電腦視覺 Assignment 2: Kagle Plant Classification

流程

大致如下

1. 資料前處理(移動資料、image resizing)
2. Feature Extraction
3. Nearest Neighbor classification
4. Output

資料前處理

移動資料

透過data_separation.m的matlab script來將原本資料夾中的train資料分割成training data以及validation data。 其中training data是由主辦方提供的train資料，將12種分類的前一半作為training data, 剩下的一半做為validation data。 在資料分割的同時，將image都resize成 256 * 256

執行環境

CPU: AMD Ryzen 5600x
RAM: 16GB DDR4 3600MHz
GPU: 3060-Ti
Matlab: R2019b

Method Description

Raw image

1. 透過imread()將12個class的資料分別存成12個3-D array
2. 讀取測試資料，透過test image - train image來計算SSD。最後加總後去比對與哪一個class較相近

Color histogram

1. 透過imread()讀取資料
2. 使用imhist()取得image histogram
3. 將12個class分別儲存成12個2D array(256 * 3 * image_count)
4. 透過測試資料計算SSD，取得分類

Local Binary Patern

1. 透過imread()讀取資料
2. 使用rgb2gray()將training images從RGB channel轉成gray scale
3. 使用extracLBPFeatures()取得training images的features (1 * 59)
4. 將features存成2-D array (image_number * 59)
5. 讀取validation images與test data，做正規化以及feature extraction
6. NN classification

Co-occurence Matrix

1. imread() 讀取資料
2. rgb2gray()轉成gray scale
3. graycomatrix()取得co-occurence matrix
4. 將training data的co-occurence matrix儲存成3-D array(image_number * 8 * 8)
5. 重複上述1~3步驟，得到validation data以及testing data的co-occurence matrix
6. 計算SSD，並分類以及計算validation accuracy

Gabor Filters

1. imread()讀取資料
2. rgb2gray()轉成gray scale
3. imgaborfilt()使用gabor filter
4. 計算SSD以及nn classification

Histogram of Oriented Gradient(HoG)

1. imread()讀取資料

2. extractHOGFeatures()取得HoG Features並存成2-D array(number * feature length)
3. 重複上述步驟，取得validation以及testing data的feature
4. 計算SSD以及NN classification

Bag-of-Features

1. 將每個class的training image存成image set的資料結構
2. 透過bagOfFeatures(image set)取得預設的SURF feature center point(總共500的vocabulary)
3. 儲存vocabulary
4. 計算SSD

Experimental results

Validation Accuracy

Raw image

Size	Time	Accuracy
512 * 512	2108 sec	4.6%
256 * 256	799 sec	4.6%

Color histogram

Size	Time	Accuracy
512 * 512	37.3 sec	19.99%
256 * 256	35 sec	20.4%
128 * 128	34 sec	20.03%
64 * 64	33.2 sec	17.5%

LBP

Size	Time	Accuracy
512 * 512	86 sec	9.07%
256 * 256	44 sec	12.86 %
128 * 128	33 sec	10.42%

Co-occurence Matrix

Size	Time	Accuracy
512 * 512	82 sec	11.64%
256 * 256	45 sec	11.85%
128 * 128	38 sec	13.03%

Gabor Filter

Size	scale, orientation	Time	Accuracy
256 * 256	4, 0	709 sec	4.01%

HoG

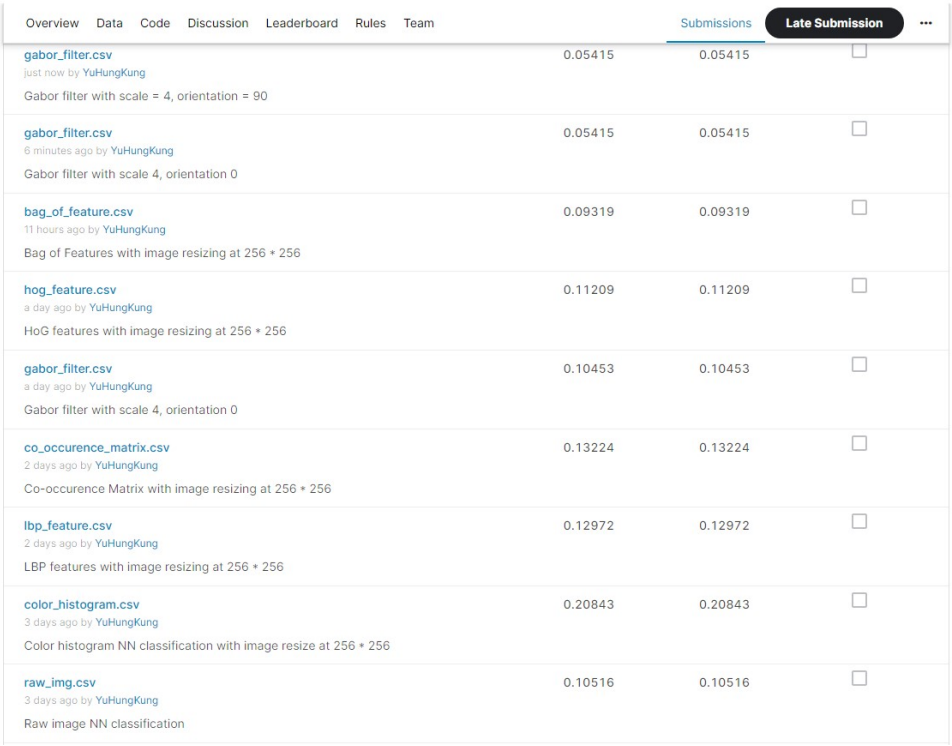
Size	Time	Accuracy
512 * 512	2108 sec	4.6%
256 * 256	618 sec	5.61%

Bag of Features

Size	Time	Accuracy
256 * 256	2852 sec	8.01%

Kagle Plant Seedlings Classification Submission Score

Method	Private Score	Public Score
Raw Image	0.10516	0.10516
Color Histogram	0.20843	0.20843
Local Binary Patern	0.12972	0.12972
Co-occurence Matrix	0.13224	0.13224
Gabor Filter	0.05415	0.05415
Histogram of Oriented Gradient	0.11209	0.11209
Bag of Features	0.09319	0.09319



Overview	Data	Code	Discussion	Leaderboard	Rules	Team	Submissions	Late Submission
gabor_filter.csv just now by YuHungKung Gabor filter with scale = 4, orientation = 90							0.05415	0.05415
gabor_filter.csv 6 minutes ago by YuHungKung Gabor filter with scale 4, orientation 0							0.05415	0.05415
bag_of_feature.csv 11 hours ago by YuHungKung Bag of Features with image resizing at 256 * 256							0.09319	0.09319
hog_feature.csv a day ago by YuHungKung HoG features with image resizing at 256 * 256							0.11209	0.11209
gabor_filter.csv a day ago by YuHungKung Gabor filter with scale 4, orientation 0							0.10453	0.10453
co_occurence_matrix.csv 2 days ago by YuHungKung Co-occurence Matrix with image resizing at 256 * 256							0.13224	0.13224
lbp_feature.csv 2 days ago by YuHungKung LBP features with image resizing at 256 * 256							0.12972	0.12972
color_histogram.csv 3 days ago by YuHungKung Color histogram NN classification with image resize at 256 * 256							0.20843	0.20843
raw_img.csv 3 days ago by YuHungKung Raw image NN classification							0.10516	0.10516

Discussion

資料前處理

原本想透過在不同方法的code對image下去重新resize，但在使用bagOfFeatures()時，遇到image size不同的時候，在feature extraction時，維度會有所不同，所以最後統一在data separation那邊同一resize成256 * 256
整體來說，應該還是以color histogram的效果會來的比較好，畢竟不同種植物，葉子的成色以及面積都有所不同，直接影響histogram的分布。 其他的方法如果轉成gray scale，在做feature extraction時，效果就沒那麼好。或許使用機器學習的方法，能夠更有效提升準確率。

Problem and difficulties

validation準確率以及資料的乾淨程度

有些資料可能大部分都是土壤或石頭，實際上有植物的部分很少，在做image resizing之後，對於資料的丟失會有影響嗎? 例如1024 * 1024的資料降成256 * 256，其中影像pixel資訊應該會被捨棄，不分資訊可能就會在降維過程中丟失，影響準確率。

參數對於準確率的影響

像是gabor filter，scale以及orientation的數值對於feature extraction都有影響。若知道不同品種的feature，透過參數的調整，或許可以精準抓取特徵並提升準確率。

效能

使用CPU計算的話，如果有核心數越多，則運算更快。或許可以透過GPU加速來完成。單純靠CPU去運算，在跑bag of features的部分，feature extraction就占用大量的時間。

Reference

LBP:
https://www.mathworks.com/help/vision/ref/extractlbpfeatures.html (https://www.mathworks.com/help/vision/ref/extractlbpfeatures.html)
Co-occurence matrix:
https://www.mathworks.com/help/images/ref/graycomatrix.html (https://www.mathworks.com/help/images/ref/graycomatrix.html)
Gabor filter:
https://www.mathworks.com/help/images/ref/imgaborfilt.html (https://www.mathworks.com/help/images/ref/imgaborfilt.html)
HoG:
https://www.mathworks.com/help/vision/ref/extracthogfeatures.html (https://www.mathworks.com/help/vision/ref/extracthogfeatures.html)
Bag of feature:
https://www.mathworks.com/help/vision/ref/bagoffeatures.html#d124e98665

(https://www.mathworks.com/help/vision/ref/bagoffeatures.html#d124e98665)