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July 25, 2024

[ ]:
```
# AI & Deep Learning-Transfer learning

1.Build an image classification using  transfer learning(VGG19)on CIFAR 10 data␣
↪set(keras package).
2.Build an image classification using  transfer learning on horses or human␣
↪dataset.
Data Set:https://www.kaggle.com/datasets/sanikamal/horses-or-humans-dataset

What Kind Of Approach You Could Follow for your Problem Statements :

Reading the Data, Understanding the Data, Exploratory Data Analysis, Splitting␣
↪the Data, Training and Testing, Modeling, Accuracy

Hints provided are only for your references or getting started. You're free to␣
↪use your own methodology to work on your assignments.
```

[1]:
```
# Import necessary libraries
import tensorflow as tf
from tensorflow.keras.datasets import cifar10
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.applications import VGG19
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.losses import SparseCategoricalCrossentropy
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.model_selection import train_test_split
import os
```

[2]:
```
# Download and extract dataset from Kaggle
!pip install kaggle
from google.colab import files
files.upload() # Upload kaggle.json file here
```

```
Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-packages
(1.6.14)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.10/dist-
```

```
packages (from kaggle) (1.16.0)
Requirement already satisfied: certifi>=2023.7.22 in
/usr/local/lib/python3.10/dist-packages (from kaggle) (2024.6.2)
Requirement already satisfied: python-dateutil in
/usr/local/lib/python3.10/dist-packages (from kaggle) (2.8.2)
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-
packages (from kaggle) (2.31.0)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages
(from kaggle) (4.66.4)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-
packages (from kaggle) (8.0.4)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-
packages (from kaggle) (2.0.7)
Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages
(from kaggle) (6.1.0)
Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-
packages (from bleach->kaggle) (0.5.1)
Requirement already satisfied: text-unidecode>=1.3 in
/usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle) (1.3)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
packages (from requests->kaggle) (3.7)
```

```
<IPython.core.display.HTML object>
```

```
Saving kaggle (1).json to kaggle (1).json
```

[2]:


```
{'kaggle (1).json':
b'{"username":"shah1111","key":"40110658890d20f20a4d07775b8cc4e5"}'}
```


[5]:

```
# Download the dataset
!kaggle datasets download -d sanikamal/horses-or-humans-dataset
```

```
Dataset URL: https://www.kaggle.com/datasets/sanikamal/horses-or-humans-dataset
License(s): other
Downloading horses-or-humans-dataset.zip to /content
 94% 289M/307M [00:03<00:00, 108MB/s]
100% 307M/307M [00:03<00:00, 86.1MB/s]
```

[6]:

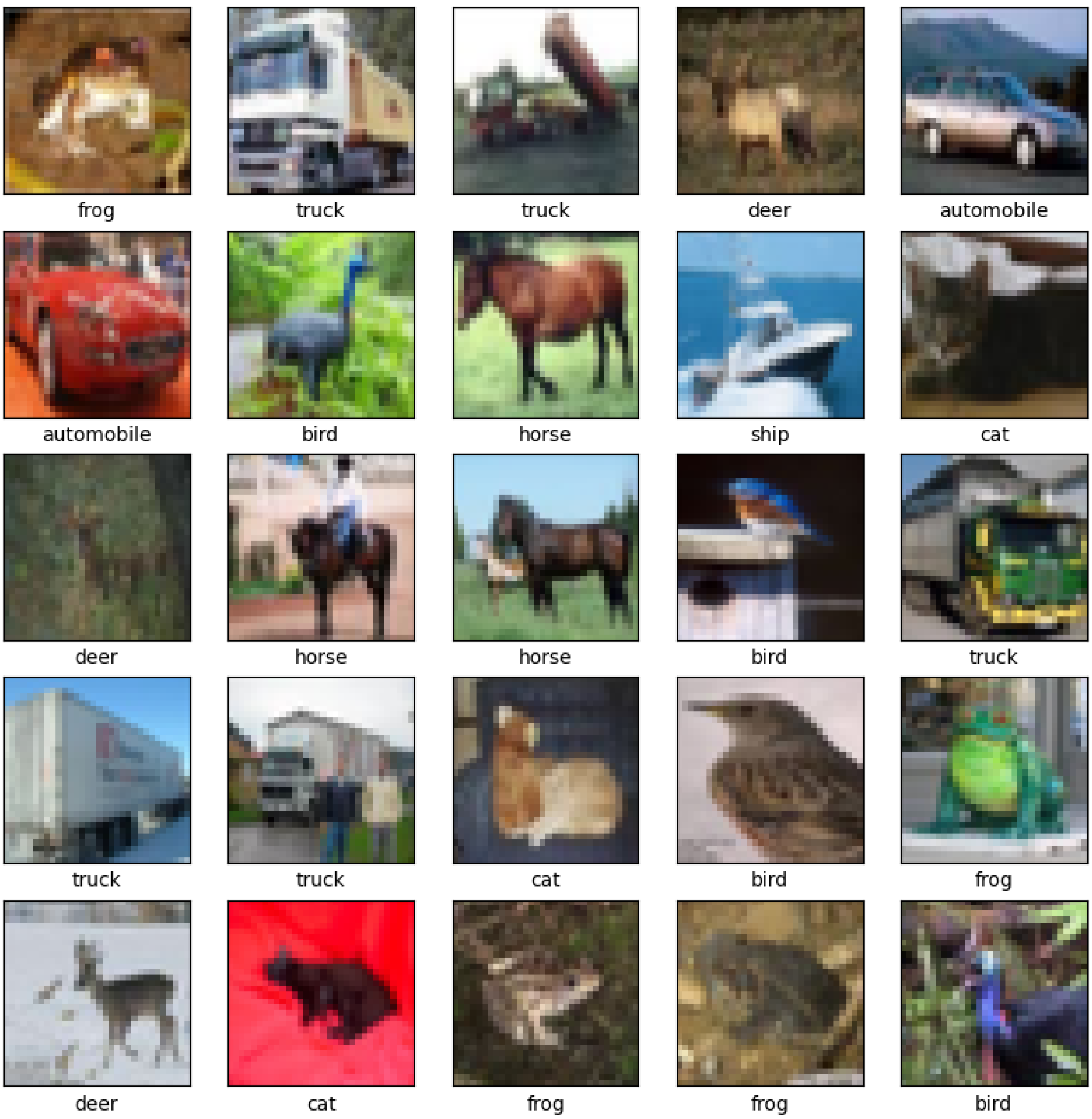
```
# Load CIFAR-10 dataset
(x_train, y_train), (x_test, y_test) = cifar10.load_data()

# Normalize the images
x_train, x_test = x_train / 255.0, x_test / 255.0
```

```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170498071/170498071 [==============================] - 2s 0us/step
```

[7]:
```
# Class names
class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer', 'dog', 'frog',␣
↪'horse', 'ship', 'truck']

# Display sample images from the dataset
plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(x_train[i])
    plt.xlabel(class_names[y_train[i][0]])
plt.show()
```



[8]:
```
print(f"x_train shape: {x_train.shape}")
print(f"y_train shape: {y_train.shape}")
print(f"x_test shape: {x_test.shape}")
print(f"y_test shape: {y_test.shape}")

# Check class distribution
unique, counts = np.unique(y_train, return_counts=True)
print(dict(zip(class_names, counts)))
```

```
x_train shape: (50000, 32, 32, 3)
y_train shape: (50000, 1)
x_test shape: (10000, 32, 32, 3)
y_test shape: (10000, 1)
{'airplane': 5000, 'automobile': 5000, 'bird': 5000, 'cat': 5000, 'deer': 5000,
'dog': 5000, 'frog': 5000, 'horse': 5000, 'ship': 5000, 'truck': 5000}
```

[9]:
```
x_train, x_val, y_train, y_val = train_test_split(x_train, y_train, test_size=0.
↪2, random_state=42)
```

[10]:
```
# Load the VGG19 model without the top layers
vgg19 = VGG19(weights='imagenet', include_top=False, input_shape=(32, 32, 3))

# Freeze all the layers
for layer in vgg19.layers:
    layer.trainable = False

# Create the model
model = Sequential([
    vgg19,
    Flatten(),
    Dense(512, activation='relu'),
    Dense(10, activation='softmax')
])

# Compile the model
model.compile(optimizer=Adam(),
              loss=SparseCategoricalCrossentropy(from_logits=False),
              metrics=['accuracy'])

# Display the model summary
model.summary()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-
applications/vgg19/vgg19_weights_tf_dim_ordering_tf_kernels_notop.h5
80134624/80134624 [==============================] - 0s 0us/step
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 vgg19 (Functional)          (None, 1, 1, 512)         20024384

 flatten (Flatten)           (None, 512)               0

 dense (Dense)               (None, 512)               262656

 dense_1 (Dense)             (None, 10)                5130

=================================================================
Total params: 20292170 (77.41 MB)
Trainable params: 267786 (1.02 MB)
Non-trainable params: 20024384 (76.39 MB)
_________________________________________________________________
```

[11]:

```python
# Train the model
history = model.fit(x_train, y_train, epochs=5, validation_data=(x_val, y_val))

# Evaluate the model
test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
print(f"\nTest accuracy: {test_acc}")
```

```
Epoch 1/5
1250/1250 [==============================] - 22s 13ms/step - loss: 1.3984 -
accuracy: 0.5074 - val_loss: 1.2789 - val_accuracy: 0.5432
Epoch 2/5
1250/1250 [==============================] - 15s 12ms/step - loss: 1.2250 -
accuracy: 0.5685 - val_loss: 1.2204 - val_accuracy: 0.5678
Epoch 3/5
1250/1250 [==============================] - 15s 12ms/step - loss: 1.1548 -
accuracy: 0.5931 - val_loss: 1.1939 - val_accuracy: 0.5770
Epoch 4/5
1250/1250 [==============================] - 17s 14ms/step - loss: 1.1067 -
accuracy: 0.6088 - val_loss: 1.1876 - val_accuracy: 0.5833
Epoch 5/5
1250/1250 [==============================] - 20s 16ms/step - loss: 1.0568 -
accuracy: 0.6275 - val_loss: 1.1548 - val_accuracy: 0.5922
313/313 - 3s - loss: 1.1650 - accuracy: 0.5895 - 3s/epoch - 10ms/step
```

Test accuracy: 0.5895000100135803

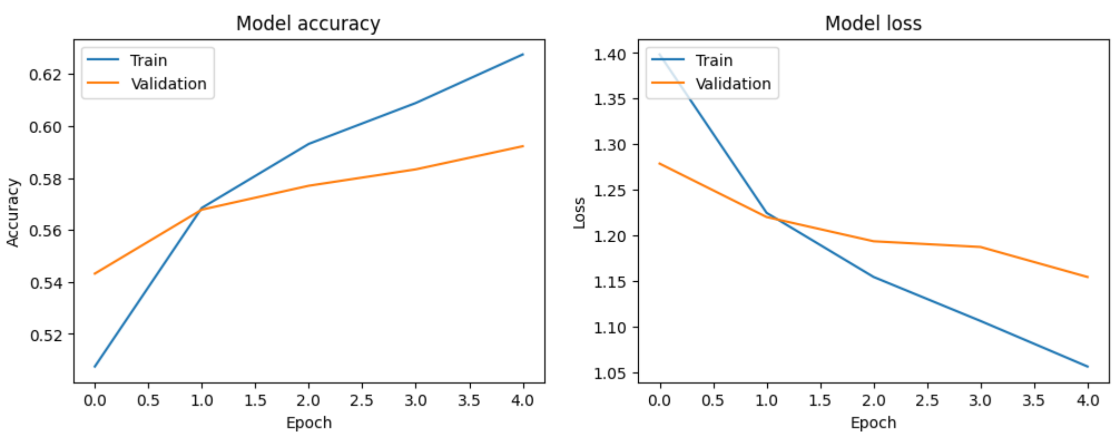
[12]:

```python
# Plot training & validation accuracy values
plt.figure(figsize=(12, 4))
```

```python
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('Model accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend(['Train', 'Validation'], loc='upper left')

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend(['Train', 'Validation'], loc='upper left')

plt.show()
```



[13]:
```python
# Extract the dataset
with zipfile.ZipFile('horses-or-humans-dataset.zip', 'r') as zip_ref:
    zip_ref.extractall('horses_or_humans')
```

[15]:
```python
# Check the content of the main directory
data_dir = 'horses_or_humans'
print(os.listdir(data_dir))
```

```
['horse-or-human']
```

[17]:
```python
# Ensure the data directories exist
horses_dir = os.path.join(data_dir, 'horse-or-human')
humans_dir = os.path.join(data_dir, 'horse-or-human')
```

```
if not os.path.exists(horses_dir) or not os.path.exists(humans_dir):
    raise FileNotFoundError(f"Directory not found. Please check the directory␣
↪structure in '{data_dir}'.")

# Count the number of images in each category
num_horses = len(os.listdir(horses_dir))
num_humans = len(os.listdir(humans_dir))
print(f"Number of horse images: {num_horses}")
print(f"Number of human images: {num_humans}")
```

```
Number of horse images: 3
Number of human images: 3
```

[18]:
```
# Data generators for loading and augmenting images
train_datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)

# Training and validation generators
train_generator = train_datagen.flow_from_directory(
    data_dir,
    target_size=(224, 224),
    batch_size=32,
    class_mode='binary',
    subset='training'
)

validation_generator = train_datagen.flow_from_directory(
    data_dir,
    target_size=(224, 224),
    batch_size=32,
    class_mode='binary',
    subset='validation'
)
```

```
Found 2053 images belonging to 1 classes.
Found 513 images belonging to 1 classes.
```

[19]:
```
# Load the VGG19 model without the top layers
vgg19_horses_humans = VGG19(weights='imagenet', include_top=False,␣
↪input_shape=(224, 224, 3))

# Freeze all the layers
for layer in vgg19_horses_humans.layers:
    layer.trainable = False

# Create the model
model_horses_humans = Sequential([
    vgg19_horses_humans,
```

```python
    Flatten(),
    Dense(512, activation='relu'),
    Dense(1, activation='sigmoid')
])

# Compile the model
model_horses_humans.compile(optimizer=Adam(),
                            loss='binary_crossentropy',
                            metrics=['accuracy'])

# Display the model summary
model_horses_humans.summary()

# Train the model
history_horses_humans = model_horses_humans.fit(train_generator, epochs=10,␣
 ↪validation_data=validation_generator)

# Evaluate the model
val_loss, val_acc = model_horses_humans.evaluate(validation_generator,␣
 ↪verbose=2)
print(f"\nValidation accuracy: {val_acc}")
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 vgg19 (Functional)          (None, 7, 7, 512)         20024384

 flatten_1 (Flatten)         (None, 25088)             0

 dense_2 (Dense)             (None, 512)               12845568

 dense_3 (Dense)             (None, 1)                 513

=================================================================
Total params: 32870465 (125.39 MB)
Trainable params: 12846081 (49.00 MB)
Non-trainable params: 20024384 (76.39 MB)
_________________________________________________________________
Epoch 1/10
65/65 [==============================] - 28s 297ms/step - loss: 0.0099 -
accuracy: 0.9942 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 2/10
65/65 [==============================] - 21s 327ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 3/10
65/65 [==============================] - 17s 257ms/step - loss: 0.0000e+00 -
```

```
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 4/10
65/65 [==============================] - 17s 262ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 5/10
65/65 [==============================] - 17s 255ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 6/10
65/65 [==============================] - 17s 256ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 7/10
65/65 [==============================] - 18s 281ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 8/10
65/65 [==============================] - 17s 263ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 9/10
65/65 [==============================] - 18s 279ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 10/10
65/65 [==============================] - 17s 256ms/step - loss: 0.0000e+00 -
accuracy: 1.0000 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
17/17 - 3s - loss: 0.0000e+00 - accuracy: 1.0000 - 3s/epoch - 203ms/step

Validation accuracy: 1.0
```

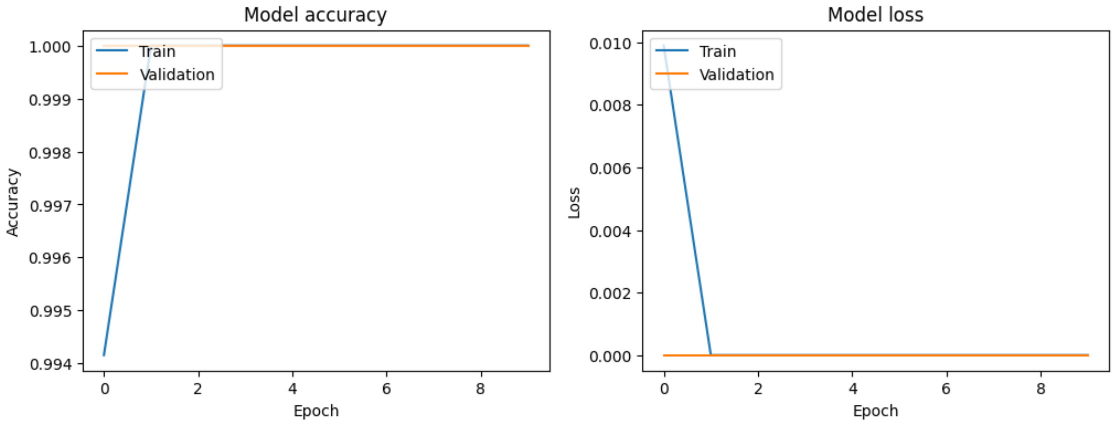
[20]:

```python
# Plot training & validation accuracy values
plt.figure(figsize=(12, 4))

plt.subplot(1, 2, 1)
plt.plot(history_horses_humans.history['accuracy'])
plt.plot(history_horses_humans.history['val_accuracy'])
plt.title('Model accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend(['Train', 'Validation'], loc='upper left')

plt.subplot(1, 2, 2)
plt.plot(history_horses_humans.history['loss'])
plt.plot(history_horses_humans.history['val_loss'])
plt.title('Model loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend(['Train', 'Validation'], loc='upper left')

plt.show()
```


Model accuracy
Accuracy
Epoch
Train
Validation
1.000
0.999
0.998
0.997
0.996
0.995
0.994
0
2
4
6
8
Model loss
Loss
0.010
0.008
0.006
0.004
0.002
0.000