Classification

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0.1 # Day and Night Image Classifier

The day/night image dataset consists of 200 RGB color images in two categories: day and night. There are equal numbers of each example: 100 day images and 100 night images.

We'd like to build a classifier that can accurately label these images as day or night, and that relies on finding distinguishing features between the two types of images!

Note: All images come from the AMOS dataset (Archive of Many Outdoor Scenes).

0.1.1 Import resources

Before you get started on the project code, import the libraries and resources that you'll need.

```
In [1]: import cv2 # computer vision library
        import helpers

        import numpy as np
        import matplotlib.pyplot as plt
        import matplotlib.image as mpimg

        %matplotlib inline
```

0.2 Training and Testing Data

The 200 day/night images are separated into training and testing datasets.

- 60% of these images are training images, for you to use as you create a classifier.
- 40% are test images, which will be used to test the accuracy of your classifier.

First, we set some variables to keep track of some where our images are stored:

```
image_dir_training: the directory where our training image data is stored
image_dir_test: the directory where our test image data is stored
```

```
In [2]: # Image data directories
        image_dir_training = "day_night_images/training/"
        image_dir_test = "day_night_images/test/"
```

0.3 Load the datasets

These first few lines of code will load the training day/night images and store all of them in a variable, `IMAGE_LIST`. This list contains the images and their associated label ("day" or "night").

For example, the first image-label pair in `IMAGE_LIST` can be accessed by index: `IMAGE_LIST[0][:]`.

```
In [3]: # Using the load_dataset function in helpers.py
        # Load training data
        IMAGE_LIST = helpers.load_dataset(image_dir_training)
```

0.4 Construct a `STANDARDIZED_LIST` of input images and output labels.

This function takes in a list of image-label pairs and outputs a **standardized** list of resized images and numerical labels.

```
In [4]: # Standardize all training images
        STANDARDIZED_LIST = helpers.standardize(IMAGE_LIST)
```

0.5 Visualize the standardized data

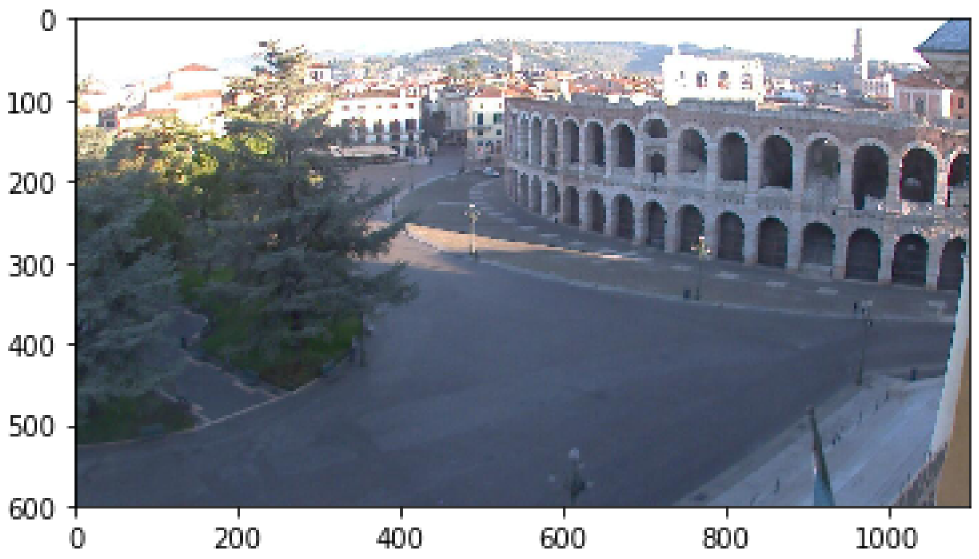
Display a standardized image from STANDARDIZED_LIST.

```
In [5]: # Display a standardized image and its label

        # Select an image by index
        image_num = 0
        selected_image = STANDARDIZED_LIST[image_num][0]
        selected_label = STANDARDIZED_LIST[image_num][1]

        # Display image and data about it
        plt.imshow(selected_image)
        print("Shape: "+str(selected_image.shape))
        print("Label [1 = day, 0 = night]: " + str(selected_label))
```

```
Shape: (600, 1100, 3)
Label [1 = day, 0 = night]: 1
```



1 Feature Extraction

Create a feature that represents the brightness in an image. We'll be extracting the **average brightness** using HSV colorspace. Specifically, we'll use the V channel (a measure of brightness), add up the pixel values in the V channel, then divide that sum by the area of the image to get the average Value of the image.

1.0.1 Find the average brightness using the V channel

This function takes in a **standardized** RGB image and returns a feature (a single value) that represent the average level of brightness in the image. We'll use this value to classify the image as day or night.

```
In [10]: # Find the average Value or brightness of an image
         def avg_brightness(rgb_image):
             # Convert image to HSV
             hsv = cv2.cvtColor(rgb_image, cv2.COLOR_RGB2HSV)

             # Add up all the pixel values in the V channel
             sum_brightness = np.sum(hsv[:,:,2])
             area = 600*1100.0  # pixels

             # find the avg
             avg = sum_brightness/area

             return avg
```

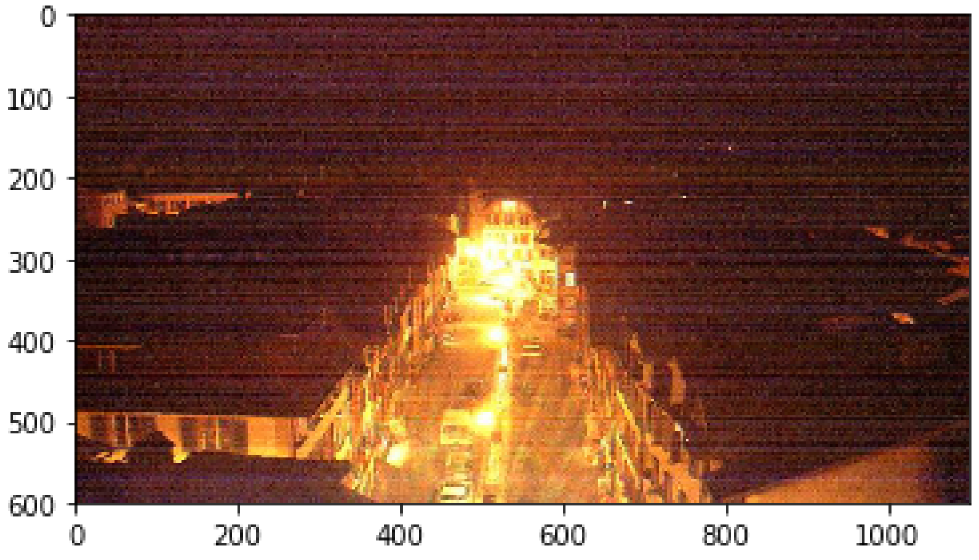
```
In [11]: # Testing average brightness levels
         # Look at a number of different day and night images and think about
         # what average brightness value separates the two types of images

         # As an example, a "night" image is loaded in and its avg brightness is displayed
         image_num = 190
         test_im = STANDARDIZED_LIST[image_num][0]

         avg = avg_brightness(test_im)
         print('Avg brightness: ' + str(avg))
         plt.imshow(test_im)
```

```
Avg brightness: 102.358769697
```

```
Out[11]: <matplotlib.image.AxesImage at 0x7f1cf6f2ed68>
```



```
In [20]: day_ave_bright_list, night_ave_bright_list = np.array([]), np.array([])
         for image_num in range(len(STANDARDIZED_LIST)):
             selected_image = STANDARDIZED_LIST[image_num][0]
             selected_label = STANDARDIZED_LIST[image_num][1]
             if selected_label == 1:
                 day_ave_bright_list = np.append(day_ave_bright_list,avg_brightness(selected_ima
             else:
                 night_ave_bright_list = np.append(night_ave_bright_list,avg_brightness(selected
         print(np.min(day_ave_bright_list),np.max(day_ave_bright_list),np.min(night_ave_bright_l
```

```
94.5718287879 200.054434848 8.14028181818 119.6223
```

2 Classification and Visualizing Error

In this section, we'll turn our average brightness feature into a classifier that takes in a standardized image and returns a `predicted_label` for that image. This `estimate_label` function should return a value: 0 or 1 (night or day, respectively).

2.0.1 TODO: Build a complete classifier

Set a threshold that you think will separate the day and night images by average brightness.

```
In [35]: # This function should take in RGB image input
         def estimate_label(rgb_image):

             ## TODO: extract average brightness feature from an RGB image
             ave_bright = avg_brightness(rgb_image)
             # Use the avg brightness feature to predict a label (0, 1)
             predicted_label = 0

             ## TODO: set the value of a threshold that will separate day and night images
             threshold_ave_bright = 100
             ## TODO: Return the predicted_label (0 or 1) based on whether the avg is
             # above or below the threshold
             predicted_label = int(ave_bright > 103)
             return predicted_label
```

```
In [36]: ## Test out your code by calling the above function and seeing
         # how some of your training data is classified
         correct = 0
         for image_num in range(len(STANDARDIZED_LIST)):
             selected_image = STANDARDIZED_LIST[image_num][0]
             selected_label = STANDARDIZED_LIST[image_num][1]
             if selected_label == estimate_label(selected_image):
                 correct += 1
         print(correct/len(STANDARDIZED_LIST))
```

```
0.9125
```