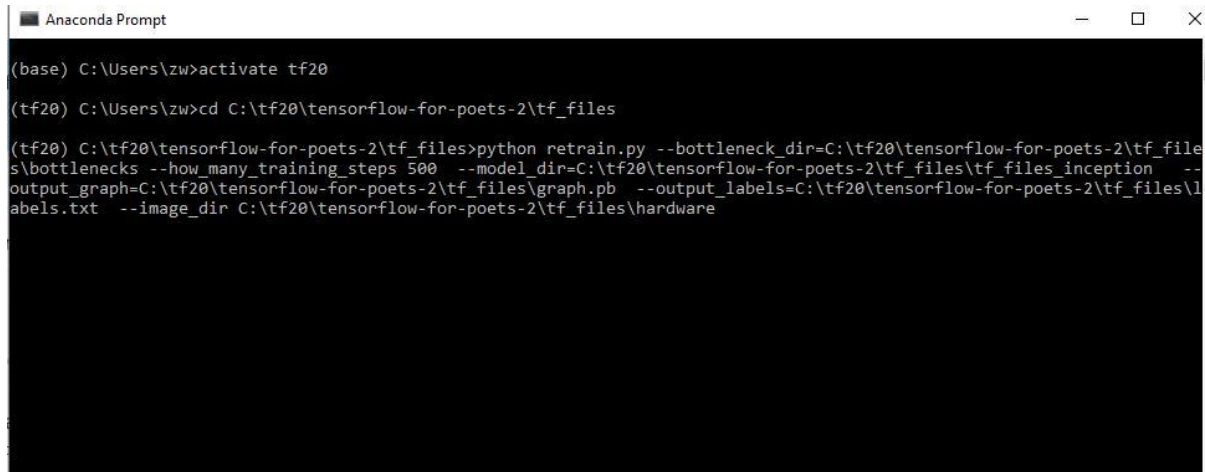


## Training Manual:

### How to train Tensorflow (briefly)



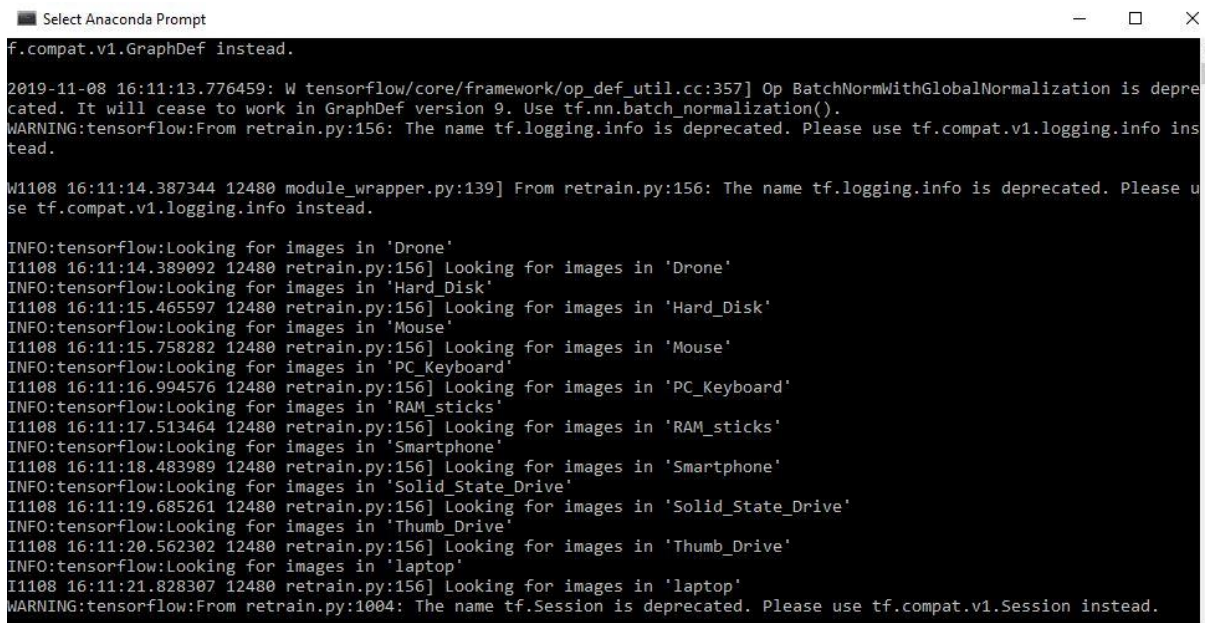
```
Anaconda Prompt

(base) C:\Users\zw>activate tf20

(tf20) C:\Users\zw>cd C:\tf20\tensorflow-for-poets-2\tf_files

(tf20) C:\tf20\tensorflow-for-poets-2\tf_files>python retrain.py --bottleneck_dir=C:\tf20\tensorflow-for-poets-2\tf_files\bottlenecks --how_many_training_steps 500 --model_dir=C:\tf20\tensorflow-for-poets-2\tf_files\tf_files_inception --output_graph=C:\tf20\tensorflow-for-poets-2\tf_files\graph.pb --output_labels=C:\tf20\tensorflow-for-poets-2\tf_files\labels.txt --image_dir C:\tf20\tensorflow-for-poets-2\tf_files\hardware
```

- Key in activate tf20 to run tensorflow.
- Change directory to the retrain.py folder and key in the following command to run tensorflow training script.



```
Select Anaconda Prompt

f.compat.v1.GraphDef instead.

2019-11-08 16:11:13.776459: W tensorflow/core/framework/op_def_util.cc:357] Op BatchNormWithGlobalNormalization is deprecated. It will cease to work in GraphDef version 9. Use tf.nn.batch_normalization().
WARNING:tensorflow:From retrain.py:156: The name tf.logging.info is deprecated. Please use tf.compat.v1.logging.info instead.

W1108 16:11:14.387344 12480 module_wrapper.py:139] From retrain.py:156: The name tf.logging.info is deprecated. Please use tf.compat.v1.logging.info instead.

INFO:tensorflow:Looking for images in 'Drone'
I1108 16:11:14.389092 12480 retrain.py:156] Looking for images in 'Drone'
INFO:tensorflow:Looking for images in 'Hard_Disk'
I1108 16:11:15.465597 12480 retrain.py:156] Looking for images in 'Hard_Disk'
INFO:tensorflow:Looking for images in 'Mouse'
I1108 16:11:15.758282 12480 retrain.py:156] Looking for images in 'Mouse'
INFO:tensorflow:Looking for images in 'PC_Keyboard'
I1108 16:11:16.994576 12480 retrain.py:156] Looking for images in 'PC_Keyboard'
INFO:tensorflow:Looking for images in 'RAM_sticks'
I1108 16:11:17.513464 12480 retrain.py:156] Looking for images in 'RAM_sticks'
INFO:tensorflow:Looking for images in 'Smartphone'
I1108 16:11:18.483989 12480 retrain.py:156] Looking for images in 'Smartphone'
INFO:tensorflow:Looking for images in 'Solid_State_Drive'
I1108 16:11:19.685261 12480 retrain.py:156] Looking for images in 'Solid_State_Drive'
INFO:tensorflow:Looking for images in 'Thumb_Drive'
I1108 16:11:20.562302 12480 retrain.py:156] Looking for images in 'Thumb_Drive'
INFO:tensorflow:Looking for images in 'laptop'
I1108 16:11:21.828307 12480 retrain.py:156] Looking for images in 'laptop'
WARNING:tensorflow:From retrain.py:1004: The name tf.Session is deprecated. Please use tf.compat.v1.Session instead.
```

- After running the python script, the program will look for images in the objects folder to train.

```
Anaconda Prompt

INFO:tensorflow:100 bottleneck files created.
I1108 16:11:28.112707 12480 retrain.py:481] 100 bottleneck files created.
INFO:tensorflow:200 bottleneck files created.
I1108 16:11:31.064148 12480 retrain.py:481] 200 bottleneck files created.
INFO:tensorflow:300 bottleneck files created.
I1108 16:11:32.372054 12480 retrain.py:481] 300 bottleneck files created.
INFO:tensorflow:400 bottleneck files created.
I1108 16:11:32.465767 12480 retrain.py:481] 400 bottleneck files created.
INFO:tensorflow:500 bottleneck files created.
I1108 16:11:32.968748 12480 retrain.py:481] 500 bottleneck files created.
INFO:tensorflow:600 bottleneck files created.
I1108 16:11:34.572389 12480 retrain.py:481] 600 bottleneck files created.
INFO:tensorflow:700 bottleneck files created.
I1108 16:11:37.346014 12480 retrain.py:481] 700 bottleneck files created.
INFO:tensorflow:800 bottleneck files created.
I1108 16:11:39.522717 12480 retrain.py:481] 800 bottleneck files created.
INFO:tensorflow:900 bottleneck files created.
I1108 16:11:40.548617 12480 retrain.py:481] 900 bottleneck files created.
INFO:tensorflow:1000 bottleneck files created.
I1108 16:11:40.638787 12480 retrain.py:481] 1000 bottleneck files created.
INFO:tensorflow:1100 bottleneck files created.
I1108 16:11:40.728600 12480 retrain.py:481] 1100 bottleneck files created.
INFO:tensorflow:1200 bottleneck files created.
I1108 16:11:41.668927 12480 retrain.py:481] 1200 bottleneck files created.
INFO:tensorflow:1300 bottleneck files created.
I1108 16:11:43.136937 12480 retrain.py:481] 1300 bottleneck files created.
INFO:tensorflow:1400 bottleneck files created.
I1108 16:11:44.963124 12480 retrain.py:481] 1400 bottleneck files created.
INFO:tensorflow:1500 bottleneck files created.
```

- Bottleneck also known as layer files are created.
- This will take about 30 minutes or more to complete.
- Every image is reused multiple times during training.

```
Anaconda Prompt - python retrain.py --bottleneck_dir=C:\tf20\tensorflow-for-poets-2\tf_files\bottlenecks --how_many_training_steps 500 --model_dir...

W1108 16:12:37.084852 12480 module_wrapper.py:139] From retrain.py:1038: The name tf.summary.merge_all is deprecated. Please use tf.compat.v1.summary.merge_all instead.
WARNING:tensorflow:From retrain.py:1039: The name tf.summary.FileWriter is deprecated. Please use tf.compat.v1.summary.FileWriter instead.

W1108 16:12:37.087854 12480 module_wrapper.py:139] From retrain.py:1039: The name tf.summary.FileWriter is deprecated. Please use tf.compat.v1.summary.FileWriter instead.
WARNING:tensorflow:From retrain.py:1046: The name tf.global_variables_initializer is deprecated. Please use tf.compat.v1.global_variables_initializer instead.

W1108 16:12:40.241751 12480 module_wrapper.py:139] From retrain.py:1046: The name tf.global_variables_initializer is deprecated. Please use tf.compat.v1.global_variables_initializer instead.

INFO:tensorflow:2019-11-08 16:12:50.776329: Step 0: Train accuracy = 52.0%
I1108 16:12:50.817588 12480 retrain.py:1082] 2019-11-08 16:12:50.776329: Step 0: Train accuracy = 52.0%
INFO:tensorflow:2019-11-08 16:12:50.819965: Step 0: Cross entropy = 2.118346
I1108 16:12:50.819965 12480 retrain.py:1084] 2019-11-08 16:12:50.819965: Step 0: Cross entropy = 2.118346
INFO:tensorflow:2019-11-08 16:12:55.161496: Step 0: Validation accuracy = 43.0% (N=100)
I1108 16:12:55.161496 12480 retrain.py:1100] 2019-11-08 16:12:55.161496: Step 0: Validation accuracy = 43.0% (N=100)
```

```
Anaconda Prompt - python retrain.py --bottleneck_dir=C:\tf20\tensorflow-for-poets-2\tf_files\bottlenecks --how_many_training_steps 500 --model_dir...

I1108 16:14:24.032747 12480 retrain.py:1082] 2019-11-08 16:14:24.032747: Step 250: Train accuracy = 97.0%
INFO:tensorflow:2019-11-08 16:14:24.033745: Step 250: Cross entropy = 0.218012
I1108 16:14:24.033745 12480 retrain.py:1084] 2019-11-08 16:14:24.033745: Step 250: Cross entropy = 0.218012
INFO:tensorflow:2019-11-08 16:14:24.134656: Step 250: Validation accuracy = 94.0% (N=100)
I1108 16:14:24.134655 12480 retrain.py:1100] 2019-11-08 16:14:24.134656: Step 250: Validation accuracy = 94.0% (N=100)
INFO:tensorflow:2019-11-08 16:14:25.195973: Step 260: Train accuracy = 98.0%
I1108 16:14:25.195973 12480 retrain.py:1082] 2019-11-08 16:14:25.195973: Step 260: Train accuracy = 98.0%
INFO:tensorflow:2019-11-08 16:14:25.196930: Step 260: Cross entropy = 0.190950
I1108 16:14:25.196930 12480 retrain.py:1084] 2019-11-08 16:14:25.196930: Step 260: Cross entropy = 0.190950
INFO:tensorflow:2019-11-08 16:14:25.305637: Step 260: Validation accuracy = 95.0% (N=100)
I1108 16:14:25.305637 12480 retrain.py:1100] 2019-11-08 16:14:25.305637: Step 260: Validation accuracy = 95.0% (N=100)
INFO:tensorflow:2019-11-08 16:14:26.556937: Step 270: Train accuracy = 96.0%
I1108 16:14:26.556937 12480 retrain.py:1082] 2019-11-08 16:14:26.556937: Step 270: Train accuracy = 96.0%
INFO:tensorflow:2019-11-08 16:14:26.556937: Step 270: Cross entropy = 0.240964
I1108 16:14:26.556937 12480 retrain.py:1084] 2019-11-08 16:14:26.556937: Step 270: Cross entropy = 0.240964
INFO:tensorflow:2019-11-08 16:14:26.666271: Step 270: Validation accuracy = 99.0% (N=100)
I1108 16:14:26.666270 12480 retrain.py:1100] 2019-11-08 16:14:26.666271: Step 270: Validation accuracy = 99.0% (N=100)
INFO:tensorflow:2019-11-08 16:14:27.687417: Step 280: Train accuracy = 96.0%
I1108 16:14:27.687417 12480 retrain.py:1082] 2019-11-08 16:14:27.687417: Step 280: Train accuracy = 96.0%
INFO:tensorflow:2019-11-08 16:14:27.688130: Step 280: Cross entropy = 0.235202
I1108 16:14:27.688130 12480 retrain.py:1084] 2019-11-08 16:14:27.688130: Step 280: Cross entropy = 0.235202
INFO:tensorflow:2019-11-08 16:14:27.792205: Step 280: Validation accuracy = 96.0% (N=100)
I1108 16:14:27.793243 12480 retrain.py:1100] 2019-11-08 16:14:27.792205: Step 280: Validation accuracy = 96.0% (N=100)
INFO:tensorflow:2019-11-08 16:14:28.812340: Step 290: Train accuracy = 97.0%
I1108 16:14:28.812340 12480 retrain.py:1082] 2019-11-08 16:14:28.812340: Step 290: Train accuracy = 97.0%
INFO:tensorflow:2019-11-08 16:14:28.812340: Step 290: Cross entropy = 0.159254
I1108 16:14:28.812340 12480 retrain.py:1084] 2019-11-08 16:14:28.812340: Step 290: Cross entropy = 0.159254
INFO:tensorflow:2019-11-08 16:14:28.926680: Step 290: Validation accuracy = 93.0% (N=100)
I1108 16:14:28.926680 12480 retrain.py:1100] 2019-11-08 16:14:28.926680: Step 290: Validation accuracy = 93.0% (N=100)
```

- Bottlenecks created previously will be loaded, once complete, the actual training begins.
- During the training, you will see a series of step outputs, displaying the training accuracy.
- New bottlenecks will be created after a group of images are trained.
- The more steps the program takes, the more accurate it is.



```
Anaconda Prompt
INFO:tensorflow:Final test accuracy = 97.9% (N=576)
I1108 16:15:00.544095 12480 retrain.py:1126] Final test accuracy = 97.9% (N=576)
WARNING:tensorflow:From retrain.py:827: convert_variables_to_constants (from tensorflow.python.framework.graph_util_impl) is deprecated and will be removed in a future version.
Instructions for updating:
Use `tf.compat.v1.graph_util.convert_variables_to_constants`
I1108 16:15:00.747175 12480 deprecation.py:323] From retrain.py:827: convert_variables_to_constants (from tensorflow.python.framework.graph_util_impl) is deprecated and will be removed in a future version.
Instructions for updating:
Use `tf.compat.v1.graph_util.convert_variables_to_constants`
WARNING:tensorflow:From C:\Users\zw\Anaconda3\envs\tf20\lib\site-packages\tensorflow_core\python\framework\graph_util_impl.py:277: extract_sub_graph (from tensorflow.python.framework.graph_util_impl) is deprecated and will be removed in a future version.
Instructions for updating:
Use `tf.compat.v1.graph_util.extract_sub_graph`
I1108 16:15:00.747175 12480 deprecation.py:323] From C:\Users\zw\Anaconda3\envs\tf20\lib\site-packages\tensorflow_core\python\framework\graph_util_impl.py:277: extract_sub_graph (from tensorflow.python.framework.graph_util_impl) is deprecated and will be removed in a future version.
Instructions for updating:
Use `tf.compat.v1.graph_util.extract_sub_graph`
INFO:tensorflow:Froze 2 variables.
I1108 16:15:01.143668 12480 graph_util_impl.py:334] Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.
I1108 16:15:01.262962 12480 graph_util_impl.py:394] Converted 2 variables to const ops.

(tf20) C:\tf20\tensorflow-for-poets-2\tf_files>
(tf20) C:\tf20\tensorflow-for-poets-2\tf_files>python retrain.py --bottleneck_dir=C:\tf20\tensorflow-for-poets-2\tf_files\bottlenecks --how_many_training_steps 500 --model_dir=C:\tf20\tensorflow-for-poets-2\tf_files\tf_files_inception --output_graph=C:\tf20\tensorflow-for-poets-2\tf_files\graph.pb --output_labels=C:\tf20\tensorflow-for-poets-2\tf_files\labels.txt --image_dir C:\tf20\tensorflow-for-poets-2\tf_files\hardware
```

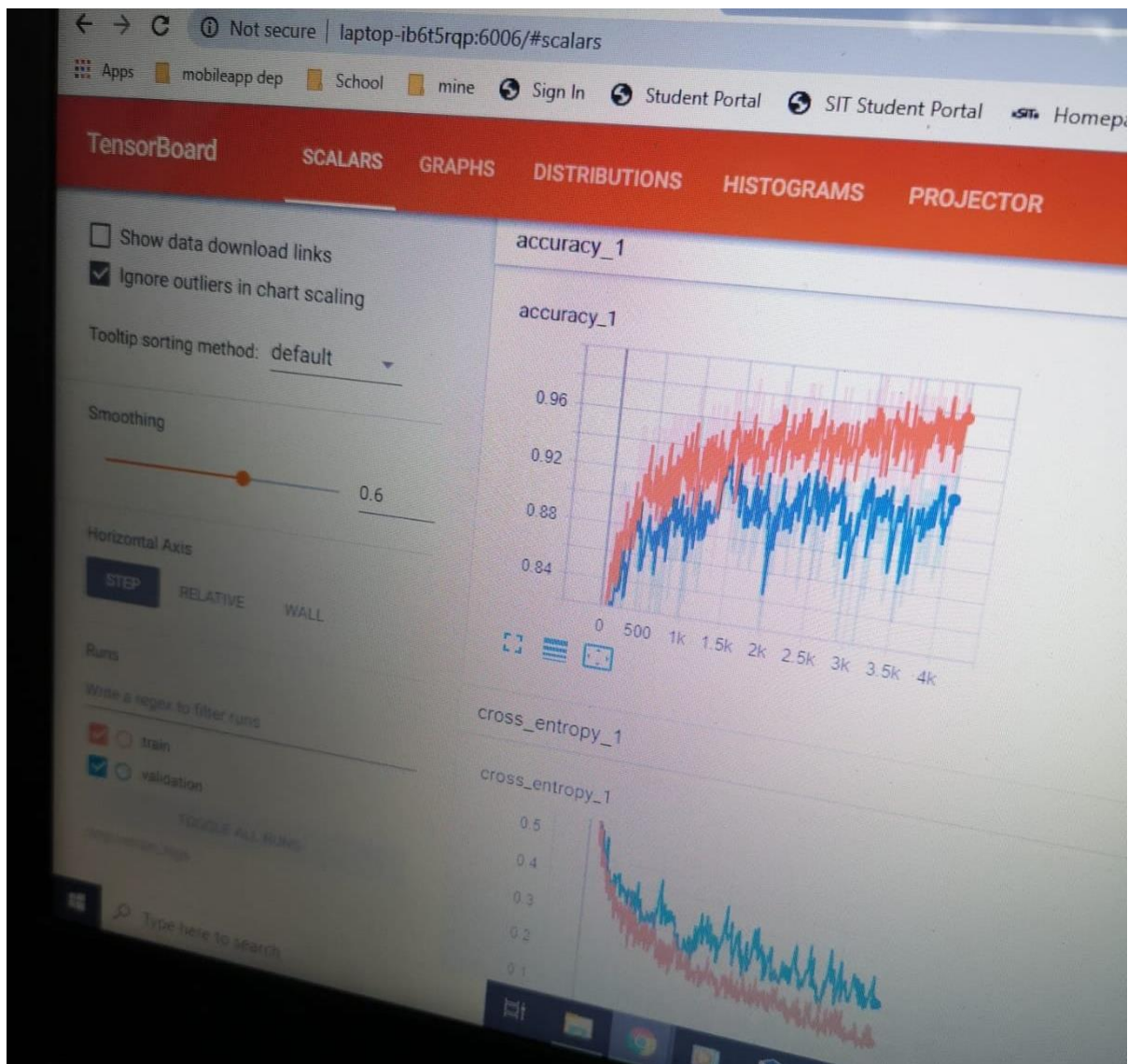
- The program is successfully trained and can be used for testing and conversion (e.g. pb to tflite or lite).

 labels.txt	8/11/2019 4:15 PM	Text Document	1 KB
 graph.pb	8/11/2019 4:15 PM	PB File	85,444 KB

- Files derived from the training which is used to retrain and deploy in android later.

```
labels.txt - Notepad
File Edit Format View Help
drone
hard disk
mouse
pc keyboard
ram sticks
smartphone
solid state drive
thumb drive
laptop
|
```

- The name of objects generated from the above training which is derived from the object folder name we have inputted at the beginning.



- The analysis of the training can be viewed by launching the Tensorboard.
- The graph shows that the rate of accuracy increases after each training steps and iteration over the time.