

Lab 4

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1 Histogram of an Image



Figure 1. race.tif

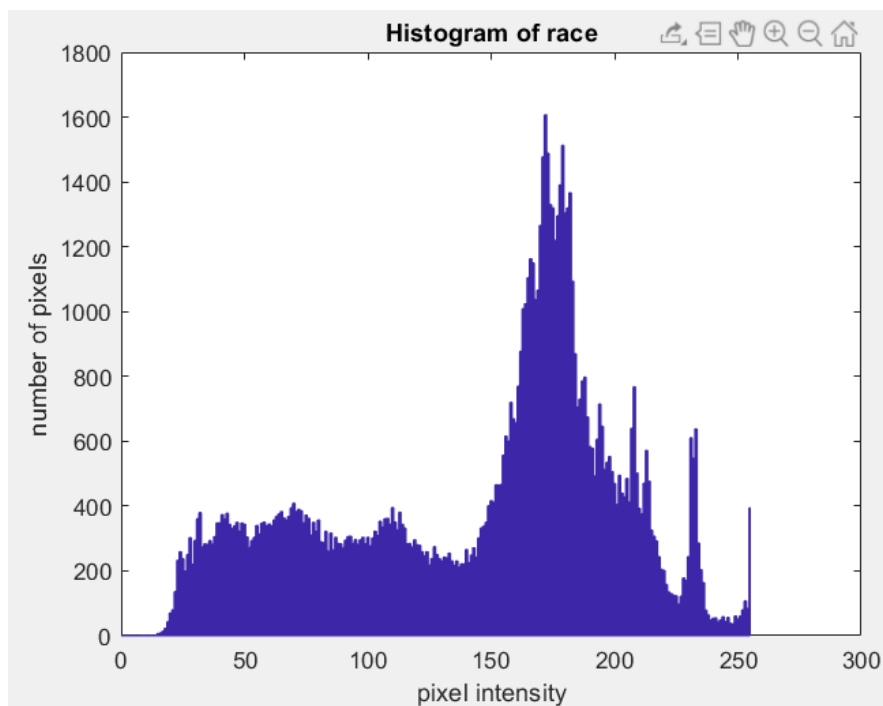
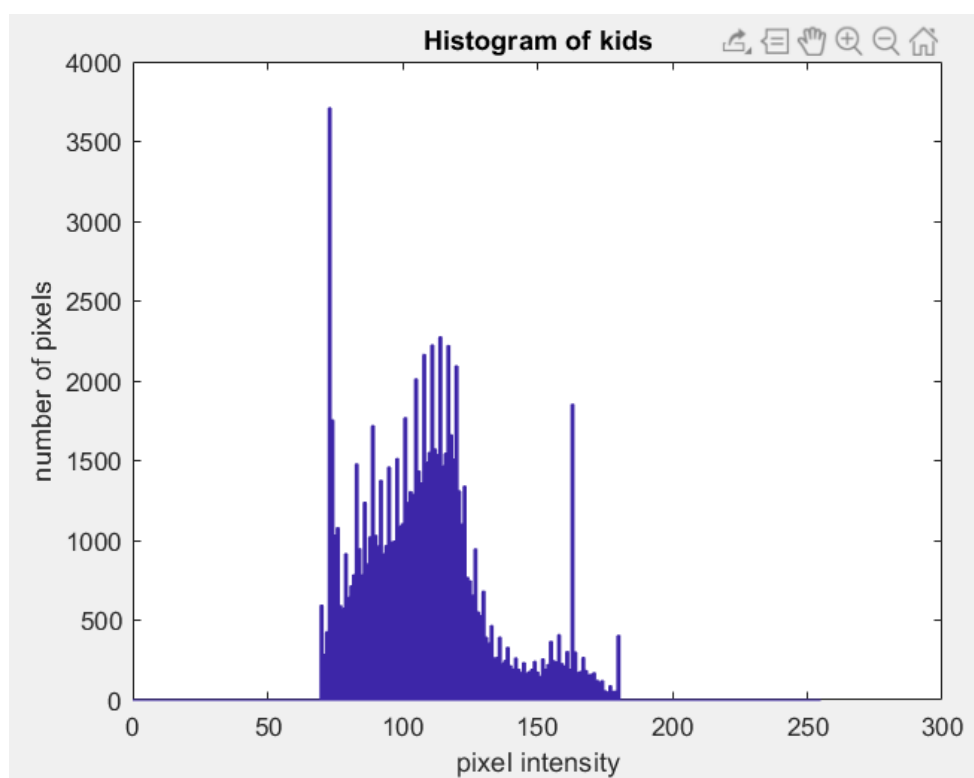


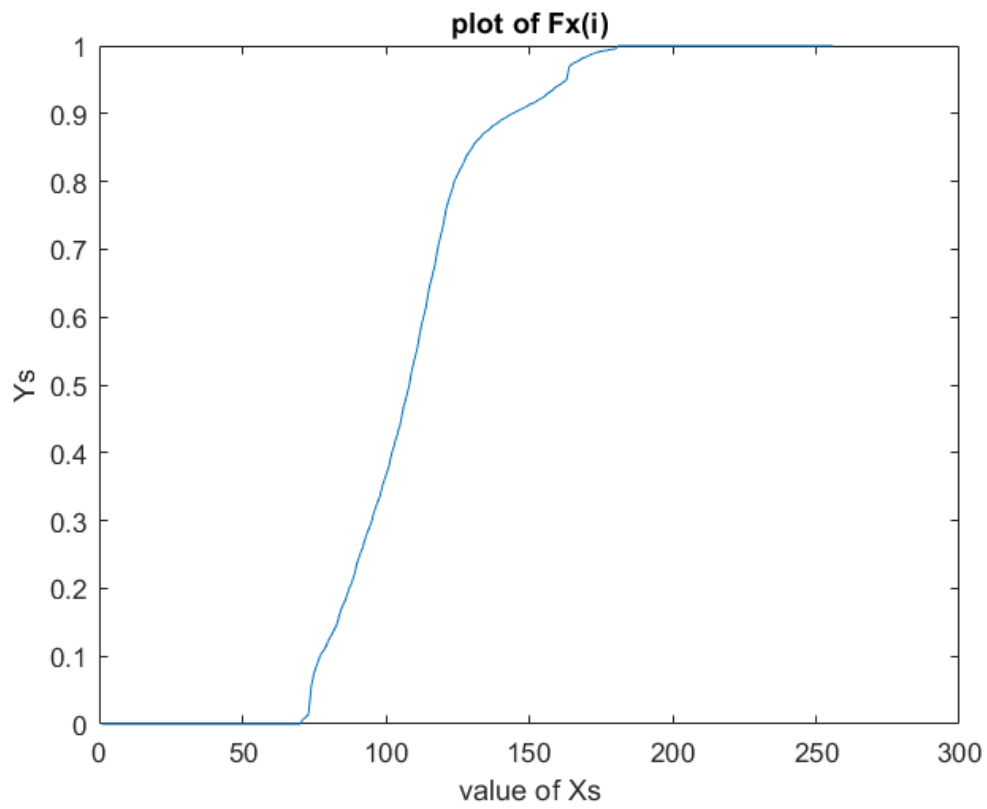


Figure 2. kids.tif

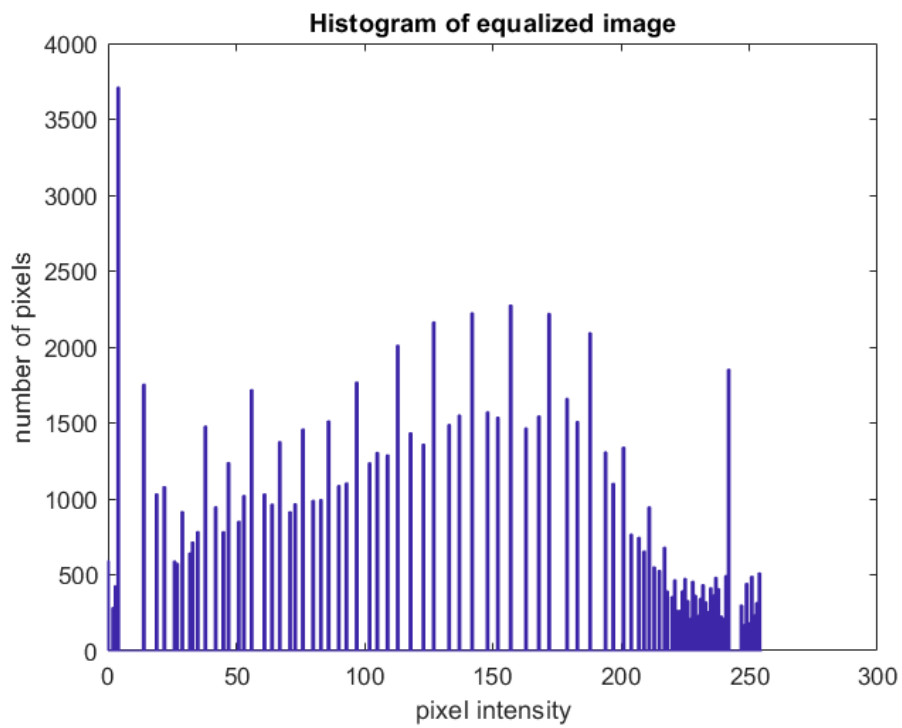


2 Histogram Equalization

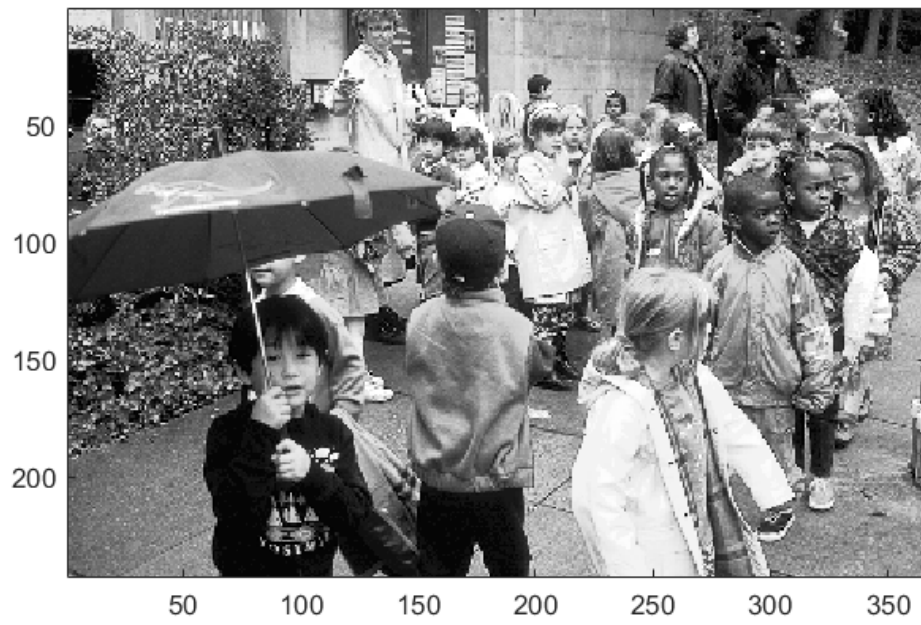
2.



3.

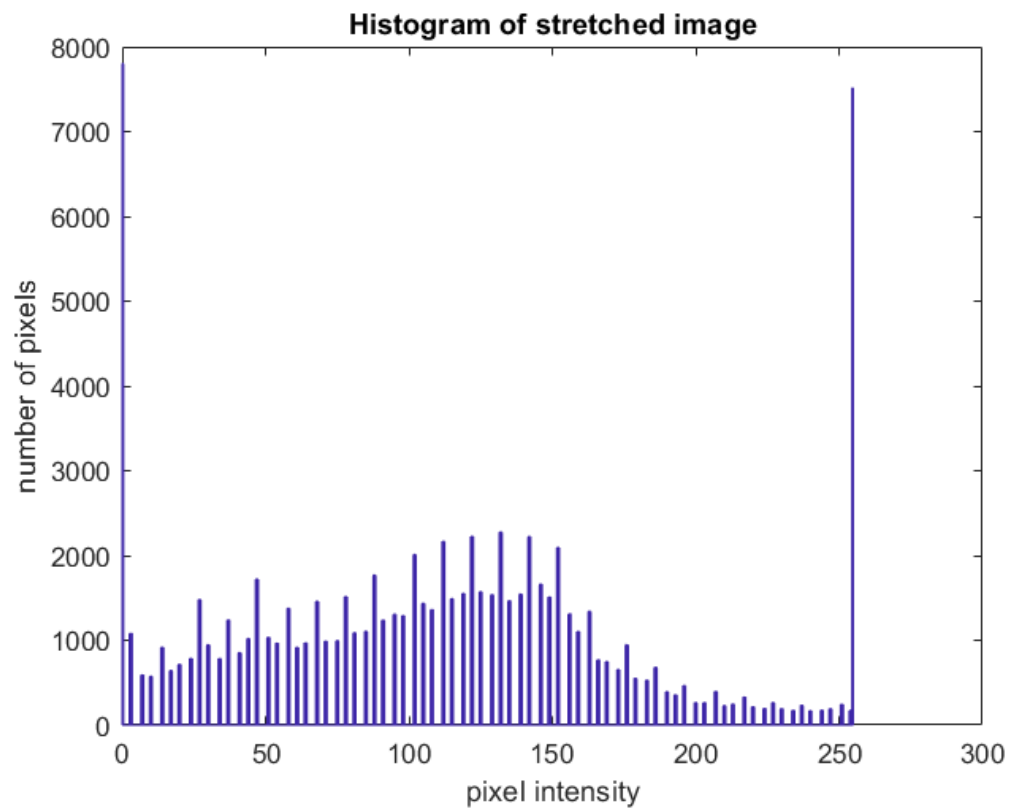
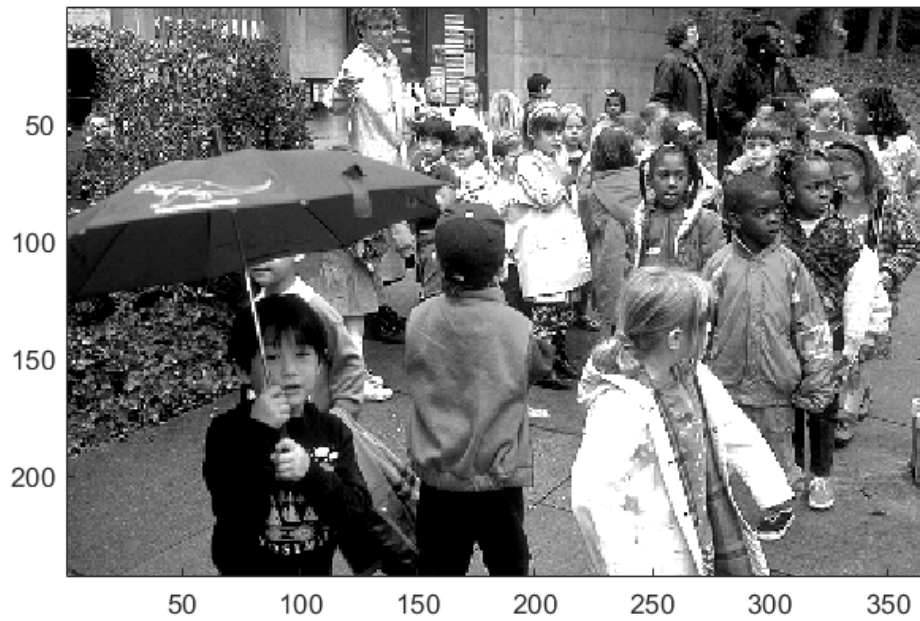


4.



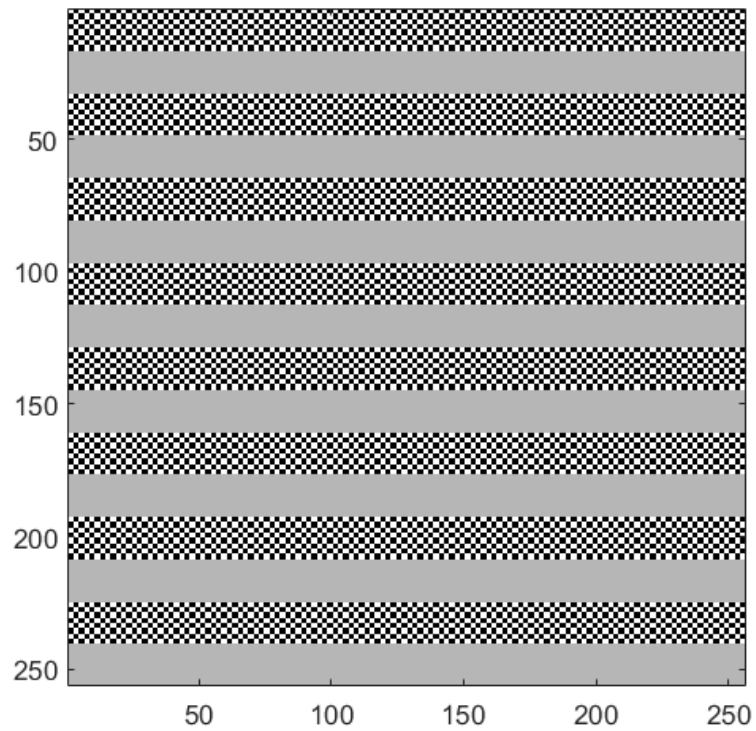
3 Contrast Stretching

2.



4.2 Determining the Gamma of Your Computer Monitor

1.



2 & 3.

$$\begin{aligned}
 4.2 \quad I_0 &= (I_{255} + 0)/2, \quad I_g = I_{255} (g/255)^r \\
 I_{255}/2 &= I_{255} (g/255)^r = \frac{1}{2} \\
 \log_{g/255} (1/2) &= r \\
 g &= 183 \quad \therefore \underline{r = 2.09}
 \end{aligned}$$

4.3 Gamma Correction

1. $\gamma = 2.09$



Figure 3. original image



Figure 4. corrected image

2.

$$\text{Corrected image} = 255 * (\text{Original Image} / 255)^{(1/\gamma)}$$

4.3 Gamma Correction

1.

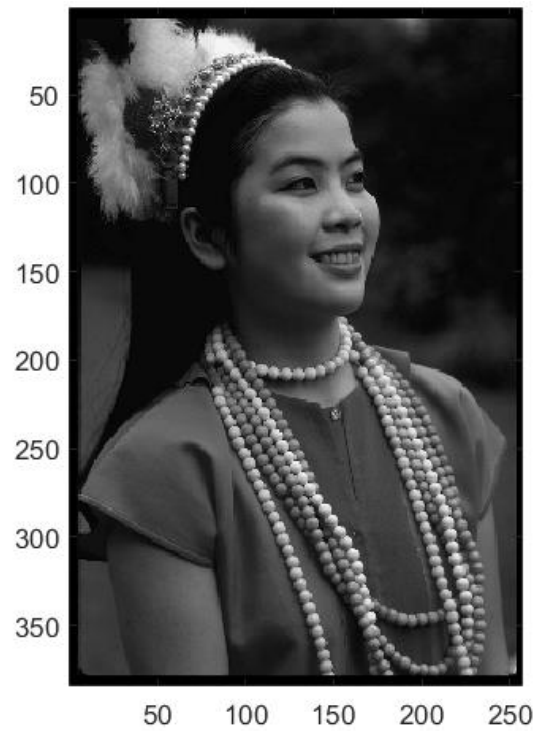


Figure 5. corrected image of gamma15.tif

2.

4.3

$$\text{gamma15} = 255 \left(\frac{I}{255} \right)^{1/1.5} \Rightarrow \frac{I}{255} = \sqrt[1.5]{\frac{\text{gamma15}}{255}}$$

$$C.I = 255 \left(\frac{I}{255} \right)^{1/\gamma}$$

$$C.I = \frac{255 \left(\sqrt[1.5]{\frac{\text{gamma15}}{255}} \right)^{1/\gamma}}{\left(\frac{I}{255} \right)^{1/\gamma}}$$

$$= 255 \left(\frac{\text{gamma15}}{255} \right)^{1.5/\gamma}$$

$\gamma = 2.09$


```
clear all
```

```
%% 1 Histogram of an Image
```

```
race = imread('./race.tif');  
figure(1)  
hist(race(:), [0:255]);  
xlabel('pixel intensity')  
ylabel('number of pixels')  
title('Histogram of race')
```

```
kids = imread('./kids.tif');  
figure(2)  
hist(kids(:), [0:255]);  
xlabel('pixel intensity')  
ylabel('number of pixels')  
title('Histogram of kids')
```

```
%% 2 Histogram Equalization
```

```
kids = imread('./kids.tif');
```

```
Y = equalize(kids);
```

```
figure  
image(Y+1);  
axis('image');  
graymap = [0:255; 0:255; 0:255]' / 255;  
colormap(graymap);
```

```
figure  
hist(Y(:), [0:255]);  
xlabel('pixel intensity')  
ylabel('number of pixels')  
title('Histogram of equalized image')
```

```
%% 3 Contrast Stretching
```

```
kids = imread('./kids.tif');
```

```
output = stretch(kids, 75, 150);
```

```
figure  
image(output);  
axis('image');  
graymap = [0:255; 0:255; 0:255]' / 255;  
colormap(graymap);
```

```
figure
hist(output(:), [0:255]);
xlabel('pixel intensity')
ylabel('number of pixels')
title('Histogram of stretched image')
```

```
%% 4.2
```

```
Y = Checkerboard(183);
```

```
figure
image(Y);
axis('image');
graymap = [0:255; 0:255; 0:255]'/255;
colormap(graymap);
%}
```

```
%% 4.3
```

```
linear = imread('./linear.tif');
linear = double(linear);
```

```
gamma = 2.09
c_image = 255 .* (linear/255).^(1/gamma);
```

```
figure
image(c_image);
axis('image');
graymap = [0:255; 0:255; 0:255]'/255;
colormap(graymap);
```

```
gamma15 = imread('./gamma15.tif');
gamma15 = double(gamma15);
```

```
gamma = 2.09
c_image = 255 .* (gamma15./255).^(1.5/gamma);
```

```
figure
image(c_image);
axis('image');
graymap = [0:255; 0:255; 0:255]'/255;
colormap(graymap);
```

```
function Y = equalize(X)

L = 256;

IM = hist(X(:), [0:L-1]);

for i = 0:L-1
    Fx(i+1) = sum(IM(1:(i+1))) / sum(IM); % calculating Fx
end

plot(Fx)
xlabel('value of Xs')
ylabel('Ys')
title('plot of Fx(i)')

Ymax = max(Fx);
Ymin = min(Fx);

Y = (L-1) * (Fx(X)-Ymin) / (Ymax-Ymin);
Y = uint8(Y);

end
```

```
function output = stretch(input, T1, T2)

[r,c] = size(input);
output = zeros(r,c);
input = double(input);

for i = 1:r
    for j = 1:c
        if input(i,j) > T2
            output(i,j) = 255;
        elseif (T1 <= input(i,j)) && (input(i,j) <= T2)
            output(i,j) = (input(i,j)-T1) / (T2-T1) * 254;
        end
    end
end

output = uint8(output);

end
```

```
function Y = Checkerboard(x)

grey_stripe = zeros(16,256);

grey_stripe(:, :) = x;
cb_pattern = [255,255,0,0;255,255,0,0;0,0,255,255;0,0,255,255];
checkerboard = repmat(cb_pattern, 4, 64);
temp = [checkerboard;grey_stripe];
Y = repmat(temp,8, 1);

end
```