Contents

Question 4. Part A

```
clear all;
close all;

road1 = imread('hw1_data/hw1_dark_road_1.jpg');
road2 = imread('hw1_data/hw1_dark_road_2.jpg');
road3 = imread('hw1_data/hw1_dark_road_3.jpg');

figure;
subplot(3,1,1); imhist(road1);
title('Hisograms of original images');
subplot(3,1,2); imhist(road2);
subplot(3,1,3); imhist(road3);

% We can see that for road_1 there is a large peak around grayscale level 5
% and then a second smaller peak around the grayscale level 10. This second
% peak is due to the dark gray (but not quite black) pixels near the bottom
% of the image. This is probably due to the lights of the car illuminating
% the road. After these two peaks there is a drop in the histogram.

% For road_2, there is a single peak around the grayscale level 5 and then
% a gradual decrease.

% For road_3, there is a very large peak near the very bottom of the
% grayscale levels. This is due to the fact that almost the entire image is
% black. It has the fewest bright spots of the three images.
```
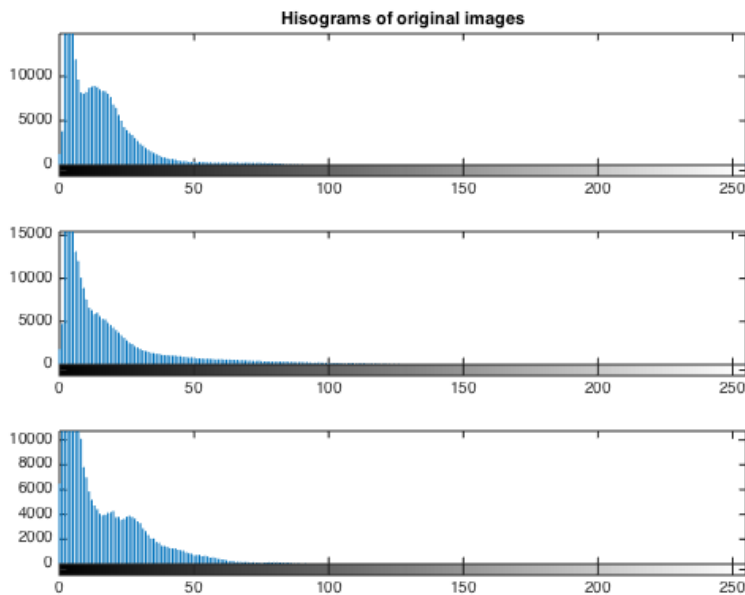

Question 4. Part B

```
road1_ghist = histeq(road1);
road2_ghist = histeq(road2);
road3_ghist = histeq(road3);

% figure;
% subplot(3,2,1); imshow(road1); title('Original Image');
% subplot(3,2,3); imshow(road2);
% subplot(3,2,5); imshow(road3);
% subplot(3,2,2); imshow(road1_ghist); title('With global histogram equalization');
% subplot(3,2,4); imshow(road2_ghist);
```

```
% subplot(3,2,6); imshow(road3_ghist);
figure; imshow(road1_ghist); title('With global histogram equalization');
figure; imshow(road2_ghist); title('With global histogram equalization');
figure; imshow(road3_ghist); title('With global histogram equalization');

figure;
subplot(3,1,1); imhist(road1_ghist);
title('Histograms with global histogram equalization');
subplot(3,1,2); imhist(road2_ghist);
subplot(3,1,3); imhist(road3_ghist);


% We can see that with equalization a lot of detail becomes visible. For
% example, in road_1 we can see the trees and the houses in front of the
% car. In road_2 we can see the edges of the house better, as well as the
% sign towards the left side of the image. In road_3 we can clearly see the
% building on the left as well as the building on the right. Both of these
% buildings were very hard to make out in the original image.

% However, we see a lot of patches showing up in the image equalized
% images. This is due to the fact that in histogram equalization, bins
% cannot be "split". That is, the number of non-zero bins cannot increase,
% and therefore there will be jumps between different grayscale values, not
% a gradual transition like we would expect.
```
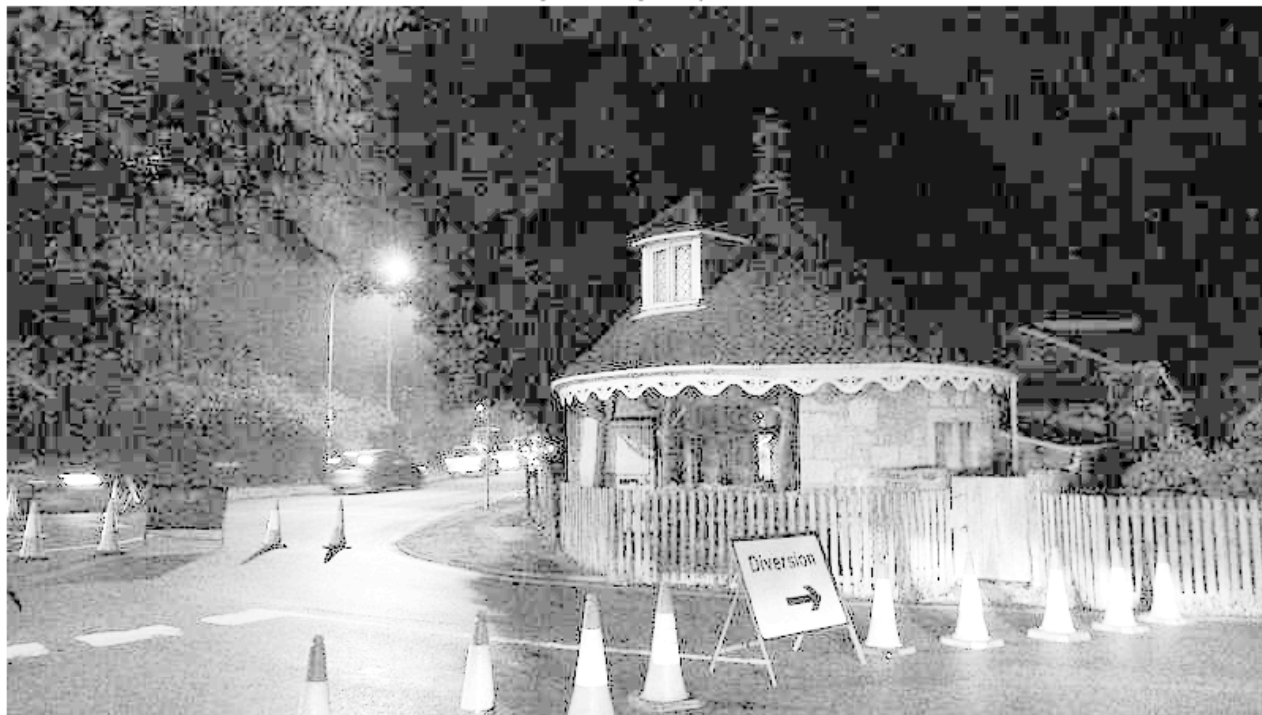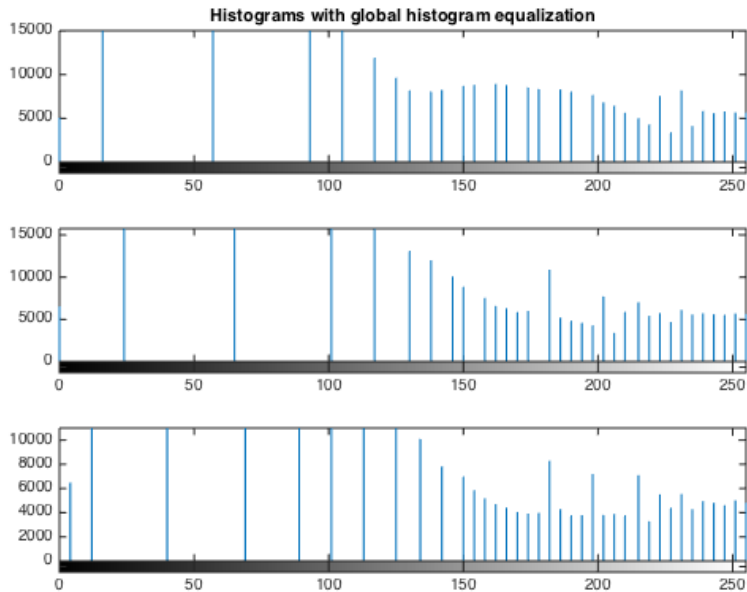

With global histogram equalization

With global histogram equalization

With global histogram equalization

Histograms with global histogram equalization

Question 4. Part C

```
road1_tiles = 16; road1_lim = 0.02;
road2_tiles = 16; road2_lim = 0.02;
road3_tiles = 16; road3_lim = 0.015;


road1_ahist = adapthisteq(road1, 'NumTiles', [road1_tiles, road1_tiles], 'ClipLimit', road1_lim);
road2_ahist = adapthisteq(road2, 'NumTiles', [road2_tiles, road2_tiles], 'ClipLimit', road2_lim);
road3_ahist = adapthisteq(road3, 'NumTiles', [road3_tiles, road3_tiles], 'ClipLimit', road3_lim);

display(['For Road_1: tiles = ' num2str(road1_tiles) 'x' num2str(road1_tiles) ' , Clipping limit = ' num2str(road1_lim) ]);
display(['For Road_2: tiles = ' num2str(road2_tiles) 'x' num2str(road2_tiles) ' , Clipping limit = ' num2str(road2_lim) ]);
display(['For Road_3: tiles = ' num2str(road3_tiles) 'x' num2str(road3_tiles) ' , Clipping limit = ' num2str(road3_lim) ]);

% figure;
% subplot(3,2,1); imshow(road1_ahist); title('With adaptive equalization');
% subplot(3,2,3); imshow(road2_ahist);
% subplot(3,2,5); imshow(road3_ahist);
% subplot(3,2,2); imshow(road1_ghist); title('With global equalization');
% subplot(3,2,4); imshow(road2_ghist);
% subplot(3,2,6); imshow(road3_ghist);

figure; imshow(road1_ahist); title('With adaptive histogram equalization');
figure; imshow(road2_ahist); title('With adaptive histogram equalization');
figure; imshow(road3_ahist); title('With adaptive histogram equalization');

figure;
subplot(3,1,1); imhist(road1_ahist);
title('Histograms with adaptive histogram equalization');
subplot(3,1,2); imhist(road2_ahist);
subplot(3,1,3); imhist(road3_ahist);


% We can see that when we apply adaptive histogram equalization as opposed
% to global histogram equalization we are able to pull out detail from the
% images without adding noise and "patchiness" to the image. We can still
% see the trees and the house in road_1, the edges of the roof and the road
% sign in road_2, and the buildings on the left and right in road_3.
```

```
For Road_1: tiles = 16x16 , Clipping limit = 0.02
For Road_2: tiles = 16x16 , Clipping limit = 0.02
For Road_3: tiles = 16x16 , Clipping limit = 0.015
```
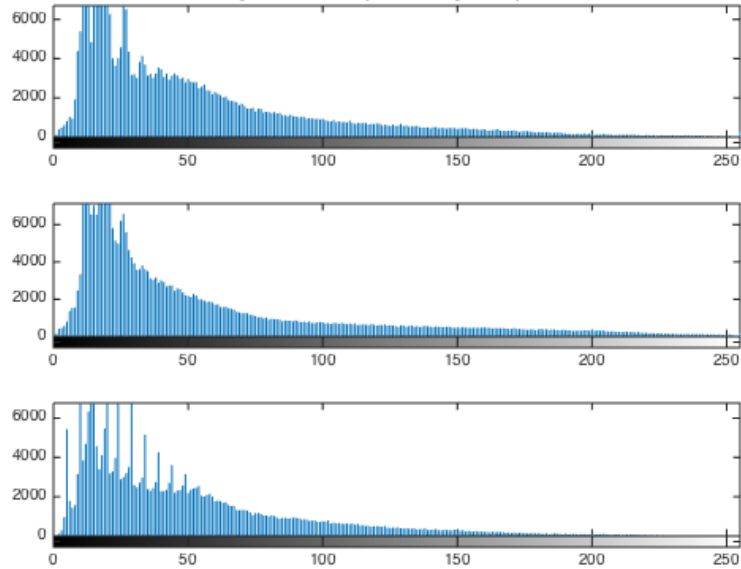
With adaptive histogram equalization

With adaptive histogram equalization

With adaptive histogram equalization

Histograms with adaptive histogram equalization