

# CSC 391 Project 3 Report

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## 1. Objective

This project intends to deal with a recognition problem: determining whether an image contains a palm tree or not. Meanwhile, we will compare and contrast the texture of images containing palm trees and images not containing palm trees. We will focus on the difference on the global features between palm trees and non palm trees images. The method used are LBP and HOG described below.

## 2. Method

Before proceeding to the recognition problem and global feature comparison, 10 samples of palm images and 10 samples of non palm images are selected. The selected samples of either palm or non palm are of different locations in a forest, different lighting situations, different size, thus different image clarity. These 20 images will be used to plot their histograms with LBP and HOG for comparison. For palm recognition, a subset of the 10 palm and 10 non palm samples will be used as dataset for matching. The rest will be used as testing data to see if they are matched to the samples in the dataset as "palm" or "non palm".

### a. Sample Images

1) Palm (Labeled `palm_1` to `10`)



2) Non Palm (Labeled `non_palm_1` to `10`)



### b. LBP - Histograms

In this part, 10 samples of palm images and 10 samples of non palm images are plotted as histograms with LBP. LBP (Local Binary Pattern) takes a central point in a patch and gives a binary result of whether the surrounding points are greater or smaller in pixel value than the central point. An image showing the possible results are as below. Based on these results above, we can have the following example histograms.

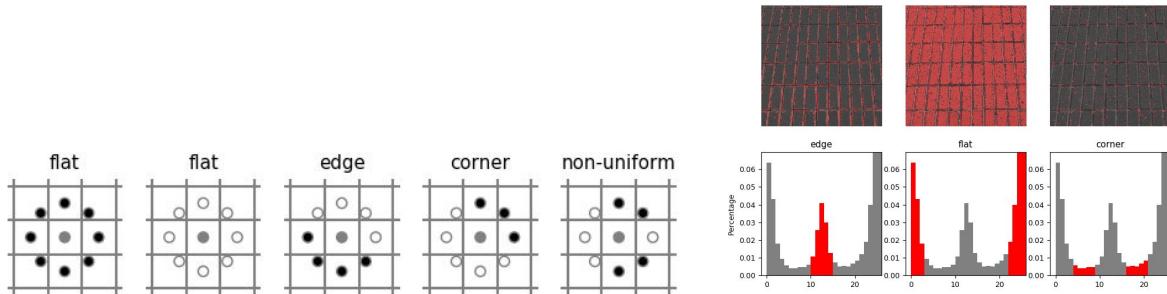


Fig 1. Example Histogram<sup>1</sup>

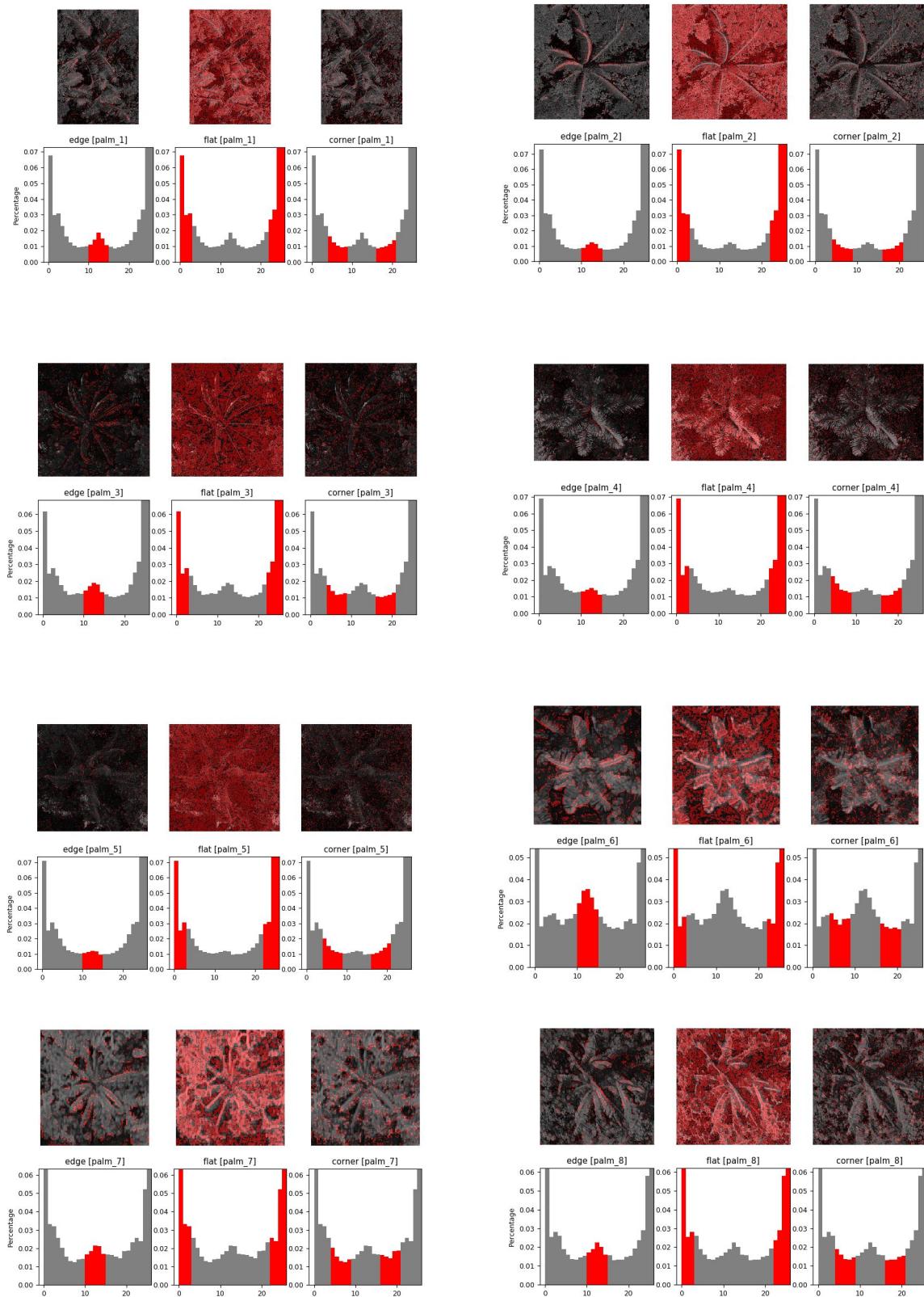
Interpretation of the histograms: Since the surrounding points for a flat region is either all black dots or all white dots, the LBP values for these areas are either high or low. Thus on the histogram, flat regions are shown on the 2 sides. Since for edges, there are similar amount of black dots and white dots. the LBP values are relatively in the middle. Corners either have more black dots or more white dots. Thus their values are slightly higher or lower than edges.

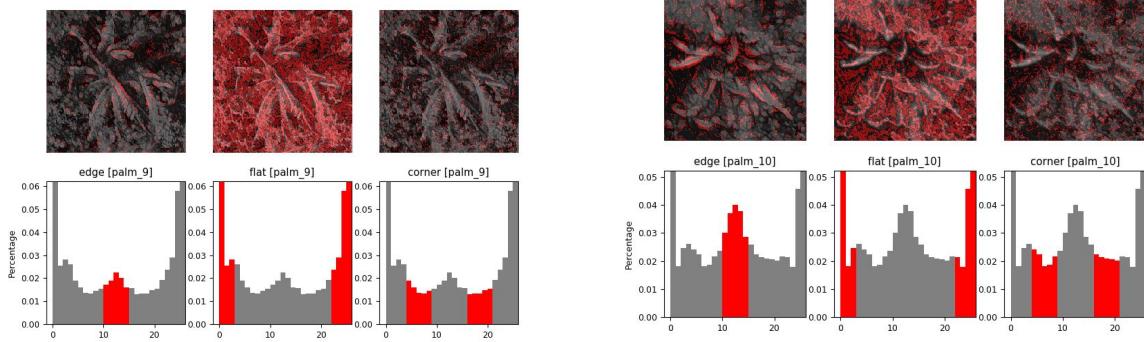
Now plot the 10 palm samples and non palm samples. Notice that palm samples have histograms that are higher in percentage in the edge region. Graphically, palm samples have a higher bump in the middle.

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<sup>1</sup> Image source: [http://scikit-image.org/docs/dev/auto\\_examples/features\\_detection/plot\\_local\\_binary\\_pattern.html](http://scikit-image.org/docs/dev/auto_examples/features_detection/plot_local_binary_pattern.html)

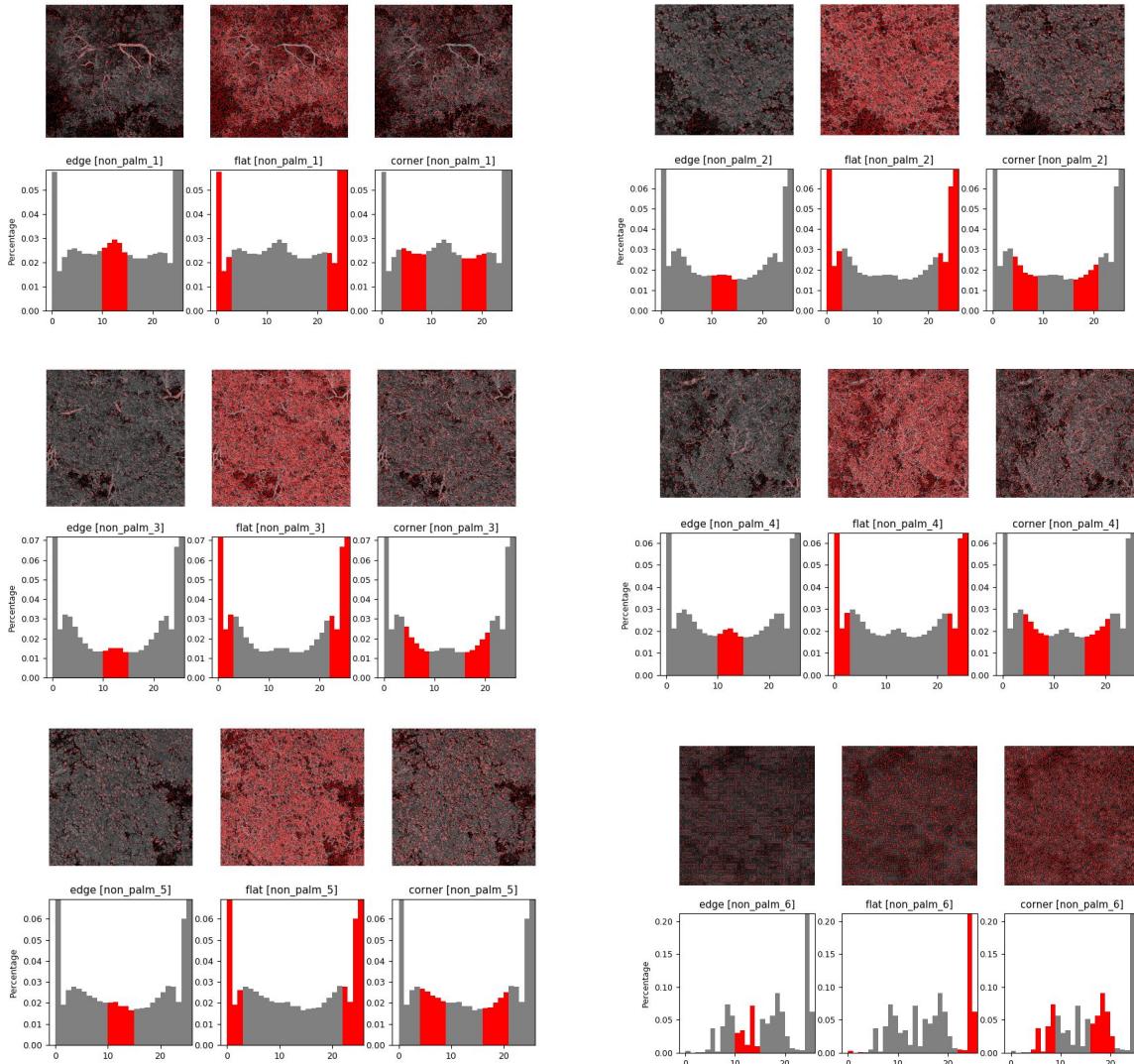
### 1) Histograms of palm images (Labeled palm\_1 to 10)

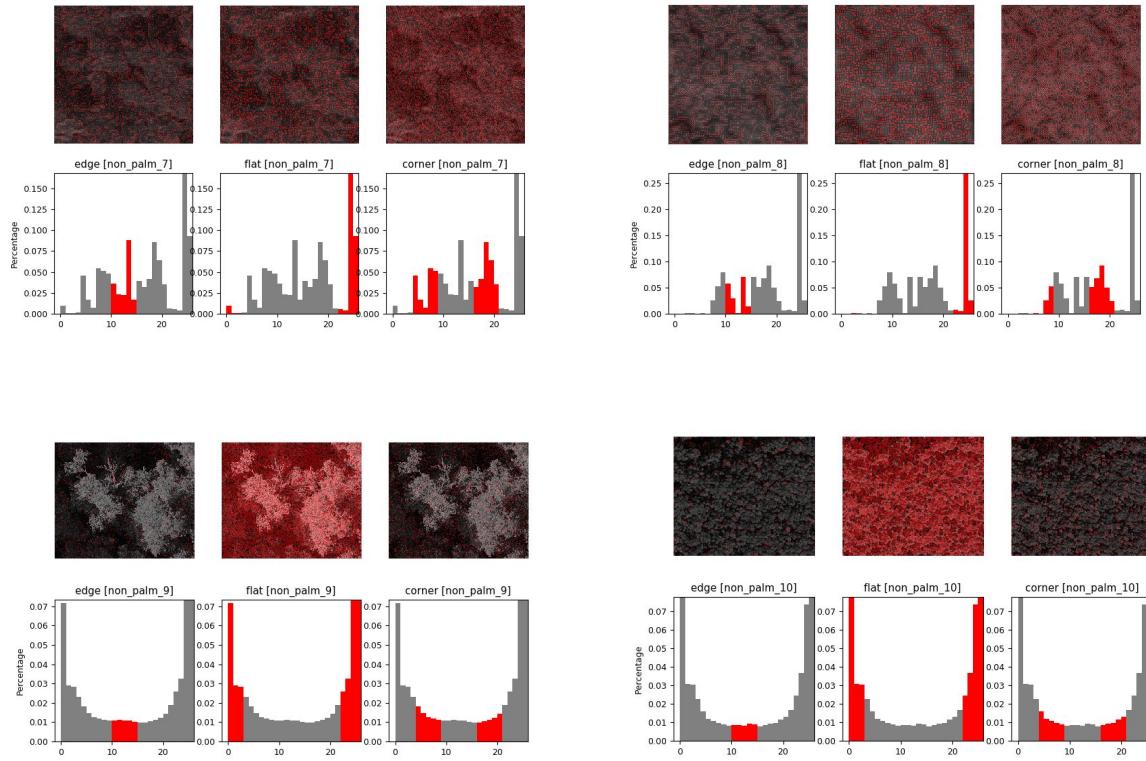




The histograms of the 10 palm images show higher percentage of edges. The height is determined by the amount of edges detected. By comparing among these 10, we find that palm\_5 has the lowest edge percentage. This might be due to its low brightness which makes edge detection harder.

## 2) Histograms of Non Palm Images (Labeled non\_palm\_1 to 10)





The histograms of the 10 non palm images show that for most of the images, edge percentage is not high. This might be due to the fact that regular tree leaves don't show clear edges. Two exceptions are `non_palm_1` which has a lot of branches, and `non_palm_7` which has dark shadows. These factors may influence the detection of edges.

### c. LBP - Matching

Then I used `local_binary_patter()` function and `match()` function to see if a testing image is classified as "palm" or "not palm". Originally, I created a dataset containing 5 palm images and 5 non palm images. Then I used the rest of the samples as testing images to see if then they match one image in database and be classified as palm or not palm. However, after trying for several sets of dataset, I find that some non palm images contain so many features that both palm and not palm will be categorized as "not palm". Thus we keep 1 palm image and 1 non palm image in the dataset. These 2 images are shown in Fig 3. The best matching outcome is shown as Fig 2. For 5 palm testing images, 3 are correctly classified as palm. For 5 non palm testing images, 3 are correctly classified as non palm. This recognition has room for improvement.

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Matching using LBP:
testing: palm_6 match result: non_palm_5
testing: palm_7 match result: palm_1
testing: palm_8 match result: palm_1
testing: palm_9 match result: palm_1
testing: palm_10 match result: non_palm_5
testing: non_palm_6 match result: non_palm_5
testing: non_palm_7 match result: non_palm_5
testing: non_palm_8 match result: non_palm_5
testing: non_palm_9 match result: palm_1
testing: non_palm_10 match result: palm_1

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Fig 2. Matching Results



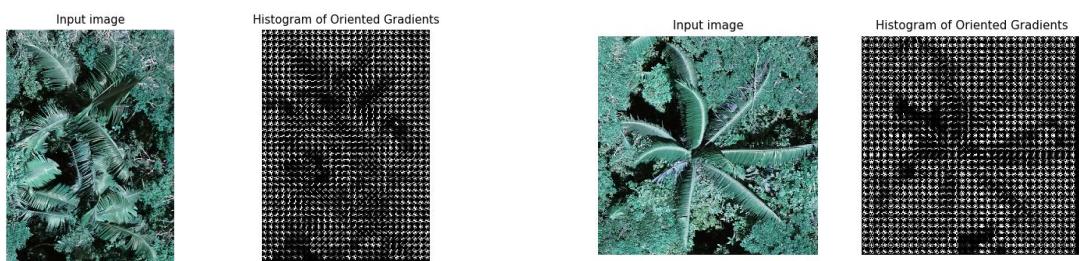
Fig 3. Database Used for Matching  
Left: palm\_1; Right: non\_palm\_5

## d. HOG

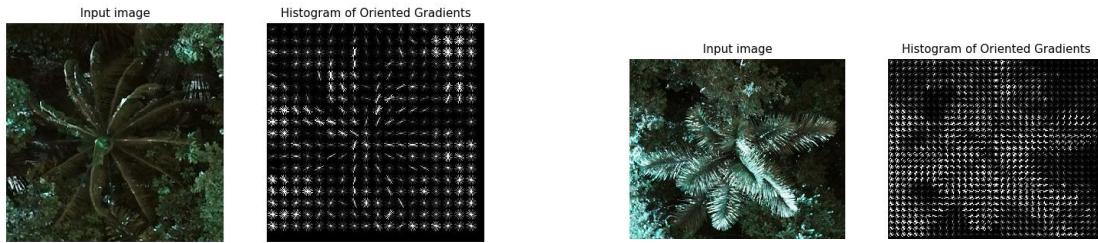
Histogram of Gradient gives the direction of changes in an image. Most palm images have a central point where several directions meet. This makes sense because the leaves of palm trees are connected by one stem and the leaves grow out in several directions. In a picture where there's mostly normal trees, we can barely see one central points connecting leaves. Also, since there is no palm, the image patterns are more uniform, with more flat regions. Thus the HOG does not show many clear changes in directions.

### 1) HOG Images

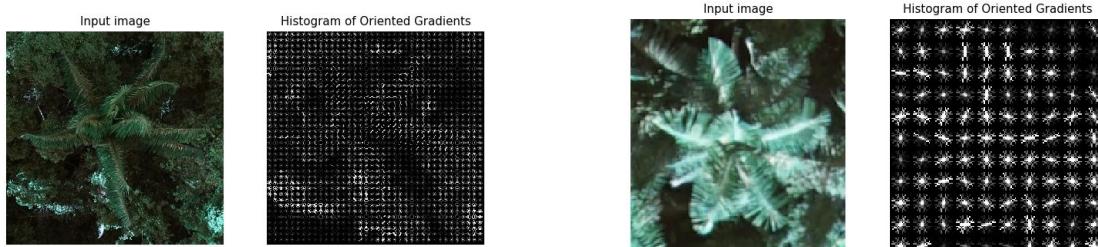
#### a) Palm (Labeled palm\_1 to 10)



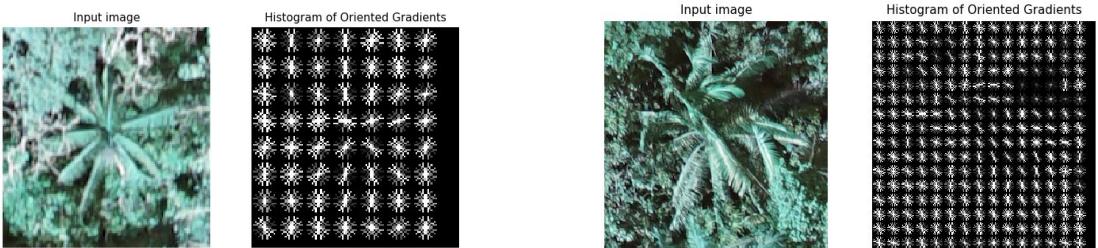
Left: palm\_1; Right: palm\_2



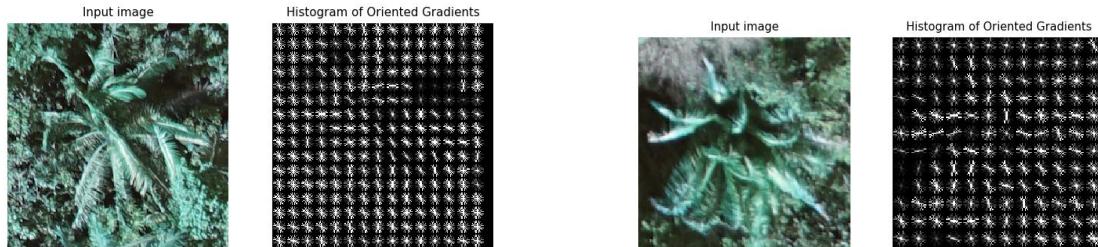
Left: palm\_3; Right: palm\_4



Left: palm\_5; Right: palm\_6

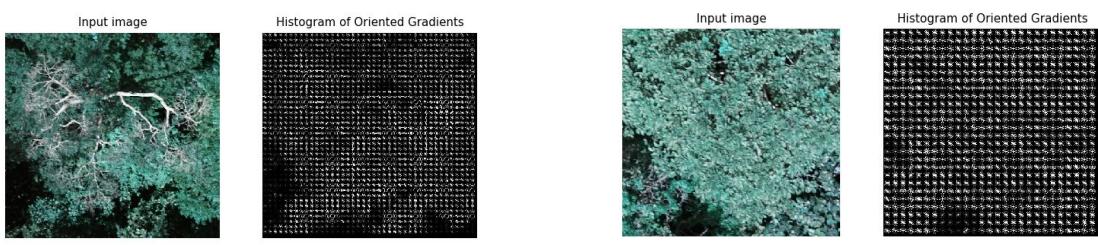


Left: palm\_7; Right: palm\_8

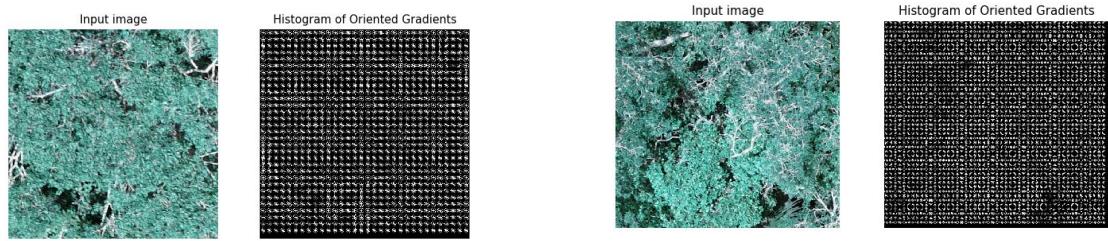


Left: palm\_9; Right: palm\_10

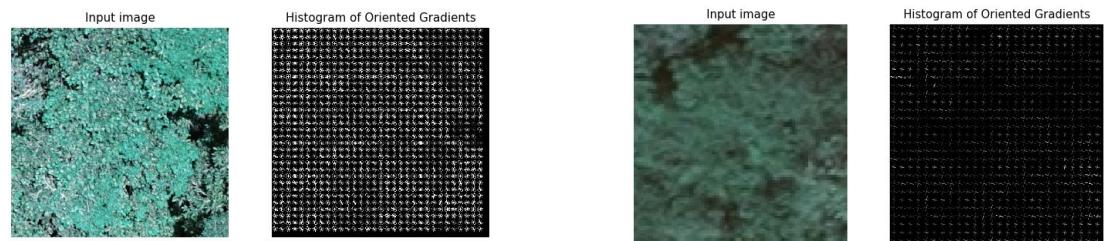
### b) Non Palm (Labeled non\_palm\_1 to 10)



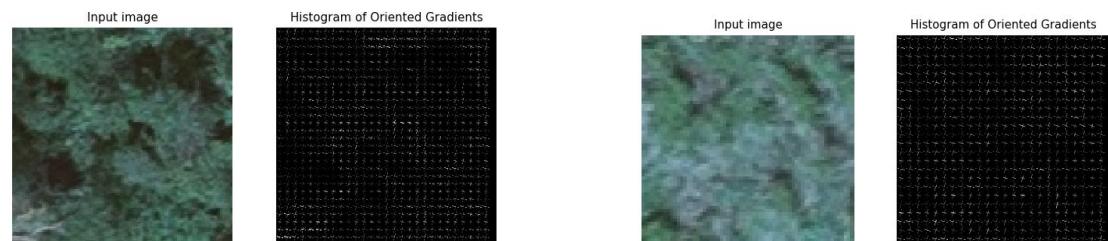
Left: non\_palm\_1; Right: non\_palm\_2



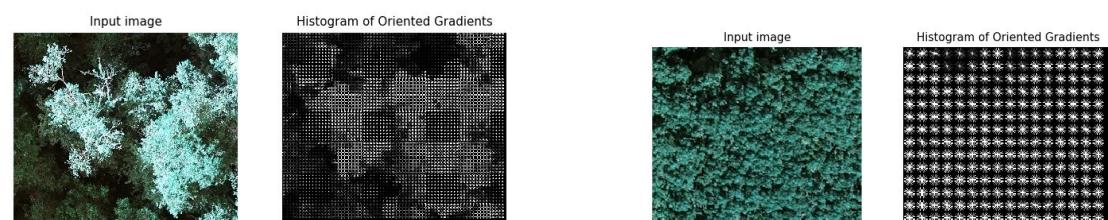
Left: non\_palm\_3; Right: non\_palm\_4



Left: non\_palm\_5; Right: non\_palm\_6



Left: non\_palm\_7; Right: non\_palm\_8



Left: non\_palm\_9; Right: non\_palm\_10

## 2) Comparing of Palm and Non Palm

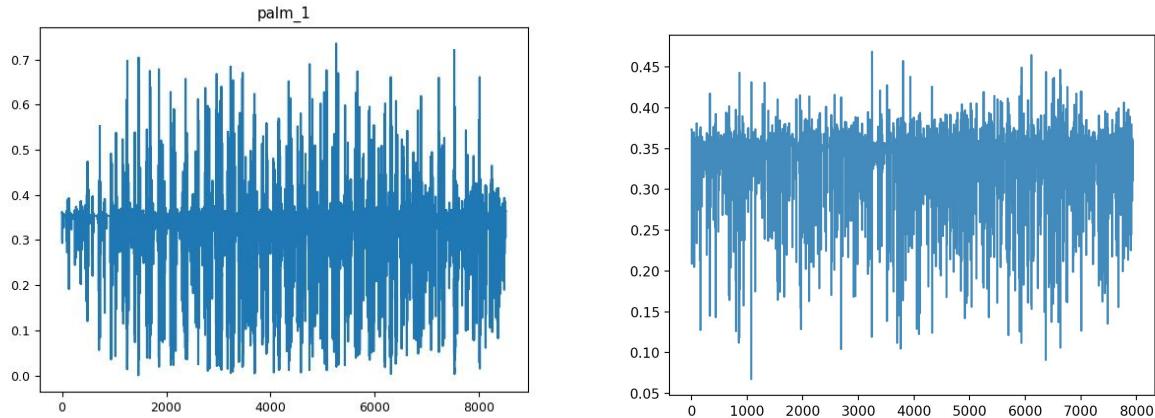
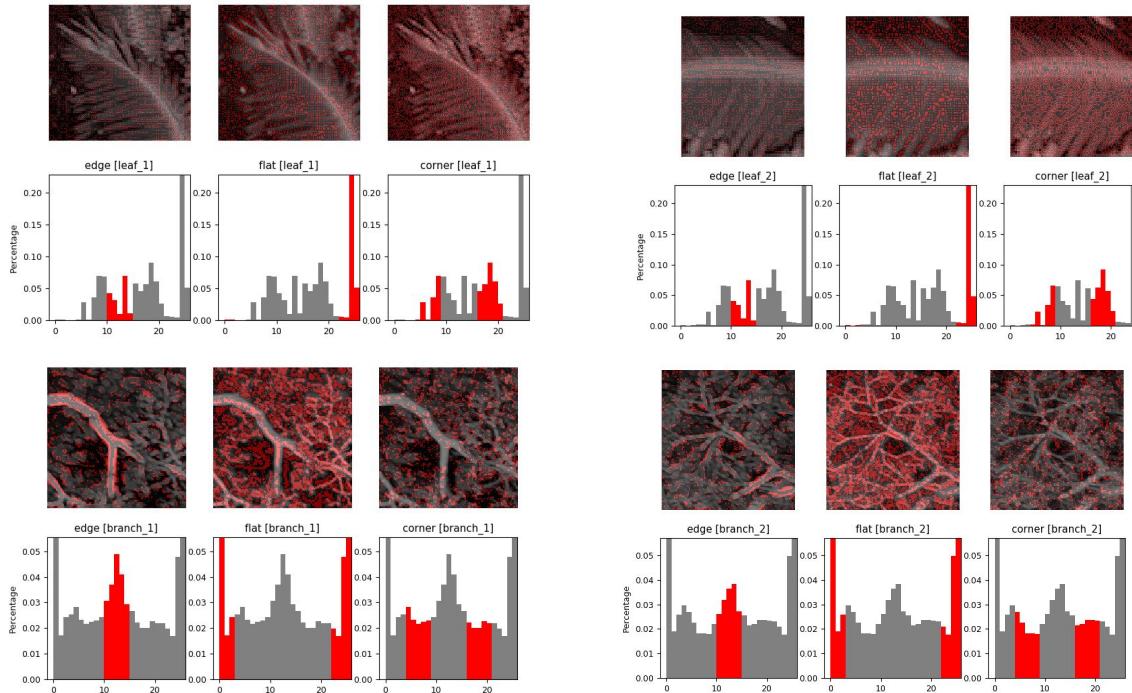


Fig 4. Left: palm\_1; Right: non\_palm\_5

The y-axis indicates the value computed using the gradients of each block of patch. The x-axis indicates the different blocks of patch. The palm image on the left has higher values at certain block, reaching maximum around 0.7, while the non palm image on the right seldom goes above 0.45. Refer back to the HOG images in the above sections, palm images have more blocks where the direction of the gradient is very clear, making the value higher. Non palm images, in most blocks, have gradients without clear direction, thus having a lower value.

### e. LBP with Smaller Patches - Palm Leaves, Regular Tree Leaves & Branches

Since palm leaves might be easily confused with branches of normal trees, I plot LBP histograms below for 2 samples of palm leaves and 2 samples of branches.



By observing the histograms of leaves and branches, we find that leaf images actually have lower percentage of edges than branch images. Overall, palm leaf images have lower percentage in edges, flat regions, and corners. This might be due to the fact that branch images have more regular leaves around it, making branch images have more corners. Branch images also have more detection points (red dots) because the patterns vary more than the patterns in palm leaf images vary.