In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from keras.datasets import cifar10
```

In [2]:
```
(xtrain,ytrain),(xtest,ytest) = cifar10.load_data()
```

In [3]:
```
print("xtrain :- ",xtrain.shape)
print("ytrain :- ",ytrain.shape)
print("xtest  :- ",xtest.shape)
print("ytest  :- ",ytest.shape)
```

```
xtrain :-  (50000, 32, 32, 3)
ytrain :-  (50000, 1)
xtest  :-  (10000, 32, 32, 3)
ytest  :-  (10000, 1)
```

In [4]:
```
from keras.utils import to_categorical
ytrain =to_categorical(ytrain)
ytest = to_categorical(ytest)
```

In [5]:
```
from keras.layers import AveragePooling2D,Conv2D,Dense,Activation,Flatten
from keras.models import Sequential
```

In [6]:
```
xtrain.shape[-3:]
```

Out[6]: (32, 32, 3)

In [7]:
```
model = Sequential()
model.add(Conv2D(64,kernel_size=(3,3),strides = (2,2),input_shape=xtrain.shape[1:]))
model.add(AveragePooling2D((2,2)))
model.add(Conv2D(20,(3,3)))
model.add(AveragePooling2D((2,2)))
model.add(Flatten())
model.add(Dense(16))
model.add(Dense(12))
model.add(Dense(10,))
model.add(Activation('softmax'))
model.compile(loss = 'categorical_crossentropy', optimizer= 'adam', metrics=['accuracy
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 15, 15, 64)        1792
_________________________________________________________________
average_pooling2d (AveragePo (None, 7, 7, 64)          0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 5, 5, 20)          11540
_________________________________________________________________
average_pooling2d_1 (Average (None, 2, 2, 20)          0
_________________________________________________________________
flatten (Flatten)            (None, 80)                0
_________________________________________________________________
dense (Dense)                (None, 16)                1296
_________________________________________________________________
dense_1 (Dense)              (None, 12)                204
_________________________________________________________________
dense_2 (Dense)              (None, 10)                130
_________________________________________________________________
activation (Activation)      (None, 10)                0
=================================================================
Total params: 14,962
Trainable params: 14,962
Non-trainable params: 0
_________________________________________________________________
```

In [8]:
```
history = model.fit(xtrain,ytrain,batch_size=256,epochs=250)
```

```
Epoch 1/250
196/196 [==============================] - 4s 6ms/step - loss: 15.1255 - accuracy: 0.16
31
Epoch 2/250
196/196 [==============================] - 1s 5ms/step - loss: 2.4541 - accuracy: 0.251
4
Epoch 3/250
196/196 [==============================] - 1s 5ms/step - loss: 2.1407 - accuracy: 0.275
7
Epoch 4/250
196/196 [==============================] - 1s 5ms/step - loss: 2.0309 - accuracy: 0.29
84
Epoch 5/250
196/196 [==============================] - 1s 5ms/step - loss: 1.9733 - accuracy: 0.310
6
Epoch 6/250
196/196 [==============================] - 1s 5ms/step - loss: 1.9349 - accuracy: 0.324
6
Epoch 7/250
```

In [9]:
```
history = pd.DataFrame(history.history)
history
```

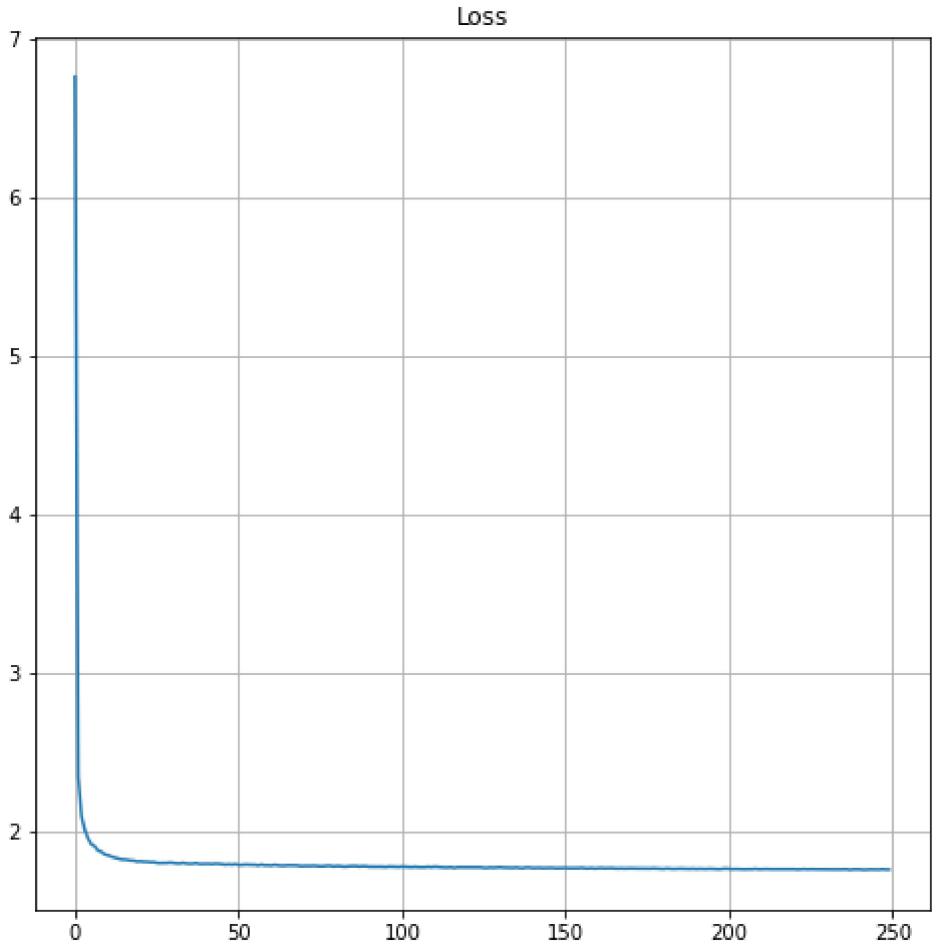
Out[9]:

	loss	accuracy
0	6.765108	0.19534
1	2.344730	0.25938
2	2.094036	0.28318
3	2.009014	0.30362
4	1.952580	0.31682
...	...	...
245	1.758080	0.39462
246	1.757231	0.39664
247	1.759657	0.39672
248	1.757356	0.39666
249	1.757499	0.39528

250 rows × 2 columns

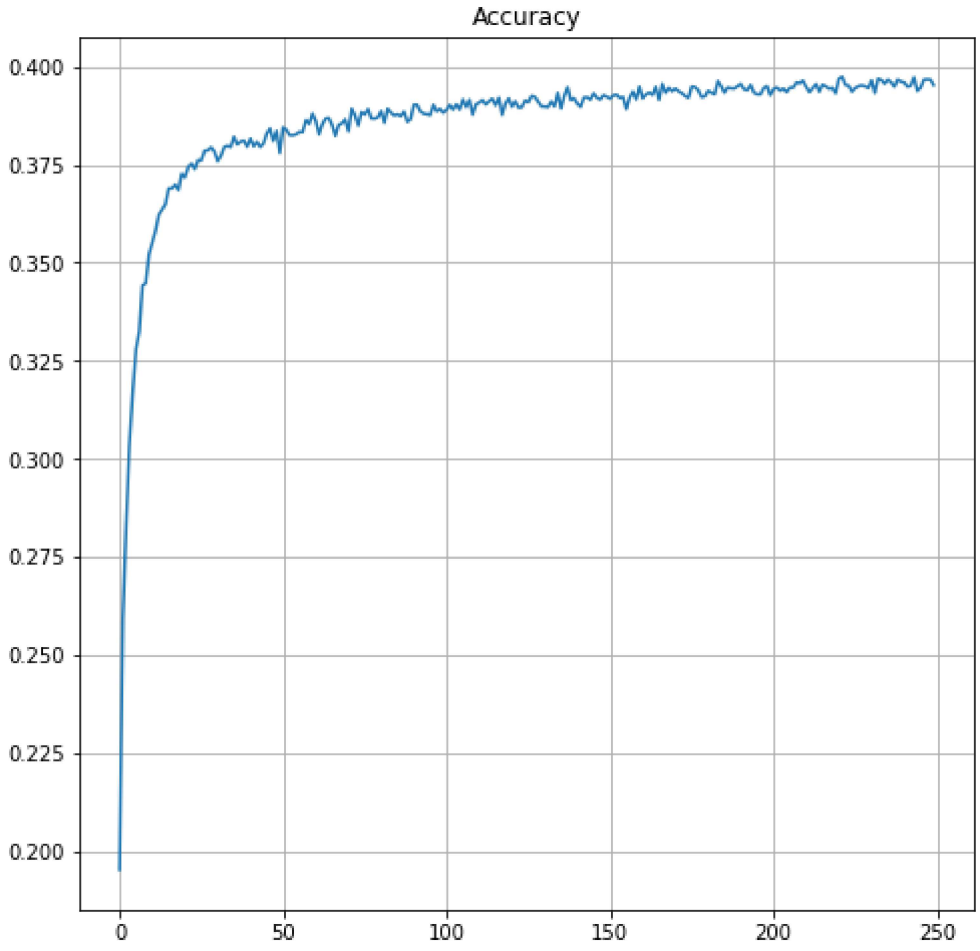
In [10]:
```
1 history.loss.plot.line(figsize=(8,8),title = "Loss",grid = "whitegrid",)
```

Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x7f0b660ae790>



In [11]:
```
1 history.accuracy.plot.line(figsize=(8,8),title = "Accuracy",grid = "whitegrid")
```

Out[11]: <matplotlib.axes._subplots.AxesSubplot at 0x7f0b5fff68d0>



In [12]:
```
1 predictions = np.argmax(model.predict(xtest),axis=1)
```

In [13]:
```
1 predictions
```

Out[13]: array([3, 8, 8, ..., 5, 5, 7])

In [14]:
```
1 ytest = np.argmax(ytest,axis=1)
```

In [15]:
```
from sklearn.metrics import accuracy_score,confusion_matrix
print(accuracy_score(predictions,ytest))
```

```
0.3779
```

In [16]:
```
print(confusion_matrix(predictions,ytest))
```

```
[[511 102 109  47  61  53  23  53 266 110]
 [ 41 432  43  39  14  34  18  34  67 160]
 [ 52  21 225  97 103  82  59  57  13  22]
 [ 21  47  77 255  67 134 141  57  28  32]
 [ 24  44 162  73 310  93 135  78  19  22]
 [ 33  55 100 201 106 362  90  73  63  37]
 [ 25  30 117 119 129  76 432  38  10  52]
 [ 86  53 124  92 165 108  68 505  57  78]
 [151  57  29  26  19  31  10  26 356  96]
 [ 56 159  14  51  26  27  24  79 121 391]]
```