Homework 1: Face Detection

Report Template

Please keep the title of each section and delete examples. Note that please keep the questions liste d in Part III.

Part I. Implementation (6%):

- Please screenshot your code snippets of Part 1, Part 2, Part 4, and explain your implement ation. For example,

```
    # Begin your code (Part 1)
    """
    use for loop to load all folders in test and train,then use os.join.path
    to generate the new path for the images.Determine whether the image is from
    the folder named 'face'.If the image is from 'face',it will be stored with
    the form image=(image,1).In contrast, if the image is from 'non-face',it
    will be stored with the form img=(img,0).All images will be appended in
    dataset.
    """
    dataset=[]
    for filename in os.listdir(dataPath):
        result1=os.path.join(dataPath,filename)
        if filename == 'face':
            for i in os.listdir(result1):
                result2=os.path.join(result1,i)
                img=cv2.imread(result2,cv2.IMREAD_GRAYSCALE)
                img=(img,1)
                dataset.append(img)
        if filename == 'non-face':
            for i in os.listdir(result1):
                result2=os.path.join(result1,i)
                img=cv2.imread(result2,cv2.IMREAD_GRAYSCALE)
                img=(img,0)
                dataset.append(img)
    # raise NotImplementedError("To be implemented")
    # End your code (Part 1)
    return dataset
```

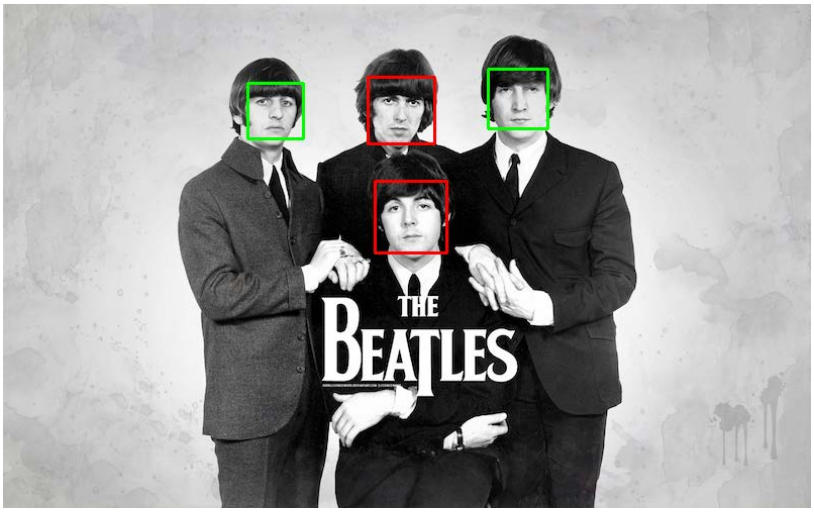
```
        # Begin your code (Part 2)
        """
        First,we set bestError as infinite.Second,we use two for loops to generate h(x)
        and calculate each weightError (weight*|h(x)-label|),then we keep the minimum weightError
        as bestError.Use the index of this featureVal to find out feature and use this to get
        bestClf.
        """
        bestError=float("inf")
        for i in range(0, len(featureVals)):
            weightedError=0.0
            for j in range(0, len(featureVals[i])):
                if featureVals[i][j]<0:
                    weightedError+=weights[j]*abs(1-labels[j])
                else:
                    weightedError+=weights[j]*abs(0-labels[j])
            if weightedError<bestError:
                bestError=weightedError
                bestClf=WeakClassifier(features[i])

        # raise NotImplementedError("To be implemented")
        # End your code (Part 2)
        return bestClf, bestError
```

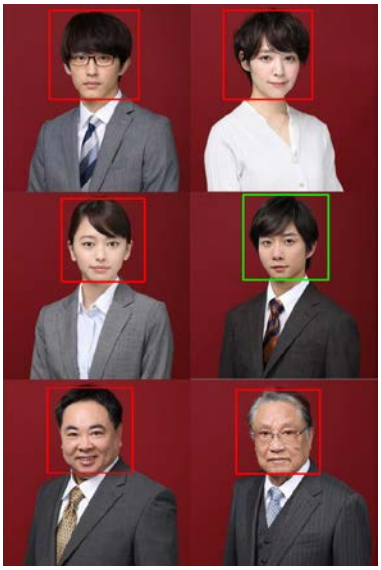
```python
    # Begin your code (Part 4)
    """
    First,we use readline to read the filename of image and split the filename and the
    amount of faces.Second,we read and split each x,y,height,and wide of each faces,then
    we crop the arange of faces and turn them into grayscale and 19x19.Finally,we use
    clf.classify to determine whether the image is face or not.If we get 1,that means
    the image is face,it will have a green frame.If we get 0,it will have a red frame.
    """
    file=open(dataPath)
    for j in range(2):
        line=file.readline()
        line=line.split()
        img=cv2.imread(os.path.join(r"data\detect",line[0]))
        #print("img:",img)
        for i in range(int(line[1])):
            position=file.readline()
            position=position.split()
            green_color=(0,255,0)
            red_color=(0,0,255)
            x=int(position[0])
            y=int(position[1])
            w=int(position[2])
            h=int(position[3])
            crop_img=img[y:y+h,x:x+w]
            image=cv2.cvtColor(crop_img,cv2.COLOR_BGR2GRAY)
            cv2.waitKey(0)
            image=cv2.resize(image,(19,19))
            if clf.classify(image)==1:
                cv2.rectangle(img,(x,y),(x+w,y+h),green_color,2)
            else:
                cv2.rectangle(img,(x,y),(x+w,y+h),red_color,2)
        cv2.imshow("final",img)
        cv2.waitKey(0)
    # raise NotImplementedError("To be implemented")
    # End your code (Part 4)
```

Part II. Results & Analysis (12%):

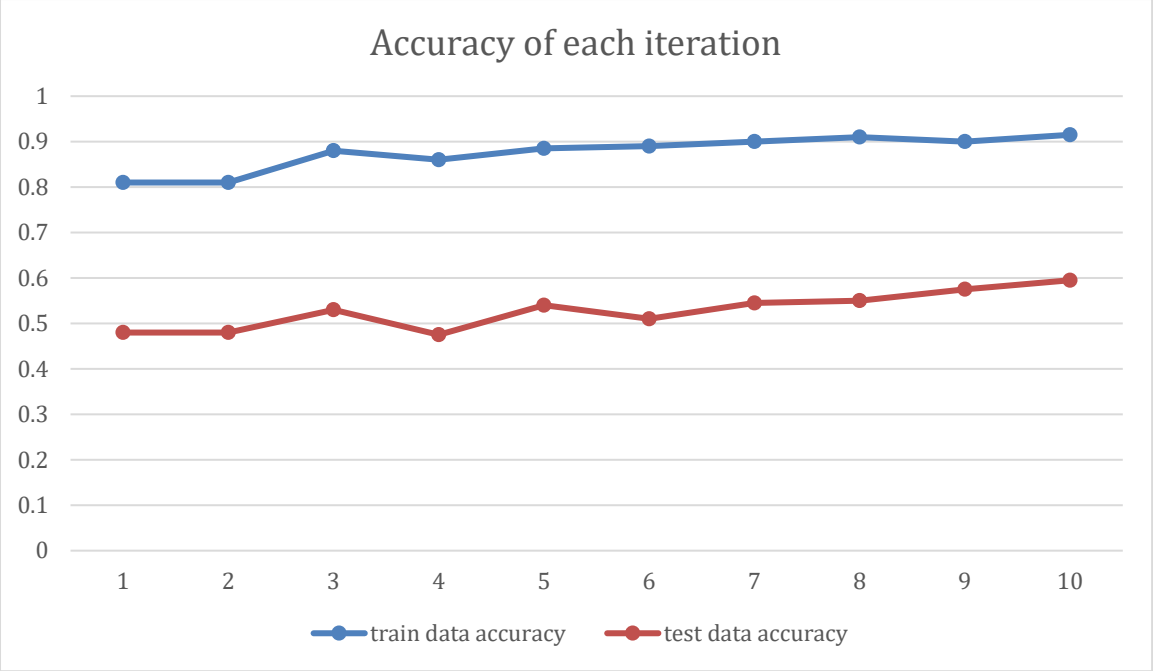
- Please screenshot the results. For instance,

```
Chose classifier: Weak Clf (threshold=0, polarity=1, Haar feature (positive regions=[RectangleRegion(12, 11, 5, 1)], negative
regions=[RectangleRegion(12, 12, 5, 1)]) with accuracy: 72.000000 and alpha: 0.685227
Run No. of Iteration: 9
Chose classifier: Weak Clf (threshold=0, polarity=1, Haar feature (positive regions=[RectangleRegion(10, 4, 1, 1)], negative
regions=[RectangleRegion(9, 4, 1, 1)]) with accuracy: 152.000000 and alpha: 0.707795
Run No. of Iteration: 10
Chose classifier: Weak Clf (threshold=0, polarity=1, Haar feature (positive regions=[RectangleRegion(4, 9, 2, 2), RectangleRegion(2,
11, 2, 2)], negative regions=[RectangleRegion(2, 9, 2, 2), RectangleRegion(4, 11, 2, 2)]) with accuracy: 137.000000 and alpha: 0.811201

Evaluate your classifier with training dataset
False Positive Rate: 17/100 (0.170000)
False Negative Rate: 0/100 (0.000000)
Accuracy: 183/200 (0.915000)

Evaluate your classifier with test dataset
False Positive Rate: 45/100 (0.450000)
False Negative Rate: 36/100 (0.360000)
Accuracy: 119/200 (0.595000)
```





- Your analysis or observation.
  Please discuss the performance difference between the training and testing dataset, and pre sent the results using a table or chart as follows.



200張	train data accuracy	test data accuracy
method 1 t=1	81.0%	48.0%
method 2 t=2	81.0%	48.0%
method 3 t=3	88.0%	53.0%
method 4 t=4	86.0%	47.5%
method 5 t=5	88.5%	54.0%
method 6 t=6	89.0%	51.0%
method 7 t=7	90.0%	54.5%
method 8 t=8	91.0%	55.0%
method 9 t=9	90.0%	57.5%
method 10 t=10	91.5%	59.5%

Both of training dataset and testing dataset become difference because of the variational parameter T.By and large,the accuracy increases when T become larger.

(T=2)

(T=8)

Part III. Answer the questions (12%):

1. Please describe a problem you encountered and how you solved it.
2. What are the limitations of the **Viola-Jones' algorithm**?
3. Based on **Viola-Jones' algorithm**, how to improve the accuracy except increasing the trai ning dataset and changing the parameter T?
4. Please propose another possible **face detection** method (no matter how good or bad, please come up with an idea). Please discuss the pros and cons of the idea you proposed, compare d to the Adaboost algorithm.

   1. I did not knew the way to use many functions well at the beginning,so debugging became a pretty difficult thing.That cost me lot of time to search and bother my intelligent classmate. I also confuse with the reqest of part 3,so I repeat studying the slides.

   2. It is sensitive to lighting condition,so it may lose effectiveness when the bachground is bright and faces are dark.It is also not effective for turned faces,detecting tilted or sub wind ows overlapping.

   3. (1) Use the gray scale phto or change the BGR scale photo before use opencv to read the image.
      (2) Rotate the image for 45 degreeds.

   4. We present a straightforward procedure for aligning positive face examplesfor training. To collect negative examples,we add false detections into the training set as the training progresses.This eliminates the difficult task of manually selecting nonface examples,whilch must be chosen to span the entire space of nonface images.

	pros	cons
Adaboost	1. the accuracy of weak classifiers can be improved 2. less prone to overfitting as the input parameters are not jointly optimized	1. it needs a quality dataset
new algorithm	1. the system has comparab le performance in terms of d etection and false-positive r ates	1.more supporting are needed for high accuracy so it increases the computat -ion cost