UNIVERSITY OF ENGINEERING AND TECHNNOLOGY, TAXILA
DEPARTMENT OF ELECTRICAL ENGINEERING

DIGITAL IMAGE PROCESSING LAB

COMPLEX ENGINEERING PROBLEM (CEP)

OBJECTIVE:

Design an algorithm in MATLAB to segment out the region of interest, i.e., the melanoma region, from the dermoscopic image.

INTRODUCTION:

Image segmentation is one of the most important tasks in image processing. Segmentation is used to isolate and extract the region of interest (ROI) from the image. It is particularly crucial for computer vision techniques which involve object classification or recognition tasks. In medical image processing, segmentation plays a critical role in isolating the ROI which could be a tumor, cancer or any other object of interest. Unique features can be extracted from the ROI for the classification and detection of disease. Melanoma is one of the deadliest cancers in the world and usually appears as pigmented lesions on the skin. If Melanoma is detected in its early stage, it can be cured. Dermoscopy is the process of observing skin lesions by dermatologists through the naked eye or by using a magnifying to identify whether the skin lesion is Melanoma. Detection of Melanoma at its early stage through a dermoscopic approach is not good because of the limitation of human vision and its variability from person to person. Computer-aided techniques can play a significant role in early melanoma detection in which a skin image containing a lesion is captured with a high-resolution camera and processed through a computer to detect melanoma.

CEP BRIEF:

Dermoscopic images with melanoma regions and their respective ground truth image are shared. Design an algorithm to segment out the melanoma region from the background in the image. After initial pre-processing, hairs from the image should be removed first either using a morphological image processing technique or any algorithm of your choice. Then, a mask containing melanoma region in the white and non-melanoma region in black should be generated through thresholding or any other suitable process. Finally, compare your segmented region with the ground truth image by calculating Jaccard Index and Dice Coefficient which are the standard segmentation performance metrics.

DELIVERABLES:

- Complete working MATLAB codes
- Values of the segmentation performance metrics
- CEP report addressing all the requirements
- Power point presentation

PRE-REQUISITE:

To carry out the CEP you should have the knowledge and understanding of

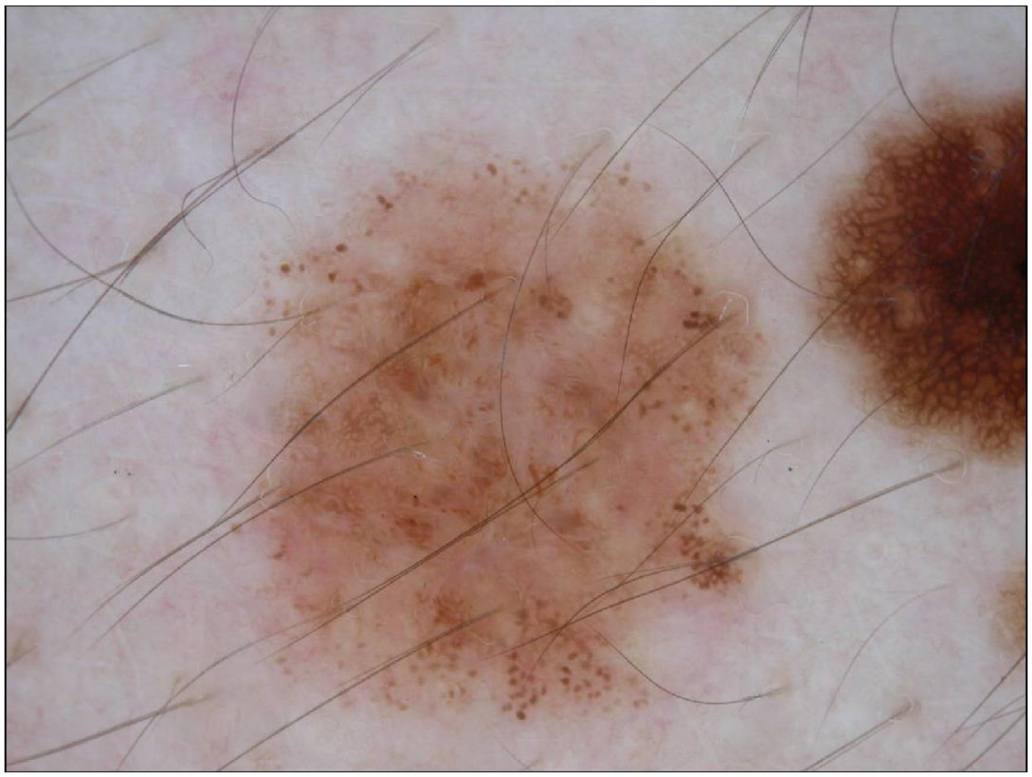
- Thresholding
- Filtering
- Morphological image processing
- MATLAB image processing toolbox

```
close all; clearvars; clc
```

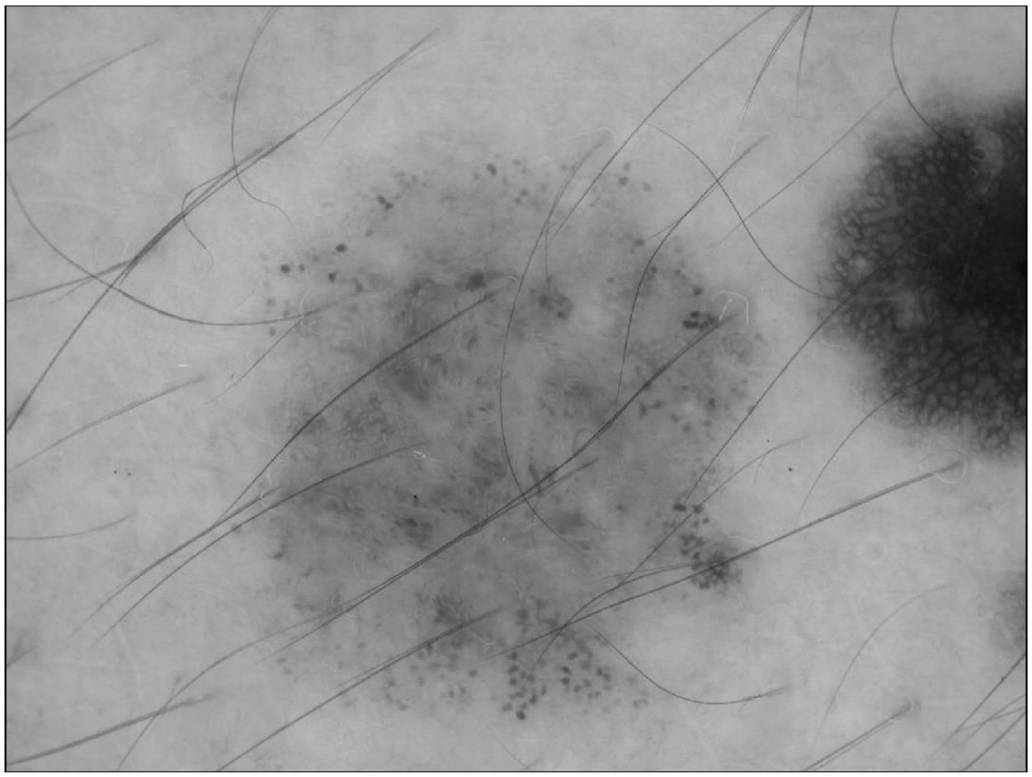
Generating a Mask for Extracting ROI from a Noisy Image

```
image = im2double(imread('ISIC_0000032.jpg'));
figure('windowstate','maximized'), imshow(image), title('Given Image', 'fontsize', 18)

grayscale = rgb2gray(image);                  % Converting to image grayscale
figure('windowstate','maximized'), imshow(grayscale), title('Grayscale Image', 'fontsize',
18)

se = strel('disk',5);                         % Disk Shaped Structuring Element
hairs = imbothat(grayscale,se);               % Bottom Hat Filtering for Extracting Hairs
figure('windowstate','maximized'), imshow(hairs), title('Hairs Extracted', 'fontsize', 18)

replacedImage = regionfill(grayscale, hairs); % Filling the Hair Region with Inward
Interpolation
figure('windowstate','maximized'), imshow(replacedImage), title('Hairs Removed', 'fontsize',
18)

I = replacedImage;
L = graythresh(I);                  % Threshold Level L
I(I>L-L/10*2 & I<L+L/10*1.5) = 1;  % Thresholding using the Level L
I = imbinarize(I);
figure('windowstate','maximized'), imshow(I), title('Thresholding the Image', 'fontsize', 18)

CC = bwconncomp(I);
n = CC.PixelIdxList;     % No. of Connected Components
num = 0;

for k=1:length(n)        % Iterating through all Connected Components
    temp = length(n{k}); % No. of pixels in the Connected Component
    if num<temp          % If Larger
        num = temp;      % number (num) updated
        obj = k;         % The 'no.' of connected component with largest no. of pixels
    end
end

a = n(obj);                                % Indexing the Largest Connected Component
Largest_CC = bwareaopen(I,length(a{:,1}));  % Getting the length of the Largest Connected
Component and filtering out the rest
figure('windowstate','maximized'), imshow(Largest_CC), title('Retaining only the Largest
Connected Component', 'fontsize', 18)

se = strel('diamond',27);                  % Diamond Shaped Structuring Element (Disk can
also be used)
Generated_Mask = imdilate(Largest_CC,se);   % Dilation Operation to fill dark regions in the
Mask
figure('windowstate','maximized'), imshow(Generated_Mask), title('Dilating the Image -
Generated Mask', 'fontsize', 18)
```

Given Image

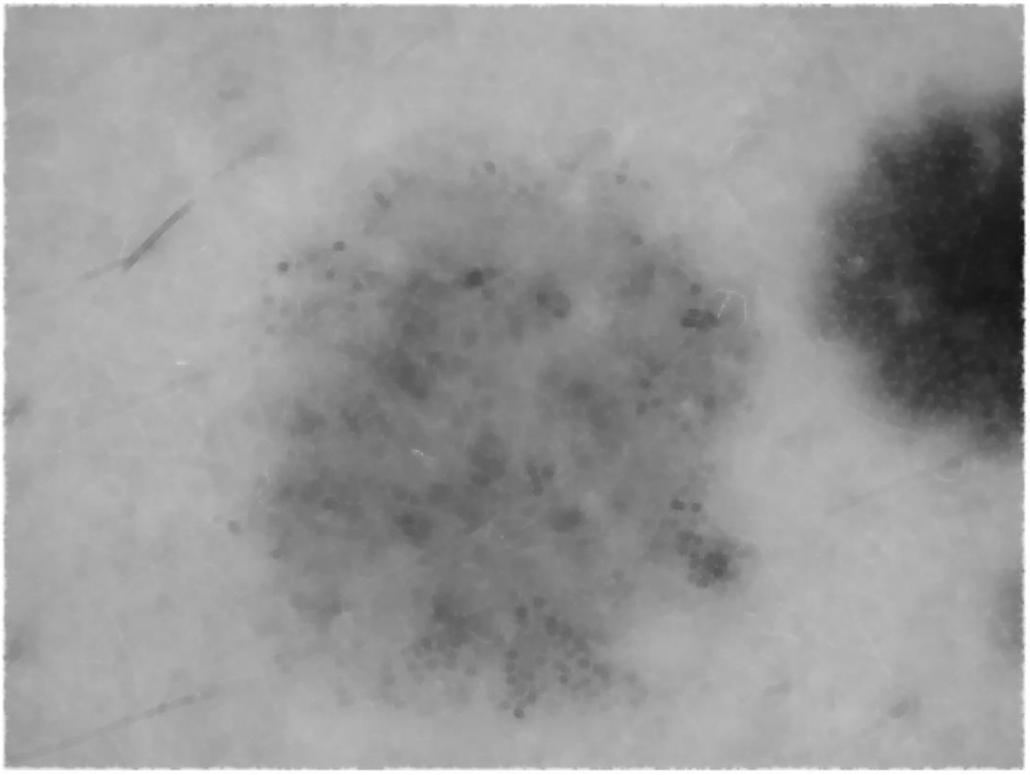


Grayscale Image

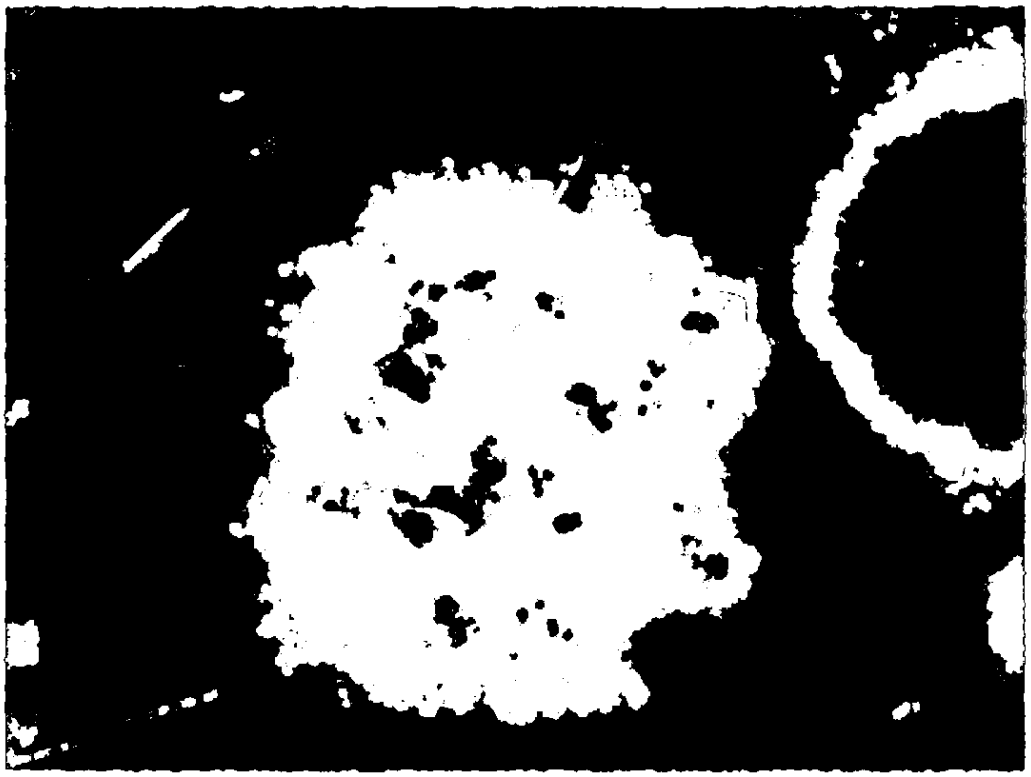


Hairs Extracted

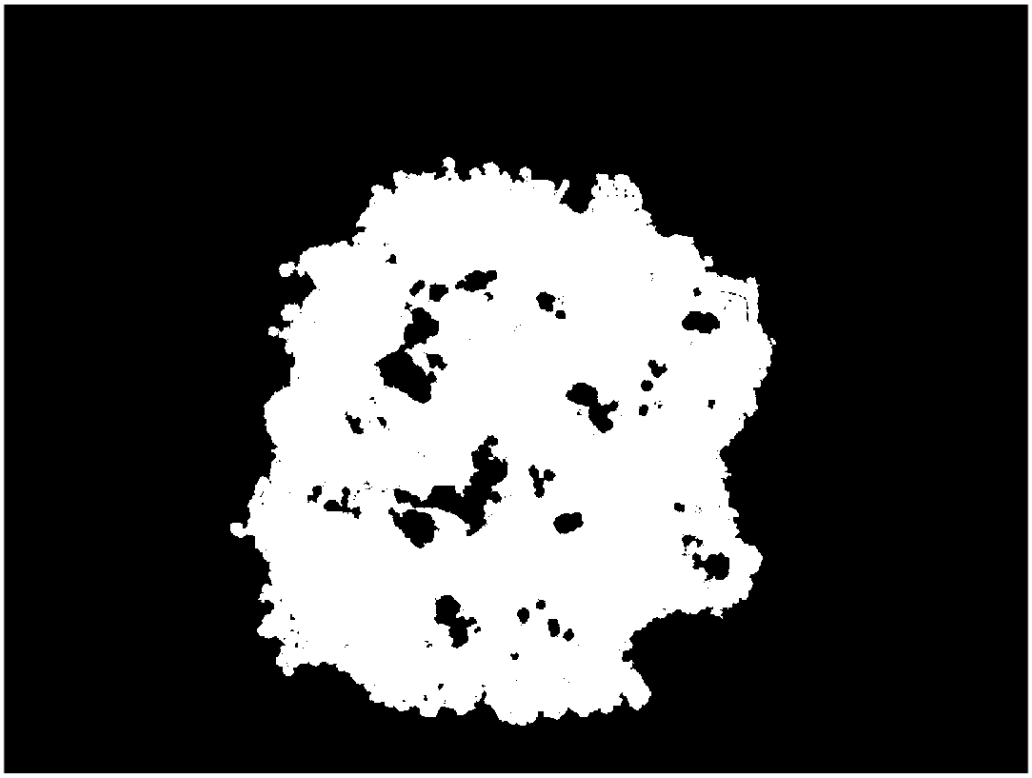
Hairs Removed

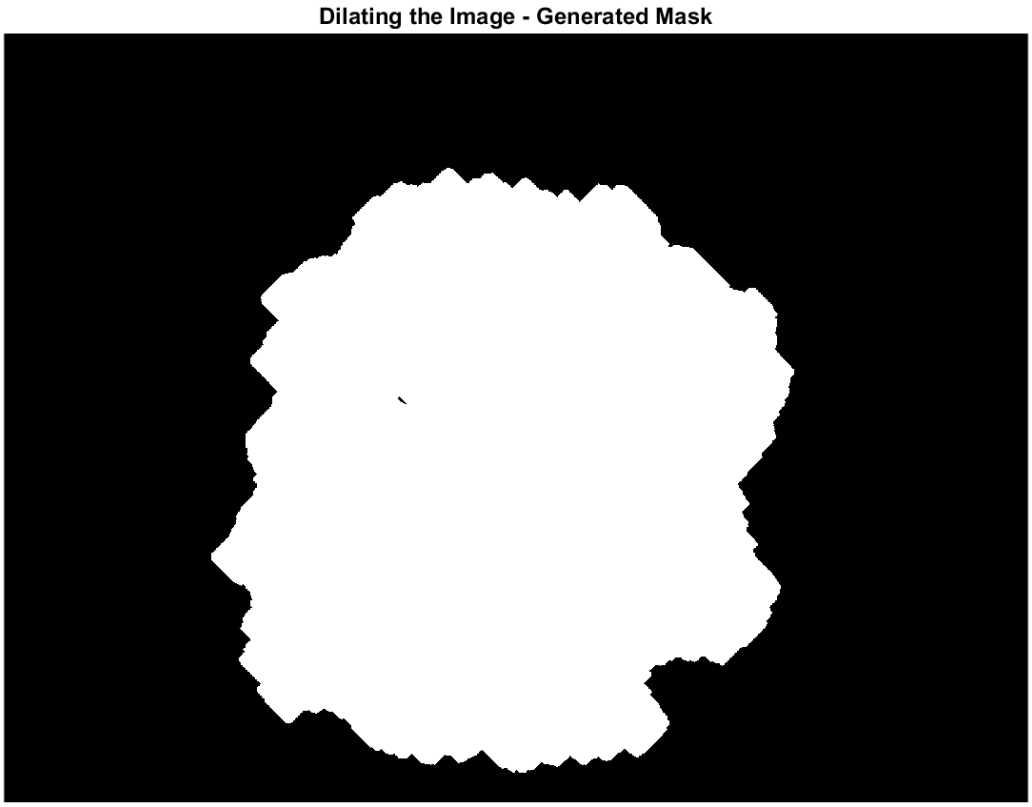


Thresholding the Image



Retaining only the Largest Connected Component





Calculating Jaccard Index and Dice Coefficient:

```
Given_Mask = imbinarize(imread('ISIC_0000032_segmentation.png'));

Jaccard_Index = jaccard(Generated_Mask,Given_Mask)
Dice_Coefficient = dice(Generated_Mask,Given_Mask)

figure('windowstate','maximized')
subplot 121, imshow(Generated_Mask), title('Generated Mask','fontsize',18);
subplot 122, imshow(Given_Mask), title('Given Mask','fontsize',18);
```

```
Jaccard_Index =

    0.9251


Dice_Coefficient =

    0.9611
```

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