결과 보고서

과제. 12주차 문제풀이

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1-1. 소스코드

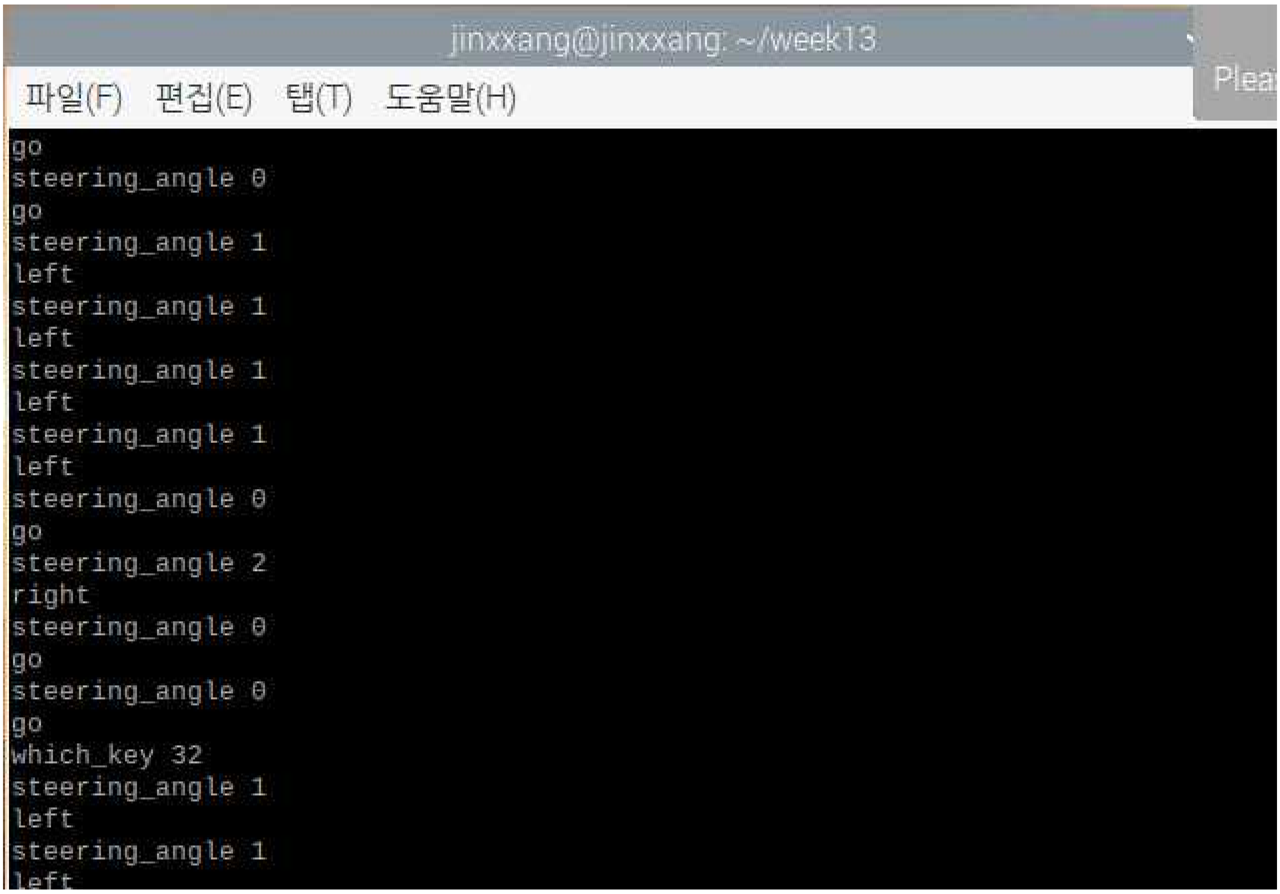
```
import tensorflow as tf
tf.__version__
# status initialize

import os



os.environ['CUDA_VISIBLE_DEVICES'] = '1'



# out of memory

import tensorflow as tf



with tf.Graph().as_default():



  gpu_options = tf.GPUOptions(allow_growth=True)
import os
import random
import fnmatch
import datetime
import pickle
import numpy as np
os.environ["HDF5_USE_FILE_LOCKING"] = "FALSE"

'''import pandas as pd
pd.set_option('display.width', 300)
pd.set_option('display.float_format', '{:,.4f}'.format)
pd.set_option('display.max_colwidth', 200)'''

import pandas as pd
import tensorflow as tf
import tensorflow.keras

print(tf.__version__)
```

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPool2D, Dropout, Flatten, Dense
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import load_model

print('tf.__version__:', tf.__version__)
print('keras__version__:', tf.keras.__version__)

from sklearn.utils import shuffle
from sklearn.model_selection import train_test_split

#import colab
#from imgaug import augmenters as img_aug
import matplotlib.pyplot as plt
import matplotlib.image as mping
from PIL import Image
data_dir = "20241130_1746"
file_list = os.listdir(data_dir)
image_paths = []
steering_angles = []
pattern ="*.png"
for filename in file_list:
    if fnmatch.fnmatch(filename, pattern):
        image_paths.append(os.path.join(data_dir, filename))
        angle = int(filename[-7:-4])
        steering_angles.append(angle)
print('image_paths', image_paths)
print('steering_angles', steering_angles)
image_index = 1
plt.imshow(Image.open(image_paths[image_index]))
print("image_path: ", image_paths[image_index])
print("steering_Angle: ", steering_angles[image_index])
df = pd.DataFrame()
df['ImagePath'] = image_paths
df['Angle'] = steering_angles
num_of_bins = 10
hist, bins = np.histogram(df['Angle'], num_of_bins)
print(hist)
print(bins)
fig, axes = plt.subplots(1,1,figsize=(10,4))
axes.hist(df['Angle'], bins=num_of_bins, width=1, color='blue')
'''s = np.array(steering_angles)
```

```
angle0=np.where(s==0)
print(angle0)
angle0=np.where(s==45)
print(angle0)
angle0=np.where(s==90)
print(angle0)
angle0=np.where(s==135)
print(angle0)'''

s = np.array(steering_angles)
new_angles = np.copy(steering_angles)
new_angles[np.where(s==0)] = 0
new_angles[np.where(s==45)] = 1
new_angles[np.where(s==135)] = 2
print(new_angles)
print(steering_angles)
print(len(np.where(new_angles==0)[0]))
print(len(np.where(new_angles==1)[0]))
print(len(np.where(new_angles==2)[0]))
#print(len(new_angles))
df['Angle'] = new_angles
X_train, X_valid, y_train, y_valid = train_test_split(image_paths, new_angles, test_size=0.2)
print("Training data: {}, Validation data : {}".format(len(X_train), len(X_valid)))

fig, axes = plt.subplots(1,2, figsize=(12,4))
axes[0].hist(y_train, bins=num_of_bins, width=1, color='blue')
axes[0].set_title("Training data")
axes[1].hist(y_valid, bins=num_of_bins, width=1, color='red')
axes[1].set_title("Validation data")

for a, b in zip(X_train, y_train):
    print(a,b)
import cv2
def my_imread(image_path):
    #print(image_path)
    image = cv2.imread(image_path)
    return image
def img_preprocess(image):
    image = np.float32(image) / 255.
    return image
fig, axes = plt.subplots(1,2,figsize=(15,10))
image_ori = my_imread(image_paths[image_index])
```

```
image_processed = img_preprocess(image_ori)
axes[0].imshow(image_ori)
axes[0].set_title("ori")
axes[1].imshow(image_processed)
axes[1].set_title("processed")
print(image_ori.shape)

def neural_net():
    model = Sequential()
    model.add(Conv2D(16, (5,5), input_shape=(66,200,3), activation='relu'))
    model.add(MaxPool2D((2,2)))
    model.add(Dropout(0.5))
    model.add(Conv2D(32, (5,5), activation='relu'))
    model.add(MaxPool2D((2,2)))
    model.add(Dropout(0.5))
    model.add(Conv2D(32, (5,5), activation='relu'))
    model.add(MaxPool2D((2,2)))
    model.add(Conv2D(32, (3,3), activation='relu'))
    model.add(Dropout(0.5))
    model.add(Flatten())
    model.add(Dropout(0.5))
    model.add(Dense(100, activation='relu'))
    model.add(Dropout(0.5))
    model.add(Dense(50, activation='relu'))
    model.add(Dropout(0.5))
    model.add(Dense(3, activation='softmax'))

    opt = Adam(lr=1e-3)
    loss_fn = tf.keras.losses.SparseCategoricalCrossentropy()
    model.compile(loss=loss_fn, optimizer=opt)

    return model

model = neural_net()
print(model.summary())

def image_data_generator(image_paths, steering_angles, batch_size):
    while True:
        batch_images = []
        batch_steering_angles = []
        len_imgs = len(image_paths)
        #print('len_imgs', len_imgs)
        for i in range(batch_size):
            random_index = random.randint(0, len_imgs-1)
            image_path = image_paths[random_index]
            image = my_imread(image_path)
            steering_angle = steering_angles[random_index]

            image = img_preprocess(image)
            batch_images.append(image)
            batch_steering_angles.append(steering_angle)
            #print('batch_images', batch_images)
            #print('batch_steering_angles', batch_steering_angles)
        yield(np.asarray(batch_images), np.asarray(batch_steering_angles))

ncol = 2
nrow = 2

print(len(X_train))
#print(len(y_train))

X_train_batch, y_train_batch = next(image_data_generator(X_train, y_train, nrow))
X_valid_batch, y_valid_batch = next(image_data_generator(X_valid, y_valid, nrow))

print(len(X_train_batch))
fig, axes = plt.subplots(nrow, ncol, figsize=(15,6))
fig.tight_layout()

for i in range(nrow):
    axes[i][0].imshow(X_train_batch[i])
    axes[i][0].set_title("training, angle={}".format(y_train_batch[i]))
    axes[i][1].imshow(X_valid_batch[i])
    axes[i][1].set_title("validation, angle={}".format(y_valid_batch[i]))

import datetime
save_dir = datetime.datetime.now().strftime('%Y%m%d_%H%M')
model_output_dir = os.path.join(save_dir)
os.mkdir(model_output_dir)
print('model_output_dir ', model_output_dir)
train_bSize = 20
valid_bSize = 100
checkpoint = 'lane_navigation_'+ save_dir + '.h5'
checkpoint_callback                                                              =
tensorflow.keras.callbacks.ModelCheckpoint(filepath=os.path.join(model_output_dir,
checkpoint),\
                                                            verbose=1, \
                                                            save_best_only=True)
history = model.fit_generator(image_data_generator(X_train, y_train, batch_size=train_bSize),
\
                            steps_per_epoch=len(X_train)/train_bSize,\
                            epochs=100, \
                            validation_data=image_data_generator(X_valid,          y_valid,
batch_size=valid_bSize), \
                            validation_steps=len(X_valid)/valid_bSize, \
                            verbose=1, \
                            shuffle=1, \
                            callbacks=[checkpoint_callback])
#model.save(os.path.join(model_output_dir, checkpoint))
history_path = os.path.join(model_output_dir, 'history.pickle')
with open(history_path, 'wb') as f:
    pickle.dump(history.history, f, pickle.HIGHEST_PROTOCOL)
img_path = X_valid[0]
image = my_imread(img_path)
steering_angle = steering_angles[0]
image = img_preprocess(image)
print(image.shape)
print(model.predict(np.expand_dims(image, 0))[0])
print(np.argmax(model.predict(np.expand_dims(image, 0))[0]))
plt.imshow(image)
print(model_output_dir)

history_path = os.path.join(model_output_dir, 'history.pickle')
with open(history_path, 'rb') as f:
    history = pickle.load(f)

plt.plot(history['loss'], color='blue')
plt.plot(history['val_loss'], color='red')
plt.legend(['training loss', 'validation loss'])
```

1-2 제어화면



```
go
steering_angle 0
go
steering_angle 1
left
steering_angle 1
left
steering_angle 1
left
steering_angle 1
left
steering_angle 0
go
steering_angle 2
right
steering_angle 0
go
steering_angle 0
go
which_key 32
steering_angle 1
left
steering_angle 1
left
```