Deep learning 3

전현호

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Intro

- 일정

1. Tensorflow 설치 과정 정리
2. Linear regression 해결을 위한 코드 구성
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} 완료

4. TF-learn을 통한 2종류 이미지 분류, mnist
5. Keras를 통한 mnist

} 발표

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8. GAN or 강화학습 or 자율 주행 시뮬레이션

} 예정

high level api

- TF-learn
  1) Google 및 기타 기업의 개발자들로 구성된 Udacity의 자율주행 연구팀이 선정한 lib
  2) TF와 섞어 사용하기 좋음 (tensorboard…)

- TF-slim
  1) 여러 신경망을 쉽게 사용할 수 있도록 제공함
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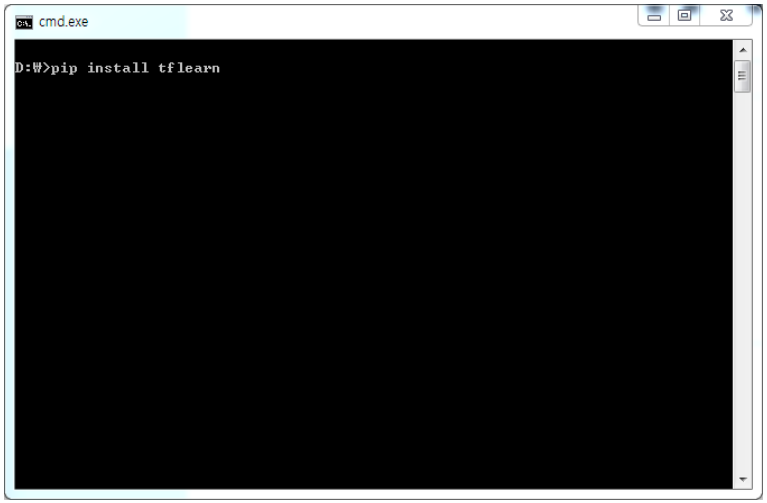
- Keras
  1) 원래 Theano 기반이었으나 최근 TF를 동시 지원하기 시작함
  2) 개발자들이 가장 밀어주고 있는 lib.
  3) 매우 간결

TF-learn

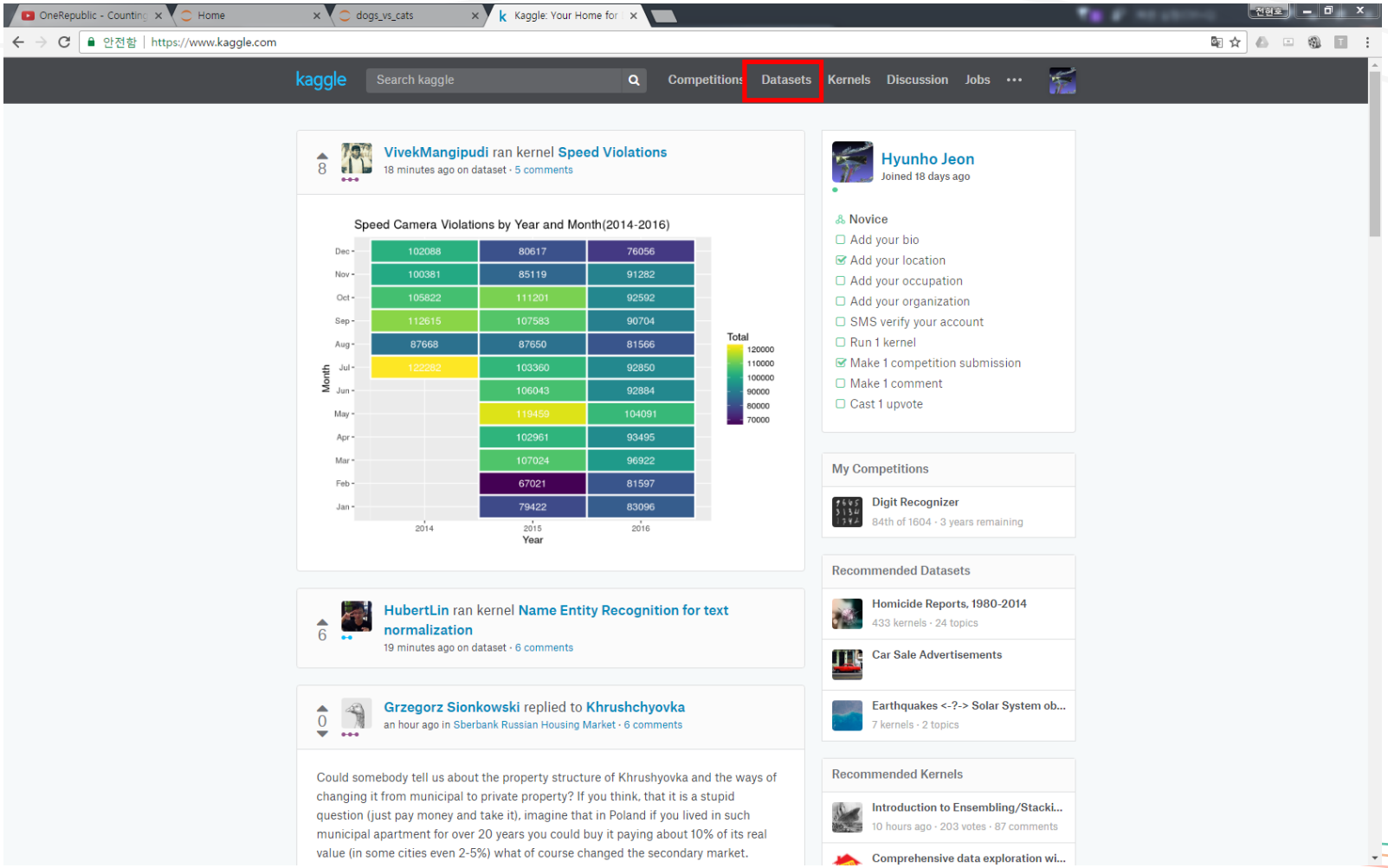
- 설치 : pip install tflearn
- 사용 : import tflearn




```
import tflearn
from tflearn.layers.conv import conv_2d, max_pool_2d
from tflearn.layers.core import input_data, dropout, fully_connected
from tflearn.layers.estimator import regression
```

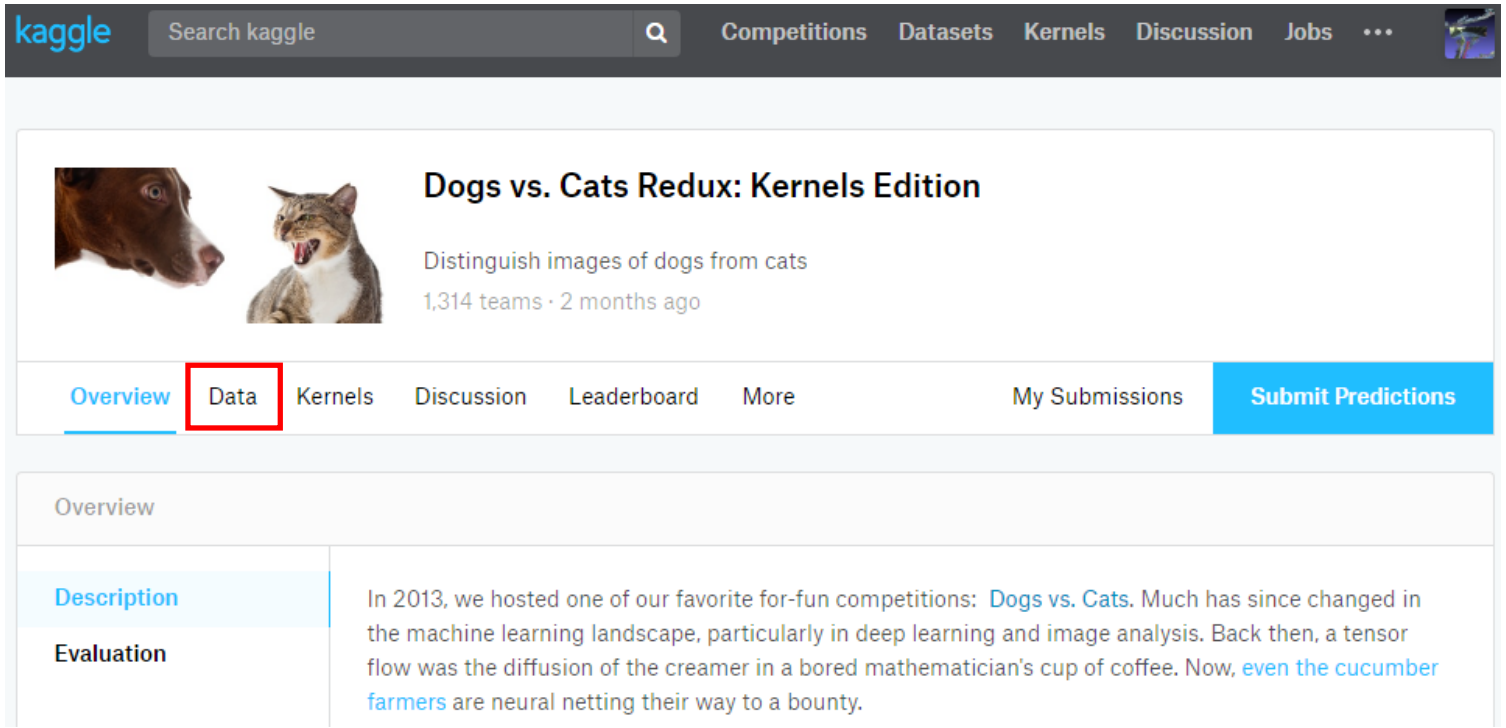
Kaggle data

- www.kaggle.com



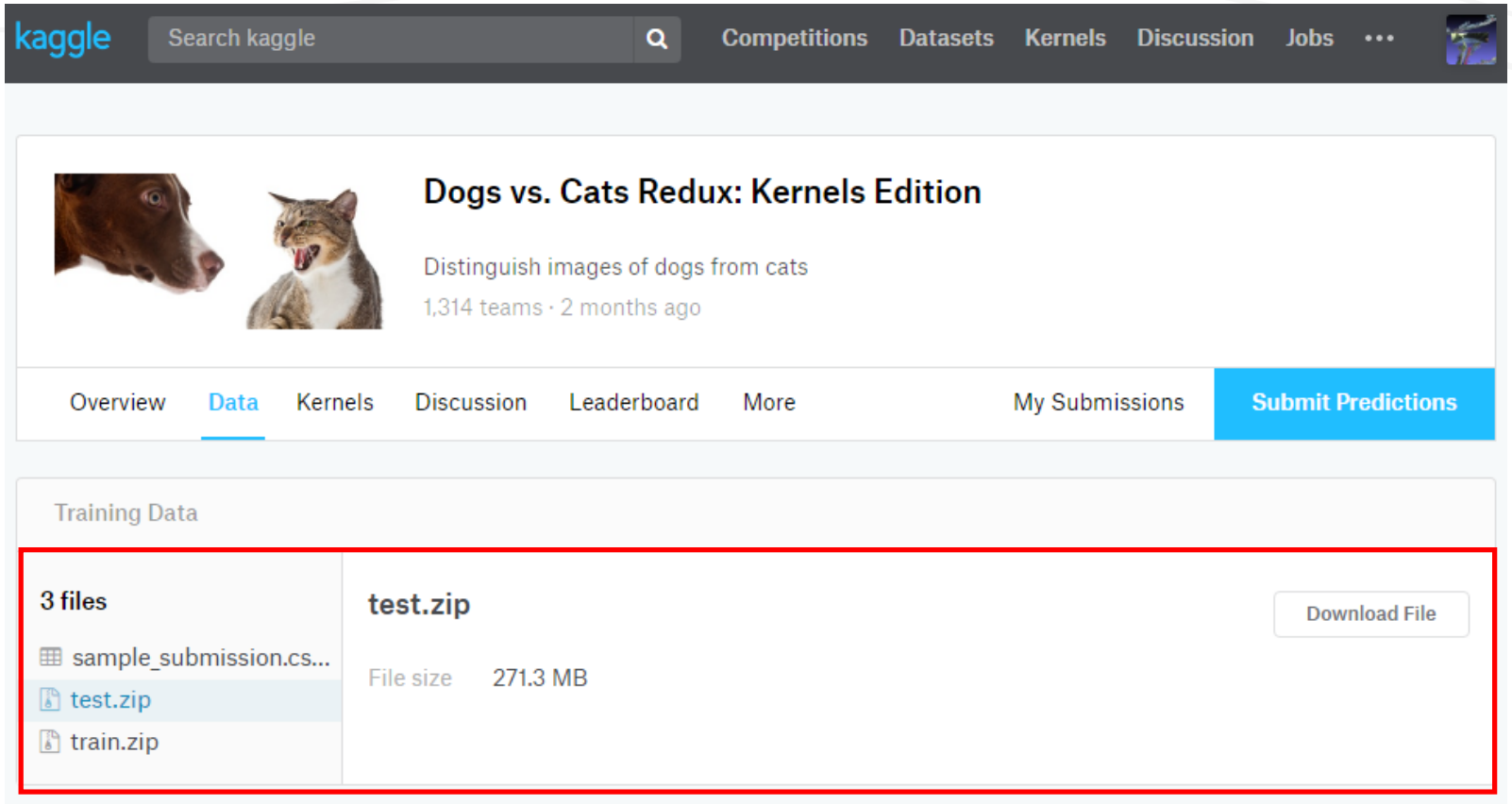
Dogs vs. Cats

- www.kaggle.com



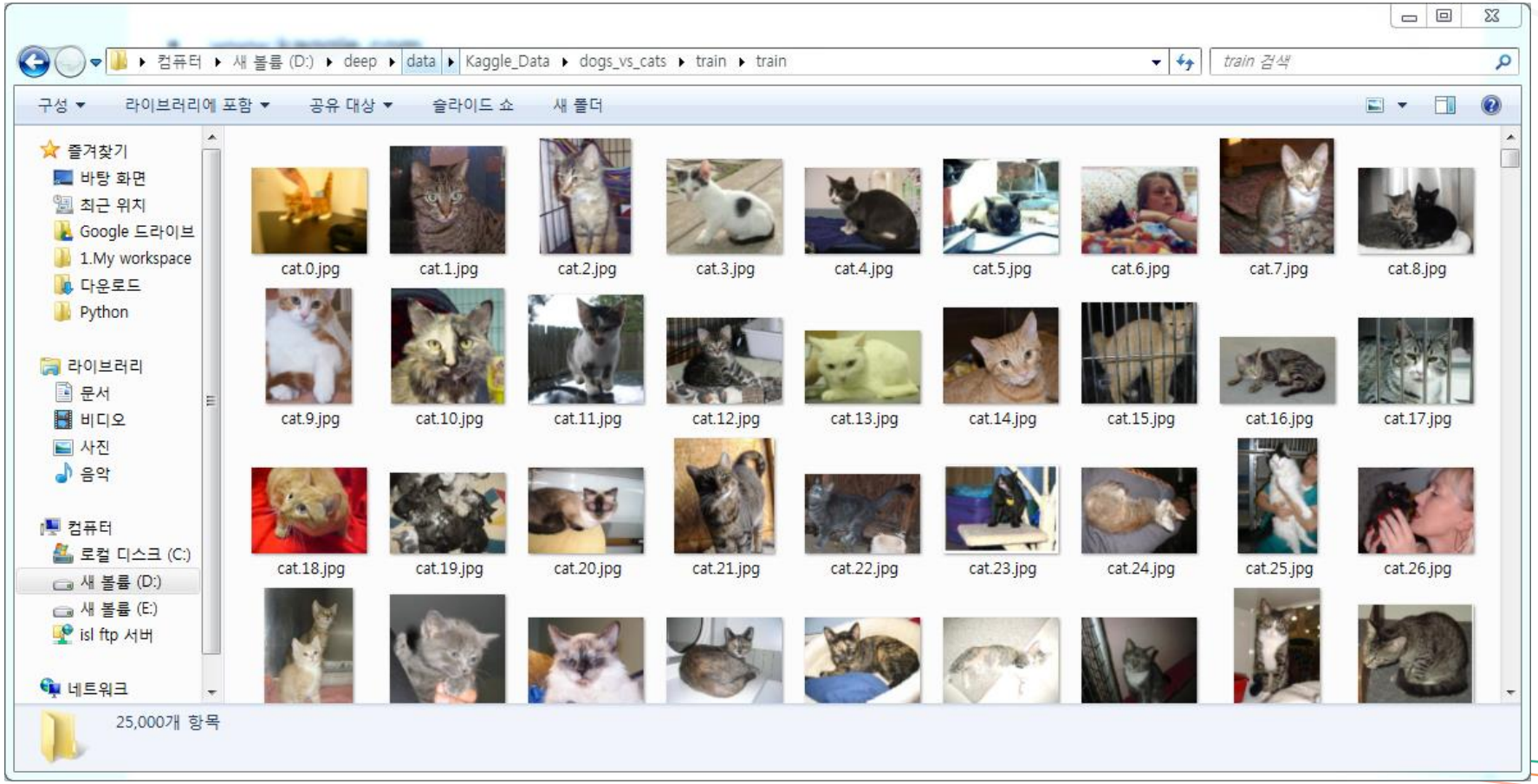
Dogs vs. Cats

- www.kaggle.com



Dogs vs. Cats

- 각각 12,500장의 학습 데이터 (총 25,000장)
- 12,500장의 테스트 데이터



Dogs vs. Cats

In [1]:
```
import cv2
import numpy as np
import os
from random import shuffle
from tqdm import tqdm
```

In [2]:
```
TRAIN_DIR = 'D:/deep/data/Kaggle_Data/dogs_vs_cats/train/train'
TEST_DIR = 'D:/deep/data/Kaggle_Data/dogs_vs_cats/test/test'
IMG_SIZE = 50
LR = 1e-3

MODEL_NAME = 'dogsvscats-{}-{}.model'.format(LR, '5conv')
```

In [3]:
```
def label_img(img):
    word_label = img.split('.')[-3]
    if word_label == 'cat': return [1,0]
    elif word_label == 'dog': return [0,1]
```

In [4]:
```
def create_train_data():
    training_data = []
    for img in tqdm(os.listdir(TRAIN_DIR)):
        label = label_img(img)
        path = os.path.join(TRAIN_DIR,img)
        img = cv2.imread(path,cv2.IMREAD_GRAYSCALE)
        img = cv2.resize(img, (IMG_SIZE,IMG_SIZE))
        training_data.append([np.array(img),np.array(label)])
    shuffle(training_data)
    np.save('train_data.npy', training_data)
    return training_data
```

Dogs vs. Cats

In [5]:
```
def process_test_data():
    testing_data = []
    for img in tqdm(os.listdir(TEST_DIR)):
        path = os.path.join(TEST_DIR,img)
        img_num = img.split('.')[0]
        img = cv2.imread(path,cv2.IMREAD_GRAYSCALE)
        img = cv2.resize(img, (IMG_SIZE,IMG_SIZE))
        testing_data.append([np.array(img), img_num])

    shuffle(testing_data)
    np.save('test_data.npy', testing_data)
    return testing_data
```

In [6]:
```
#train_data = create_train_data()
# If you have already created the dataset:
train_data = np.load('train_data.npy')
```

Dogs vs. Cats

In [7]:

```
import tflearn
from tflearn.layers.conv import conv_2d, max_pool_2d
from tflearn.layers.core import input_data, dropout, fully_connected
from tflearn.layers.estimator import regression

import tensorflow as tf
tf.reset_default_graph()

convnet = input_data(shape=[None, IMG_SIZE, IMG_SIZE, 1], name='input')

convnet = conv_2d(convnet, 32, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 64, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 128, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 64, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 32, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = fully_connected(convnet, 1024, activation='relu')
convnet = dropout(convnet, 0.8)

convnet = fully_connected(convnet, 2, activation='softmax')
convnet = regression(convnet, optimizer='adam', learning_rate=LR, loss='categorical_crossentropy', name='targets')

model = tflearn.DNN(convnet, tensorboard_dir='log')
```

Dogs vs. Cats

- 비교

```
import tflearn
from tflearn.layers.conv import conv_2d, max_pool_2d
from tflearn.layers.core import input_data, dropout, fully_connected
from tflearn.layers.estimator import regression

import tensorflow as tf
tf.reset_default_graph()

convnet = input_data(shape=[None, IMG_SIZE, IMG_SIZE, 1], name='input')

convnet = conv_2d(convnet, 32, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 64, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 128, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 64, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = conv_2d(convnet, 32, 5, activation='relu')
convnet = max_pool_2d(convnet, 5)

convnet = fully_connected(convnet, 1024, activation='relu')
convnet = dropout(convnet, 0.8)

convnet = fully_connected(convnet, 2, activation='softmax')
convnet = regression(convnet, optimizer='adam', learning_rate=LR, loss='categorical_crossentropy', name='targets')

model = tflearn.DNN(convnet, tensorboard_dir='log')
```

TF-learn
5conv net

```
import tensorflow as tf
from tensorflow.examples.tutorials.mnist import input_data
mnist = input_data.read_data_sets("/tmp/data/", one_hot = True)

n_nodes_hl1 = 500
n_nodes_hl2 = 500
n_nodes_hl3 = 500

n_classes = 10
batch_size = 100

x = tf.placeholder('float', [None, 784])
y = tf.placeholder('float')


hidden_1_layer = {'weights':tf.Variable(tf.random_normal([784, n_nodes_hl1])),
                  'biases':tf.Variable(tf.random_normal([n_nodes_hl1]))}

hidden_2_layer = {'weights':tf.Variable(tf.random_normal([n_nodes_hl1, n_nodes_hl2])),
                  'biases':tf.Variable(tf.random_normal([n_nodes_hl2]))}

hidden_3_layer = {'weights':tf.Variable(tf.random_normal([n_nodes_hl2, n_nodes_hl3])),
                  'biases':tf.Variable(tf.random_normal([n_nodes_hl3]))}

output_layer = {'weights':tf.Variable(tf.random_normal([n_nodes_hl3, n_classes])),
                'biases':tf.Variable(tf.random_normal([n_classes])),}


l1 = tf.add(tf.matmul(x,hidden_1_layer['weights']), hidden_1_layer['biases'])
l1 = tf.nn.relu(l1)

l2 = tf.add(tf.matmul(l1,hidden_2_layer['weights']), hidden_2_layer['biases'])
l2 = tf.nn.relu(l2)

l3 = tf.add(tf.matmul(l2,hidden_3_layer['weights']), hidden_3_layer['biases'])
l3 = tf.nn.relu(l3)

output = tf.matmul(l3,output_layer['weights']) + output_layer['biases']


prediction = output
cost = tf.reduce_mean( tf.nn.softmax_cross_entropy_with_logits(prediction,y) )
optimizer = tf.train.AdamOptimizer().minimize(cost)

hm_epochs = 10
sess = tf.Session()
sess.run(tf.global_variables_initializer())
```

Tensorflow
3 hidden layer

+Session ~~~

Dogs vs. Cats

In [8]:
```
if os.path.exists('{}.meta'.format(MODEL_NAME)):
    model.load(MODEL_NAME)
    print('model loaded!')
```

```
model loaded!
```

In [9]:
```
train = train_data[:-500]
test = train_data[-500:]
```

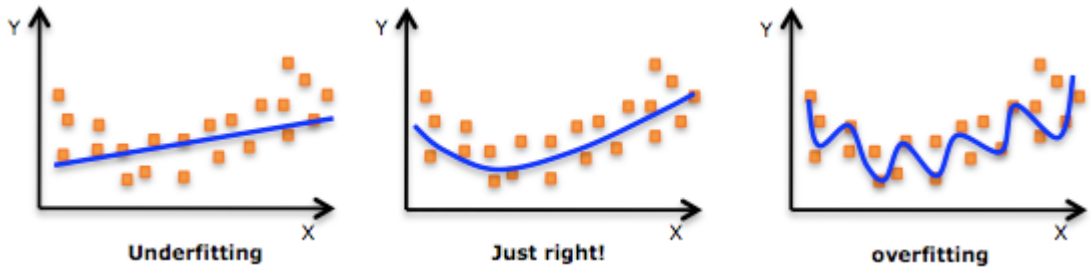
In [10]:
```
print(train.shape)
X = np.array([i[0] for i in train]).reshape(-1,IMG_SIZE,IMG_SIZE,1)
Y = [i[1] for i in train]

test_x = np.array([i[0] for i in test]).reshape(-1,IMG_SIZE,IMG_SIZE,1)
test_y = [i[1] for i in test]
```

```
(24500, 2)
```

Validation set 생성

Dogs vs. Cats

- Validation

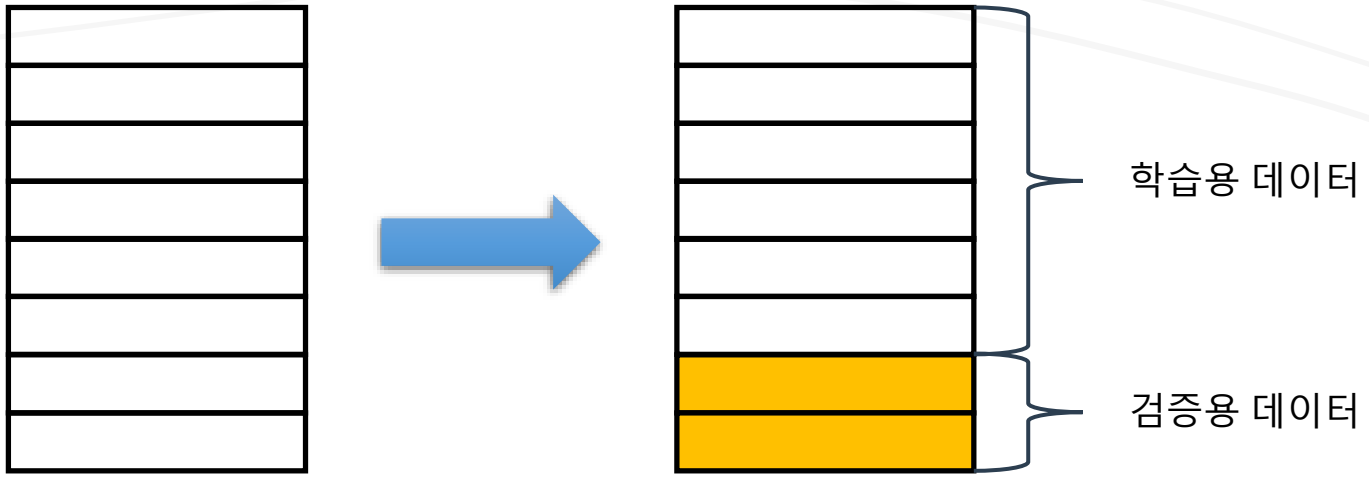


- 간단한 문제에서는 과적합(overfitting)을 확인하기 쉬움
- 하지만 실제 해결하고자 하는 문제는 차원이 높아 확인하기 어려움

➢ 검증(Validation) 기법 고안 – 모든 데이터를 학습에 사용하지 않고 일부를 떼어 성능 검증에 사용함

Dogs vs. Cats

- Validation



- 검증이 도입된 학습 절차
  1. 학습 데이터를 학습용 데이터와 검증용 데이터로 나눔. 보통 8:2 비율 사용
  2. 학습용 데이터로 모델을 학습
  3. 검증용 데이터로 모델의 성능을 평가
     a. 성능이 만족스러운 경우, 학습 종료
     b. 성능이 떨어질 경우, 모델의 구조 등을 수정해 다시 학습

Dogs vs. Cats

```
In [11]: model.fit({'input': X}, {'targets': Y}, n_epoch=30, validation_set=({'input': test_x}, {'targets': test_y}),
             snapshot_step=500, show_metric=True, run_id=MODEL_NAME)
         #tensorboard --logdir=foo:d:#deep#log
```

학습

```
Training Step: 11489  | total loss: 0.07476 | time: 6.873s
| Adam | epoch: 030 | loss: 0.07476 - acc: 0.9727 -- iter: 24448/24500
Training Step: 11490  | total loss: 0.07033 | time: 7.907s
| Adam | epoch: 030 | loss: 0.07033 - acc: 0.9738 | val_loss: 1.51778 - val_acc: 0.7540 -- iter: 24500/24500
--
```

```
In [12]: model.save(MODEL_NAME)
```

모델 저장

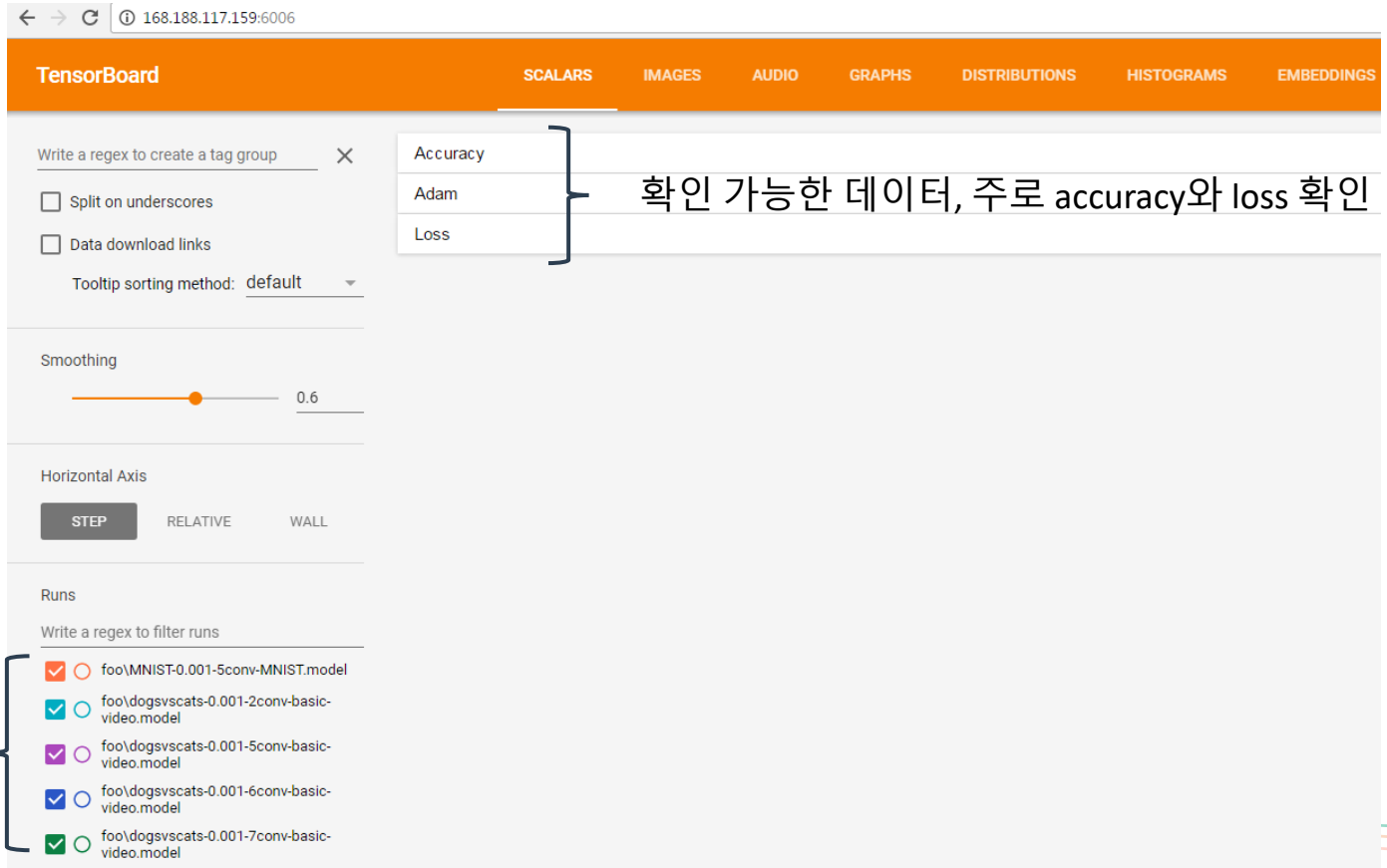
cmd.exe - tensorboard --logdir=foo:d:#deep#log

```
D:#>tensorboard --logdir=foo:d:#deep#log
I c:#tf_jenkins#home#workspace#release-win#device#gpu#os#windows#tensorflow#stre
am_executor#dso_loader.cc:135] successfully opened CUDA library cublas64_80.dll
locally
I c:#tf_jenkins#home#workspace#release-win#device#gpu#os#windows#tensorflow#stre
am_executor#dso_loader.cc:135] successfully opened CUDA library cudnn64_5.dll lo
cally
I c:#tf_jenkins#home#workspace#release-win#device#gpu#os#windows#tensorflow#stre
am_executor#dso_loader.cc:135] successfully opened CUDA library cufft64_80.dll l
ocally
I c:#tf_jenkins#home#workspace#release-win#device#gpu#os#windows#tensorflow#stre
am_executor#dso_loader.cc:135] successfully opened CUDA library nvcuda.dll local
ly
I c:#tf_jenkins#home#workspace#release-win#device#gpu#os#windows#tensorflow#stre
am_executor#dso_loader.cc:135] successfully opened CUDA library curand64_80.dll
locally
Starting TensorBoard b'41' on port 6006
(You can navigate to http://168.188.117.159:6006)
```

Tensorboard 실행

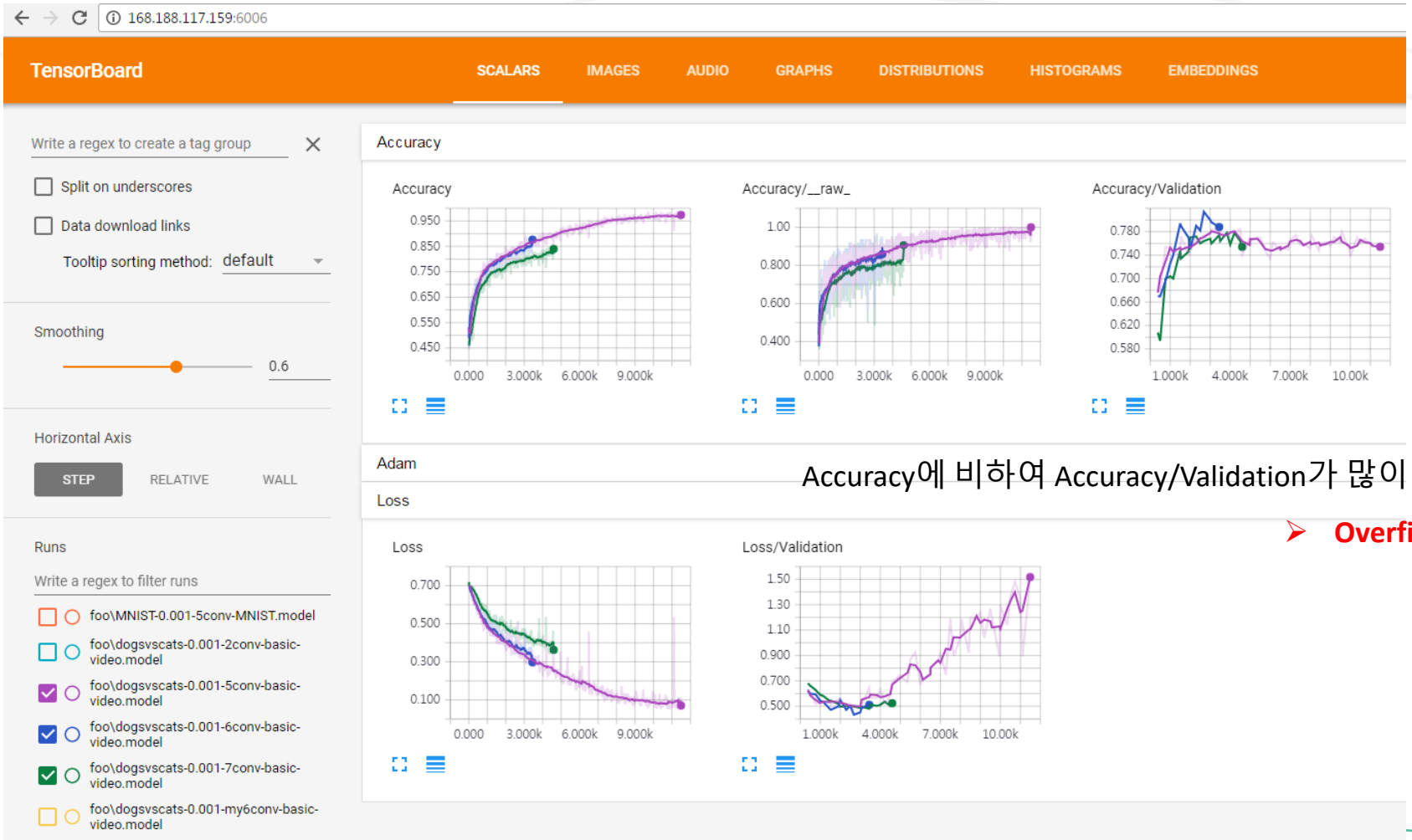
Dogs vs. Cats

- Tensorboard
  - 학습 과정에서 curses가 없다는 경고 문구가 나올 경우 tensorboard에 데이터가 보이지 않는 문제가 있음
  - ➢ pip install curses로 해결



Dogs vs. Cats

- Tensorboard



Accuracy에 비하여 Accuracy/Validation가 많이 낮음

➢ **Overfitting**

Dogs vs. Cats

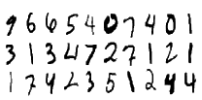
In [13]:
```
import matplotlib.pyplot as plt

#if you dont have this file yet
#test_data = process_test_data()
#if you already have it
test_data = np.load('test_data.npy')

fig = plt.figure()

for num, data, in enumerate(test_data[:12]):
    # cat : [1,0]
    # dog : [0,1]

    img_num = data[1]
    img_data = data[0]

    y = fig.add_subplot(3, 4, num+1)
    orig = img_data
    data = img_data.reshape(IMG_SIZE, IMG_SIZE, 1)

    model_out = model.predict([data])[0]

    if np.argmax(model_out) == 1: str_label = 'Dog'
    else: str_label = 'Cat'

    y.imshow(orig, cmap = 'gray')
    plt.title(str_label)
    y.axes.get_xaxis().set_visible(False)
    y.axes.get_yaxis().set_visible(False)
plt.show()
```

MNIST : TF-learn & Keras

Digit Recognizer

Learn computer vision fundamentals with the famous MNIST data

Getting Started · 3 years to go · Entered



Digit Recognizer

Learn computer vision fundamentals with the famous MNIST data

1,594 teams · 3 years to go

Overview | Data | Kernels | Discussion | Leaderboard | More | My Submissions | Submit Predictions

Your most recent submission

Name	Submitted	Wait time	Execution time	Score
MNIST-0.001-keras-3conv-MNIST.mo...	11 days ago	2 seconds	0 seconds	0.99614

Complete

Jump to your position on the leaderboard

Public Leaderboard | Private Leaderboard

This leaderboard is calculated with approximately 25% of the test data.
The final results will be based on the other 75%, so the final standings may be different.

Raw Data | Refresh

#	△1w	Team Name	Kernel	Team Members	Score	Entries	Last
1	—	Jakob Peterlin			1.00000	5	2mo
2	—	linbo_iacas			1.00000	1	2mo
3	—	Tanaka			1.00000	1	1mo
4	—	XueHao Xiang			1.00000	8	1mo

MNIST - Keras

In [1]:
```
import cv2                # working with, mainly resizing, images
import numpy as np        # dealing with arrays
import os                 # dealing with directories
from random import shuffle # mixing up or currently ordered data that might lead our network astray in training.
from tqdm import tqdm     # a percentage bar for tasks
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix

import keras
from keras.utils import np_utils
from keras.models import Sequential
from keras.models import load_model

from keras.layers import Dense, Dropout, Flatten, Conv2D, MaxPool2D, BatchNormalization
from keras.optimizers import Adam
from keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import LearningRateScheduler

import tensorflow as tf
#1
```

```
Using TensorFlow backend.
```

MNIST - Keras

In [2]:
```
# get data
train_data  = np.array(pd.read_csv('D:/deep/data/Kaggle_Data/MNIST/train/train.csv'))
test_data = np.array(pd.read_csv('D:/deep/data/Kaggle_Data/MNIST/test/test.csv'))

x_train, x_val, y_train, y_val = train_test_split(train_data[:,1:], train_data[:,0], test_size=0.1)

x_train = x_train.astype("float32")/255.0
x_val = x_val.astype("float32")/255.0
y_train = np_utils.to_categorical(y_train)
y_val = np_utils.to_categorical(y_val)

n_train = x_train.shape[0]
n_val = x_val.shape[0]
x_train = x_train.reshape(n_train, 28, 28, 1)
x_val = x_val.reshape(n_val, 28, 28, 1)
n_classes = y_train.shape[1]
```

MNIST - Keras

In [3]:
```
LR = 1e-3
MODEL_NAME = 'MNIST-{}-{}.model'.format(LR, 'keras-conv-MNIST-0502-padding')
#2
```

In [4]:
```
model = Sequential()

model.add(Conv2D(filters = 32, kernel_size = (3, 3), padding = 'same', activation='relu',
                 input_shape = (28, 28, 1)))
model.add(Conv2D(filters = 32, kernel_size = (3, 3), activation='relu'))
model.add(BatchNormalization())
model.add(Dropout(0.3))
model.add(MaxPool2D(strides=(2,2)))
model.add(Conv2D(filters = 64, kernel_size = (3, 3), padding = 'same', activation='relu'))
model.add(Conv2D(filters = 64, kernel_size = (3, 3), activation='relu'))
model.add(Conv2D(filters = 128, kernel_size = (3, 3), activation='relu'))
model.add(Conv2D(filters = 128, kernel_size = (3, 3), activation='relu'))
model.add(BatchNormalization())
model.add(Dropout(0.3))
model.add(MaxPool2D(strides=(2,2)))

model.add(Flatten())
#model.add(Dense(512, activation='relu'))
#model.add(Dropout(0.25))
#model.add(Dense(1024, activation='relu'))
#model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
```

MNIST - Keras

In [5]:
```
datagen = ImageDataGenerator(zoom_range = 0.1,
                             height_shift_range = 0.1,
                             width_shift_range = 0.1,
                             rotation_range = 10)
```

In [6]:
```
model.compile(loss='categorical_crossentropy', optimizer = Adam(lr=3e-5), metrics = ["accuracy"])
if os.path.exists('{}.h5'.format(MODEL_NAME)):
    model = load_model('{}.h5'.format(MODEL_NAME))
    print('model loaded!')
#8
```

In [ ]:
```
hist = model.fit_generator(datagen.flow(x_train, y_train, batch_size = 16),
                           steps_per_epoch = 500, #Increase this when not on Kaggle kernel
                           epochs = 100, #Increase this when not on Kaggle kernel
                           verbose = 2,  #verbose=1 outputs ETA, but doesn't work well in the cloud
                           validation_data = (x_val[:400,:], y_val[:400,:]), #To evaluate faster
                           callbacks = [annealer])
```

```
Epoch 1/100
10s - loss: 0.5677 - acc: 0.8127 - val_loss: 0.2417 - val_acc: 0.9375
Epoch 2/100
10s - loss: 0.2338 - acc: 0.9223 - val_loss: 0.1808 - val_acc: 0.9475
Epoch 3/100
10s - loss: 0.1999 - acc: 0.9376 - val_loss: 0.2587 - val_acc: 0.9275
Epoch 4/100
```

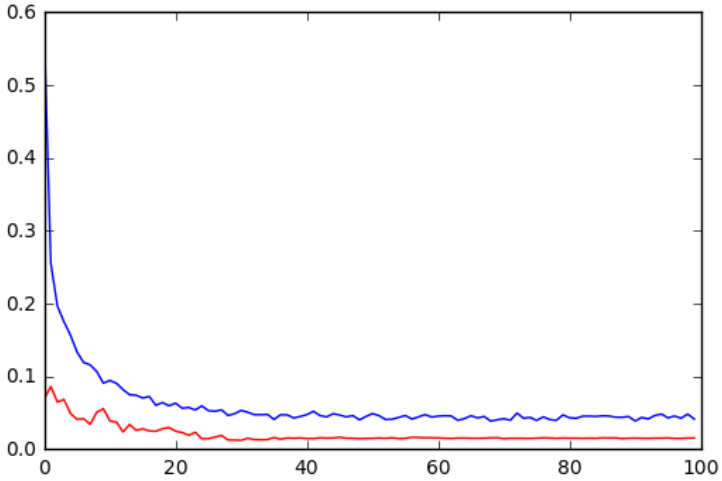
MNIST - Keras

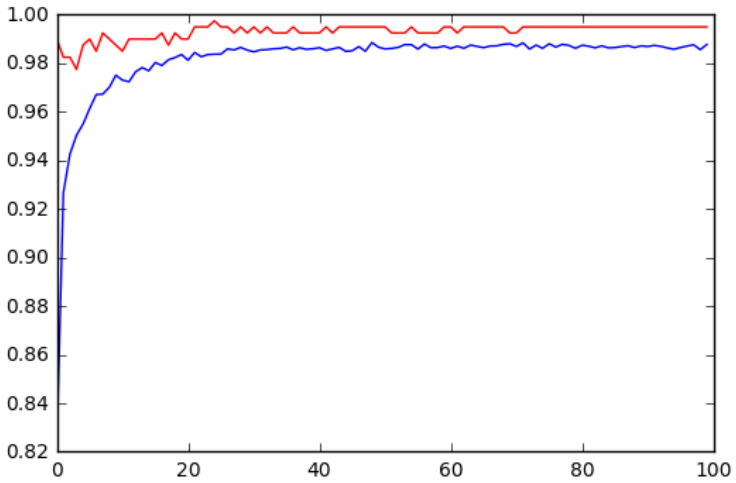
```
In [12]: model.save('{}.h5'.format(MODEL_NAME))
```

```
In [12]: model.evaluate(x_val, y_val, verbose=0)
```

```
Out[12]: [0.022180345102481493, 0.9940476190476907]
```

```
In [13]: import matplotlib.pyplot as plt
         plt.plot(hist.history['loss'], color='b')
         plt.plot(hist.history['val_loss'], color='r')
         plt.show()
         plt.plot(hist.history['acc'], color='b')
         plt.plot(hist.history['val_acc'], color='r')
         plt.show()
```





MNIST - Keras

```
In [12]: x_test = test_data.astype("float32")/255.0
         n_test = x_test.shape[0]
         x_test = x_test.reshape(n_test, 28, 28, 1)

In [13]: y_hat = model.predict(x_test, batch_size=64)

In [14]: y_pred = np.argmax(y_hat,axis=1)

In [15]: with open('{}.csv'.format(MODEL_NAME), 'w') as f :
             f.write('ImageId,Label\n')
             for i in range(0, n_test) :
                 f.write("".join([str(i+1),',',str(y_pred[i]),'\n']))
```

Competitions Novice

Unranked

0	0	0

Digit Recognizer
3 years to go · Top 5%

83rd
of 1662

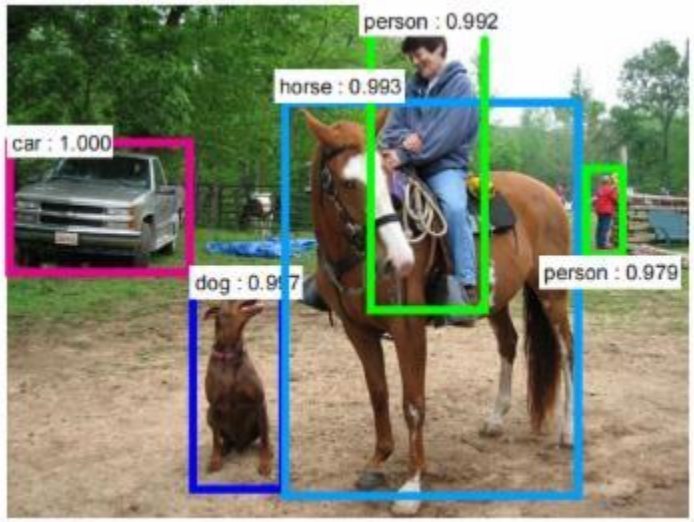
83	—	Hyunho Jeon		0.99614	5	11d

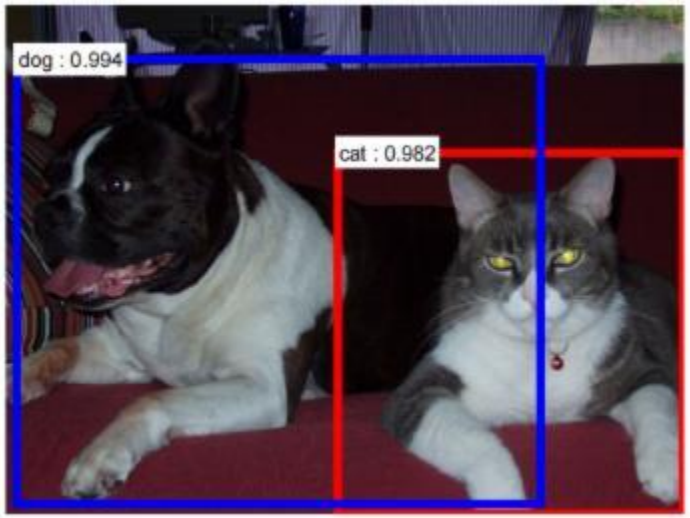
Your Best Entry ↑

Your submission scored 0.99614, which is an improvement of your previous score of 0.99600. Great job! Tweet this!

Conclusion

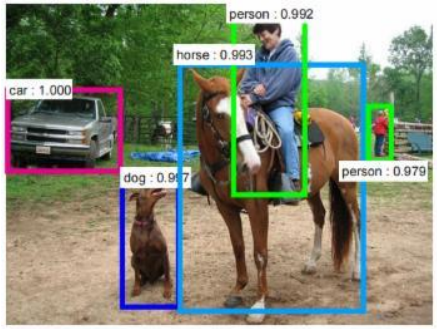
- Object detection + RAFSet ME

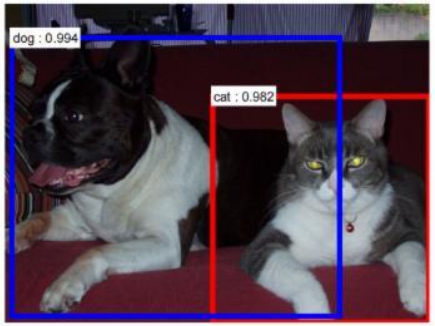




Conclusion

- Future work : Imagenet classification and Object detection + RAFSet ME





- Future work…? : GAN or Self-driving car simulation

(b) Handbag images (input) & **Generated** shoe images (output)

(c) Shoe images (input) & **Generated** handbag images (output)

Q&A