Computer Vision Assignment 2

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Assignment 2a: Image Processing & Face Detection

Assignment 2b: Data Statistics

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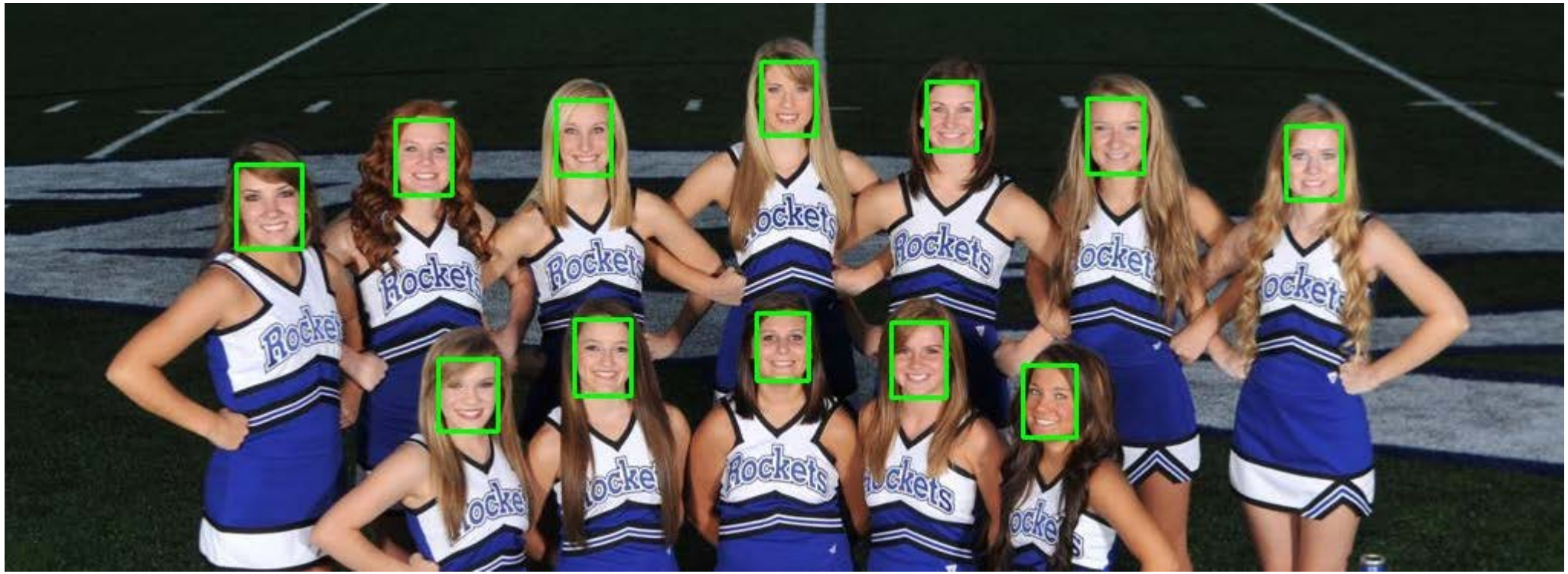
- 讀取 annotation.pkl 中定界框(bounding box)之資訊，將定界框畫在原圖，結果如下圖。接著將所有綠色框區域裁切下來存成檔案至指定目錄。



Steps for Assignment 2a 於原始影像畫出臉之定界框

Step 2a.1: Open assignment_2a.ipynb

Ensure that assignment_2a.ipynb, annotation.pkl, data_dir/ are in the same folder.

Step 2a.2: Implement the following pseudo code to draw bounding boxes of faces in function `draw_bbox()`

```
for img_name in annotate_dict:
  # get the image path from img_name
  # use cv2.imread() to read from the image path
  for bbox in annotate_dict[img_name]:
    # draw bounding boxes on the image
  # use plt.imshow() to show the image
```

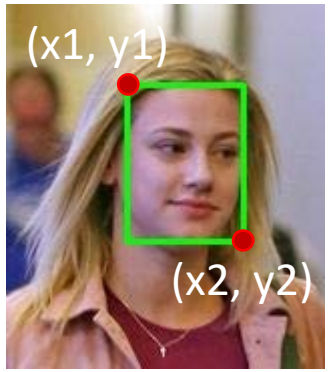
- Notice that in Step 2a.2

  `annotate_dict` is a python dictionary
  - Use `for key in annotate_dict:` to access the keys of `annotate_dict`
  - Each key is the name of an image in the folder `data_dir`, e.g.

    ```
    7_Cheering_Cheering_7_74.jpg
    7_Cheering_Cheering_7_543.jpg
    7_Cheering_Cheering_7_889.jpg
    ```

  - Each element of `annotate_dict` is a list of bounding boxes.
  - Use `for bbox in annotate_dict[key]:` to access each bounding box
  - Samples of bounding boxes are as below

```
 62 294  79 319
152 141 196 193
255 103 298 158
 x1  y1  x2  y2
```



Hints for Step 2a.2

- To get the image path from `img_name`
  - `img_path = os.path.join(data_dir, img_name)`
- To read an image from an image path
  - `img = cv2.imread(img_path)`
  - `if img is None`, this means that `img_path` is not a legal path of an image
- To draw bounding boxes
  - `cv2.rectangle(img, (x1,y1), (x2,y2), (0,255,0), thickness=2)`
- To show the image
  - `img = img[:,:,::-1] # convert from BGR to RGB`
  - `plt.imshow(img)`
  - `plt.show()`

從原始影像根據定界框裁切所有臉部區域，將每一臉部區域存成檔案至指定目錄

Step 2a.3: Implement the following pseudo code to save the cropped faces in function save_bbox( )

```
# create a directory named save_dir
for img_name in annotate_dict:
  # get the image path from img_name
  # use cv2.imread() to read from the image path
  for bbox in annotate_dict[img_name]:
    # crop faces according to bbox
    # create the save_path for the cropped face
    # use cv2.imwrite() to save the cropped face
```

Hints for Step 2a.3

- To create a directory
  - Use `os.path.exists(save_dir)` to determine whether `save_dir` exists.
  - If `save_dir` does not exist, use `os.mkdir(save_dir)` to create an directory.
  - If `save_dir` exists, then do nothing.
- To crop faces
  - `x1, y1, x2, y2 = bbox`
  - `img_crop = img[y1:y2, x1:x2]`
- The `save_name` of each face is as follows
  - `7_Cheering_Cheering_7_74_0.jpg`
  - `7_Cheering_Cheering_7_74_1.jpg`
  - `7_Cheering_Cheering_7_74_2.jpg`
  - You can create `save_name` from `img_name` with a counter `j`
  - The counter `j` can be created using `enumerate()` as below
    - `for j, bbox in enumerate(annotate_dict[img_name]):`
- To create `save_path` with `save_dir` and `save_name`, use
  - `save_path = os.path.join(save_dir, save_name)`

Hints for Step 2a.3

- To save the cropped image, use `cv2.imwrite()`
- The samples for cropped faces with their file names are as follows

Step 2a.4: Implement the function `test_dlib()` that applies `dlib` to detect faces in the input image (`7_Cheering_Cheering_7_889.jpg`), and then draw the bounding box of each detected face as done in Step 2a.2. You also need to display the following information in `test_dlib()`

`7_Cheering_Cheering_7_889.jpg #det1`

where `#det1` is the number of faces detected by `dlib`.

Next, resize the input image such that its height is 1400, and the aspect ratio (height/width) should remain the same as that of the original input image. Then, repeat the above step to draw the bounding boxes detected by `dlib`, and display the number of faces detected by `dlib`.

Hints for using `dlib`:

Install the `dlib` library and use the following code

```
detector = dlib.get_frontal_face_detector()
img = cv2.imread(img_path)
dets = detector(img, 1)
for det in dets:
  x1, y1, x2, y2 = det.left(), det.top(), det.right(), det.bottom()
  # draw bounding box based on x1, y1, x2, y2
```

Assignment 2b: Data Statistics

Step 2b.1: Open assignment_2b.ipynb

Ensure that assignment_2b.ipynb, annotation.txt are in the same folder.

前面練習都是從 annotate.pkl 來讀取定界框資訊，此練習改成從 annotate.txt 來讀取定界框資訊 (網路上下載之資料庫不一定都會將資料庫資訊存成 pkl 檔)

annotate.txt 內容如下

```
7_Cheering_Cheering_7_74.jpg 152  141 196  193 255  103 298  158 …
```

file name x1 y1 x2 y2 x1 y1 x2 y2

每一行開頭是影像檔案名稱，接著是人臉定界框(bounding box)座標，每一張影像通常包含多張人臉，所以每一行通常會有多組定界框座標

- A bounding box is called valid if the following four inequalities are satisfied

  `x1 >=0, y1 >= 0, x2 > x1, y2 > y1`

- The width of a bounding box is defined as `x2-x1+1`
- The height of a bounding box is defined as `y2-y1+1`

Assignment 2b: Data Statistics

Step 2b.2: Display the following information

```
        width < 10: #1
10 <= width < 20: #2
20 <= width < 30: #3
30 <= width < 40: #4
40 <= width < 50: #5
50 <= width     : #6
```

where #1 is the number of valid bounding boxes belonging to range 1 (`width < 10`), and #2 is the number of valid bounding boxes belonging to range 2 (`10 <= width < 20`), etc.

Hints for Step 2b.2:

- Use `annotation = line.strip().split(' ')` to convert each line to a list
- Convert the type of each element of `annotation[1:]` to integer

Hints for Step 2b.2

- Suppose `line` (a string) is

```
0--Parade/0_Parade_marchingband_1_799 78 221 85 229 78 237 92 255 112
212 123 226
```

- After the steps in the previous page, we obtain a list of integers as

```
[78, 221, 85, 229, 78, 237, 92, 255, 112, 212, 123, 226]
```

- Use `np.array()` and `np.reshape()` to convert the above to an array of bounding boxes as below

```
[[ 78 221  85 229]        -> bbox1 [x1 y1 x2 y2]
 [ 78 237  92 255]        -> bbox2 [x1 y1 x2 y2]
 [112 212 123 226]]       -> bbox3 [x1 y1 x2 y2]
```

- Compute the width of each bounding box, `x2-x1+1`, to obtain a list of widths

```
[8, 5, 12]
```

- Display the required information in Step 2 based on the above list.

Assignment 2b: Data Statistics

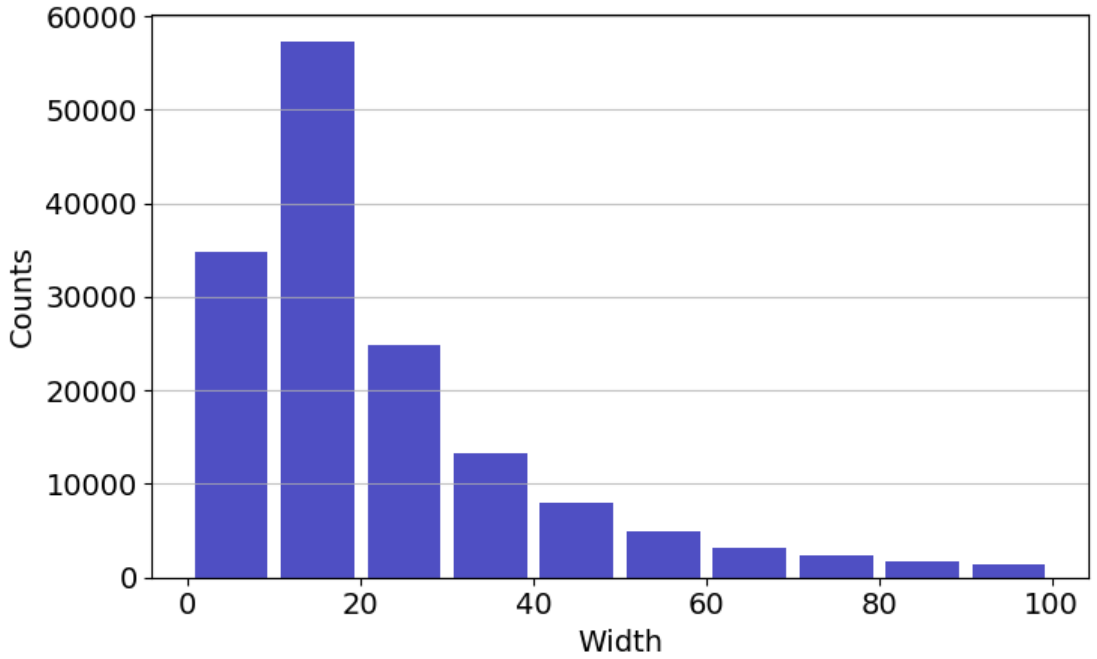
Step 2b.3: Display the following information

```
          width/height < 0.6: #1
0.6 <= width/height < 0.7: #2
0.7 <= width/height < 0.8: #3
0.8 <= width/height < 0.9: #4
0.9 <= width/height < 1.0: #5
1.0 <= width/height      : #6
```

where #1 is the number of valid bounding boxes belonging to range 1 (`width/height < 0.6`), and #2 is the number of valid bounding boxes belonging to range 2 (`0.6 <= width/height <0.7`), etc.

Assignment 2b: Data Statistics

Step 2b.4: Display the following figure



Hint: Use `plt.hist(widths, range(0,101,10), rwidth=0.85)`
where `widths` is a python list of the width of valid bounding boxes.
Use `xlabel` to set the label for the x-axis, and `ylabel` to set the label for the y-axis.

Assignment 2b: Data Statistics

Step 2b.5:

In Step 2b.1, we consider only the valid bounding boxes. Modify your code to find the number of **invalid** bounding boxes.