**Assessment Overview**

The need for trying out this assessment is the application of the theories acquired through class lectures to make up the assessment, thereby improving my knowledge and skillset needed to solve problems relating to computer vision-related tasks as it affects society.

1. **Introduction**

When digital images are partitioned into multiple regions or segments to represent objects or meaningful parts of that objects is termed SEGMENTATION. Image segmentation is a branch of digital image processing that focus on partition of an image into different parts according to their features and properties. Presently, I will be simplifying my image for easy analysis on task 1. The need for image segmentation leads me to computer vision application, and it is applicable throughout the image techniques that I will be doing using instance image segmentation.

**MATLAB** is a programming and numeric computing platform used to analyze data, develop algorithms, and create models use by millions of scientists and engineers in the industries and academics.

**Color (RGB image)** is a type of picture that specifies the red, green, and blue colour components for each pixel.

**A grayscale image** is mostly referred to as an intensity image. It is a single matrix with each element corresponding to one image pixel

**The Otsu method** selects a threshold value to reduce the high intraclass variance of thresholded black and white pixels.

**Histograms** are a type of bar plot for numeric data that group the data into bins and it is useful for quickly modifying the properties of the bins

**A structuring element** is a matrix that identifies and defines each pixel's processing neighborhood in the image to be processed. It can be in the form of a line, a disc, or an octagon.

**Strel** is a morphological structuring element. A strel object represents a flat morphological structuring element which is an essential part of morphological dilation and erosion operations. strel function to create a flat structuring element.

In a **complement** to a grayscale image, each pixel value is subtracted from the maximum pixel value supported by the class (or 1.0 for double-precision images). **Converting RGB to Grayscale:**This was done to eliminate the hue and saturation information while retaining its luminance.

**Dice similarity** score: to note the similarity of two samples presented for modeling in the algorithm.

**Image quantization**-a measure of the smallest discernible change in intensity level or values i.e it gives intensity resolution. It can be perform in a bits

**Mathematical Morphology** is a technique juse for pre or post-processing e.g. noise filtering, filling holes, and extracting connected components.

**Morphology operations**- erosion. Dilate, opening and closing

**Morphology operators**- using matlab function such as imerode, imdilate etc

**Subset syntax** (nfiles)- Create a set of indices that represent a randomly selected subset containing 60% of the files.

**Datastore** is a repository that allows you to access a single file or a group of files or data.

They must be structured and formatted in the same way, whether numeric or text.

**TASK 1.1: OBJECT SEGMENTATION**

**TASK 1 Report on IMAGE SEGMENTATION AND DETECTION**

1. Three skin Images report that includes the original image, final segmented lesion binary images and the calculated Dice similarity score can be found on the appendix with the figure 1.
2. (ISIC\_0000019,
3. And ISIC\_0000095
4. ISIC\_0000214),

**2) The graph for the 60 skin images where the x-axis representing the number of the image, and**

**y-axis representing the corresponding Dice similarity Score can be found on the appendix in fig 2.**

**3) Calculate the mean and standard deviation of the DICE SIMILARITRY SCORE for all the 60 images.**

**Mean = 0.8027**

**Std = 0.1615**

**4) Briefly describe and justify the implementation steps.**

**Implementation steps**

**Step 1:**

I tried to get a deep reflection on the topic of image segmentation. Understanding the MATLAB environment was the focus, and studies on literature as illustrated above before commencing theassessment. I understood that I was to apply the image instance segmentation method since it can detect and localize an object in an image.

**1) Uploading the dataset:** I downloaded the file (skin lesion dataset) and noticed that it was on zip. I unzip the file and save it in an imageDatastore that keeps the document. Then, I uploaded the dataset to my MATLAB environment and created a pathway for the skin lesion dataset to be readable by MATLAB. **Note: If I had not unzip the skin lesion image file, I won’t have been able to read the file**

**2) Reading of files**

**So**I made a directory of all my documents, which can be viewed on my line of code from the basefolder, segmentation, imagefiles, and groundthruthfiles.

The basefolder has the content of the skin lesion dataset in an imageDatastore.

**segmentation** directory has a content of the segmentation of the skin lesion data in an imageDatastore.

**imagefiles** directory has the contents of the original data of the skin lesion dataset in an imageDatastore saved in jpg.

**groundtruthfiles** directory have the contents of the groundtruth in imageDatastore saved in png.

**3) Using “For Loop” for the file images: I have** to read the number of image from the beginning to the end since we have it in numbers of 60’s at both the original data and the groundtruth. I performed all my operations using mathematical morphology to pre-process the data by using imclose function to eliminate small holes, followed by binarize using strel, the strel function presented the image a disk like form having designated and complement on the skin lesion dataset. I call for my files inside the created function. Below are the operations performed.

**4) Operations on the dataset**

**Converted to grayscale:**I converted the images from the color RGB to grayscaleto eliminate the hue and saturation information while retaining the luminance.

**I binarize the Grayscale image by using the Otsu’s method** so that I can replace all values above a globally determined threshold with 1s and setting all other value to 0s.

I perform morphological**“close**operation” on the grayscale imageto eliminate small holes by assigning a disk shape structuring element and a parameter of 10 defines the radius of pixel.

I computed the complement of the I\_gray (grayscale image) and returns the result.

I read the groundtruth and perform binarization on it. Result for the dice similarity score was produces including the Mean Deviation, Standard Mean Deviation. A **filename function** was created to plot the dice similarity score It was also presented in a Graph form to illustrate better view.

**1.2: TASK 2 SEGMENTATION EVALUATION**

**Table 1: Dice Similarity score1 for the whole image = 0.7846. Since it is close to one (1), It is an indication that the segmentation matches perfectly with the ground-truth mask.**

**TASK 2: FEATURE CALCULATION**

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**TASK 1**

**1.0 Introduction**

The intent is to demonstrate how spectral features (frequency and spatial space) can be used to differentiate between images with different textural characteristics. Feature extraction as the name implies translating raw data into numerical features.

**Inverse Fourier Fast Transform**- computes the inverse discrete Fourier transform of Y using a fast **Fourier fast transform**- computes the discrete Fourier transform (DFT) of x using a fast Fourier transform (FFT)

**Feature extraction in special domains**- The process of translating raw data into numerical features that may be handled while keeping the information in the original data set is known as feature extraction.

**First order gray-level statistics** describe the distribution of gray-values within the volume

**Gray Level Run Length-** A gray level run is defined as the length  
in number of pixels, of consecutive pixels that have the same gray level value

**Gray Level Co-occurrence matrix (GLCM) -** The gray-level co-occurrence matrix is a statistical approach of assessing texture that takes into account the spatial interaction of pixels.

**1.1: Implementation steps**

**Step 1:**

I have deep reflection on the topic “feature extraction and its calculation”. I read literatures and made some personal research to get a detailed explanation of the concept.

**1a) Uploading the dataset:** I downloaded the file (ImgPIA.jpg) and save the image in the MATLAB current folder. Then, I uploaded the image to my MATLAB environment and created a pathway for the image to be readable by MATLAB. Meanwhile, I observed that while I tried to load the image before its conversion to gray, it could not load until I applied the rgbb2gray function which aided me to convert the color image to gray. The image can be seen in figure 4.

**2) Reading of files**

**I segmented the image into four pieces to get it into a smaller size, and this sub-image (smaller size) represented different textures within the main test image (ImgPIA.jpg) seen in figure 5. From our assessment note, I applied the Fourier Fast Transform and Inverse Fourier Fast Transform that was given and I observed the changes made for the final image to be presented. This was shown in the diagram in figure 6, figure 7, and figure 8 respectively in the appendix. I tried first with the inverse Fourier transform and replaces it with both the Fourier transform, and the inverse Fourier transform simultaneously, and I got the effect of the changes made. Figure 5 shows when I loaded it with a Fourier fast transform. Figure 6 shows when it was replaced with an inverse Fourier fast transform, and figure 8 shows when both the inverse and Fourier fast transform was applied. All the images produces algorithm and amplitude values as shown in the diagram** (Ans **=** 5.158801618675188e+00, Ans = 10136717)

**2) Operations on the IMAGE**

**Converted to grayscale:**I converted the images from the color RGB to grayscaleto eliminate the hue and saturation information while retaining the luminance. I selected the features for both radius and direction using the graycomatrix function provided in the workshop thereby tweaking the radius at different value from (1 to 4) in the direction of 0, 45, 90 and 135 degree respectively and printed the output as they offset in different angle and radius a shown in the figure 9, 10, 11, 12 &13 and plotted a table of the degree and radius using a table function. This can be seen in table 2.

**TASK2**

**Converted to grayscale:**I converted the images from the color RGB to grayscaleto eliminate the hue and saturation information while retaining the luminance. I make use of the graycocrops function from the workshop to display some of the features suggested by Haralick. I also went further to consult some literature which had to give me other knowledge of other features in addition to the Haralick book on Texture analysis. My result and reference were presented in the appendix and reference section. I make sure I tweak the bit-depth of the image using the specified bits as shown (4 bits, 6 bits and 8 bits) on the assessment booklet. I did for the Gray Level Run Length (GLRL) and observed that for each time when I run the GLRL feature (Short Run Emphasis, Long Run Emphasis, Gray level Non- Uniformity, Run Percentage, Run-length Non-Uniformity, Low Gray Level Run Emphasis, High Gray level Run emphasis), I notices that the values changes. My result were presented in the table section of the appendix. The processed is known as image quantization.