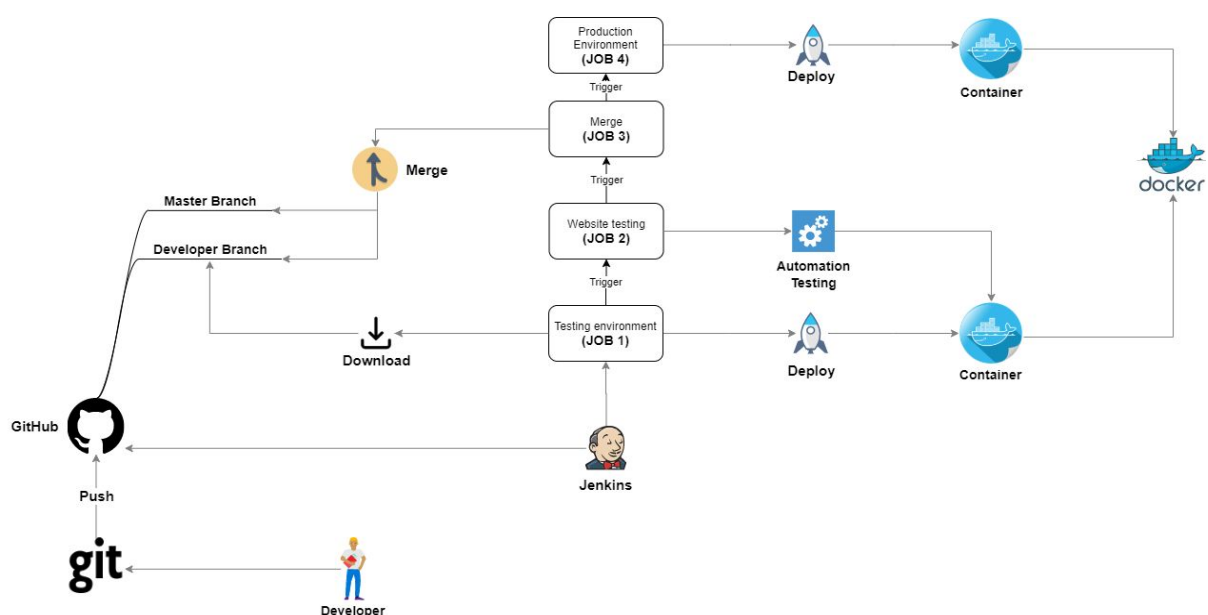


MLOPS TASK:

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.

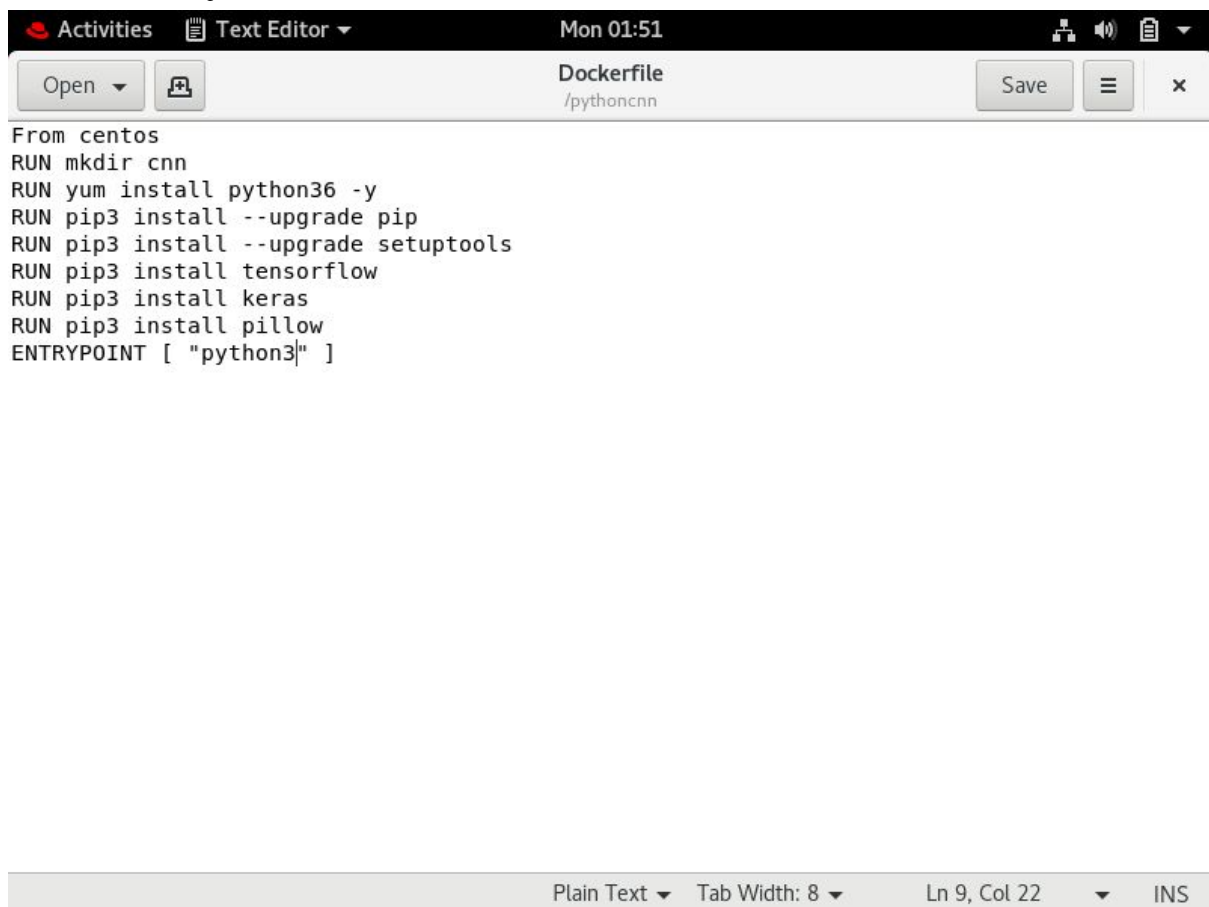
Flow of Automation Task :



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 :



```
From centos
RUN mkdir cnn
RUN yum install python36 -y
RUN pip3 install --upgrade pip
RUN pip3 install --upgrade setuptools
RUN pip3 install tensorflow
RUN pip3 install keras
RUN pip3 install pillow
ENTRYPOINT [ "python3" ]
```

Python Code:

```
Activities Text Editor Mon 01:52
tweaking.py /pythoncnn
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
hyperparameter.sh /pythoncnn
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

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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.

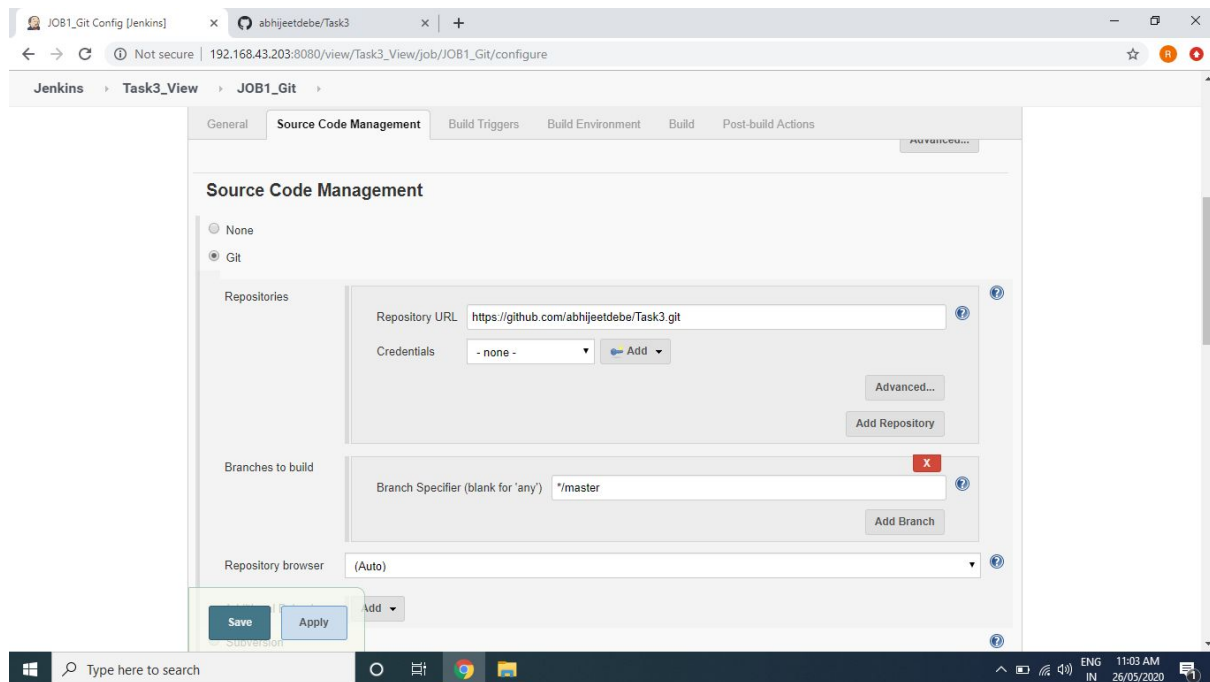
4. Fourth job:

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.

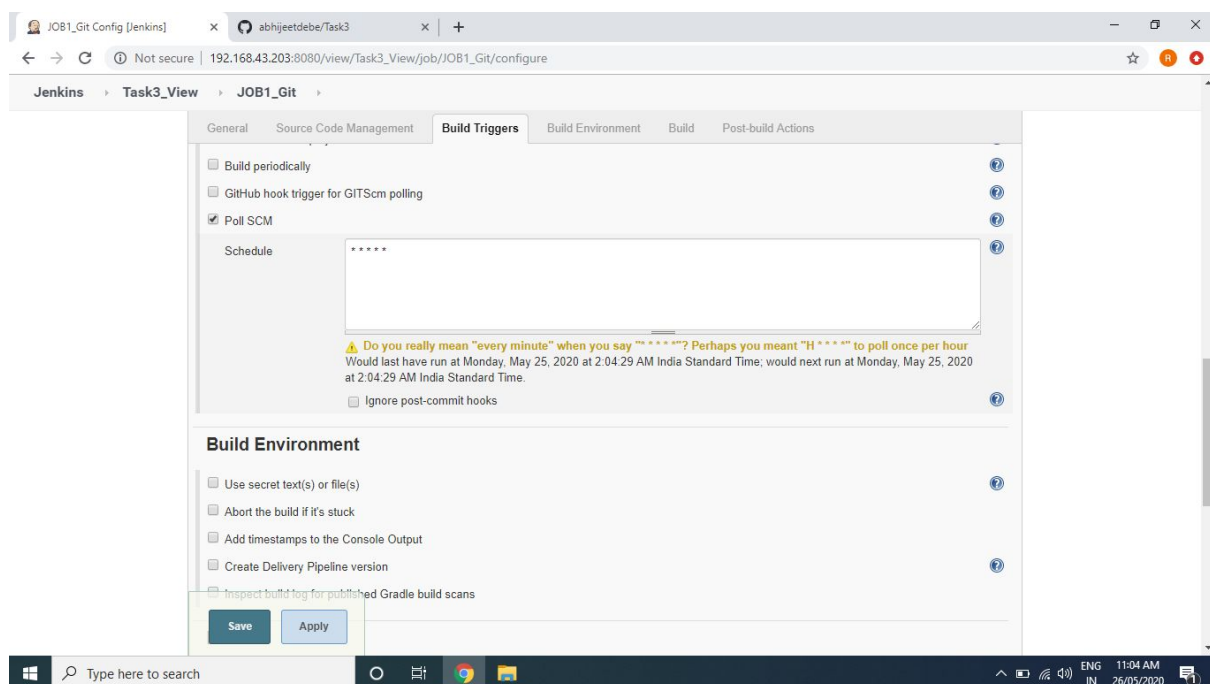
Following is step by step job creation:

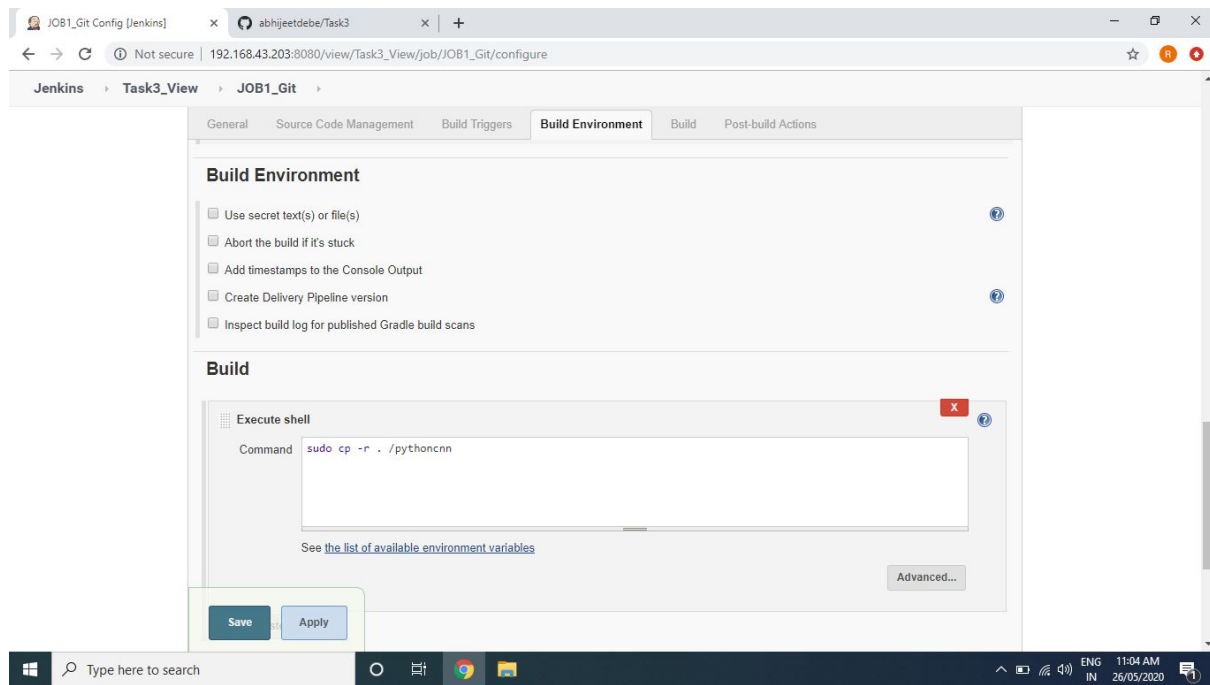
1. JOB1:

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.



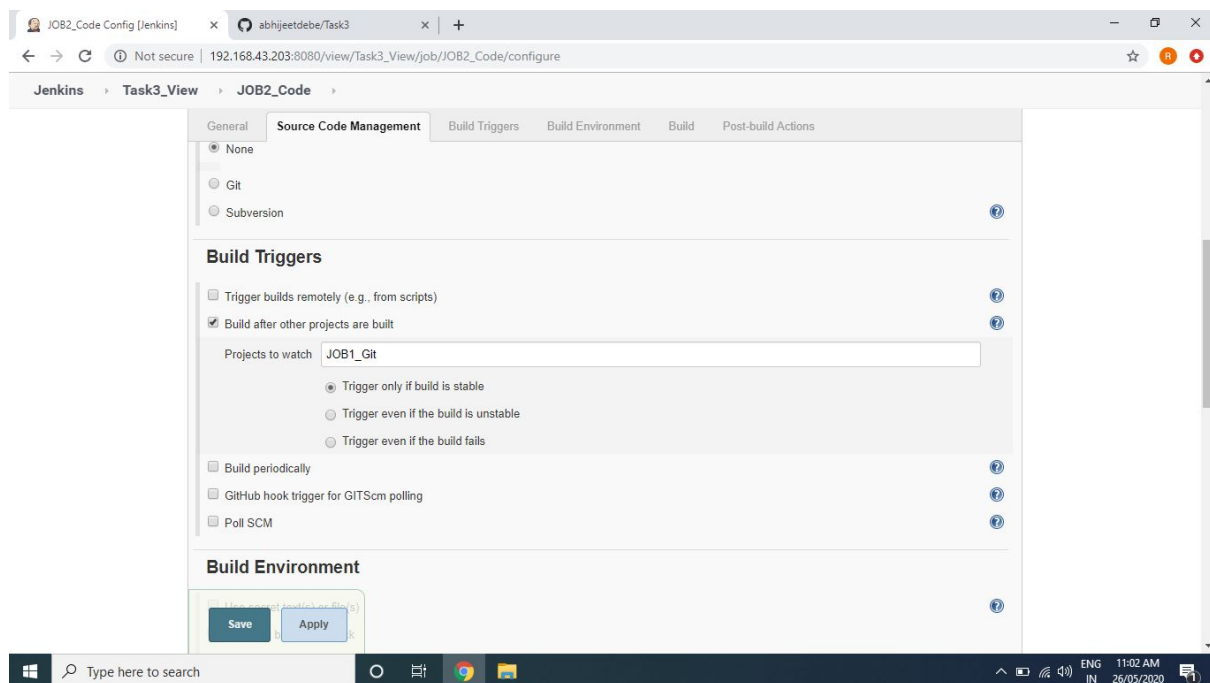
Now build triggers to poll scm so that jenkins can go to Github and keep on checking for uploads. And then we write a shell code to copy the program file to the respective folder which is to be mounted to container.

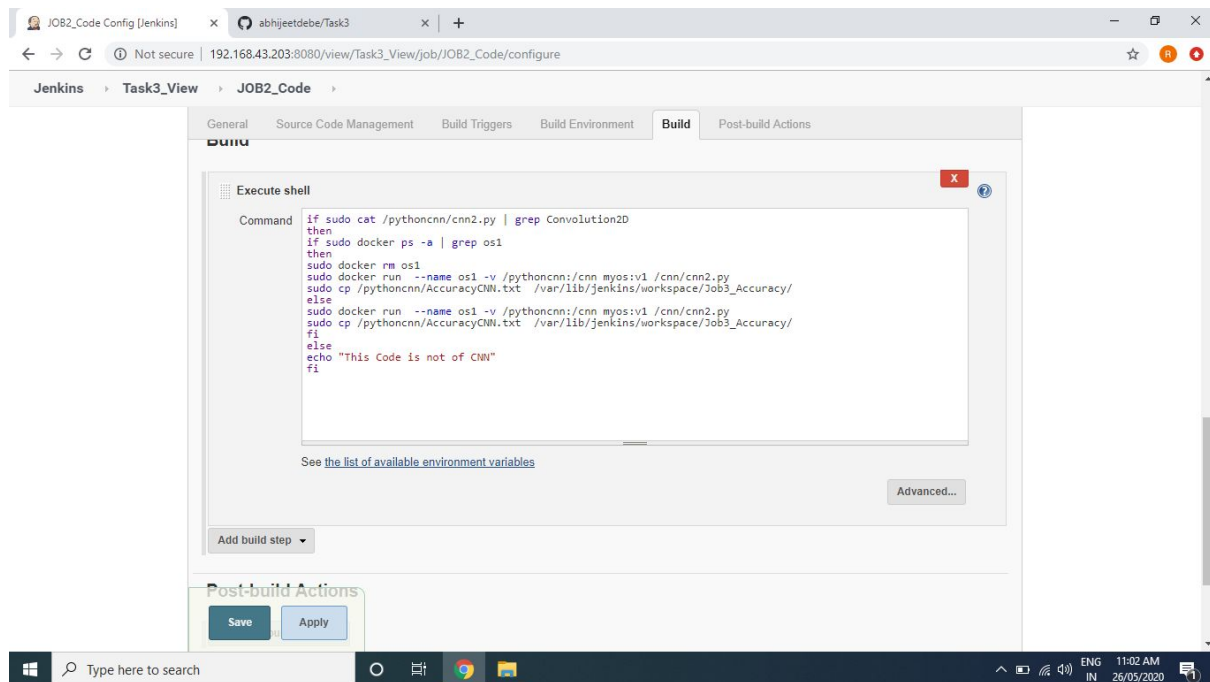




2. JOB2 :

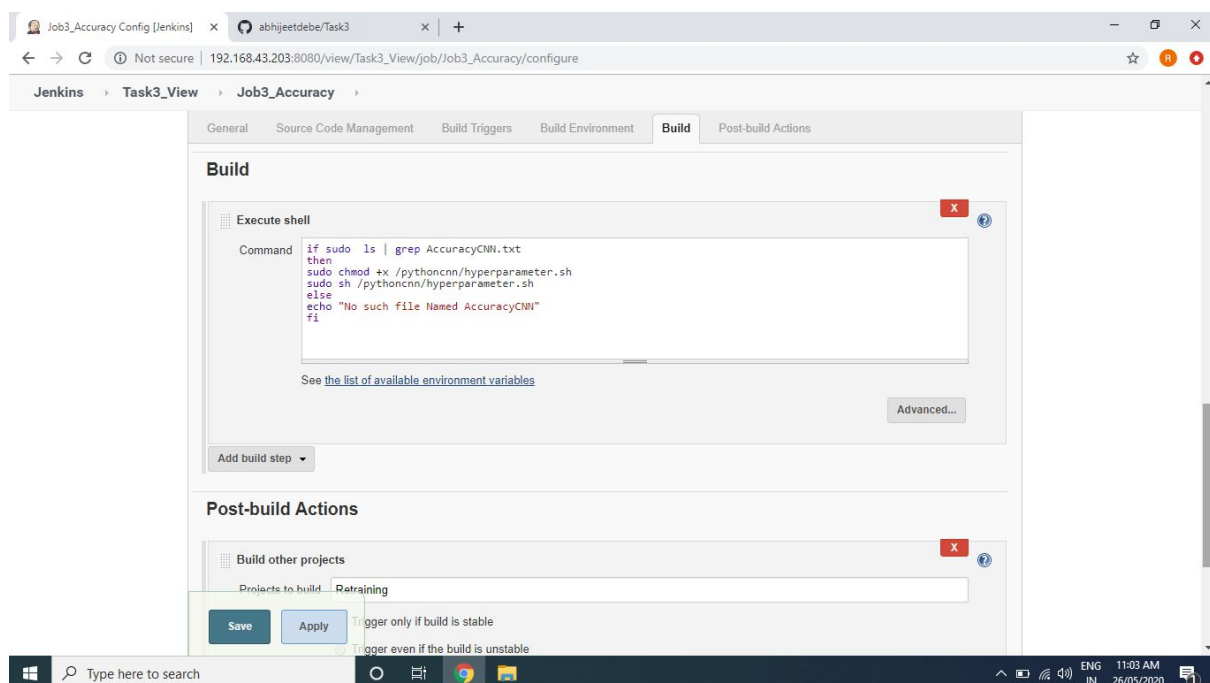
In this we build a trigger that when the job1 runs stable then this job will run the respective docker container by looking at the program file or code.





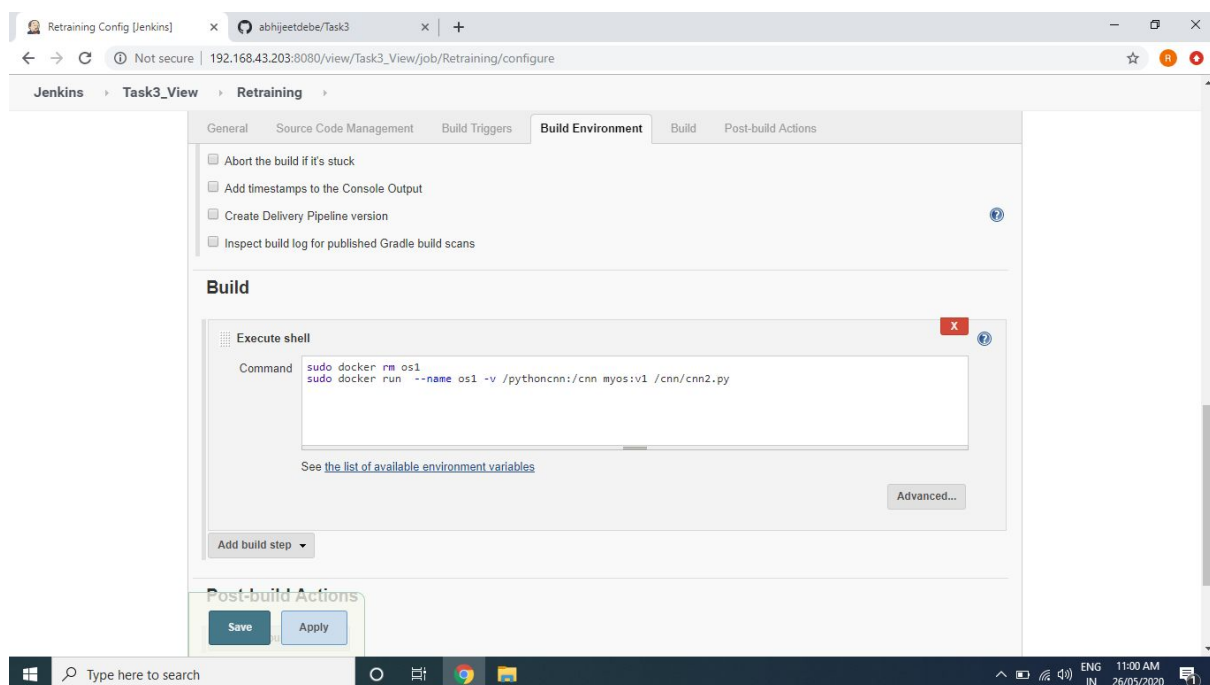
3. JOB3 :

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.



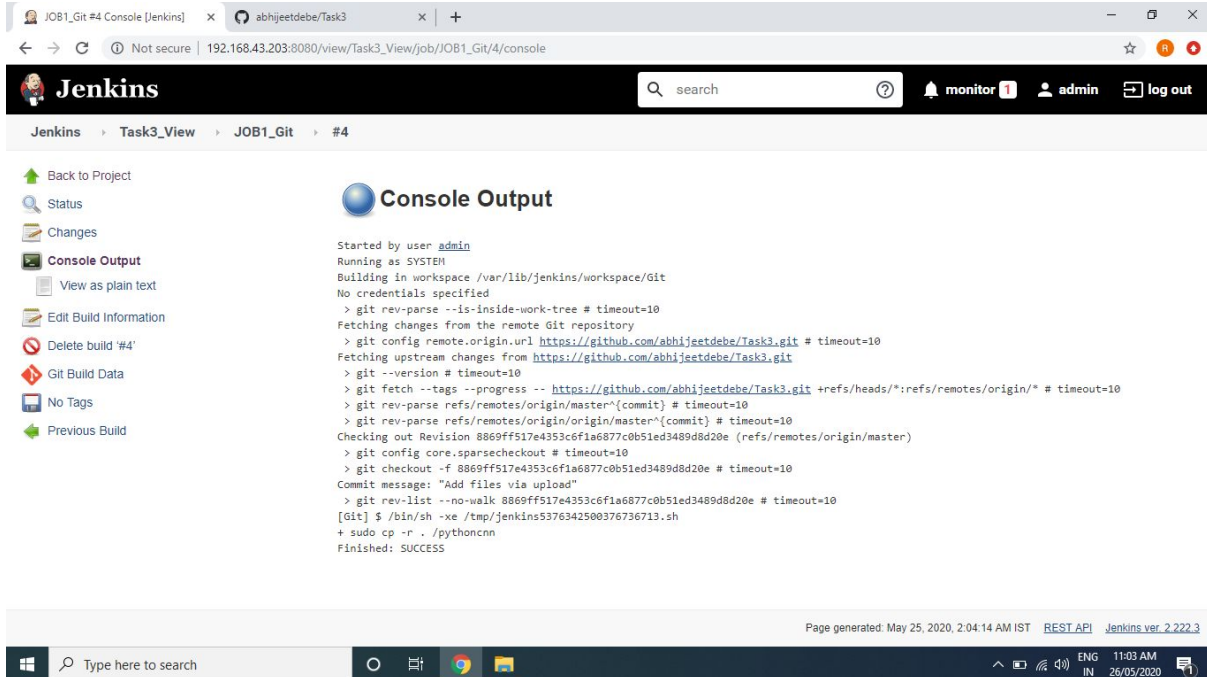
4. JOB4 :

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:

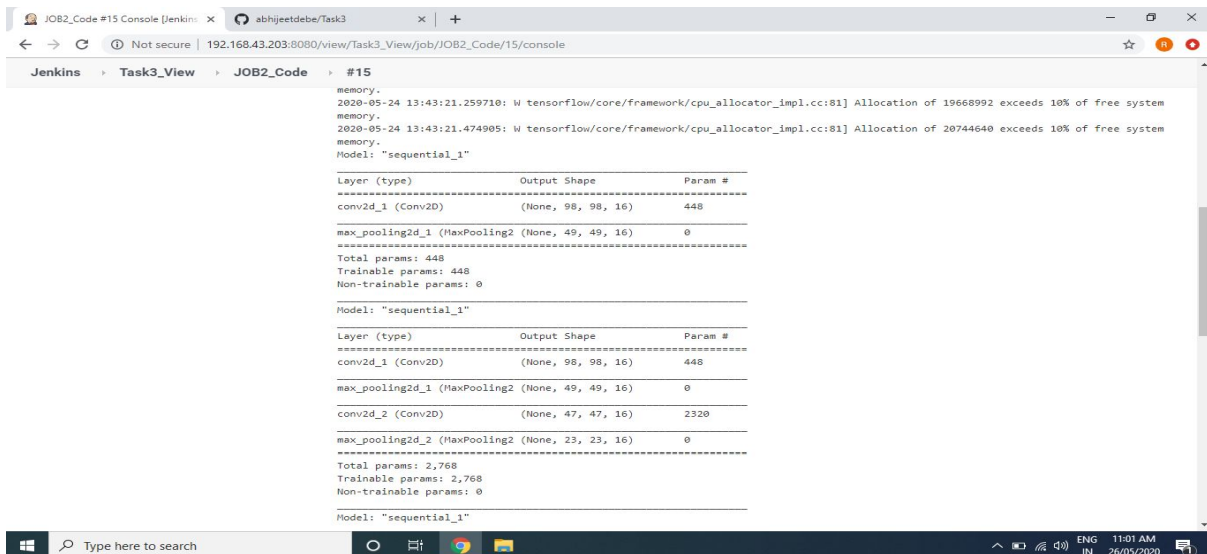


The screenshot shows the Jenkins web interface for a job named 'JOB1_Git #4'. The console output displays the following text:

```
Started by user admin
Running as SYSTEM
Building in workspace /var/lib/jenkins/workspace/Git
No credentials specified
> git rev-parse --is-inside-work-tree # timeout=10
Fetching changes from the remote Git repository
> git config remote.origin.url https://github.com/abhijeetdebe/Task3.git # timeout=10
Fetching upstream changes from https://github.com/abhijeetdebe/Task3.git
> git --version # timeout=10
> git fetch --tags --progress -- https://github.com/abhijeetdebe/Task3.git +refs/heads/*:refs/remotes/origin/* # timeout=10
> git rev-parse refs/remotes/origin/master^{commit} # timeout=10
> git rev-parse refs/remotes/origin/master^{commit} # timeout=10
Checking out Revision 8869ff517e4353c6f1a6877c0b51ed3489d8d20e (refs/remotes/origin/master)
> git config core.sparsecheckout # timeout=10
> git checkout -f 8869ff517e4353c6f1a6877c0b51ed3489d8d20e # timeout=10
Commit message: "Add files via upload"
> git rev-list --no-walk 8869ff517e4353c6f1a6877c0b51ed3489d8d20e # timeout=10
[Git] $ /bin/sh -xe /tmp/jenkins5376342500376736713.sh
+ sudo cp -r . /pythoncnn
Finished: SUCCESS
```

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2. JOB2:



The screenshot shows the Jenkins web interface for a job named 'JOB2_Code #15'. The console output displays the following text:

```
memory.
2020-05-24 13:43:21.259710: W tensorflow/core/framework/cpu_allocator_impl.cc:81] Allocation of 19668992 exceeds 10% of free system memory.
2020-05-24 13:43:21.474985: W tensorflow/core/framework/cpu_allocator_impl.cc:81] Allocation of 20744640 exceeds 10% of free system memory.
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
-----
Total params: 448
Trainable params: 448
Non-trainable params: 0

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, 16)          2320
-----
max_pooling2d_2 (MaxPooling2 (None, 23, 23, 16)          0
-----
Total params: 2,768
Trainable params: 2,768
Non-trainable params: 0

Model: "sequential_1"
```

```
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

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```

3. Job3:

Job3_Accuracy #10 Console [Jeni

abhiheetdebe/Task3

← → ↻ Not secure | 192.168.43.203:8080/view/Task3_View/job/Job3_Accuracy/10/console

☆ 0 0

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/jenkins18444371390935789588.sh

+ sudo ls

+ grep AccuracyCNN.txt

AccuracyCNN.txt

+ sudo chmod +x /pythoncnn/hyperparameter.sh

+ sudo sh /pythoncnn/hyperparameter.sh

Checking the Accuracy

Accuracy is : 0.0625

Hyper Parameter Changed successful

Triggering a new build of [Retraining](#)

Finished: SUCCESS

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4. Job4:

Retraining #8 Console [Jenkins] x abhijeetdebe/Task3 x +

← → ↻ ⓘ 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 (MaxPooling2D)	(None, 49, 49, 16)	0
conv2d_2 (Conv2D)	(None, 47, 47, 32)	4640
max_pooling2d_2 (MaxPooling2D)	(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
5/1284 [.....] - ETA: 3:13:16 - loss: 3.4788 - accuracy: 0.0625

Retraining #8 Console [Jenkins] x abhijeetdebe/Task3 x +

← → ↻ ⓘ 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: 0.0062 - accuracy: 1.0000
13/1284 [.....] - ETA: 49:22 - loss: 0.0067 - accuracy: 1.0000
14/1284 [.....] - ETA: 47:59 - loss: 0.0067 - accuracy: 1.0000
15/1284 [.....] - ETA: 46:42 - loss: 0.0066 - accuracy: 1.0000
16/1284 [.....] - ETA: 45:21 - loss: 0.0065 - accuracy: 1.0000
17/1284 [.....] - ETA: 44:11 - loss: 0.0064 - accuracy: 1.0000
18/1284 [.....] - ETA: 43:05 - loss: 0.0062 - accuracy: 1.0000

Retraining #8 Console [Jenkins] x abhijeetdebe/Task3 x +

← → ↻ 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
```

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Retraining #8 Console [Jenkins] x abhijeetdebe/Task3 x +

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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
```

Page generated: May 24, 2020, 7:23:44 PM IST REST API Jenkins ver. 2.222.3

Windows taskbar: Type here to search, O, Chrome, File Explorer, ENG IN 10:59 AM 26/05/2020