gesture_recog_binary

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

# -import os
# -import shutil
```

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

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[MESSAGE]
Category /home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/06 06
[MESSAGE] Type
/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/06/03_fist
03_fist
[MESSAGE] Type
/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/06/08_palm_moved
08_palm_moved
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/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/06/06_index
06_index
[MESSAGE] Type
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[MESSAGE] Type
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01_palm
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[MESSAGE] Type
/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/09/07_ok 07_ok
[MESSAGE] Done
/home/mike/Documents/image_gesture/leapgestrecog/leapGestRecog/09/07_ok
[MESSAGE] All Done!
```

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

# -import os
# -import shutil

# 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)
    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 tfile 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
[MESSAGE] Copy completed :
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[MESSAGE] Copy completed : /home/mike/Documents/image_gesture/dset_data/tfile/3
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[MESSAGE] Train folders: 10
[MESSAGE] Validation folders: 10
[MESSAGE] Tfile folders: 10
[MESSAGE] Train images per folder: 1000
[MESSAGE] Validation images per folder: 500
[MESSAGE] Tfile images per folder: 500
```

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

# -import os
# -import shutil

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)
```

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

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

[8]:
```
# Call the AlexNet model

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

[9]:
```
# Compile the Model with RMSprop and binary_crossentropy in the usage for one
# specific image prediction (called by predict_image.py)

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

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

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

    break
```

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

[13]:
```
# 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 [==============================] - 25s 162ms/step - loss: -53.3386 -
acc: 0.1000 - val_loss: -53.3754 - val_acc: 0.1000
Epoch 2/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3479 -
acc: 0.1001 - val_loss: -53.3601 - val_acc: 0.1000
Epoch 3/32
156/156 [==============================] - 25s 162ms/step - loss: -53.3585 -
acc: 0.1001 - val_loss: -53.3876 - val_acc: 0.0998
Epoch 4/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3539 -
acc: 0.1004 - val_loss: -53.3662 - val_acc: 0.1000
Epoch 5/32
156/156 [==============================] - 25s 159ms/step - loss: -53.5304 -
acc: 0.0990 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 6/32
156/156 [==============================] - 25s 160ms/step - loss: -53.1697 -
acc: 0.1007 - val_loss: -53.3510 - val_acc: 0.1002
Epoch 7/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2879 -
acc: 0.1006 - val_loss: -53.3632 - val_acc: 0.1000
Epoch 8/32
156/156 [==============================] - 25s 162ms/step - loss: -53.5734 -
acc: 0.0981 - val_loss: -53.3448 - val_acc: 0.1000
Epoch 9/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3708 -
acc: 0.1006 - val_loss: -53.4029 - val_acc: 0.0998
Epoch 10/32
156/156 [==============================] - 25s 158ms/step - loss: -53.3862 -
acc: 0.0994 - val_loss: -53.3723 - val_acc: 0.1002
Epoch 11/32
156/156 [==============================] - 25s 161ms/step - loss: -53.2541 -
acc: 0.0995 - val_loss: -53.3632 - val_acc: 0.1002
Epoch 12/32
156/156 [==============================] - 25s 161ms/step - loss: -53.5872 -
acc: 0.1009 - val_loss: -53.3601 - val_acc: 0.0998
Epoch 13/32
156/156 [==============================] - 25s 161ms/step - loss: -53.2664 -
acc: 0.0988 - val_loss: -53.4182 - val_acc: 0.0998
Epoch 14/32
156/156 [==============================] - 25s 160ms/step - loss: -53.1820 -
acc: 0.1027 - val_loss: -53.3876 - val_acc: 0.0998
Epoch 15/32
156/156 [==============================] - 25s 159ms/step - loss: -53.4982 -
acc: 0.0992 - val_loss: -53.3479 - val_acc: 0.0998
```

```
Epoch 16/32
156/156 [==============================] - 26s 163ms/step - loss: -53.4153 -
acc: 0.0990 - val_loss: -53.4243 - val_acc: 0.0998
Epoch 17/32
156/156 [==============================] - 25s 162ms/step - loss: -53.4844 -
acc: 0.1012 - val_loss: -53.3998 - val_acc: 0.1000
Epoch 18/32
156/156 [==============================] - 25s 161ms/step - loss: -53.3309 -
acc: 0.0985 - val_loss: -53.3632 - val_acc: 0.1000
Epoch 19/32
156/156 [==============================] - 25s 162ms/step - loss: -53.3156 -
acc: 0.1012 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 20/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2388 -
acc: 0.0998 - val_loss: -53.3785 - val_acc: 0.1002
Epoch 21/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2941 -
acc: 0.1004 - val_loss: -53.3693 - val_acc: 0.0998
Epoch 22/32
156/156 [==============================] - 25s 161ms/step - loss: -53.5580 -
acc: 0.0985 - val_loss: -53.3937 - val_acc: 0.0998
Epoch 23/32
156/156 [==============================] - 26s 164ms/step - loss: -53.5396 -
acc: 0.1017 - val_loss: -53.4029 - val_acc: 0.1000
Epoch 24/32
156/156 [==============================] - 25s 163ms/step - loss: -53.2480 -
acc: 0.0995 - val_loss: -53.3509 - val_acc: 0.1000
Epoch 25/32
156/156 [==============================] - 25s 162ms/step - loss: -53.4168 -
acc: 0.0999 - val_loss: -53.3876 - val_acc: 0.1000
Epoch 26/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2710 -
acc: 0.0980 - val_loss: -53.3846 - val_acc: 0.1000
Epoch 27/32
156/156 [==============================] - 25s 160ms/step - loss: -53.0055 -
acc: 0.1036 - val_loss: -53.4090 - val_acc: 0.0998
Epoch 28/32
156/156 [==============================] - 25s 162ms/step - loss: -53.6624 -
acc: 0.0991 - val_loss: -53.3876 - val_acc: 0.1000
Epoch 29/32
156/156 [==============================] - 25s 162ms/step - loss: -53.3063 -
acc: 0.0983 - val_loss: -53.3387 - val_acc: 0.1002
Epoch 30/32
156/156 [==============================] - 25s 162ms/step - loss: -53.2741 -
acc: 0.1012 - val_loss: -53.3601 - val_acc: 0.1002
Epoch 31/32
156/156 [==============================] - 25s 163ms/step - loss: -53.9709 -
acc: 0.0965 - val_loss: -53.3754 - val_acc: 0.1002
```

```
Epoch 32/32
156/156 [==============================] - 26s 164ms/step - loss: -53.1590 -
acc: 0.1010 - val_loss: -53.3204 - val_acc: 0.1002
```

[14]:
```
# Save the model

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

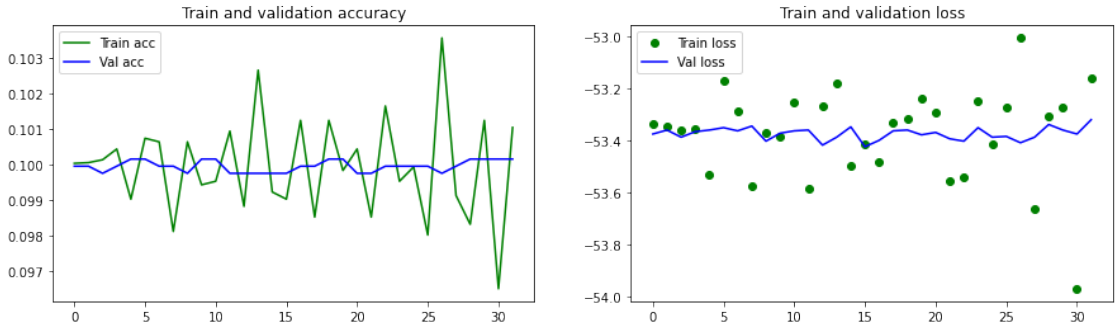
[15]:
```
# Evaluate the model with visulizing the result

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



[16]:
```
# Release the GPU memory

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