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[1]:
```
import tensorflow as tf
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.utils import to_categorical
import matplotlib.pyplot as plt
import pandas as pd

(x_train, y_train), (x_test, y_test) = mnist.load_data()

x_train = x_train / 255.0
x_test = x_test / 255.0

y_train = to_categorical(y_train, 10)
y_test = to_categorical(y_test, 10)

model = Sequential([
    Flatten(input_shape=(28, 28)),
    Dense(128, activation='relu'),
    Dense(64, activation='relu'),
    Dense(10, activation='softmax')
])

model.compile(optimizer='adam',
              loss='categorical_crossentropy',
              metrics=['accuracy'])


history = model.fit(x_train, y_train,
                    epochs=5,
                    batch_size=128,
                    validation_data=(x_test, y_test),
```

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```
                    batch_size=128,
                    validation_data=(x_test, y_test),
                    verbose=1)

test_loss, test_acc = model.evaluate(x_test, y_test, verbose=0)

results = pd.DataFrame({
    "Epoch": range(1, len(history.history['accuracy']) + 1),
    "Accuracy": history.history['accuracy'],
    "Loss": history.history['loss']
})

print("\nTraining Results:")
print(results.to_string(index=False))

print("\nFinal Training Accuracy:", round(history.history['accuracy'][-1], 4))
print("Final Training Loss:", round(history.history['loss'][-1], 4))
print("\nTesting Accuracy:", round(test_acc * 100, 2), "%")

plt.figure(figsize=(12,5))

plt.subplot(1,2,1)
plt.plot(history.history['accuracy'], marker='o', label="Training Accuracy")
plt.plot(history.history['val_accuracy'], marker='s', label="Validation Accuracy")
plt.title("Accuracy vs Epochs")
plt.xlabel("Epochs")
plt.ylabel("Accuracy")
plt.legend()
plt.grid(True)

plt.subplot(1,2,2)
plt.plot(history.history['loss'], marker='o', label="Training Loss")
plt.plot(history.history['val_loss'], marker='s', label="Validation Loss")
```

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plt.grid(True)

plt.subplot(1,2,2)
plt.plot(history.history['loss'], marker='o', label="Training Loss")
plt.plot(history.history['val_loss'], marker='s', label="Validation Loss")
plt.title("Loss vs Epochs")
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.legend()
plt.grid(True)

plt.show()
```

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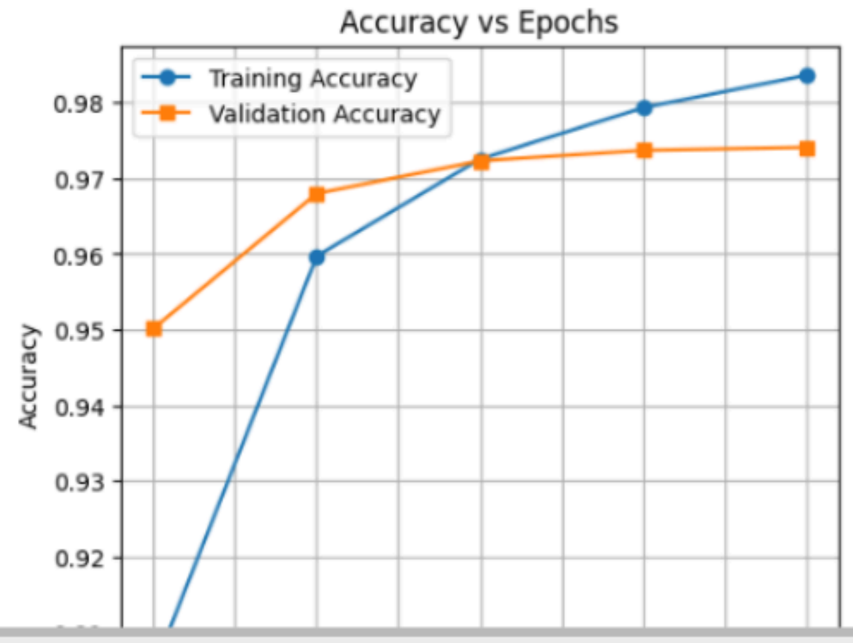
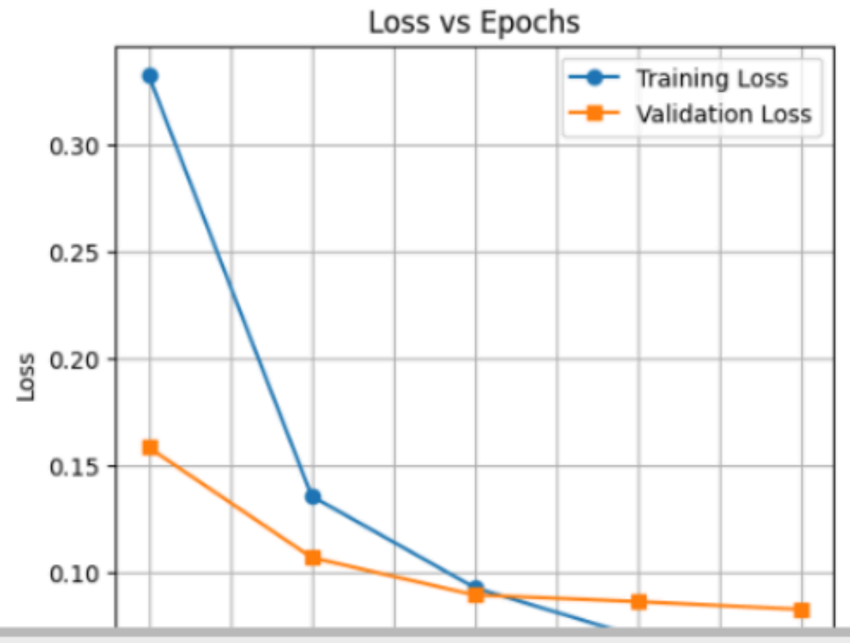
```
Training Results:
 Epoch  Accuracy     Loss
     1  0.905133 0.332415
     2  0.959733 0.135630
     3  0.972533 0.092820
     4  0.979317 0.069880
     5  0.983600 0.054622

Final Training Accuracy: 0.9836
Final Training Loss: 0.0546

Testing Accuracy: 97.41 %
```





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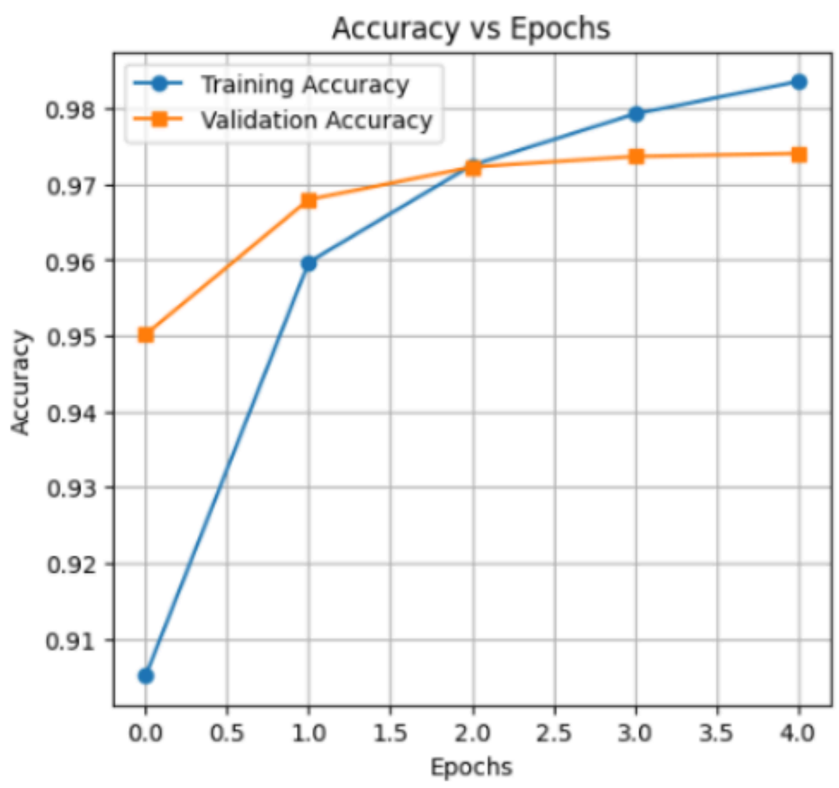

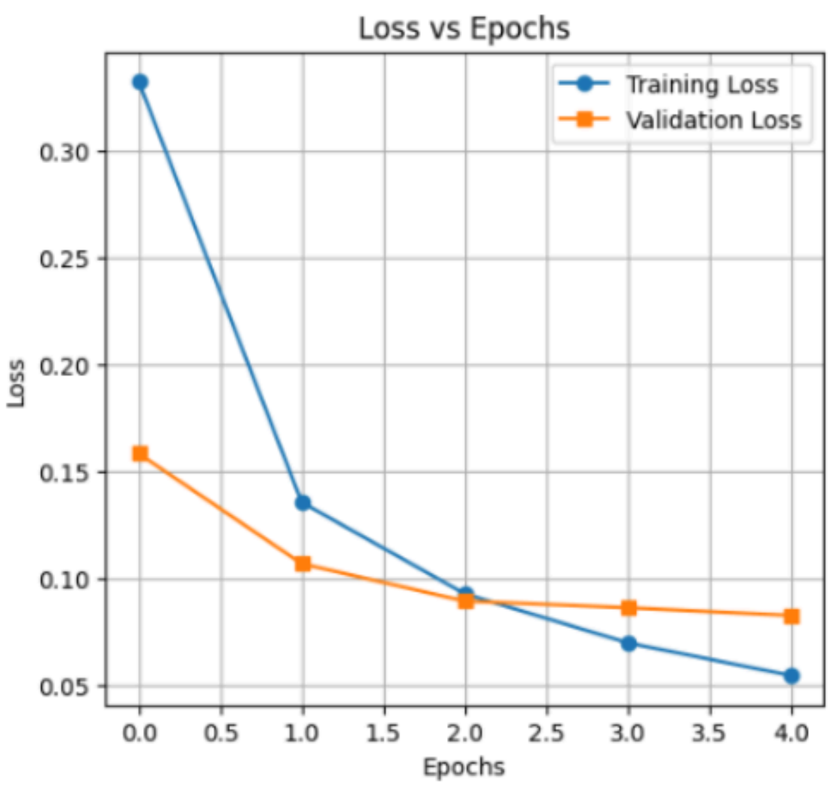

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4. Build a Simple feed forward neural network to recognize hand written character

Aim :- to desin and implement a simple feed forward neural network using open source data set to recognize hand written character.

objective :-

① To load And preprocess the MNIST data set for neural network input

② to build feed forward network model with hidden layer

③ To train the model using gradient desent optimizer and sparge cross-entry loss

④ Evalute the trained model on test data and measure its accuracy

⑤ to predict the accuracy of a image of handwritten charater.

pseudo code :-

start
load MNIST dataset
pattern each image from 28x28 to 784 fatores
normalize pixals values to range [0,1]

create a sequential neural network

layer 1:- dense (128, neurons, Relu activation)
layer 2:- dense (64, neurons, Relu activation)
output layer:- dense (10 neurons, softmax activation.

compile model:-

optimizer = stachastic gradient descent
loss = spark categorial cossentropy
metric = accuracy

train model on training data for epoch
evalute model on testing data

observation:-

→ the loss decrease with each showing that model is learning
→ Accuracy improves steding during learning

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2218

Result:- Successfully built a simple feed forward neural network to recognize hand written characters and. accuray while testing is 97.46%.

output:-

training

epoh	Accracy	loss
1	0.8748	0.4363
2	0.9649	0.1134
3	0.9775	0.0715
4	0.9727	0.545
5	0.9861	0.0431

accuray : 0.9698

loss : 0.0968

testing

accuray: 97.46%