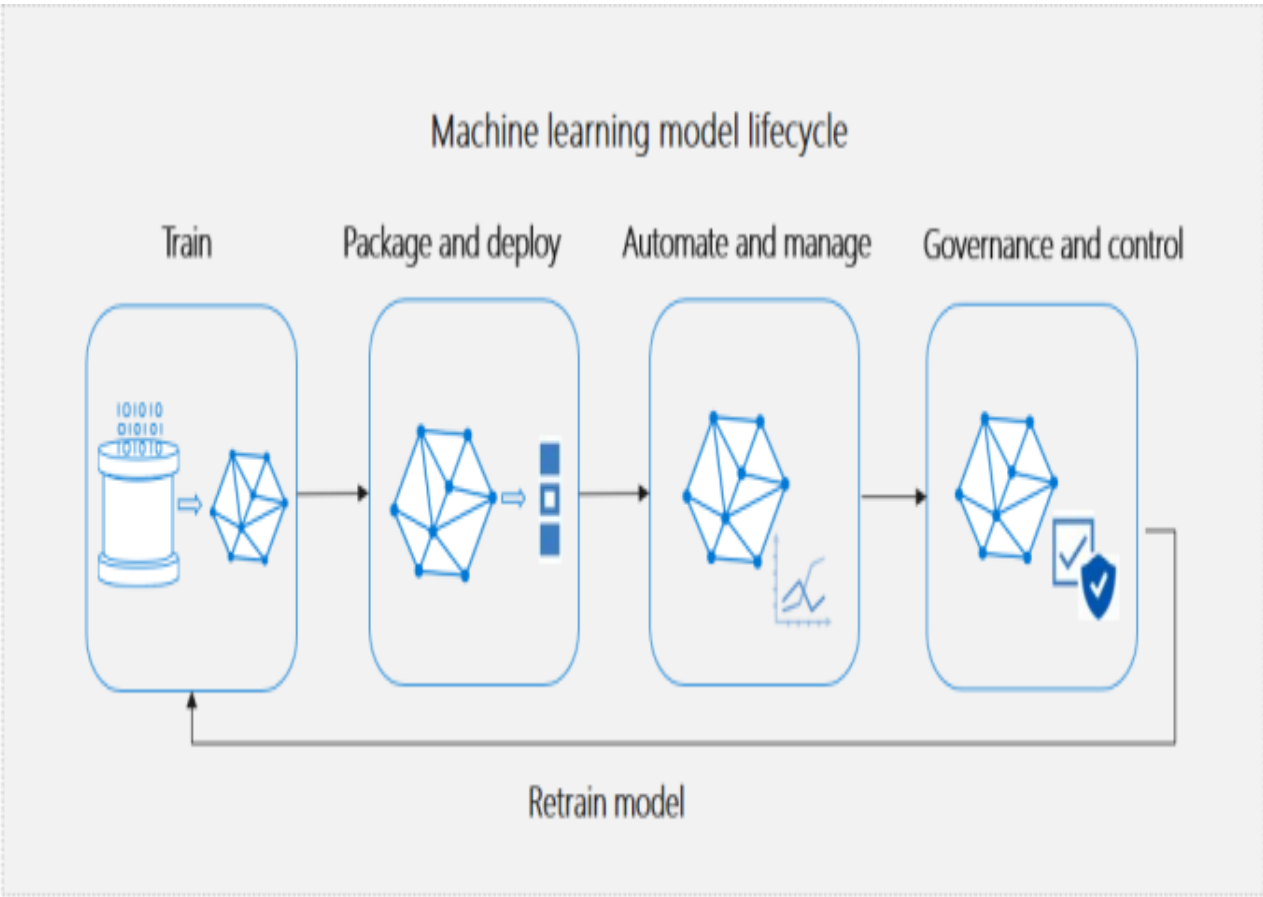
MLOPS


Machine learning model lifecycle
Train
Package and deploy
Automate and manage
Governance and control
Retrain model

TASK DESCRIPTION

1. Create container image that's has Python3 and Keras or numpy installed using dockerfile

2. When we launch this image, it should automatically starts train the model in the container.

3. Create a job chain of job1, job2, job3, job4 and job5 using build pipeline plugin in Jenkins

4. Job1 : Pull the Github repo automatically when some developers push repo to Github.

5. Job2 : By looking at the code or program file, Jenkins should automatically start the respective machine learning software installed interpreter install image container to deploy code and start training(eg. If code uses CNN, then Jenkins should start the container that has already installed all the softwares required for the cnn processing).

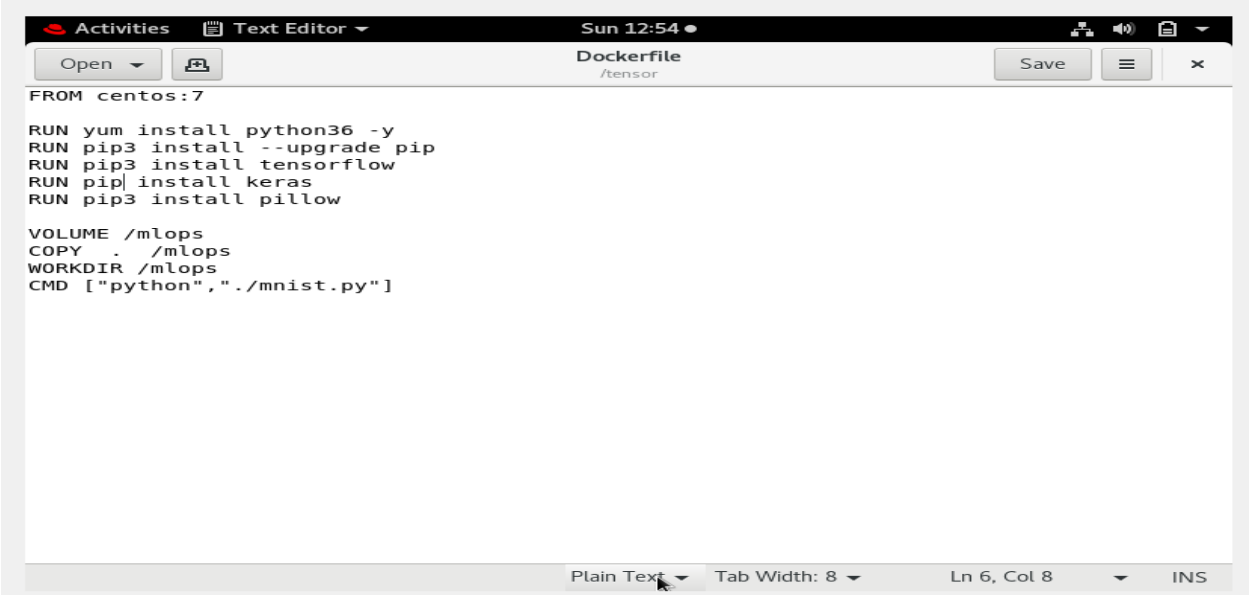
6. Job3 : Train your model and predict accuracy or metrics.

7. Job4 : if metrics accuracy is less than 80% , then tweak the machine learning model architecture.

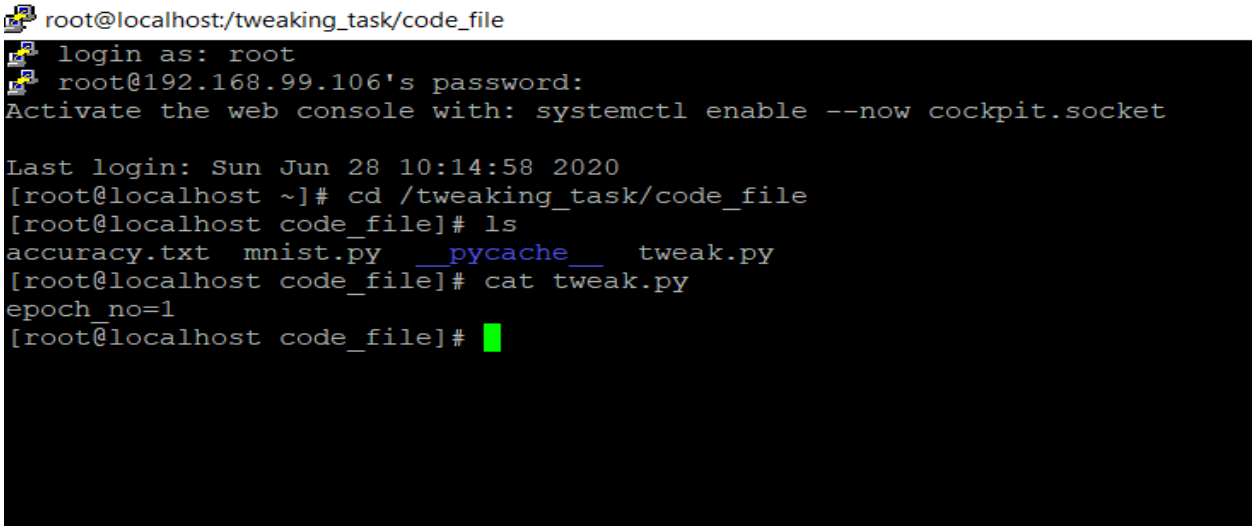
8. Job5: Retrain the model or notify that the best model is being created

9. Create One extra job job6 for monitor : If container where app is running. fails due to any reason then this job should automatically start the container again from where the last trained model left

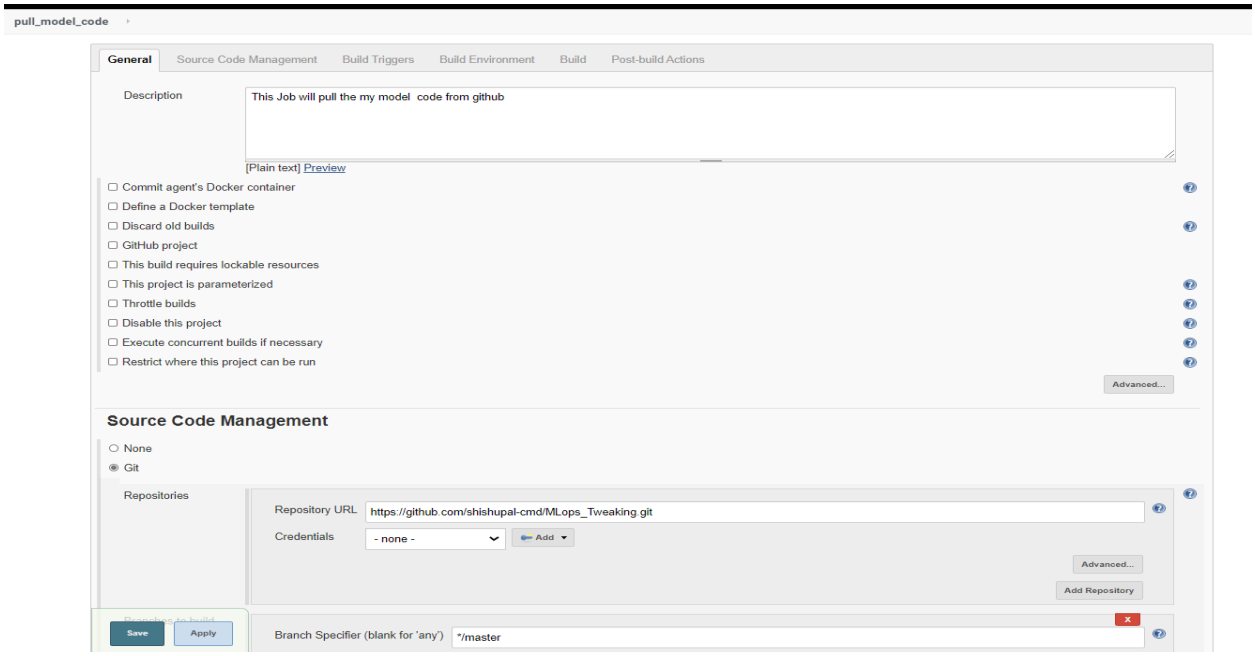
STEP ->> By this Dockerfile I created the docker Image , that has all the required modules for running my model

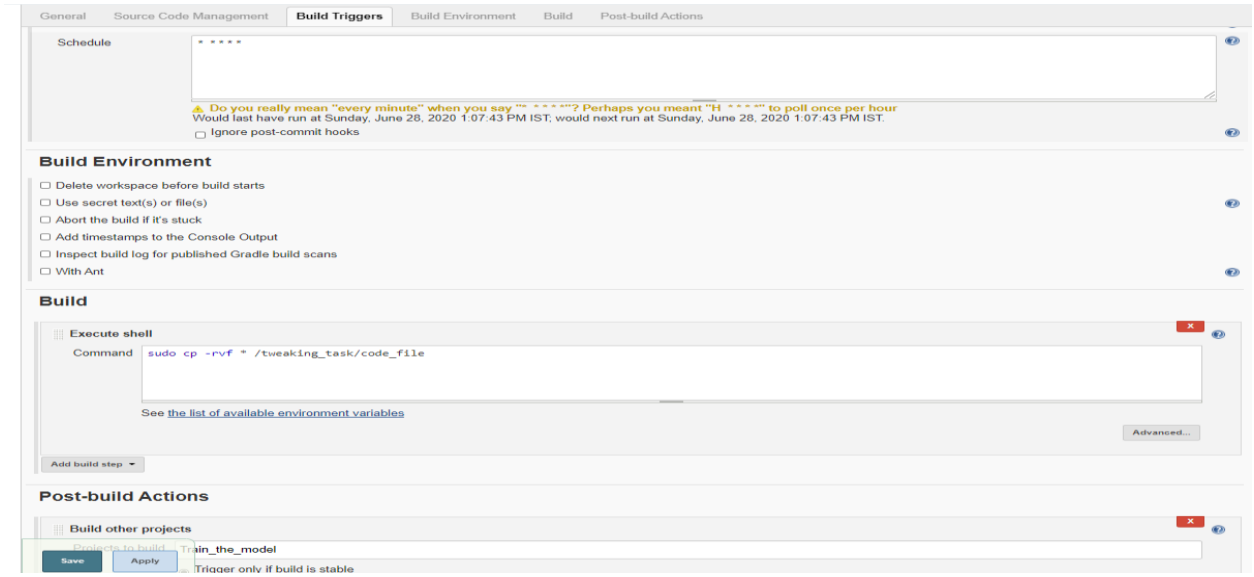


Here is the directory where I stored my code form github in my RHEL8 VM

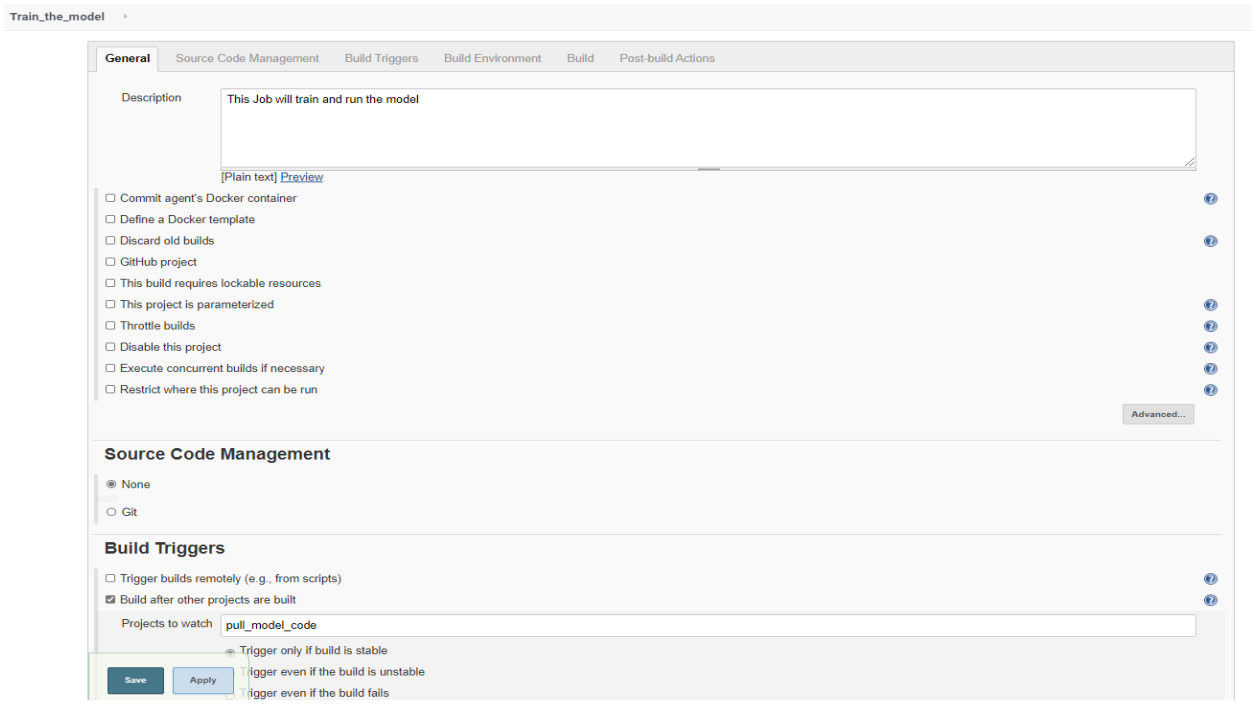


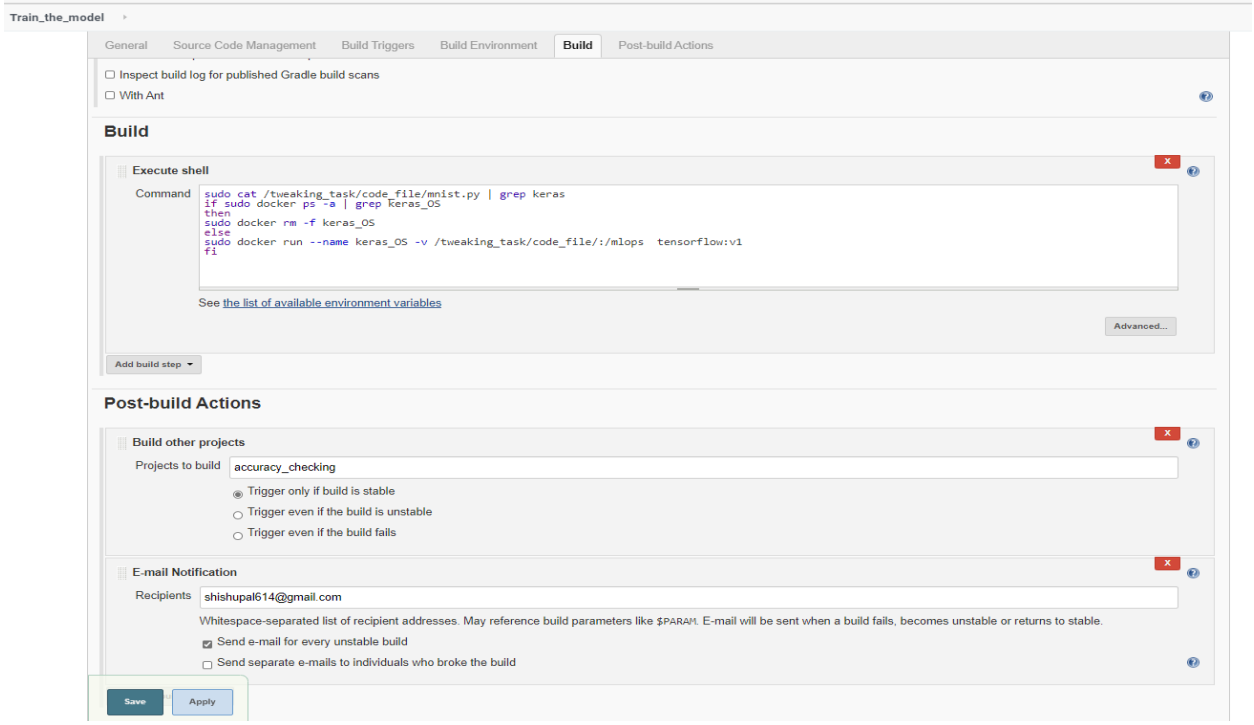
JOB 1 ->> This Job is pulling the model code from my github repository





JOB 2 ->> This Job will train the model and give the accuracy and but I have created this Job only for mnist code , you can use same code for multiple type of Code , just by adding few more lines in build shell





Here is Output of the JOB 2 and I have got 89% accuracy in one epoch

Train_the_model ▸ #2

Console Output

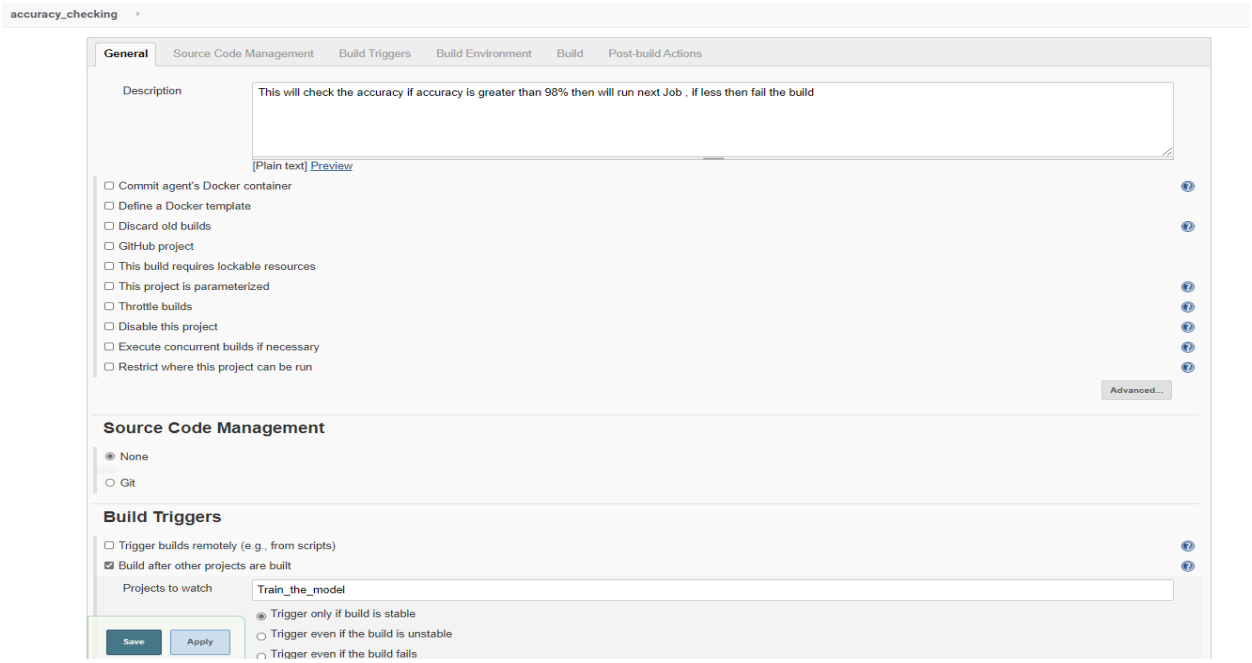
```
Started by upstream project "pull_model_code" build number 2
originally caused by:
 Started by user admin
Started by upstream project "pull_model_code" build number 2
originally caused by:
 Started by user admin
Running as SYSTEM
Building on master in workspace /var/lib/jenkins/workspace/Train_the_model
[Train_the_model] $ /bin/sh -xe /tmp/jenkins2217219505617638202.sh
+ sudo cat /tweaking_task/code_file/mnist.py
+ grep keras
from keras.datasets import mnist
from keras.utils.np_utils import to_categorical
from keras.models import Sequential
from keras.layers import Dense
from keras.optimizers import RMSprop
+ sudo docker ps -a
+ grep keras_OS
+ sudo docker run --name keras_OS -v /tweaking_task/code_file/:/mlops tensorflow:v1
Downloading data from https://s3.amazonaws.com/img-datasets/mnist.npz

    8192/11490434 [..............................] - ETA: 8:03
   40960/11490434 [..............................] - ETA: 3:12
   73728/11490434 [..............................] - ETA: 2:46
  106496/11490434 [..............................] - ETA: 2:34
  163840/11490434 [..............................] - ETA: 2:05
  180224/11490434 [..............................] - ETA: 2:16
  196608/11490434 [..............................] - ETA: 2:23
  212992/11490434 [..............................] - ETA: 2:31
  229376/11490434 [..............................] - ETA: 3:26
  245760/11490434 [..............................] - ETA: 4:15
  262144/11490434 [..............................] - ETA: 4:29
  278528/11490434 [..............................] - ETA: 4:51
  294912/11490434 [..............................] - ETA: 4:37
  303104/11490434 [..............................] - ETA: 4:51
  319488/11490434 [..............................] - ETA: 4:48
  335872/11490434 [..............................] - ETA: 4:45
  352256/11490434 [..............................] - ETA: 4:42
  368640/11490434 [..............................] - ETA: 4:32
  385024/11490434 [>.............................] - ETA: 4:28
  401408/11490434 [>.............................] - ETA: 4:20
  417792/11490434 [>.............................] - ETA: 4:15
  442368/11490434 [>.............................] - ETA: 4:09
```

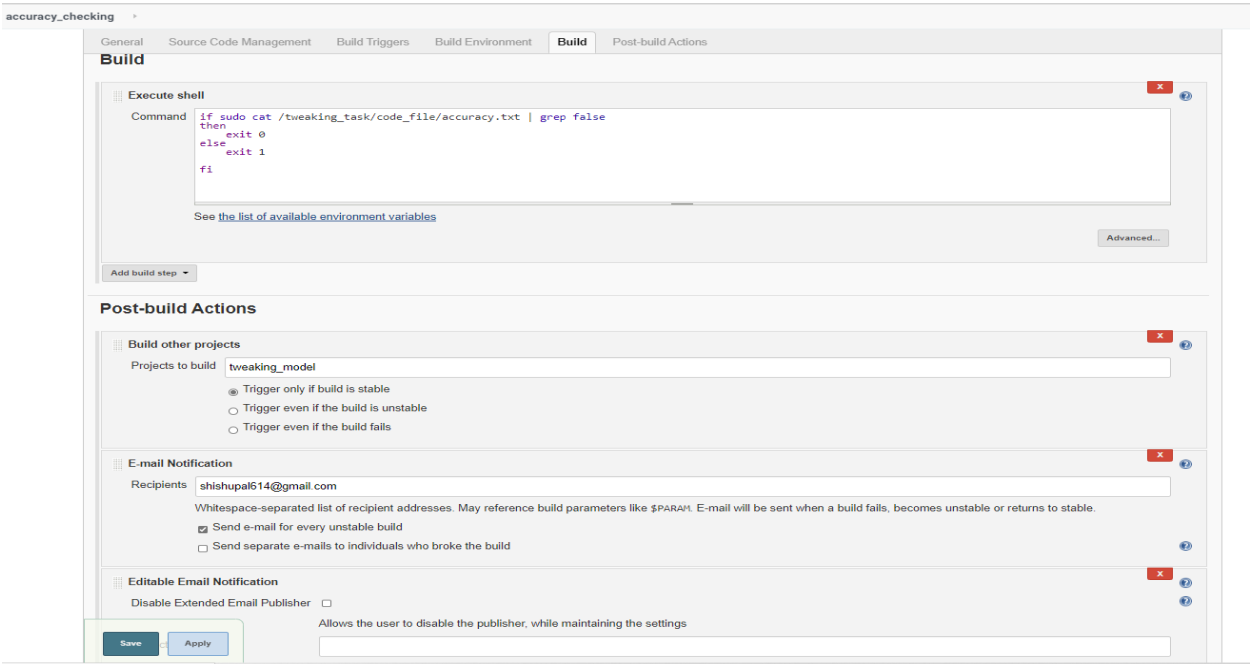
Train_the_model ▸ #2

```
 8585216/11490434 [=====================>........] - ETA: 16s
 8740864/11490434 [=====================>........] - ETA: 15s
 8798208/11490434 [=====================>........] - ETA: 15s
 8863744/11490434 [=====================>........] - ETA: 14s
 8953856/11490434 [======================>.......] - ETA: 13s
 9019392/11490434 [======================>.......] - ETA: 13s
 9437184/11490434 [=======================>......] - ETA: 10s
 9510912/11490434 [=======================>......] - ETA: 10s
 9576448/11490434 [=======================>......] - ETA: 9s
 9609216/11490434 [=======================>......] - ETA: 9s
 9707520/11490434 [========================>.....] - ETA: 9s
 9822208/11490434 [========================>.....] - ETA: 8s
 9912320/11490434 [========================>.....] - ETA: 7s
10010624/11490434 [=========================>....] - ETA: 7s
10100736/11490434 [=========================>....] - ETA: 6s
10223616/11490434 [=========================>....] - ETA: 6s
10346496/11490434 [==========================>...] - ETA: 5s
10436608/11490434 [==========================>...] - ETA: 5s
10567680/11490434 [==========================>...] - ETA: 4s
10674176/11490434 [==========================>...] - ETA: 3s
10747904/11490434 [==========================>...] - ETA: 3s
10780672/11490434 [==========================>...] - ETA: 3s
10960896/11490434 [===========================>..] - ETA: 2s
11091968/11490434 [===========================>..] - ETA: 1s
11264000/11490434 [============================>.] - ETA: 1s
11403264/11490434 [============================>.] - ETA: 0s
11493376/11490434 [==============================] - 51s 4us/step
2020-06-28 07:31:33.050934: W tensorflow/stream_executor/platform/default/dso_loader.cc:55] Could not load d
2020-06-28 07:31:33.051377: E tensorflow/stream_executor/cuda/cuda_driver.cc:313] failed call to cuInit: UNK
2020-06-28 07:31:33.051665: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:156] kernel driver does no
2020-06-28 07:31:33.053536: I tensorflow/core/platform/cpu_feature_guard.cc:143] Your CPU supports instructi
2020-06-28 07:31:34.050668: I tensorflow/core/platform/profile_utils/cpu_utils.cc:102] CPU Frequency: 220800
2020-06-28 07:31:34.052488: I tensorflow/compiler/xla/service/service.cc:168] XLA service 0x7fa2f4000b20 ini
2020-06-28 07:31:34.052655: I tensorflow/compiler/xla/service/service.cc:176]   StreamExecutor device (0): H
Epoch 1/1

   32/60000 [..............................] - ETA: 44:43 - loss: 142.5349 - accuracy: 0.0000e+00
  160/60000 [..............................] - ETA: 9:18 - loss: 209.3978 - accuracy: 0.1937
  288/60000 [..............................] - ETA: 5:20 - loss: 130.9213 - accuracy: 0.3750
  448/60000 [..............................] - ETA: 3:33 - loss: 88.5913 - accuracy: 0.4821
  608/60000 [..............................] - ETA: 2:41 - loss: 67.8683 - accuracy: 0.5378
  768/60000 [..............................] - ETA: 2:11 - loss: 55.4421 - accuracy: 0.5872
  896/60000 [..............................] - ETA: 1:56 - loss: 49.5984 - accuracy: 0.5960
 1056/60000 [..............................] - ETA: 1:41 - loss: 43.2604 - accuracy: 0.6241
 1216/60000 [..............................] - ETA: 1:30 - loss: 38.8343 - accuracy: 0.6390
 1408/60000 [..............................] - ETA: 1:20 - loss: 35.1918 - accuracy: 0.6420
 1600/60000 [..............................] - ETA: 1:12 - loss: 31.6080 - accuracy: 0.6612
 1792/60000 [..............................] - ETA: 1:06 - loss: 28.6405 - accuracy: 0.6797
 1984/60000 [..............................] - ETA: 1:01 - loss: 26.5519 - accuracy: 0.6900
 2176/60000 [>.............................] - ETA: 57s - loss: 24.6479 - accuracy: 0.7031
 2368/60000 [>.............................] - ETA: 53s - loss: 23.2681 - accuracy: 0.7090
```

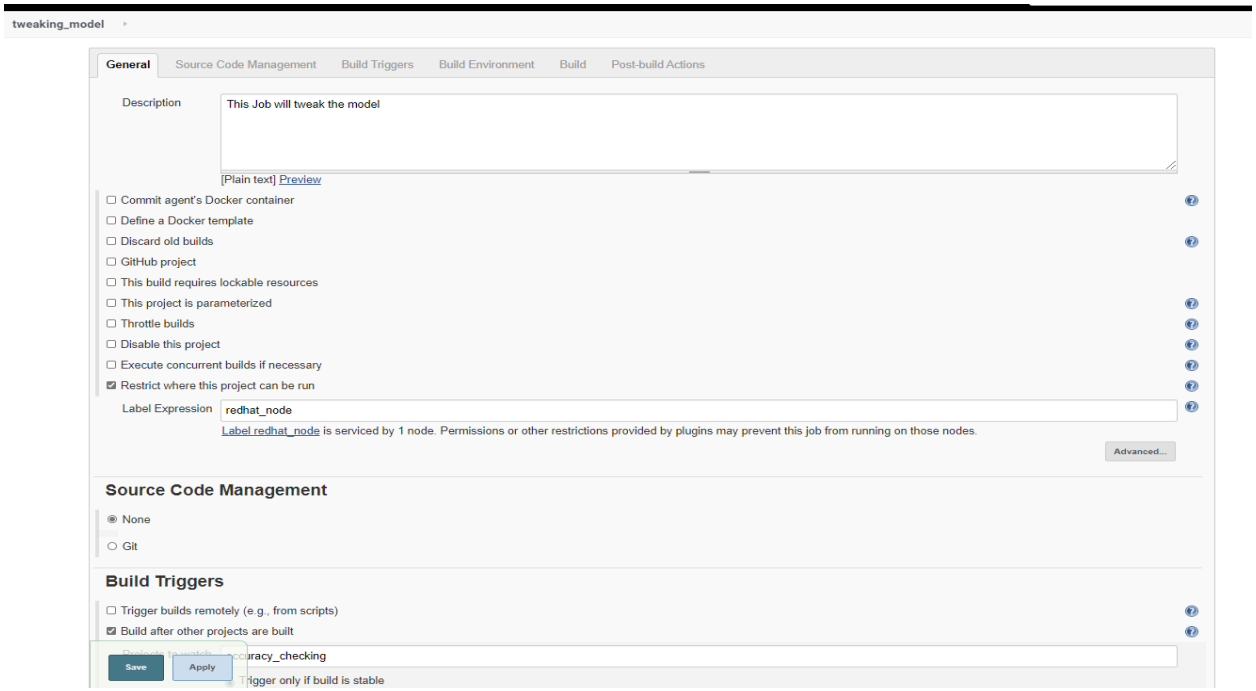
```
57888/60000 [============================>..] - ETA: 0s - loss: 2.0848 - accuracy: 0.
58080/60000 [============================>.] - ETA: 0s - loss: 2.0810 - accuracy: 0.
58272/60000 [============================>.] - ETA: 0s - loss: 2.0746 - accuracy: 0.
58464/60000 [============================>.] - ETA: 0s - loss: 2.0694 - accuracy: 0.
58656/60000 [============================>.] - ETA: 0s - loss: 2.0641 - accuracy: 0.
58848/60000 [============================>.] - ETA: 0s - loss: 2.0584 - accuracy: 0.
59040/60000 [============================>.] - ETA: 0s - loss: 2.0548 - accuracy: 0.
59232/60000 [============================>.] - ETA: 0s - loss: 2.0494 - accuracy: 0.
59264/60000 [============================>.] - ETA: 0s - loss: 2.0486 - accuracy: 0.
59296/60000 [============================>.] - ETA: 0s - loss: 2.0479 - accuracy: 0.
59328/60000 [============================>.] - ETA: 0s - loss: 2.0470 - accuracy: 0.
59424/60000 [============================>.] - ETA: 0s - loss: 2.0447 - accuracy: 0.
59552/60000 [============================>.] - ETA: 0s - loss: 2.0410 - accuracy: 0.
59680/60000 [============================>.] - ETA: 0s - loss: 2.0386 - accuracy: 0.
59776/60000 [============================>.] - ETA: 0s - loss: 2.0366 - accuracy: 0.
59872/60000 [============================>.] - ETA: 0s - loss: 2.0340 - accuracy: 0.
60000/60000 [==============================] - 24s 394us/step - loss: 2.0311 - accur

   32/10000 [..............................] - ETA: 39s
  480/10000 [>.............................] - ETA: 3s
  960/10000 [=>............................] - ETA: 2s
 1408/10000 [===>..........................] - ETA: 1s
 1984/10000 [====>.........................] - ETA: 1s
 2336/10000 [=======>......................] - ETA: 1s
 2656/10000 [=======>......................] - ETA: 1s
 3232/10000 [========>.....................] - ETA: 1s
 3808/10000 [==========>...................] - ETA: 0s
 4320/10000 [===========>..................] - ETA: 0s
 4480/10000 [============>.................] - ETA: 0s
 4672/10000 [============>.................] - ETA: 0s
 5280/10000 [===============>..............] - ETA: 0s
 5728/10000 [================>.............] - ETA: 0s
 5952/10000 [================>.............] - ETA: 0s
 6176/10000 [=================>............] - ETA: 0s
 6656/10000 [==================>...........] - ETA: 0s
 7168/10000 [====================>.........] - ETA: 0s
 7680/10000 [=====================>........] - ETA: 0s
 8032/10000 [========================>.....] - ETA: 0s
 8512/10000 [=========================>....] - ETA: 0s
 9088/10000 [==========================>...] - ETA: 0s
 9632/10000 [===========================>..] - ETA: 0s
10000/10000 [==============================] - 2s 154us/step
Using TensorFlow backend.
acc=89.73%
Triggering a new build of accuracy_checking
Triggering a new build of accuracy_checking
Finished: SUCCESS
```

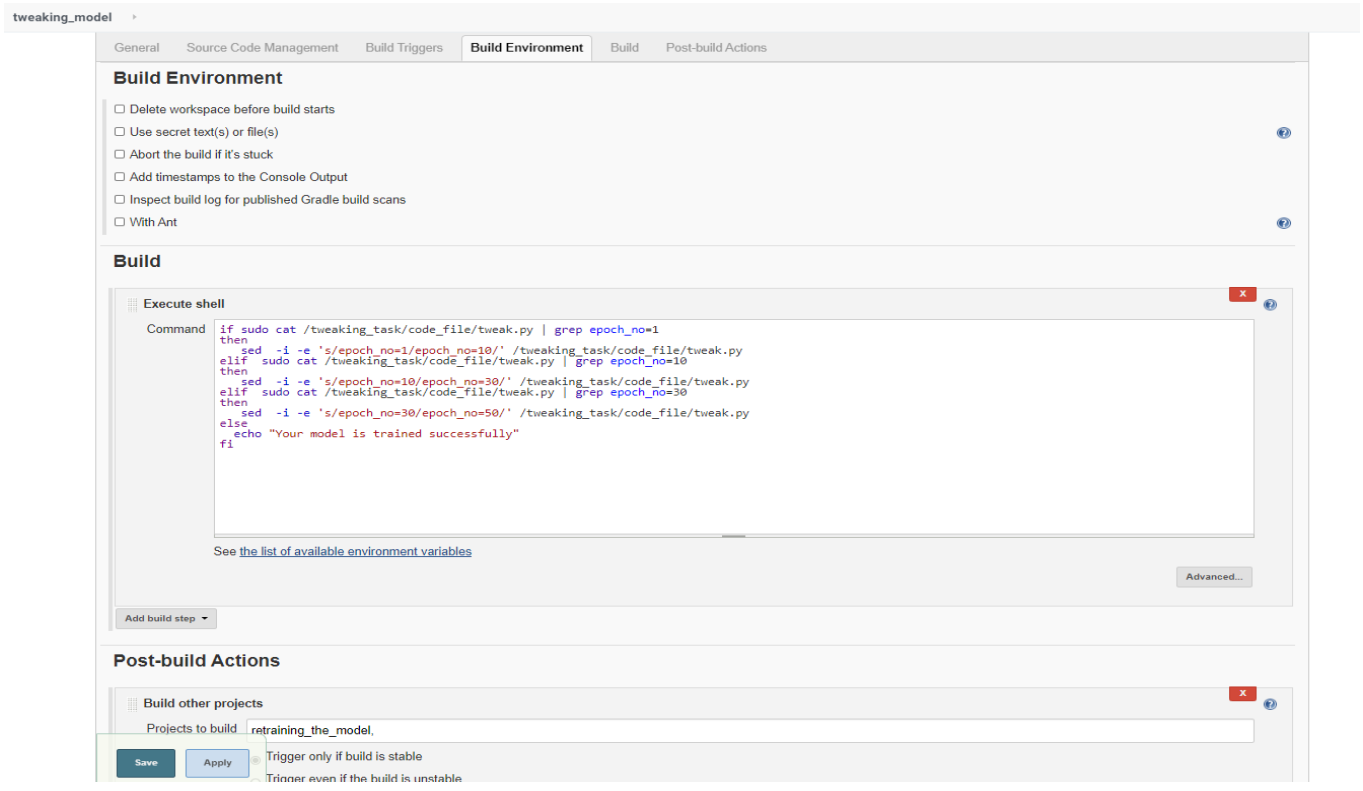
JOB 3 ->> This checks the accuracy the accuracy of model if accuracy is greater than 98% than it exxcute exit 1 else exit 0





JOB 4 ->> This Job wil tweak the no. of epochs of model





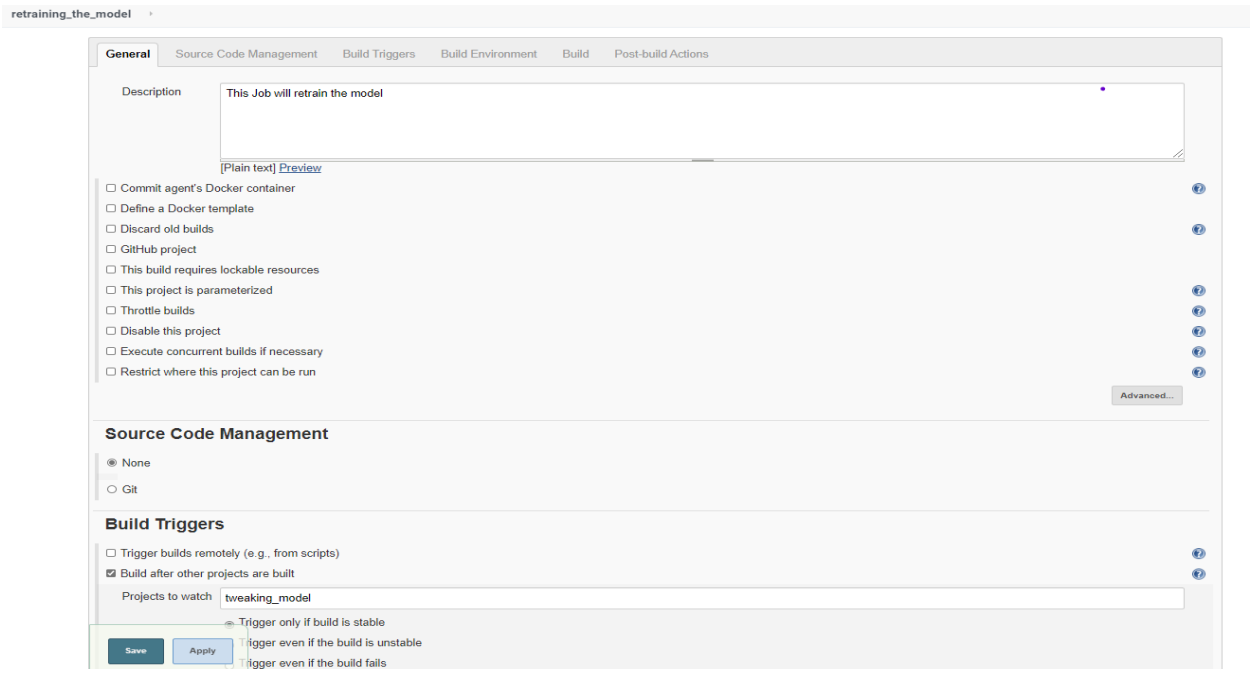
Here is the Output of the JOB 3

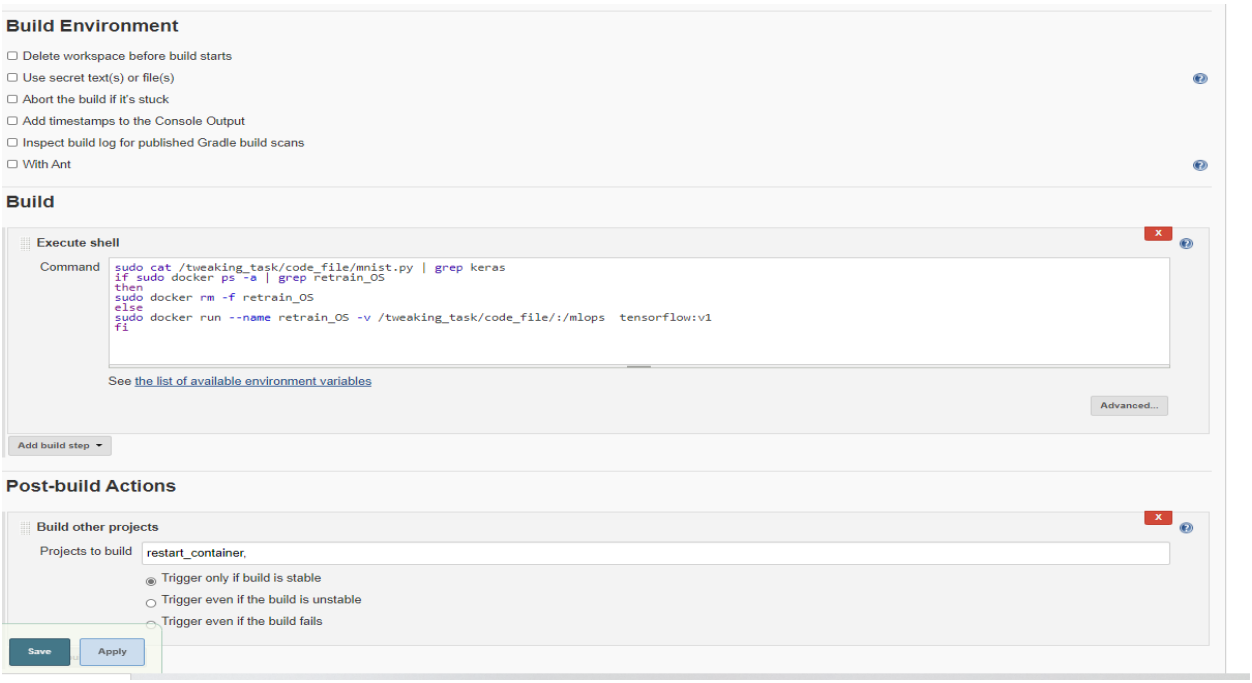
tweaking_model › #12

Console Output

```
Started by upstream project "accuracy_checking" build number 3
originally caused by:
 Started by upstream project "Train_the_model" build number 2
 originally caused by:
  Started by upstream project "pull_model_code" build number 2
  originally caused by:
   Started by user admin
  Started by upstream project "pull_model_code" build number 2
 Started by upstream project "Train_the_model" build number 2
Started by upstream project "accuracy_checking" build number 3
originally caused by:
 Started by upstream project "Train_the_model" build number 2
 originally caused by:
  Started by upstream project "pull_model_code" build number 2
  originally caused by:
   Started by user admin
  Started by upstream project "pull_model_code" build number 2
 Started by upstream project "Train_the_model" build number 2
Running as SYSTEM
Building remotely on redhat_node (redhat) in workspace /mlops/workspace/tweaking_model
[tweaking_model] $ /bin/sh -xe /tmp/jenkins7197480978607770608.sh
+ grep epoch_no=1
+ sudo cat /tweaking_task/code_file/tweak.py
epoch_no=1
+ sed -i -e s/epoch_no=1/epoch_no=10/ /tweaking_task/code_file/tweak.py
Triggering a new build of retraining_the_model
Finished: SUCCESS
```

JOB 5 ->> This Job will retrain the model , after increasing the no. of epochs





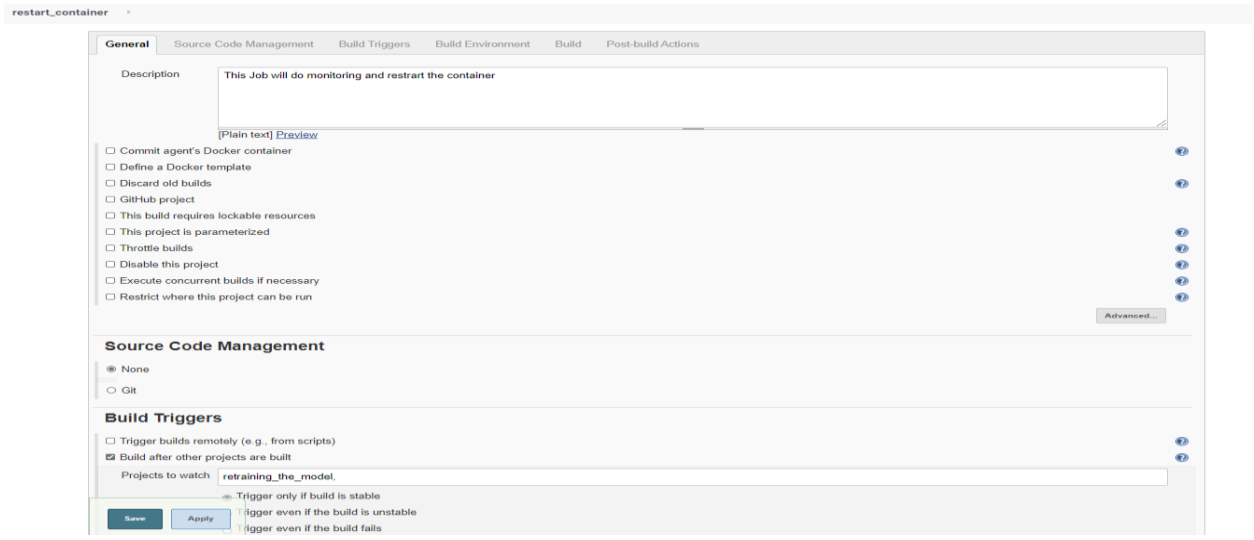
Here is the Output after retraining the model , but I have got approx 92% accuracy , you can wait for more time to get better accuracy

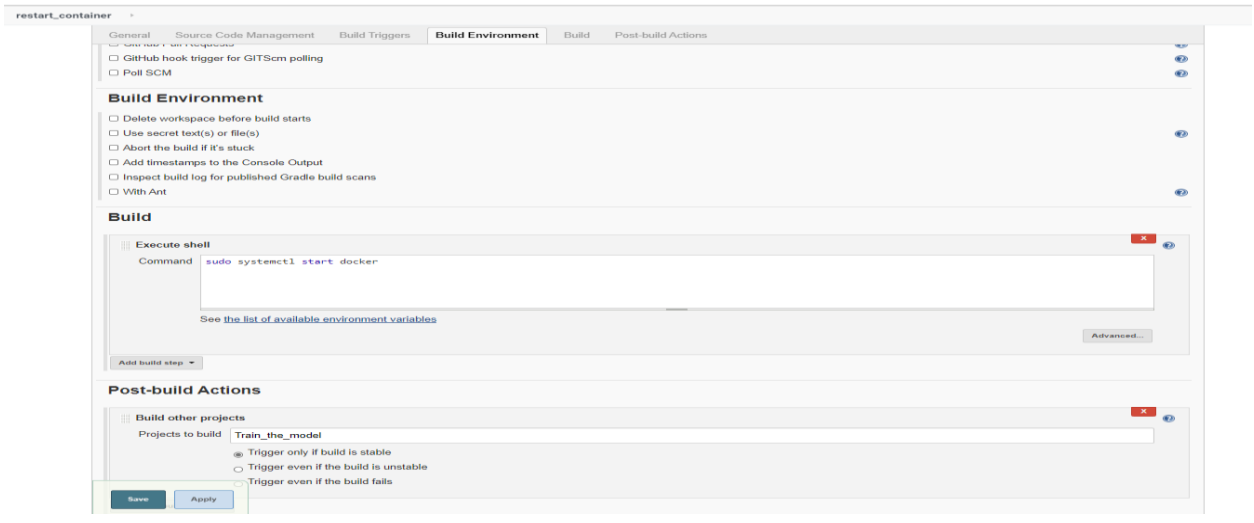
```
Epoch 9/10

   32/60000 [..............................] - ETA: 54s - loss: 0.0640 - accuracy: 0.9688
  128/60000 [..............................] - ETA: 54s - loss: 0.2279 - accuracy: 0.9297
  192/60000 [..............................] - ETA: 52s - loss: 0.2148 - accuracy: 0.9375
  288/60000 [..............................] - ETA: 45s - loss: 0.2253 - accuracy: 0.9410
  384/60000 [..............................] - ETA: 42s - loss: 0.5540 - accuracy: 0.9401
  512/60000 [..............................] - ETA: 40s - loss: 0.6697 - accuracy: 0.9336
  608/60000 [..............................] - ETA: 39s - loss: 0.5803 - accuracy: 0.9375
  736/60000 [..............................] - ETA: 37s - loss: 0.5362 - accuracy: 0.9402
  864/60000 [..............................] - ETA: 36s - loss: 0.5190 - accuracy: 0.9433
  992/60000 [..............................] - ETA: 35s - loss: 0.4905 - accuracy: 0.9385
 1120/60000 [..............................] - ETA: 34s - loss: 0.4690 - accuracy: 0.9357
 1216/60000 [..............................] - ETA: 33s - loss: 0.4858 - accuracy: 0.9367
 1344/60000 [..............................] - ETA: 33s - loss: 0.4807 - accuracy: 0.9368
 1472/60000 [..............................] - ETA: 32s - loss: 0.4909 - accuracy: 0.9361
 1568/60000 [..............................] - ETA: 32s - loss: 0.4859 - accuracy: 0.9337
 1664/60000 [..............................] - ETA: 32s - loss: 0.4660 - accuracy: 0.9351
 1728/60000 [..............................] - ETA: 33s - loss: 0.4715 - accuracy: 0.9346
 1856/60000 [..............................] - ETA: 33s - loss: 0.5137 - accuracy: 0.9327
 1984/60000 [..............................] - ETA: 32s - loss: 0.4862 - accuracy: 0.9345
 2112/60000 [>.............................] - ETA: 32s - loss: 0.4753 - accuracy: 0.9332
 2208/60000 [>.............................] - ETA: 32s - loss: 0.4561 - accuracy: 0.9352
 2304/60000 [>.............................] - ETA: 32s - loss: 0.4397 - accuracy: 0.9366
 2336/60000 [>.............................] - ETA: 33s - loss: 0.4355 - accuracy: 0.9371
 2432/60000 [>.............................] - ETA: 33s - loss: 0.4525 - accuracy: 0.9367
 2496/60000 [>.............................] - ETA: 34s - loss: 0.4442 - accuracy: 0.9375
 2592/60000 [>.............................] - ETA: 34s - loss: 0.4392 - accuracy: 0.9375
 2688/60000 [>.............................] - ETA: 34s - loss: 0.4842 - accuracy: 0.9371
 2784/60000 [>.............................] - ETA: 34s - loss: 0.4779 - accuracy: 0.9368
 2880/60000 [>.............................] - ETA: 34s - loss: 0.4683 - accuracy: 0.9378
 2976/60000 [>.............................] - ETA: 34s - loss: 0.4615 - accuracy: 0.9382
 3072/60000 [>.............................] - ETA: 34s - loss: 0.4617 - accuracy: 0.9368
 3168/60000 [>.............................] - ETA: 34s - loss: 0.4572 - accuracy: 0.9369
 3264/60000 [>.............................] - ETA: 34s - loss: 0.4800 - accuracy: 0.9366
 3360/60000 [>.............................] - ETA: 34s - loss: 0.4815 - accuracy: 0.9366
 3456/60000 [>.............................] - ETA: 33s - loss: 0.4799 - accuracy: 0.9346
 3552/60000 [>.............................] - ETA: 33s - loss: 0.4726 - accuracy: 0.9344
 3648/60000 [>.............................] - ETA: 33s - loss: 0.4651 - accuracy: 0.9342
```

```
retraining_the_model  ▸  #11
58208/60000 [============================>.] - ETA: 1s - loss: 0.5188 - accuracy: 0.9309
58304/60000 [============================>.] - ETA: 1s - loss: 0.5182 - accuracy: 0.9309
58400/60000 [============================>.] - ETA: 0s - loss: 0.5178 - accuracy: 0.9309
58496/60000 [============================>.] - ETA: 0s - loss: 0.5182 - accuracy: 0.9308
58624/60000 [============================>.] - ETA: 0s - loss: 0.5179 - accuracy: 0.9308
58720/60000 [============================>.] - ETA: 0s - loss: 0.5172 - accuracy: 0.9308
58816/60000 [============================>.] - ETA: 0s - loss: 0.5164 - accuracy: 0.9309
58912/60000 [============================>.] - ETA: 0s - loss: 0.5167 - accuracy: 0.9309
59008/60000 [============================>.] - ETA: 0s - loss: 0.5176 - accuracy: 0.9310
59040/60000 [============================>.] - ETA: 0s - loss: 0.5174 - accuracy: 0.9310
59104/60000 [============================>.] - ETA: 0s - loss: 0.5170 - accuracy: 0.9310
59200/60000 [============================>.] - ETA: 0s - loss: 0.5173 - accuracy: 0.9309
59328/60000 [============================>.] - ETA: 0s - loss: 0.5177 - accuracy: 0.9310
59456/60000 [============================>.] - ETA: 0s - loss: 0.5232 - accuracy: 0.9310
59552/60000 [============================>.] - ETA: 0s - loss: 0.5256 - accuracy: 0.9310
59648/60000 [============================>.] - ETA: 0s - loss: 0.5262 - accuracy: 0.9310
59712/60000 [============================>.] - ETA: 0s - loss: 0.5258 - accuracy: 0.9310
59808/60000 [============================>.] - ETA: 0s - loss: 0.5251 - accuracy: 0.9310
59904/60000 [============================>.] - ETA: 0s - loss: 0.5244 - accuracy: 0.9311
60000/60000 [==============================] - 36s 596us/step - loss: 0.5237 - accuracy: 0.9311
Epoch 10/10

   32/60000 [..............................] - ETA: 40s - loss: 0.0059 - accuracy: 1.0000
  128/60000 [..............................] - ETA: 35s - loss: 0.5437 - accuracy: 0.9609
  224/60000 [..............................] - ETA: 34s - loss: 0.3908 - accuracy: 0.9509
  352/60000 [..............................] - ETA: 32s - loss: 0.3298 - accuracy: 0.9574
  448/60000 [..............................] - ETA: 32s - loss: 0.2968 - accuracy: 0.9531
  576/60000 [..............................] - ETA: 31s - loss: 0.2540 - accuracy: 0.9601
  704/60000 [..............................] - ETA: 31s - loss: 0.2740 - accuracy: 0.9602
  832/60000 [..............................] - ETA: 30s - loss: 0.3511 - accuracy: 0.9531
  960/60000 [..............................] - ETA: 30s - loss: 0.3134 - accuracy: 0.9552
 1056/60000 [..............................] - ETA: 30s - loss: 0.3050 - accuracy: 0.9527
 1152/60000 [..............................] - ETA: 31s - loss: 0.2862 - accuracy: 0.9531
 1216/60000 [..............................] - ETA: 32s - loss: 0.2857 - accuracy: 0.9507
 1312/60000 [..............................] - ETA: 32s - loss: 0.3003 - accuracy: 0.9436
 1440/60000 [..............................] - ETA: 32s - loss: 0.2911 - accuracy: 0.9451
 1536/60000 [..............................] - ETA: 32s - loss: 0.2979 - accuracy: 0.9434
 1632/60000 [..............................] - ETA: 32s - loss: 0.3146 - accuracy: 0.9418
 1760/60000 [..............................] - ETA: 31s - loss: 0.3655 - accuracy: 0.9392
 1856/60000 [..............................] - ETA: 31s - loss: 0.3856 - accuracy: 0.9343
 1952/60000 [..............................] - ETA: 31s - loss: 0.4153 - accuracy: 0.9308
 2016/60000 [>.............................] - ETA: 32s - loss: 0.4162 - accuracy: 0.9301
 2144/60000 [>.............................] - ETA: 32s - loss: 0.4655 - accuracy: 0.9282
 2240/60000 [>.............................] - ETA: 32s - loss: 0.4545 - accuracy: 0.9277
 2336/60000 [>.............................] - ETA: 32s - loss: 0.4448 - accuracy: 0.9277
 2432/60000 [>.............................] - ETA: 32s - loss: 0.4520 - accuracy: 0.9252
 2528/60000 [>.............................] - ETA: 32s - loss: 0.4448 - accuracy: 0.9244
 2624/60000 [>.............................] - ETA: 32s - loss: 0.4473 - accuracy: 0.9234
 2752/60000 [>.............................] - ETA: 31s - loss: 0.4429 - accuracy: 0.9230
 2880/60000 [>.............................] - ETA: 31s - loss: 0.4651 - accuracy: 0.9219
```

```
   32/10000 [..............................] - ETA: 2:09
  288/10000 [..............................] - ETA: 15s
  544/10000 [>.............................] - ETA: 9s
  864/10000 [=>............................] - ETA: 6s
 1216/10000 [==>...........................] - ETA: 4s
 1504/10000 [===>..........................] - ETA: 3s
 1760/10000 [====>.........................] - ETA: 3s
 2112/10000 [=====>........................] - ETA: 2s
 2464/10000 [======>.......................] - ETA: 2s
 2848/10000 [=======>......................] - ETA: 2s
 3232/10000 [========>.....................] - ETA: 1s
 3616/10000 [=========>....................] - ETA: 1s
 4000/10000 [==========>...................] - ETA: 1s
 4352/10000 [===========>..................] - ETA: 1s
 4704/10000 [============>.................] - ETA: 1s
 5088/10000 [==============>...............] - ETA: 1s
 5472/10000 [===============>..............] - ETA: 1s
 5728/10000 [================>.............] - ETA: 0s
 6016/10000 [=================>............] - ETA: 0s
 6272/10000 [=================>............] - ETA: 0s
 6592/10000 [==================>...........] - ETA: 0s
 6944/10000 [===================>..........] - ETA: 0s
 7328/10000 [====================>.........] - ETA: 0s
 7680/10000 [=====================>........] - ETA: 0s
 8064/10000 [======================>.......] - ETA: 0s
 8416/10000 [=======================>......] - ETA: 0s
 8640/10000 [=======================>......] - ETA: 0s
 8928/10000 [========================>.....] - ETA: 0s
 9280/10000 [=========================>....] - ETA: 0s
 9696/10000 [==========================>...] - ETA: 0s
10000/10000 [==============================] - 2s 200us/step
Using TensorFlow backend.
acc=91.63%
Triggering a new build of restart_container
Triggering a new build of restart_container
Finished: SUCCESS
```

JOB 6 ->> This Job will do monitoring , if docker goes down then it will restart it and will trigger the JOB1





BUILD PIPELINE VIEW OF WHOLE TASK

THANK YOU!!!

For any query watsapp -9690881508