793.0], [1044.0, -246.0, -96.0], [946.0, 101
4    {"gesture": "wing", "accel_xyz": [[885.0, -195.0, 714.0], [923.0, -179.0, 648.0], [1014.0, -418.0, 520.0], [1052.0, -3
5    {"gesture": "wing", "accel_xyz": [[1009.0, -200.0, 683.0], [1067.0, -129.0, 683.0], [944.0, -482.0, 1096.0], [1047.0,
6    {"gesture": "wing", "accel_xyz": [[869.0, -128.0, 661.0], [879.0, -134.0, 651.0], [986.0, -166.0, 640.0], [1027.0, -41
7    {"gesture": "wing", "accel_xyz": [[908.0, -55.0, 517.0], [904.0, -35.0, 536.0], [916.0, -60.0, 566.0], [953.0, -112.0,
8    {"gesture": "wing", "accel_xyz": [[872.0, -105.0, 429.0], [870.0, -172.0, 433.0], [810.0, -196.0, 354.0], [770.0, -190
9    {"gesture": "wing", "accel_xyz": [[856.0, -55.0, 659.0], [931.0, -113.0, 587.0], [1016.0, -98.0, 730.0], [1006.0, -98.0
10   {"gesture": "wing", "accel_xyz": [[875.0, -118.0, 649.0], [861.0, -120.0, 724.0], [880.0, -224.0, 748.0], [877.0, -253
11   {"gesture": "wing", "accel_xyz": [[898.0, -73.0, 622.0], [926.0, -69.0, 691.0], [916.0, -118.0, 700.0], [927.0, -163.0
12   {"gesture": "wing", "accel_xyz": [[858.0, -154.0, 590.0], [902.0, -181.0, 548.0], [852.0, -166.0, 464.0], [856.0, -132
13   {"gesture": "wing", "accel_xyz": [[868.0, -165.0, 678.0], [890.0, -100.0, 670.0], [872.0, -2.0, 698.0], [873.0, -93.0,
14   {"gesture": "wing", "accel_xyz": [[874.0, -100.0, 614.0], [867.0, -87.0, 678.0], [872.0, -66.0, 654.0], [866.0, -110.0
15   {"gesture": "wing", "accel_xyz": [[834.0, -186.0, 659.0], [840.0, -186.0, 621.0], [866.0, -130.0, 654.0], [894.0, -149
16   {"gesture": "wing", "accel_xyz": [[844.0, -52.0, 627.0], [840.0, -106.0, 589.0], [802.0, -134.0, 690.0], [813.0, -147.0
17   {"gesture": "wing", "accel_xyz": [[859.0, -4.0, 609.0], [870.0, -20.0, 635.0], [1042.0, -262.0, 350.0], [959.0, -216.0
18   {"gesture": "wing", "accel_xyz": [[-677.0, 611.0, 515.0], [-701.0, 486.0, 465.0], [-678.0, 512.0, 634.0], [-657.0, 529
19   {"gesture": "wing", "accel_xyz": [[-754.0, 448.0, 444.0], [-772.0, 387.0, 363.0], [-736.0, 422.0, 460.0], [-777.0, 509
20   {"gesture": "wing", "accel_xyz": [[-738.0, 381.0, 627.0], [-735.0, 295.0, 555.0], [-664.0, 382.0, 698.0], [-636.0, 419
21   {"gesture": "wing", "accel_xyz": [[-581.0, 141.0, 864.0], [-595.0, 204.0, 865.0], [-614.0, 256.0, 910.0], [-622.0, 253
22   {"gesture": "wing", "accel_xyz": [[-781.0, 235.0, 577.0], [-766.0, 244.0, 566.0], [-742.0, 274.0, 614.0], [-712.0, 250
23   {"gesture": "wing", "accel_xyz": [[-860.0, 237.0, 551.0], [-873.0, 220.0, 571.0], [-870.0, 228.0, 556.0], [-873.0, 214
24   {"gesture": "wing", "accel_xyz": [[-850.0, 189.0, 481.0], [-860.0, 174.0, 479.0], [-884.0, 64.0, 522.0], [-881.0, 125.0
```

After write the new gesture data into the complete_data file

```
1    {"gesture": "clockwize-square", "accel_xyz": [[818.0, -217.0, 581.0], [832.0, -227.0, 575.0], [836.0, -274.0, 604.0]
2    {"gesture": "clockwize-square", "accel_xyz": [[829.0, -69.0, 525.0], [755.0, -138.0, 121.0], [604.0, 134.0, 418.0], [
3    {"gesture": "clockwize-square", "accel_xyz": [[886.0, -157.0, 620.0], [908.0, -201.0, 793.0], [1044.0, -246.0, -96.0]
4    {"gesture": "clockwize-square", "accel_xyz": [[885.0, -195.0, 714.0], [923.0, -179.0, 648.0], [1014.0, -418.0, 520.0]
5    {"gesture": "clockwize-square", "accel_xyz": [[1009.0, -200.0, 683.0], [1067.0, -129.0, 683.0], [944.0, -482.0, 1096.0
6    {"gesture": "clockwize-square", "accel_xyz": [[869.0, -128.0, 661.0], [879.0, -134.0, 651.0], [986.0, -166.0, 640.0],
7    {"gesture": "clockwize-square", "accel_xyz": [[908.0, -55.0, 517.0], [904.0, -35.0, 536.0], [916.0, -60.0, 566.0], [9
8    {"gesture": "clockwize-square", "accel_xyz": [[872.0, -105.0, 429.0], [870.0, -172.0, 433.0], [810.0, -196.0, 354.0],
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10   {"gesture": "clockwize-square", "accel_xyz": [[875.0, -118.0, 649.0], [861.0, -120.0, 724.0], [880.0, -224.0, 748.0],
11   {"gesture": "clockwize-square", "accel_xyz": [[898.0, -73.0, 622.0], [926.0, -69.0, 691.0], [916.0, -118.0, 700.0], [9
12   {"gesture": "clockwize-square", "accel_xyz": [[858.0, -154.0, 590.0], [902.0, -181.0, 548.0], [852.0, -166.0, 464.0],
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14   {"gesture": "clockwize-square", "accel_xyz": [[874.0, -100.0, 614.0], [867.0, -87.0, 678.0], [872.0, -66.0, 654.0], [
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16   {"gesture": "clockwize-square", "accel_xyz": [[844.0, -52.0, 627.0], [840.0, -106.0, 589.0], [802.0, -134.0, 690.0],
17   {"gesture": "clockwize-square", "accel_xyz": [[859.0, -4.0, 609.0], [870.0, -20.0, 635.0], [1042.0, -262.0, 350.0], [9
18   {"gesture": "clockwize-square", "accel_xyz": [[-677.0, 611.0, 515.0], [-701.0, 486.0, 465.0], [-678.0, 512.0, 634.0],
19   {"gesture": "clockwize-square", "accel_xyz": [[-754.0, 448.0, 444.0], [-772.0, 387.0, 363.0], [-736.0, 422.0, 460.0],
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21   {"gesture": "clockwize-square", "accel_xyz": [[-581.0, 141.0, 864.0], [-595.0, 204.0, 865.0], [-614.0, 256.0, 910.0],
22   {"gesture": "clockwize-square", "accel_xyz": [[-781.0, 235.0, 577.0], [-766.0, 244.0, 566.0], [-742.0, 274.0, 614.0],
```

2. I need to modify some parameters in the train.py file.

(1) I can change the seq_length from 128 to 256 to deal with more data with a larger input.
(2) Because I have a new gesture result now, I have three labels: wing (label 0), other movement (label 2) clockwise-square (label 3). I need to change the parameter of the last dense layer from 2 to 3(like below).

```python
    tf.keras.layers.Dense(16, activation="relu"),  # (batch, 16)
    tf.keras.layers.Dropout(0.1),   # (batch, 16)
    tf.keras.layers.Dense(2, activation="softmax")  # (batch, ?)
```
to
```python
    tf.keras.layers.Dense(16, activation="relu"),  # (batch, 16)
    tf.keras.layers.Dropout(0.1),   # (batch, 16)
    tf.keras.layers.Dense(3, activation="softmax")  # (batch, ?)
```

3. I need to change anything else in the data_split.py file

I need to change the *num_dic* in data_split.py like this:

```python
train_data = []  # pylint: disable=redefined-outer-name
valid_data = []  # pylint: disable=redefined-outer-name
test_data = []   # pylint: disable=redefined-outer-name
num_dic = {"wing": 0, "negative": 0}
```
to
```python
train_data = []  # pylint: disable=redefined-outer-name
valid_data = []  # pylint: disable=redefined-outer-name
test_data = []   # pylint: disable=redefined-outer-name
num_dic = {"wing": 0, "negative": 0, "clockwise-square":0}
```

Apart from that, I can also change the proportion of three set from (0.6, 0.2, 0.2) to (0.7, 0.2, 0.1)
```python
data = read_data("./data/complete_data")
train_data, valid_data, test_data = split_data(data, 0.7, 0.2)
```

4. How would you train the new model?

1.Step 1: Prepare Your Data.

2.Step 2: Create a Training Dataset.

3.Step 3: Create an ML Model by run the train.py.

4.Convert the model to the TensorFlow Lite format both without quantization and with quantization

5.Step 5: Use the ML Model to Generate Predictions.

6.Step 6: Clean Up.

5. Would you need to make any change in the Android App?

Change the parameters:

Modify the OUTPUT_CLASSES_COUNT from 2 to 3

Modify the MAX_SAMPLES from 128 to 256.

```kotlin
const val MODEL_FILE = "koujunnan.tflite"
const val OUTPUT_CLASSES_COUNT = 3
const val MAX_SAMPLES = 256
```

Then repeat a serious of operations corresponding to the previous "wing" gesture App then run the code to install the new gesture App.