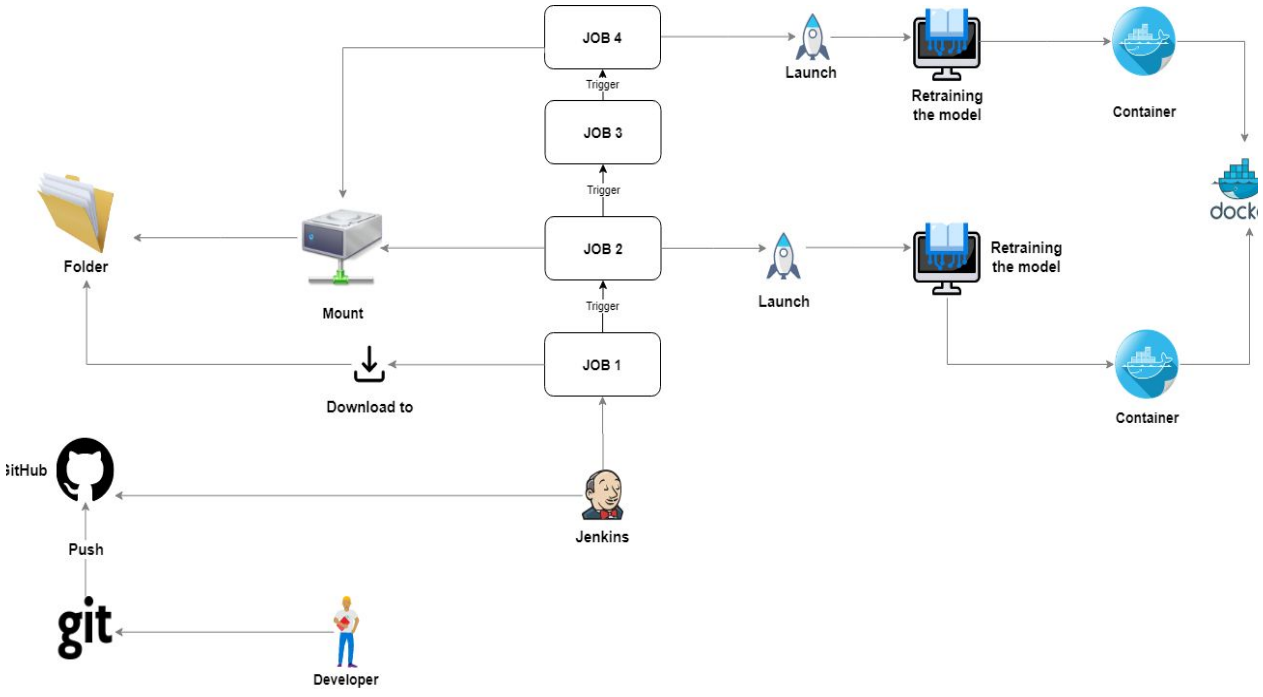
MLOPS TASK :

Building a workflow of system in which ML developer writes a code for training a model and upload to the Centralized system and Jenkins system will download the code and check which type of code it is Jenkins will start the respective docker container and train the model also if the accuracy is less than 80% jenkins will automatically tweak hyperparameters or add the layers to the model and keep on checking if the container is running or not. To complete this task we are integrating Machine learning and Devops (i.e.MLOPS). Here we use Python CNN, Jenkins, Docker, Github.

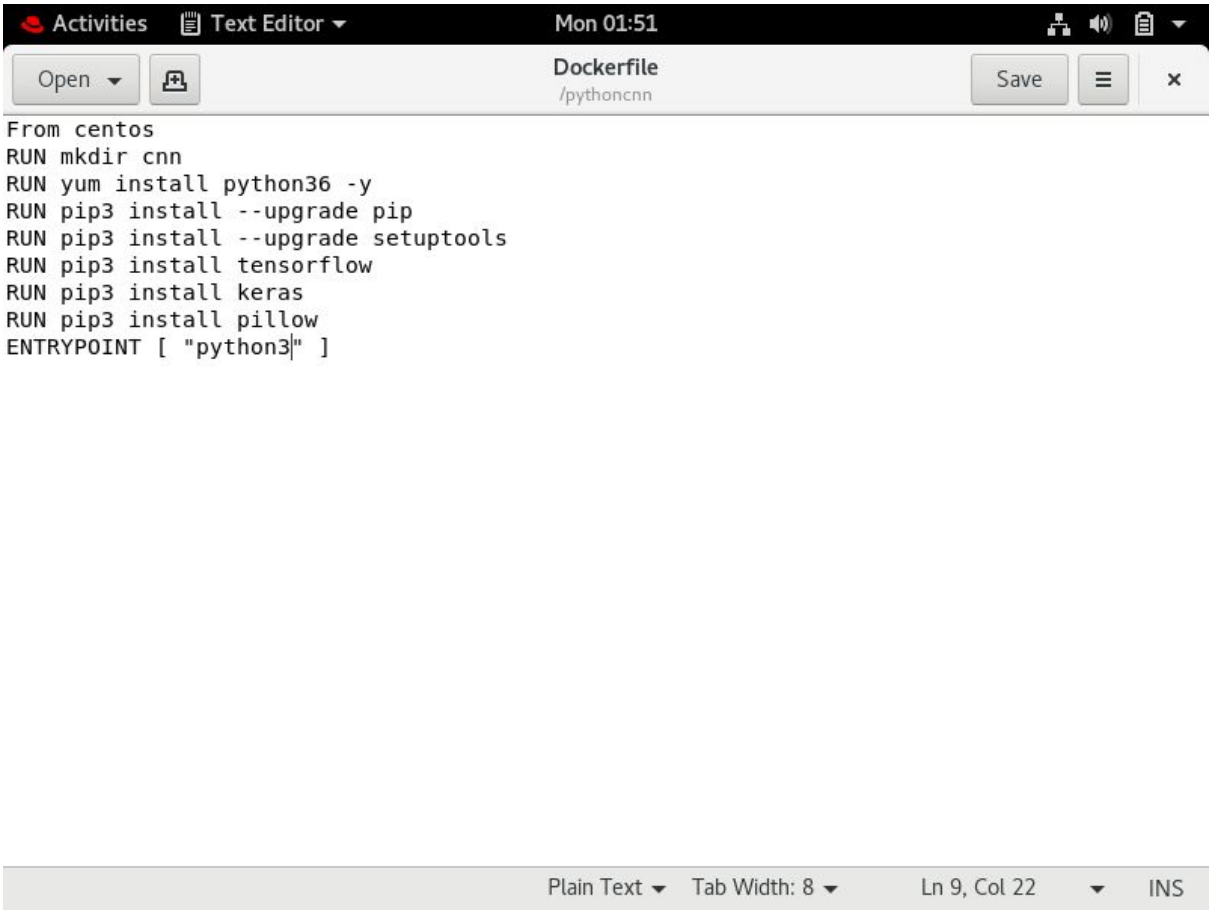
Flow of Automation Task :



Before starting first build some files :

Before going to the jenkins and doing further stuff first we will build a **Dockerfile** to create our own image from which jenkins can launch the container and also we will create an image having all the software required by the program file. Also we will write a **Bash script** and **Python code** to tweak hyperparameters and add layers to the model respectively.

Dockerfile :



Python Code :

Activities Text Editor Mon 01:52

Open tweaking.py /pythoncnn Save

```
line_number1 = 34

line_number2 = 46

with open('/pythoncnn/cnn2.py','r+') as fh :
    lines = fh.readlines()
    fh.seek(0)
    lines.insert(line_number1 -
1,'model.add(Convolution2D(filters=64,kernel_size=(3,3),activation=activationconvo))\n')
    fh.writelines(lines)
    fh.seek(0)
    lines.insert(line_number2 -
1,'model.add(Dense(units=128,activation=actiavtiondense))\n')
    fh.writelines(lines)
```

Loading file "/pythoncnn/tweaking.py"... Python Tab Width: 8 Ln 5, Col 23 INS

Bash Script :

Activities Text Editor Mon 01:52

Open hyperparameter.sh /pythoncnn Save

```
echo "Checking the Accuracy\n"
value=$(<AccuracyCNN.txt)
echo "Accuracy is : $value\n"

if [ "$value" != 80 ]

then
        sed -i 's/filters2=.*/filters2=32/' /pythoncnn/cnn2.py
        sed -i 's/units1=.*/units1=256/' /pythoncnn/cnn2.py
        sed -i 's/steps_per_epoch1=.*/steps_per_epoch1=1284/' /pythoncnn/cnn2.py
        sed -i 's/validation_steps1=.*/validation_steps1=4297/' /pythoncnn/cnn2.py
        sed -i 's/epochs1=.*/epochs1=3/' /pythoncnn/cnn2.py
        python3 /pythoncnn/tweaking.py
        echo "Hyper Parameter Changed successful"

else
        echo "accuracy is $value so no need of changing the hyper parameter"
fi
```

sh Tab Width: 8 Ln 11, Col 71 INS

Let's understand the task of each jenkins jobs first :

1. First job :

The task of this job is to keep an eye on the Github repository where the developer will upload or push a python code so when he pushes it this job will download and copy to the respective directory which is to be mounted to the docker container. After this job is being executed the job2 starts.

2. Second job :

After the job 1 is successfully built then this job is being triggered as this job is a downstream project. By looking at the code or program file the job is to automatically start the respective Docker container having all the softwares required by the program file. And as this Docker container is created the program file is being executed the model starts training.

3. Third job :

This is a downstream project means when job 2 runs stable then and then only this job is being built. The task of this job is to check the accuracy given by the model while training and

if the accuracy is less than 80% then this job will tweak the hyperparameters and add the layers to the model. And after this job the fourth and final job is being executed.

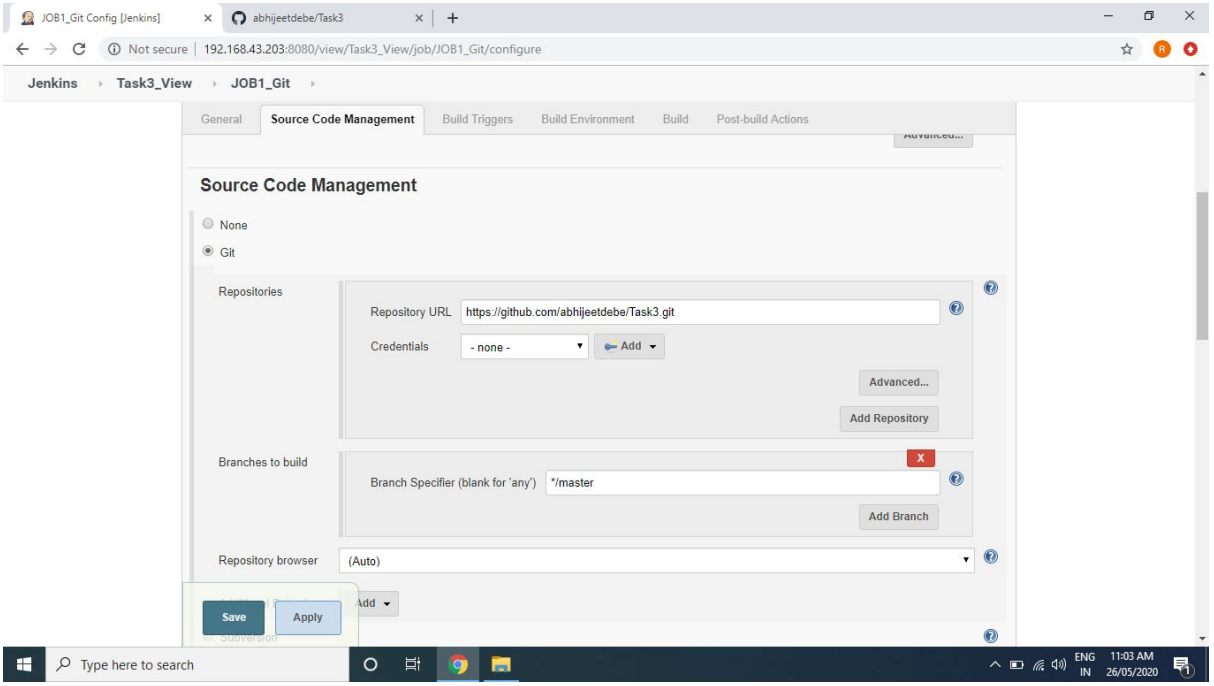
4. Fourth job :

After the job 3 is runned stable this job is being triggered and we can say this job is a downstream project. The task of this job is to Retrain the model by running the tweaked and newly added layers to the program file. So this job removes the previous container and launches a new container which simultaneously runs the respective new program file.

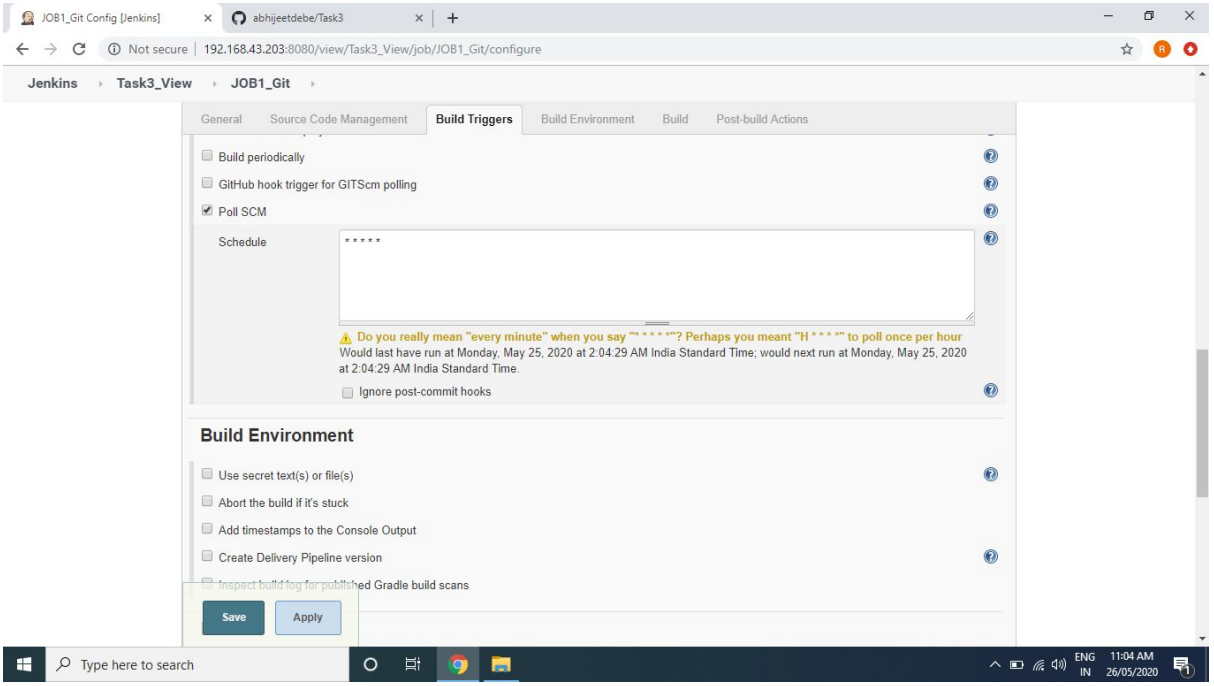
Following is step by step job creation :

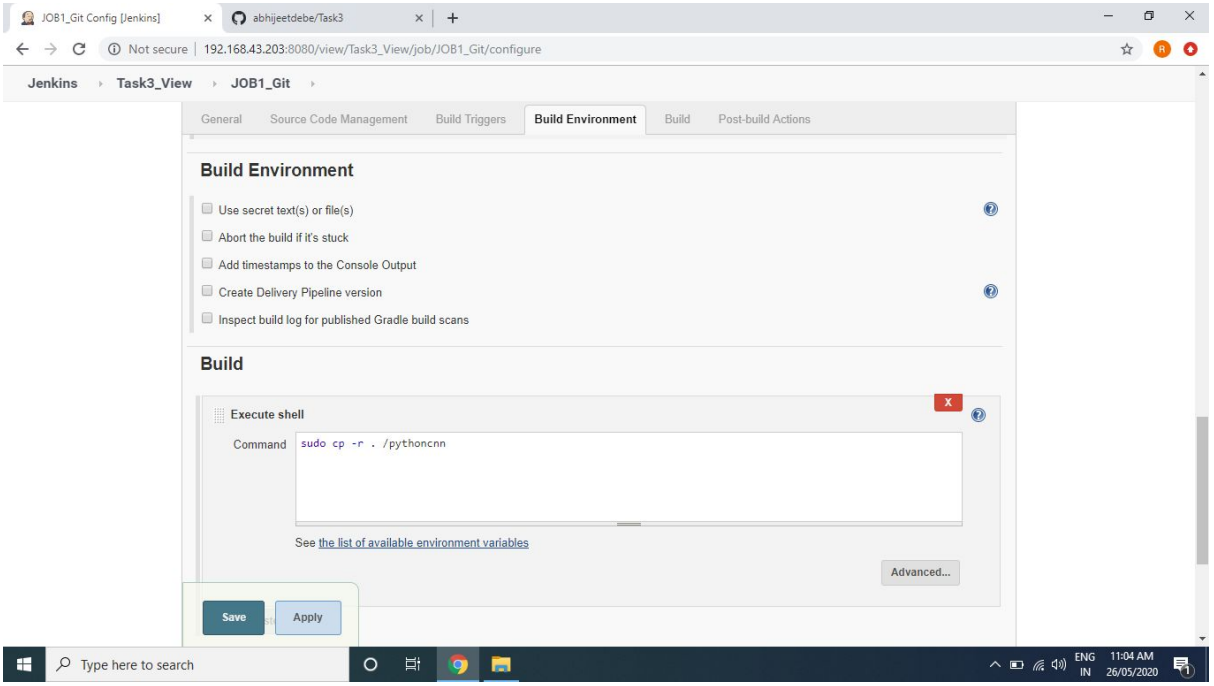
1. JOB1 :

Create a job and configure it as shown in the image here in SCM we enabled the Git option and gave the repository so that this job can go to that repository of developer and download it. Following image shows it.



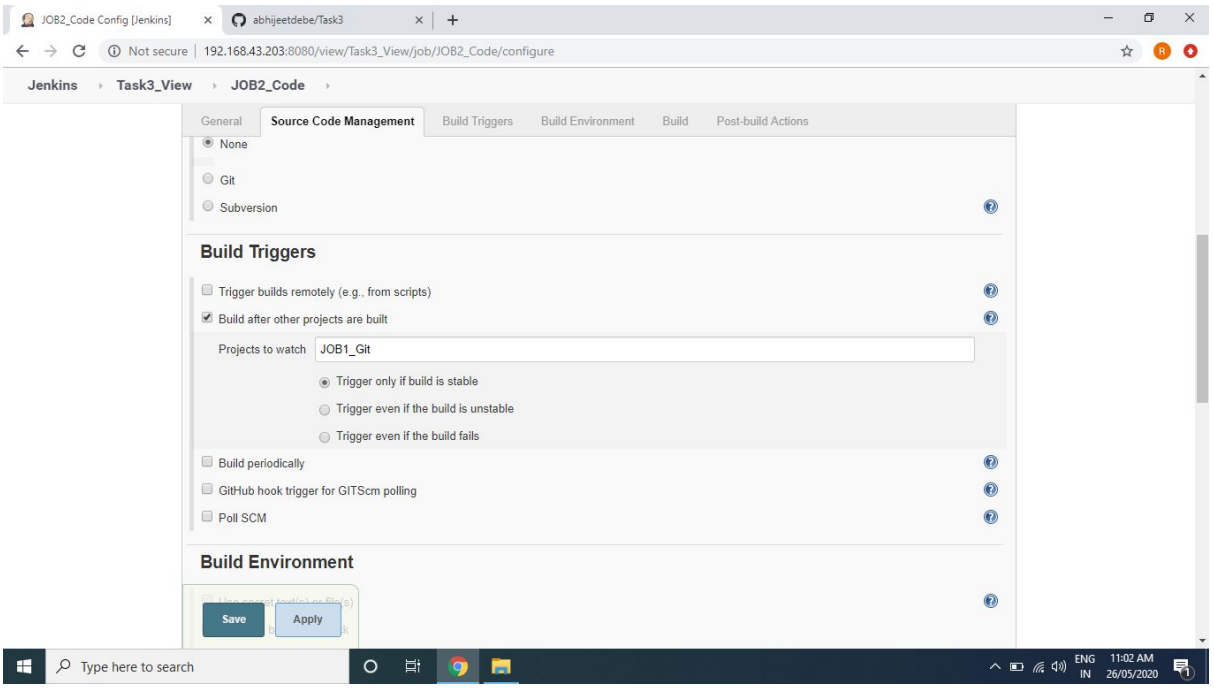
Now build triggers to poll scm so that jenkins can go to Github and keep on checking for uploads. And then we write a shell code to copy the program file to the respective folder which is to be mounted to container.

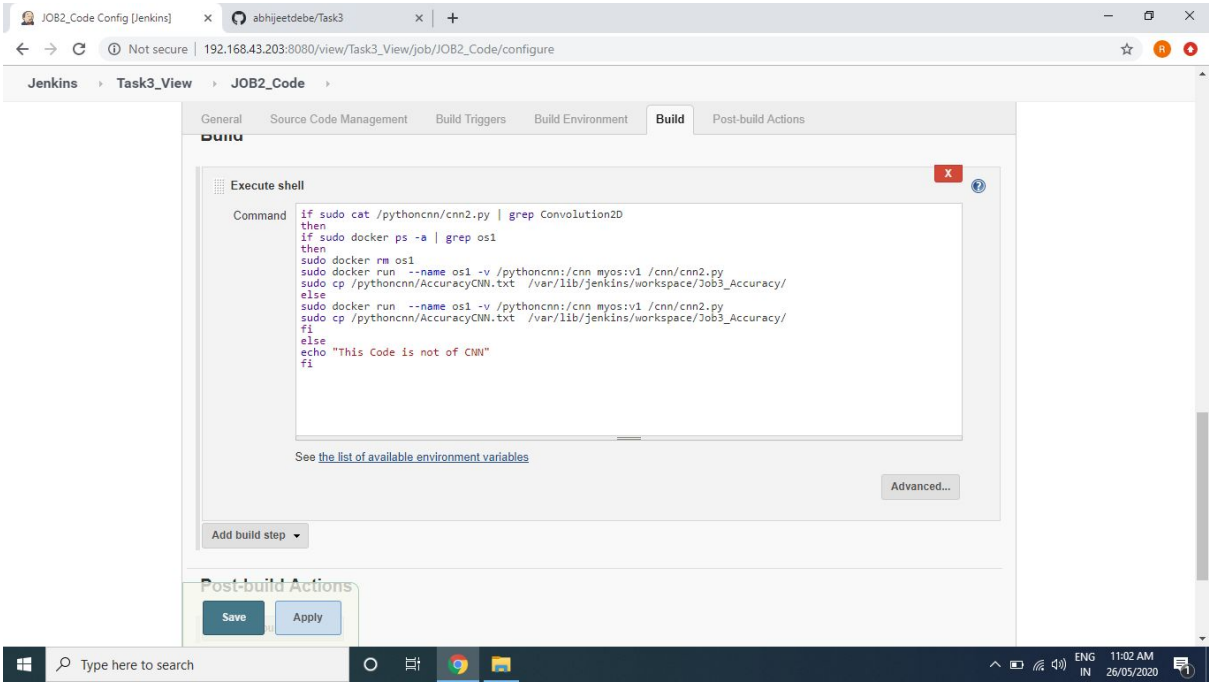




2. JOB2 :

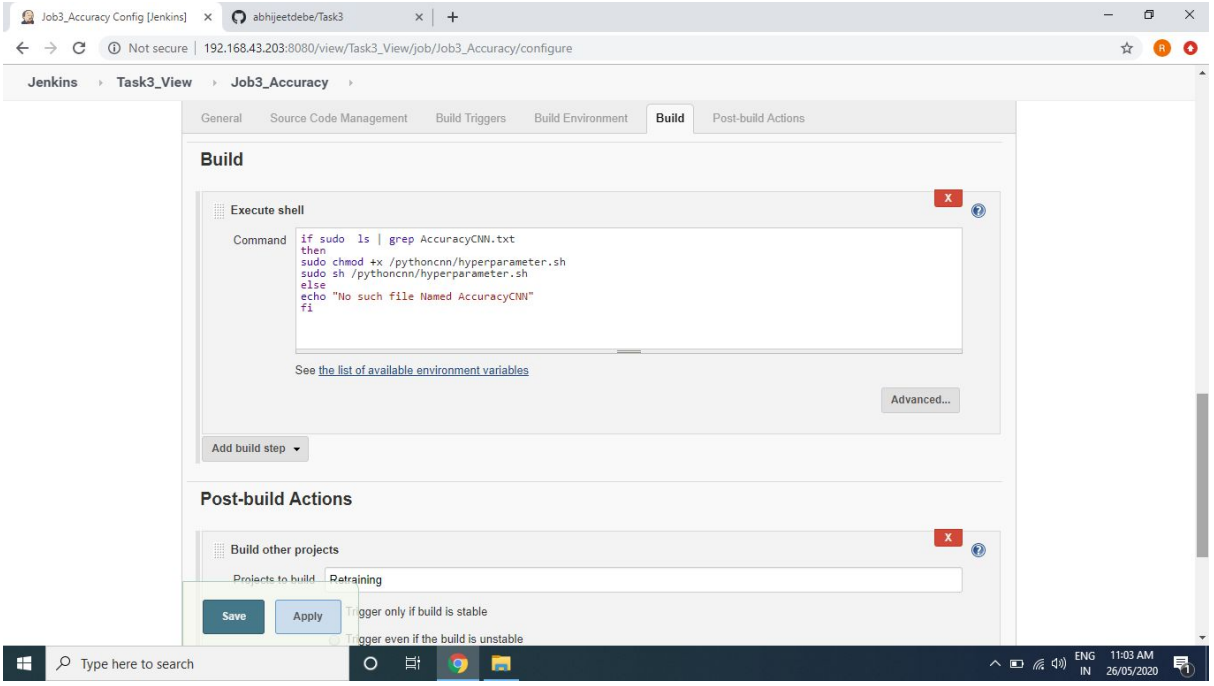
In this we build a trigger that when the job1 runs stable then this job will run the respective docker container by looking at the program file or code.





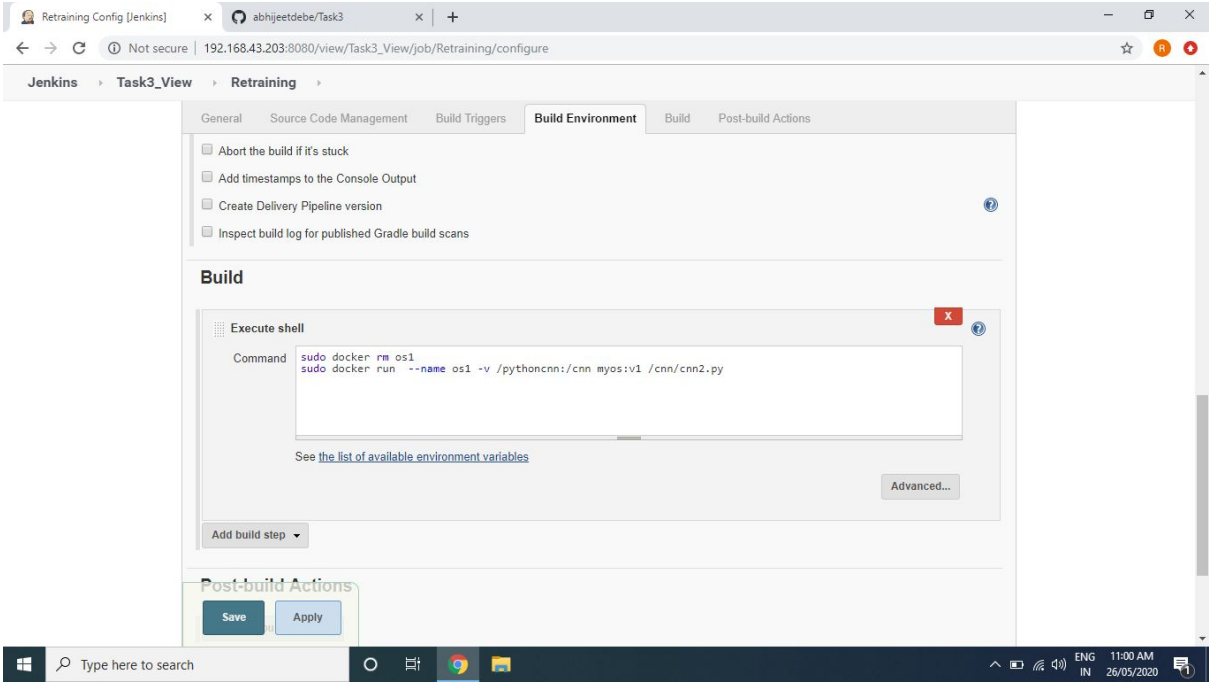
3. JOB3 :

This job will check the accuracy of the model and if the accuracy of the model is less than 80% then it will tweak the hyperparameter and add some new layers to it and build the next job4.



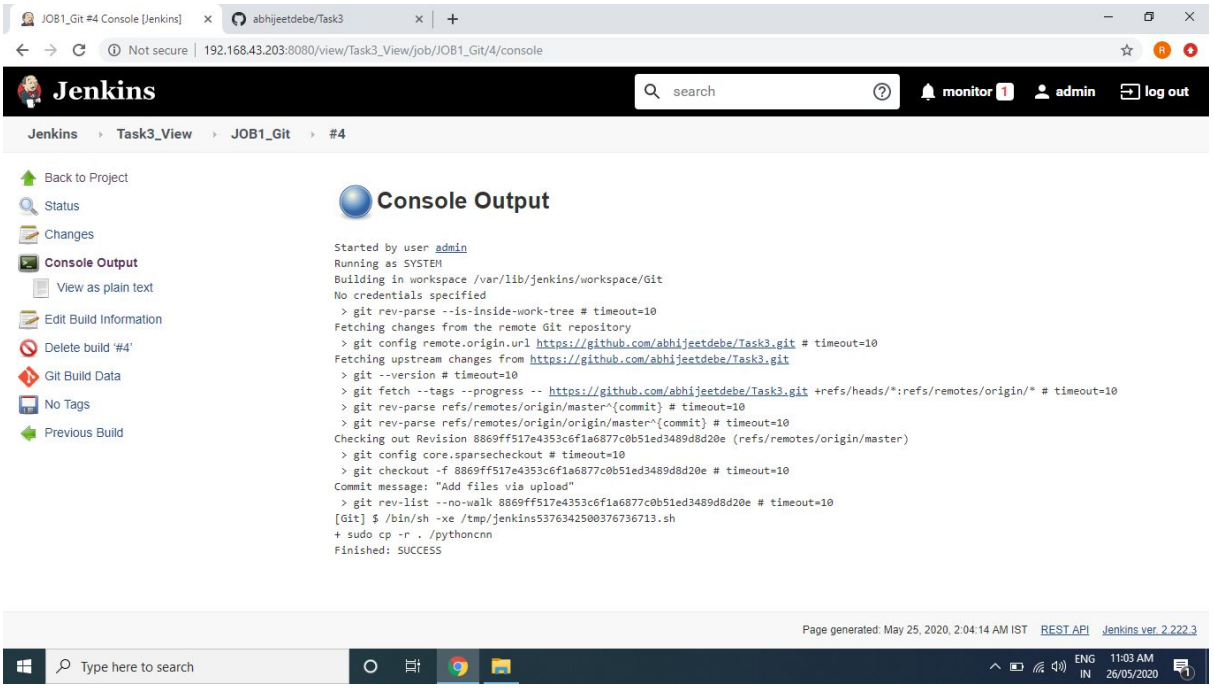
4. JOB4 :

When the job3 will tweak the hyperparameters and add some layers this job4 will retrain the model as the hyperparameters are being modified, some new layers are added and launch new container before that it will remove the previous docker container running.

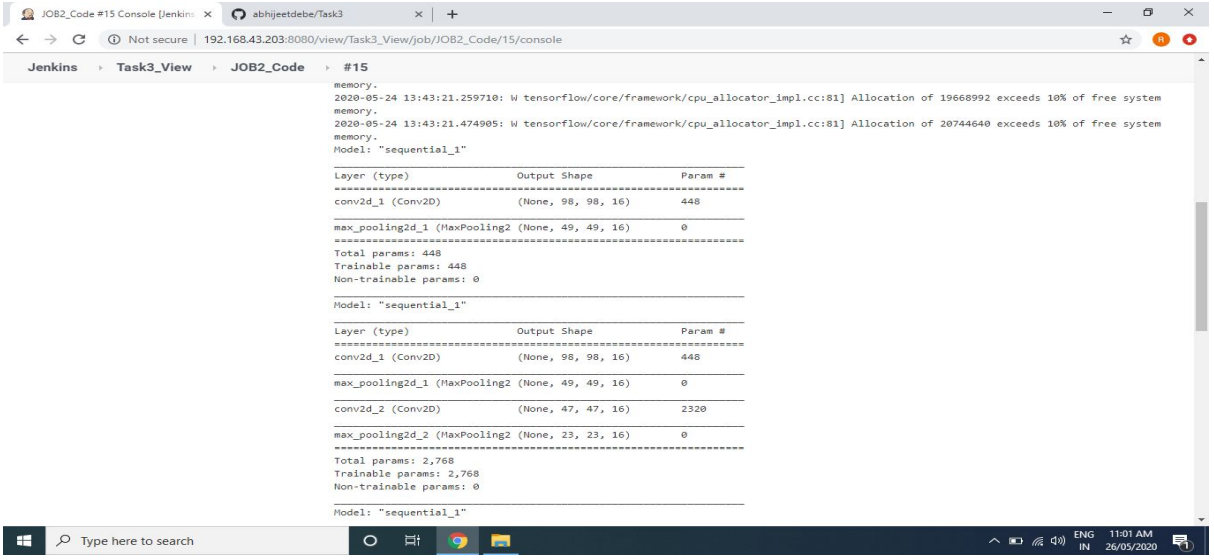


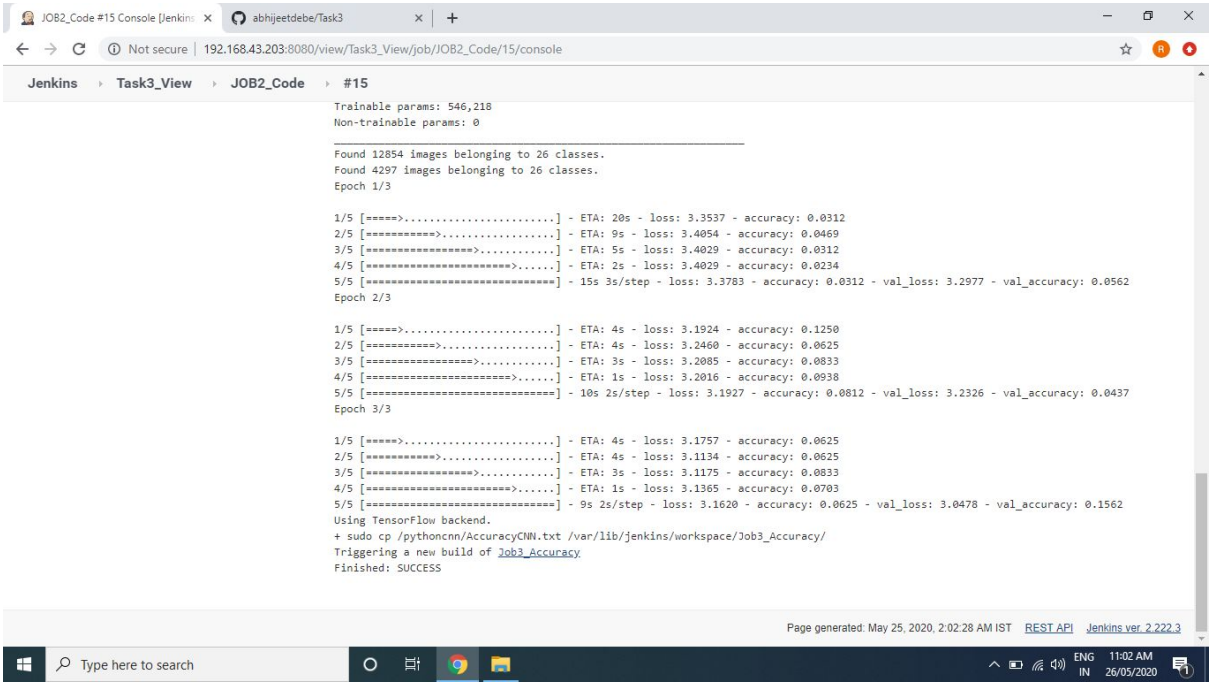
Output of the above Task :

1. JOB1:

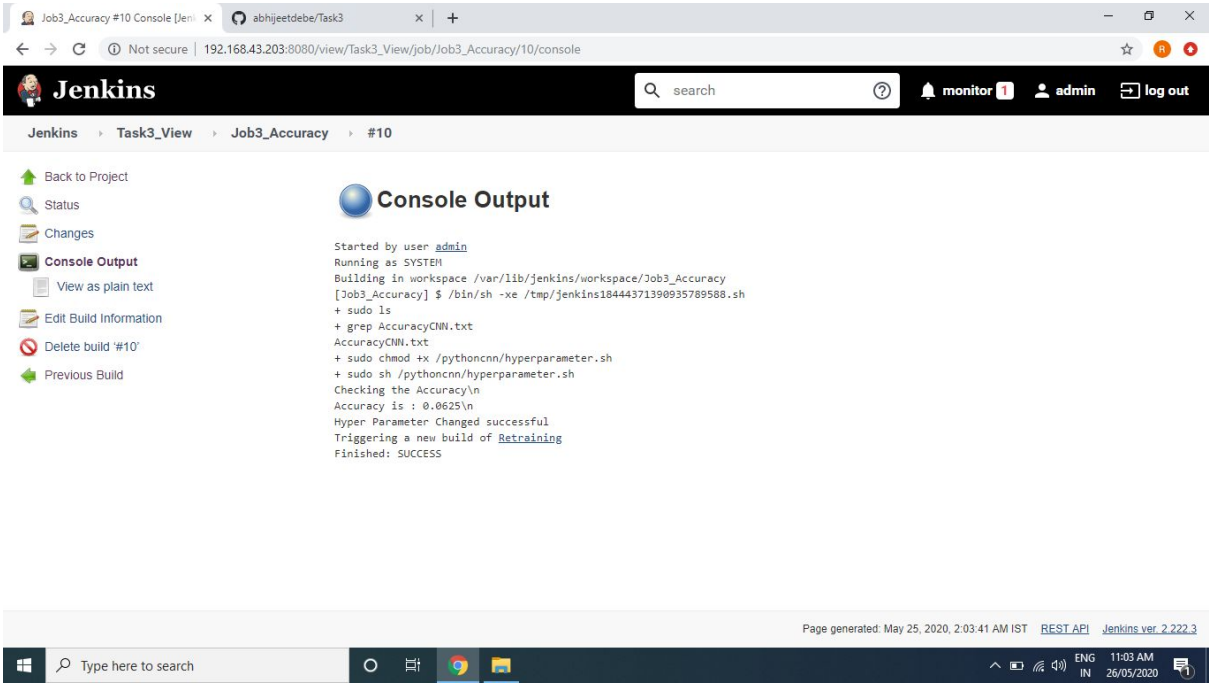


2. JOB2:




JOB2_Code #15 Console [Jenkins
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/JOB2_Code/15/console
Jenkins › Task3_View › JOB2_Code › #15
Trainable params: 546,218
Non-trainable params: 0
Found 12854 images belonging to 26 classes.
Found 4297 images belonging to 26 classes.
Epoch 1/3
1/5 [=====>.....] - ETA: 20s - loss: 3.3537 - accuracy: 0.0312
2/5 [==========>.....] - ETA: 9s - loss: 3.4054 - accuracy: 0.0469
3/5 [===============>.....] - ETA: 5s - loss: 3.4029 - accuracy: 0.0312
4/5 [====================>.....] - ETA: 2s - loss: 3.4029 - accuracy: 0.0234
5/5 [==============================] - 15s 3s/step - loss: 3.3783 - accuracy: 0.0312 - val_loss: 3.2977 - val_accuracy: 0.0562
Epoch 2/3
1/5 [=====>.....] - ETA: 4s - loss: 3.1924 - accuracy: 0.1250
2/5 [==========>.....] - ETA: 4s - loss: 3.2460 - accuracy: 0.0625
3/5 [===============>.....] - ETA: 3s - loss: 3.2085 - accuracy: 0.0833
4/5 [====================>.....] - ETA: 1s - loss: 3.2016 - accuracy: 0.0938
5/5 [==============================] - 10s 2s/step - loss: 3.1927 - accuracy: 0.0812 - val_loss: 3.2326 - val_accuracy: 0.0437
Epoch 3/3
1/5 [=====>.....] - ETA: 4s - loss: 3.1757 - accuracy: 0.0625
2/5 [==========>.....] - ETA: 4s - loss: 3.1134 - accuracy: 0.0625
3/5 [===============>.....] - ETA: 3s - loss: 3.1175 - accuracy: 0.0833
4/5 [====================>.....] - ETA: 1s - loss: 3.1365 - accuracy: 0.0703
5/5 [==============================] - 9s 2s/step - loss: 3.1620 - accuracy: 0.0625 - val_loss: 3.0478 - val_accuracy: 0.1562
Using TensorFlow backend.
+ sudo cp /pythoncnn/AccuracyCNN.txt /var/lib/jenkins/workspace/Job3_Accuracy/
Triggering a new build of Job3_Accuracy
Finished: SUCCESS
Page generated: May 25, 2020, 2:02:28 AM IST REST API Jenkins ver. 2.222.3
Type here to search
ENG IN 11:02 AM 26/05/2020

3. Job3:


Job3_Accuracy #10 Console [Jenk
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/Job3_Accuracy/10/console
Jenkins
search
monitor 1
admin
log out
Jenkins › Task3_View › Job3_Accuracy › #10
Back to Project
Status
Changes
Console Output
View as plain text
Edit Build Information
Delete build '#10'
Previous Build
Console Output
Started by user admin
Running as SYSTEM
Building in workspace /var/lib/jenkins/workspace/Job3_Accuracy
[Job3_Accuracy] $ /bin/sh -xe /tmp/jenkins1844437139093578958 8.sh
+ sudo ls
+ grep AccuracyCNN.txt
AccuracyCNN.txt
+ sudo chmod +x /pythoncnn/hyperparameter.sh
+ sudo sh /pythoncnn/hyperparameter.sh
Checking the Accuracy\n
Accuracy is : 0.0625\n
Hyper Parameter Changed successful
Triggering a new build of Retraining
Finished: SUCCESS
Page generated: May 25, 2020, 2:03:41 AM IST REST API Jenkins ver. 2.222.3
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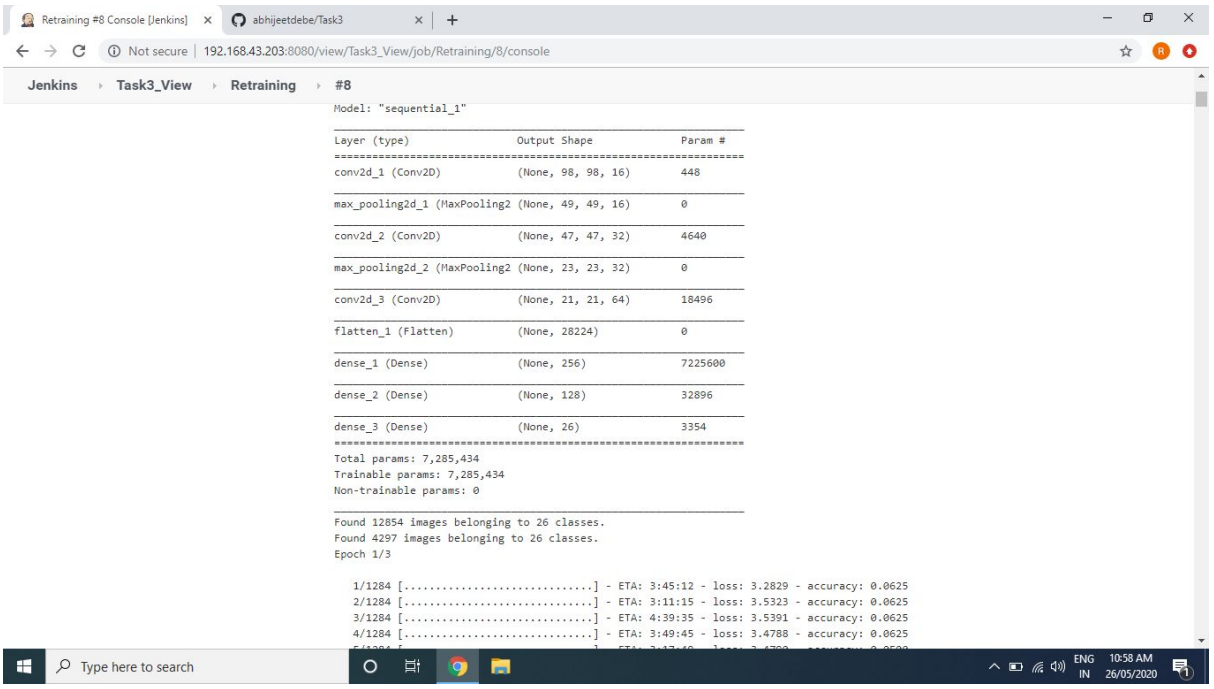
4. Job4:


Retraining #8 Console [Jenkins]
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/Retraining/8/console
Jenkins › Task3_View › Retraining › #8
Model: "sequential_1"
____
Layer (type) Output Shape Param #
===
conv2d_1 (Conv2D) (None, 98, 98, 16) 448
____
max_pooling2d_1 (MaxPooling2 (None, 49, 49, 16) 0
____
conv2d_2 (Conv2D) (None, 47, 47, 32) 4640
____
max_pooling2d_2 (MaxPooling2 (None, 23, 23, 32) 0
____
conv2d_3 (Conv2D) (None, 21, 21, 64) 18496
____
flatten_1 (Flatten) (None, 28224) 0
____
dense_1 (Dense) (None, 256) 7225600
____
dense_2 (Dense) (None, 128) 32896
____
dense_3 (Dense) (None, 26) 3354
===
Total params: 7,285,434
Trainable params: 7,285,434
Non-trainable params: 0
____
Found 12854 images belonging to 26 classes.
Found 4297 images belonging to 26 classes.
Epoch 1/3
1/1284 [..............................] - ETA: 3:45:12 - loss: 3.2829 - accuracy: 0.0625
2/1284 [..............................] - ETA: 3:11:15 - loss: 3.5323 - accuracy: 0.0625
3/1284 [..............................] - ETA: 4:39:35 - loss: 3.5391 - accuracy: 0.0625
4/1284 [..............................] - ETA: 3:49:45 - loss: 3.4788 - accuracy: 0.0625
Type here to search
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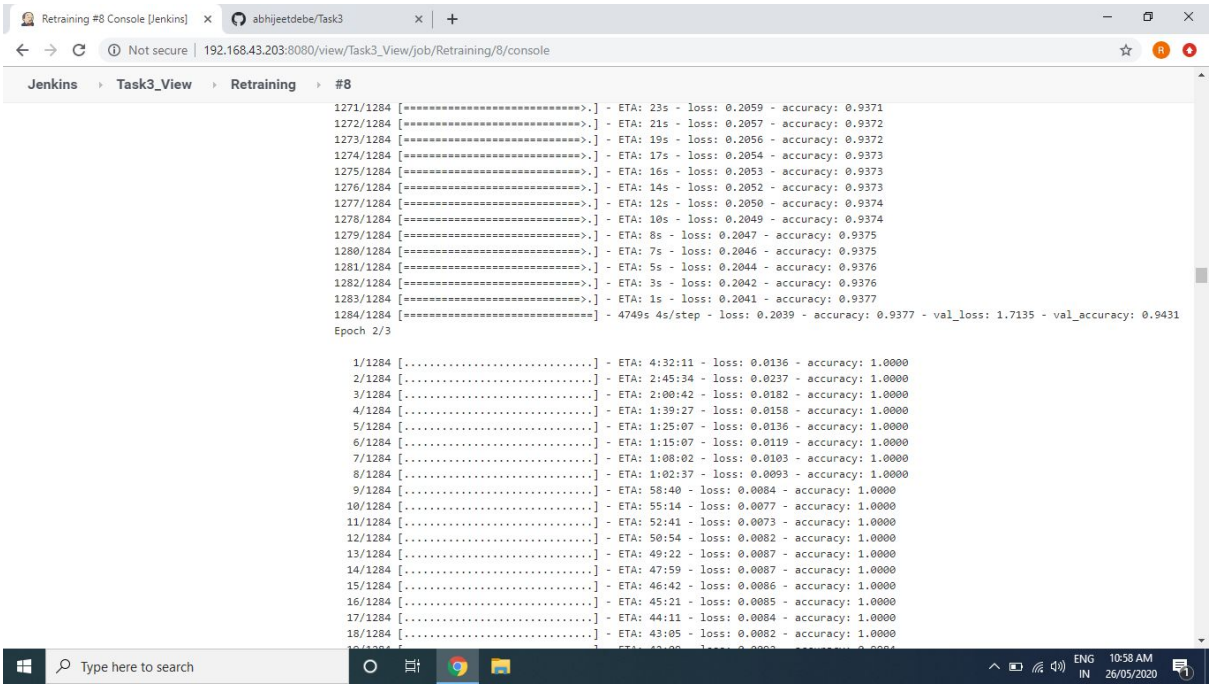
Retraining #8 Console [Jenkins]
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/Retraining/8/console
Jenkins › Task3_View › Retraining › #8
1271/1284 [============================>.] - ETA: 23s - loss: 0.2059 - accuracy: 0.9371
1272/1284 [============================>.] - ETA: 21s - loss: 0.2057 - accuracy: 0.9372
1273/1284 [============================>.] - ETA: 19s - loss: 0.2056 - accuracy: 0.9372
1274/1284 [============================>.] - ETA: 17s - loss: 0.2054 - accuracy: 0.9373
1275/1284 [============================>.] - ETA: 16s - loss: 0.2053 - accuracy: 0.9373
1276/1284 [============================>.] - ETA: 14s - loss: 0.2052 - accuracy: 0.9373
1277/1284 [============================>.] - ETA: 12s - loss: 0.2050 - accuracy: 0.9374
1278/1284 [============================>.] - ETA: 10s - loss: 0.2049 - accuracy: 0.9374
1279/1284 [============================>.] - ETA: 8s - loss: 0.2047 - accuracy: 0.9375
1280/1284 [============================>.] - ETA: 7s - loss: 0.2046 - accuracy: 0.9375
1281/1284 [============================>.] - ETA: 5s - loss: 0.2044 - accuracy: 0.9376
1282/1284 [============================>.] - ETA: 3s - loss: 0.2042 - accuracy: 0.9376
1283/1284 [============================>.] - ETA: 1s - loss: 0.2041 - accuracy: 0.9377
1284/1284 [==============================] - 4749s 4s/step - loss: 0.2039 - accuracy: 0.9377 - val_loss: 1.7135 - val_accuracy: 0.9431
Epoch 2/3
1/1284 [..............................] - ETA: 4:32:11 - loss: 0.0136 - accuracy: 1.0000
2/1284 [..............................] - ETA: 2:45:34 - loss: 0.0237 - accuracy: 1.0000
3/1284 [..............................] - ETA: 2:00:42 - loss: 0.0182 - accuracy: 1.0000
4/1284 [..............................] - ETA: 1:39:27 - loss: 0.0158 - accuracy: 1.0000
5/1284 [..............................] - ETA: 1:25:07 - loss: 0.0136 - accuracy: 1.0000
6/1284 [..............................] - ETA: 1:15:07 - loss: 0.0119 - accuracy: 1.0000
7/1284 [..............................] - ETA: 1:08:02 - loss: 0.0103 - accuracy: 1.0000
8/1284 [..............................] - ETA: 1:02:37 - loss: 0.0093 - accuracy: 1.0000
9/1284 [..............................] - ETA: 58:40 - loss: 0.0084 - accuracy: 1.0000
10/1284 [..............................] - ETA: 55:14 - loss: 0.0077 - accuracy: 1.0000
11/1284 [..............................] - ETA: 52:41 - loss: 0.0073 - accuracy: 1.0000
12/1284 [..............................] - ETA: 50:54 - loss: 0.0082 - accuracy: 1.0000
13/1284 [..............................] - ETA: 49:22 - loss: 0.0087 - accuracy: 1.0000
14/1284 [..............................] - ETA: 47:59 - loss: 0.0087 - accuracy: 1.0000
15/1284 [..............................] - ETA: 46:42 - loss: 0.0086 - accuracy: 1.0000
16/1284 [..............................] - ETA: 45:21 - loss: 0.0085 - accuracy: 1.0000
17/1284 [..............................] - ETA: 44:11 - loss: 0.0084 - accuracy: 1.0000
18/1284 [..............................] - ETA: 43:05 - loss: 0.0082 - accuracy: 1.0000
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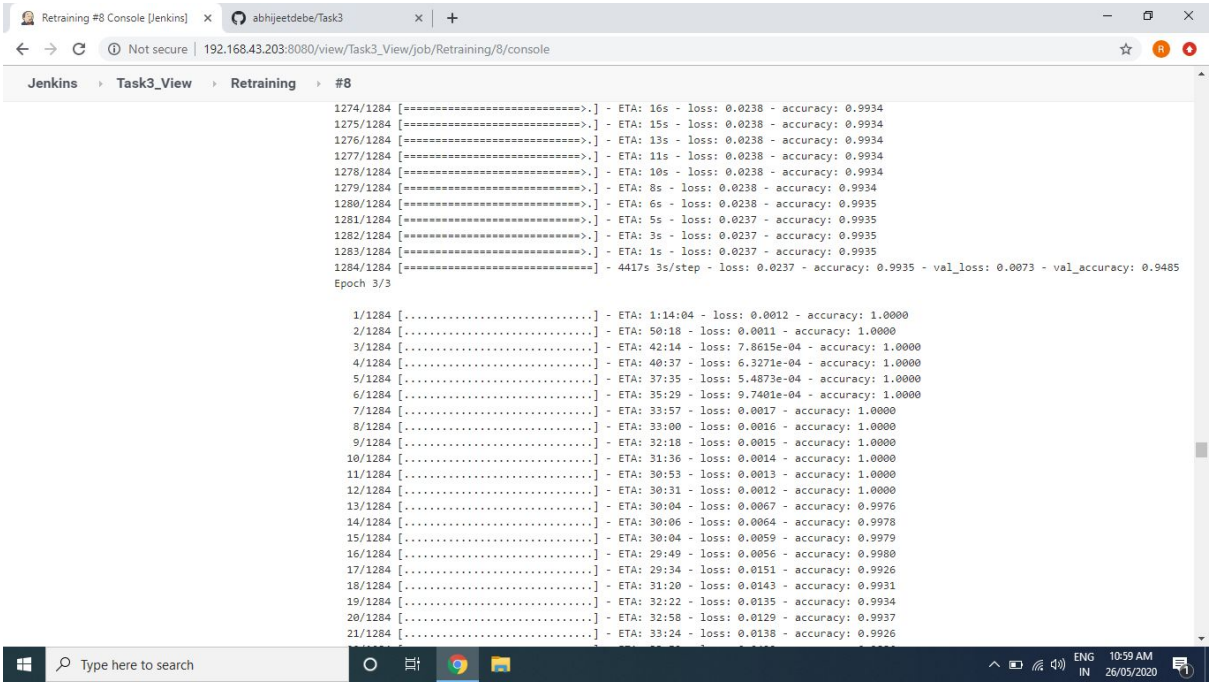
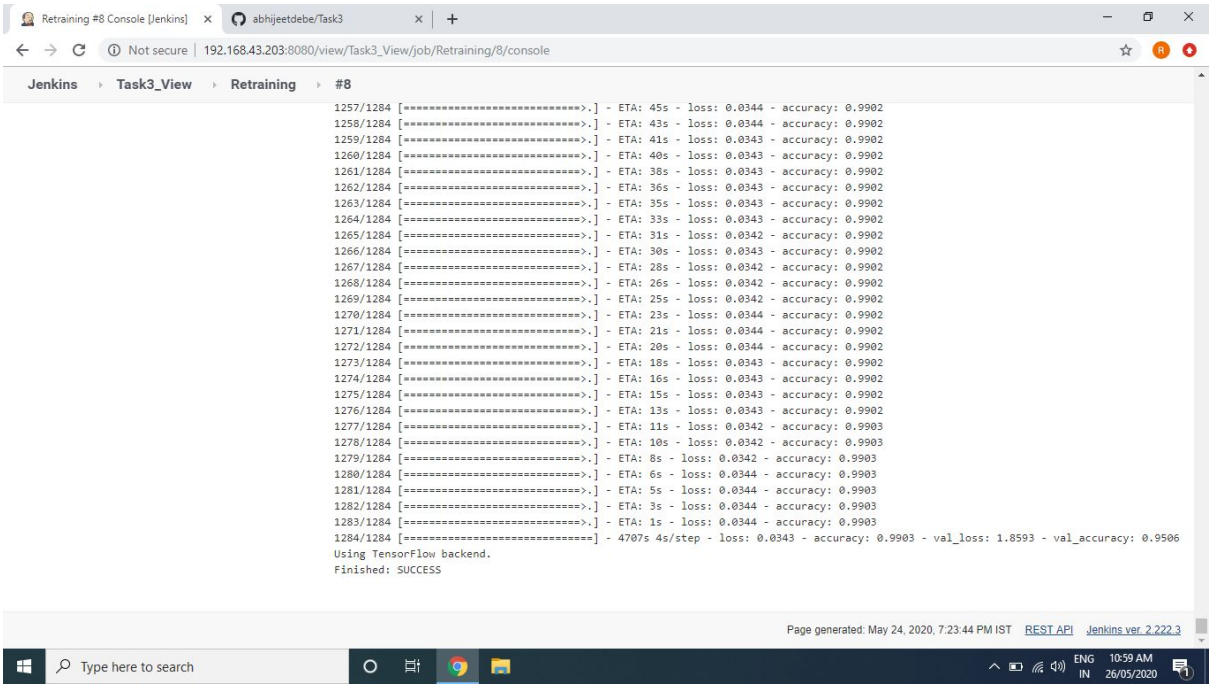

Retraining #8 Console [Jenkins]
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/Retraining/8/console
Jenkins › Task3_View › Retraining › #8
1274/1284 [============================>.] - ETA: 16s - loss: 0.0238 - accuracy: 0.9934
1275/1284 [============================>.] - ETA: 15s - loss: 0.0238 - accuracy: 0.9934
1276/1284 [============================>.] - ETA: 13s - loss: 0.0238 - accuracy: 0.9934
1277/1284 [============================>.] - ETA: 11s - loss: 0.0238 - accuracy: 0.9934
1278/1284 [============================>.] - ETA: 10s - loss: 0.0238 - accuracy: 0.9934
1279/1284 [============================>.] - ETA: 8s - loss: 0.0238 - accuracy: 0.9934
1280/1284 [============================>.] - ETA: 6s - loss: 0.0238 - accuracy: 0.9935
1281/1284 [============================>.] - ETA: 5s - loss: 0.0237 - accuracy: 0.9935
1282/1284 [============================>.] - ETA: 3s - loss: 0.0237 - accuracy: 0.9935
1283/1284 [============================>.] - ETA: 1s - loss: 0.0237 - accuracy: 0.9935
1284/1284 [==============================] - 4417s 3s/step - loss: 0.0237 - accuracy: 0.9935 - val_loss: 0.0073 - val_accuracy: 0.9485
Epoch 3/3
1/1284 [..............................] - ETA: 1:14:04 - loss: 0.0012 - accuracy: 1.0000
2/1284 [..............................] - ETA: 50:18 - loss: 0.0011 - accuracy: 1.0000
3/1284 [..............................] - ETA: 42:14 - loss: 7.8615e-04 - accuracy: 1.0000
4/1284 [..............................] - ETA: 40:37 - loss: 6.3271e-04 - accuracy: 1.0000
5/1284 [..............................] - ETA: 37:35 - loss: 5.4873e-04 - accuracy: 1.0000
6/1284 [..............................] - ETA: 35:29 - loss: 9.7401e-04 - accuracy: 1.0000
7/1284 [..............................] - ETA: 33:57 - loss: 0.0017 - accuracy: 1.0000
8/1284 [..............................] - ETA: 33:00 - loss: 0.0016 - accuracy: 1.0000
9/1284 [..............................] - ETA: 32:18 - loss: 0.0015 - accuracy: 1.0000
10/1284 [..............................] - ETA: 31:36 - loss: 0.0014 - accuracy: 1.0000
11/1284 [..............................] - ETA: 30:53 - loss: 0.0013 - accuracy: 1.0000
12/1284 [..............................] - ETA: 30:31 - loss: 0.0012 - accuracy: 1.0000
13/1284 [..............................] - ETA: 30:04 - loss: 0.0067 - accuracy: 0.9976
14/1284 [..............................] - ETA: 30:06 - loss: 0.0064 - accuracy: 0.9978
15/1284 [..............................] - ETA: 30:04 - loss: 0.0059 - accuracy: 0.9979
16/1284 [..............................] - ETA: 29:49 - loss: 0.0056 - accuracy: 0.9980
17/1284 [..............................] - ETA: 29:34 - loss: 0.0151 - accuracy: 0.9926
18/1284 [..............................] - ETA: 31:20 - loss: 0.0143 - accuracy: 0.9931
19/1284 [..............................] - ETA: 32:22 - loss: 0.0135 - accuracy: 0.9934
20/1284 [..............................] - ETA: 32:58 - loss: 0.0129 - accuracy: 0.9937
21/1284 [..............................] - ETA: 33:24 - loss: 0.0138 - accuracy: 0.9926
Type here to search
ENG IN
10:59 AM 26/05/2020


Retraining #8 Console [Jenkins]
abhijeetdebe/Task3
Not secure | 192.168.43.203:8080/view/Task3_View/job/Retraining/8/console
Jenkins › Task3_View › Retraining › #8
1257/1284 [============================>.] - ETA: 45s - loss: 0.0344 - accuracy: 0.9902
1258/1284 [============================>.] - ETA: 43s - loss: 0.0344 - accuracy: 0.9902
1259/1284 [============================>.] - ETA: 41s - loss: 0.0343 - accuracy: 0.9902
1260/1284 [============================>.] - ETA: 40s - loss: 0.0343 - accuracy: 0.9902
1261/1284 [============================>.] - ETA: 38s - loss: 0.0343 - accuracy: 0.9902
1262/1284 [============================>.] - ETA: 36s - loss: 0.0343 - accuracy: 0.9902
1263/1284 [============================>.] - ETA: 35s - loss: 0.0343 - accuracy: 0.9902
1264/1284 [============================>.] - ETA: 33s - loss: 0.0343 - accuracy: 0.9902
1265/1284 [============================>.] - ETA: 31s - loss: 0.0342 - accuracy: 0.9902
1266/1284 [============================>.] - ETA: 30s - loss: 0.0343 - accuracy: 0.9902
1267/1284 [============================>.] - ETA: 28s - loss: 0.0342 - accuracy: 0.9902
1268/1284 [============================>.] - ETA: 26s - loss: 0.0342 - accuracy: 0.9902
1269/1284 [============================>.] - ETA: 25s - loss: 0.0342 - accuracy: 0.9902
1270/1284 [============================>.] - ETA: 23s - loss: 0.0344 - accuracy: 0.9902
1271/1284 [============================>.] - ETA: 21s - loss: 0.0344 - accuracy: 0.9902
1272/1284 [============================>.] - ETA: 20s - loss: 0.0344 - accuracy: 0.9902
1273/1284 [============================>.] - ETA: 18s - loss: 0.0343 - accuracy: 0.9902
1274/1284 [============================>.] - ETA: 16s - loss: 0.0343 - accuracy: 0.9902
1275/1284 [============================>.] - ETA: 15s - loss: 0.0343 - accuracy: 0.9902
1276/1284 [============================>.] - ETA: 13s - loss: 0.0343 - accuracy: 0.9902
1277/1284 [============================>.] - ETA: 11s - loss: 0.0342 - accuracy: 0.9903
1278/1284 [============================>.] - ETA: 10s - loss: 0.0342 - accuracy: 0.9903
1279/1284 [============================>.] - ETA: 8s - loss: 0.0342 - accuracy: 0.9903
1280/1284 [============================>.] - ETA: 6s - loss: 0.0344 - accuracy: 0.9903
1281/1284 [============================>.] - ETA: 5s - loss: 0.0344 - accuracy: 0.9903
1282/1284 [============================>.] - ETA: 3s - loss: 0.0344 - accuracy: 0.9903
1283/1284 [============================>.] - ETA: 1s - loss: 0.0344 - accuracy: 0.9903
1284/1284 [==============================] - 4707s 4s/step - loss: 0.0343 - accuracy: 0.9903 - val_loss: 1.8593 - val_accuracy: 0.9506
Using TensorFlow backend.
Finished: SUCCESS
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