Architecture of model

```
model = Sequential()
model.add(Conv2D(32, (3,3), input_shape= (100,100,3)))
model.add(Activation("relu"))
model.add(MaxPooling2D())

model.add(Conv2D(32, (3,3),))
model.add(Activation("relu"))
model.add(MaxPooling2D())

model.add(Conv2D(64, (3,3),))
model.add(Activation("relu"))
model.add(MaxPooling2D())
model.add(Flatten())
model.add(Dense(1024))
model.add(Activation("relu"))
model.add(Dropout(0.5))
model.add(Dense(4))#output
model.add(Activation("softmax"))
```

Summary

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 98, 98, 32)        896
_________________________________________________________________
activation (Activation)      (None, 98, 98, 32)        0
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 49, 49, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 47, 47, 32)        9248
_________________________________________________________________
activation_1 (Activation)    (None, 47, 47, 32)        0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 23, 23, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 21, 21, 64)        18496
_________________________________________________________________
activation_2 (Activation)    (None, 21, 21, 64)        0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 10, 10, 64)        0
_________________________________________________________________
flatten (Flatten)            (None, 6400)              0
_________________________________________________________________
dense (Dense)                (None, 1024)              6554624
_________________________________________________________________
activation_3 (Activation)    (None, 1024)              0
_________________________________________________________________
dropout (Dropout)            (None, 1024)              0
_________________________________________________________________
dense_1 (Dense)              (None, 4)                 4100
_________________________________________________________________
activation_4 (Activation)    (None, 4)                 0
=================================================================
Total params: 6,587,364
Trainable params: 6,587,364
Non-trainable params: 0
_________________________________________________________________
```

Dataset link:

https://www.kaggle.com/datasets/ayushv322/animal-classification

Dataset details:

There are four classes (Zebra _ elephant _ Rhino _ Buffalo)

Each class has one thousand of images in it

And the total number is four thousands image

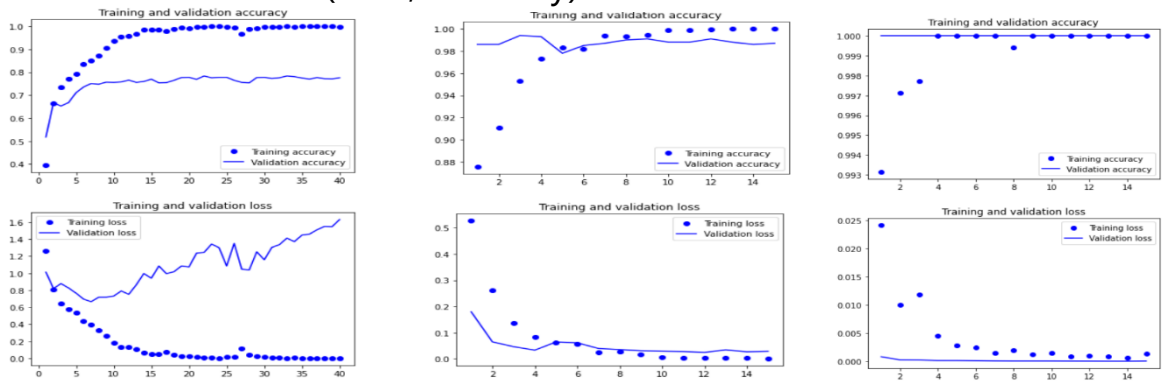
Implementation details

A) A CSV file has been created to contain an index for all images from classes [Zebra_elephant_bufflao_Rhino]
B) With python scripting code three CSV files have been generated to index the chosen images and partition images randomly into four equal subset [G1 – G2 – G3 - test] contain the images name, image classes
C) Each subset contain equal number of images (250 image for each class) and the total number is 1000.
D) The cross-validation technique has been used in training and validation. In the first training and validation cycle, the subsets G1 and G2 have been used for training the model and the subset G3 has been used for the validation
E) In the second training and validation cycle subsets G1 and G3 have been used for training and the subset G2 are used for the validation process. In the third training and validation cycle, subsets G2 and G3 have been used for the training process and subset G1 for the validation process.
F) After each cycle we test the algorithm with (test data) and see the accuracy and try to develop it.

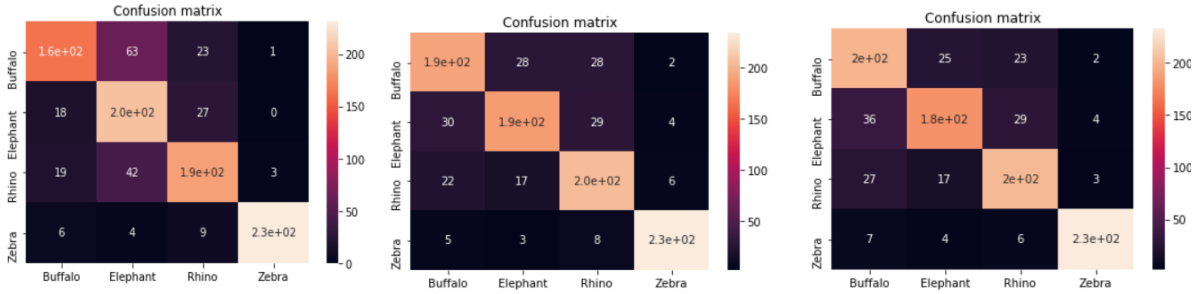
Results and visualizations

Accuracy on test images after cycle 1 =79% ,cycle 2 =81% ,cycle 3 = 81%
Accuracy average is = 80%

Train and validation (loss , accuracy) :



Confusion matrix on test images:



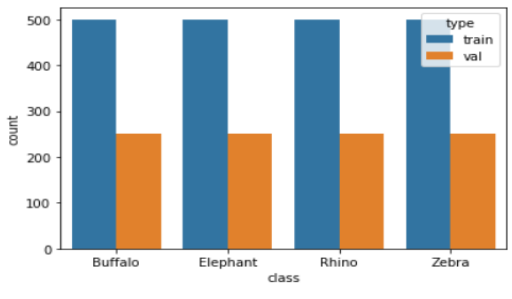
Reports on test images:

	precision	recall	f1-score	support
Buffalo	0.79	0.65	0.71	250
Elephant	0.65	0.82	0.73	250
Rhino	0.76	0.74	0.75	250
Zebra	0.98	0.92	0.95	250
accuracy			0.79	1000
macro avg	0.80	0.79	0.79	1000
weighted avg	0.80	0.79	0.79	1000

	precision	recall	f1-score	support
Buffalo	0.77	0.77	0.77	250
Elephant	0.80	0.75	0.77	250
Rhino	0.76	0.82	0.79	250
Zebra	0.95	0.94	0.94	250
accuracy			0.82	1000
macro avg	0.82	0.82	0.82	1000
weighted avg	0.82	0.82	0.82	1000

	precision	recall	f1-score	support
Buffalo	0.74	0.80	0.77	250
Elephant	0.80	0.72	0.76	250
Rhino	0.78	0.81	0.79	250
Zebra	0.96	0.93	0.95	250
accuracy			0.82	1000
macro avg	0.82	0.82	0.82	1000
weighted avg	0.82	0.82	0.82	1000

Images of train and validation:



images of test :