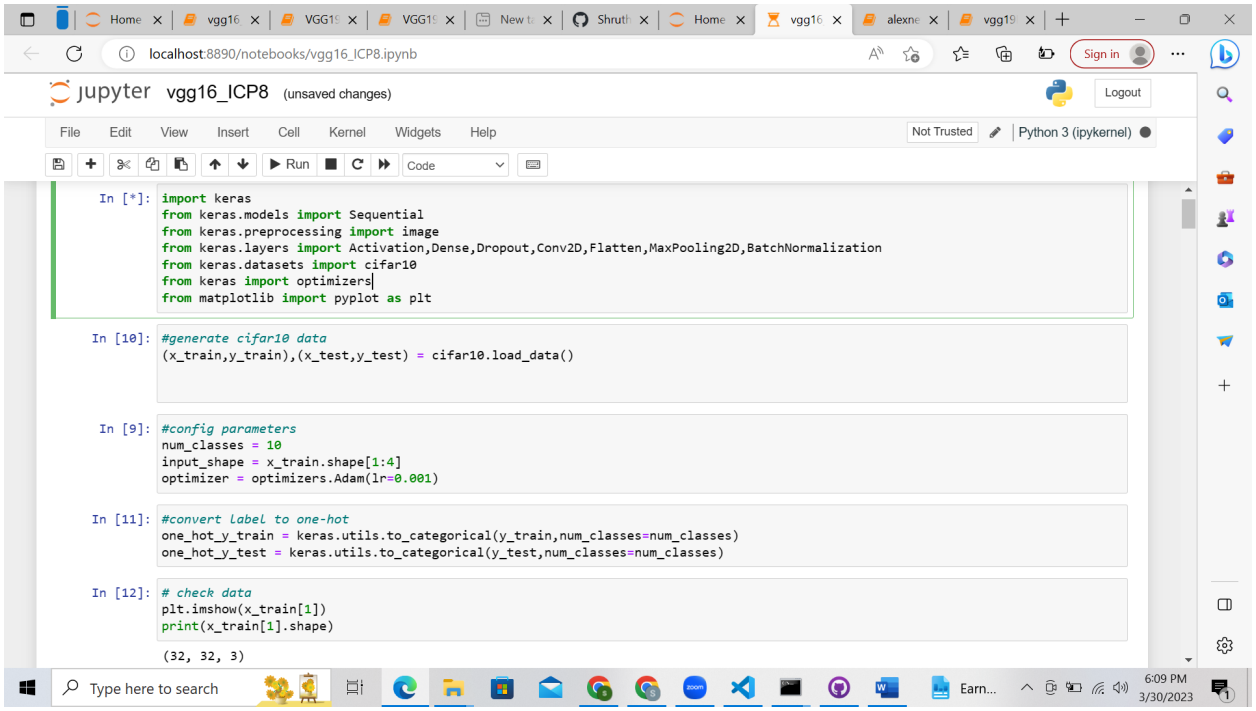
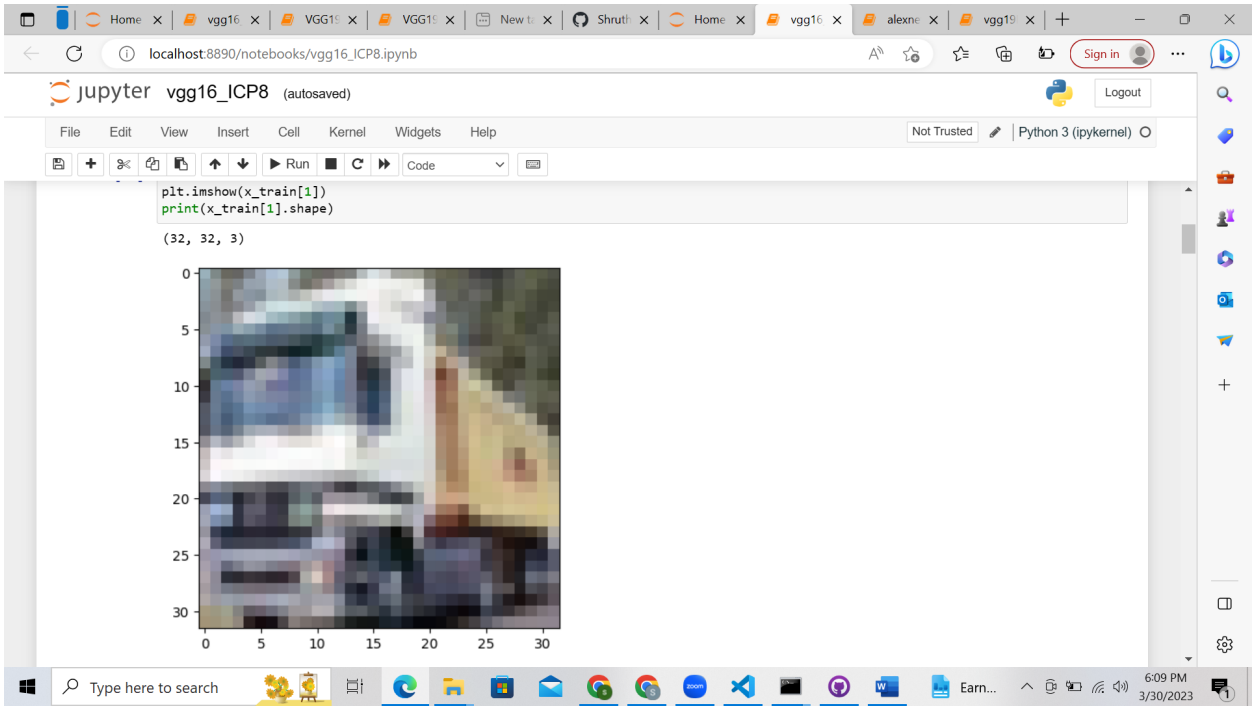
NN & DeepLearning : Image Classification with CNN_ICP8

In class programming:

1. Tune hyperparameter and make necessary addition to the baseline model to improve validation accuracy and reduce validation loss.
2. Provide logical description of which steps lead to improved response and what was its impact on architecture behavior.
3. Create at least two more visualizations using matplotlib (Other than provided in the source file)
4. Use dataset of your own choice and implement baseline models provided.
5. Apply modified architecture to your own selected dataset and train it.
6. Evaluate your model on testing set.
7. Save the improved model and use it for prediction on testing data
8. Provide plot of confusion matric
9. Provide Training and testing Loss and accuracy plots in one plot using subplot command and history object.
10. Provide at least two more visualizations reflecting your solution.
11. Provide logical description of which steps lead to improved response for new dataset when compared with baseline model and enhance architecture and what was its impact on architecture behavior

Ans




jupyter vgg16_ICP8 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Not Trusted
Python 3 (ipykernel)
Run
Code
plt.imshow(x_train[1])
print(x_train[1].shape)
(32, 32, 3)
0
5
10
15
20
25
30
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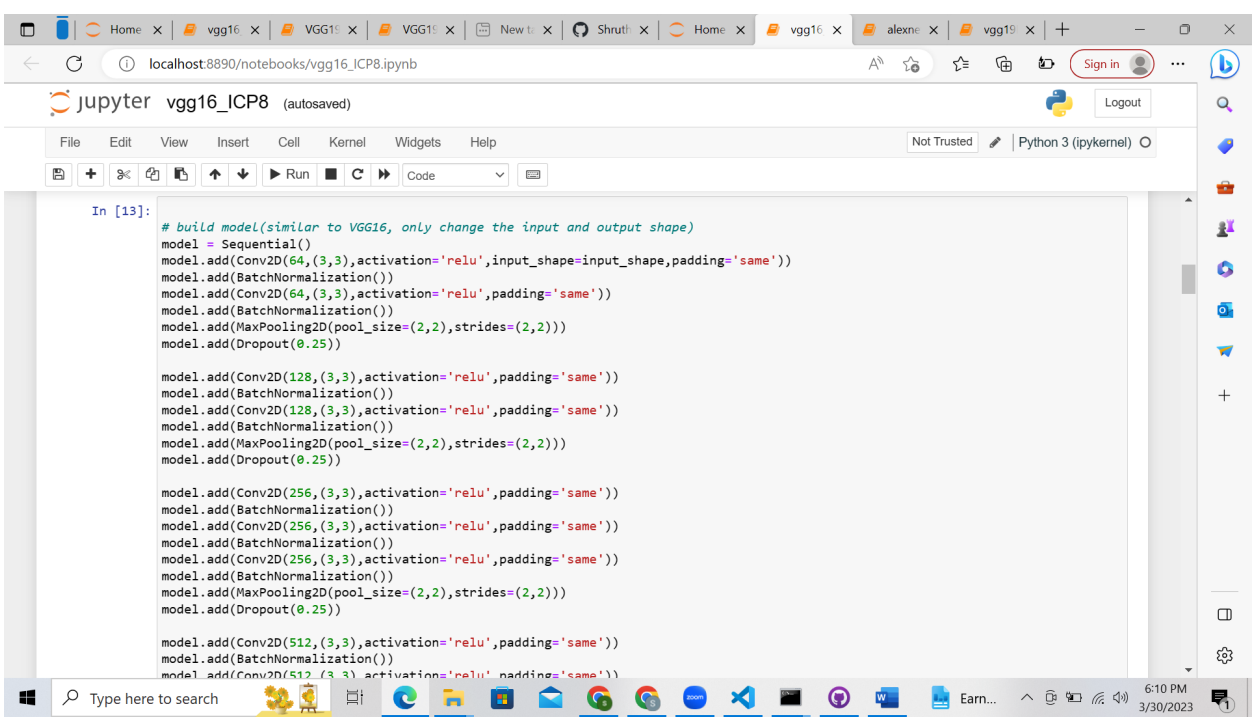
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [13]:
# build model(similar to VGG16, only change the input and output shape)
model = Sequential()
model.add(Conv2D(64,(3,3),activation='relu',input_shape=input_shape,padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(64,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=(2,2)))
model.add(Dropout(0.25))
model.add(Conv2D(128,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(128,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=(2,2)))
model.add(Dropout(0.25))
model.add(Conv2D(256,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(256,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(256,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=(2,2)))
model.add(Dropout(0.25))
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
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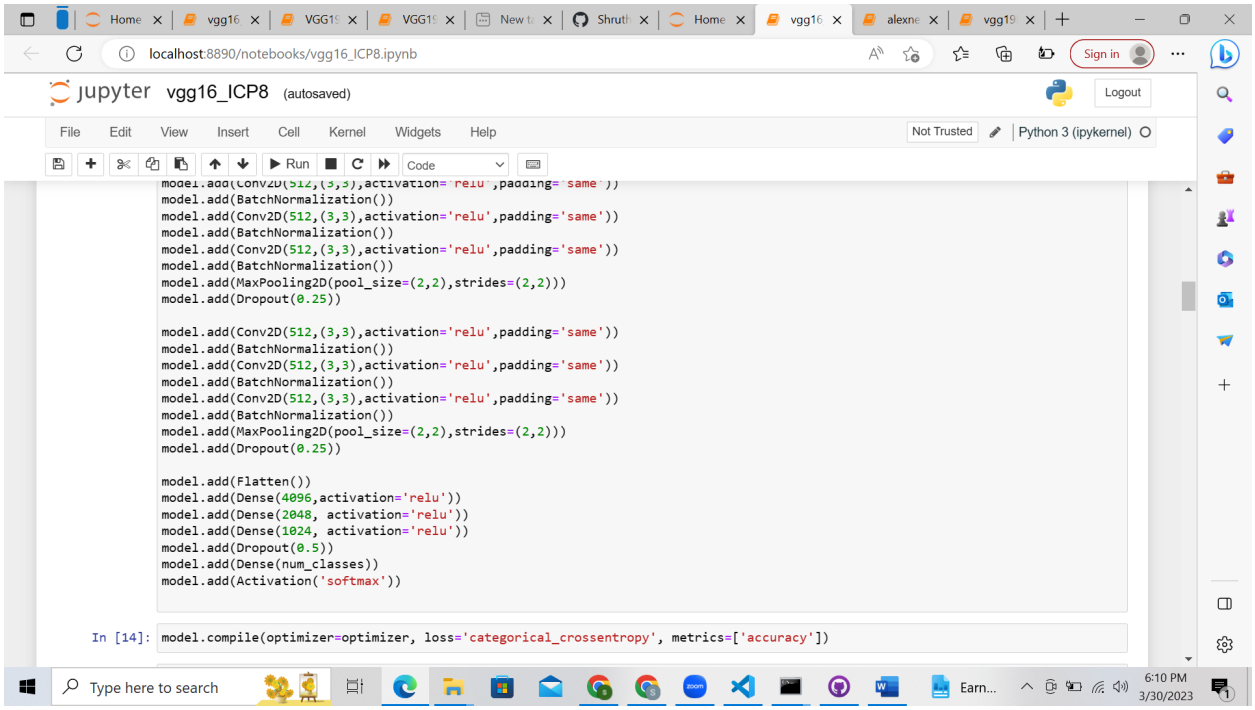
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
model.add(BatchNormalization())
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=(2,2)))
model.add(Dropout(0.25))
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(512,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=(2,2)))
model.add(Dropout(0.25))
model.add(Flatten())
model.add(Dense(4096,activation='relu'))
model.add(Dense(2048, activation='relu'))
model.add(Dense(1024, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(num_classes))
model.add(Activation('softmax'))
In [14]:
model.compile(optimizer=optimizer, loss='categorical_crossentropy', metrics=['accuracy'])
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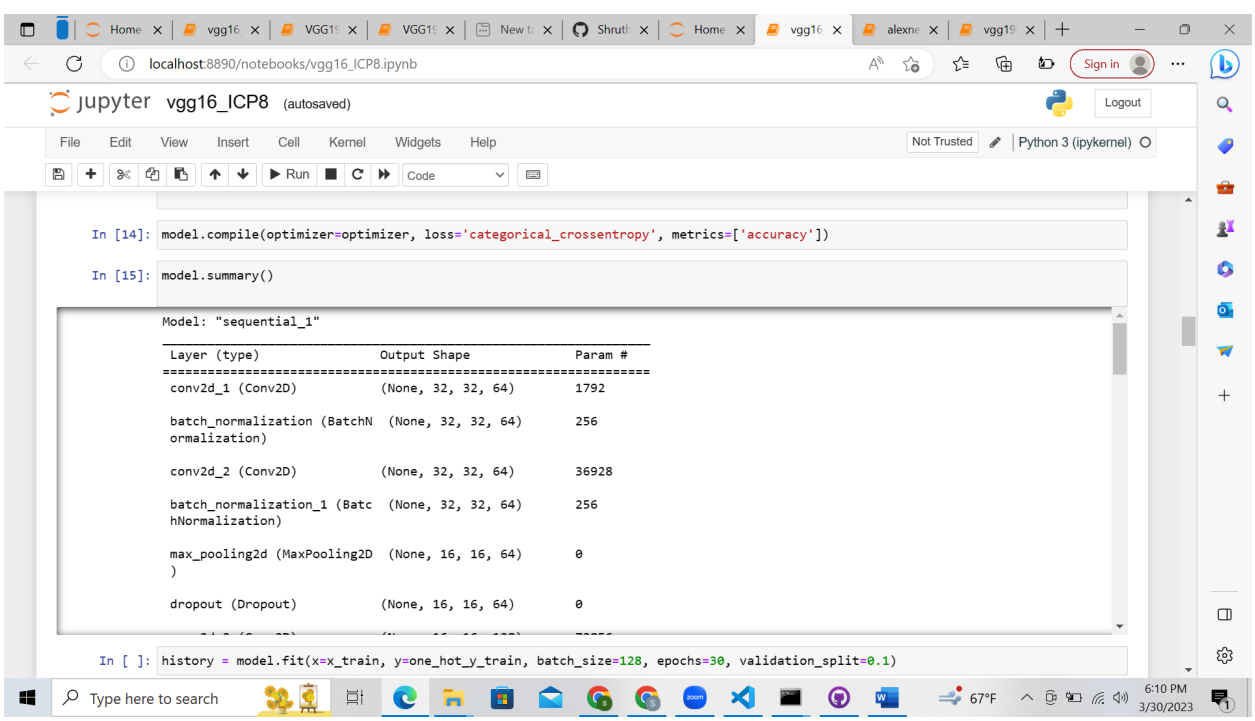
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [14]:
model.compile(optimizer=optimizer, loss='categorical_crossentropy', metrics=['accuracy'])
In [15]:
model.summary()
Model: "sequential_1"
Layer (type) Output Shape Param #
conv2d_1 (Conv2D) (None, 32, 32, 64) 1792
batch_normalization (BatchN ormalization) (None, 32, 32, 64) 256
conv2d_2 (Conv2D) (None, 32, 32, 64) 36928
batch_normalization_1 (Batc hNormalization) (None, 32, 32, 64) 256
max_pooling2d (MaxPooling2D) (None, 16, 16, 64) 0
dropout (Dropout) (None, 16, 16, 64) 0
In [ ]:
history = model.fit(x=x_train, y=one_hot_y_train, batch_size=128, epochs=30, validation_split=0.1)
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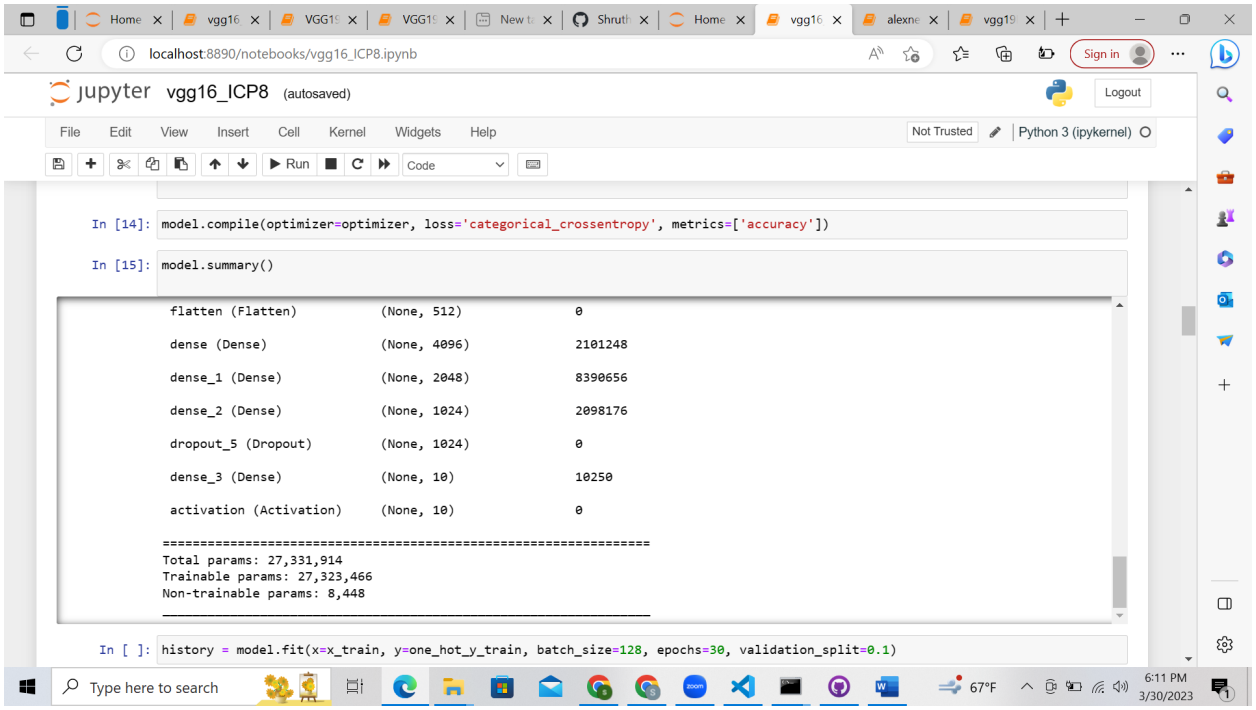
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [14]: model.compile(optimizer=optimizer, loss='categorical_crossentropy', metrics=['accuracy'])
In [15]: model.summary()
flatten (Flatten) (None, 512) 0
dense (Dense) (None, 4096) 2101248
dense_1 (Dense) (None, 2048) 8390656
dense_2 (Dense) (None, 1024) 2098176
dropout_5 (Dropout) (None, 1024) 0
dense_3 (Dense) (None, 10) 10250
activation (Activation) (None, 10) 0
Total params: 27,331,914
Trainable params: 27,323,466
Non-trainable params: 8,448
In [ ]: history = model.fit(x=x_train, y=one_hot_y_train, batch_size=128, epochs=30, validation_split=0.1)
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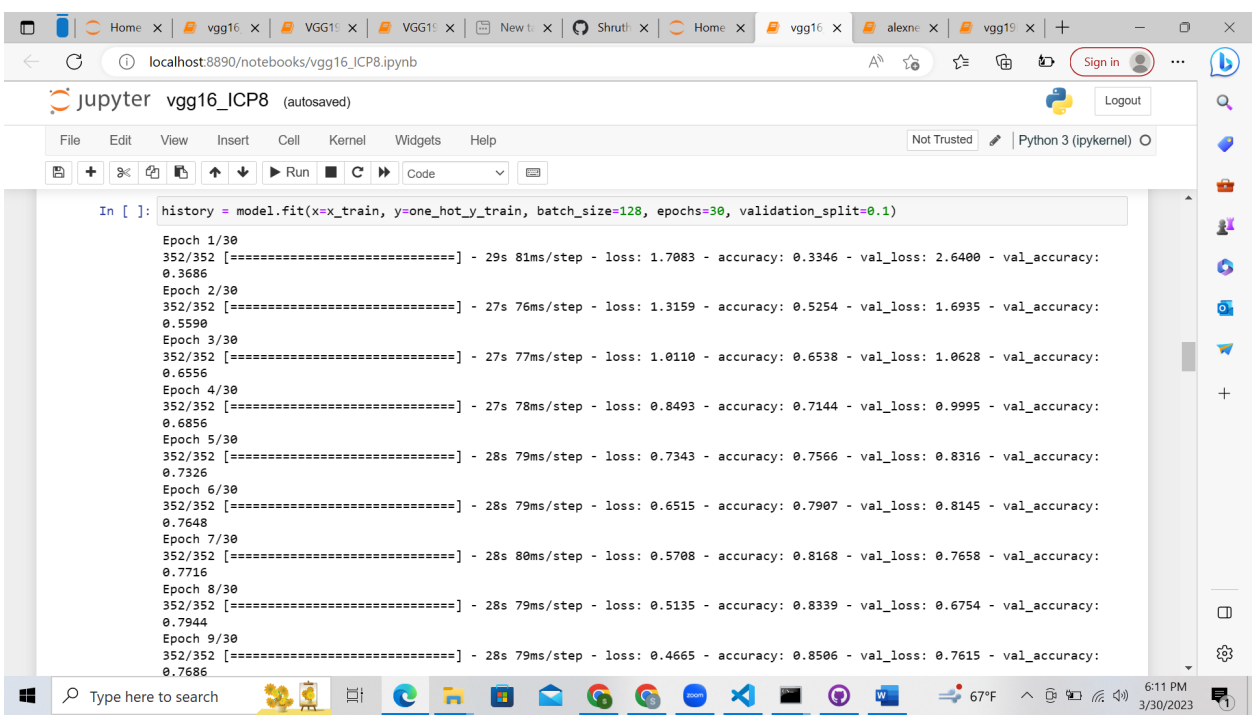
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [ ]: history = model.fit(x=x_train, y=one_hot_y_train, batch_size=128, epochs=30, validation_split=0.1)
Epoch 1/30
352/352 [==========] - 29s 81ms/step - loss: 1.7083 - accuracy: 0.3346 - val_loss: 2.6400 - val_accuracy: 0.3686
Epoch 2/30
352/352 [==========] - 27s 76ms/step - loss: 1.3159 - accuracy: 0.5254 - val_loss: 1.6935 - val_accuracy: 0.5590
Epoch 3/30
352/352 [==========] - 27s 77ms/step - loss: 1.0110 - accuracy: 0.6538 - val_loss: 1.0628 - val_accuracy: 0.6556
Epoch 4/30
352/352 [==========] - 27s 78ms/step - loss: 0.8493 - accuracy: 0.7144 - val_loss: 0.9995 - val_accuracy: 0.6856
Epoch 5/30
352/352 [==========] - 28s 79ms/step - loss: 0.7343 - accuracy: 0.7566 - val_loss: 0.8316 - val_accuracy: 0.7326
Epoch 6/30
352/352 [==========] - 28s 79ms/step - loss: 0.6515 - accuracy: 0.7907 - val_loss: 0.8145 - val_accuracy: 0.7648
Epoch 7/30
352/352 [==========] - 28s 80ms/step - loss: 0.5708 - accuracy: 0.8168 - val_loss: 0.7658 - val_accuracy: 0.7716
Epoch 8/30
352/352 [==========] - 28s 79ms/step - loss: 0.5135 - accuracy: 0.8339 - val_loss: 0.6754 - val_accuracy: 0.7944
Epoch 9/30
352/352 [==========] - 28s 79ms/step - loss: 0.4665 - accuracy: 0.8506 - val_loss: 0.7615 - val_accuracy: 0.7686
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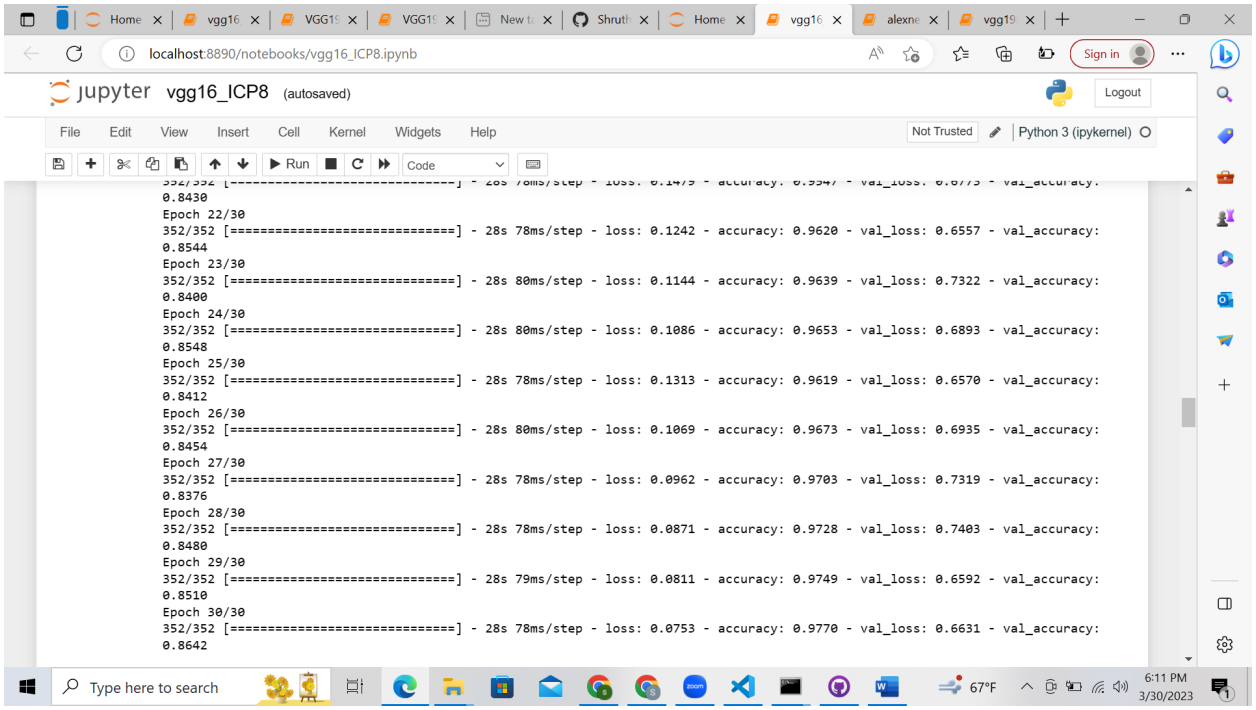
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
0.8430
Epoch 22/30
352/352 [==============================] - 28s 78ms/step - loss: 0.1242 - accuracy: 0.9620 - val_loss: 0.6557 - val_accuracy:
0.8544
Epoch 23/30
352/352 [==============================] - 28s 80ms/step - loss: 0.1144 - accuracy: 0.9639 - val_loss: 0.7322 - val_accuracy:
0.8400
Epoch 24/30
352/352 [==============================] - 28s 80ms/step - loss: 0.1086 - accuracy: 0.9653 - val_loss: 0.6893 - val_accuracy:
0.8548
Epoch 25/30
352/352 [==============================] - 28s 78ms/step - loss: 0.1313 - accuracy: 0.9619 - val_loss: 0.6570 - val_accuracy:
0.8412
Epoch 26/30
352/352 [==============================] - 28s 80ms/step - loss: 0.1069 - accuracy: 0.9673 - val_loss: 0.6935 - val_accuracy:
0.8454
Epoch 27/30
352/352 [==============================] - 28s 78ms/step - loss: 0.0962 - accuracy: 0.9703 - val_loss: 0.7319 - val_accuracy:
0.8376
Epoch 28/30
352/352 [==============================] - 28s 78ms/step - loss: 0.0871 - accuracy: 0.9728 - val_loss: 0.7403 - val_accuracy:
0.8480
Epoch 29/30
352/352 [==============================] - 28s 79ms/step - loss: 0.0811 - accuracy: 0.9749 - val_loss: 0.6592 - val_accuracy:
0.8510
Epoch 30/30
352/352 [==============================] - 28s 78ms/step - loss: 0.0753 - accuracy: 0.9770 - val_loss: 0.6631 - val_accuracy:
0.8642
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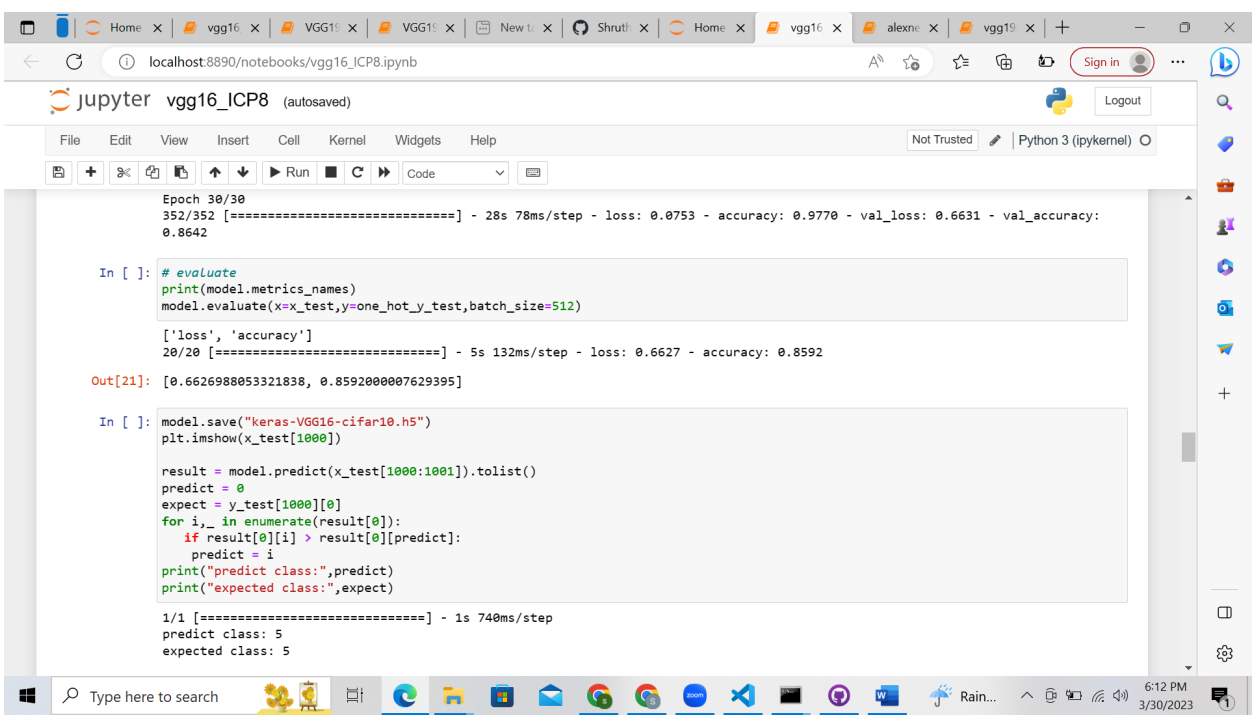
localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
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Python 3 (ipykernel)
Run
Code
Epoch 30/30
352/352 [==============================] - 28s 78ms/step - loss: 0.0753 - accuracy: 0.9770 - val_loss: 0.6631 - val_accuracy:
0.8642
In [ ]:
# evaluate
print(model.metrics_names)
model.evaluate(x=x_test,y=one_hot_y_test,batch_size=512)
['loss', 'accuracy']
20/20 [==============================] - 5s 132ms/step - loss: 0.6627 - accuracy: 0.8592
Out[21]:
[0.6626988053321838, 0.8592000007629395]
In [ ]:
model.save("keras-VGG16-cifar10.h5")
plt.imshow(x_test[1000])
result = model.predict(x_test[1000:1001]).tolist()
predict = 0
expect = y_test[1000][0]
for i,_ in enumerate(result[0]):
if result[0][i] > result[0][predict]:
predict = i
print("predict class:",predict)
print("expected class:",expect)
1/1 [==============================] - 1s 740ms/step
predict class: 5
expected class: 5
Type here to search
Rain...
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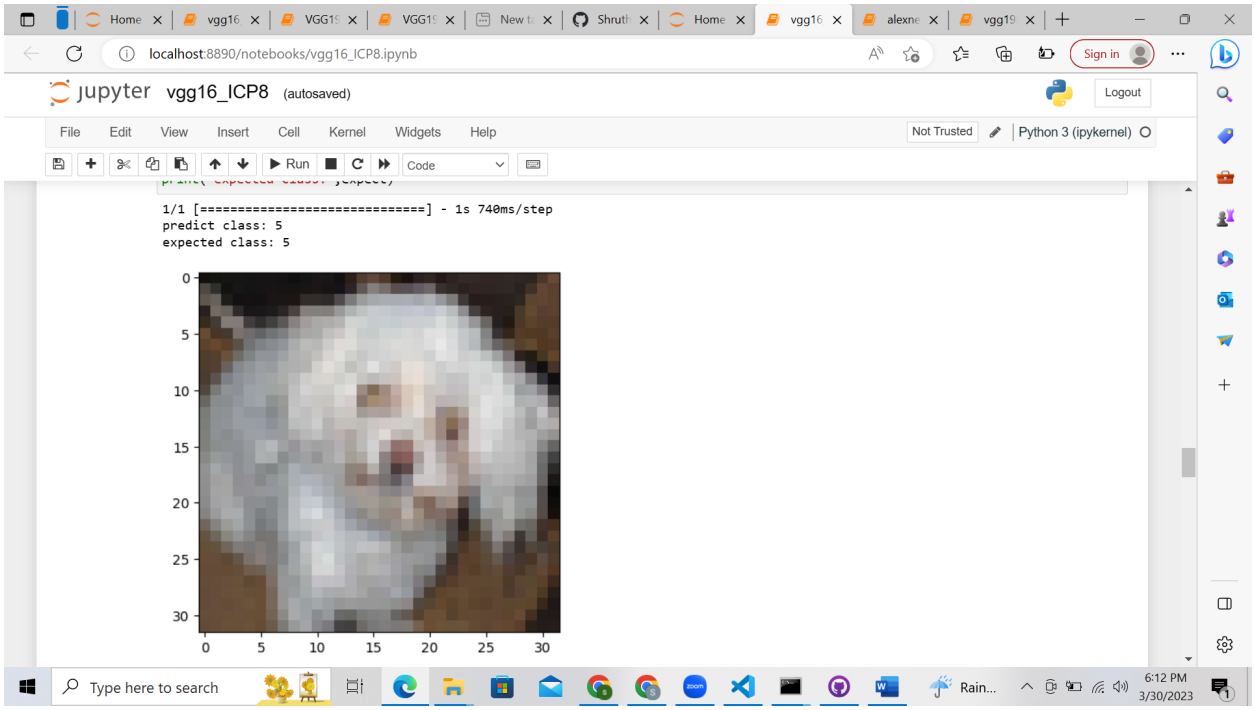
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
1/1 [==============================] - 1s 740ms/step
predict class: 5
expected class: 5
0
5
10
15
20
25
30
Type here to search
Rain...
6:12 PM
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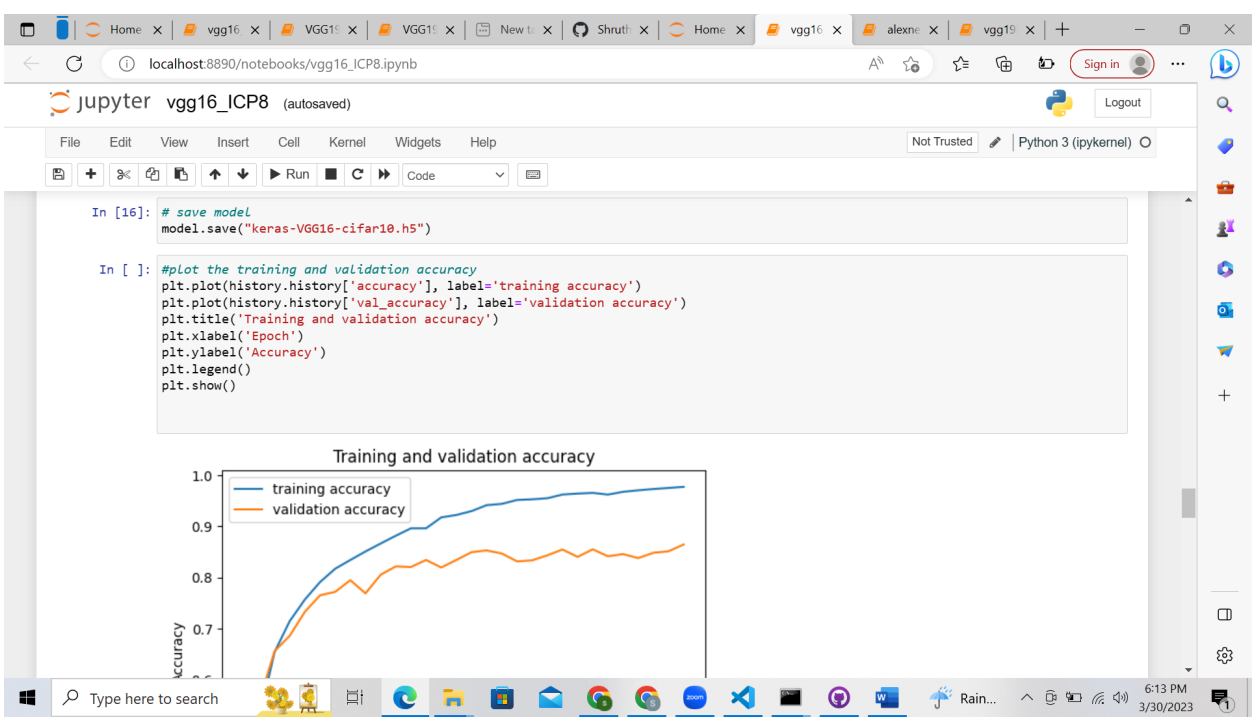
jupyter vgg16_ICP8 (autosaved)
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File Edit View Insert Cell Kernel Widgets Help
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Python 3 (ipykernel)
Run
Code
In [16]:
# save model
model.save("keras-VGG16-cifar10.h5")
In [ ]:
#plot the training and validation accuracy
plt.plot(history.history['accuracy'], label='training accuracy')
plt.plot(history.history['val_accuracy'], label='validation accuracy')
plt.title('Training and validation accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
Training and validation accuracy
training accuracy
validation accuracy
1.0
0.9
0.8
0.7
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Rain...
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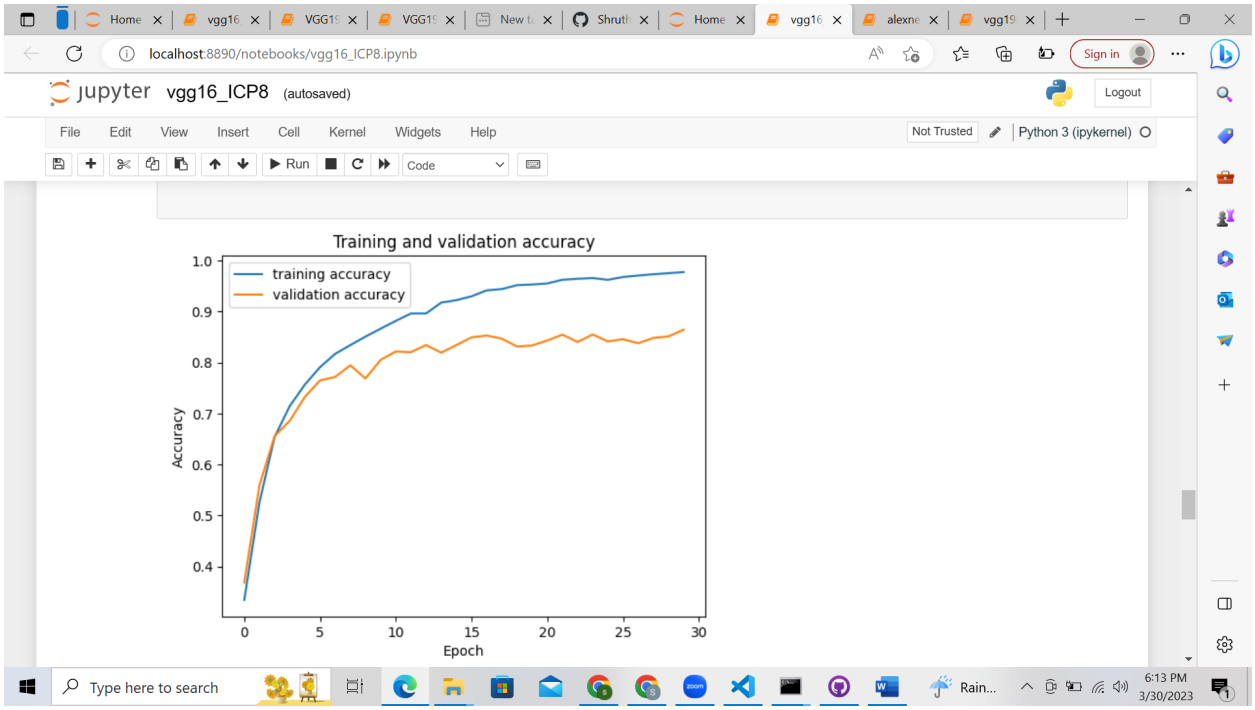
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Python 3 (ipykernel)
Run
Code
Training and validation accuracy
training accuracy
validation accuracy
Accuracy
Epoch
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
5
10
15
20
25
30
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Rain...
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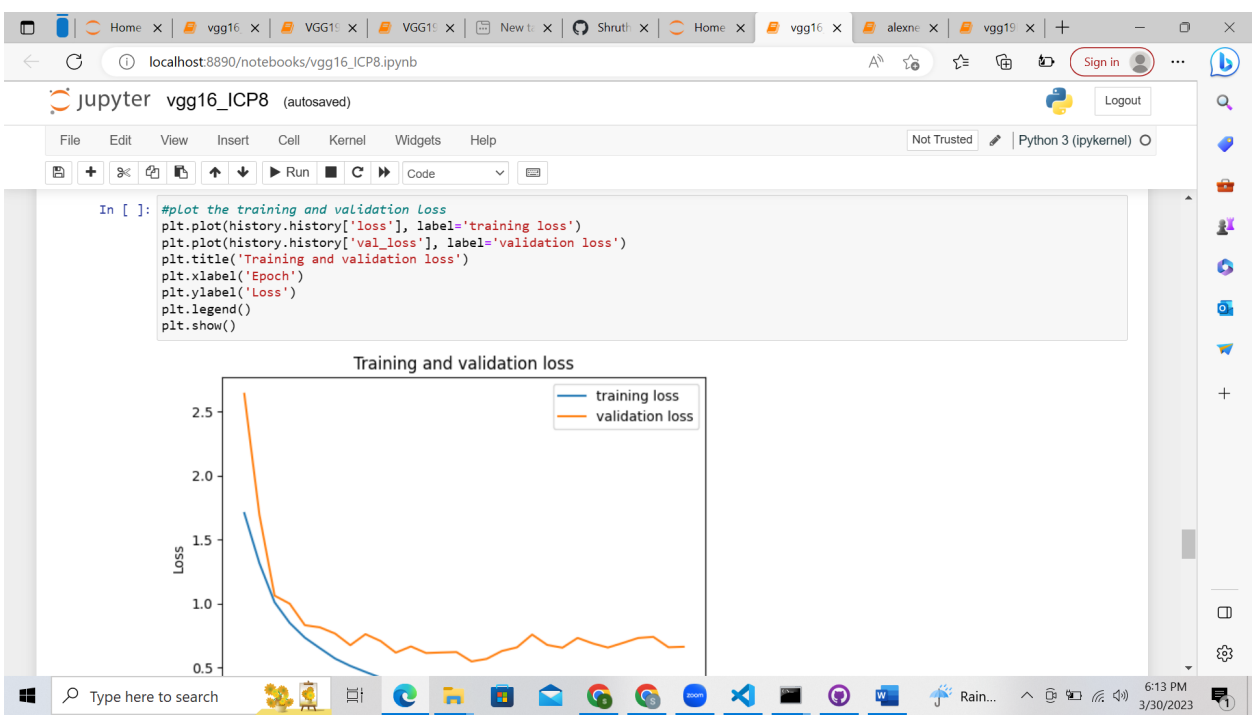
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [ ]:
#plot the training and validation loss
plt.plot(history.history['loss'], label='training loss')
plt.plot(history.history['val_loss'], label='validation loss')
plt.title('Training and validation loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()
Training and validation loss
training loss
validation loss
Loss
2.5
2.0
1.5
1.0
0.5
Type here to search
Rain...
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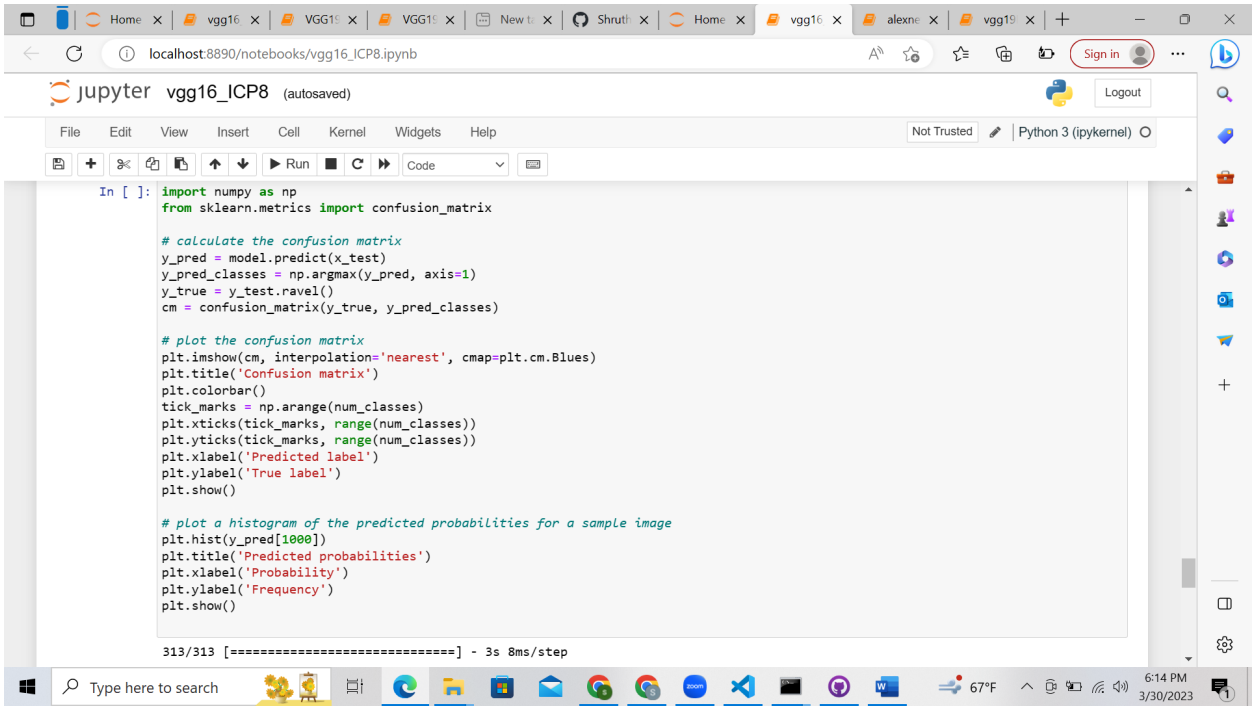
3/30/2023


localhost:8890/notebooks/vgg16_ICP8.ipynb
jupyter vgg16_ICP8 (autosaved)
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Python 3 (ipykernel)
Run
Code
In [ ]:
import numpy as np
from sklearn.metrics import confusion_matrix
# calculate the confusion matrix
y_pred = model.predict(x_test)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = y_test.ravel()
cm = confusion_matrix(y_true, y_pred_classes)
# plot the confusion matrix
plt.imshow(cm, interpolation='nearest', cmap=plt.cm.Blues)
plt.title('Confusion matrix')
plt.colorbar()
tick_marks = np.arange(num_classes)
plt.xticks(tick_marks, range(num_classes))
plt.yticks(tick_marks, range(num_classes))
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()
# plot a histogram of the predicted probabilities for a sample image
plt.hist(y_pred[1000])
plt.title('Predicted probabilities')
plt.xlabel('Probability')
plt.ylabel('Frequency')
plt.show()
313/313 [==============================] - 3s 8ms/step
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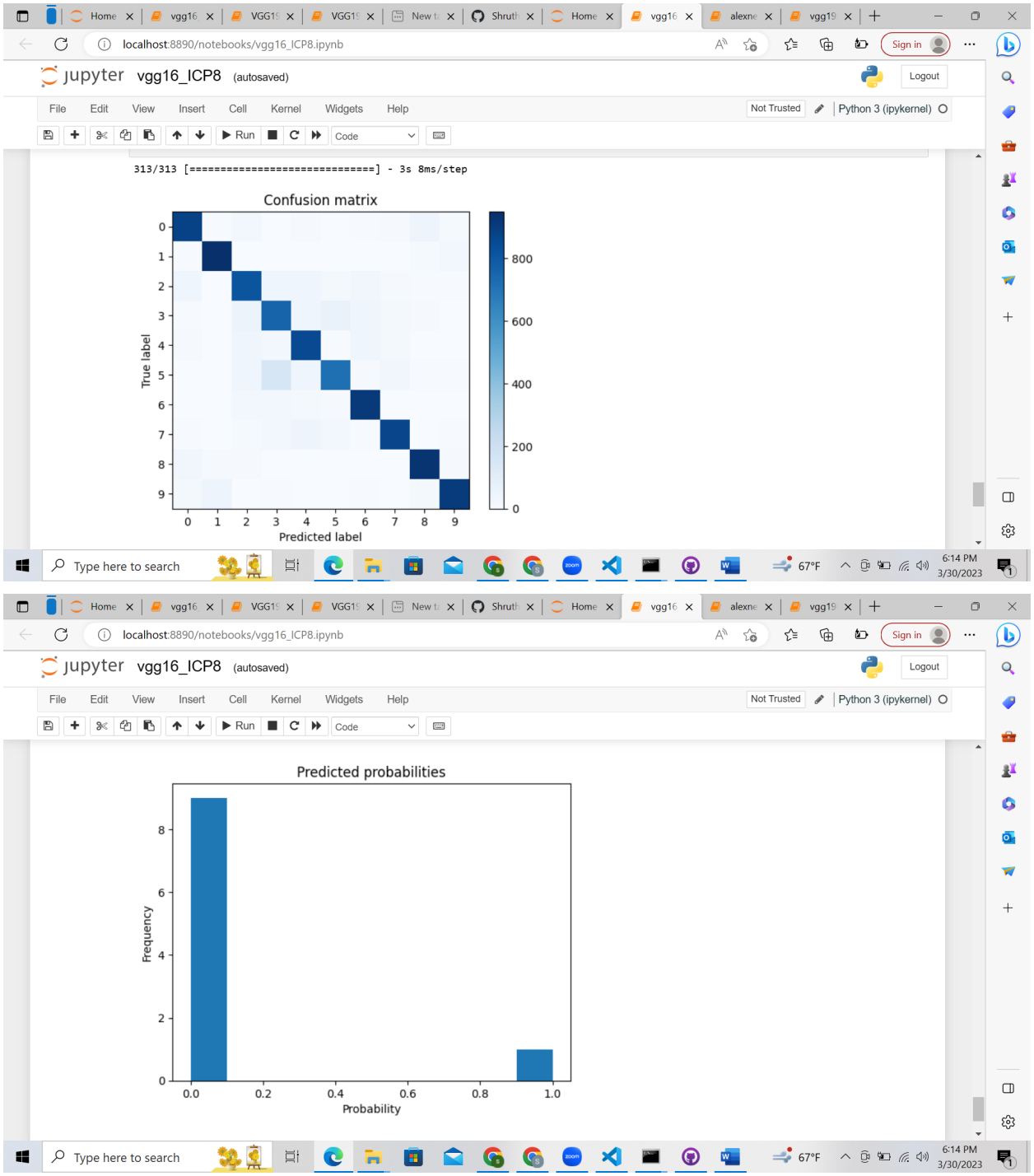

Model after improvising

localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb

jupyter VGG19Model_(CIFAR100) (4) Last Checkpoint: 6 hours ago (autosaved)

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Import libraries

In [11]:
```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow as tf
from tensorflow.keras.datasets import mnist

from tensorflow.keras.optimizers import RMSprop
from keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.layers import Dense, Flatten, Conv2D, MaxPooling2D, Dropout, BatchNormalization

%matplotlib inline
```

Extract data and train and test dataset

In [12]:
```
#cifar100 = tf.keras.datasets.cifar100
(X_train,Y_train) , (X_test,Y_test) = cifar10.load_data()
```

In [13]:
```
classes = ['airplane', 'automobile', 'bird', 'cat', 'deer', 'dog', 'frog', 'horse', 'ship', 'truck']
```

Let's look into the dataset images

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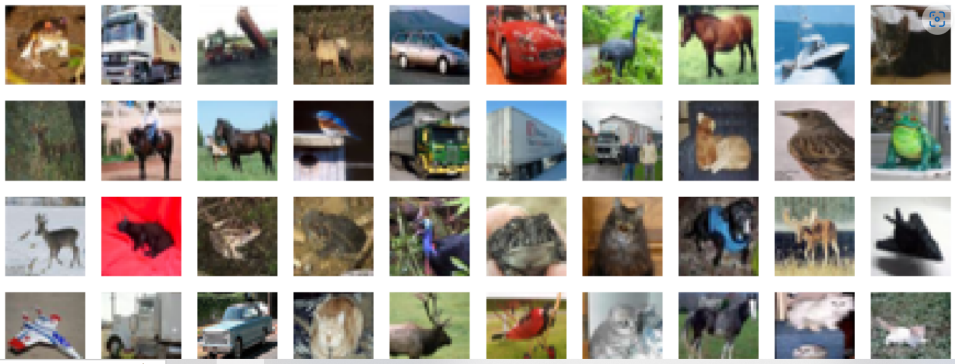
Run | Markdown

In [14]:
```
plt.figure(figsize = (16,16))
for i in range(100):
  plt.subplot(10,10,1+i)
  plt.axis('off')
  plt.imshow(X_train[i], cmap = 'gray')
```



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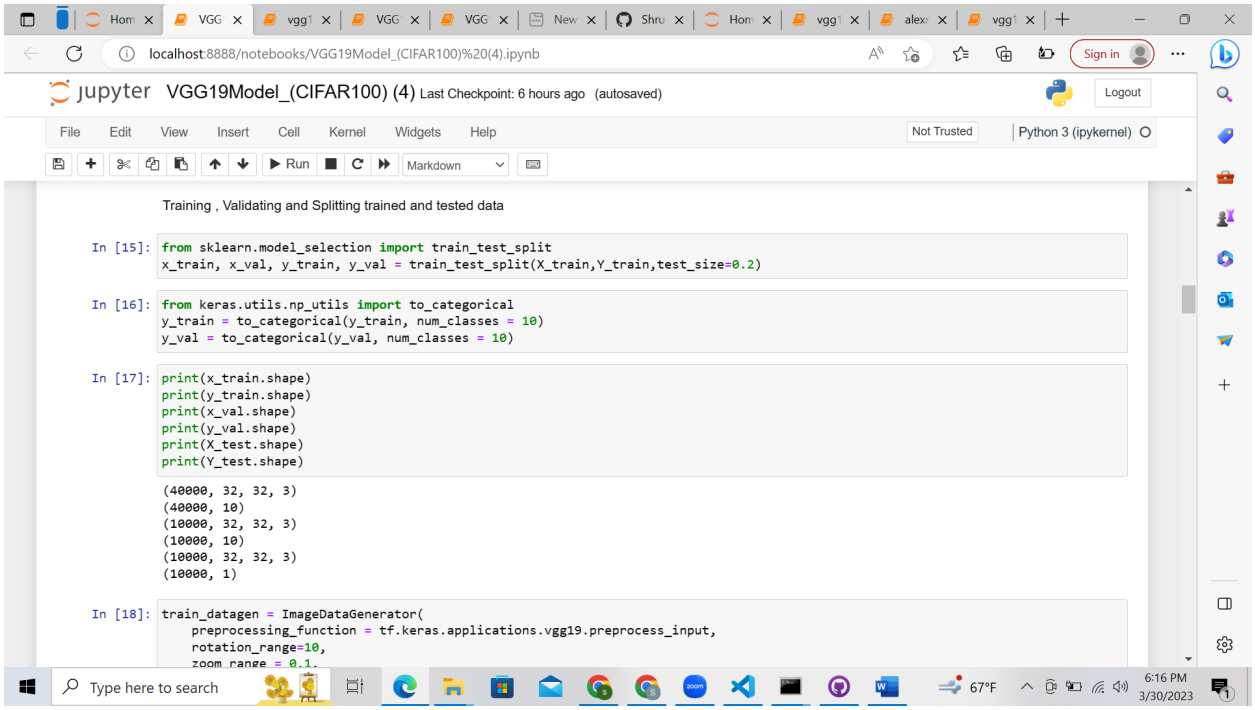
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jupyter VGG19Model_(CIFAR100) (4) Last Checkpoint: 6 hours ago (autosaved)
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Python 3 (ipykernel)
Run
Markdown
Training , Validating and Splitting trained and tested data
In [15]:
from sklearn.model_selection import train_test_split
x_train, x_val, y_train, y_val = train_test_split(X_train,Y_train,test_size=0.2)
In [16]:
from keras.utils.np_utils import to_categorical
y_train = to_categorical(y_train, num_classes = 10)
y_val = to_categorical(y_val, num_classes = 10)
In [17]:
print(x_train.shape)
print(y_train.shape)
print(x_val.shape)
print(y_val.shape)
print(X_test.shape)
print(Y_test.shape)
(40000, 32, 32, 3)
(40000, 10)
(10000, 32, 32, 3)
(10000, 10)
(10000, 32, 32, 3)
(10000, 1)
In [18]:
train_datagen = ImageDataGenerator(
preprocessing_function = tf.keras.applications.vgg19.preprocess_input,
rotation_range=10,
zoom_range = 0.1,
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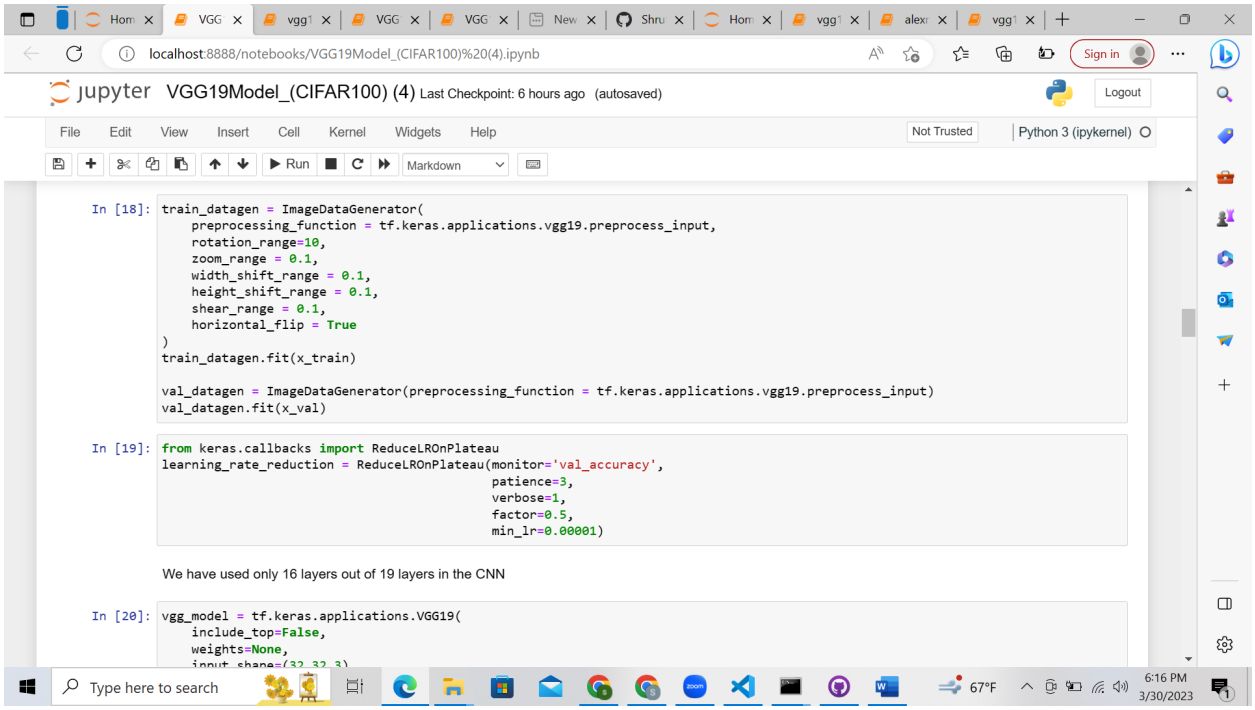
localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
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In [18]:
train_datagen = ImageDataGenerator(
preprocessing_function = tf.keras.applications.vgg19.preprocess_input,
rotation_range=10,
zoom_range = 0.1,
width_shift_range = 0.1,
height_shift_range = 0.1,
shear_range = 0.1,
horizontal_flip = True
)
train_datagen.fit(x_train)
val_datagen = ImageDataGenerator(preprocessing_function = tf.keras.applications.vgg19.preprocess_input)
val_datagen.fit(x_val)
In [19]:
from keras.callbacks import ReduceLROnPlateau
learning_rate_reduction = ReduceLROnPlateau(monitor='val_accuracy',
patience=3,
verbose=1,
factor=0.5,
min_lr=0.00001)
We have used only 16 layers out of 19 layers in the CNN
In [20]:
vgg_model = tf.keras.applications.VGG19(
include_top=False,
weights=None,
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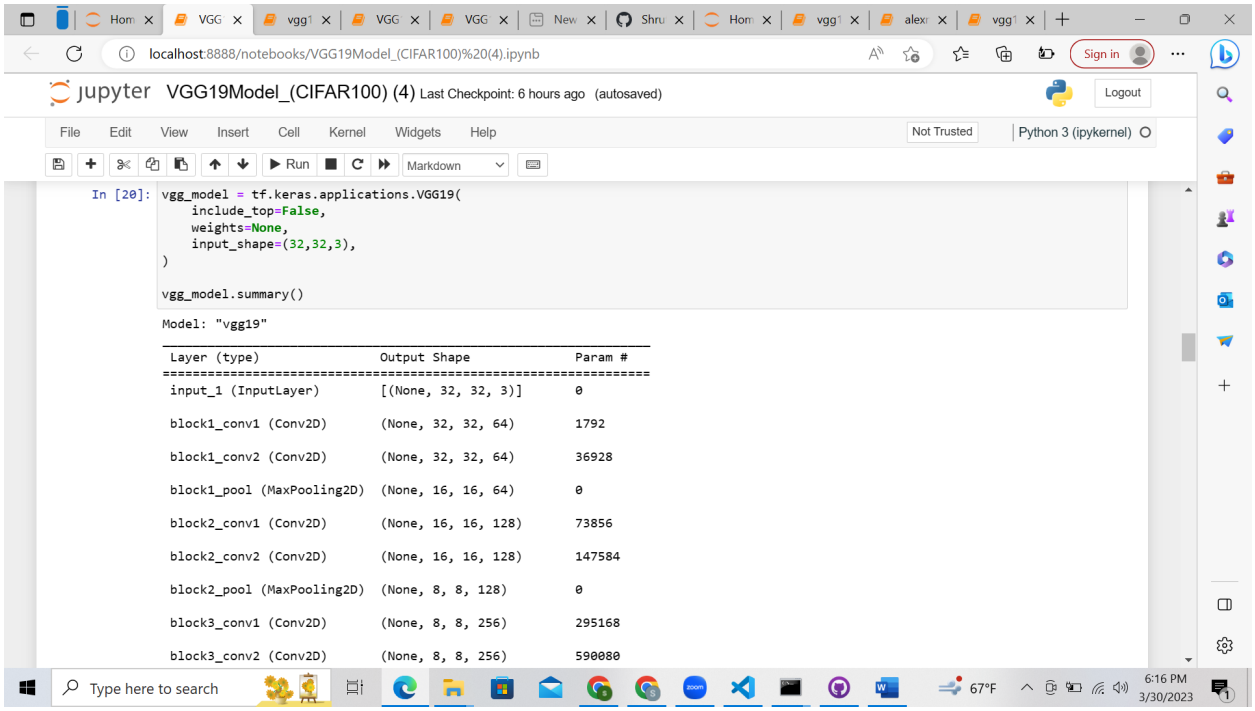
localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
jupyter VGG19Model_(CIFAR100) (4) Last Checkpoint: 6 hours ago (autosaved)
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Python 3 (ipykernel)
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In [20]:
vgg_model = tf.keras.applications.VGG19(
include_top=False,
weights=None,
input_shape=(32,32,3),
)
vgg_model.summary()
Model: "vgg19"
Layer (type) Output Shape Param #
input_1 (InputLayer) [(None, 32, 32, 3)] 0
block1_conv1 (Conv2D) (None, 32, 32, 64) 1792
block1_conv2 (Conv2D) (None, 32, 32, 64) 36928
block1_pool (MaxPooling2D) (None, 16, 16, 64) 0
block2_conv1 (Conv2D) (None, 16, 16, 128) 73856
block2_conv2 (Conv2D) (None, 16, 16, 128) 147584
block2_pool (MaxPooling2D) (None, 8, 8, 128) 0
block3_conv1 (Conv2D) (None, 8, 8, 256) 295168
block3_conv2 (Conv2D) (None, 8, 8, 256) 590080
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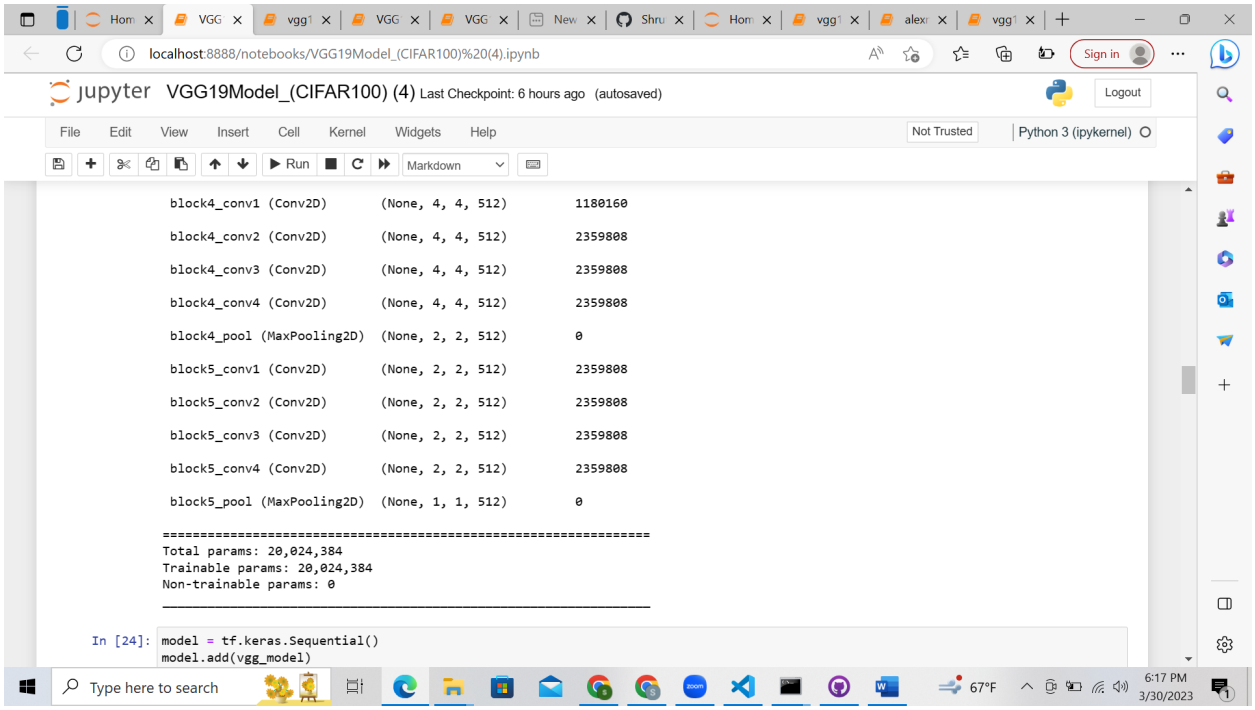
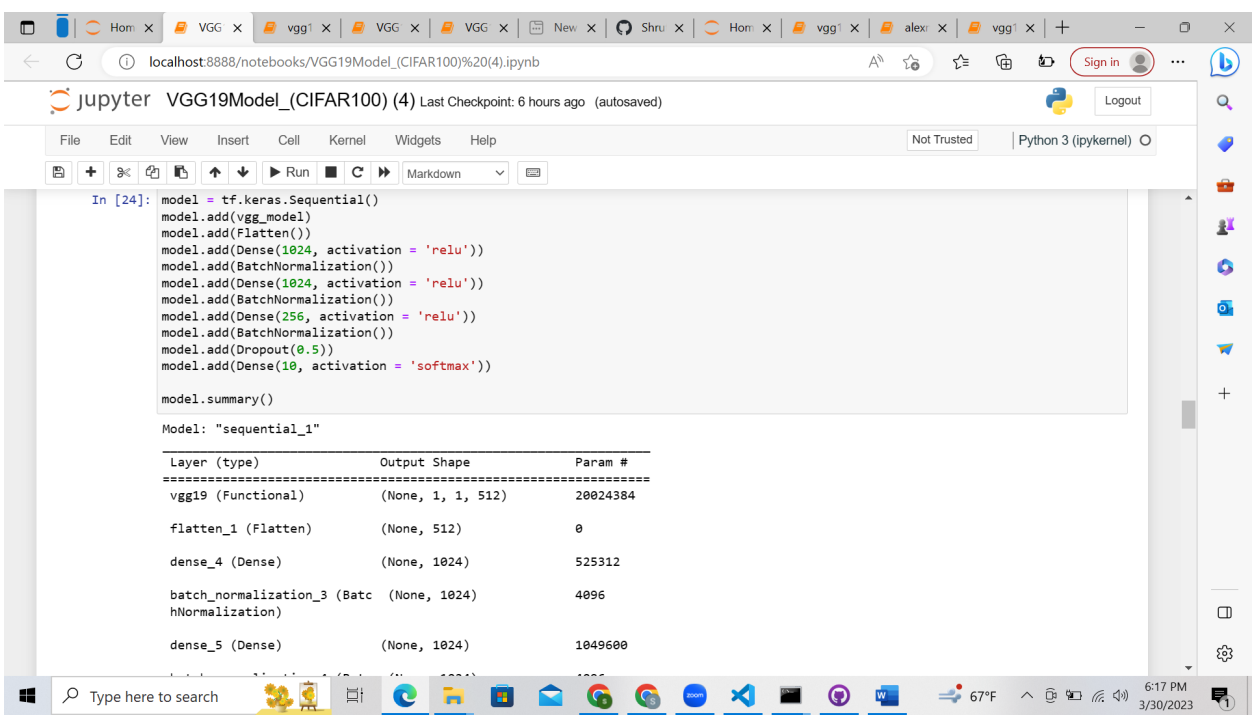


```
block4_conv1 (Conv2D)       (None, 4, 4, 512)         1180160

block4_conv2 (Conv2D)       (None, 4, 4, 512)         2359808

block4_conv3 (Conv2D)       (None, 4, 4, 512)         2359808

block4_conv4 (Conv2D)       (None, 4, 4, 512)         2359808

block4_pool (MaxPooling2D)  (None, 2, 2, 512)         0

block5_conv1 (Conv2D)       (None, 2, 2, 512)         2359808

block5_conv2 (Conv2D)       (None, 2, 2, 512)         2359808

block5_conv3 (Conv2D)       (None, 2, 2, 512)         2359808

block5_conv4 (Conv2D)       (None, 2, 2, 512)         2359808

block5_pool (MaxPooling2D)  (None, 1, 1, 512)         0

=================================================================
Total params: 20,024,384
Trainable params: 20,024,384
Non-trainable params: 0
_________________________________________________________________
```

In [24]:

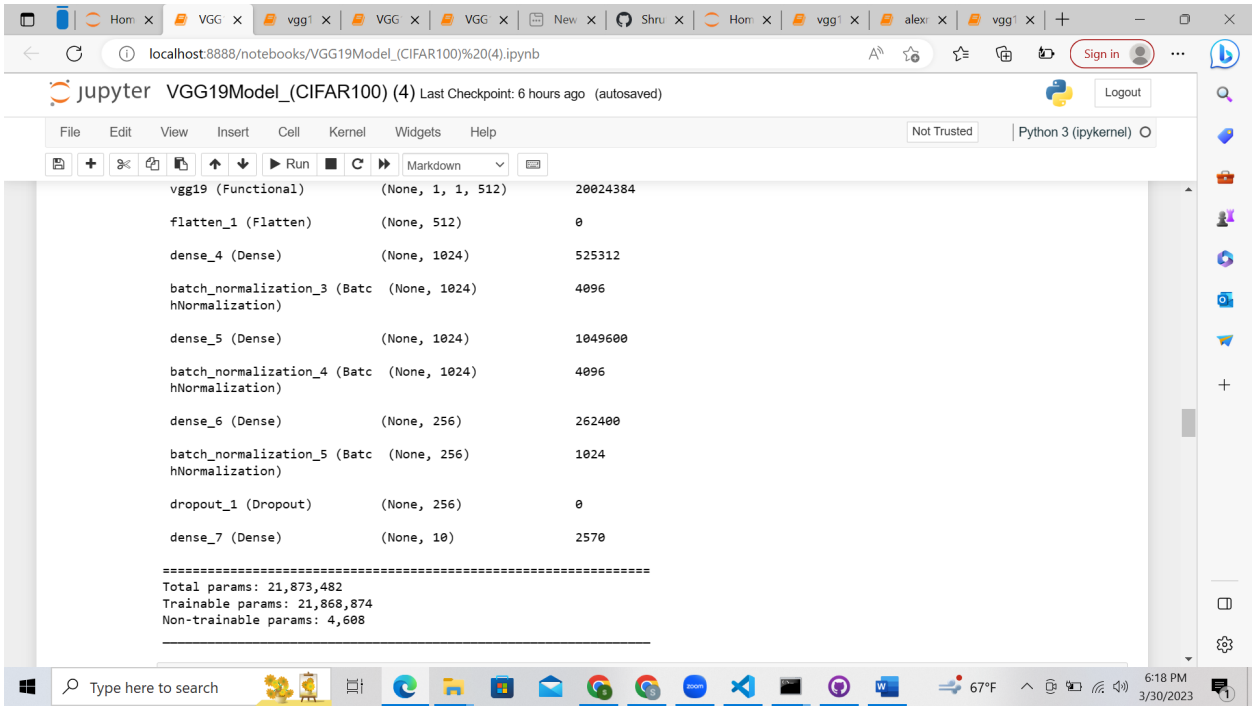
```
model = tf.keras.Sequential()
model.add(vgg_model)
```



In [24]:

```
model = tf.keras.Sequential()
model.add(vgg_model)
model.add(Flatten())
model.add(Dense(1024, activation = 'relu'))
model.add(BatchNormalization())
model.add(Dense(1024, activation = 'relu'))
model.add(BatchNormalization())
model.add(Dense(256, activation = 'relu'))
model.add(BatchNormalization())
model.add(Dropout(0.5))
model.add(Dense(10, activation = 'softmax'))

model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 vgg19 (Functional)          (None, 1, 1, 512)         20024384

 flatten_1 (Flatten)         (None, 512)               0

 dense_4 (Dense)             (None, 1024)              525312

 batch_normalization_3 (Batc  (None, 1024)             4096
 hNormalization)

 dense_5 (Dense)             (None, 1024)              1049600
```


localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
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Python 3 (ipykernel)
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vgg19 (Functional) (None, 1, 1, 512) 20024384
flatten_1 (Flatten) (None, 512) 0
dense_4 (Dense) (None, 1024) 525312
batch_normalization_3 (Batc hNormalization) (None, 1024) 4096
dense_5 (Dense) (None, 1024) 1049600
batch_normalization_4 (Batc hNormalization) (None, 1024) 4096
dense_6 (Dense) (None, 256) 262400
batch_normalization_5 (Batc hNormalization) (None, 256) 1024
dropout_1 (Dropout) (None, 256) 0
dense_7 (Dense) (None, 10) 2570
Total params: 21,873,482
Trainable params: 21,868,874
Non-trainable params: 4,608
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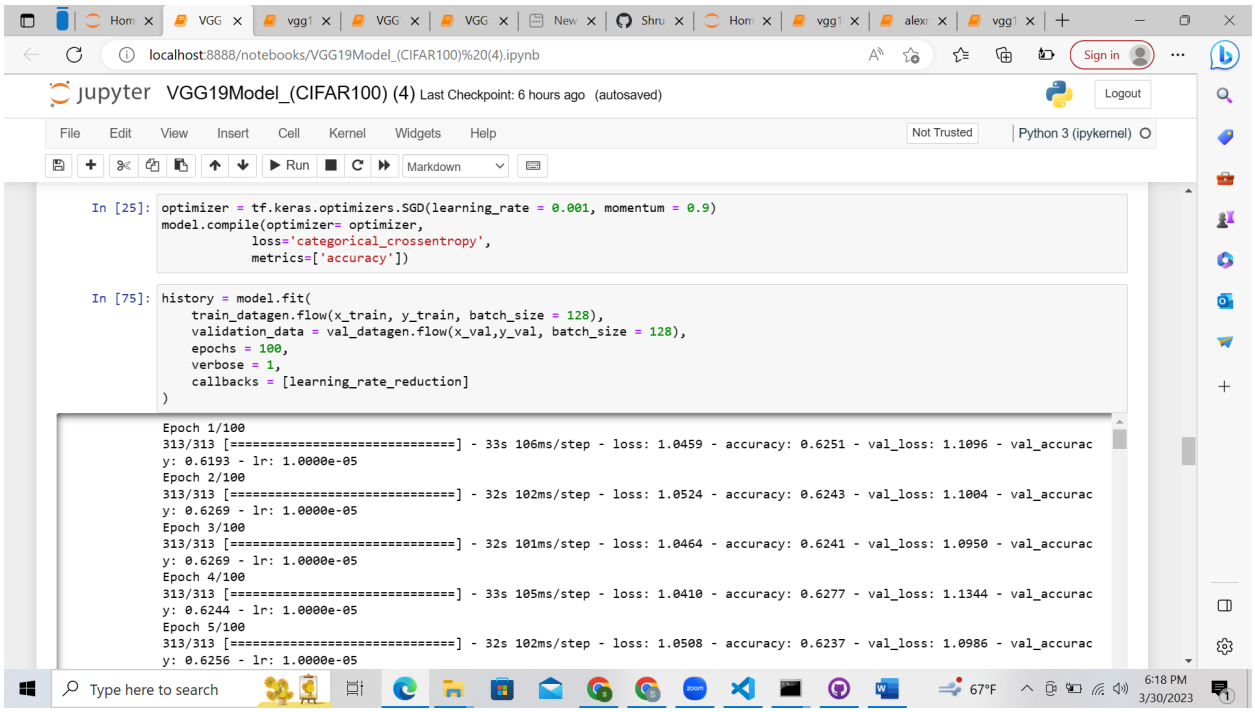
localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
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Python 3 (ipykernel)
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In [25]:
optimizer = tf.keras.optimizers.SGD(learning_rate = 0.001, momentum = 0.9)
model.compile(optimizer= optimizer,
loss='categorical_crossentropy',
metrics=['accuracy'])
In [75]:
history = model.fit(
train_datagen.flow(x_train, y_train, batch_size = 128),
validation_data = val_datagen.flow(x_val,y_val, batch_size = 128),
epochs = 100,
verbose = 1,
callbacks = [learning_rate_reduction]
)
Epoch 1/100
313/313 [==============================] - 33s 106ms/step - loss: 1.0459 - accuracy: 0.6251 - val_loss: 1.1096 - val_accurac
y: 0.6193 - lr: 1.0000e-05
Epoch 2/100
313/313 [==============================] - 32s 102ms/step - loss: 1.0524 - accuracy: 0.6243 - val_loss: 1.1004 - val_accurac
y: 0.6269 - lr: 1.0000e-05
Epoch 3/100
313/313 [==============================] - 32s 101ms/step - loss: 1.0464 - accuracy: 0.6241 - val_loss: 1.0950 - val_accurac
y: 0.6269 - lr: 1.0000e-05
Epoch 4/100
313/313 [==============================] - 33s 105ms/step - loss: 1.0410 - accuracy: 0.6277 - val_loss: 1.1344 - val_accurac
y: 0.6244 - lr: 1.0000e-05
Epoch 5/100
313/313 [==============================] - 32s 102ms/step - loss: 1.0508 - accuracy: 0.6237 - val_loss: 1.0986 - val_accurac
y: 0.6256 - lr: 1.0000e-05
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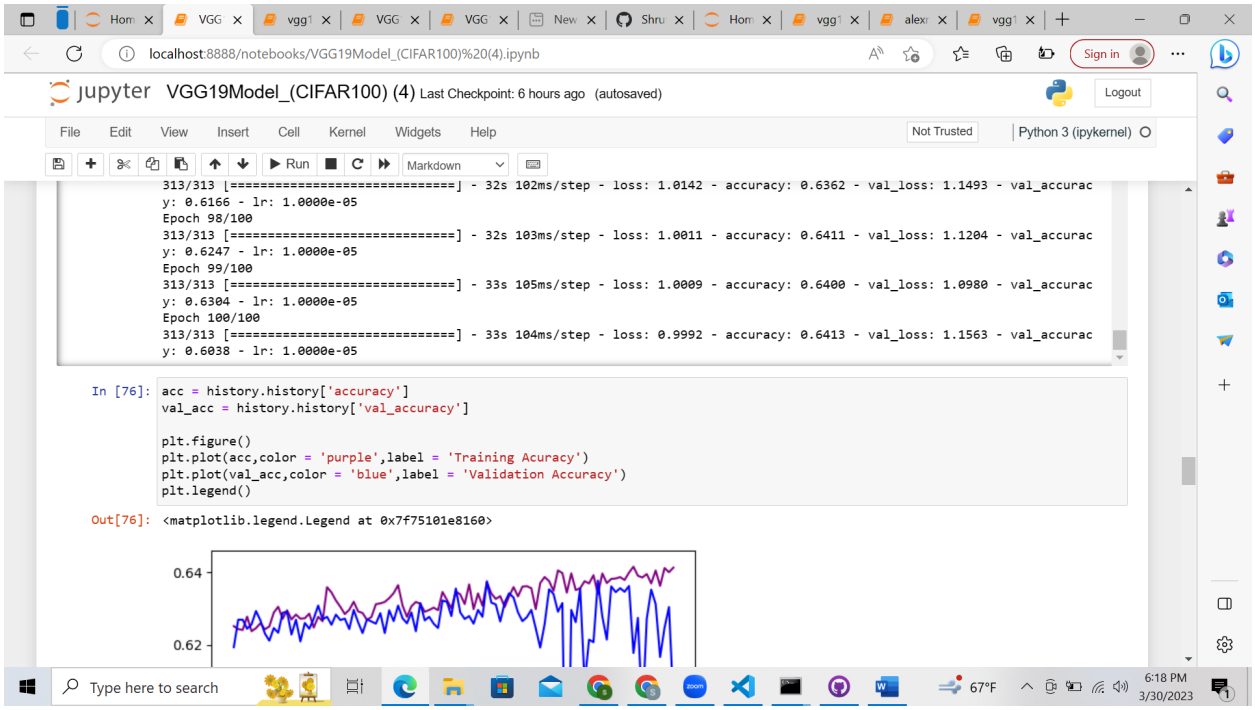
localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
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Python 3 (ipykernel)
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313/313 [==============================] - 32s 102ms/step - loss: 1.0142 - accuracy: 0.6362 - val_loss: 1.1493 - val_accurac
y: 0.6166 - lr: 1.0000e-05
Epoch 98/100
313/313 [==============================] - 32s 103ms/step - loss: 1.0011 - accuracy: 0.6411 - val_loss: 1.1204 - val_accurac
y: 0.6247 - lr: 1.0000e-05
Epoch 99/100
313/313 [==============================] - 33s 105ms/step - loss: 1.0009 - accuracy: 0.6400 - val_loss: 1.0980 - val_accurac
y: 0.6304 - lr: 1.0000e-05
Epoch 100/100
313/313 [==============================] - 33s 104ms/step - loss: 0.9992 - accuracy: 0.6413 - val_loss: 1.1563 - val_accurac
y: 0.6038 - lr: 1.0000e-05
In [76]:
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
plt.figure()
plt.plot(acc,color = 'purple',label = 'Training Acuracy')
plt.plot(val_acc,color = 'blue',label = 'Validation Accuracy')
plt.legend()
Out[76]: <matplotlib.legend.Legend at 0x7f75101e8160>
0.64
0.62
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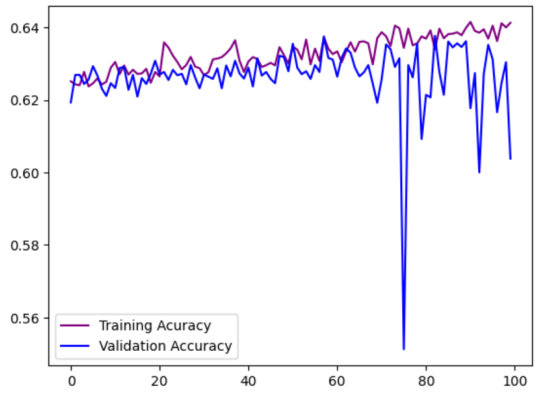
```
plt.plot(val_acc,color = 'blue',label = 'Validation Accuracy')
plt.legend()
```

Out[76]: <matplotlib.legend.Legend at 0x7f75101e8160>



In [77]:
```
loss = history.history['loss']
val_loss = history.history['val_loss']

plt.figure()
plt.plot(loss,color = 'green',label = 'Training Loss')
plt.plot(val_loss,color = 'red',label = 'Validation Loss')
plt.legend()
```

Out[77]: <matplotlib.legend.Legend at 0x7f75101e8d30>

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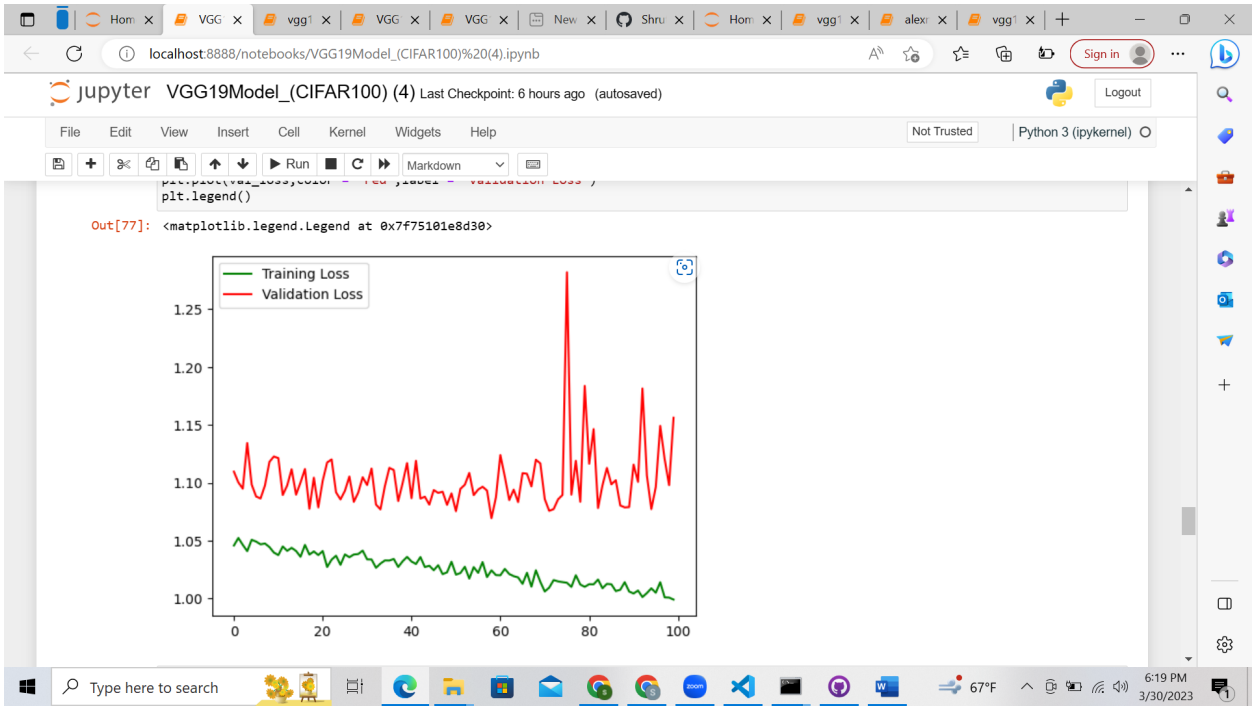
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Python 3 (ipykernel)
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plt.legend()
Out[77]: <matplotlib.legend.Legend at 0x7f75101e8d30>
Training Loss
Validation Loss
1.25
1.20
1.15
1.10
1.05
1.00
0
20
40
60
80
100
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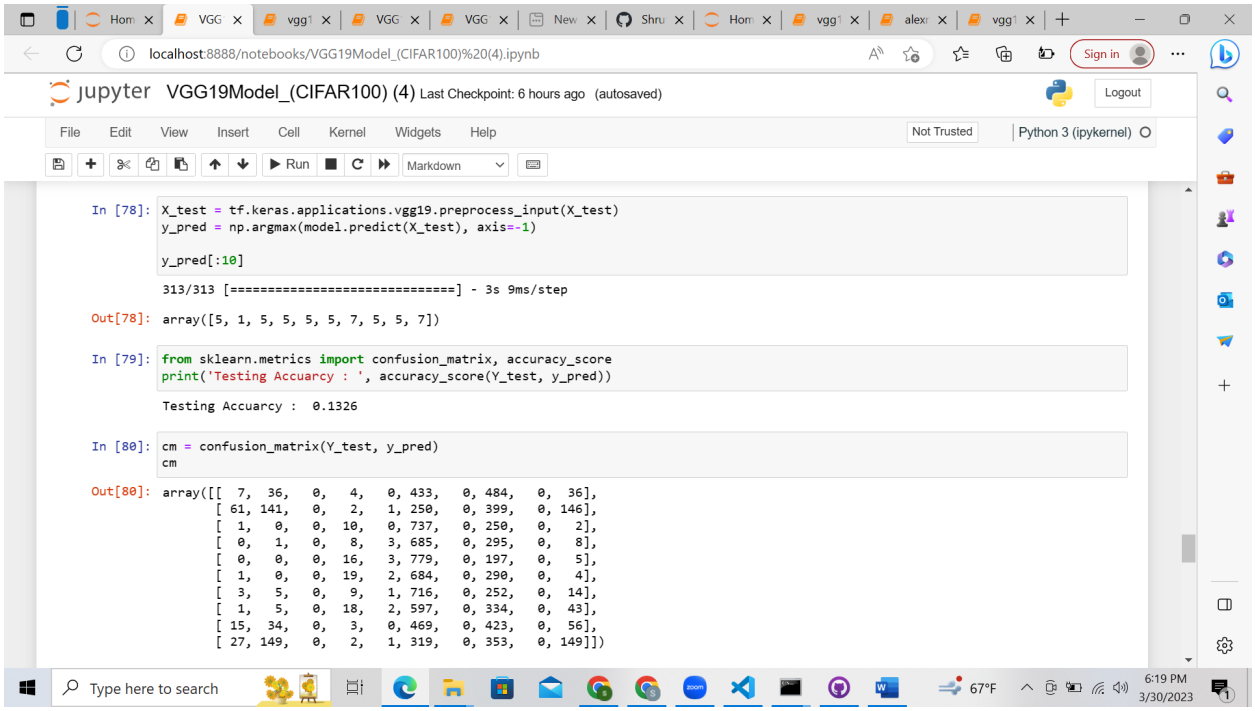
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Python 3 (ipykernel)
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In [78]:
X_test = tf.keras.applications.vgg19.preprocess_input(X_test)
y_pred = np.argmax(model.predict(X_test), axis=-1)
y_pred[:10]
313/313 [==============================] - 3s 9ms/step
Out[78]: array([5, 1, 5, 5, 5, 5, 7, 5, 5, 7])
In [79]:
from sklearn.metrics import confusion_matrix, accuracy_score
print('Testing Accuarcy : ', accuracy_score(Y_test, y_pred))
Testing Accuarcy : 0.1326
In [80]:
cm = confusion_matrix(Y_test, y_pred)
cm
Out[80]: array([[7, 36, 0, 4, 0, 433, 0, 484, 0, 36],
[61, 141, 0, 2, 1, 250, 0, 399, 0, 146],
[1, 0, 0, 10, 0, 737, 0, 250, 0, 2],
[0, 1, 0, 8, 3, 685, 0, 295, 0, 8],
[0, 0, 0, 16, 3, 779, 0, 197, 0, 5],
[1, 0, 0, 19, 2, 684, 0, 290, 0, 4],
[3, 5, 0, 9, 1, 716, 0, 252, 0, 14],
[1, 5, 0, 18, 2, 597, 0, 334, 0, 43],
[15, 34, 0, 3, 0, 469, 0, 423, 0, 56],
[27, 149, 0, 2, 1, 319, 0, 353, 0, 149]])
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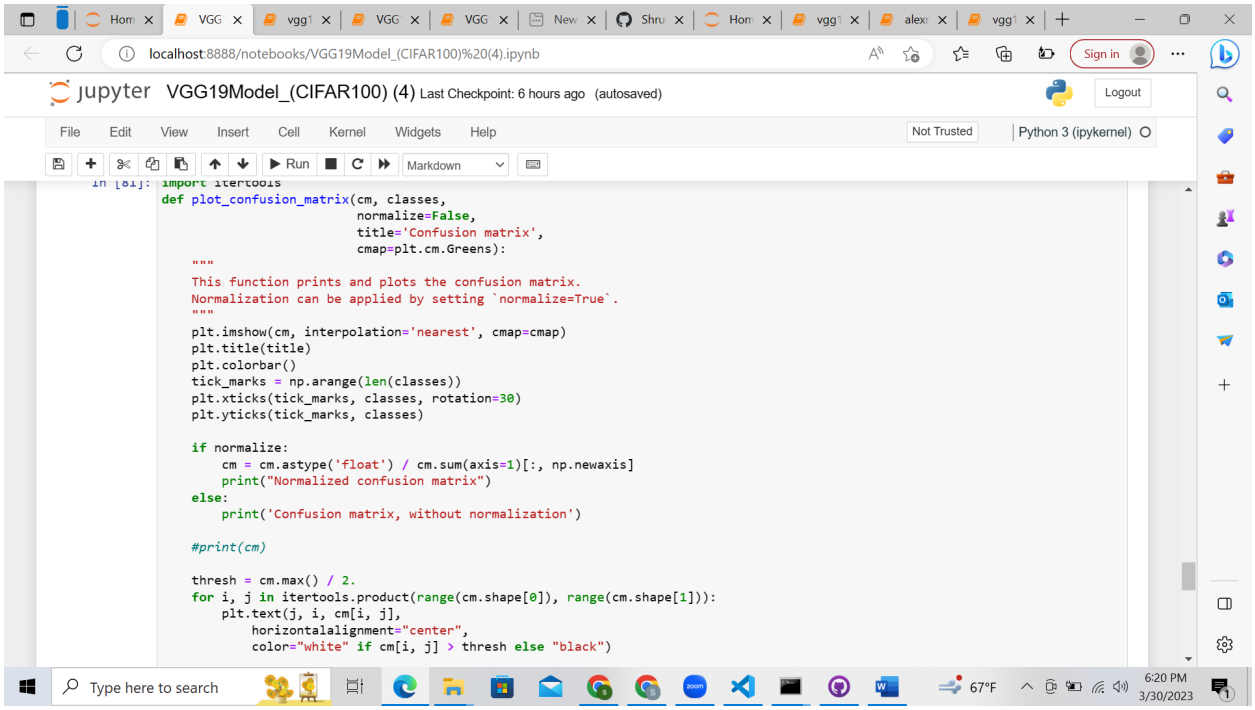
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Python 3 (ipykernel)
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In [81]:
import itertools
def plot_confusion_matrix(cm, classes,
normalize=False,
title='Confusion matrix',
cmap=plt.cm.Greens):
"""
This function prints and plots the confusion matrix.
Normalization can be applied by setting `normalize=True`.
"""
plt.imshow(cm, interpolation='nearest', cmap=cmap)
plt.title(title)
plt.colorbar()
tick_marks = np.arange(len(classes))
plt.xticks(tick_marks, classes, rotation=30)
plt.yticks(tick_marks, classes)
if normalize:
cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
print("Normalized confusion matrix")
else:
print('Confusion matrix, without normalization')
#print(cm)
thresh = cm.max() / 2.
for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",
color="white" if cm[i, j] > thresh else "black")
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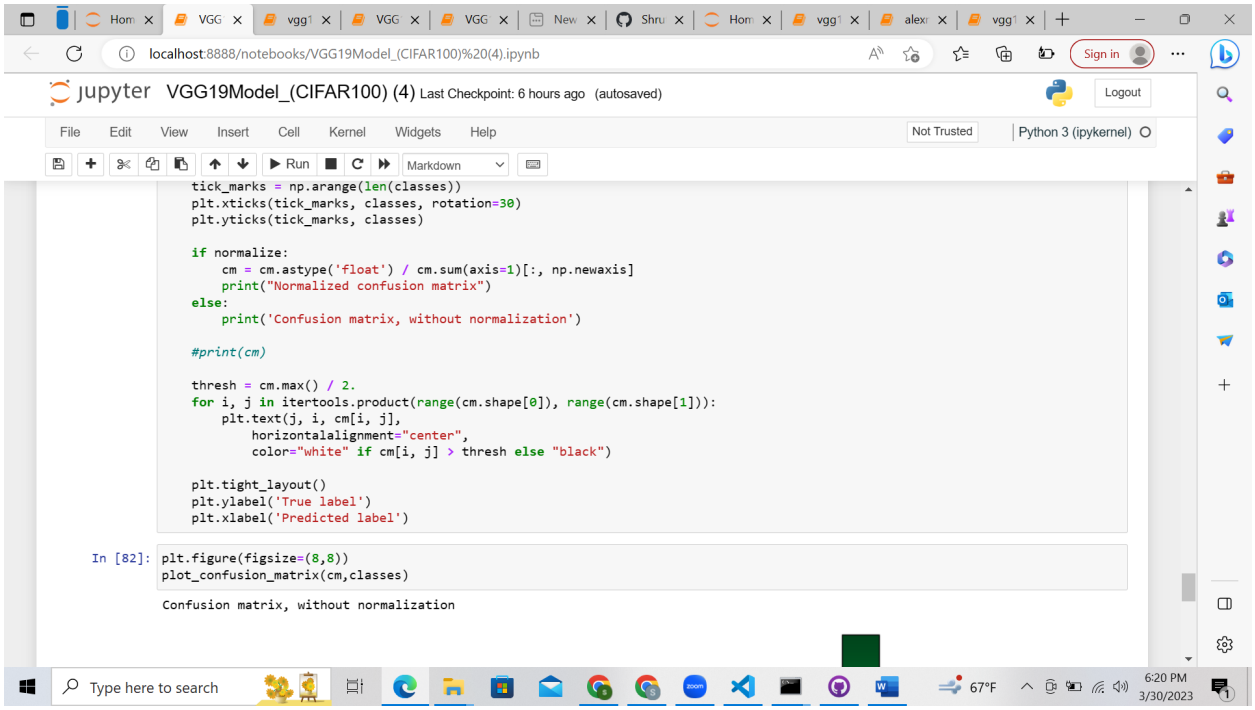
localhost:8888/notebooks/VGG19Model_(CIFAR100)%20(4).ipynb
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tick_marks = np.arange(len(classes))
plt.xticks(tick_marks, classes, rotation=30)
plt.yticks(tick_marks, classes)
if normalize:
cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
print("Normalized confusion matrix")
else:
print('Confusion matrix, without normalization')
#print(cm)
thresh = cm.max() / 2.
for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",
color="white" if cm[i, j] > thresh else "black")
plt.tight_layout()
plt.ylabel('True label')
plt.xlabel('Predicted label')
In [82]:
plt.figure(figsize=(8,8))
plot_confusion_matrix(cm,classes)
Confusion matrix, without normalization
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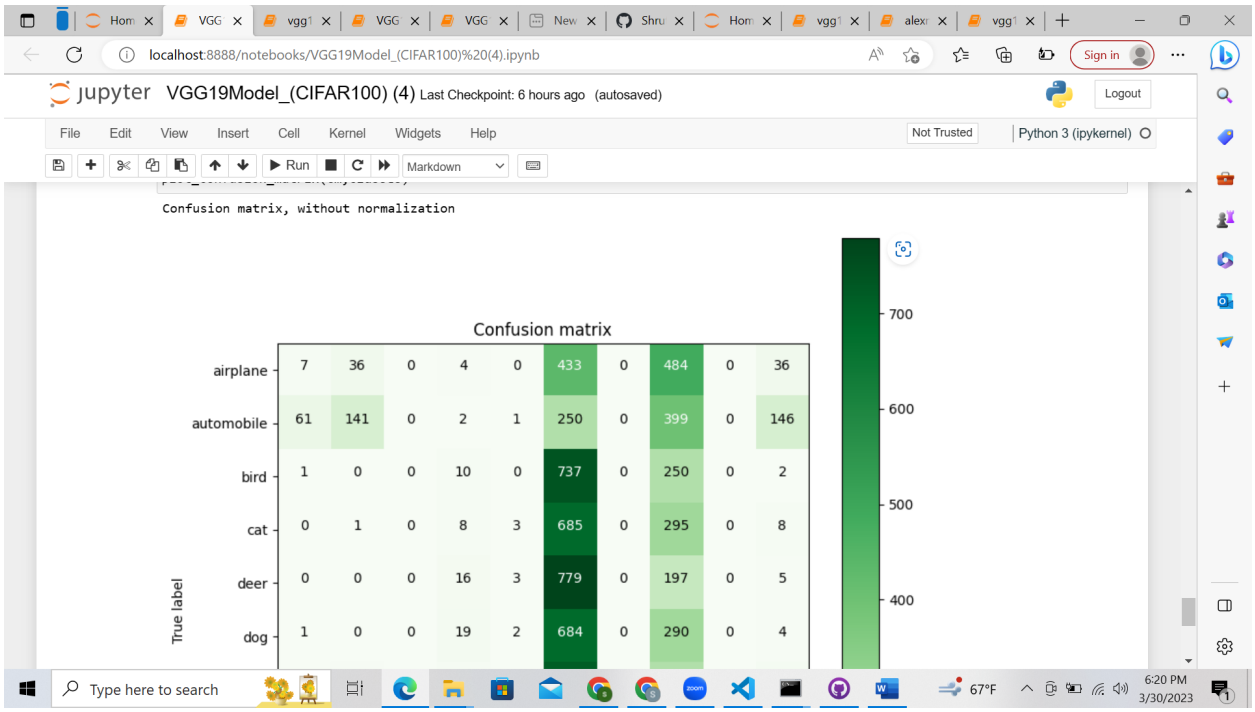
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Python 3 (ipykernel)
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Confusion matrix, without normalization
Confusion matrix
airplane 7 36 0 4 0 433 0 484 0 36
automobile 61 141 0 2 1 250 0 399 0 146
bird 1 0 0 10 0 737 0 250 0 2
cat 0 1 0 8 3 685 0 295 0 8
deer 0 0 0 16 3 779 0 197 0 5
dog 1 0 0 19 2 684 0 290 0 4
True label
700
600
500
400
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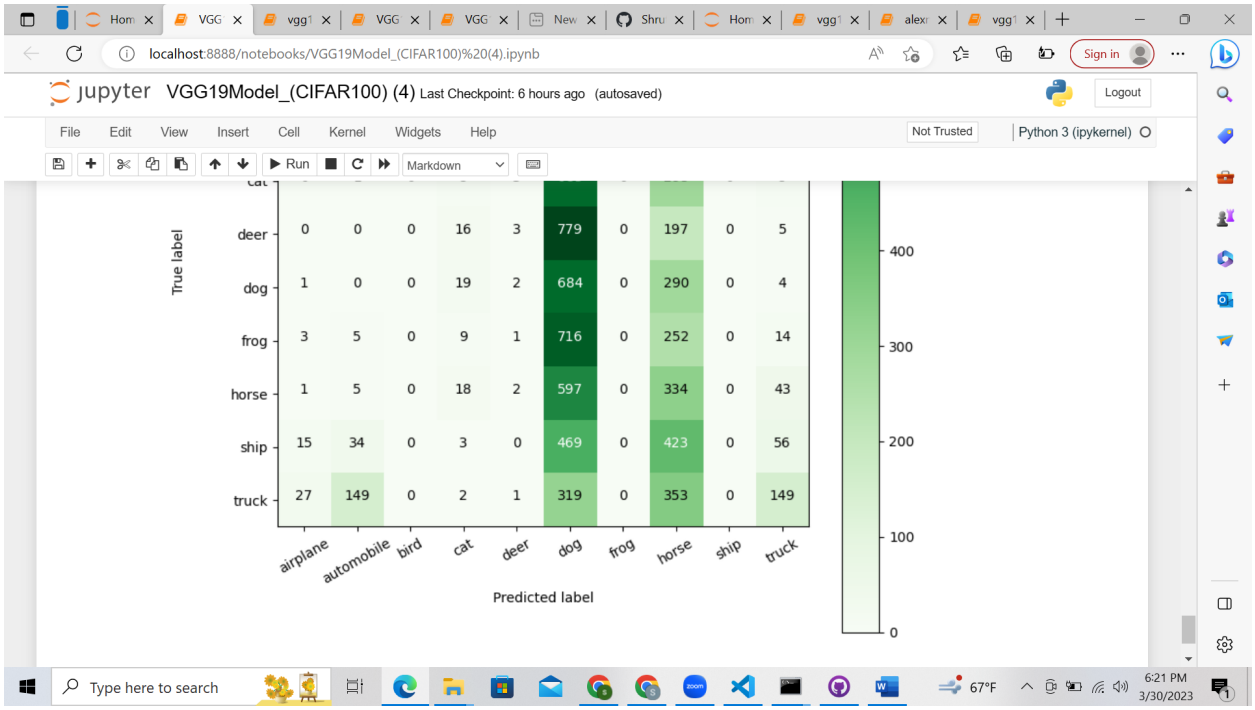
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Python 3 (ipykernel)
Run
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True label
deer 0 0 0 16 3 779 0 197 0 5
dog 1 0 0 19 2 684 0 290 0 4
frog 3 5 0 9 1 716 0 252 0 14
horse 1 5 0 18 2 597 0 334 0 43
ship 15 34 0 3 0 469 0 423 0 56
truck 27 149 0 2 1 319 0 353 0 149
airplane automobile bird cat deer dog frog horse ship truck
Predicted label
400
300
200
100
0
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