

# CS 105 Final Project: Animal Classifier

Hallie Pham (hpham087), Divyank Shah (dshah048), Nicholas Kang (nkang017), Majd Kawak (mkawa025), Ben Bravo (bbrav013)

For this project, our group decided to create a model that could accurately an animal's species based on an image. This involved building a CNN (Convolutional Neural Network), which is a form of supervised learning.

We are using a CNN because CNN's have something called translation invariance, where they can recognize the subject of the image regardless of the position of the subject in the photo. This is important for animal photos where we are unsure where the animal subject is located in the picture. WE also use ReLU. Essentially, ReLU, short for Rectified Linear Unit, helps our model by keeping only the positive values and ditching the negatives after each convolution layer. So, by leveraging ReLU, we're setting ourselves up for a smoother and more effective learning process, making our animal classification task a lot more accurate.

Our project goal is for our model to be able to accurately classify animal species from a new image it has never seen, and to integrate this functionality onto a website that will interface with the model so that the user can upload any photo and it will be classified correctly.

The types of animals we can classify are as followed:

1. Bear
2. Cat
3. Eagle
4. Dog
5. Cow
6. Gorilla

The data we have used are from the following sites:

- <https://www.csc.kth.se/~heydarma/Datasets.html>
- <https://images.cv/category/animal>
- <https://images.cv/animals-labeled-image-dataset>

For each classification of animal, we used around 1,500 images per class.

# Training

```
In [ ]: ! pip install tensorflow
! pip install keras
```

```
In [ ]: import tensorflow as tf
import keras

print(tf.version.VERSION)
print(keras.__version__)
```

```
In [ ]: from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D, GlobalAveragePooling2D, Dense
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import EarlyStopping, ModelCheckpoint
import matplotlib.pyplot as plt
```

## Preprocessing

To preprocess our data, we are scaling our images then normalizing them. For training, we are splitting our data into training and validation sets at a ratio of 70% for training and 30% for validation. We also convert the images as grayscale to reduce our color channels from RGB (3) to GRAYSCALE (1) to reduce the overall computation required. In addition, the values are normalized such that they range from 0 - 1 instead of 0 - 255

```
In [ ]: # Data Preprocessing and Augmentation
train_datagen = ImageDataGenerator(
    # Scales each pixel value in the image from a range of 0-255 to 0-1 for
    rescale=1./255,
    # Split the data into training (70%) and validation (30%)
    validation_split=0.3,
)

# Validation Data
validation_datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.3
)

# Flow training images in batches of 32 using train_datagen generator
train_generator = train_datagen.flow_from_directory(
    'animal_database/',
    target_size=(150, 150), # All images will be resized to 150x150
    batch_size=32,
    class_mode='categorical',
    subset='training', # Set as training data
```

```

        color_mode="grayscale",
    )

    # Flow validation images in batches of 32 using validation_datagen generator
    validation_generator = validation_datagen.flow_from_directory(
        'animal_database/',
        target_size=(150, 150),
        batch_size=32,
        class_mode='categorical',
        subset='validation', # Set as validation data
        color_mode="grayscale",
    )

    class_indices = train_generator.class_indices
    print(class_indices)

```

Found 5782 images belonging to 6 classes.

Found 2473 images belonging to 6 classes.

```
{'bear': 0, 'cat': 1, 'cow': 2, 'dog': 3, 'eagle': 4, 'gorilla': 5}
```

```

In [ ]: # Model Architecture
model = Sequential([
    # First convolutional block
    Conv2D(32, (3, 3), activation='relu', input_shape=(150, 150, 1)),
    BatchNormalization(),
    MaxPooling2D(2, 2),
    Dropout(0.25),

    # Second convolutional block
    Conv2D(64, (3, 3), activation='relu'),
    BatchNormalization(),
    Conv2D(64, (3, 3), activation='relu'),
    BatchNormalization(),
    MaxPooling2D(2, 2),
    Dropout(0.25),

    # Third convolutional block
    Conv2D(128, (3, 3), activation='relu'),
    BatchNormalization(),
    Conv2D(128, (3, 3), activation='relu'),
    BatchNormalization(),
    MaxPooling2D(2, 2),
    Dropout(0.25),

    # Fourth convolutional block
    Conv2D(256, (3, 3), activation='relu'),
    BatchNormalization(),
    Conv2D(256, (3, 3), activation='relu'),
    BatchNormalization(),
    GlobalAveragePooling2D(),

```

```

Dropout(0.5),

# Fully connected layers
Dense(512, activation='relu'),
BatchNormalization(),
Dropout(0.5),
Dense(train_generator.num_classes, activation='softmax')
])

```

/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-packages/keras/src/layers/convolutional/base\_conv.py:99: UserWarning: Do not pass an `input\_shape`/`input\_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

```
super().__init__(
```

```

In [ ]: # Compile the model
model.compile(optimizer='adam',
              loss='categorical_crossentropy',
              metrics=['accuracy'])

# Define early stopping callback
# If the validation accuracy does not improve (increase, since mode='max') t
early_stopping = EarlyStopping(
    monitor='val_accuracy',
    patience=20,
    mode='max',
    restore_best_weights=True,
    verbose=1
)

# Train your model
history = model.fit(
    train_generator,
    steps_per_epoch=train_generator.samples // train_generator.batch_size,
    epochs=50,
    validation_data=validation_generator,
    validation_steps=validation_generator.samples // validation_generator.ba
    callbacks=[early_stopping]
)

```

Epoch 1/200

/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-packages/keras/src/trainers/data\_adapters/py\_dataset\_adapter.py:122: UserWarning: Your `PyDataset` class should call `super().\_\_init\_\_(\*\*kwargs)` in its constructor. `\*\*kwargs` can include `workers`, `use\_multiprocessing`, `max\_queue\_size`. Do not pass these arguments to `fit()`, as they will be ignored.

```
self._warn_if_super_not_called()
```

**180/180** ————— **135s** 737ms/step – accuracy: 0.3251 – loss: 2.1960 – val\_accuracy: 0.1944 – val\_loss: 7.1372  
Epoch 2/200

**180/180** ————— **1s** 394us/step – accuracy: 0.4375 – loss: 0.7838 – val\_accuracy: 0.1111 – val\_loss: 4.4725  
Epoch 3/200

2024-03-18 02:11:25.665143: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]  
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/contextlib.py:158: UserWarning: Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps\_per\_epoch \* epochs` batches. You may need to use the `.repeat()` function when building your dataset.  
self.gen.throw(value)  
2024-03-18 02:11:25.719092: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **129s** 715ms/step – accuracy: 0.5517 – loss: 1.3413 – val\_accuracy: 0.1786 – val\_loss: 3.9029  
Epoch 4/200

**180/180** ————— **1s** 323us/step – accuracy: 0.5938 – loss: 0.6211 – val\_accuracy: 0.0000e+00 – val\_loss: 2.5858  
Epoch 5/200

2024-03-18 02:13:35.533933: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]  
2024-03-18 02:13:35.585621: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **126s** 699ms/step – accuracy: 0.6554 – loss: 1.0001 – val\_accuracy: 0.3003 – val\_loss: 2.0703  
Epoch 6/200

**180/180** ————— **1s** 344us/step – accuracy: 0.7812 – loss: 0.3741 – val\_accuracy: 0.3333 – val\_loss: 1.2028  
Epoch 7/200

2024-03-18 02:15:42.387061: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]  
2024-03-18 02:15:42.439351: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **128s** 710ms/step – accuracy: 0.7120 – loss: 0.8268 – val\_accuracy: 0.5929 – val\_loss: 1.2634  
Epoch 8/200

**180/180** ————— **1s** 323us/step – accuracy: 0.8125 – loss: 0.3081 – val\_accuracy: 0.4444 – val\_loss: 0.8002  
Epoch 9/200

```
2024-03-18 02:17:51.432496: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 02:17:51.484522: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

**180/180** ————— **129s** 713ms/step - accuracy: 0.7571 - loss: 0.7190 - val\_accuracy: 0.5146 - val\_loss: 1.9126  
Epoch 10/200

**180/180** ————— **1s** 334us/step - accuracy: 0.6875 - loss: 0.5074 - val\_accuracy: 0.5556 - val\_loss: 0.6622  
Epoch 11/200

```
2024-03-18 02:20:01.150149: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 02:20:01.203733: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

**180/180** ————— **129s** 713ms/step - accuracy: 0.7906 - loss: 0.6141 - val\_accuracy: 0.6307 - val\_loss: 1.3296  
Epoch 12/200

**180/180** ————— **1s** 316us/step - accuracy: 0.6875 - loss: 0.3213 - val\_accuracy: 0.6667 - val\_loss: 0.5673  
Epoch 13/200

```
2024-03-18 02:22:10.570116: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 02:22:10.617608: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

**180/180** ————— **132s** 731ms/step - accuracy: 0.7963 - loss: 0.5812 - val\_accuracy: 0.4850 - val\_loss: 2.2113  
Epoch 14/200

**180/180** ————— **1s** 377us/step - accuracy: 0.7188 - loss: 0.3140 - val\_accuracy: 0.3333 - val\_loss: 2.4738  
Epoch 15/200

```
2024-03-18 02:24:23.250516: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 02:24:23.311156: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

**180/180** ————— **133s** 735ms/step - accuracy: 0.8228 - loss: 0.5189 - val\_accuracy: 0.7171 - val\_loss: 0.9988  
Epoch 16/200

**180/180** ————— **1s** 324us/step - accuracy: 0.9375 - loss: 0.1295 - val\_accuracy: 0.7778 - val\_loss: 0.3187  
Epoch 17/200

2024-03-18 02:26:36.817354: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:26:36.866909: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **130s** 723ms/step - accuracy: 0.8520 - loss: 0.4235 - val\_accuracy: 0.6830 - val\_loss: 1.4923  
Epoch 18/200

**180/180** ————— **1s** 371us/step - accuracy: 0.8125 - loss: 0.2867 - val\_accuracy: 0.5556 - val\_loss: 0.8052  
Epoch 19/200

2024-03-18 02:28:48.027205: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:28:48.085873: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **134s** 742ms/step - accuracy: 0.8540 - loss: 0.4054 - val\_accuracy: 0.4501 - val\_loss: 2.5939  
Epoch 20/200

**180/180** ————— **1s** 304us/step - accuracy: 0.7812 - loss: 0.2522 - val\_accuracy: 0.2222 - val\_loss: 2.6215  
Epoch 21/200

2024-03-18 02:31:02.845360: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:31:02.893033: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **131s** 726ms/step - accuracy: 0.8703 - loss: 0.3867 - val\_accuracy: 0.5081 - val\_loss: 2.3394  
Epoch 22/200

**180/180** ————— **1s** 313us/step - accuracy: 0.8750 - loss: 0.1956 - val\_accuracy: 0.4444 - val\_loss: 1.2291  
Epoch 23/200

2024-03-18 02:33:14.583222: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:33:14.632655: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **133s** 737ms/step - accuracy: 0.8819 - loss: 0.3359 - val\_accuracy: 0.7058 - val\_loss: 1.0980  
Epoch 24/200

**180/180** ————— **1s** 350us/step - accuracy: 0.9062 - loss: 0.1494 - val\_accuracy: 0.4444 - val\_loss: 1.0845  
Epoch 25/200



2024-03-18 02:35:28.587950: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:35:28.643398: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **132s** 731ms/step - accuracy: 0.8892 - loss: 0.3331 - val\_accuracy: 0.7500 - val\_loss: 0.9034  
Epoch 26/200

**180/180** ————— **1s** 325us/step - accuracy: 0.8125 - loss: 0.3478 - val\_accuracy: 0.5556 - val\_loss: 0.5845  
Epoch 27/200

2024-03-18 02:37:41.312247: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:37:41.363552: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **133s** 737ms/step - accuracy: 0.9103 - loss: 0.2665 - val\_accuracy: 0.7370 - val\_loss: 0.8896  
Epoch 28/200

**180/180** ————— **1s** 323us/step - accuracy: 0.8750 - loss: 0.1839 - val\_accuracy: 0.7778 - val\_loss: 0.2158  
Epoch 29/200

2024-03-18 02:39:55.114527: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:39:55.166098: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **135s** 747ms/step - accuracy: 0.9010 - loss: 0.3056 - val\_accuracy: 0.7833 - val\_loss: 0.7796  
Epoch 30/200

**180/180** ————— **1s** 375us/step - accuracy: 0.8438 - loss: 0.2471 - val\_accuracy: 0.8889 - val\_loss: 0.0799  
Epoch 31/200

2024-03-18 02:42:10.923368: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:42:10.980988: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **134s** 740ms/step - accuracy: 0.9130 - loss: 0.2487 - val\_accuracy: 0.8166 - val\_loss: 0.7391  
Epoch 32/200

**180/180** ————— **1s** 328us/step - accuracy: 0.9375 - loss: 0.0778 - val\_accuracy: 0.6667 - val\_loss: 0.7172  
Epoch 33/200



2024-03-18 02:44:25.319322: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:44:25.371254: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **134s** 743ms/step - accuracy: 0.9142 - loss: 0.2501 - val\_accuracy: 0.7541 - val\_loss: 1.0047  
Epoch 34/200

**180/180** ————— **1s** 306us/step - accuracy: 0.9375 - loss: 0.0951 - val\_accuracy: 0.7778 - val\_loss: 1.2329  
Epoch 35/200

2024-03-18 02:46:40.234739: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:46:40.282381: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **134s** 745ms/step - accuracy: 0.9220 - loss: 0.2311 - val\_accuracy: 0.8348 - val\_loss: 0.6111  
Epoch 36/200

**180/180** ————— **1s** 387us/step - accuracy: 0.9375 - loss: 0.1630 - val\_accuracy: 0.8889 - val\_loss: 0.1702  
Epoch 37/200

2024-03-18 02:48:55.694212: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:48:55.753963: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **133s** 735ms/step - accuracy: 0.9232 - loss: 0.2051 - val\_accuracy: 0.8145 - val\_loss: 0.7253  
Epoch 38/200

**180/180** ————— **1s** 317us/step - accuracy: 0.8750 - loss: 0.1261 - val\_accuracy: 0.7778 - val\_loss: 0.2071  
Epoch 39/200

2024-03-18 02:51:09.108576: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:51:09.158657: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **133s** 734ms/step - accuracy: 0.9401 - loss: 0.1806 - val\_accuracy: 0.8287 - val\_loss: 0.6662  
Epoch 40/200

**180/180** ————— **1s** 325us/step - accuracy: 1.0000 - loss: 0.0285 - val\_accuracy: 0.8889 - val\_loss: 0.1946  
Epoch 41/200

2024-03-18 02:53:22.484987: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:53:22.535839: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **134s** 742ms/step - accuracy: 0.9388 - loss: 0.1700 - val\_accuracy: 0.7691 - val\_loss: 1.1556  
Epoch 42/200

**180/180** ————— **1s** 332us/step - accuracy: 0.9688 - loss: 0.0285 - val\_accuracy: 0.5556 - val\_loss: 1.2106  
Epoch 43/200

2024-03-18 02:55:37.212744: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:55:37.263995: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **126s** 697ms/step - accuracy: 0.9516 - loss: 0.1436 - val\_accuracy: 0.6778 - val\_loss: 1.4656  
Epoch 44/200

**180/180** ————— **1s** 330us/step - accuracy: 0.9375 - loss: 0.1109 - val\_accuracy: 0.7778 - val\_loss: 0.4850  
Epoch 45/200

2024-03-18 02:57:43.903062: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:57:43.955257: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **126s** 700ms/step - accuracy: 0.9450 - loss: 0.1771 - val\_accuracy: 0.8072 - val\_loss: 0.7234  
Epoch 46/200

**180/180** ————— **1s** 313us/step - accuracy: 0.9062 - loss: 0.1062 - val\_accuracy: 0.8889 - val\_loss: 0.4389  
Epoch 47/200

2024-03-18 02:59:51.062758: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

2024-03-18 02:59:51.112021: W tensorflow/core/framework/local\_rendezvous.cc:404] Local rendezvous is aborting with status: OUT\_OF\_RANGE: End of sequence  
[[{{node IteratorGetNext}}]]

**180/180** ————— **131s** 727ms/step - accuracy: 0.9500 - loss: 0.1518 - val\_accuracy: 0.8214 - val\_loss: 0.6750  
Epoch 48/200

**180/180** ————— **1s** 414us/step - accuracy: 0.9375 - loss: 0.1051 - val\_accuracy: 0.7778 - val\_loss: 0.4377  
Epoch 49/200

```
2024-03-18 03:02:03.365429: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 03:02:03.433481: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

```
180/180 ————— 128s 710ms/step - accuracy: 0.9493 - loss: 0.15
26 - val_accuracy: 0.8377 - val_loss: 0.5922
Epoch 50/200
180/180 ————— 1s 335us/step - accuracy: 0.9688 - loss: 0.0615
- val_accuracy: 0.8889 - val_loss: 0.2354
Epoch 50: early stopping
Restoring model weights from the end of the best epoch: 30.
```

```
2024-03-18 03:04:12.528241: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
2024-03-18 03:04:12.581489: W tensorflow/core/framework/local_rendezvous.cc:
404] Local rendezvous is aborting with status: OUT_OF_RANGE: End of sequence
[[{{node IteratorGetNext}}]]
```

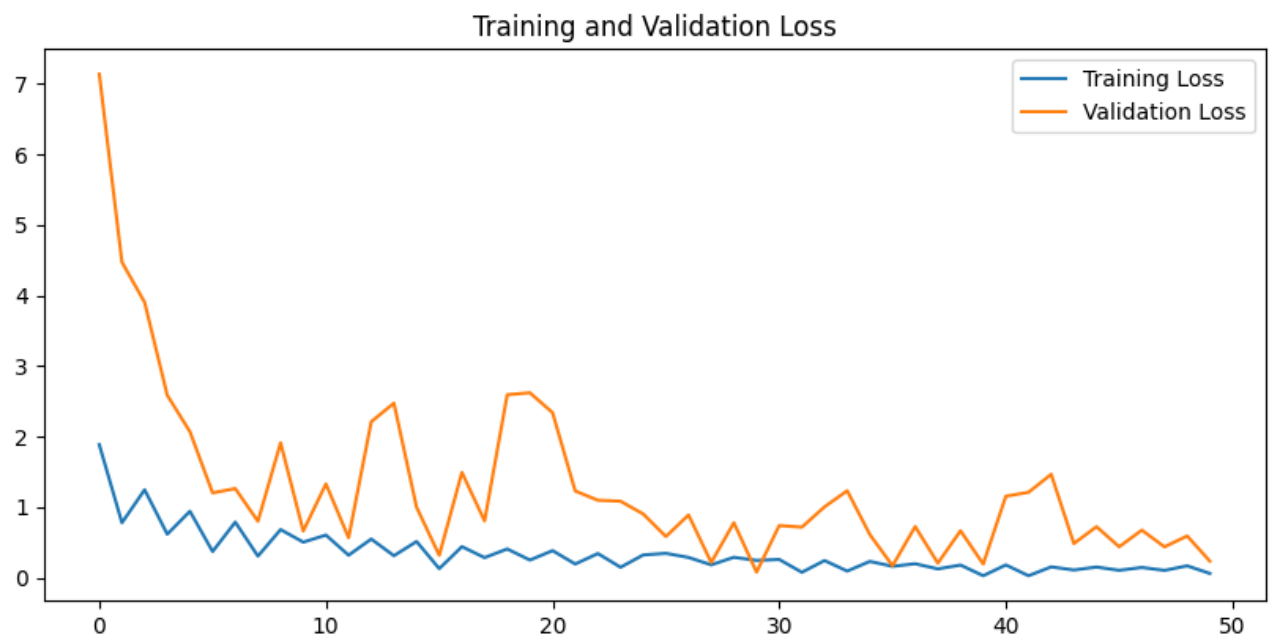
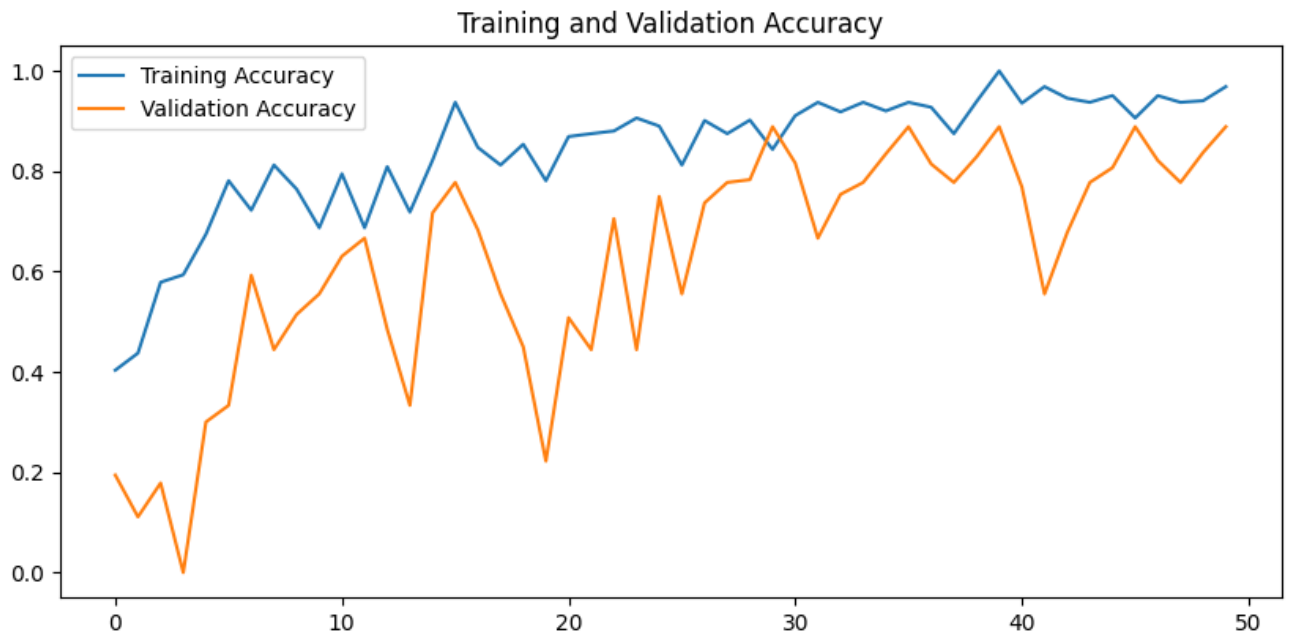
Notice, when we run model fit, the model's accuracy increases with each run. The ending accuracy was 96.88% after being trained on 1.5k photos. We initially trained the model with only about 100 photos per class and the accuracy was only 56.8%.

```
In [ ]: # Plotting Training Results
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
loss = history.history['loss']
val_loss = history.history['val_loss']

plt.figure(figsize=(10, 10))
plt.subplot(211)
plt.plot(acc, label='Training Accuracy')
plt.plot(val_acc, label='Validation Accuracy')
plt.title('Training and Validation Accuracy')
plt.legend()

plt.subplot(212)
plt.plot(loss, label='Training Loss')
plt.plot(val_loss, label='Validation Loss')
plt.title('Training and Validation Loss')
plt.legend()

plt.show()
```



```
In [ ]: model.save('animals.keras')
```