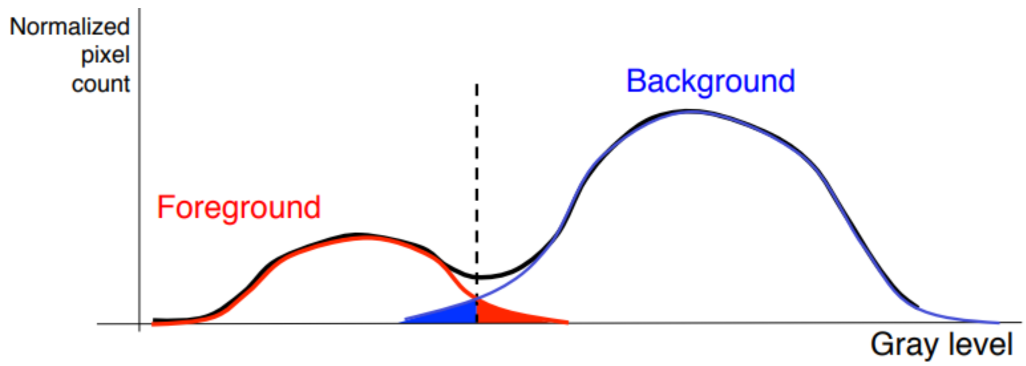
LAB 6: SEGMENTATION

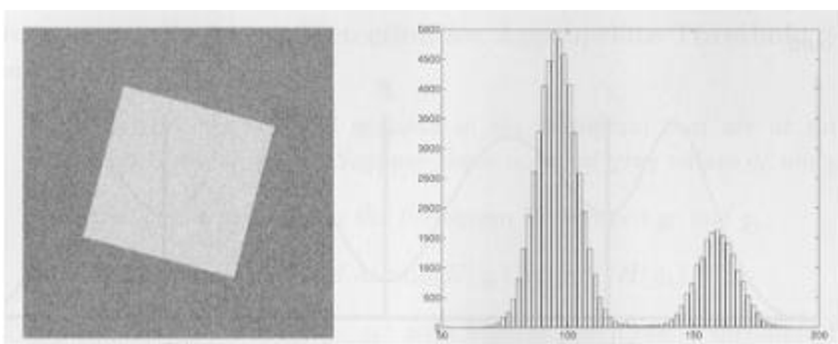
I. Single thresholding:

- The simplest approach to segment an image is using thresholding.

$$\text{If } f(x,y) > T \text{ then } f(x,y) = 0 \text{ else } f(x,y) = 255$$

- **Choosing the theshold using the image histogram**



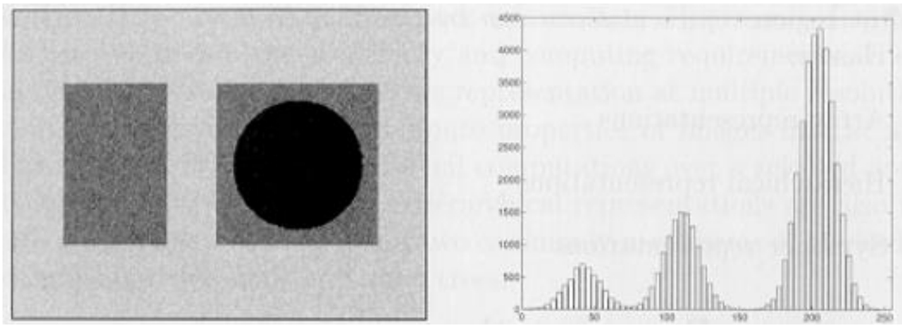


- **Example:**

```
% Load test image
img = imread('peter.png');

% Threshold
level = 105;
bwImg = img < level;
holeImg = img .* uint8(bwImg);

% Show images
subplot(1, 3, 1), imshow(img); title('Original Image');
subplot(1, 3, 2), imshow(bwImg); title('Thresholded Image');
```

```
subplot(1, 3, 3), imshow(holeImg); title('Binary Map \times
Original');

% Save images
imwrite(bwImg, 'Graylevel_Thresholding_thresholded.png');
imwrite(holeImg, 'Graylevel_Thresholding_blend.png');
```

II. Multilevel thresholding

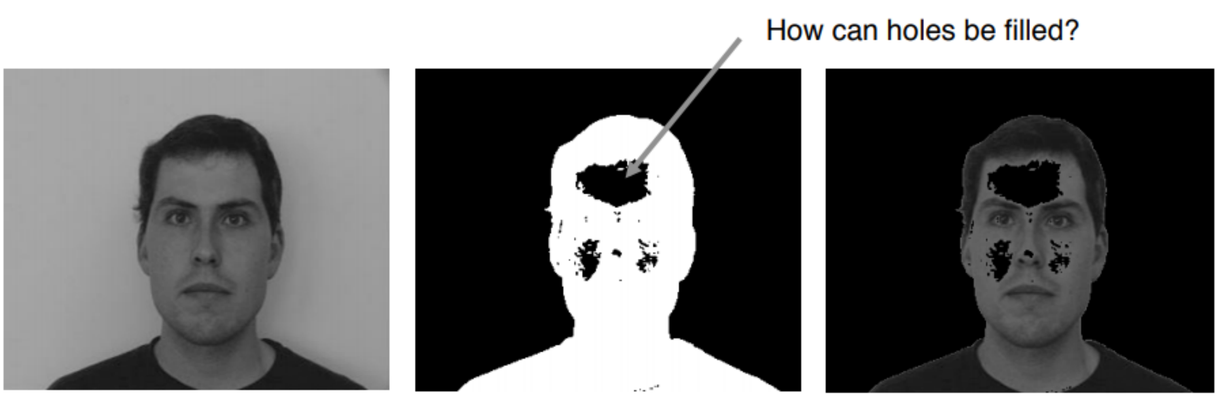


$$\text{If } f(x,y) < T_1 \text{ then } f(x,y) = 255$$

$$\text{else if } T_1 \le f(x,y) < T_2 \text{ then } f(x,y) = 128$$

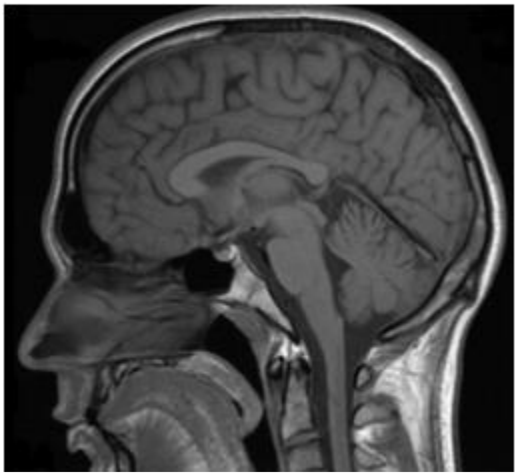
$$\text{else } f(x,y) = 0$$

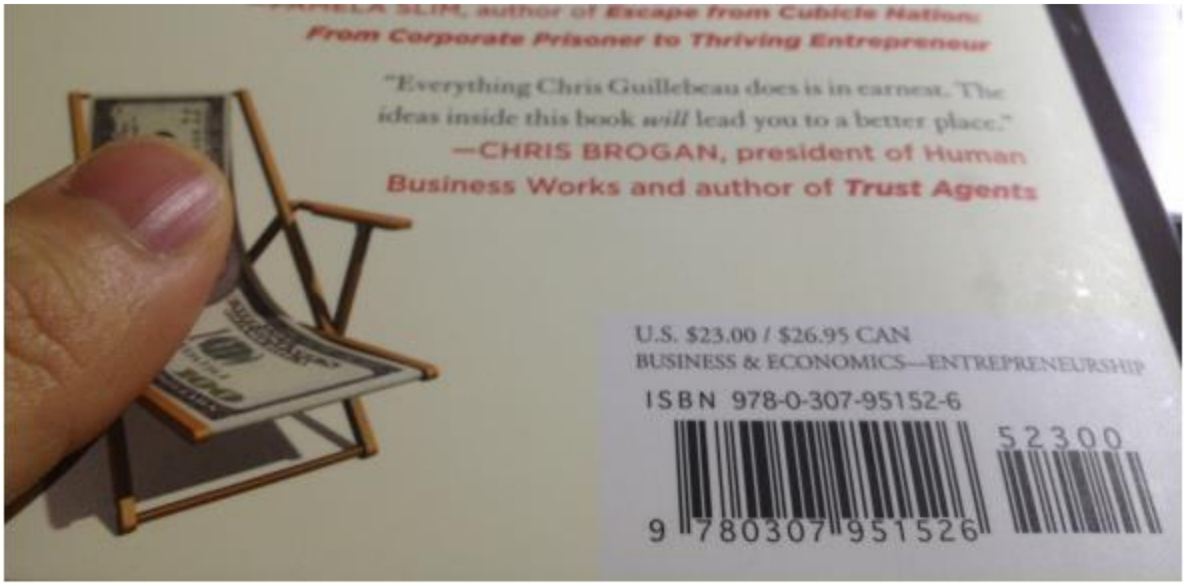
Exercise: Thực hiện phân đoạn cho các image sau:



Original image *Peter* $f[x,y]$ | Thresholded *Peter* $m[x,y]$ | $f[x,y] \cdot m[x,y]$

Ảnh gốc **Kết quả phân đoạn**

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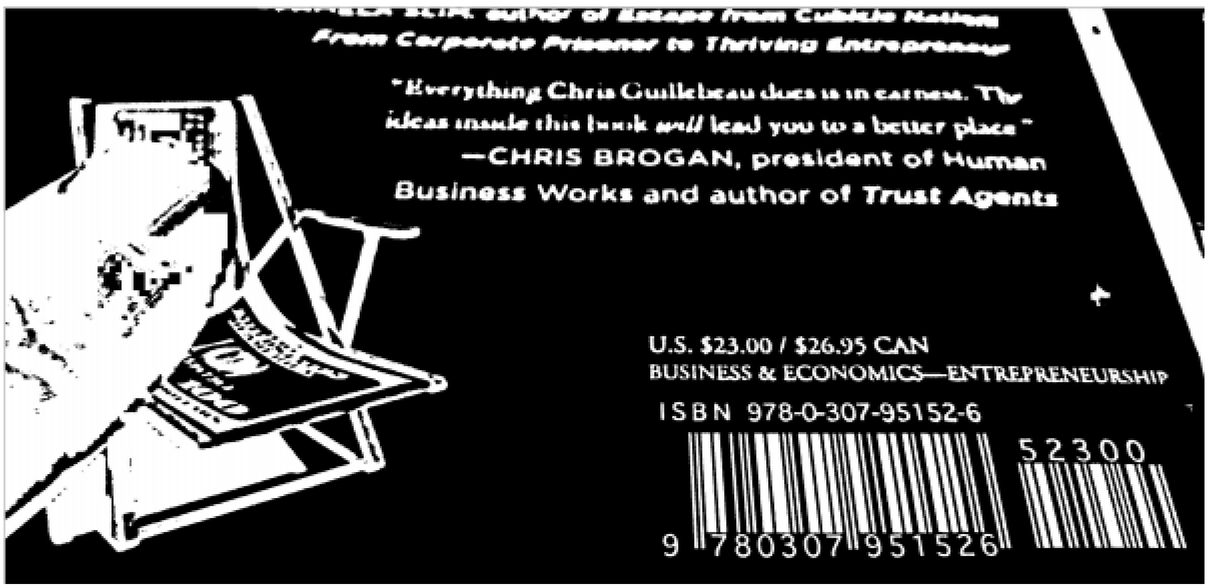
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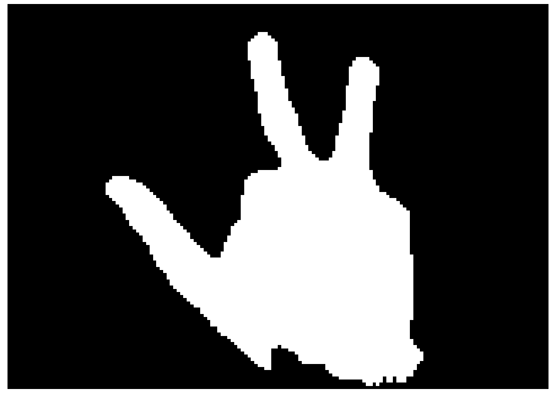
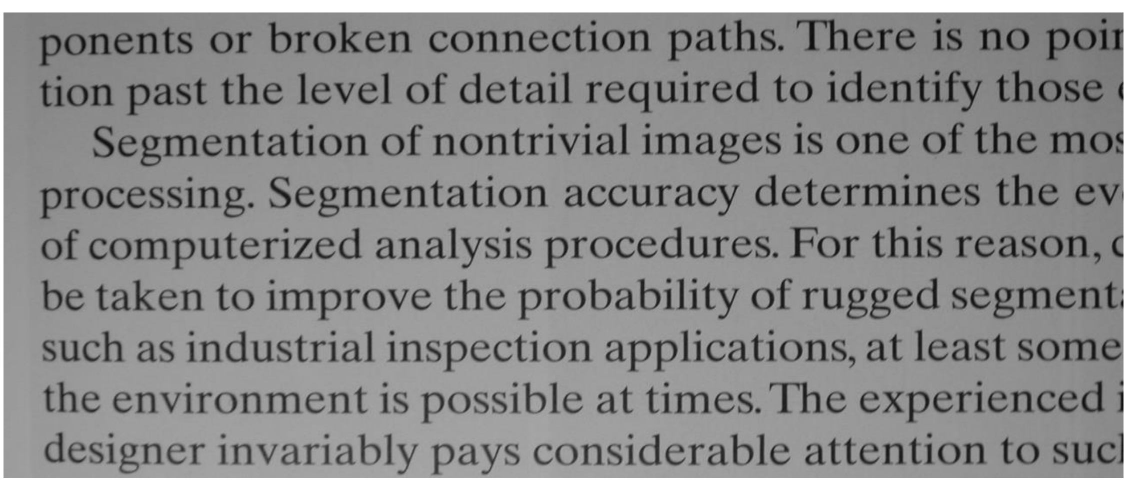



ponents or broken connection paths. There is no poir
tion past the level of detail required to identify those c
Segmentation of nontrivial images is one of the mos
processing. Segmentation accuracy determines the ev
of computerized analysis procedures. For this reason, c
be taken to improve the probability of rugged segment
such as industrial inspection applications, at least some
the environment is possible at times. The experienced i
designer invariably pays considerable attention to such

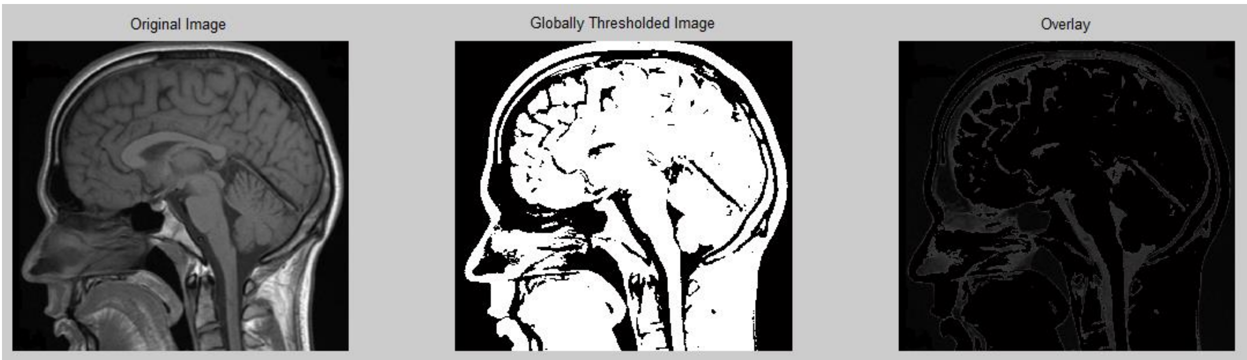
III. Automatic Thresholding Algorithm - Otsu:

```
% Load test image
img = imread('brain.jpg');

% Perform Otsu thresholding
level = graythresh(img); % chooses Otsu threshold
% otsuThresh = round(level * 255)
bwImg = im2bw(img, level);

% Show images
subplot(1, 3, 1), imshow(img); title('Original Image');
subplot(1, 3, 2), imshow(bwImg); title('Globally Thresholded Image');
subplot(1, 3, 3),imshow((1-bwImg) .* im2double(img));title('Overlay');

% Save images
imwrite(bwImg, 'Global_Thresholding_bw.png');
saveas(gcf, 'Global_Thresholding_hist.png')
```



- **Thuật toán:**

Thuật toán sau được sử dụng để chọn ngưỡng, T tự động:

1. Select an initial estimate for T. A possible initial value is the midpoint between the minimum and maximun intensity values in the image.
2. Segment the image using T. This will produce two groups of pixels:
   - G1 consisting of all pixels with intensity values > T
   - G2, consisting of pixels with values < T.
3. Compute the average intensity values x1 and x2 for the pixels in regions G1 and G2.
4. Compute a new threshod value: T=1/2(x1+x2)
5. Repeat steps 2 through 4 until the difference in T in successive iterations is smaller than a predifined parameter T0.

Hiện thực hàm **gray_thresh** như sau:

```
T=0.5*(double(min(f(:)))+double(max(f(:))));
done = false;
while ~done
  g = f >= T;
  Tnext = 0.5*(mean(f(g))+mean(f(~g)));
  done = abs (T-Tnext) < 0.5;
  T = Tnext;
end
```

Exercise: So sánh kết quả của hàm gray_thresh và **graythresh thực hiện trên các ảnh của phần I.**

II. HOLE FILLING AS DUAL TO SMALL REGION REMOVAL

```
% Load test image
img = imread('peter.png');

% Binarize image
level = 105;
bwImg = img < level;
filledBwImg = imfill(bwImg, 'holes');

% Show images
subplot(1, 2, 1), imshow(bwImg); title('Original Binary Image');
subplot(1, 2, 2), imshow(filledBwImg); title('Filled Binary Image');

% Save images
imwrite(bwImg, 'Hole_Filling_bw.png');
imwrite(filledBwImg, 'Hole_Filling_filled.png');
```

Exercise: **Áp dụng hàm `imfill` cho các ảnh nhị phân có được ở phần I, II trên.**