Hot_Dog

June 23, 2019

In [1]:
```
from __future__ import absolute_import
from __future__ import division
from __future__ import print_function

import collections
import math
import os
import random
from six.moves import urllib

from IPython.display import clear_output, Image, display
from io import BytesIO

import tensorflow as tf
import tensorflow_hub as hub

import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import sklearn.metrics as sk_metrics
import time

os.environ['KMP_DUPLICATE_LIB_OK'] = 'True'
tf.logging.set_verbosity(tf.logging.ERROR)
```

```
WARNING: Logging before flag parsing goes to stderr.
W0623 13:33:57.094846 4677387712 __init__.py:56] Some hub symbols are not available because Tens
```

In [2]:
```
DIR = './hot_dog_not_hot_dog'
TRAIN_FRACTION = 0.8
RANDOM_SEED = 2018

def make_train_and_test_sets():
    """Split the data into train and test sets and get the label classes."""
    train_examples, test_examples = [], []
    shuffler = random.Random(RANDOM_SEED)
```

```
            is_root = True

            for (dirname, subdirs, filenames) in tf.gfile.Walk(DIR):
                # The root directory gives us the classes
                if is_root:
                    subdirs = sorted(subdirs)
                    classes = collections.OrderedDict(enumerate(subdirs))
                    label_to_class = dict([(x, i) for i, x in enumerate(subdirs)])
                    is_root = False

                # The sub directories give us the image files for training.
                else:
                    filenames.sort()
                    shuffler.shuffle(filenames)
                    full_filenames = [os.path.join(dirname, f) for f in filenames]
                    label = dirname.split('/')[-1]
                    label_class = label_to_class[label]

                    # An example is the image file and it's label class.
                    examples = list(zip(full_filenames, [label_class] * len(filenames)))
                    num_train = int(len(filenames) * TRAIN_FRACTION)
                    train_examples.extend(examples[:num_train])
                    test_examples.extend(examples[num_train:])

            shuffler.shuffle(train_examples)
            shuffler.shuffle(test_examples)
            return train_examples, test_examples, classes
```

In [3]:
```
# Download the images and split the images into train and test sets.
TRAIN_EXAMPLES, TEST_EXAMPLES, CLASSES = make_train_and_test_sets()
NUM_CLASSES = len(CLASSES)

print('The dataset has %d label classes: %s' % (NUM_CLASSES, list(CLASSES.values())))
print('There are %d training images' % len(TRAIN_EXAMPLES))
print('There are %d test images' % len(TEST_EXAMPLES))
```

```
The dataset has 2 label classes: ['hot_dog', 'not_hot_dog']
There are 798 training images
There are 200 test images
```

In [4]:
```
LEARNING_RATE = 0.01

image_module = hub.Module('https://tfhub.dev/google/imagenet/mobilenet_v2_035_128/featur

# Preprocessing images into tensors with size expected by the image module.
encoded_images = tf.placeholder(tf.string, shape = [None])
image_size     = hub.get_expected_image_size(image_module)
```

```
        def decode_and_resize_image(encoded):
            decoded = tf.image.decode_jpeg(encoded, channels = 3)
            decoded = tf.image.convert_image_dtype(decoded, tf.float32)
            return tf.image.resize_images(decoded, image_size)

        batch_images = tf.map_fn(decode_and_resize_image,
                                 encoded_images,
                                 dtype=tf.float32)

        features = image_module(batch_images)

        def create_model(features):
            """Build a model for classification from extracted features."""
            layer1 = tf.layers.dense(inputs = features, units = 70, activation = tf.nn.relu)
            layer2 = tf.layers.dense(inputs = layer1, units = NUM_CLASSES, activation = None)
            return layer2

        logits = create_model(features)
        labels = tf.placeholder(tf.float32, [None, NUM_CLASSES])

        cross_entropy      = tf.nn.softmax_cross_entropy_with_logits_v2(logits = logits, labels
        cross_entropy_mean = tf.reduce_mean(cross_entropy)

        optimizer = tf.train.AdamOptimizer(learning_rate = LEARNING_RATE)
        train_op  = optimizer.minimize(loss = cross_entropy_mean)

        probabilities = tf.nn.softmax(logits)

        prediction         = tf.argmax(probabilities, 1)
        correct_prediction = tf.equal(prediction, tf.argmax(labels, 1))

        accuracy = tf.reduce_mean(tf.cast(correct_prediction, tf.float32))
```

In [5]:
```
        def get_label(example):
            """Get the label (number) for given example."""
            return example[1]

        def get_class(example):
            """Get the class (string) of given example."""
            return CLASSES[get_label(example)]

        def get_encoded_image(example):
            """Get the image data (encoded jpg) of given example."""
            image_path = example[0]
            return tf.gfile.FastGFile(image_path, 'rb').read()

        def get_image(example):
```

```
    """Get image as np.array of pixels for given example."""
    return plt.imread(BytesIO(get_encoded_image(example)), format = 'jpg')

def display_images(images_and_classes, cols = 5):
    """Display given images and their labels in a grid."""
    rows = int(math.ceil(len(images_and_classes) / cols))
    fig = plt.figure()
    fig.set_size_inches(cols * 3, rows * 3)
    for i, (image, flower_class) in enumerate(images_and_classes):
        plt.subplot(rows, cols, i + 1)
        plt.axis('off')
        plt.imshow(image)
        plt.title(flower_class)

NUM_IMAGES = 15
images_and_classes = []
for example in TRAIN_EXAMPLES[:NUM_IMAGES]:
    images_and_classes.append((get_image(example), get_class(example)))

display_images(images_and_classes)
```

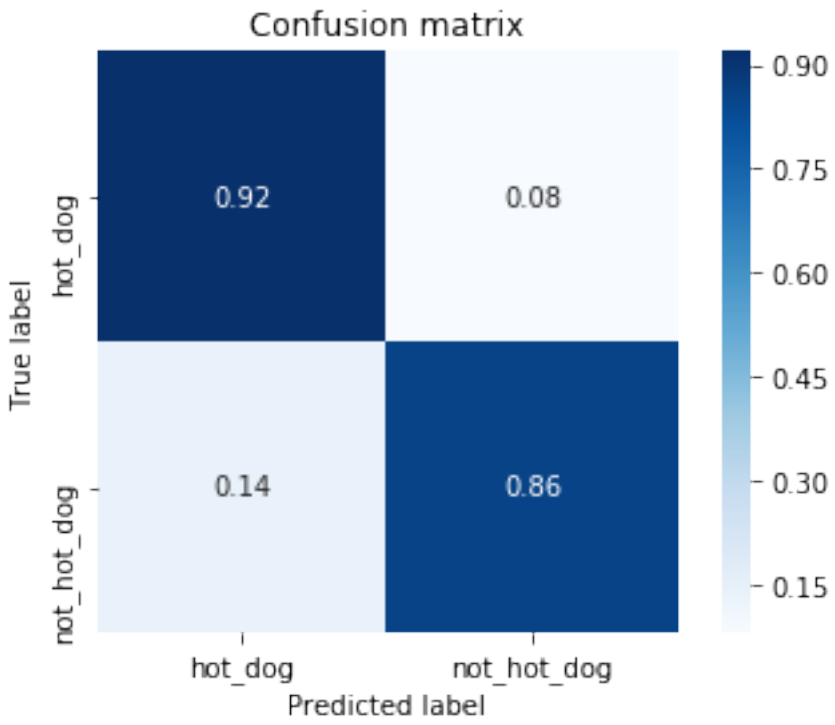
In [6]:
```
NUM_TRAIN_STEPS  = 200
TRAIN_BATCH_SIZE = 10
EVAL_EVERY = 10

def get_batch(batch_size = None, test = False):
```

```
        """Get a random batch of examples."""
        examples = TEST_EXAMPLES if test else TRAIN_EXAMPLES
        if batch_size:
            batch_examples = random.sample(examples, batch_size)
        else:
            batch_examples = examples
        return batch_examples

    def get_images_and_labels(batch_examples):
        images = [get_encoded_image(e) for e in batch_examples]
        one_hot_labels = [get_label_one_hot(e) for e in batch_examples]
        return images, one_hot_labels

    def get_label_one_hot(example):
        """Get the one hot encoding vector for the example."""
        one_hot_vector = np.zeros(NUM_CLASSES)
        np.put(one_hot_vector, get_label(example), 1)
        return one_hot_vector

    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for i in range(NUM_TRAIN_STEPS):
            # Get a random batch of training examples.
            train_batch = get_batch(batch_size = TRAIN_BATCH_SIZE)
            batch_images, batch_labels = get_images_and_labels(train_batch)

            # Run the train_op to train the model.
            feed_dict = {encoded_images: batch_images, labels: batch_labels}
            train_loss, _, train_accuracy = sess.run([cross_entropy_mean, train_op, accuracy
                                                      feed_dict = feed_dict)
            is_final_step = (i == (NUM_TRAIN_STEPS - 1))
            if i % EVAL_EVERY == 0 or is_final_step:
                # Get a batch of test examples.
                test_batch = get_batch(batch_size = None, test = True)
                batch_images, batch_labels = get_images_and_labels(test_batch)

                # Evaluate how well our model performs on the test set.
                test_loss, test_accuracy, test_prediction, correct_predicate = sess.run(
                [cross_entropy_mean, accuracy, prediction, correct_prediction],
                feed_dict = {encoded_images: batch_images, labels: batch_labels})
                print('Test accuracy at step %s: %.2f%%' % (i, (test_accuracy * 100)))
```

```
Test accuracy at step 0: 53.50%
Test accuracy at step 10: 79.00%
Test accuracy at step 20: 74.50%
Test accuracy at step 30: 73.50%
Test accuracy at step 40: 77.50%
Test accuracy at step 50: 83.50%
```

```
Test accuracy at step 60: 82.00%
Test accuracy at step 70: 84.00%
Test accuracy at step 80: 83.00%
Test accuracy at step 90: 84.50%
Test accuracy at step 100: 85.50%
Test accuracy at step 110: 84.00%
Test accuracy at step 120: 84.50%
Test accuracy at step 130: 83.00%
Test accuracy at step 140: 88.00%
Test accuracy at step 150: 85.00%
Test accuracy at step 160: 88.00%
Test accuracy at step 170: 87.00%
Test accuracy at step 180: 89.00%
Test accuracy at step 190: 87.50%
Test accuracy at step 199: 89.00%
```

```
In [7]: def show_confusion_matrix(test_labels, predictions):
            """Compute confusion matrix and normalize."""
            get_label   = np.argmax(test_labels, axis = 1)
            confusion   = sk_metrics.confusion_matrix(get_label, predictions)
            #Renormalize confusion
            confusion   = confusion.astype("float") / confusion.sum(axis = 1)
            axis_labels = list(CLASSES.values())
            ax = sns.heatmap(
                    confusion, xticklabels = axis_labels, yticklabels = axis_labels,
                    cmap = 'Blues', annot = True, fmt = '.2f', square = True)
            plt.title("Confusion matrix")
            plt.ylabel("True label")
            plt.xlabel("Predicted label")

        show_confusion_matrix(batch_labels, test_prediction)
```




```
In [8]: Zip = zip(test_batch, test_prediction, correct_predicate)
        incorrect = []
        for example, prediction, is_correct in Zip:
            if not is_correct: incorrect.append((example, CLASSES[prediction]))

        incorrectly_labelled_images = []
        label_template = "prediction: {0}\nlabel: {1}"
        for (example, wrong_pred) in incorrect[:]:
            img = (
                   get_image(example),
                   label_template.format(wrong_pred, get_class(example))
                  )
            incorrectly_labelled_images.append(img)

        display_images(incorrectly_labelled_images)
```

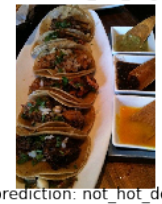
prediction: hot_dog
label: not_hot_dog

prediction: hot_dog
label: not_hot_dog

prediction: hot_dog
label: not_hot_dog

prediction: hot_dog
label: not_hot_dog

prediction: hot_dog
label: not_hot_dog



prediction: hot_dog
label: not_hot_dog

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