Bear Identification and Analysis
for people that are bear enthusists

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[1]Dr.Liu Intro to Artificial Intelligence class. Cap 4630

Abstract

This application is a React app that communicates with a Python back end that uses fast API to communicate via a web API. The application has a data set about bears that the model is trained on, we used this data set here for our testing. https://www.kaggle.com/datasets/hoturam/bear-dataset .

Introduction

The project was conducted to educate users about bears and to let them know more about endangered bear species and educate users that bears are not scary mean creatures but great and interesting animals. The motivation came from the groups love of bears and how cool we thought they where. The group also felt the desire to do a image classifier because this was the first time in our group that any of us have implemented such a program. The bears we have in this program that the application will classify and retort facts about is.

- Polar Bear
- Panda Bear
- Black Bear
- Teddy Bear
- Grizzly Bear

Related work

This project is a image classifier which has been implemented by many people before. However there has been much work done with deep learning or image classifications. Particularly like the way we did with using Keras to build a neural network and then TensorFlow to train and allow the model to make predictions. The algorithm we used allowed for the model to be trained and in a efficient manor thus allowing us to train the data set more accurately.

Inspiration and some starting point for our early implementation came from. https://www.tensorflow.org/tutorials/keras/classification

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Methodologies/algorithms/approaches

For this project we used Python programming language for the machine learning and the prediction along with our restful web API. The other language we used was Typescript with the react library to build out our front end. The libraries we used are **Python libraries**

- Numpy
- TensorFlow(used for back end model)
- Pillow(used for back end model)
- fastapi (used for the web server)
- "uvicorn[standard]" (used for the web server)

Typescript Libraries

- Axios

After the data directory path is set and the names of the classes are obtained from the sub directories within the data directory.

The images are prepossessed using Keras' ImageData-Generator to resize them to a uniform size of 128x128 and set the validation split to 0.2. Transfer learning is used, with a pre-trained VGG16 model being loaded and the last layer removed. A new neural network is then built on top of the VGG16 model, consisting of a Flatten layer, a dense layer with 256 units, a dropout layer, and a final dense layer with the number of output classes as the number of units and softmax activation function. The reason we used a pre-trained model like VGG16 instead of building a model from scratch is because we initially achieved an accuracy of only 75

The model is compiled with the Adam optimizer and categorical cross-entropy loss function, and the fit() function is used to train the model with the training and validation generators, with the number of epochs set to 20. The trained model is saved as a .h5 file, and the evaluate() function is used to evaluate the model's performance on the validation set, with the test loss and accuracy being printed.

Finally, a new image is loaded and preprocessed for prediction by resizing it to 128x128 and converting it to a NumPy array. The model's predict() function is used to make a prediction on the new image. This methodology shows how to build a deep learning model using transfer learning, pre-processing data, compiling, and training the model, and evaluating the model's performance. The image used for the predict() is obtained by receiving a POST request from the

front end where the user uploads a photo of a bear to be identified. Then, once the bear is identified, the result is returned to the front end.

Experiments and results

At the start of testing we first build-model.py file which is where our data is built. The below output is what the model returns when building out our bear model.

```
Total image count: 309
Image dimensions: 312 x 162
Label names: ['black', 'grizzly', 'panda', 'polar', 'teddy']
Label counts: [68, 46, 45, 100, 50]
Found 248 images belonging to 5 classes.
Found 61 images belonging to 5 classes.
Epoch 1/20
7/7 [==============================] - 5s 661ms/step -
loss: 13.4139 - accuracy: 0.2222 -
val_loss: 1.8837 - val_accuracy: 0.2500
....

...
Epoch 20/20
7/7 [==============================] - 4s 524ms/step - loss: 0.1                                  uracy: 0.8125
2/2 [==============================] - 1s 422ms/step - loss: 0.5
Test loss: 0.5762965679168701
Test accuracy: 0.8196721076965332
```

After the model was built we tested it in a TensorFlow python file where we modified the image the file would predict the class for and see what results would be returned for a picture of a panda or of a polar bear. Below is the listed output we would expect to get from it to verify if the model was correct or not with its prediction.

```
1/1 [==============================] - 0s 82ms/step
Predicted class: grizzly
```

Once we knew the model was predicting correctly we then moved on to making a react front end for our back end.

Bear Type Identification and Facts

Browse... No file selected.   Upload

Here is our react website without out and the back end connected to it.We found during testing

Once we had both of our pieces created we then worked on implementing a server for this we used fast API to make a API for our front end and back end to communicate functioning as middle ware. Below is output of us turning on our API and making sure out back-end comes online allowing us to see if our connection is ready for the react app to start up.

```
INFO: Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to qu
INFO:     Started reloader process [22540] using WatchFiles
1/1 [==============================] - 0s 270ms/step
Predicted class: grizzly
INFO:     Started server process [6084]
```

```
INFO:     Waiting for application startup.
INFO:     Application startup complete.
```

After this was executed we then tested our react front end with our python model to see if it could identify bears and display the proper facts about them.

Panda Bear

Scientific Name: Ailuropoda melanoleuca

Population: 1864

Extinction Status: Endangered Species

Type: Herbivore

Diet: Bamboo

Location: Bamboo forests of Shaanxi, Sichuan, and Gansu provinces of China

Facts:

- The typical panda grows from 1.2m to 1.9m.
- Pandas are native to south-central China.
- In captivity, the average lifespan of a panda is 30 years.
- Pandas typically weigh from 70kg to 100kg.
- An estimated 1,864 pandas still roam the wild, while 400 are kept in capitvity.
- Newly-born pandas are only as big as a stick of butter.
- Pandas have the digestive system of a carnivore.
- Pandas in captivity are omnivorous.
- The panda's name comes from the Nepalese word 'Nigalya Ponya'.
- Scientists are uncertain why pandas have their color patterns.
- Male pandas usually grow bigger than female pandas.
- Wild pandas have a lifespan of 20 years.
- Pandas do not hibernate.
- Pandas are the only bears with thumbs.
- Pandas are strong climbers and swimmers.

This is a picture of a panda bear image being classified

Black Bear

Scientific Name: Ursus americanus

Population: Between 339,000 and 465,000

Extinction Status: Not Endangered

Type: Omnivore

Diet: Plants, fruits, insects, birds, eggs, fish, animals

Location: North America, Asia

Facts:

- A black bear's head alone can measure up to 13 inches long.
- A black bear's paw can measure up to 10 inches long.
- A male black bear averages a weight of around 154 kg.
- A female black bear averages a weight of around 106 kg.
- The biggest black bear ever recorded reached a weight of around 500 kg.
- Black bears can run at a speed of 48 kph.
- Black bears diverged from brown bears and polar bears around 5.05 million years ago.
- Teddy Roosevelt gained his nickname by refusing to shoot a black bear cub in 1902.
- Humans began hunting the black bear between 11,000 and 10,000 B.C.
- More black bears live in the world than every other bear species combined.
- Black bears can identify colors better than even chimpanzees.
- American black bears have a reputation for attacking humans.
- American black bears are known to attack livestock.
- Black bear hunting peaked during the 18th and 19th centuries.
- American and Asian black bears have subtle physical differences from eachother.

This is a picture of a black bear image being classified

Polar Bear

Scientific Name: Ursus maritimus

Population: Between 21,000 and 32,000

Extinction Status: Endangered

Type: Carnivore

Diet: Meat

Location: Arctic Circle

Facts:

- Adult polar bears can live up to 30 years.
- Polar bears weigh between 150 to at least 600 kg.
- Newborn polar bears weigh just like a guinea pig.
- Female polar bears can concieve at least 5 litter cubs in its lifetime.
- Canada houses roughly 60% of the whole polar bear population.
- Polar bears are considered to be the largest carnivore on land.
- Although polar bears spend most of their time hunting, successful hunts are only at 2%.
- Polar bears are fond of "snow baths" to clean their dirty furs after hunting.
- A polar bear's blubber, or layer of fat, allows them to survive the harsh environment in the arctic.
- Female polar bears give birth in November and December in snow dens to protect the cubs.
- The cub follows the mother polar bear to learn hunting and survival skills for 2 years.
- White classic polar bears have black skin.
- Polar bears can experience overheating despite the cold.
- Polar bears are fast on land and in water.
- A single seal could keep a polar bear full for 8 days.

**This is a picture of a polar bear image being classified**
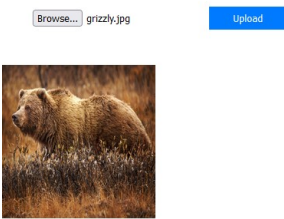
Grizzly Bear

Scientific Name: Ursus arctos horribilis

Population: 55000

Extinction Status: Not Endangered

Type: Omnivore

Diet: Fleshy roots, fruits, berries, grasses, insects, salmon, mammals

Location: North America

Facts:

- In the wild, grizzly bears can live between 25 to 30 years.
- In captivity, grizzly bears can live for more than 40 years.
- When a grizzly bear stands on 2 legs, its height can reach up to 8 feet tall.
- Grizzly bears can run up to 62 kilometers per hour.
- Around 30,000 grizzlies live in Alaska alone.
- Experts believe that the grizzly bear is the strongest bear.
- The alternative name for a grizzly is the North American brown bear.
- The male grizzly can weigh more than 250kg, or 551 pounds.
- Grizzly bears are territorial.
- The oldest grizzly bear who lived in the wild reached 39 years of age.
- The largest grizzly bear ever found weighed over 700kg.

This is a picture of a grizzly bear image being classified

The model despite its accuracy had some failures too
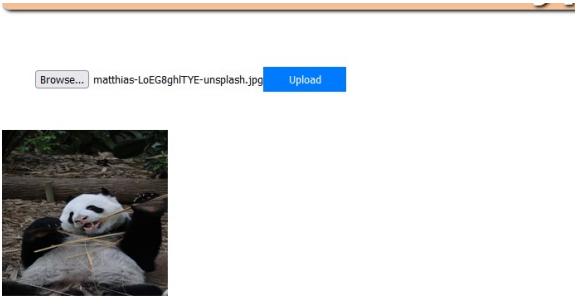

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Facts:

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- Newborn polar bears weigh just like a guinea pig.
- Female polar bears can concieve at least 5 litter cubs in its lifetime.
- Canada houses roughly 60% of the whole polar bear population.
- Polar bears are considered to be the largest carnivore on land.

The model is still very accurate and can predict bears at high rates but sometimes it still fails since its at **81 percent accuracy** which is very high and very good.
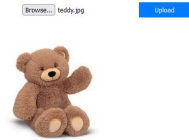
Teddy Bear

Scientific Name: N/A

Population: N/A

Extinction Status: N/A

Type: N/A

Diet: N/A

Location: Worldwide

Facts:

- The 'Teddy Bear' was named after President Theodore Roosevelt after he refused to shoot a bear during a Mississippi hunting trip in November 1902.
- The largest collection of teddy bears is 20,367.
- The largest teddy bear measures 19.41 m (63 ft 8 in) in length.
- A Steiff 'Louis Vuitton' teddy bear made in 2000 and measuring 45 cm, sold for $182,550.
- The smallest commercially available stitched teddy bear measures 9 mm.
- The longest line of teddy bears consists of 15,534 bears and measured 2,106 m (6,909 ft 5.22 in).
- Teddy Bear is considered as a symbol of sympathy, congratulation and love. People like to buy Teddy Bears as a present for adults or kids.

This is a picture of a teddy bear image being classified

After completion of these steps we then finalized that our application was working correctly.

There is a folder in this directory called Bears Testing images which contains the images that can be used for testing the program.

Conclusions

Over the course of this project our team learned a whole lot about machine learning and each got a basis that leads to a better understanding of not only development but of machine learning and a greater understanding of python projects. We learned about accuracy with models and how important that plays in training and in other research.One key aspect we took into consideration is that the size of the data set can dictate the complexity of the project. Even with our data set of around 400 pictures we still found out that optimizing and time to build the model played a pivotal role in accuracy.

Cameron's favorite thing was seeing the react connect to our back end and having the model being able to classify it. Cameron said he learned the most out of training a model and how a model should run and classify images.

Brian's favorite part was learning how the neural network is created and understanding how it can be used to create an image classifier. Brian learned

Aboubacar learn about how to build a neural network and how to improve the accuracy of your model by using a pre-trained model and fine tune it with the data set. Aboubacar also learned how to re scale the images to acceptable input in the model creation

References

Our data set

- https://www.kaggle.com/datasets/hoturam/bear-dataset

  Technical Documentation

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  Bear knowledge

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Thank you for reading these instructions carefully. We look forward to you grading soon!