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Performance Analysis (sprint-3)

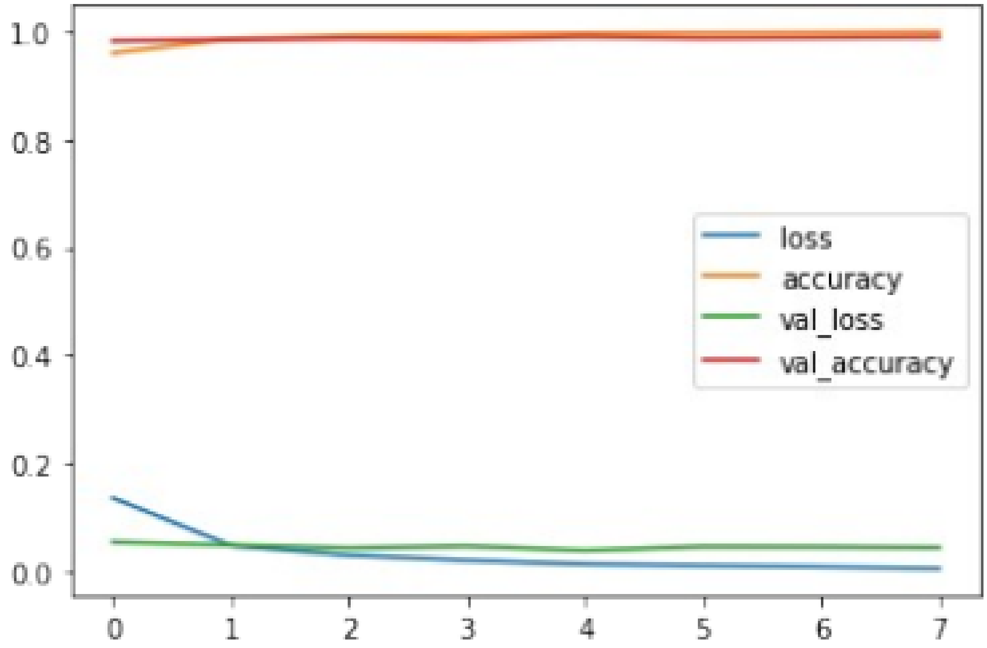
(i).Performance Analysis

```
metrics = pd.DataFrame(model.history.history) metrics
```

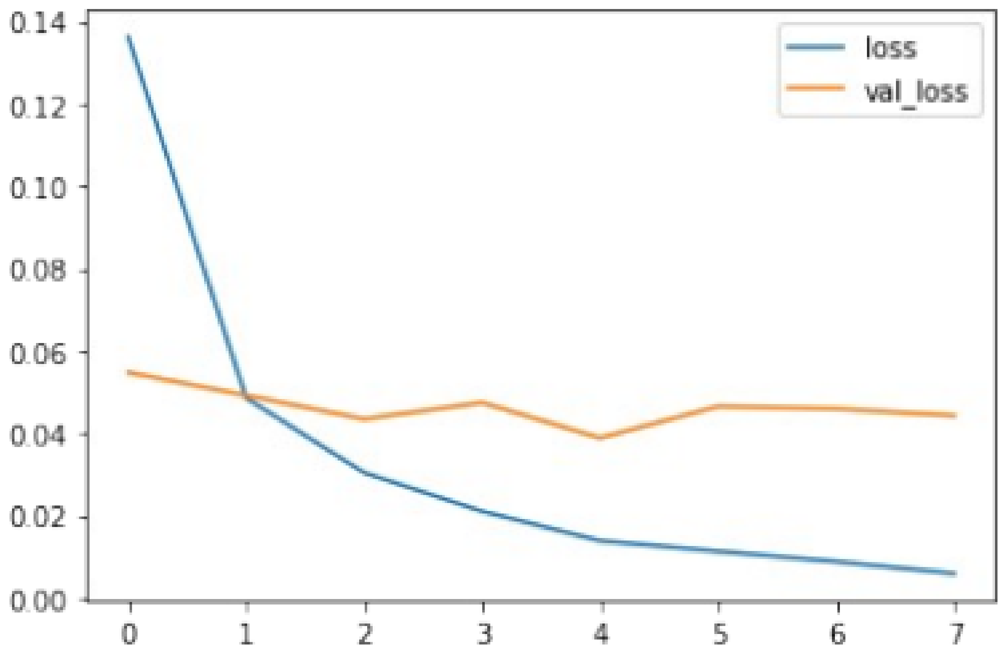
```
 loss accuracy val_loss val_accuracy 0 0.136240 0.959183
0.054753 0.9811 1 0.048557 0.985233 0.049157 0.9839 2
0.030406 0.990800 0.043443 0.9861 3 0.020990 0.993350
0.047409 0.9850 4 0.013883 0.995450 0.038858 0.9890 5
0.011308 0.996183 0.046504 0.9865 6 0.008813 0.996933
0.045933 0.9875 7 0.005928 0.997917 0.044267 0.9886
```

```
metrics.plot()
```

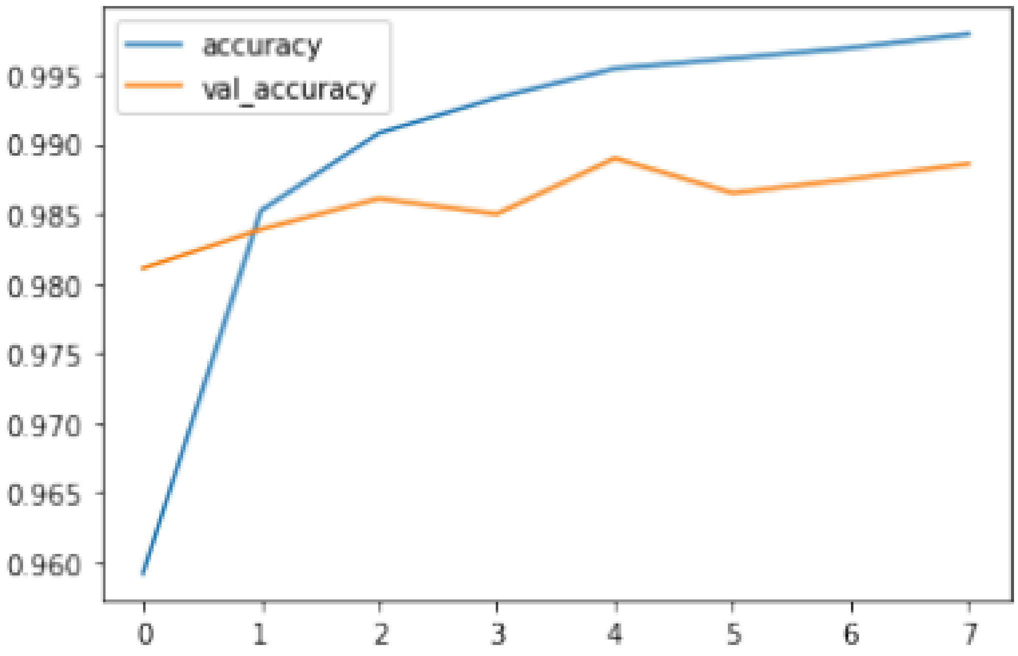
```
<matplotlib.axes._subplots.AxesSubplot            at            0x7f9be00620d0>
```



```
metrics[['loss','val_loss']].plot()
<matplotlib.axes._subplots.AxesSubplot at 0x7f9b8a38eb90>
```



```
metrics[['accuracy','val_accuracy']].plot()
<matplotlib.axes._subplots.AxesSubplot at 0x7f9b8a2a36d0>
```



(ii).Evaluate the Model

```
model.evaluate(x_test,y_cat_test,verbose=0)
 #loss | #accuracy

 [0.04426722601056099, 0.9886000156402588]
                from sklearn.metrics import classification_report,confusion_matrix
```

```
predict_x=model.predict(x_test)
classes_x=np.argmax(predict_x,axis=1)
```

```
313/313 [==============================] - 1s 2ms/step
```

```
print(classification_report(y_test,classes_x))
```

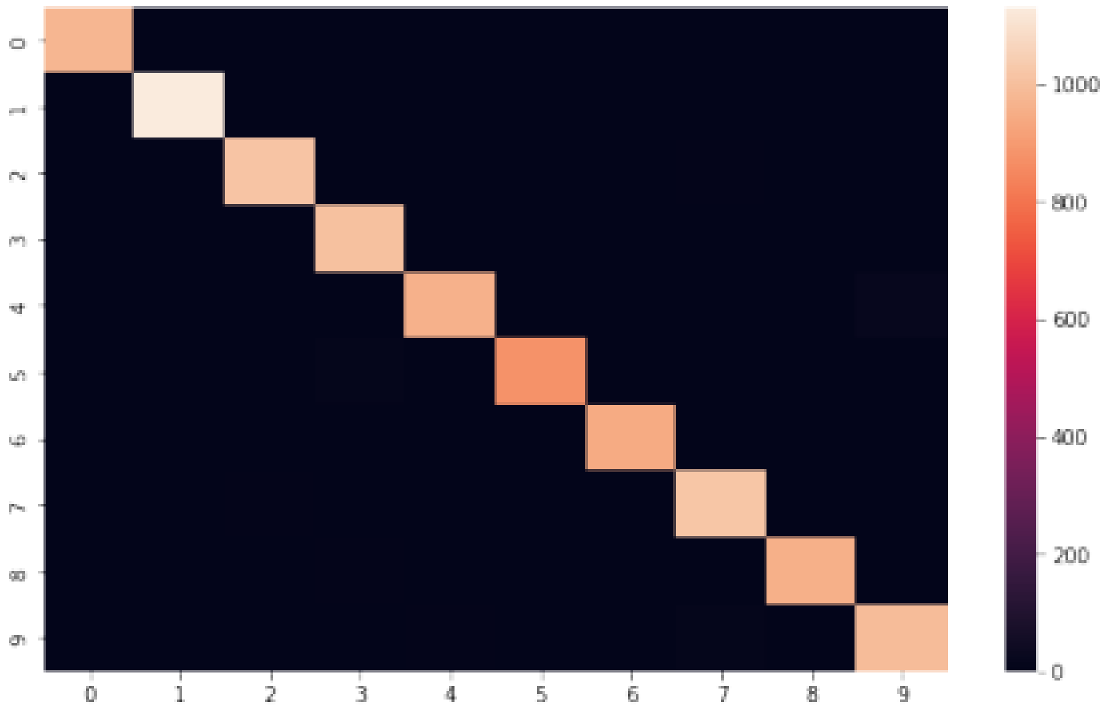
```
 precision recall f1-score support

 0 0.99 1.00 0.99 980  1 0.99 1.00 1.00 1135  2 0.99 0.99 0.99 1032  3
0.98 1.00 0.99 1010  4 0.99 0.98 0.99 982  5 1.00 0.99 0.99 892  6 0.99
0.98 0.99 958  7 0.98 0.99 0.99 1028  8 0.99 0.98 0.99 974  9 0.98 0.98
0.98 1009

 accuracy 0.99 10000   macro avg 0.99 0.99 0.99 10000 weighted avg
0.99 0.99 0.99 10000
```

```
print(confusion_matrix(y_test,classes_x))
```

```
 [[ 977 0 0 1 0 0 1 0 1 0]  [ 0 1132 1 2 0 0 0 0 0 0]  [ 1 1 1017 2 0 0 2 7 2
0]  [ 0 0 1 1005 0 1 0 1 1 1]  [ 0 0 0 0 963 0 1 0 0 18]  [ 0 0 0 12 0 879 1
0 0 0]  [ 4 2 1 0 4 2 943 0 2 0]  [ 0 2 5 0 0 0 0 1019 1 1]  [ 4 0 1 6 0 0 0 1
959 3]  [ 0 1 0 1 5 1 0 9 0 992]]
```

```
import seaborn as sns
plt.figure(figsize=(10,6))
sns.heatmap(confusion_matrix(y_test,classes_x))
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9b73f53750>
```



(iii).Make Prediction

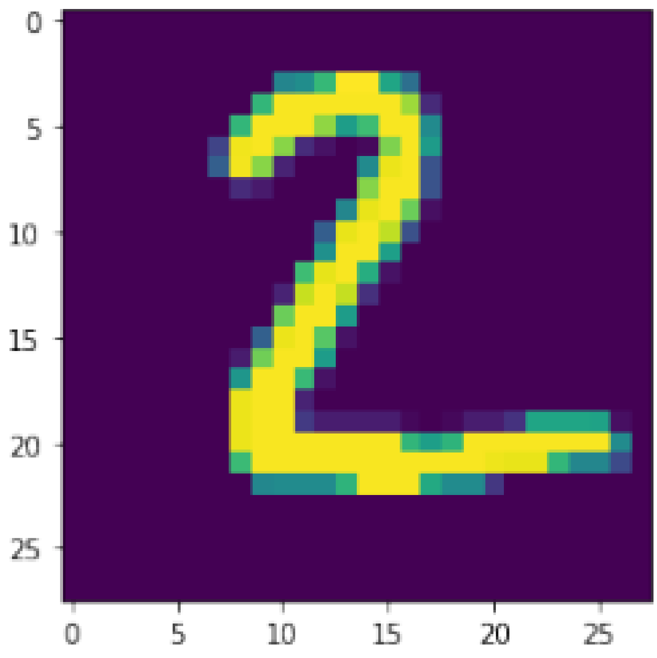
```
my_num = x_test[1]
```

```
classes_x
```

```
array([7, 2, 1, ..., 4, 5, 6])
```

```
plt.imshow(my_num.reshape(28,28))
```

```
<matplotlib.image.AxesImage at 0x7f9b73a95b10>
```



(iv).Save the Model

```
from tensorflow.keras.models import load_model

model.save('CNN.h5')
print('Model Saved!')

savedModel=load_model('CNN.h5')
savedModel.summary()
```

```
Model Saved!
Model: "sequential"

Layer (type) Output Shape Param #
=================================================================
conv2d (Conv2D) (None, 25, 25, 32) 544
 max_pooling2d (MaxPooling2D (None, 12, 12, 32) 0   )

 flatten (Flatten) (None, 4608) 0   dense (Dense) (None, 128) 589952   dense_1

(Dense) (None, 10) 1290

=================================================================
Total params: 591,786
Trainable params: 591,786
Non-trainable params: 0
```