In [41]:
```
#Assignment No: 3
#Title: To Implement Image classification model using CNN Deep Learning Arch
#Dataset: fashion_mnist
```

In [3]:
```
from tensorflow import keras
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
from sklearn.metrics import classification_report
```

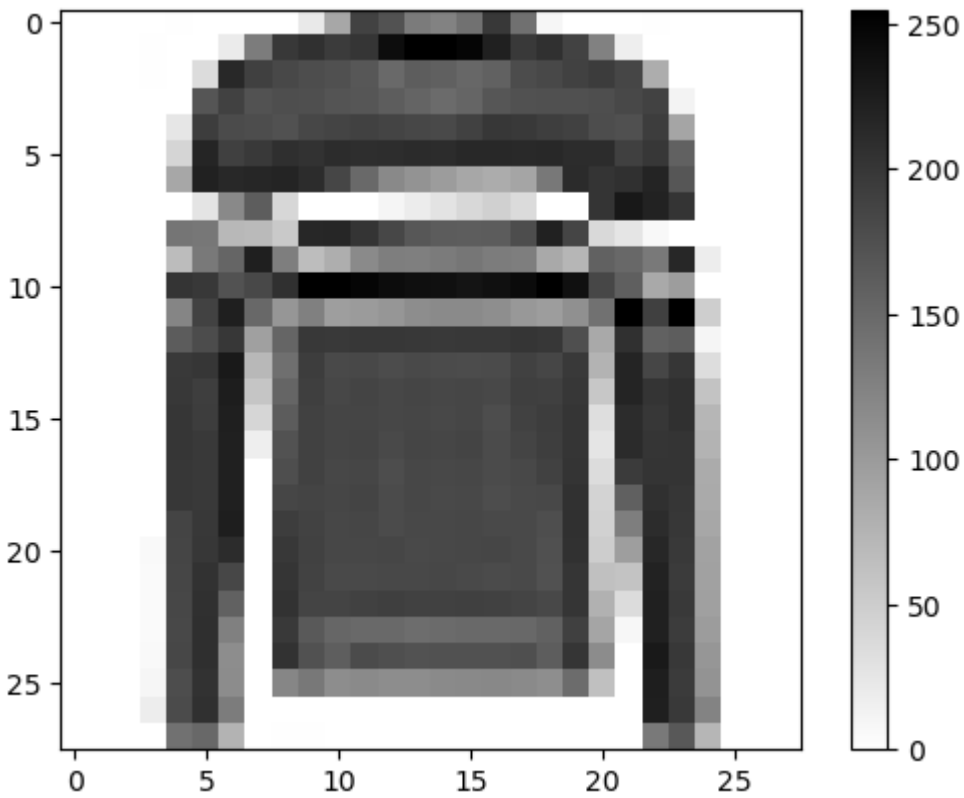
In [5]:
```
fashion_mnist = keras.datasets.fashion_mnist
(train_images, train_labels), (test_images, test_labels) = fashion_mnist.loa
```

In [6]:
```
class_names = ['T-shirt/top', 'Trouser', 'Pullover', 'Dress', 'Coat',
               'Sandal', 'Shirt', 'Sneaker', 'Bag', 'Ankle boot']
```

In [7]:
```
print(train_images.shape)
print(train_labels.shape)
print(test_images.shape)
print(test_labels.shape)
```

```
(60000, 28, 28)
(60000,)
(10000, 28, 28)
(10000,)
```

In [8]:
```
plt.figure()
plt.imshow(train_images[5],cmap=plt.cm.binary)
plt.colorbar()
plt.grid(False)
plt.show()
```



In [9]:
```
plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i], cmap=plt.cm.binary)
    plt.xlabel(class_names[train_labels[i]])
plt.show()
```

In [10]:
```
train_images = train_images / 255.0
test_images = test_images / 255.0
```

In [11]:
```
print("train_images: ", train_images.shape)
print("test_images: ", test_images.shape)
```

```
train_images:  (60000, 28, 28)
test_images:  (10000, 28, 28)
```

In [12]:
```
model = keras.Sequential([
    keras.layers.Conv2D(filters=64, kernel_size=3, activation='relu', paddi
    keras.layers.MaxPool2D(pool_size=2),
    keras.layers.Conv2D(filters=128, kernel_size=3, activation='relu', padd
    keras.layers.MaxPool2D(pool_size=2),
    keras.layers.Flatten(),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dropout(0.25),
    keras.layers.Dense(64, activation='relu'),
    keras.layers.Dropout(0.25),
    keras.layers.Dense(10, activation='softmax')
])
```

```
C:\Users\yadav\anaconda3\Lib\site-packages\keras\src\layers\convolutional
\base_conv.py:107: UserWarning: Do not pass an `input_shape`/`input_dim` a
rgument to a layer. When using Sequential models, prefer using an `Input(s
hape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

In [13]:
```
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metr
```

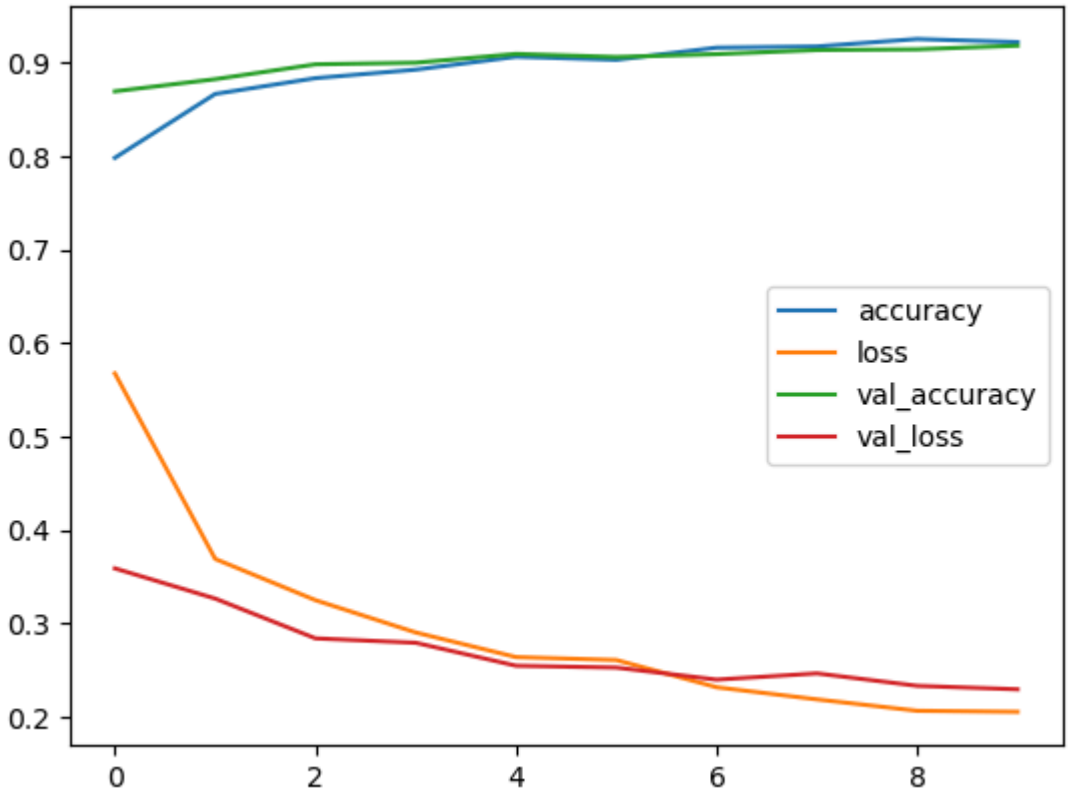
In [14]:
```
model_history = model.fit(train_images, train_labels, batch_size=50, epochs=
```

```
Epoch 1/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 116s 132ms/step - accuracy: 0.7107 - loss: 0.
8085 - val_accuracy: 0.8691 - val_loss: 0.3588
Epoch 2/10
360/840 ━━━━━━━━━━━━━━━━━━━━ 54s 113ms/step - accuracy: 0.8641 - loss: 0.3
885

C:\Users\yadav\anaconda3\Lib\contextlib.py:158: UserWarning: Your input ra
n out of data; interrupting training. Make sure that your dataset or gener
ator can generate at least `steps_per_epoch * epochs` batches. You may nee
d to use the `.repeat()` function when building your dataset.
  self.gen.throw(typ, value, traceback)

840/840 ━━━━━━━━━━━━━━━━━━━━ 49s 58ms/step - accuracy: 0.8654 - loss: 0.37
73 - val_accuracy: 0.8821 - val_loss: 0.3264
Epoch 3/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 147s 124ms/step - accuracy: 0.8775 - loss: 0.
3376 - val_accuracy: 0.8980 - val_loss: 0.2839
Epoch 4/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 52s 62ms/step - accuracy: 0.8943 - loss: 0.28
79 - val_accuracy: 0.8997 - val_loss: 0.2792
Epoch 5/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 102s 122ms/step - accuracy: 0.9073 - loss: 0.
2615 - val_accuracy: 0.9091 - val_loss: 0.2546
Epoch 6/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 49s 58ms/step - accuracy: 0.9047 - loss: 0.25
95 - val_accuracy: 0.9058 - val_loss: 0.2526
Epoch 7/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 155s 124ms/step - accuracy: 0.9153 - loss: 0.
2336 - val_accuracy: 0.9089 - val_loss: 0.2397
Epoch 8/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 49s 59ms/step - accuracy: 0.9190 - loss: 0.21
77 - val_accuracy: 0.9133 - val_loss: 0.2464
Epoch 9/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 143s 112ms/step - accuracy: 0.9248 - loss: 0.
2095 - val_accuracy: 0.9140 - val_loss: 0.2331
Epoch 10/10
840/840 ━━━━━━━━━━━━━━━━━━━━ 49s 58ms/step - accuracy: 0.9232 - loss: 0.20
29 - val_accuracy: 0.9180 - val_loss: 0.2294
```

In [16]:
```
pd.DataFrame(model_history.history).plot()
plt.show()
```



In [18]:
```
test_loss, test_acc = model.evaluate(test_images, test_labels, verbose=2)
print('\nTest accuracy:' , test_acc)
```

```
313/313 - 7s - 24ms/step - accuracy: 0.9180 - loss: 0.2294

Test accuracy: 0.9179999828338623
```

In [19]:
```
predictions = model.predict(test_images)
```

```
313/313 ━━━━━━━━━━━━━━━━━━━━ 8s 25ms/step
```

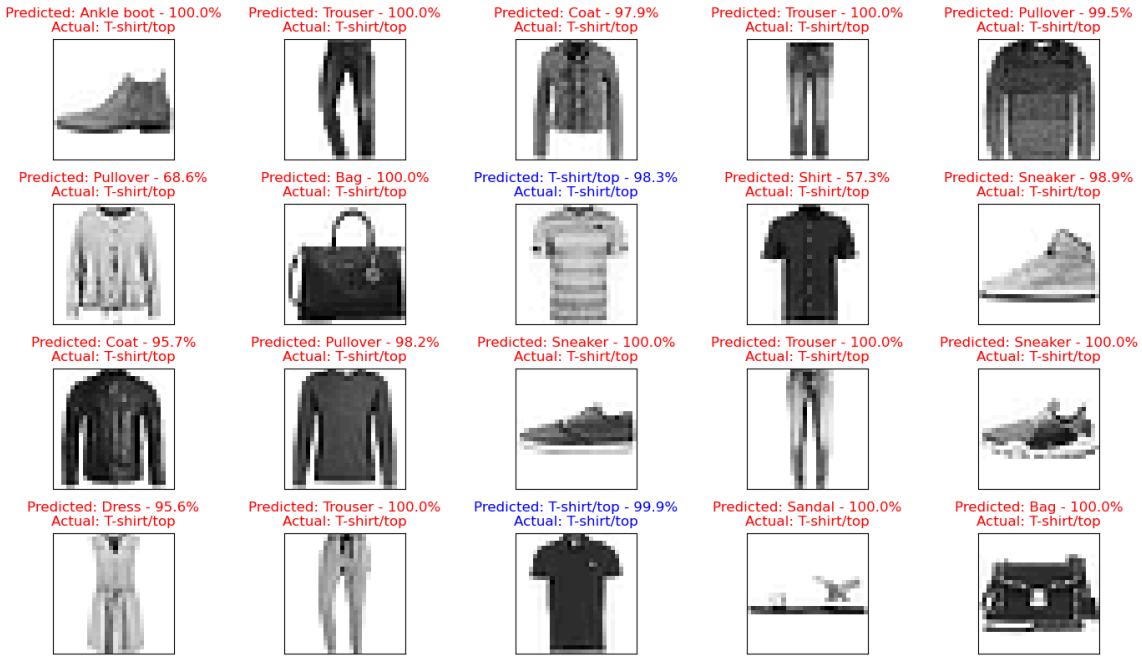
In [21]:
```
def plot_img_label(img, pred_class, pred_percentage, true_class):
    plt.imshow(img,cmap=plt.cm.binary)
    if pred_class == true_class:
        color = 'blue'
    else:
        color='red'
    plt.title(label= f"Predicted: {pred_class} - {pred_percentage:2.1f}%\nA
              fontdict={'color': color})
```

In [23]:
```
plt.figure(figsize=(14,10))

for i in range(20):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    i=i*5
    img = test_images[i].reshape(28,28)
    pred_class = class_names[np.argmax(predictions[i])]
    pred_percentage = np.max(predictions[i])*100
    true_class = class_names[np.argmax(test_labels[i])]

    plot_img_label(img, pred_class, pred_percentage, true_class)

plt.tight_layout()
plt.show()
```



In [32]:
```
predicted_label = np.argmax(predictions, axis=1) if predictions.ndim > 1 els
true_label = np.argmax(test_labels, axis=1) if test_labels.ndim > 1 else tes
```

In [33]:
```
print(classification_report(true_label, predicted_label, target_names=class_
```

	precision	recall	f1-score	support
T-shirt/top	0.89	0.85	0.87	1000
Trouser	0.99	0.98	0.99	1000
Pullover	0.89	0.84	0.86	1000
Dress	0.89	0.94	0.92	1000
Coat	0.83	0.90	0.87	1000
Sandal	0.99	0.98	0.99	1000
Shirt	0.77	0.75	0.76	1000
Sneaker	0.96	0.98	0.97	1000
Bag	0.99	0.98	0.99	1000
Ankle boot	0.98	0.97	0.97	1000
accuracy			0.92	10000
macro avg	0.92	0.92	0.92	10000
weighted avg	0.92	0.92	0.92	10000