gesture_recog

September 5, 2020

```
[1]: # gesture_recog.ipynb

     # The model is to train the guesture of images with the Leap Motion
     # T. Mantecón, C.R. del Blanco, F. Jaureguizar, N. García, "Hand Gesture␣
      ↪Recognition using Infrared
     # Imagery Provided by Leap Motion Controller", Int. Conf. on Advanced Concepts␣
      ↪for Intelligent Vision
     # Systems, ACIVS 2016, Lecce, Italy, pp. 47-57, 24-27 Oct. 2016. (doi: 10.1007/
      ↪978-3-319-48680-2_5)

     # Please download the leapgestrecog dataset from Kaggle.
     # https://www.kaggle.com/gti-upm/leapgestrecog
```

```
[2]: import tensorflow as tf
     from keras.preprocessing.image import ImageDataGenerator
     from keras import optimizers
     import matplotlib.pyplot as plt
     from alexnet import AlexNet
     from keras.preprocessing import image

     import numpy as np
     import datetime
     import os
     import shutil
     from PIL import Image
     from numba import cuda
```

```
[3]: # Set up the GPU growth to avoid the sudden runtime error.

     gpus = tf.config.experimental.list_physical_devices('GPU')
     for gpu in gpus:
         tf.config.experimental.set_memory_growth(gpu, True)
```

```
[4]: # Move the iamges from the original path to the source path

     orig_dir = '/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog'
     src_dir  = '/home/mike/Documents/image_gesture/leapgestrecog/src_data'
```

```python
if not os.path.exists(src_dir):
    os.makedirs(src_dir)

def move_data(orig_dir, src_dir):

    # Conduct three iterations with i, j and k counters
    for i in os.listdir(orig_dir):
        label = 0
        # Get the original category(ca) with i pointing to any folder from 00␣
↪to 09
        origca_dir = os.path.join(orig_dir, i)
        print("[MESSAGE] Category %s %s"% (origca_dir,i))

        # The counter j points to any folder from 01_palm to 10_down.
        for j in os.listdir(origca_dir):
            # The label is related to str(label) in the k iterations.
            label = label + 1
            # Create the origcaty_dir.Type(ty) represents the type of the above␣
↪folders
            origcaty_dir = os.path.join(origca_dir, j)
            print("[MESSAGE] Type    %s %s"% (origcaty_dir,j))

            for k in os.listdir(origcaty_dir):
                # origimg_path is the absolute path that holds the images such␣
↪as frame_00_7_0001.png
                origimg_path = os.path.join(origcaty_dir, k)
                # Create the diretort for the label with str(label) ranging␣
↪from 1 to 10
                srclbl_dir = os.path.join(src_dir, str(label))
                if not os.path.exists(srclbl_dir):
                    os.makedirs(srclbl_dir)
                # Create the absolute path
                srcimg_path = os.path.join(srclbl_dir, k)
                 # Move the images
                shutil.move(origimg_path, srcimg_path)

        print("[MESSAGE] Done    ", origcaty_dir)

    print("[MESSAGE] All Done!")

if __name__ == '__main__':

    move_data(orig_dir, src_dir)
```

[MESSAGE]
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[MESSAGE] Done
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[MESSAGE] All Done!
```

[5]:
```python
# Divide the dataset into train, validation and tfile sets.

# Designate source and division datasets
src_dir = '/home/mike/Documents/image_gesture/leapgestrecog/src_data'
dset_dir = '/home/mike/Documents/image_gesture/dset_data'
if not os.path.exists(dset_dir):
    os.makedirs(dset_dir)


# Make three directories for training, validation and test
train_dir = os.path.join(dset_dir, 'train')
if not os.path.exists(train_dir):
    os.mkdir(train_dir)

val_dir = os.path.join(dset_dir, 'validation')
if not os.path.exists(val_dir):
    os.mkdir(val_dir)

tfile_dir = os.path.join(dset_dir, 'tfile')
if not os.path.exists(tfile_dir):
    os.mkdir(tfile_dir)


for num in os.listdir(src_dir):
    # Folder 1~10
    train_idx_dir = os.path.join(train_dir, num)
```

```python
    if not os.path.exists(train_idx_dir):
        os.mkdir(train_idx_dir)

    val_idx_dir = os.path.join(val_dir, num)
    if not os.path.exists(val_idx_dir):
        os.mkdir(val_idx_dir)

    tfile_idx_dir = os.path.join(tfile_dir, num)
    if not os.path.exists(tfile_idx_dir):
        os.mkdir(tfile_idx_dir)

    # Index is increasing.
    src_idx_dir = os.path.join(src_dir, num)

    # print(src_idx_dir)

    j = 0

    for fname in os.listdir(src_idx_dir):

        if j < 1000:  # Copy 1000 images to the train directory
            src = os.path.join(src_idx_dir, fname)
            dst = os.path.join(train_idx_dir, fname)
            shutil.copyfile(src, dst)
        elif (j >= 1000 and j < 1500):  # Copy 500 images to the val directory
            src = os.path.join(src_idx_dir, fname)
            dst = os.path.join(val_idx_dir, fname)
            shutil.copyfile(src, dst)
        elif (j >= 1500):  # Copy 500 images to the test directory
            src = os.path.join(src_idx_dir, fname)
            dst = os.path.join(tfile_idx_dir, fname)
            shutil.copyfile(src, dst)

        j = j + 1

    print("[MESSAGE] Copy completed :", train_idx_dir)
    print("[MESSAGE] Copy completed :", val_idx_dir)
    print("[MESSAGE] Copy completed :", tfile_idx_dir)


print('[MESSAGE] Train folders:', len(os.listdir(train_dir)))
print('[MESSAGE] Validation folders:', len(os.listdir(val_dir)))
print('[MESSAGE] Tfile folders:', len(os.listdir(tfile_dir)))

print('[MESSAGE] Train images per folder:', len(os.listdir(train_dir+"/1/")))
print('[MESSAGE] Validation images per folder:', len(os.listdir(val_dir+"/1/")))
print('[MESSAGE] Tfile images per folder:', len(os.listdir(tfile_dir+"/1/")))
```

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[MESSAGE] Copy completed : /home/mike/Documents/image_gesture/dset_data/train/3
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```

```python
[6]:  # Shift the dataset from tfile_dir to test_dir with only one subsidiary folder

      tfile_dir =  '/home/mike/Documents/image_gesture/dset_data/tfile'
      test_dir  = '/home/mike/Documents/image_gesture/dset_data/test'
      if not os.path.exists(test_dir):
          os.makedirs(test_dir)

      def shift_data(tfile_dir, test_dir):

          for i in os.listdir(tfile_dir):
              tfca_dir = os.path.join(tfile_dir, i)

              for j in os.listdir(tfca_dir):
                  tfcaimg_path = os.path.join(tfca_dir, j)
                  tfol_dir = os.path.join(test_dir, 'folder')
                  if not os.path.exists(tfol_dir):
                      os.makedirs(tfol_dir)
                  tfolimg_path = os.path.join(tfol_dir, j)
                  shutil.move(tfcaimg_path, tfolimg_path)

      if __name__ == '__main__':

          shift_data(tfile_dir, test_dir)
```

```python
[7]:  # Assign the global constants

      EPOCHS = 32
      BATCH_SIZE = 64
      image_width = 227
      image_height = 227
      channels = 3
      num_classes = 1
```

```python
[8]:  # Call the cnn/alexnet model

      model = AlexNet((image_width,image_height,channels), num_classes)
```

```python
[9]:  # Model configuration

      model.compile(optimizer=optimizers.RMSprop(lr=1e-4),
                    loss='binary_crossentropy',
                    metrics=['acc'])
```

```python
[10]: # Summary

      model.summary()
```

```
Model: "alex_net"

_____
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 55, 55, 96)        34944
_____
max_pooling2d (MaxPooling2D) (None, 27, 27, 96)        0
_____
conv2d_1 (Conv2D)            (None, 27, 27, 256)       614656
_____
max_pooling2d_1 (MaxPooling2 (None, 13, 13, 256)       0
_____
conv2d_2 (Conv2D)            (None, 13, 13, 384)       885120
_____
conv2d_3 (Conv2D)            (None, 13, 13, 384)       1327488
_____
conv2d_4 (Conv2D)            (None, 13, 13, 256)       884992
_____
max_pooling2d_2 (MaxPooling2 (None, 6, 6, 256)         0
_____
flatten (Flatten)            (None, 9216)              0
_____
dense (Dense)                (None, 4096)              37752832
_____
dropout (Dropout)            (None, 4096)              0
_____
dense_1 (Dense)              (None, 4096)              16781312
_____
dropout_1 (Dropout)          (None, 4096)              0
_____
dense_2 (Dense)              (None, 1000)              4097000
_____
dense_3 (Dense)              (None, 1)                 1001
=================================================================
Total params: 62,379,345
Trainable params: 62,379,345
Non-trainable params: 0
_____
```

[11]:
```python
# Preprocess the images

train_datagen = ImageDataGenerator(rescale=1.0/255)

train_generator = train_datagen.flow_from_directory(train_dir,
                                                    ␣
 ↪target_size=(image_width,image_height),
                                                    batch_size=BATCH_SIZE,
```

```
                                         class_mode='binary')

train_num = train_generator.samples

test_datagen = ImageDataGenerator(rescale=1.0/255)

val_generator = test_datagen.flow_from_directory(val_dir,
                                         ␣
 →target_size=(image_width,image_height),
                                         batch_size=BATCH_SIZE,
                                         class_mode='binary')

val_num = val_generator.samples
```

Found 10000 images belonging to 10 classes.
Found 5000 images belonging to 10 classes.

[12]:
```python
# Get the batch shape

for data_batch, label_batch in train_generator:
    print("data batch shape:", data_batch.shape)
    print("labels batch shape:", label_batch)

    break
```

data batch shape: (64, 227, 227, 3)
labels batch shape: [4. 7. 2. 2. 9. 7. 9. 5. 6. 3. 8. 3. 9. 7. 2. 9. 5. 4. 4. 6.
2. 4. 9. 0.
 4. 0. 5. 7. 8. 1. 2. 0. 7. 6. 3. 8. 5. 4. 3. 9. 4. 7. 5. 0. 2. 4. 3. 9.
 2. 8. 9. 5. 7. 3. 1. 8. 5. 2. 6. 9. 2. 1. 1. 0.]

[13]:
```python
# Train the model
history = model.fit(train_generator,
                    steps_per_epoch=train_num//BATCH_SIZE,
                    epochs=EPOCHS,
                    validation_data=val_generator,
                    validation_steps=val_num//BATCH_SIZE)
```

Epoch 1/32
156/156 [==============================] - 26s 168ms/step - loss: -53.3524 -
acc: 0.1002 - val_loss: -53.3693 - val_acc: 0.1002
Epoch 2/32
156/156 [==============================] - 26s 165ms/step - loss: -53.3571 -
acc: 0.1002 - val_loss: -53.3357 - val_acc: 0.1002
Epoch 3/32
156/156 [==============================] - 25s 163ms/step - loss: -53.3278 -
acc: 0.0999 - val_loss: -53.3448 - val_acc: 0.1002
Epoch 4/32

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```
156/156 [==============================] - 25s 163ms/step - loss: -53.3923 -
acc: 0.0997 - val_loss: -53.4182 - val_acc: 0.0998
Epoch 5/32
156/156 [==============================] - 25s 163ms/step - loss: -53.4352 -
acc: 0.0997 - val_loss: -53.3662 - val_acc: 0.1000
Epoch 6/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3846 -
acc: 0.1000 - val_loss: -53.3082 - val_acc: 0.1002
Epoch 7/32
156/156 [==============================] - 25s 163ms/step - loss: -53.4061 -
acc: 0.1003 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 8/32
156/156 [==============================] - 25s 162ms/step - loss: -53.3018 -
acc: 0.1000 - val_loss: -53.3479 - val_acc: 0.1000
Epoch 9/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3493 -
acc: 0.1001 - val_loss: -53.3510 - val_acc: 0.1002
Epoch 10/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2250 -
acc: 0.1002 - val_loss: -53.3387 - val_acc: 0.1000
Epoch 11/32
156/156 [==============================] - 26s 164ms/step - loss: -53.5366 -
acc: 0.0981 - val_loss: -53.3418 - val_acc: 0.1002
Epoch 12/32
156/156 [==============================] - 26s 164ms/step - loss: -53.4107 -
acc: 0.1022 - val_loss: -53.3693 - val_acc: 0.1000
Epoch 13/32
156/156 [==============================] - 26s 164ms/step - loss: -53.2741 -
acc: 0.0990 - val_loss: -53.3876 - val_acc: 0.1000
Epoch 14/32
156/156 [==============================] - 25s 160ms/step - loss: -53.4629 -
acc: 0.1001 - val_loss: -53.3296 - val_acc: 0.1000
Epoch 15/32
156/156 [==============================] - 25s 163ms/step - loss: -53.2081 -
acc: 0.0997 - val_loss: -53.3846 - val_acc: 0.0998
Epoch 16/32
156/156 [==============================] - 26s 164ms/step - loss: -53.4215 -
acc: 0.1013 - val_loss: -53.3998 - val_acc: 0.0998
Epoch 17/32
156/156 [==============================] - 25s 163ms/step - loss: -53.6455 -
acc: 0.0993 - val_loss: -53.3784 - val_acc: 0.1002
Epoch 18/32
156/156 [==============================] - 26s 164ms/step - loss: -53.1682 -
acc: 0.0999 - val_loss: -53.3632 - val_acc: 0.1002
Epoch 19/32
156/156 [==============================] - 26s 166ms/step - loss: -53.3723 -
acc: 0.0992 - val_loss: -53.3540 - val_acc: 0.1000
Epoch 20/32
```

```
156/156 [==============================] - 26s 165ms/step - loss: -53.5120 -
acc: 0.0999 - val_loss: -53.3510 - val_acc: 0.1002
Epoch 21/32
156/156 [==============================] - 26s 168ms/step - loss: -53.5074 -
acc: 0.0978 - val_loss: -53.4090 - val_acc: 0.1000
Epoch 22/32
156/156 [==============================] - 26s 166ms/step - loss: -52.9963 -
acc: 0.1036 - val_loss: -53.4365 - val_acc: 0.0994
Epoch 23/32
156/156 [==============================] - 26s 165ms/step - loss: -53.6056 -
acc: 0.1000 - val_loss: -53.3601 - val_acc: 0.1000
Epoch 24/32
156/156 [==============================] - 26s 166ms/step - loss: -53.0761 -
acc: 0.1004 - val_loss: -53.3876 - val_acc: 0.0998
Epoch 25/32
156/156 [==============================] - 26s 166ms/step - loss: -53.6977 -
acc: 0.0976 - val_loss: -53.3937 - val_acc: 0.1000
Epoch 26/32
156/156 [==============================] - 26s 167ms/step - loss: -53.4122 -
acc: 0.0996 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 27/32
156/156 [==============================] - 26s 165ms/step - loss: -53.1191 -
acc: 0.1006 - val_loss: -53.3479 - val_acc: 0.1000
Epoch 28/32
156/156 [==============================] - 25s 163ms/step - loss: -53.2526 -
acc: 0.1026 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 29/32
156/156 [==============================] - 25s 162ms/step - loss: -53.5565 -
acc: 0.0969 - val_loss: -53.3296 - val_acc: 0.1002
Epoch 30/32
156/156 [==============================] - 26s 165ms/step - loss: -53.5104 -
acc: 0.1017 - val_loss: -53.3845 - val_acc: 0.1000
Epoch 31/32
156/156 [==============================] - 26s 164ms/step - loss: -53.0715 -
acc: 0.0986 - val_loss: -53.3876 - val_acc: 0.1002
Epoch 32/32
156/156 [==============================] - 25s 163ms/step - loss: -53.7023 -
acc: 0.1031 - val_loss: -53.3723 - val_acc: 0.1002
```

[14]:
```python
# Save the model

model.save('/home/mike/Documents/image_gesture/leapGestRecog_small_1.h5')
model.save('/home/mike/Documents/image_gesture/leapGestRecog_small_2.h5')
```

[15]:
```python
# Evaluate the model with visulizing the result

acc = history.history['acc']
```

```python
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(len(acc))

plt.figure(figsize=(15,4))
plt.subplot(1,2,1)
plt.plot(epochs, acc, 'b', label='Train acc', color='green')
plt.plot(epochs, val_acc, 'b', label='Val acc')
plt.title('Train and validation accuracy')
plt.legend()

plt.subplot(1,2,2)
plt.plot(epochs, loss, 'bo', label='Train loss', color='green')
plt.plot(epochs, val_loss, 'b', label='Val loss')
plt.title('Train and validation loss')
plt.legend()

plt.show()
```
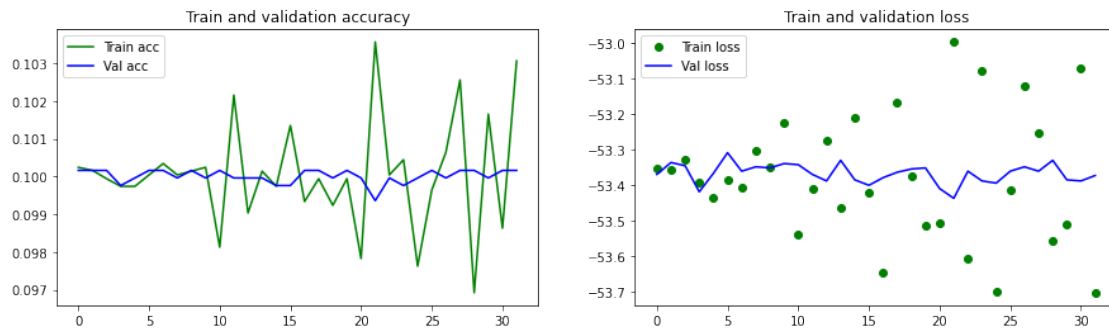


```python
# Release the GPU memory

cuda.select_device(0)
cuda.close()
```