Question 1 (Section 4)

When adding 128 to the image, we can observe an increase in brightness (as shown in Figure 1), and some details of the image become invisible. Conversely, the image shows a decrease in brightness when subtracting 128 from the image (as shown in Figure 2). The reason is that the pixel value determines the brightness of the grayscale image, and adding or subtracting values may cause it to exceed the range of 0 to 255 and thus be displayed as pure black or pure white points, thereby losing details.
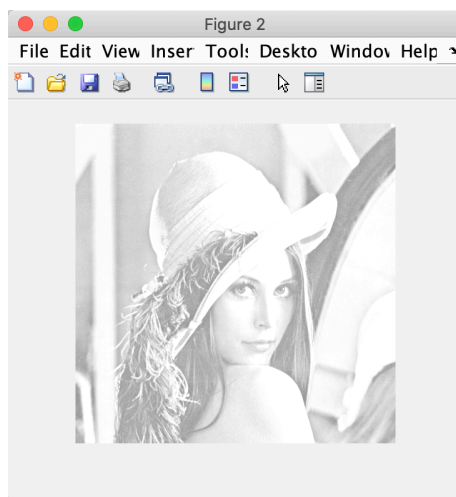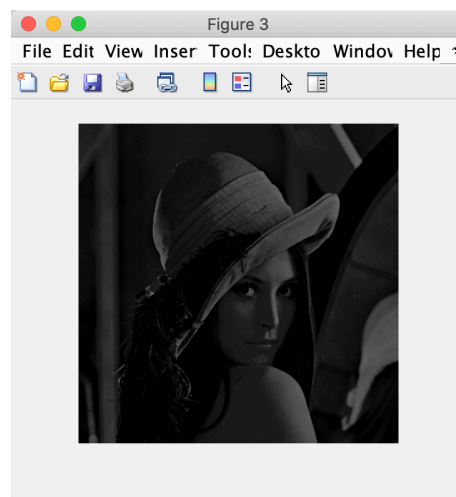

Figure 1: Output imaged added by 128   Figure 2: Output imaged subtracted by 128

Question 2 (Section 5)

Read image and type '*size(pic)*', the output is '*576   720   3*'. This shows that there are 300 pixels in the vertical direction, 200 pixels in the horizontal direction and R, G, B channels in total. (see Figure 3 and Figure 4 below)
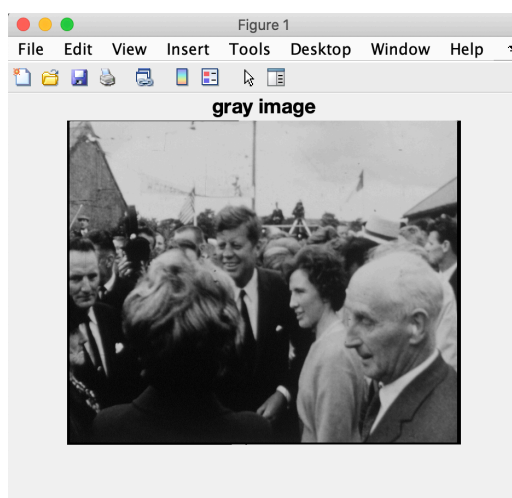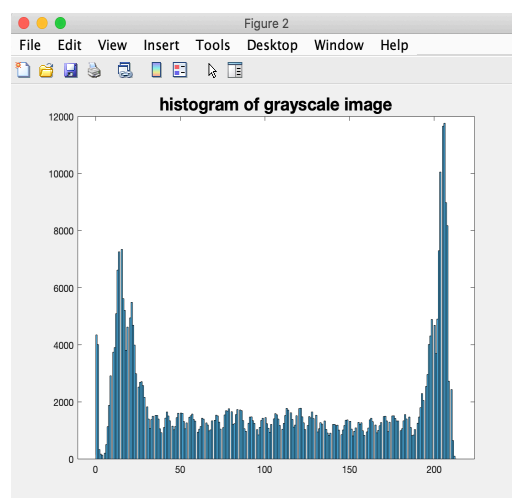

Figure 3: Grayscale image   Figure 4: Histogram of the image

Question 3 (Section 5.1)

Figure 3 shows the original RGB image. It is obvious that the green table area takes up most of the picture, so the green component is concentrated in the range of 150 to 200, while the pixel values of most of the red and green components are less than 100. The histograms of three component is also shown in Figure 5, and the code is shown as follows in Table 1.
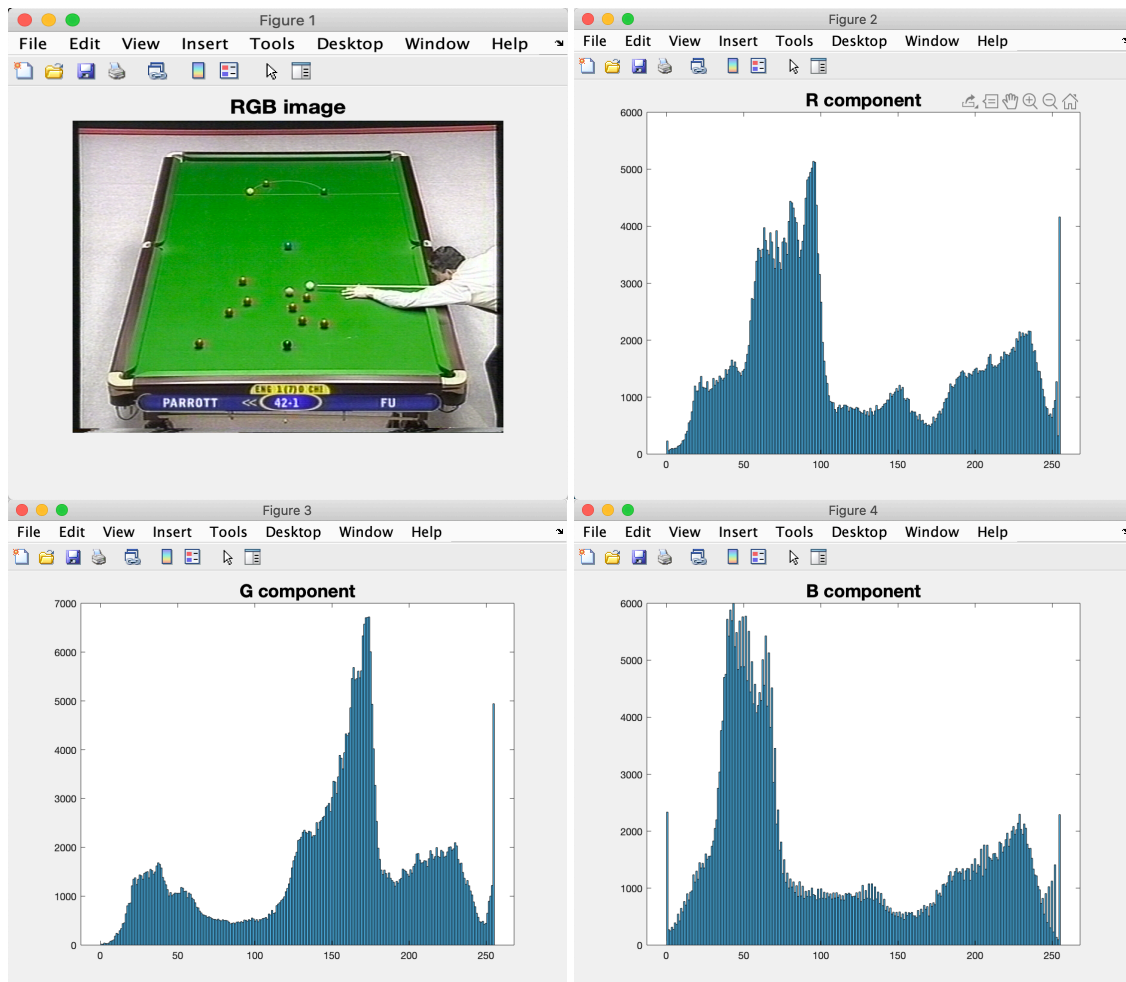

Figure 5: RGB image and three histograms of the R, G, B components

```
name = 'pool.01.bmp';
pic = imread(name);
figure(1)
imshow(pic);
title('RGB image', 'FontSize', 18)

gray = rgb2gray(pic);
[vres,hres]=size(gray);
disp(vres);
disp(hres);
% the output is 576 and 720

figure(2)
histogram(pic(:, :, 1), 256)
title('R component', 'FontSize', 18)

figure(3)
histogram(pic(:, :, 2), 256)
title('G component', 'FontSize', 18)

figure(4)
histogram(pic(:, :, 3), 256)
title('B component', 'FontSize', 18)
```

Table 1: Code of Question 3

Question 4 (Section 6)

By applying threshold 65 and 255 to the nuclei image (Figure 6), the result is shown in Figure 7, and the code is shown as follows in Table 2.
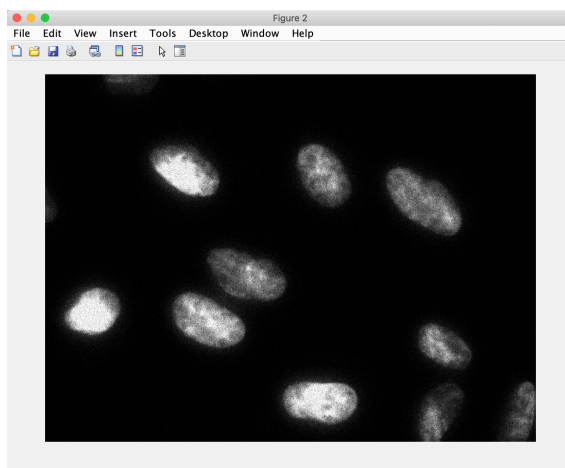

Figure 6: Grayscale nuclei image

Figure 7: Segmentation result

```
f = 'nuclei.02.png';
pic = imread(f);
% set the threshold
mask = (pic >= 65 & pic <= 255);
figure(1)
imshow(mask)
figure(2)
imshow(pic)
```

Table 2: Code of Question 4

Question 5 (Section 6)

The threshold values used in this segmentation task are 50 and 140 for red channel, 40 and 180 for green channel, 30 and 150 for blue channel. Compared with performing the segmentation only on the green channel, non-table areas have better segmentation performance (Figure 8 & Figure 9), but some brown table borders are not recognized. This is because the table area consists of not only green pixels, but also red and blue components. The introduction of three channel segmentation can improve the segmentation results. This method is not suitable for the gray-scale image.
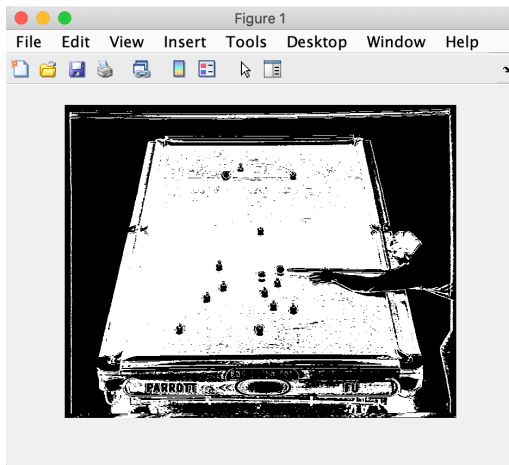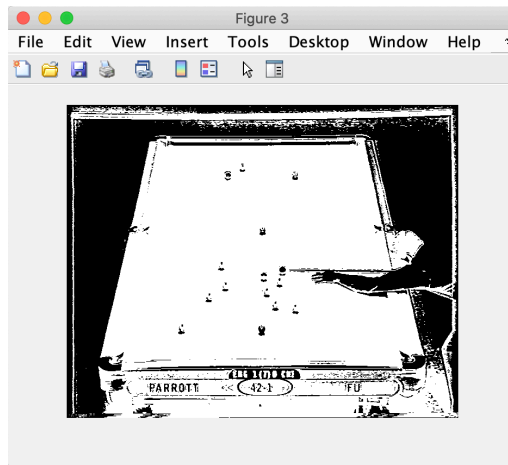

Figure 8: RGB Segmentation result   Figure 9: Green channel segmentation result

```matlab
name = 'pool.01.bmp';
pic = imread(name);
r = pic(:, :, 1);
g = pic(:, :, 2);
b = pic(:, :, 3);
% pic = b;
mask = (r >= 50 & r <= 140 & g >= 40 & g <= 180 &
b >= 30 & b <= 150);
figure(1)
imshow(mask)
figure(2)
imshow(pic)
figure(3)
imshow((r >= 40 & r <= 180))
```

Table 3: Code of Question 5