Colin Keenan

ECE 5470

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Homework 10

1. Opening and Closing

# Fingerprint 1

clear

fprintf("Question 1, Fingerprint 1:")

Question 1, Fingerprint 1:

image = im2double(imread('Fig6-1a.tif'));

mask\_1 = [[0 1 0]

[1 1 1]

[0 1 0]];

mask\_2 = [[1 1 1]

[1 1 1]

[1 1 1]];

% Opening: Erosion, then Dilation

opened\_1 = open\_3x3(image, mask\_1);

opened\_2 = open\_3x3(image, mask\_2);

% Closing: Dilation, then Erosion

closed\_1 = close\_3x3(image, mask\_1);

closed\_2 = close\_3x3(image, mask\_2);

figure();

imshow(image);

title('Original Image');



figure();

imshow(opened\_1);

title('Opened Image with Mask 1');



figure();

imshow(opened\_2);

title('Opened Image with Mask 2');



figure();

imshow(closed\_1);

title('Closed Image with Mask 1');



figure();

imshow(closed\_2);

title('Closed Image with Mask 2');



# Fingerprint 2

clear

fprintf("Question 1, Fingerprint 2:")

Question 1, Fingerprint 2:

image = im2double(imread('Fig6-1b.tif'));

mask\_1 = [[0 1 0]

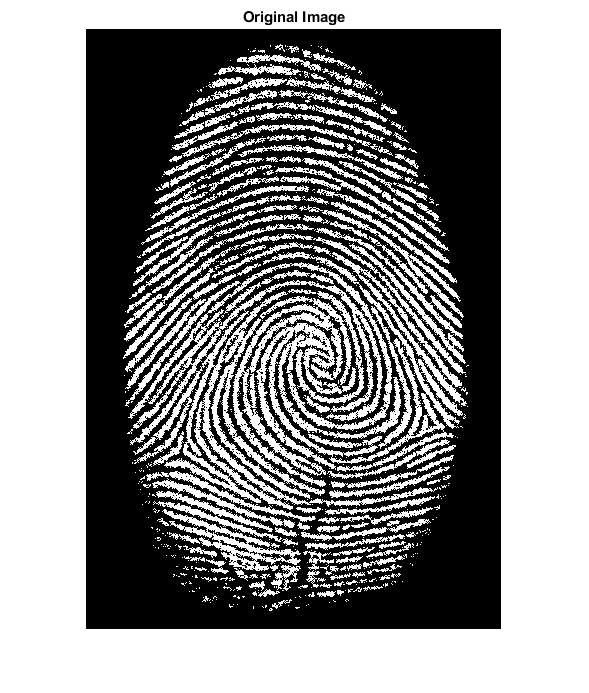
[1 1 1]

[0 1 0]];

mask\_2 = [[1 1 1]

[1 1 1]

[1 1 1]];



% Opening: Erosion, then Dilation

opened\_1 = open\_3x3(image, mask\_1);

opened\_2 = open\_3x3(image, mask\_2);

% Closing: Dilation, then Erosion

closed\_1 = close\_3x3(image, mask\_1);

closed\_2 = close\_3x3(image, mask\_2);

figure();

imshow(image);

title('Original Image');

figure();

imshow(opened\_1);

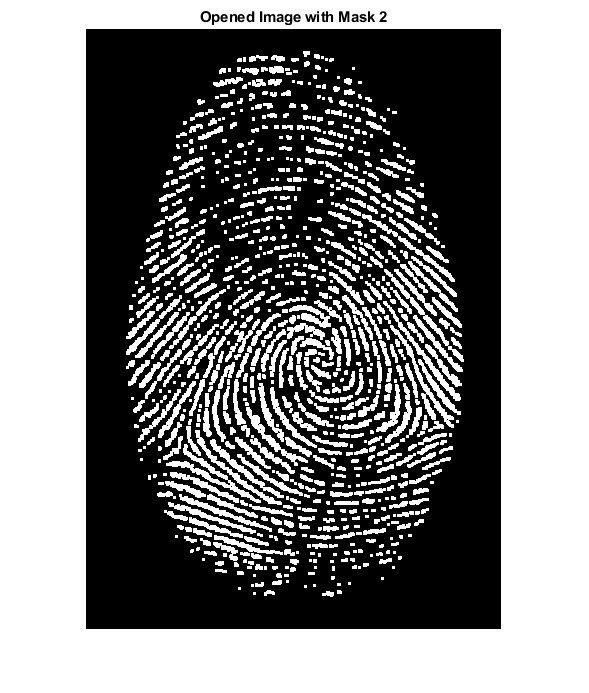
title('Opened Image with Mask 1');



figure();

imshow(opened\_2);

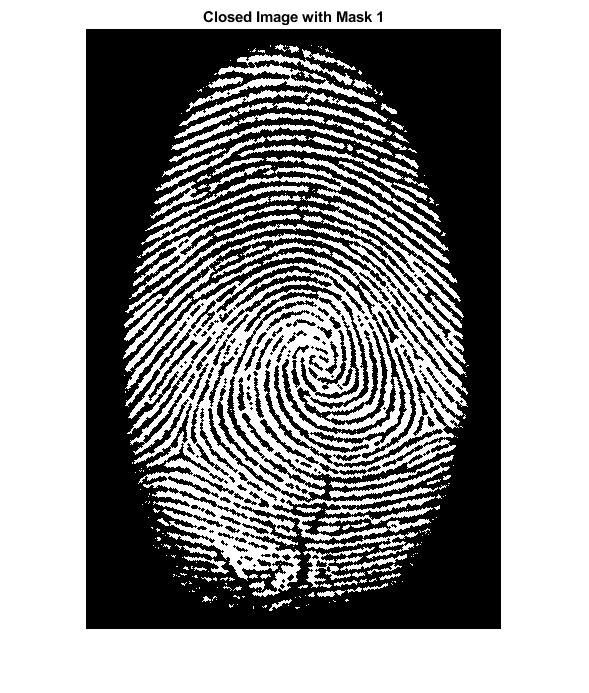
title('Opened Image with Mask 2');



figure();

imshow(closed\_1);

title('Closed Image with Mask 1');



figure();

imshow(closed\_2);

title('Closed Image with Mask 2');



# Appendix (Functions Used)

function eroded = erode\_3x3(image, mask)

eroded = zeros(size(image));

pad = floor(size(mask,1)/2);

for i = 1+pad : size(image,1)-pad

for j = 1+pad : size(image,2)-pad

frame = [[image(i-1,j-1) image(i-1,j+0) image(i-1,j+1)]

[image(i+0,j-1) image(i+0,j+0) image(i+0,j+1)]

[image(i+1,j-1) image(i+1,j+0) image(i+1,j+1)]];

if((frame & mask) == mask)

eroded(i,j) = 1;

else

eroded(i,j) = 0;

end

end

end

end

function dilated = dilate\_3x3(image, mask)

dilated = zeros(size(image));

pad = floor(size(mask,1)/2);

for i = 1+pad : size(image,1)-pad

for j = 1+pad : size(image,2)-pad

frame = [[image(i-1,j-1) image(i-1,j+0) image(i-1,j+1)]

[image(i+0,j-1) image(i+0,j+0) image(i+0,j+1)]

[image(i+1,j-1) image(i+1,j+0) image(i+1,j+1)]];

if((frame & mask) == 0)

dilated(i,j) = 0;

else

dilated(i,j) = 1;

end

end

end

end

function opened = open\_3x3(image,mask)

eroded = erode\_3x3(image,mask);

opened = dilate\_3x3(eroded,mask);

end

function closed = close\_3x3(image,mask)

dilated = dilate\_3x3(image,mask);

closed = erode\_3x3(dilated,mask);

end