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**Binarization**

**Bin-1. Binarization based on histogram**

coins\_image = imread('coins.png');

% Display

figure;

subplot(2, 2, 1);

imshow(coins\_image);

title('Original Image');

subplot(2, 2, 2);

imhist(coins\_image);

title('Histogram');

threshold = 120;

binary\_coins = imbinarize(coins\_image, threshold / 255);

subplot(2, 2, 3);

imshow(binary\_coins);

title('Binary Image');

shape1\_image = imread('shape1.png');

shape2\_image = imread('shape2.png');

shape3\_image = imread('shape3.png');

% Display

figure;

images = {shape1\_image, shape2\_image, shape3\_image};

for i = 1:3

subplot(3, 4, (i - 1) \* 4 + 1);

imshow(images{i});

title(['Shape ' num2str(i)]);

subplot(3, 4, (i - 1) \* 4 + 2);

imhist(images{i});

title('Histogram');

threshold = 120;

binary\_shape = imbinarize(images{i}, threshold / 255);

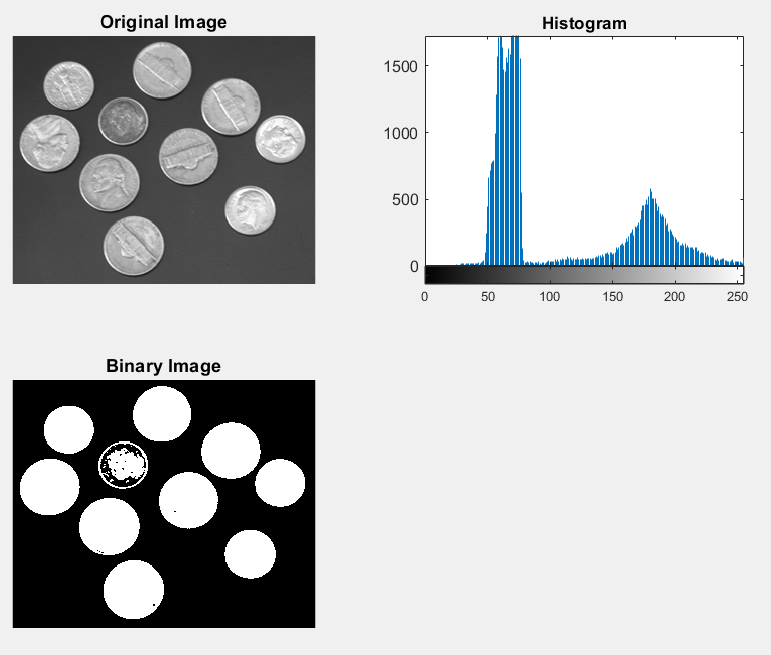
subplot(3, 4, (i - 1) \* 4 + 3);

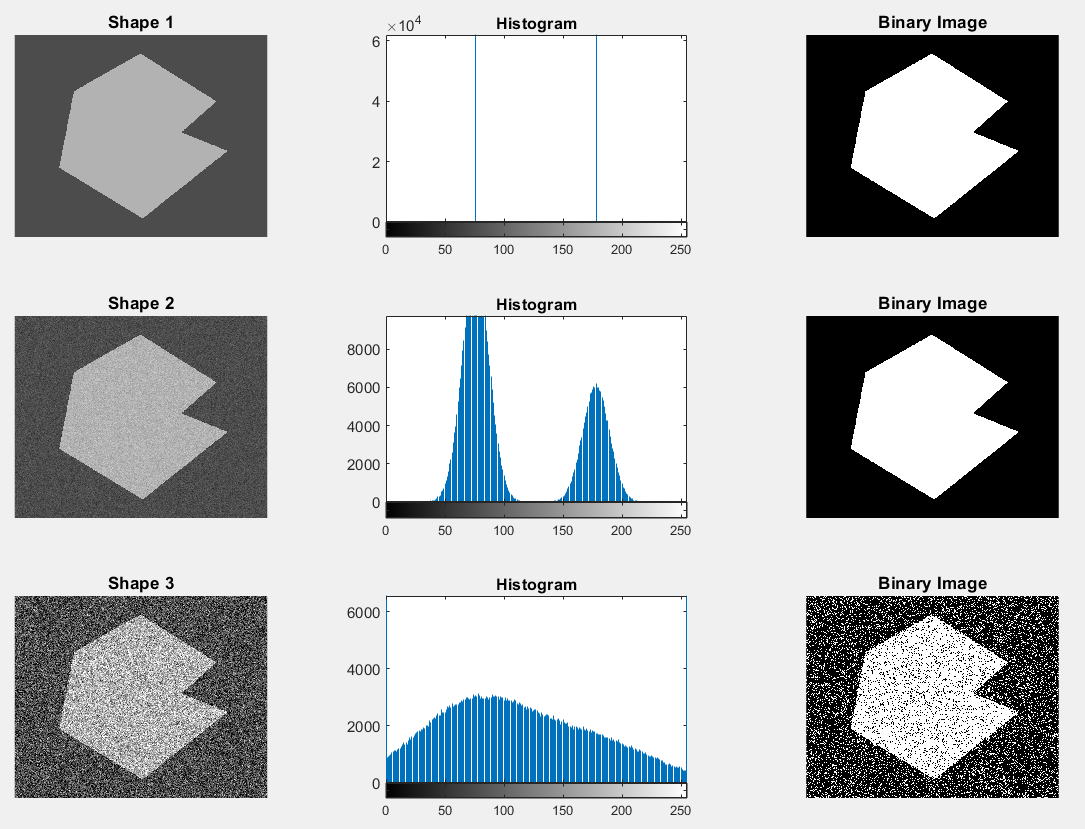
imshow(binary\_shape);

title('Binary Image');

end

**Result of the code:**





**Bin-2. Automatic binarization methods**

coins\_image = imread('coins.png');

rice\_image = imread('rice.png');

text\_image = imread('text.bmp');

% Binarization using Otsu method

otsu\_coins = imbinarize(coins\_image, graythresh(coins\_image));

otsu\_rice = imbinarize(rice\_image, graythresh(rice\_image));

otsu\_text = imbinarize(text\_image, graythresh(text\_image));

% Binarization using Kittler method

threshold\_kittler\_coins = clusterKittler(coins\_image);

kittler\_coins = imbinarize(coins\_image, threshold\_kittler\_coins / 255);

threshold\_kittler\_rice = clusterKittler(rice\_image);

kittler\_rice = imbinarize(rice\_image, threshold\_kittler\_rice / 255);

threshold\_kittler\_text = clusterKittler(text\_image);

kittler\_text = imbinarize(text\_image, threshold\_kittler\_text / 255);

% Binarization using Yen method

threshold\_yen\_coins = entropyYen(coins\_image);

yen\_coins = imbinarize(coins\_image, threshold\_yen\_coins / 255);

threshold\_yen\_rice = entropyYen(rice\_image);

yen\_rice = imbinarize(rice\_image, threshold\_yen\_rice / 255);

threshold\_yen\_text = entropyYen(text\_image);

yen\_text = imbinarize(text\_image, threshold\_yen\_text / 255);

% Display

figure;

% Coins image

subplot(3, 4, 1);

imshow(coins\_image);

title('Original Coins');

subplot(3, 4, 2);

imshow(otsu\_coins);

title('Otsu Binarization');

subplot(3, 4, 3);

imshow(kittler\_coins);

title('Kittler Binarization');

subplot(3, 4, 4);

imshow(yen\_coins);

title('Yen Binarization');

% Rice image

subplot(3, 4, 5);

imshow(rice\_image);

title('Original Rice');

subplot(3, 4, 6);

imshow(otsu\_rice);

title('Otsu Binarization');

subplot(3, 4, 7);

imshow(kittler\_rice);

title('Kittler Binarization');

subplot(3, 4, 8);

imshow(yen\_rice);

title('Yen Binarization');

% Text image

subplot(3, 4, 9);

imshow(text\_image);

title('Original Text');

subplot(3, 4, 10);

imshow(otsu\_text);

title('Otsu Binarization');

subplot(3, 4, 11);

imshow(kittler\_text);

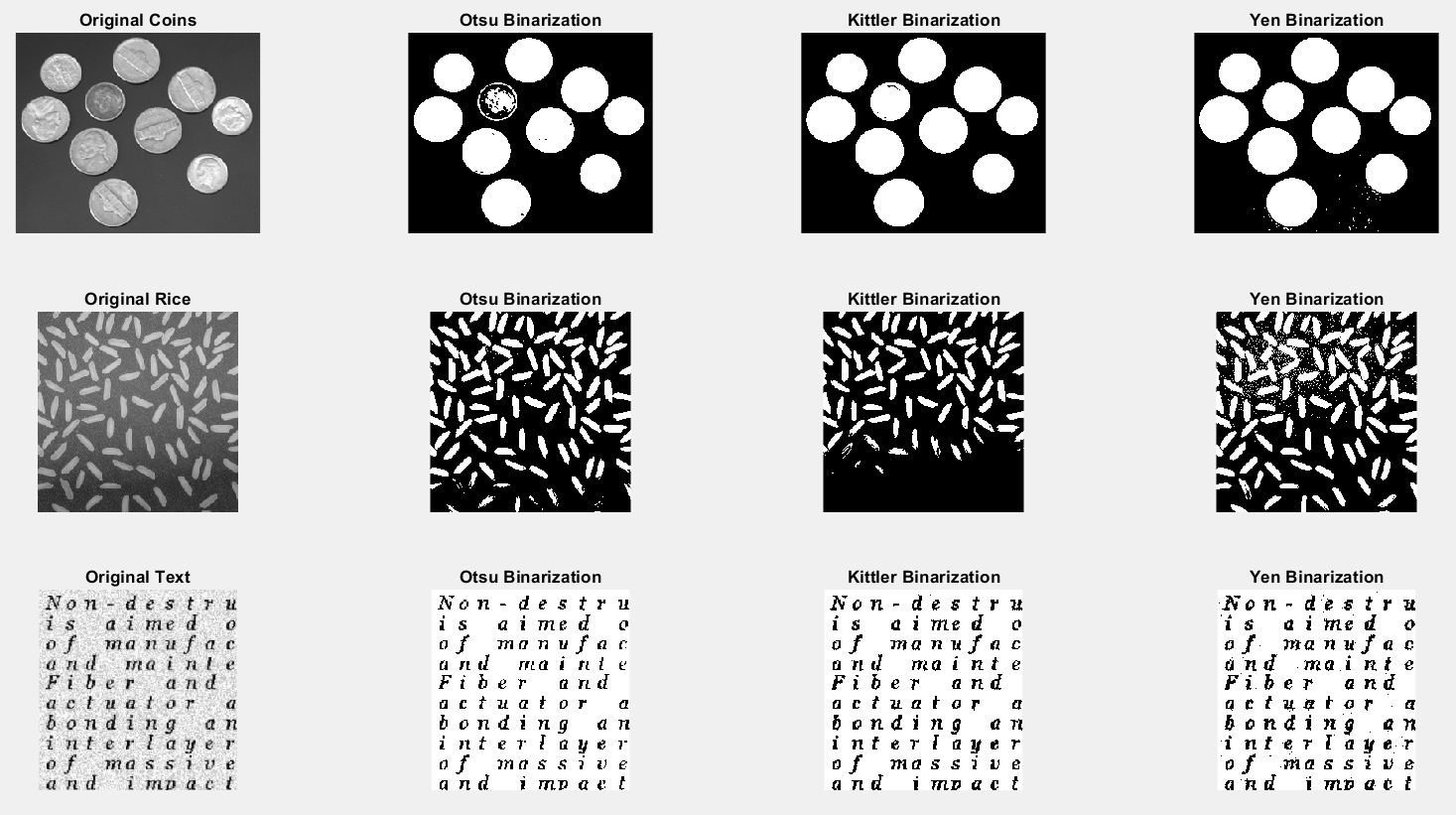
title('Kittler Binarization');

subplot(3, 4, 12);

imshow(yen\_text);

title('Yen Binarization');

**Result of the code:**



**Bin-3. Adaptive threshold**

coins\_grad\_image = imread('coins\_grad.png');

figure;

subplot(2, 3, 1);

imshow(coins\_grad\_image);

title('Original Image');

subplot(2, 3, 2);

imhist(coins\_grad\_image);

title('Histogram');

manual\_threshold = 100;

manual\_binary\_image = imbinarize(coins\_grad\_image, manual\_threshold / 255);

% Otsu, Kittler, and Yen binarization

otsu\_binary\_image = imbinarize(coins\_grad\_image, graythresh(coins\_grad\_image));

kittler\_threshold = clusterKittler(coins\_grad\_image);

kittler\_binary\_image = imbinarize(coins\_grad\_image, kittler\_threshold / 255);

yen\_threshold = entropyYen(coins\_grad\_image);

yen\_binary\_image = imbinarize(coins\_grad\_image, yen\_threshold / 255);

% Display

subplot(2, 3, 3);

imshow(manual\_binary\_image);

title('Manual Binarization');

subplot(2, 3, 4);

imshow(otsu\_binary\_image);

title('Otsu Binarization');

subplot(2, 3, 5);

imshow(kittler\_binary\_image);

title('Kittler Binarization');

subplot(2, 3, 6);

imshow(yen\_binary\_image);

title('Yen Binarization');

adaptive\_threshold = adaptthresh(coins\_grad\_image, 'NeighborhoodSize', 21, 'Statistic', 'Mean');

adaptive\_binary\_image = imbinarize(coins\_grad\_image, adaptive\_threshold);

% Display

figure;

subplot(1, 3, 1);

imshow(adaptive\_threshold);

title('Adaptive Threshold');

filled\_image = imfill(adaptive\_binary\_image, 'holes');

opened\_image = imopen(filled\_image, strel('disk', 5));

subplot(1, 3, 2);

imshow(filled\_image);

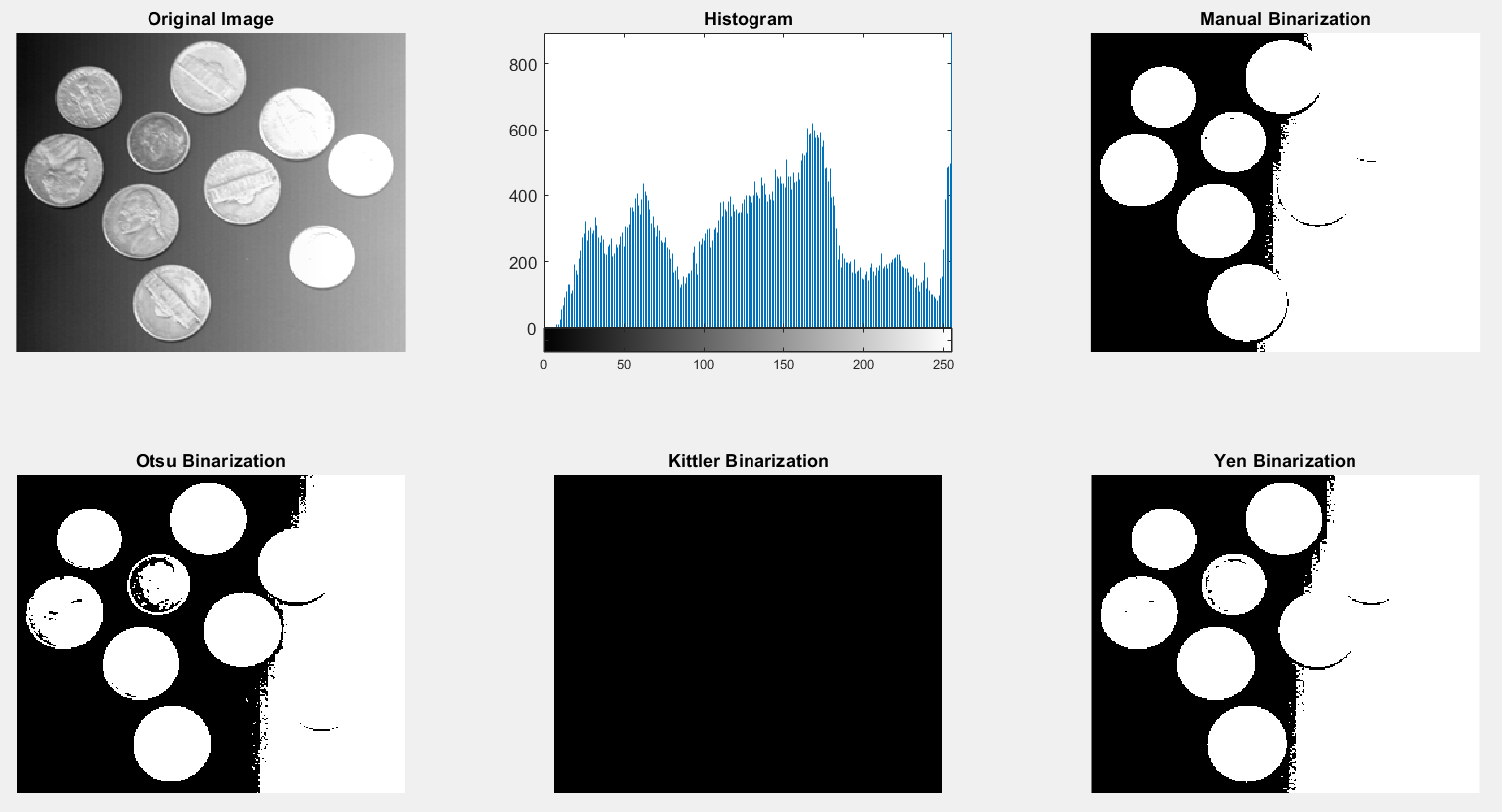
title('Filled Image');

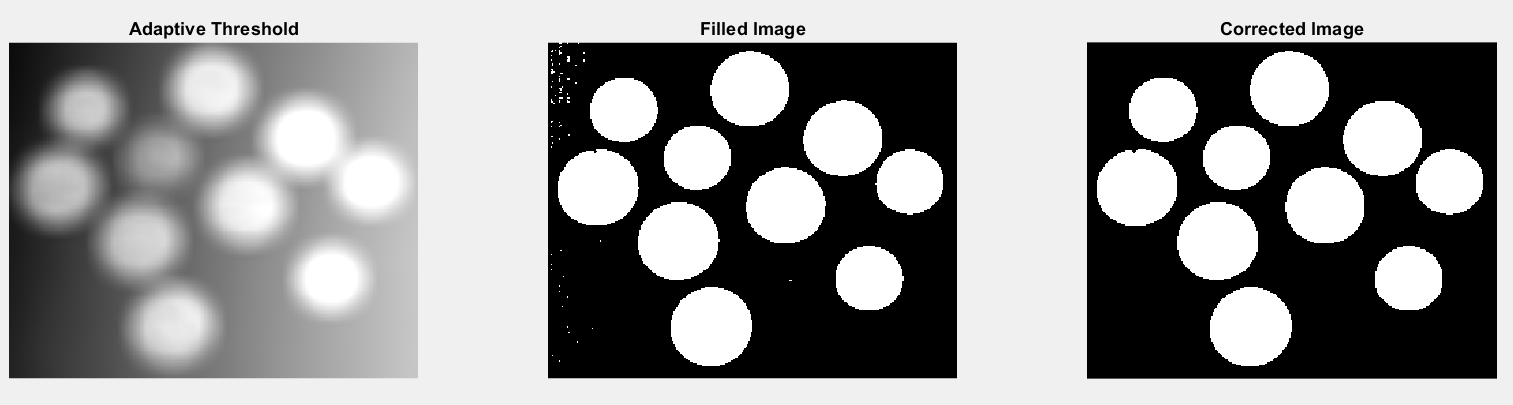
subplot(1, 3, 3);

imshow(opened\_image);

title('Corrected Image');

**Result of the code:**





**Bin-4. Binarization with two thresholds**

bart\_image = imread('bart.bmp');

figure;

subplot(2, 3, 1);

imshow(bart\_image);

title('Original Image');

subplot(2, 3, 2);

imhist(bart\_image);

title('Histogram');

lower\_threshold = 130;

upper\_threshold = 190;

binary\_image = (bart\_image > lower\_threshold) & (bart\_image < upper\_threshold);

subplot(2, 3, 3);

imshow(binary\_image);

title('Binarized Image');

skin\_color\_image = bart\_image;

skin\_color\_image(~binary\_image) = 0;

subplot(2, 3, [4, 5, 6]);

imshow(skin\_color\_image);

title('Skin Color Areas');

**Result of the code:**

