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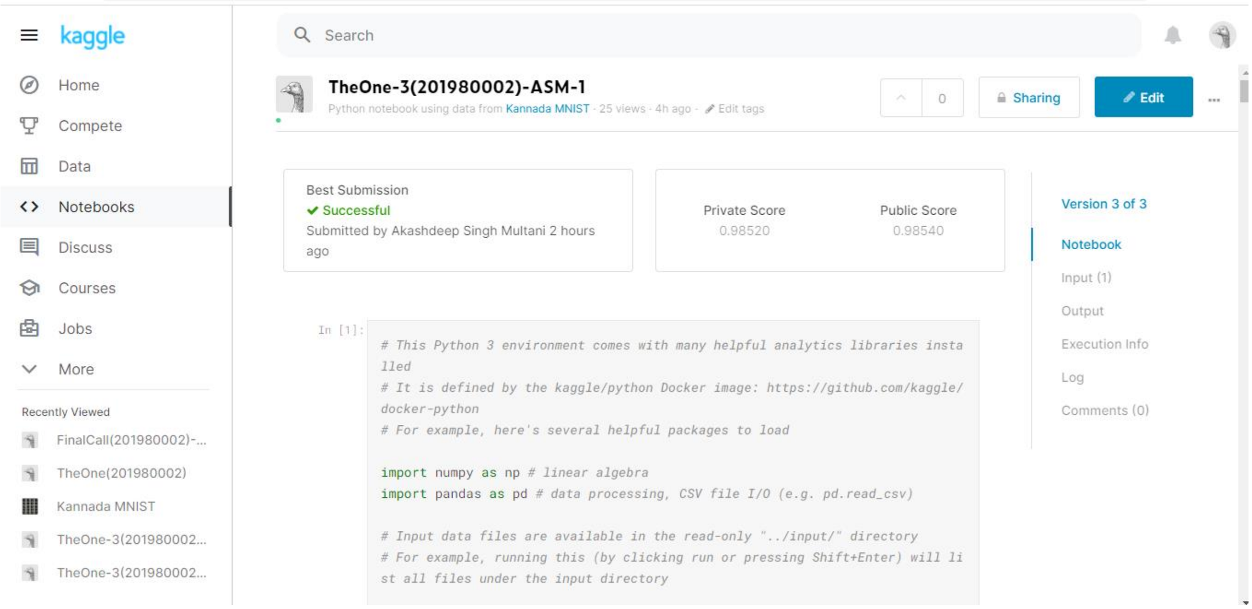
Roll No- 201980002

Class-MCA

Lab Evaluation-1

(Challenge-Kannada MNIST)

Code Snippet 1:



TheOne-3(201980002)-ASM-1

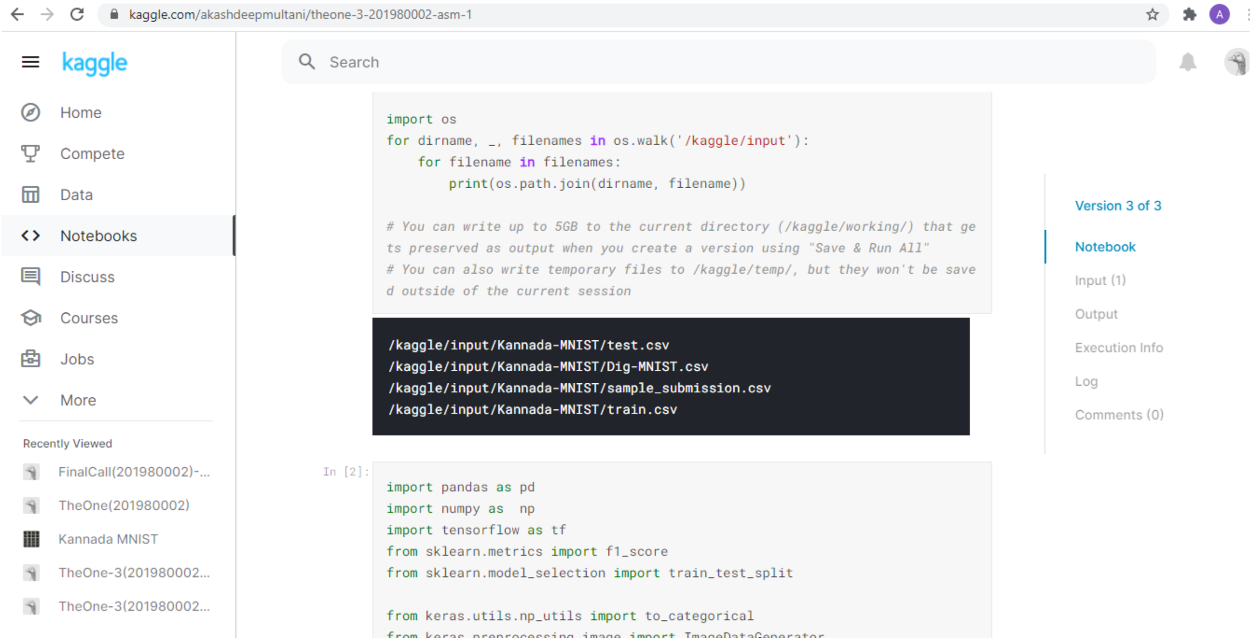
Python notebook using data from Kannada MNIST · 25 views · 4h ago · Edit tags

Best Submission
✓ Successful
Submitted by Akashdeep Singh Multani 2 hours ago

Private Score	Public Score
0.98520	0.98540

```
In [1]:
# This Python 3 environment comes with many helpful analytics libraries insta
lled
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/
docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will li
st all files under the input directory
```

- This snippet is the default importing which is done after we make a notebook for a particular challenge, in my case it is Kannada MNIST.



```
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 5GB to the current directory (/kaggle/working/) that ge
ts preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be save
d outside of the current session
```

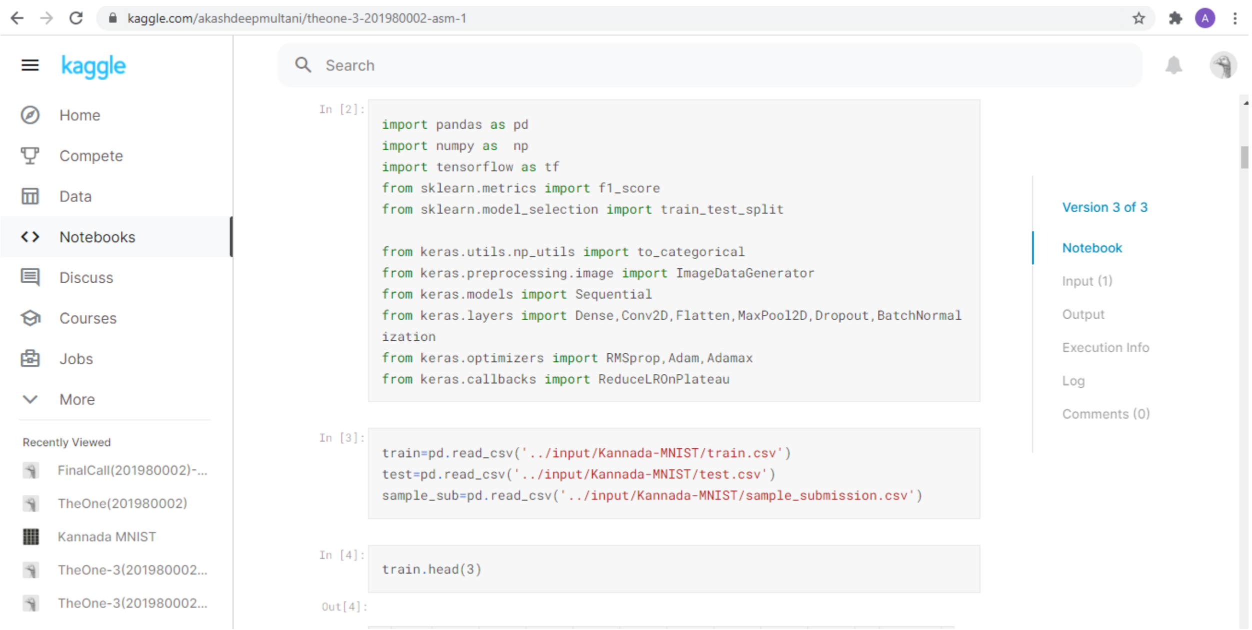
```
/kaggle/input/Kannada-MNIST/test.csv
/kaggle/input/Kannada-MNIST/Dig-MNIST.csv
/kaggle/input/Kannada-MNIST/sample_submission.csv
/kaggle/input/Kannada-MNIST/train.csv
```

In [2]:

```
import pandas as pd
import numpy as  np
import tensorflow as tf
from sklearn.metrics import f1_score
from sklearn.model_selection import train_test_split

from keras.utils.np_utils import to_categorical
from keras.preprocessing.image import ImageDataGenerator
```

- In this snippet necessary files for the challenge are imported by default.

Code Snippet 2:



```
import pandas as pd
import numpy as  np
import tensorflow as tf
from sklearn.metrics import f1_score
from sklearn.model_selection import train_test_split

from keras.utils.np_utils import to_categorical
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Dense,Conv2D,Flatten,MaxPool2D,Dropout,BatchNormal
ization
from keras.optimizers import RMSprop,Adam,Adamax
from keras.callbacks import ReduceLROnPlateau
```

```
train=pd.read_csv('../input/Kannada-MNIST/train.csv')
test=pd.read_csv('../input/Kannada-MNIST/test.csv')
sample_sub=pd.read_csv('../input/Kannada-MNIST/sample_submission.csv')
```

```
train.head(3)
```

- In this snippet I have imported pandas as pd means we will use the pandas as the name pd for the reference and this is needed for reading the '.csv' files.

- Then I have imported numpy as np for the tasks related to arrays .

- Then I have imported train_test_split which will be used afterwards for the splitting of training and testing set.

- Then I have imported to_categorical to convert the dataset values to 'one-hot vector'.

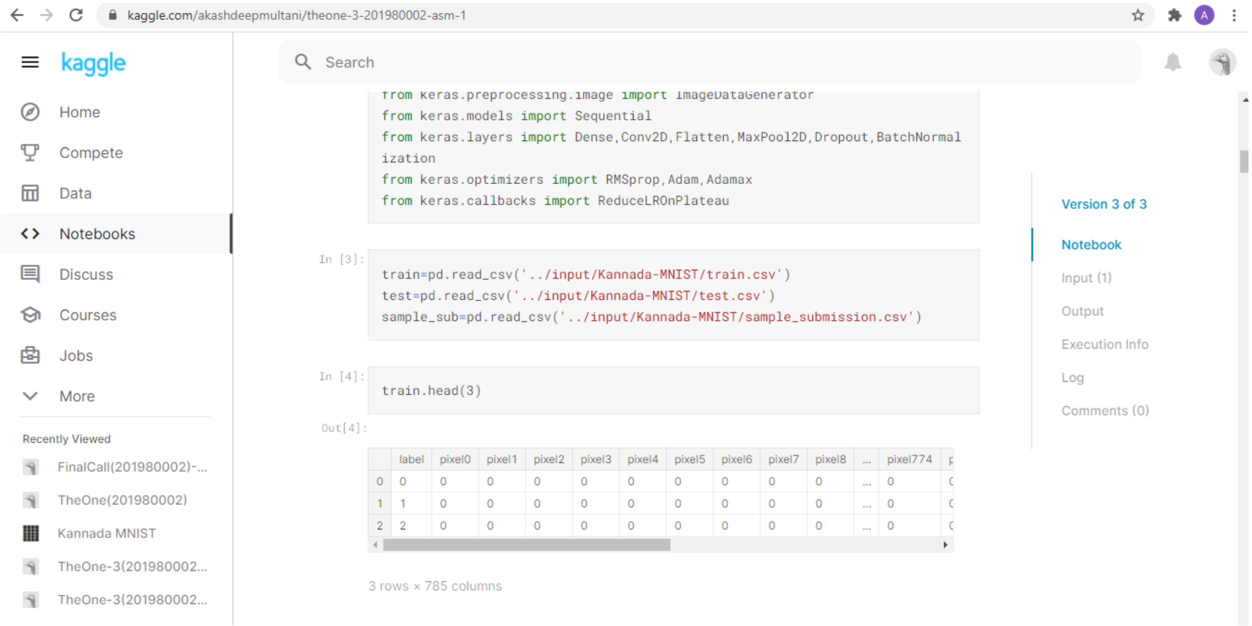
- ImageDataGenerator is imported for the preprocessing on the dataset.

- Sequential is imported for the model that will have one layer after another and so on for the rest of layers in the model.

- Conv2D is imported for the 2-dimensional convolution layers.
- Dense is the fully connected neural network layer, each input node is connected to each output node.
- Maxpooling2D is used for selecting the maximum value out of 2*2 matrix which applied on the input.
- Dropout is used for discontinuing some links according to values provided to dropout for eliminating over-fitting.
- BatchNormalization is the normalization which is applied on the batches which will normalize the values of the dataset such that no particular value in the dataset can counter-part another on the basis of more values.

- Adam optimizer is used for minimizing the loss such that difference between actual and predicted values is small.

- Then I have imported ‘ReduceLROnPleateau’ which will adjust the learning rate according to the height or slope.



```
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Dense,Conv2D,Flatten,MaxPool2D,Dropout,BatchNormal
ization
from keras.optimizers import RMSprop,Adam,Adamax
from keras.callbacks import ReduceLROnPlateau
```

In [3]:

```
train=pd.read_csv('../input/Kannada-MNIST/train.csv')
test=pd.read_csv('../input/Kannada-MNIST/test.csv')
sample_sub=pd.read_csv('../input/Kannada-MNIST/sample_submission.csv')
```

In [4]:

```
train.head(3)
```

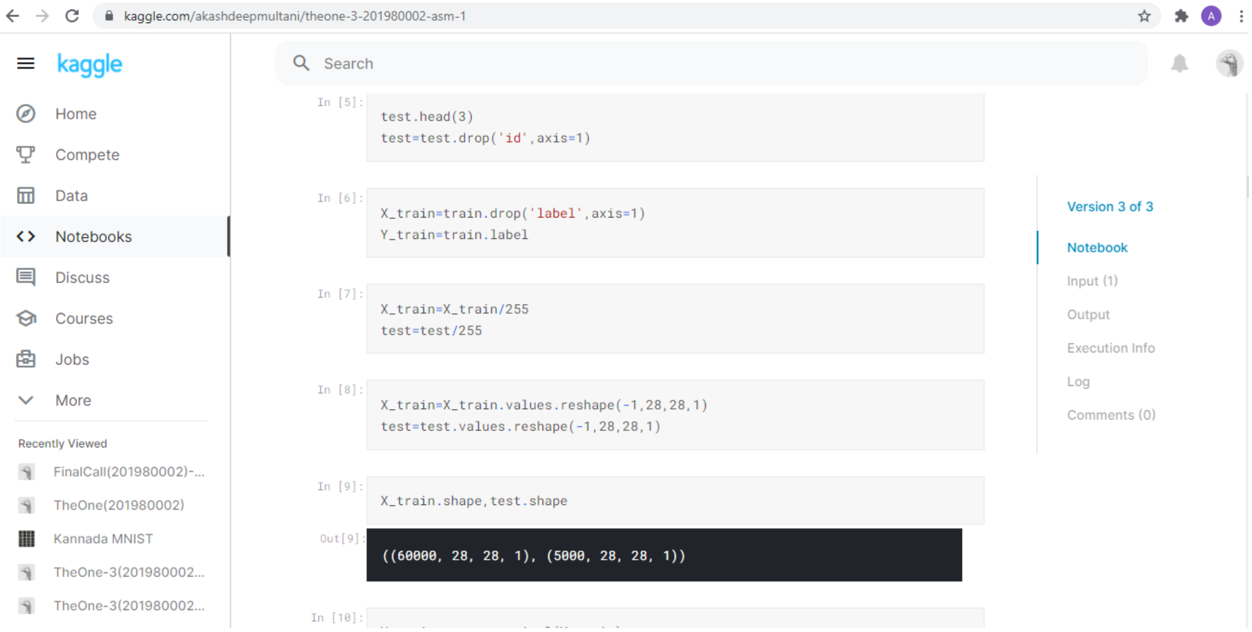
Out[4]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	...	pixel774
0	0	0	0	0	0	0	0	0	0	0	...	0
1	1	0	0	0	0	0	0	0	0	0	...	0
2	2	0	0	0	0	0	0	0	0	0	...	0

3 rows × 785 columns

- In this first of all I have looked upon the training set about the values it contains by head function which will return only that row values which I specify in the brackets. Here I have specified 3 so first three rows is fetched and shown.

Code Snippet 3:



```
In [5]:
test.head(3)
test=test.drop('id',axis=1)

In [6]:
X_train=train.drop('label',axis=1)
Y_train=train.label

In [7]:
X_train=X_train/255
test=test/255

In [8]:
X_train=X_train.values.reshape(-1,28,28,1)
test=test.values.reshape(-1,28,28,1)

In [9]:
X_train.shape,test.shape

Out[9]:
((60000, 28, 28, 1), (5000, 28, 28, 1))

In [10]:
```

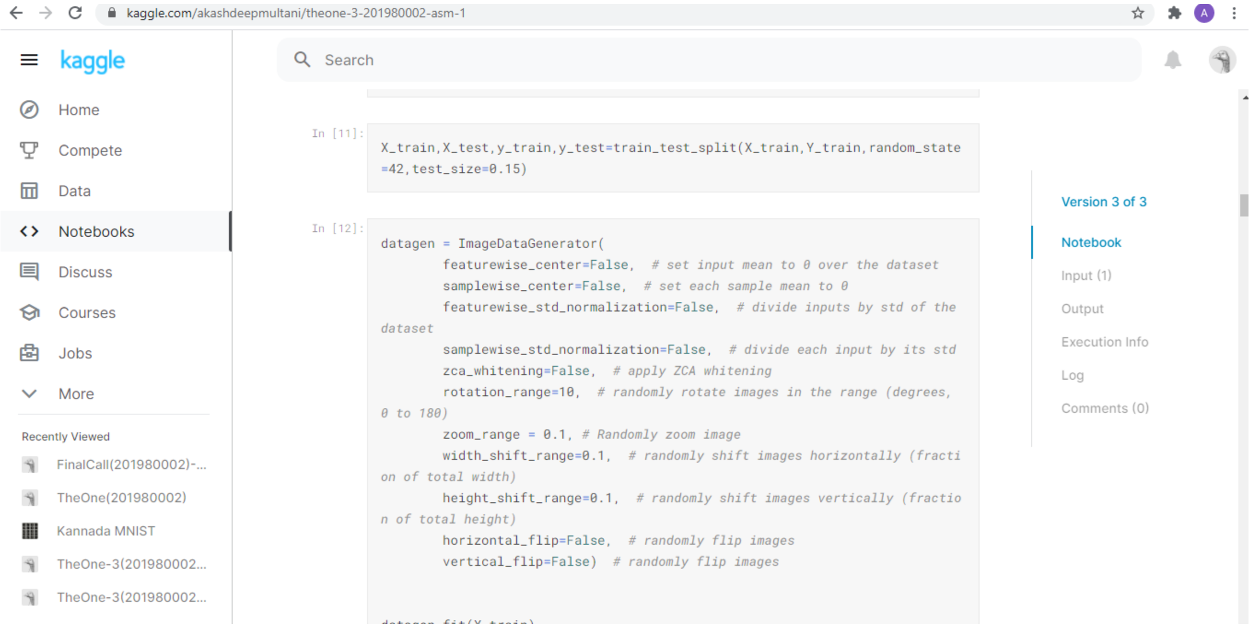
- Next I have dropped the ‘Id’ column which is not needed or contributing to the task assigned or challenge assigned. Here only ‘label’ is the column which will be predicted according to the challenge whether the image is related to that particular Kannnada character or not.

- As according to the challenge we need ‘label’ column for the testing purpose but not for training .So I have dropped the column ‘label’ here from the train set.

- Next I have normalized the X_train and test values.

- Here first the dimensionality is changed for X_train and test for the convenience that images should focus more on the data in the image that is character in the image not on whole image.

Code Snippet 4:



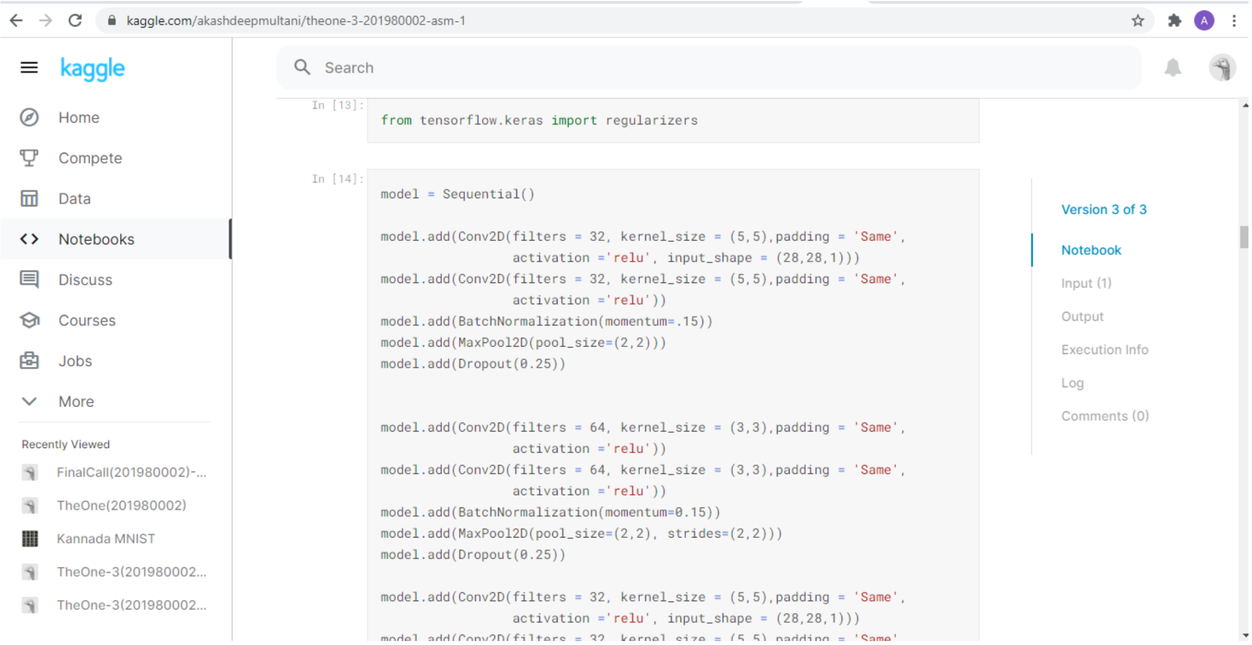
```
X_train,X_test,y_train,y_test=train_test_split(X_train,Y_train,random_state
=42,test_size=0.15)
```

```
datagen = ImageDataGenerator(
        featurewise_center=False,  # set input mean to 0 over the dataset
        samplewise_center=False,  # set each sample mean to 0
        featurewise_std_normalization=False,  # divide inputs by std of the
dataset
        samplewise_std_normalization=False,  # divide each input by its std
        zca_whitening=False,  # apply ZCA whitening
        rotation_range=10,  # randomly rotate images in the range (degrees,
0 to 180)
        zoom_range = 0.1, # Randomly zoom image
        width_shift_range=0.1,  # randomly shift images horizontally (fracti
on of total width)
        height_shift_range=0.1,  # randomly shift images vertically (fractio
n of total height)
        horizontal_flip=False,  # randomly flip images
        vertical_flip=False)  # randomly flip images


datagen.fit(X_train)
```

- Then training set and testing set is splitted from the original train set and 15% of data values are given to the test set and remaining to train set.

- Then here data preprocessing is done such that the number of imges on which model is to be trained increases which subsequently increases the more precise prediction for the dataset.

Code Snippet 5:



```
In [13]:
from tensorflow.keras import regularizers
```

```
In [14]:
model = Sequential()

model.add(Conv2D(filters = 32, kernel_size = (5,5),padding = 'Same',
                 activation ='relu', input_shape = (28,28,1)))
model.add(Conv2D(filters = 32, kernel_size = (5,5),padding = 'Same',
                 activation ='relu'))
model.add(BatchNormalization(momentum=.15))
model.add(MaxPool2D(pool_size=(2,2)))
model.add(Dropout(0.25))


model.add(Conv2D(filters = 64, kernel_size = (3,3),padding = 'Same',
                 activation ='relu'))
model.add(Conv2D(filters = 64, kernel_size = (3,3),padding = 'Same',
                 activation ='relu'))
model.add(BatchNormalization(momentum=0.15))
model.add(MaxPool2D(pool_size=(2,2), strides=(2,2)))
model.add(Dropout(0.25))

model.add(Conv2D(filters = 32, kernel_size = (5,5),padding = 'Same',
                 activation ='relu', input_shape = (28,28,1)))
model.add(Conv2D(filters = 32, kernel_size = (5,5),padding = 'Same'
```

- Here I have imported regularizers for preventing overfitting when the model is trained.
- Then here sequential function is used for layer by layer arrangement in sequential manner.

- In Conv2D I have used initially filters=32, it means it learns 32 filters first.
- Then model learns 64 filters.

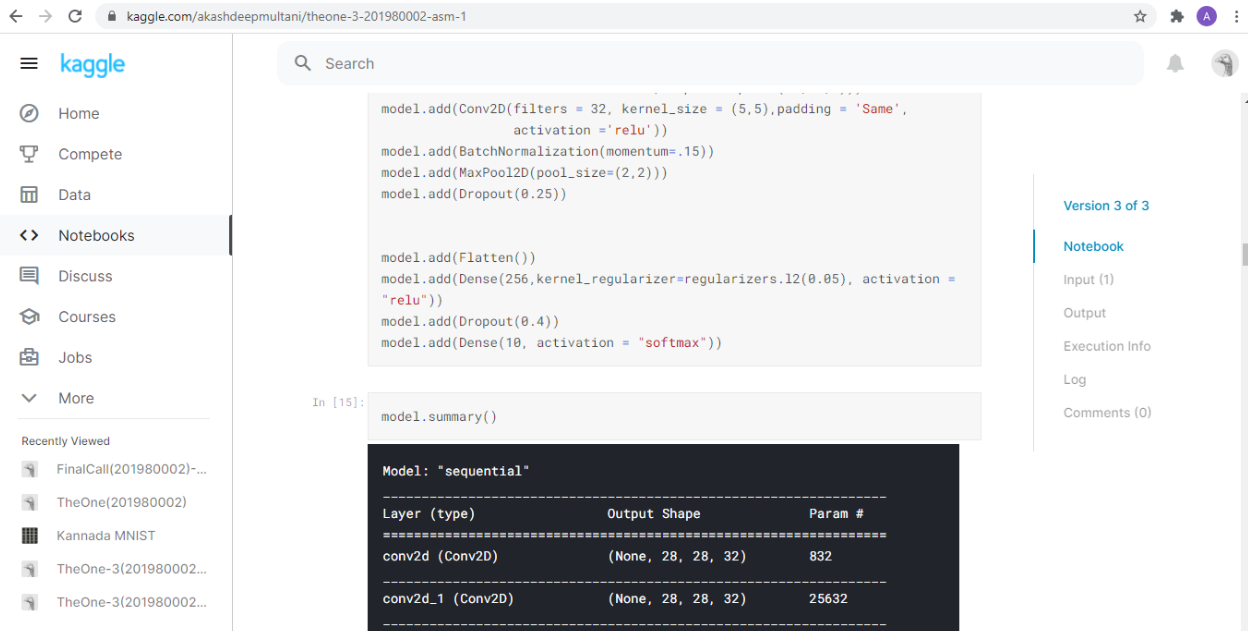
- Kernel_size means how much size of convolution or kernel should be applied on image.
- Here I have use height=5 and width=5.

- Padding=”same” means original dimension of the image will remain conserve after applying filter.

- Here batch normalization is used for standardizing the inputs and momentum is the “lag” in learning mean and variance, so that noise due to mini-batch can be ignored.

- MaxPool2D is used to select one maximum value out of 2*2 matrix when filter is applied to image.

- Dropout Regularization is used to reduce over fitting.



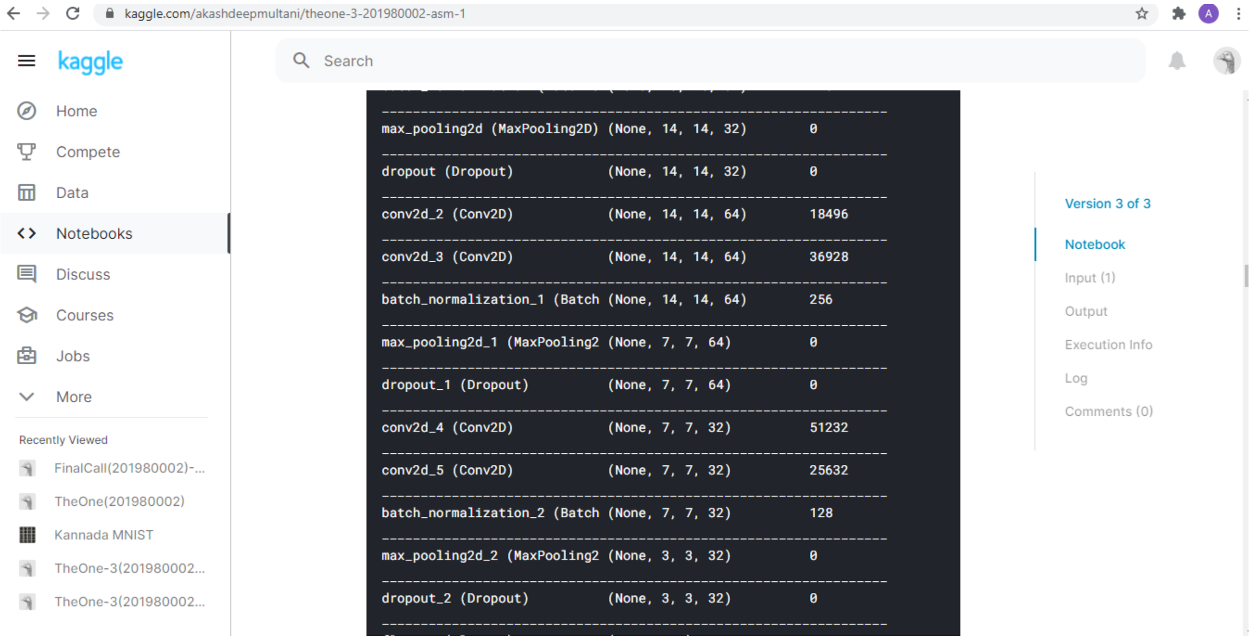
```
model.add(Conv2D(filters = 32, kernel_size = (5,5),padding = 'Same',
                 activation ='relu'))
model.add(BatchNormalization(momentum=.15))
model.add(MaxPool2D(pool_size=(2,2)))
model.add(Dropout(0.25))


model.add(Flatten())
model.add(Dense(256,kernel_regularizer=regularizers.l2(0.05), activation =
"relu"))
model.add(Dropout(0.4))
model.add(Dense(10, activation = "softmax"))
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 28, 28, 32)        832
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 28, 28, 32)        25632
_________________________________________________________________
```

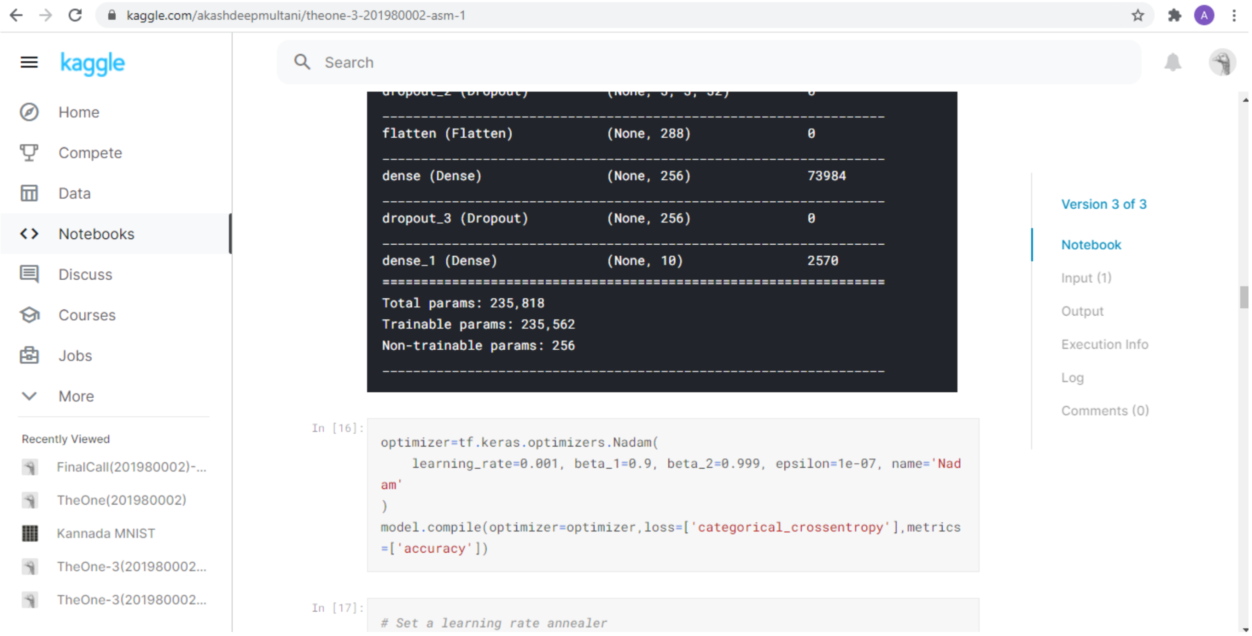
- Flatten function will convert multidimensional tensor to single 1D tensor.

Code Snippet 6:



```
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 14, 14, 32)        0
_________________________________________________________________
dropout (Dropout)            (None, 14, 14, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 14, 14, 64)        18496
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 14, 14, 64)        36928
_________________________________________________________________
batch_normalization_1 (Batch (None, 14, 14, 64)        256
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 7, 7, 64)          0
_________________________________________________________________
dropout_1 (Dropout)          (None, 7, 7, 64)          0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 7, 7, 32)          51232
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 7, 7, 32)          25632
_________________________________________________________________
batch_normalization_2 (Batch (None, 7, 7, 32)          128
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 3, 3, 32)          0
_________________________________________________________________
dropout_2 (Dropout)          (None, 3, 3, 32)          0
_________________________________________________________________
```

Code Snippet 7:



```
dropout_2 (Dropout)          (None, 3, 3, 32)          0
_________________________________________________________________
flatten (Flatten)            (None, 288)               0
_________________________________________________________________
dense (Dense)                (None, 256)               73984
_________________________________________________________________
dropout_3 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_1 (Dense)              (None, 10)                2570
=================================================================
Total params: 235,818
Trainable params: 235,562
Non-trainable params: 256
_________________________________________________________________
```

In [16]:

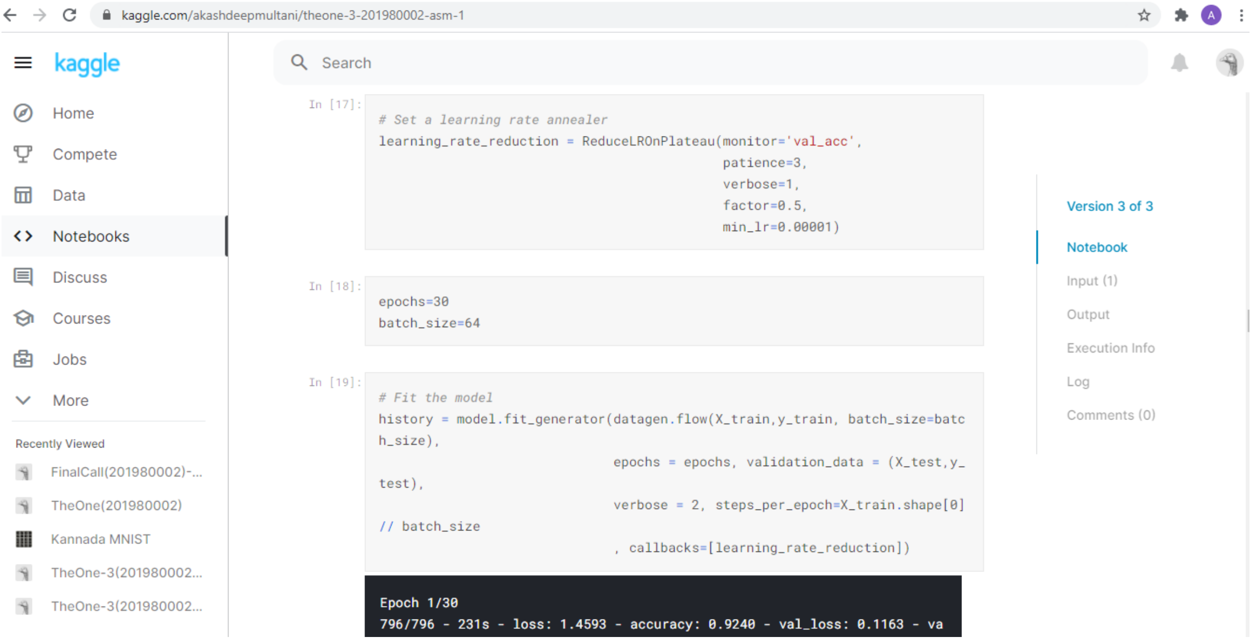
```
optimizer=tf.keras.optimizers.Nadam(
    learning_rate=0.001, beta_1=0.9, beta_2=0.999, epsilon=1e-07, name='Nad
am'
)
model.compile(optimizer=optimizer,loss=['categorical_crossentropy'],metrics
=['accuracy'])
```

In [17]:

```
# Set a learning rate annealer
```

- Dense layer will multiply input tensor that is 256 in my case is multiplied to weight of dense layer that is 10 in my case plus bias which leads to (2560+10)=2570.
- It connects neurons in one layer to neurons in another layer. It is used to classify images between different category by training.

- In this snippet I have used **‘Nadam’** as the optimizer to reduce the loss i.e difference between actual and predicted values because it converges to the global minima with the fastest speed as compared to other and also efficient.
- **Categorical Crossentropy** is used as the loss because of multiclass classification as in my case there are 10 classes.



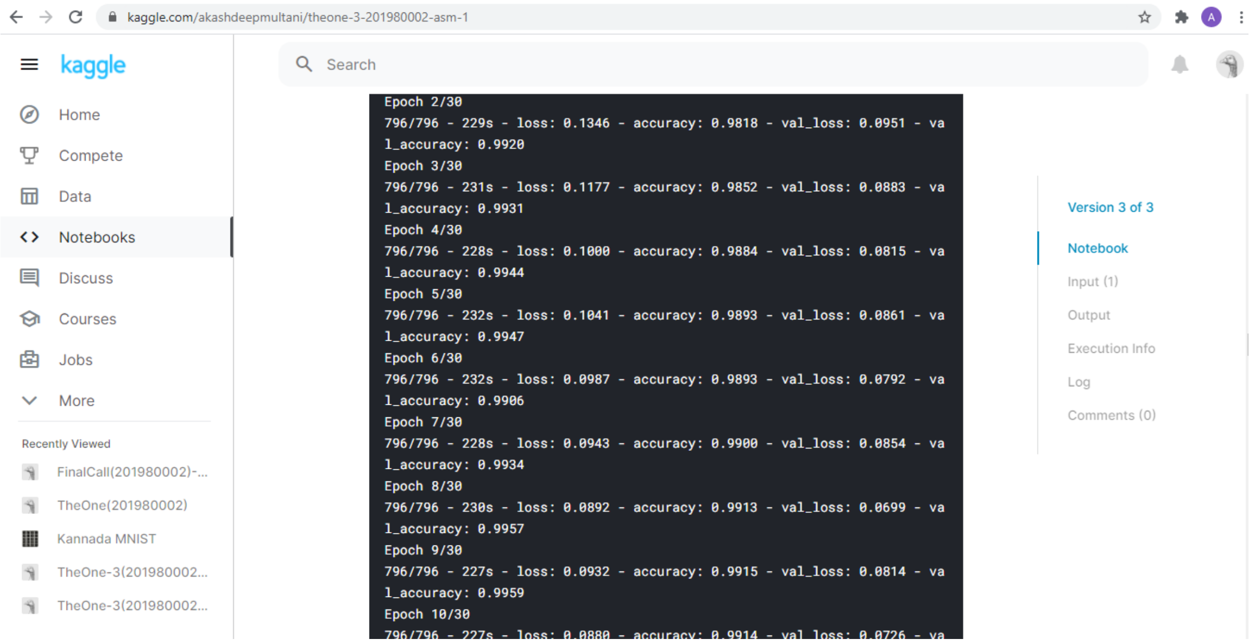
```
# Set a learning rate annealer
learning_rate_reduction = ReduceLROnPlateau(monitor='val_acc',
                                            patience=3,
                                            verbose=1,
                                            factor=0.5,
                                            min_lr=0.00001)
```

```
epochs=30
batch_size=64
```

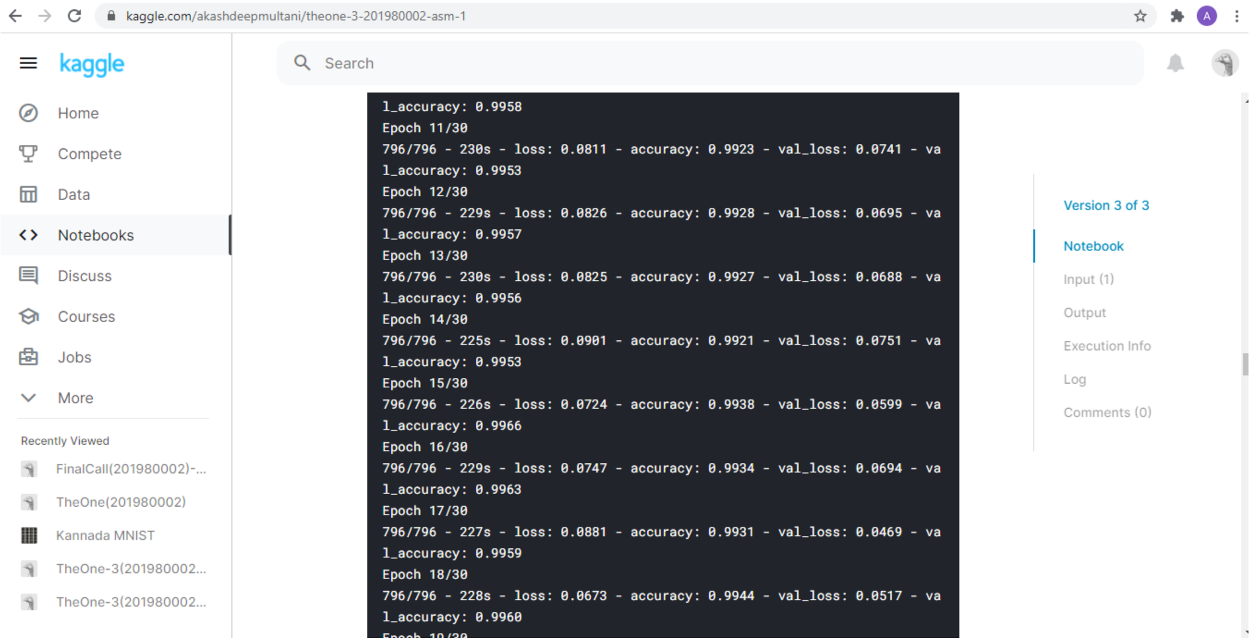
```
# Fit the model
history = model.fit_generator(datagen.flow(X_train,y_train, batch_size=batc
h_size),
                              epochs = epochs, validation_data = (X_test,y_
test),
                              verbose = 2, steps_per_epoch=X_train.shape[0]
// batch_size
                              , callbacks=[learning_rate_reduction])
```

```
Epoch 1/30
796/796 - 231s - loss: 1.4593 - accuracy: 0.9240 - val_loss: 0.1163 - va
```

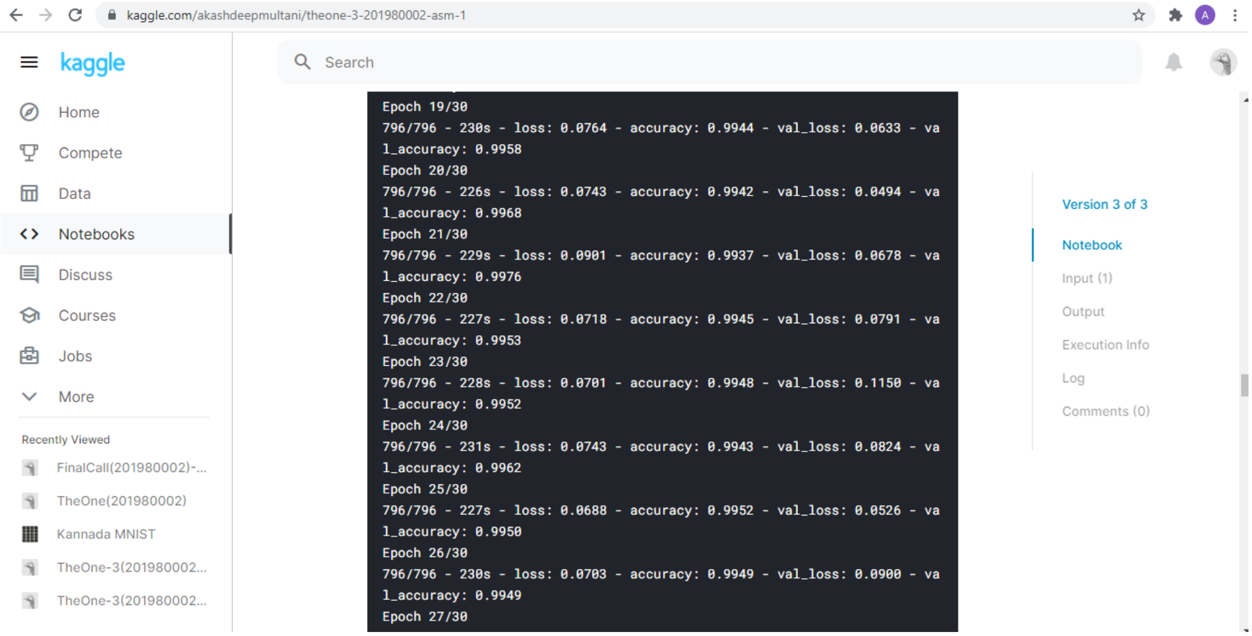
- Then I have fitted the model with my preprocessed data and with epochs=30 and batch_size=64.



```
Epoch 2/30
796/796 - 229s - loss: 0.1346 - accuracy: 0.9818 - val_loss: 0.0951 - va
l_accuracy: 0.9920
Epoch 3/30
796/796 - 231s - loss: 0.1177 - accuracy: 0.9852 - val_loss: 0.0883 - va
l_accuracy: 0.9931
Epoch 4/30
796/796 - 228s - loss: 0.1000 - accuracy: 0.9884 - val_loss: 0.0815 - va
l_accuracy: 0.9944
Epoch 5/30
796/796 - 232s - loss: 0.1041 - accuracy: 0.9893 - val_loss: 0.0861 - va
l_accuracy: 0.9947
Epoch 6/30
796/796 - 232s - loss: 0.0987 - accuracy: 0.9893 - val_loss: 0.0792 - va
l_accuracy: 0.9906
Epoch 7/30
796/796 - 228s - loss: 0.0943 - accuracy: 0.9900 - val_loss: 0.0854 - va
l_accuracy: 0.9934
Epoch 8/30
796/796 - 230s - loss: 0.0892 - accuracy: 0.9913 - val_loss: 0.0699 - va
l_accuracy: 0.9957
Epoch 9/30
796/796 - 227s - loss: 0.0932 - accuracy: 0.9915 - val_loss: 0.0814 - va
l_accuracy: 0.9959
Epoch 10/30
796/796 - 227s - loss: 0.0880 - accuracy: 0.9914 - val_loss: 0.0726 - va
```

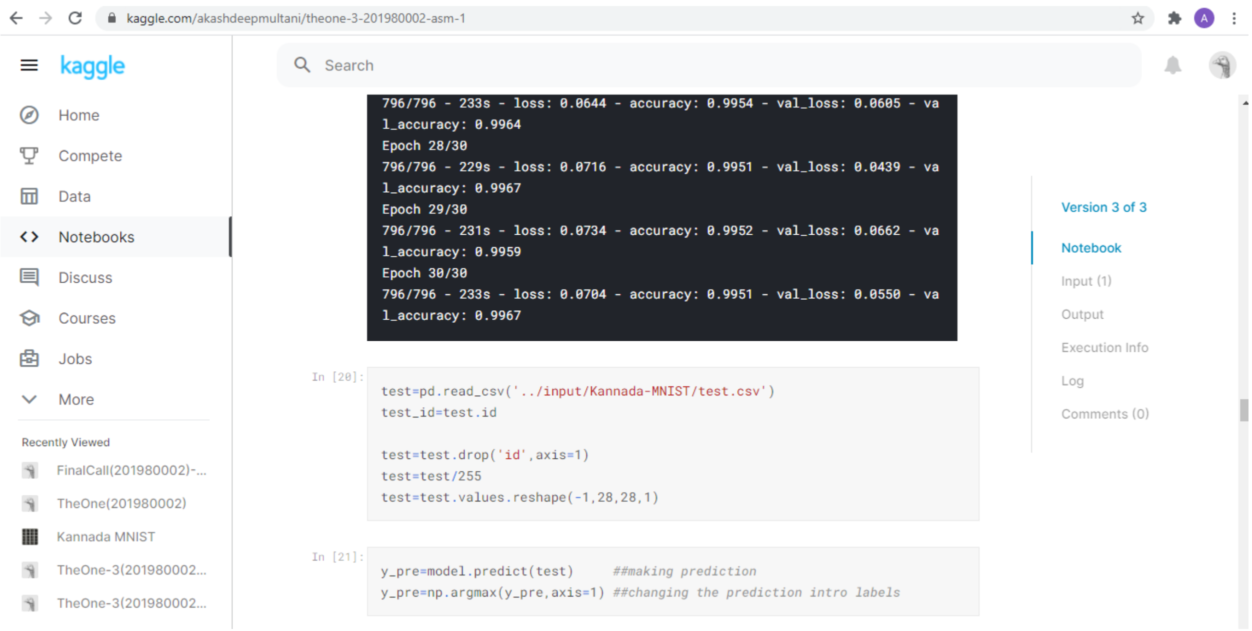


```
l_accuracy: 0.9958
Epoch 11/30
796/796 - 230s - loss: 0.0811 - accuracy: 0.9923 - val_loss: 0.0741 - va
l_accuracy: 0.9953
Epoch 12/30
796/796 - 229s - loss: 0.0826 - accuracy: 0.9928 - val_loss: 0.0695 - va
l_accuracy: 0.9957
Epoch 13/30
796/796 - 230s - loss: 0.0825 - accuracy: 0.9927 - val_loss: 0.0688 - va
l_accuracy: 0.9956
Epoch 14/30
796/796 - 225s - loss: 0.0901 - accuracy: 0.9921 - val_loss: 0.0751 - va
l_accuracy: 0.9953
Epoch 15/30
796/796 - 226s - loss: 0.0724 - accuracy: 0.9938 - val_loss: 0.0599 - va
l_accuracy: 0.9966
Epoch 16/30
796/796 - 229s - loss: 0.0747 - accuracy: 0.9934 - val_loss: 0.0694 - va
l_accuracy: 0.9963
Epoch 17/30
796/796 - 227s - loss: 0.0881 - accuracy: 0.9931 - val_loss: 0.0469 - va
l_accuracy: 0.9959
Epoch 18/30
796/796 - 228s - loss: 0.0673 - accuracy: 0.9944 - val_loss: 0.0517 - va
l_accuracy: 0.9960
Epoch 19/30
```



```
Epoch 19/30
796/796 - 230s - loss: 0.0764 - accuracy: 0.9944 - val_loss: 0.0633 - va
l_accuracy: 0.9958
Epoch 20/30
796/796 - 226s - loss: 0.0743 - accuracy: 0.9942 - val_loss: 0.0494 - va
l_accuracy: 0.9968
Epoch 21/30
796/796 - 229s - loss: 0.0901 - accuracy: 0.9937 - val_loss: 0.0678 - va
l_accuracy: 0.9976
Epoch 22/30
796/796 - 227s - loss: 0.0718 - accuracy: 0.9945 - val_loss: 0.0791 - va
l_accuracy: 0.9953
Epoch 23/30
796/796 - 228s - loss: 0.0701 - accuracy: 0.9948 - val_loss: 0.1150 - va
l_accuracy: 0.9952
Epoch 24/30
796/796 - 231s - loss: 0.0743 - accuracy: 0.9943 - val_loss: 0.0824 - va
l_accuracy: 0.9962
Epoch 25/30
796/796 - 227s - loss: 0.0688 - accuracy: 0.9952 - val_loss: 0.0526 - va
l_accuracy: 0.9950
Epoch 26/30
796/796 - 230s - loss: 0.0703 - accuracy: 0.9949 - val_loss: 0.0900 - va
l_accuracy: 0.9949
Epoch 27/30
```

Code Snippet 8:



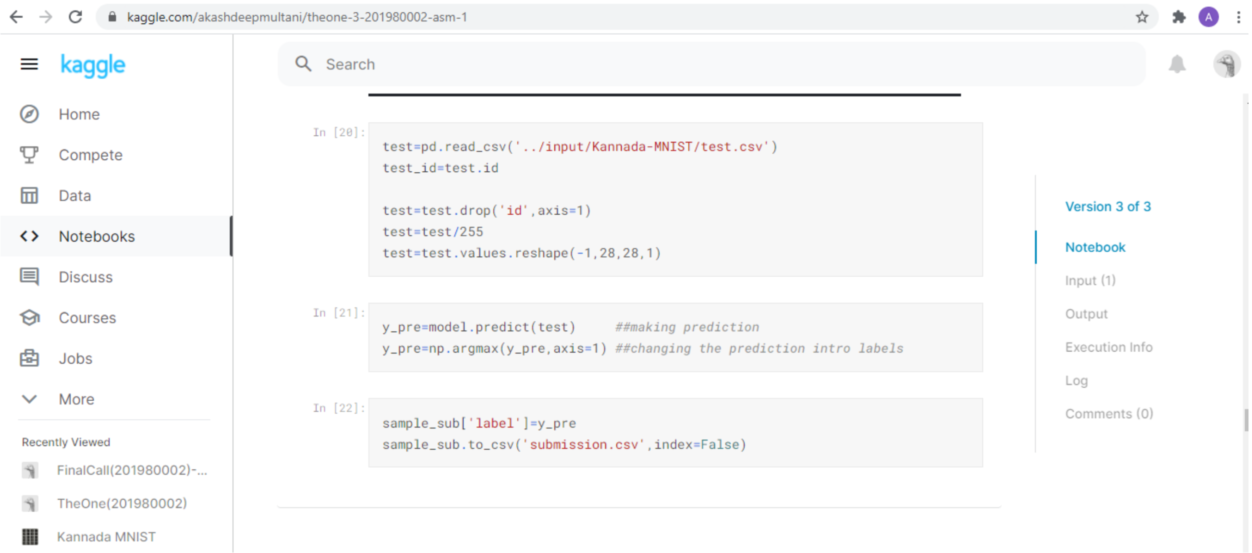
```
796/796 - 233s - loss: 0.0644 - accuracy: 0.9954 - val_loss: 0.0605 - va
l_accuracy: 0.9964
Epoch 28/30
796/796 - 229s - loss: 0.0716 - accuracy: 0.9951 - val_loss: 0.0439 - va
l_accuracy: 0.9967
Epoch 29/30
796/796 - 231s - loss: 0.0734 - accuracy: 0.9952 - val_loss: 0.0662 - va
l_accuracy: 0.9959
Epoch 30/30
796/796 - 233s - loss: 0.0704 - accuracy: 0.9951 - val_loss: 0.0550 - va
l_accuracy: 0.9967
```

```
test=pd.read_csv('../input/Kannada-MNIST/test.csv')
test_id=test.id

test=test.drop('id',axis=1)
test=test/255
test=test.values.reshape(-1,28,28,1)
```

```
y_pre=model.predict(test)     ##making prediction
y_pre=np.argmax(y_pre,axis=1) ##changing the prediction intro labels
```

- Here I have used pandas for reading the csv file i.e test.csv.
- Here test.csv contains column ‘id’ which is removed from test.csv file.
- And then reshaping the test.csv file values for making the dimensionality same for submitting to Kaggle.

Code Snippet 9:



In [20]:

```
test=pd.read_csv('../input/Kannada-MNIST/test.csv')
test_id=test.id

test=test.drop('id',axis=1)
test=test/255
test=test.values.reshape(-1,28,28,1)
```

In [21]:

```
y_pre=model.predict(test)     ##making prediction
y_pre=np.argmax(y_pre,axis=1) ##changing the prediction intro labels
```

In [22]:

```
sample_sub['label']=y_pre
sample_sub.to_csv('submission.csv',index=False)
```

- Here predict function is used for making the prediction.
- np.argmax is used here for getting the maximum value from the prediction.
- Then submission is done for the evaluation on Kaggle.