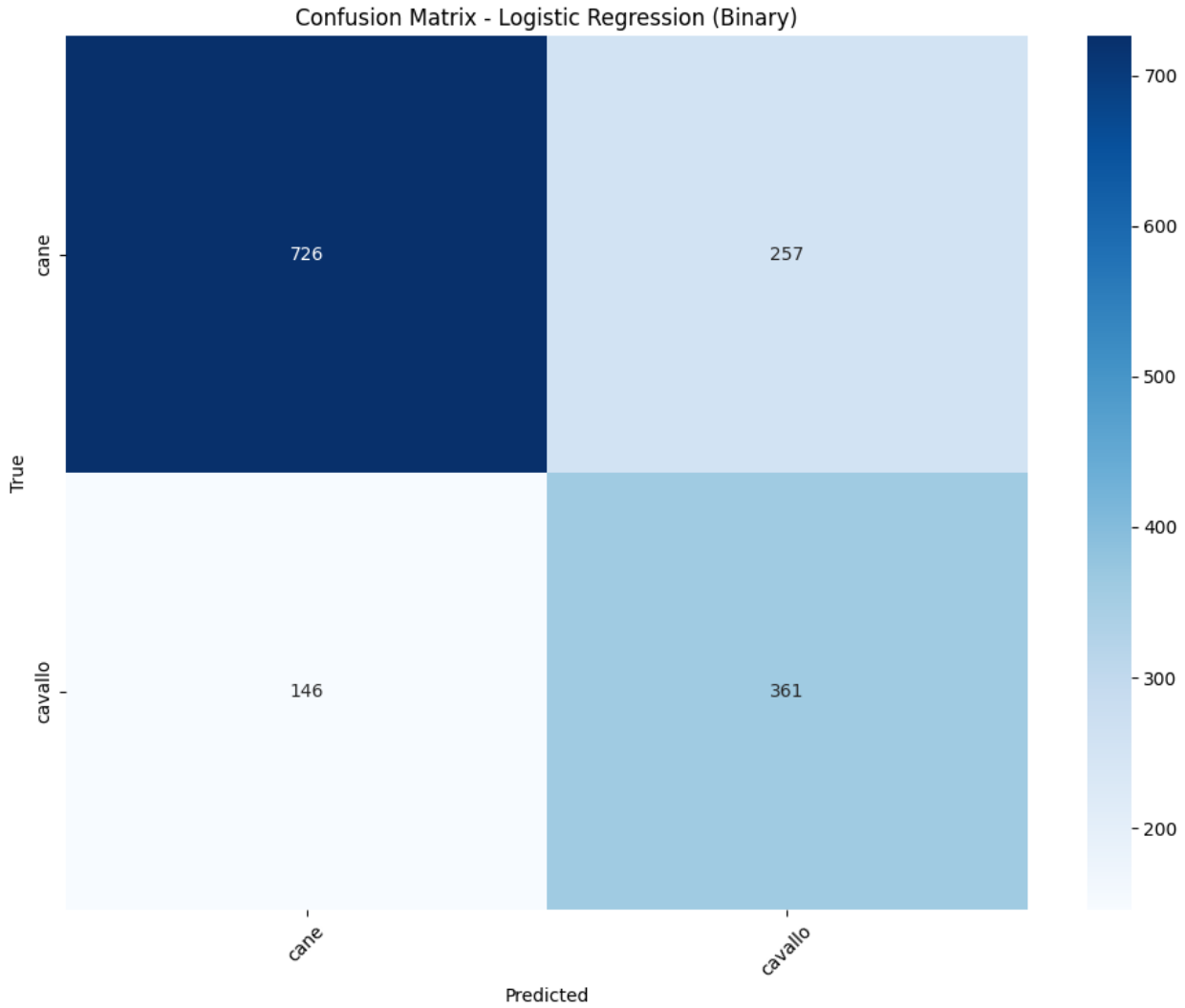
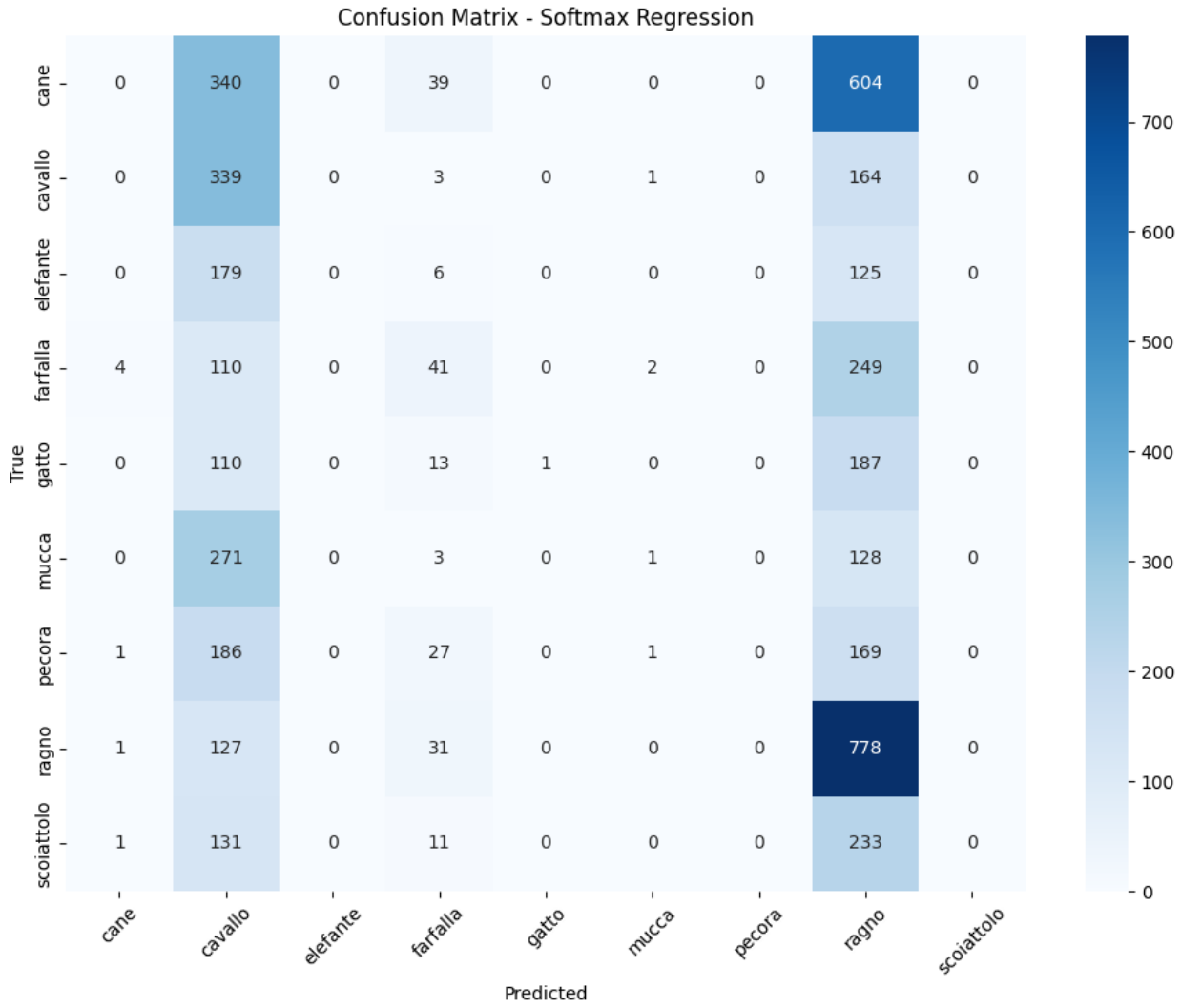
```
Running Binary Logistic Regression...

Logistic Regression (Binary) Results:
Accuracy: 0.7295302013422819

Classification Report:
              precision    recall  f1-score   support

        cane       0.83      0.74      0.78       983
     cavallo       0.58      0.71      0.64       507

    accuracy                           0.73      1490
   macro avg       0.71      0.73      0.71      1490
weighted avg       0.75      0.73      0.73      1490
```



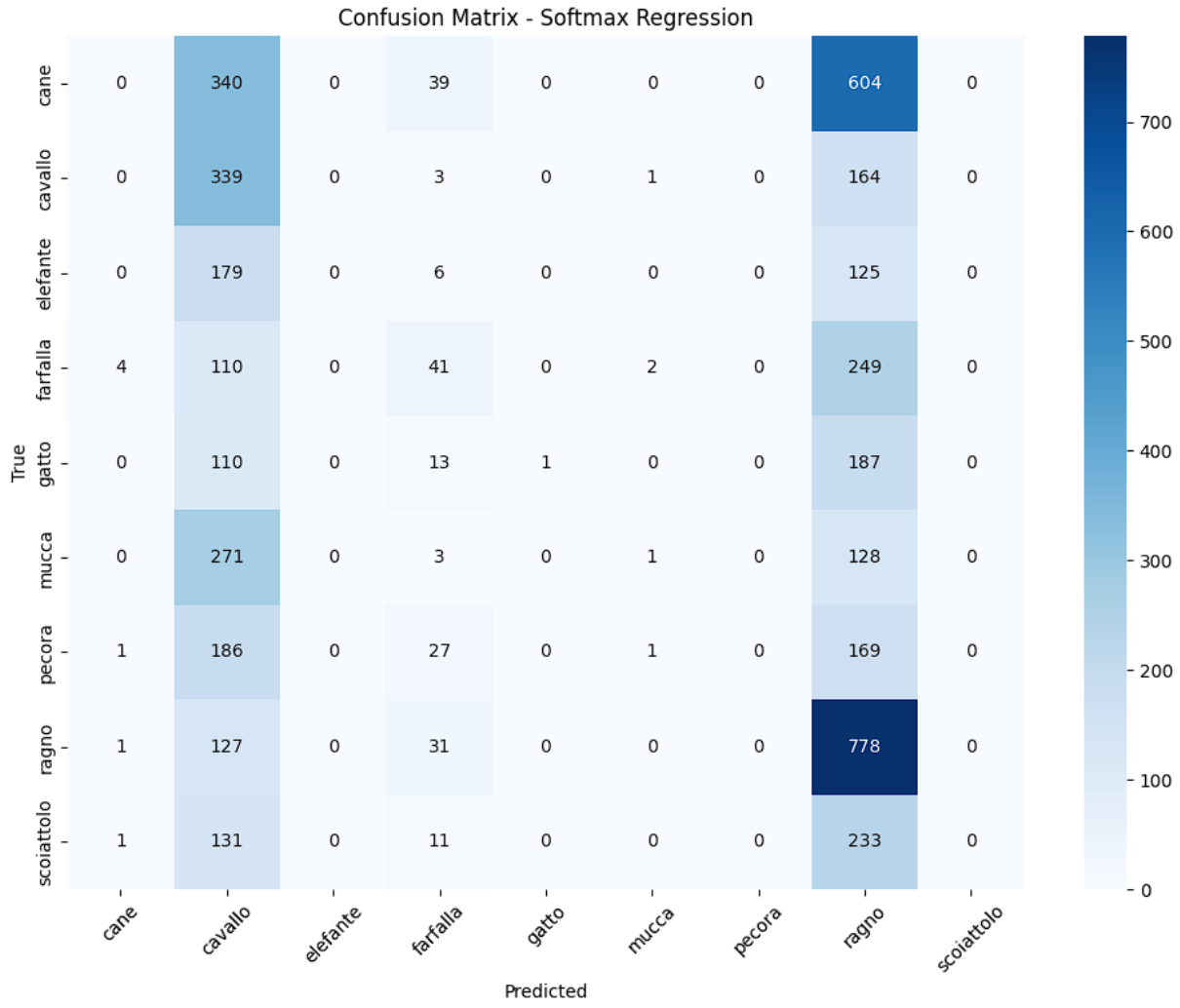
```
Running Softmax Regression...

Softmax Regression Results:
Accuracy: 0.25124539744422786

Classification Report:
              precision    recall  f1-score   support

        cane       0.00      0.00      0.00       983
     cavallo       0.19      0.67      0.29       507
    elefante       0.00      0.00      0.00       310
    farfalla       0.24      0.10      0.14       406
      gatto        1.00      0.00      0.01       311
      mucca        0.20      0.00      0.00       403
     pecora        0.00      0.00      0.00       384
      ragno        0.30      0.83      0.44       937
  scoiattolo       0.00      0.00      0.00       376

   accuracy                           0.25      4617
  macro avg       0.21      0.18      0.10      4617
weighted avg      0.19      0.25      0.13      4617
```



SVM (RBF Kernel) Results:
Accuracy: 0.46242148581329867

Classification Report:

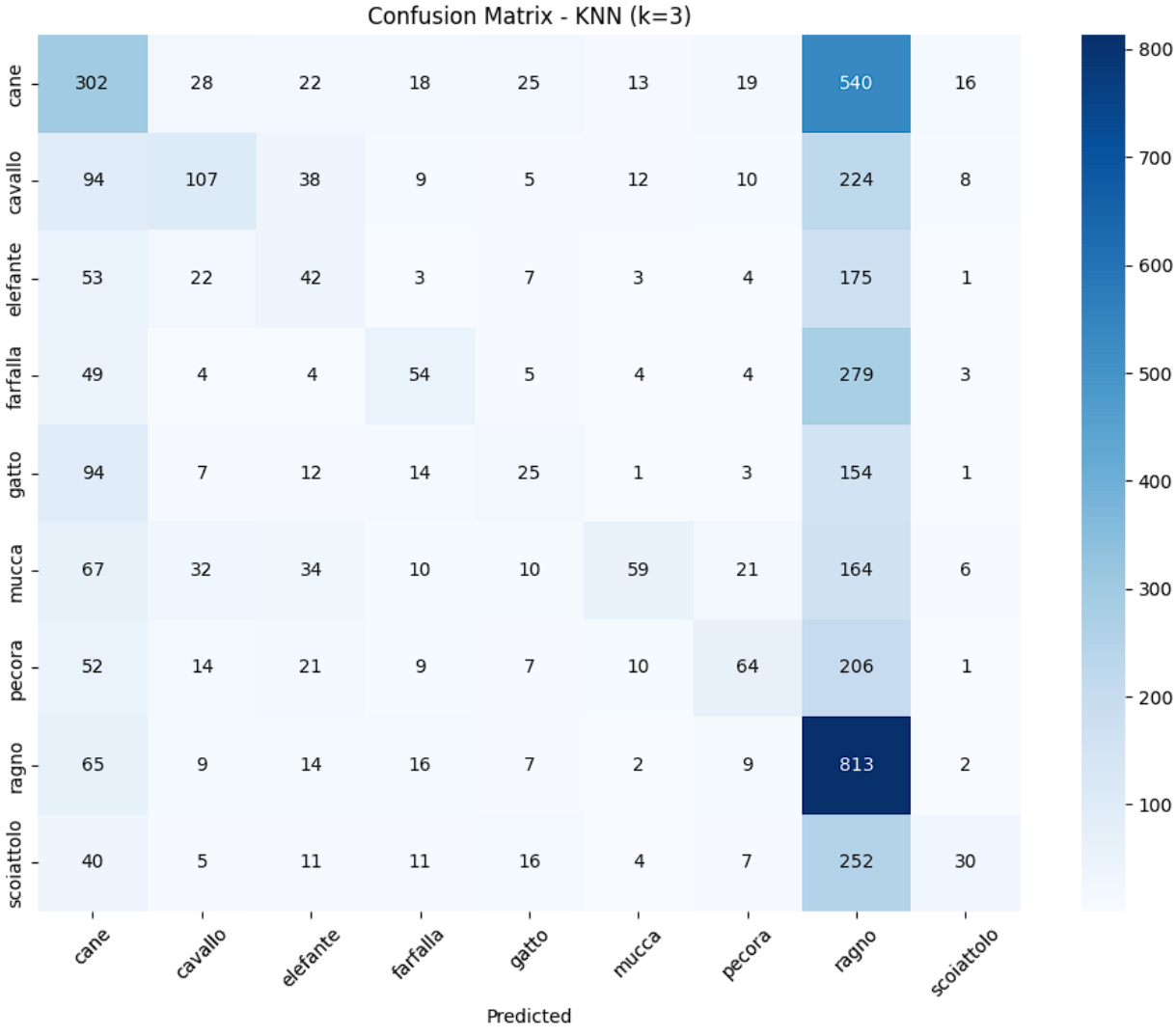
| | precision | recall | f1-score | support |
|---|---|---|---|---|
| cane | 0.37 | 0.66 | 0.47 | 983 |
| cavallo | 0.50 | 0.53 | 0.51 | 507 |
| elefante | 0.52 | 0.13 | 0.21 | 310 |
| farfalla | 0.62 | 0.39 | 0.48 | 406 |
| gatto | 0.36 | 0.03 | 0.05 | 311 |
| mucca | 0.52 | 0.29 | 0.37 | 403 |
| pecora | 0.53 | 0.35 | 0.42 | 384 |
| ragno | 0.52 | 0.74 | 0.61 | 937 |
| scoiattolo | 0.48 | 0.15 | 0.23 | 376 |
| accuracy | | | 0.46 | 4617 |
| macro avg | 0.49 | 0.36 | 0.37 | 4617 |
| weighted avg | 0.48 | 0.46 | 0.43 | 4617 |



KNN (k=3) Results:
Accuracy: 0.32401992635910765

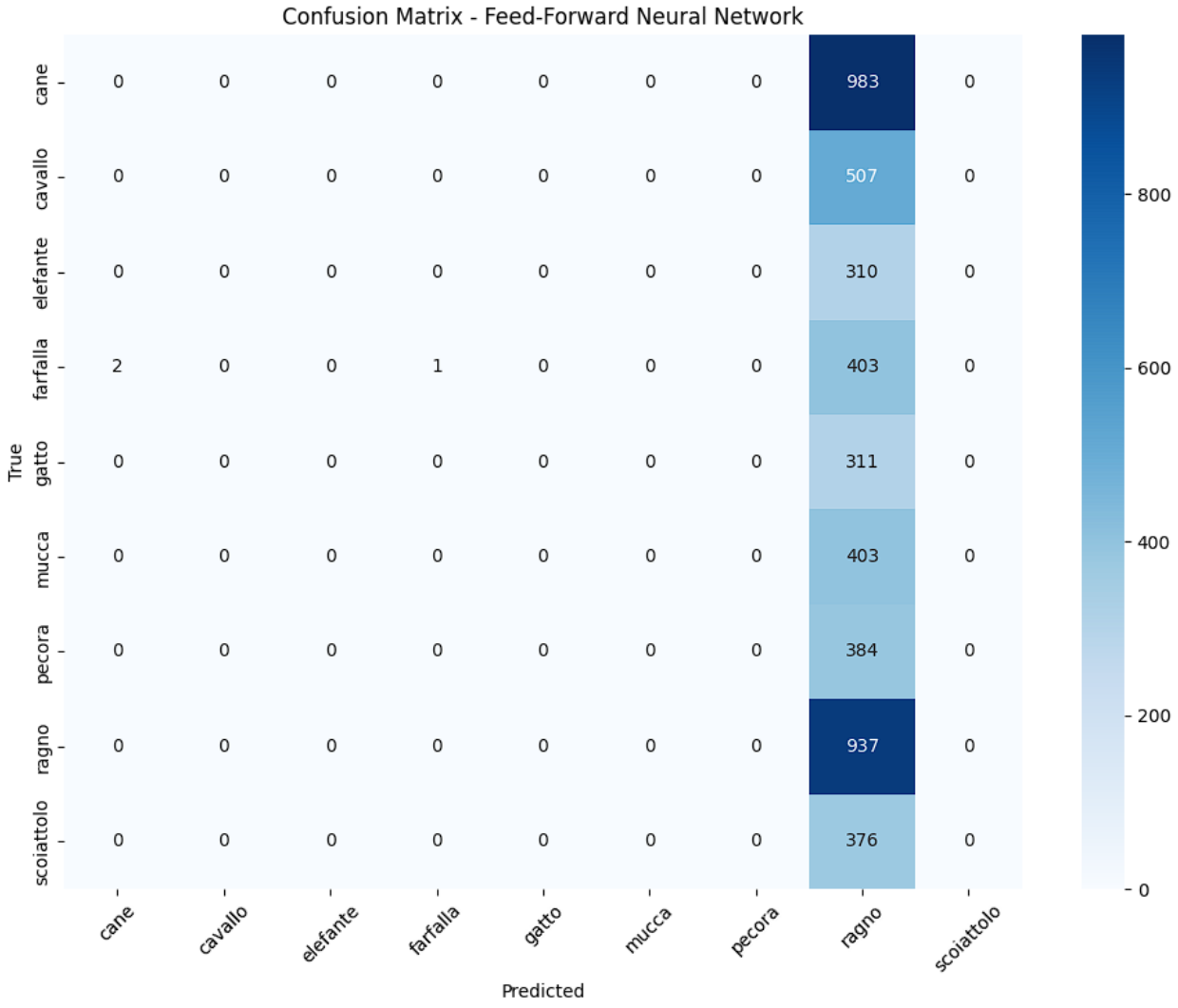
Classification Report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| cane | 0.37 | 0.31 | 0.34 | 983 |
| cavallo | 0.47 | 0.21 | 0.29 | 507 |
| elefante | 0.21 | 0.14 | 0.17 | 310 |
| farfalla | 0.38 | 0.13 | 0.20 | 406 |
| gatto | 0.23 | 0.08 | 0.12 | 311 |
| mucca | 0.55 | 0.15 | 0.23 | 403 |
| pecora | 0.45 | 0.17 | 0.24 | 384 |
| ragno | 0.29 | 0.87 | 0.43 | 937 |
| scoiattolo | 0.44 | 0.08 | 0.14 | 376 |
| accuracy | | | 0.32 | 4617 |
| macro avg | 0.38 | 0.24 | 0.24 | 4617 |
| weighted avg | 0.37 | 0.32 | 0.28 | 4617 |



```
Running Feed-Forward Neural Network...
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_d
quential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 7s 14ms/step - accuracy: 0.1890 - loss: 2.5841 - val_accuracy: 0.2077 - val_loss: 2.1254
Epoch 2/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2112 - loss: 2.1140 - val_accuracy: 0.2077 - val_loss: 2.1019
Epoch 3/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2091 - loss: 2.0952 - val_accuracy: 0.2077 - val_loss: 2.0977
Epoch 4/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2122 - loss: 2.0854 - val_accuracy: 0.2077 - val_loss: 2.0972
Epoch 5/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2053 - loss: 2.0938 - val_accuracy: 0.2077 - val_loss: 2.0973
Epoch 6/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2115 - loss: 2.0867 - val_accuracy: 0.2044 - val_loss: 2.0973
Epoch 7/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 12ms/step - accuracy: 0.2049 - loss: 2.0899 - val_accuracy: 0.2077 - val_loss: 2.0975
Epoch 8/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2109 - loss: 2.0885 - val_accuracy: 0.2044 - val_loss: 2.0974
Epoch 9/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2162 - loss: 2.0819 - val_accuracy: 0.2082 - val_loss: 2.0966
Epoch 10/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 5s 11ms/step - accuracy: 0.2097 - loss: 2.0837 - val_accuracy: 0.2077 - val_loss: 2.0973
145/145 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step

Feed-Forward Neural Network Results:
Accuracy: 0.20316222655403943
```

```
Feed-Forward Neural Network Results:
Accuracy: 0.20316222655403943

Classification Report:
              precision    recall  f1-score   support

        cane       0.00      0.00      0.00       983
     cavallo       0.00      0.00      0.00       507
    elefante       0.00      0.00      0.00       310
    farfalla       1.00      0.00      0.00       406
       gatto       0.00      0.00      0.00       311
       mucca       0.00      0.00      0.00       403
      pecora       0.00      0.00      0.00       384
       ragno       0.20      1.00      0.34       937
   scoiattolo       0.00      0.00      0.00       376

    accuracy                           0.20      4617
   macro avg       0.13      0.11      0.04      4617
weighted avg       0.13      0.20      0.07      4617
```

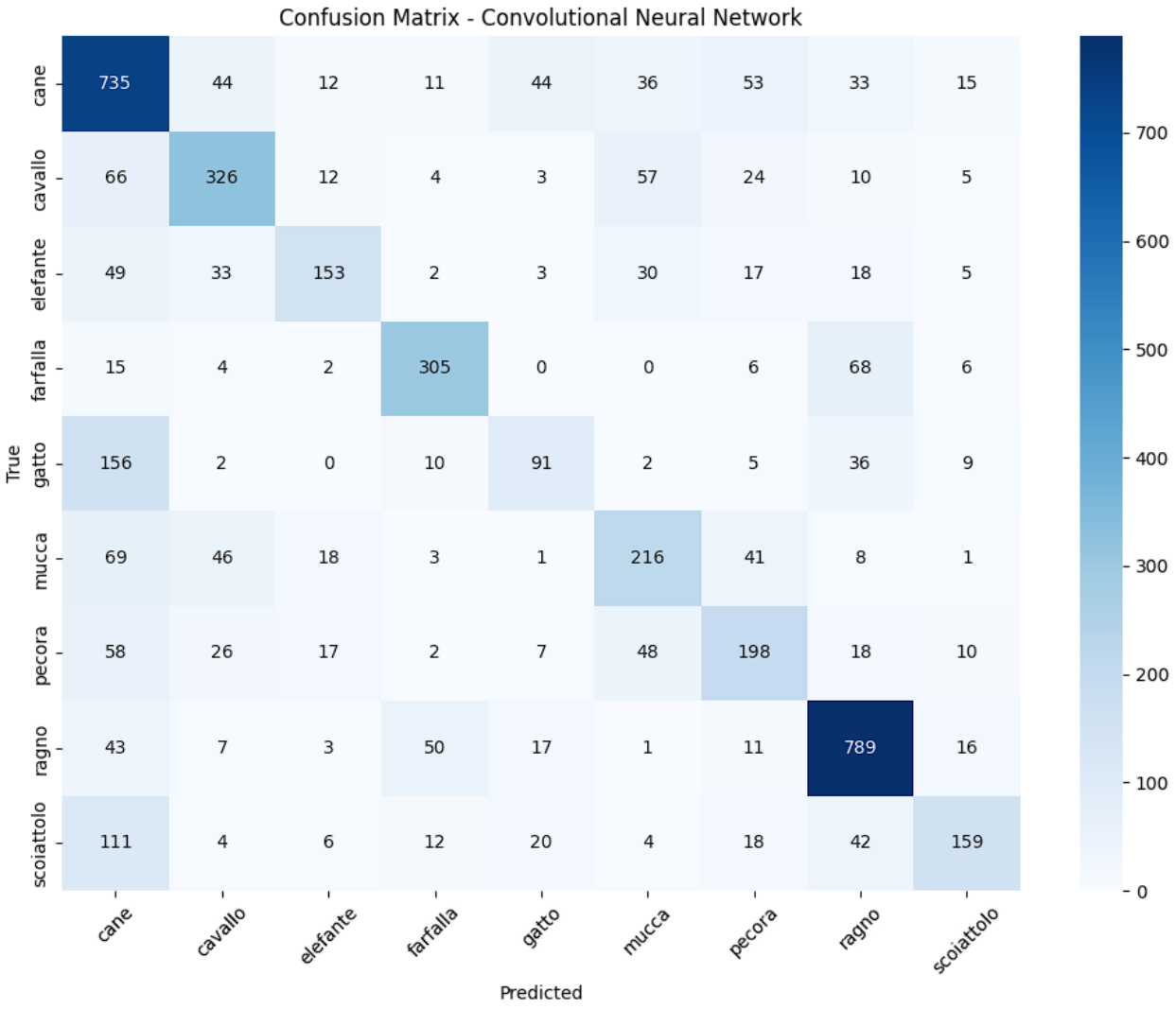

Confusion Matrix - Feed-Forward Neural Network
True
cane
cavallo
elefante
farfalla
gatto
mucca
pecora
ragno
scoiattolo
0 0 0 0 0 0 0 983 0
0 0 0 0 0 0 0 507 0
0 0 0 0 0 0 0 310 0
2 0 0 1 0 0 0 403 0
0 0 0 0 0 0 0 311 0
0 0 0 0 0 0 0 403 0
0 0 0 0 0 0 0 384 0
0 0 0 0 0 0 0 937 0
0 0 0 0 0 0 0 376 0
cane
cavallo
elefante
farfalla
gatto
mucca
pecora
ragno
scoiattolo
Predicted
800
600
400
200
0

```
Running Convolutional Neural Network...
/usr/local/lib/python3.10/dist-packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not pass an `input
When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 44s 93ms/step - accuracy: 0.2650 - loss: 2.0237 - val_accuracy: 0.4308 - val_loss: 1.6340
Epoch 2/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 42s 91ms/step - accuracy: 0.4232 - loss: 1.6085 - val_accuracy: 0.5045 - val_loss: 1.4673
Epoch 3/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 81s 90ms/step - accuracy: 0.4867 - loss: 1.4283 - val_accuracy: 0.5435 - val_loss: 1.3408
Epoch 4/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 82s 90ms/step - accuracy: 0.5324 - loss: 1.3306 - val_accuracy: 0.5665 - val_loss: 1.2408
Epoch 5/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 42s 90ms/step - accuracy: 0.5753 - loss: 1.2146 - val_accuracy: 0.5792 - val_loss: 1.2094
Epoch 6/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 42s 91ms/step - accuracy: 0.5987 - loss: 1.1440 - val_accuracy: 0.5903 - val_loss: 1.1742
Epoch 7/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 43s 93ms/step - accuracy: 0.6226 - loss: 1.0741 - val_accuracy: 0.6131 - val_loss: 1.1238
Epoch 8/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 42s 91ms/step - accuracy: 0.6337 - loss: 1.0191 - val_accuracy: 0.6168 - val_loss: 1.1026
Epoch 9/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 82s 92ms/step - accuracy: 0.6652 - loss: 0.9430 - val_accuracy: 0.6047 - val_loss: 1.1376
Epoch 10/10
462/462 ━━━━━━━━━━━━━━━━━━━━ 86s 100ms/step - accuracy: 0.6802 - loss: 0.8934 - val_accuracy: 0.6320 - val_loss: 1.0893
145/145 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step
```

Convolutional Neural Network Results:
Accuracy: 0.6437080355209011

Classification Report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| cane | 0.56 | 0.75 | 0.64 | 983 |
| cavallo | 0.66 | 0.64 | 0.65 | 507 |
| elefante | 0.69 | 0.49 | 0.57 | 310 |
| farfalla | 0.76 | 0.75 | 0.76 | 406 |
| gatto | 0.49 | 0.29 | 0.37 | 311 |
| mucca | 0.55 | 0.54 | 0.54 | 403 |
| pecora | 0.53 | 0.52 | 0.52 | 384 |
| ragno | 0.77 | 0.84 | 0.81 | 937 |
| scoiattolo | 0.70 | 0.42 | 0.53 | 376 |
| accuracy | | | 0.64 | 4617 |
| macro avg | 0.64 | 0.58 | 0.60 | 4617 |
| weighted avg | 0.65 | 0.64 | 0.64 | 4617 |


Confusion Matrix - Convolutional Neural Network
True
Predicted
cane
cavallo
elefante
farfalla
gatto
mucca
pecora
ragno
scoiattolo
735 44 12 11 44 36 53 33 15
66 326 12 4 3 57 24 10 5
49 33 153 2 3 30 17 18 5
15 4 2 305 0 0 6 68 6
156 2 0 10 91 2 5 36 9
69 46 18 3 1 216 41 8 1
58 26 17 2 7 48 198 18 10
43 7 3 50 17 1 11 789 16
111 4 6 12 20 4 18 42 159
700
600
500
400
300
200
100
0