CIFAR10

April 2, 2023

[ ]:
```python
import tensorflow as tf
import tensorflow_datasets as tfds
import numpy as np
import matplotlib.pyplot as plt
from tensorflow import keras
print("Num GPUs Available: ", len(tf.config.list_physical_devices('GPU')))
```

```
2023-04-02 15:25:49.054591: I tensorflow/core/platform/cpu_feature_guard.cc:193]
This TensorFlow binary is optimized with oneAPI Deep Neural Network Library
(oneDNN) to use the following CPU instructions in performance-critical
operations:  SSE3 SSE4.1 SSE4.2 AVX AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate
compiler flags.
```

```
Num GPUs Available:  1
```

[ ]:
```python
(ds_train, ds_test), ds_info = tfds.load(
    'cifar10',
    split=['train', 'test'],
    shuffle_files=True,
    as_supervised=True,
    with_info=True,
)
```

[ ]:
```python
```

[ ]:
```python
def normalize_img(image, label):
  """Normalizes images: `uint8` -> `float32`."""
  return tf.cast(image, tf.float32) / 255., label

ds_train = ds_train.map(
    normalize_img, num_parallel_calls=tf.data.AUTOTUNE)
ds_train = ds_train.cache()
ds_train = ds_train.shuffle(ds_info.splits['train'].num_examples)
ds_train = ds_train.batch(128)
ds_train = ds_train.prefetch(tf.data.AUTOTUNE)
```

[ ]:
```
ds_test = ds_test.map(
    normalize_img, num_parallel_calls=tf.data.AUTOTUNE)
ds_test = ds_test.batch(128)
ds_test = ds_test.cache()
ds_test = ds_test.prefetch(tf.data.AUTOTUNE)
```

[ ]:
```
'''
base_model = keras.applications.Xception(
    weights='imagenet',  # Load weights pre-trained on ImageNet.
    input_shape=(150, 150, 3),
    include_top=False)  # Do not include the ImageNet classifier at the top.
'''
base_model = keras.applications.ResNet50(
    weights="imagenet",
    input_shape=(64,64,3),
    include_top=False
)
```

[ ]:
```
testing_model = keras.applications.ResNet50(
    weights="imagenet",
    input_shape=(32,32,3),
    include_top=False
)
testing_model.compile(
    optimizer=tf.keras.optimizers.Adam(0.001),
    loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
    metrics=[tf.keras.metrics.SparseCategoricalAccuracy(name='accuracy')],
)

testing_model.evaluate(ds_test)
```

```
79/79 [==============================] - 2s 15ms/step - loss: 23.9925 -
accuracy: 0.0000e+00
```

[ ]: [23.99248695373535, 0.0]

[ ]:
```
'''
#original
base_model.trainable = False


inputs = keras.Input(shape=(32, 32, 3))
# We make sure that the base_model is running in inference mode here,
# by passing `training=False`. This is important for fine-tuning, as you will
# learn in a few paragraphs.
x = base_model(inputs, training=False)
# Convert features of shape `base_model.output_shape[1:]` to vectors
```

```
x = keras.layers.GlobalAveragePooling2D()(x)
#x = keras.layers.Dense(128,activation='relu''relu')
# A Dense classifier with a single unit (binary classification)
outputs = keras.layers.Dense(10)(x)
model = keras.Model(inputs, outputs)
'''
```

[ ]: "\n#original \nbase_model.trainable = False\n\n\ninputs = keras.Input(shape=(32, 32, 3))\n# We make sure that the base_model is running in inference mode here,\n# by passing `training=False`. This is important for fine-tuning, as you will\n# learn in a few paragraphs.\nx = base_model(inputs, training=False)\n# Convert features of shape `base_model.output_shape[1:]` to vectors\nx = keras.layers.GlobalAveragePooling2D()(x)\n#x = keras.layers.Dense(128,activation='relu''relu')\n# A Dense classifier with a single unit (binary classification)\noutputs = keras.layers.Dense(10)(x)\nmodel = keras.Model(inputs, outputs)\n"

[ ]:
```
#sequential
model = tf.keras.models.Sequential()
model.add(tf.keras.layers.UpSampling2D((2,2)))
#model.add(tf.keras.layers.UpSampling2D((2,2)))
#model.add(tf.keras.layers.UpSampling2D((2,2)))
model.add(base_model)
model.add(tf.keras.layers.Flatten())
model.add(tf.keras.layers.BatchNormalization())
model.add(tf.keras.layers.Dense(128, activation='relu'))
model.add(tf.keras.layers.Dense(256, activation='relu'))
model.add(tf.keras.layers.Dense(10,activation='softmax'))
```

[ ]:
```
#Traditional Training
#model = tf.keras.models.Sequential([
#  tf.keras.layers.Flatten(input_shape=(32, 32, 3)),
#  tf.keras.layers.Dense(128, activation='relu'),
#  tf.keras.layers.Dense(10)
#])
model.compile(
    optimizer=tf.keras.optimizers.Adam(0.001),
    loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
    metrics=[tf.keras.metrics.SparseCategoricalAccuracy(name='accuracy')],
)

model.fit(
    ds_train,
    epochs=20,
    batch_size=20,
```

```
    validation_data=ds_test,
)
```

```
Epoch 1/20
```

```
/home/sjhjrok/anaconda3/envs/ai/lib/python3.10/site-
packages/keras/backend.py:5585: UserWarning: "`sparse_categorical_crossentropy`
received `from_logits=True`, but the `output` argument was produced by a Softmax
activation and thus does not represent logits. Was this intended?
  output, from_logits = _get_logits(
```

```
391/391 [==============================] - 170s 363ms/step - loss: 0.8578 -
accuracy: 0.7140 - val_loss: 3.0410 - val_accuracy: 0.1000
Epoch 2/20
391/391 [==============================] - 149s 374ms/step - loss: 0.6433 -
accuracy: 0.7894 - val_loss: 2.6151 - val_accuracy: 0.2915
Epoch 3/20
391/391 [==============================] - 171s 438ms/step - loss: 0.3785 -
accuracy: 0.8735 - val_loss: 0.6494 - val_accuracy: 0.7917
Epoch 4/20
391/391 [==============================] - 136s 349ms/step - loss: 0.2942 -
accuracy: 0.9003 - val_loss: 0.7085 - val_accuracy: 0.7996
Epoch 5/20
391/391 [==============================] - 145s 364ms/step - loss: 0.4361 -
accuracy: 0.8687 - val_loss: 64.6098 - val_accuracy: 0.0924
Epoch 6/20
391/391 [==============================] - 158s 398ms/step - loss: 0.6221 -
accuracy: 0.7910 - val_loss: 0.9636 - val_accuracy: 0.6986
Epoch 7/20
391/391 [==============================] - 122s 311ms/step - loss: 0.3762 -
accuracy: 0.8768 - val_loss: 0.7076 - val_accuracy: 0.7739
Epoch 8/20
391/391 [==============================] - 131s 328ms/step - loss: 0.2854 -
accuracy: 0.9070 - val_loss: 0.8675 - val_accuracy: 0.7325
Epoch 9/20
391/391 [==============================] - 149s 381ms/step - loss: 0.2473 -
accuracy: 0.9177 - val_loss: 0.7059 - val_accuracy: 0.8042
Epoch 10/20
391/391 [==============================] - 143s 366ms/step - loss: 0.1874 -
accuracy: 0.9379 - val_loss: 1.0850 - val_accuracy: 0.7111
Epoch 11/20
391/391 [==============================] - 155s 382ms/step - loss: 0.2440 -
accuracy: 0.9174 - val_loss: 0.7248 - val_accuracy: 0.7925
Epoch 12/20
391/391 [==============================] - 123s 307ms/step - loss: 0.0995 -
accuracy: 0.9670 - val_loss: 0.7636 - val_accuracy: 0.8171
Epoch 13/20
391/391 [==============================] - 119s 298ms/step - loss: 0.0623 -
```

```
accuracy: 0.9787 - val_loss: 0.7432 - val_accuracy: 0.8305
Epoch 14/20
391/391 [==============================] - 121s 309ms/step - loss: 0.0712 -
accuracy: 0.9760 - val_loss: 1.0912 - val_accuracy: 0.7640
Epoch 15/20
391/391 [==============================] - 119s 296ms/step - loss: 0.0694 -
accuracy: 0.9765 - val_loss: 1.0764 - val_accuracy: 0.7595
Epoch 16/20
391/391 [==============================] - 150s 378ms/step - loss: 0.0719 -
accuracy: 0.9757 - val_loss: 1.3735 - val_accuracy: 0.7396
Epoch 17/20
391/391 [==============================] - 121s 311ms/step - loss: 0.0732 -
accuracy: 0.9761 - val_loss: 0.9182 - val_accuracy: 0.7879
Epoch 18/20
391/391 [==============================] - 129s 321ms/step - loss: 0.0665 -
accuracy: 0.9783 - val_loss: 2.1652 - val_accuracy: 0.6273
Epoch 19/20
391/391 [==============================] - 145s 358ms/step - loss: 0.0545 -
accuracy: 0.9815 - val_loss: 0.8588 - val_accuracy: 0.8179
Epoch 20/20
391/391 [==============================] - 130s 319ms/step - loss: 0.0682 -
accuracy: 0.9791 - val_loss: 13.3233 - val_accuracy: 0.4040
```

[ ]: <keras.callbacks.History at 0x7f303002f5b0>

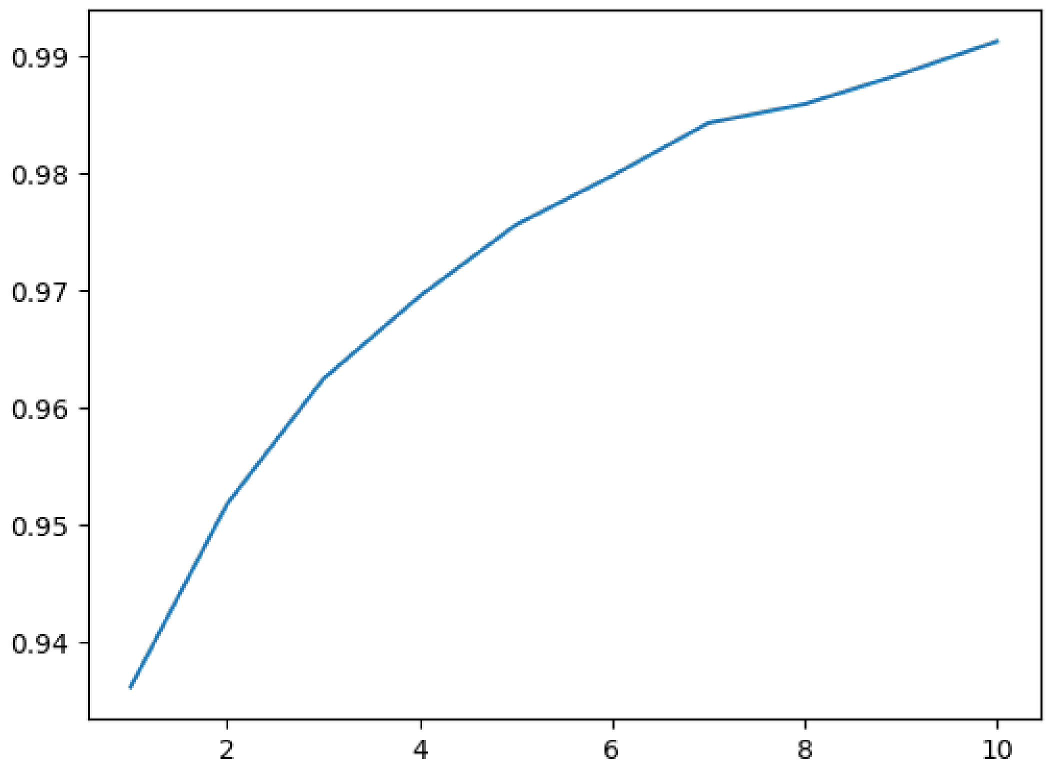
[ ]:
```python
# Unfreeze the base model
base_model.trainable = True

# It's important to recompile your model after you make any changes
# to the `trainable` attribute of any inner layer, so that your changes
# are take into account
model.compile(
    optimizer=tf.keras.optimizers.Adam(1e-5),
    loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
    metrics=[tf.keras.metrics.SparseCategoricalAccuracy(name='accuracy')],
)
testing = model.fit(
    ds_train,
    epochs=10,
    batch_size=20,
    validation_data=ds_test,
)
```

```
Epoch 1/10
391/391 [==============================] - 125s 295ms/step - loss: 0.2673 -
accuracy: 0.9362 - val_loss: 0.7178 - val_accuracy: 0.8143
Epoch 2/10
391/391 [==============================] - 109s 280ms/step - loss: 0.1791 -
```

```
accuracy: 0.9518 - val_loss: 0.6613 - val_accuracy: 0.8252
Epoch 3/10
391/391 [==============================] - 112s 287ms/step - loss: 0.1329 -
accuracy: 0.9624 - val_loss: 0.6403 - val_accuracy: 0.8339
Epoch 4/10
391/391 [==============================] - 115s 295ms/step - loss: 0.1029 -
accuracy: 0.9695 - val_loss: 0.6272 - val_accuracy: 0.8391
Epoch 5/10
391/391 [==============================] - 113s 289ms/step - loss: 0.0824 -
accuracy: 0.9756 - val_loss: 0.6233 - val_accuracy: 0.8434
Epoch 6/10
391/391 [==============================] - 112s 286ms/step - loss: 0.0673 -
accuracy: 0.9797 - val_loss: 0.6205 - val_accuracy: 0.8458
Epoch 7/10
391/391 [==============================] - 112s 286ms/step - loss: 0.0550 -
accuracy: 0.9842 - val_loss: 0.6178 - val_accuracy: 0.8484
Epoch 8/10
391/391 [==============================] - 112s 287ms/step - loss: 0.0467 -
accuracy: 0.9859 - val_loss: 0.6245 - val_accuracy: 0.8497
Epoch 9/10
391/391 [==============================] - 115s 294ms/step - loss: 0.0407 -
accuracy: 0.9884 - val_loss: 0.6309 - val_accuracy: 0.8523
Epoch 10/10
391/391 [==============================] - 110s 280ms/step - loss: 0.0302 -
accuracy: 0.9912 - val_loss: 0.6389 - val_accuracy: 0.8532
```

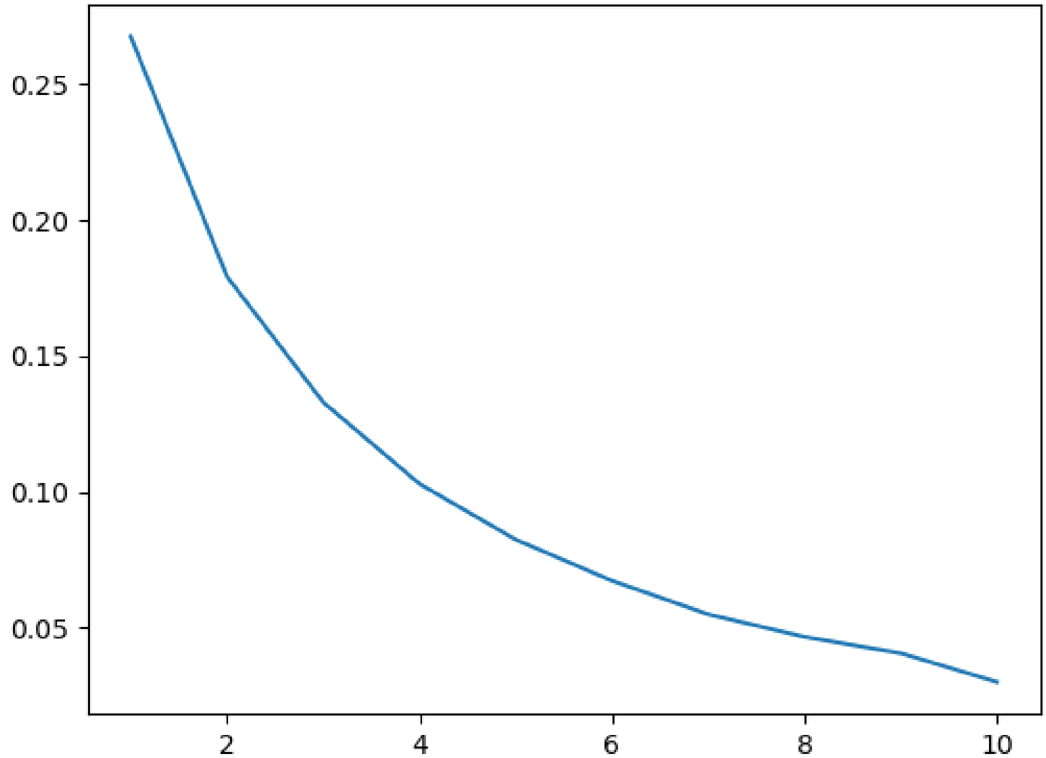
[ ]:
```
plt.plot(
    np.arange(1, 11),
    testing.history['accuracy'], label='Accuracy'
)
plt.show
```

[ ]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



[ ]:
```
plt.plot(
    np.arange(1, 11),
    testing.history['loss'], label='Loss'
)
plt.show
```

[ ]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



[ ]:
```
model.evaluate(ds_test)
```

```
79/79 [==============================] - 3s 32ms/step - loss: 0.6389 - accuracy:
0.8532
```

[ ]:
```
[0.6388927698135376, 0.8532000184059143]
```