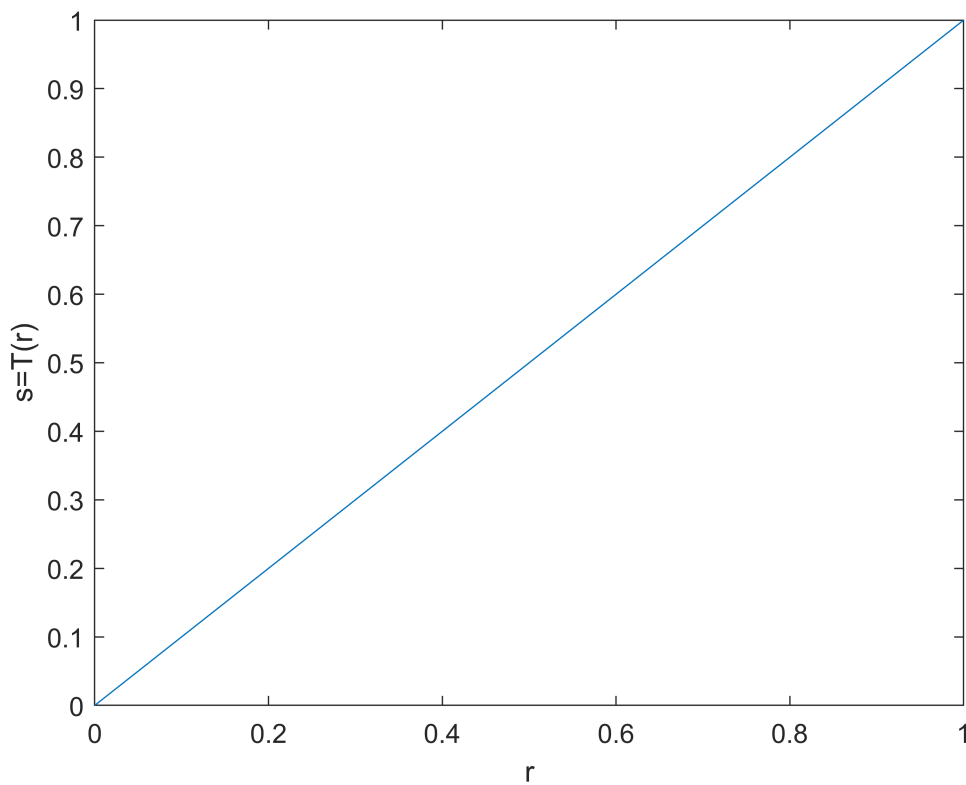


Přednáška 4

```
% g(x,y) = T[f(x,y)]  
%f ... vstupní obrázek  
%g ... výstupní obrázek  
% T - transformace barev  
% s = T(r)
```

```
figure,  
r = (0:255)/255;  
plot(r,r);  
xlabel('r');  
ylabel('s=T(r)');  
xlim([0,1]);
```

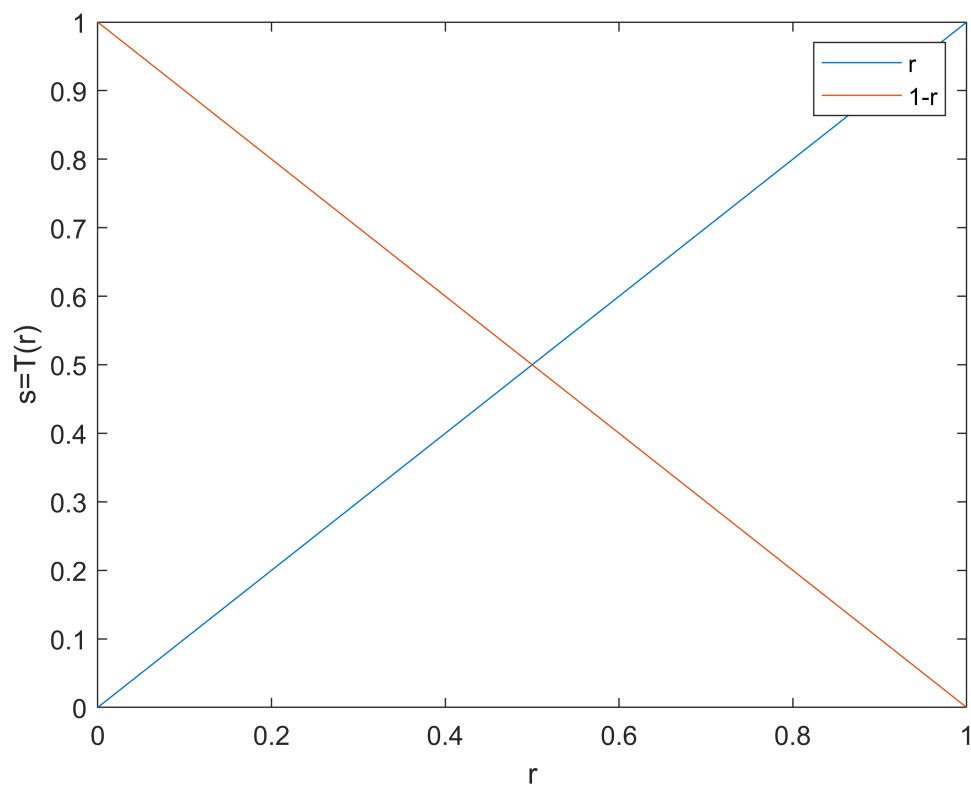


```
f = imread('pastelky_gray.png');
```

Negativ obrazku

```
figure,  
s5 = 1-r;  
plot(r,r);  
xlabel('r');  
ylabel('s=T(r)');  
xlim([0,1]);  
hold on;
```

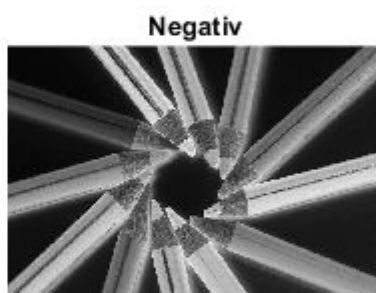
```
plot(r,s5);
legend('r','1-r','Location','northeast');
```



Aplikace negativu

```
map5 = createMap(s5);
```

```
figure
subplot(1,2,1)
imshow(f)
title('Original')
subplot(1,2,2)
imshow(f,map5)
title('Negativ')
```

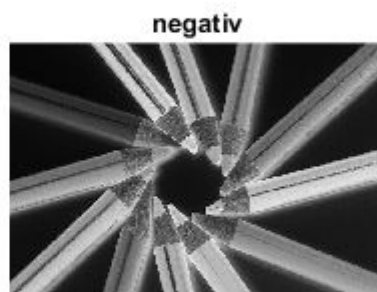


Aplikace na kazdy pixel

$neg = 255 - I$; `neg = imcomplement(I)`;

```
g1 = imcomplement(f);
```

```
figure
subplot(1,2,1)
imshow(f)
title('Original')
subplot(1,2,2)
imshow(g1)
title('negativ')
```

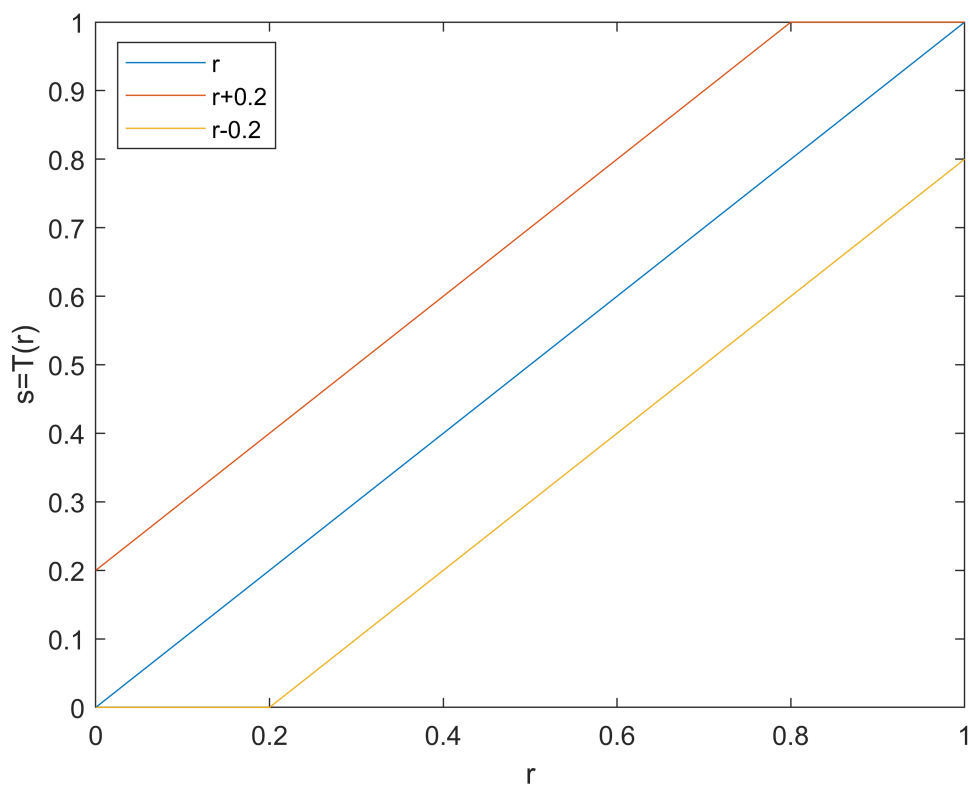


Změna jasu

```
k1= 0.2;
k2 = -0.2;

s1 = clipMap(r + k1,0,1);
s2 = clipMap(r + k2,0,1);

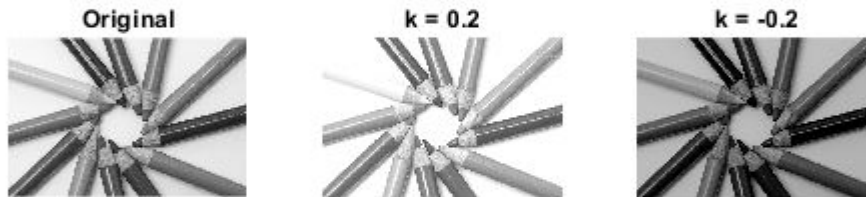
figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s1);
plot(r,s2);
legend('r', 'r+0.2', 'r-0.2', 'Location', 'northwest');
```



Aplikace zmeny jasu

```
map1 = createMap(s1);
map2 = createMap(s2);
```

```
figure
subplot(1,3,1)
imshow(f)
title('Original')
subplot(1,3,2)
imshow(f,map1)
title('k = 0.2')
subplot(1,3,3)
imshow(f,map2)
title('k = -0.2')
```



Gamma transformace

Gamma < 1

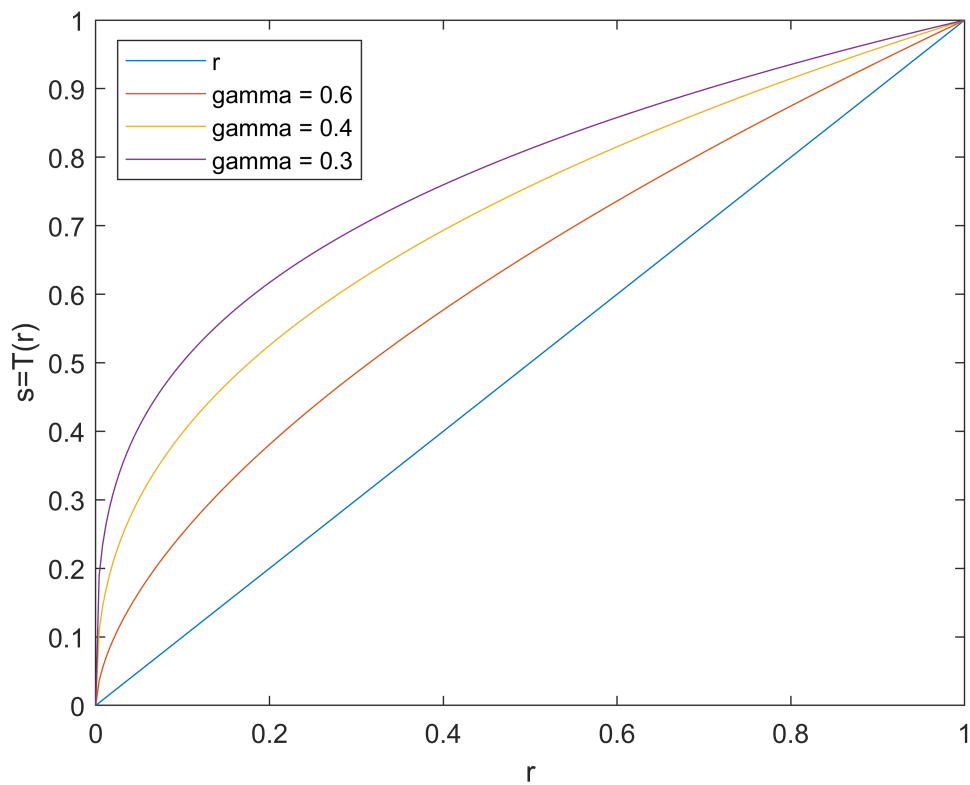
```
f=imread('prechod.png');
c=1;
Gamma=[0.6 0.4 0.3];

%x1=double(x);
% y=c*(x1.^Gamma(1));
% y1=c*(x1.^Gamma(2));
% y2=c*(x1.^Gamma(3));

% s=c*(r^ ?)

s7 = clipMap(c*(r.^Gamma(1)),0,1);
s8 = clipMap(c*(r.^Gamma(2)),0,1);
s9 = clipMap(c*(r.^Gamma(3)),0,1);

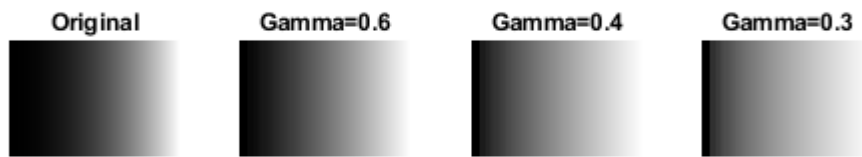
figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s7);
plot(r,s8);
plot(r,s9);
legend('r','gamma = 0.6','gamma = 0.4','gamma = 0.3','Location','northwest');
```



Aplikace na obrazek

```
map7 = createMap(s7);
map8 = createMap(s8);
map9 = createMap(s9);
```

```
figure
subplot(1,4,1)
imshow(f)
title('Original')
subplot(1,4,2)
imshow(f,map7)
title('Gamma=0.6')
subplot(1,4,3)
imshow(f,map8)
title('Gamma=0.4')
subplot(1,4,4)
imshow(f,map9)
title('Gamma=0.3')
```



Gamma > 1

```

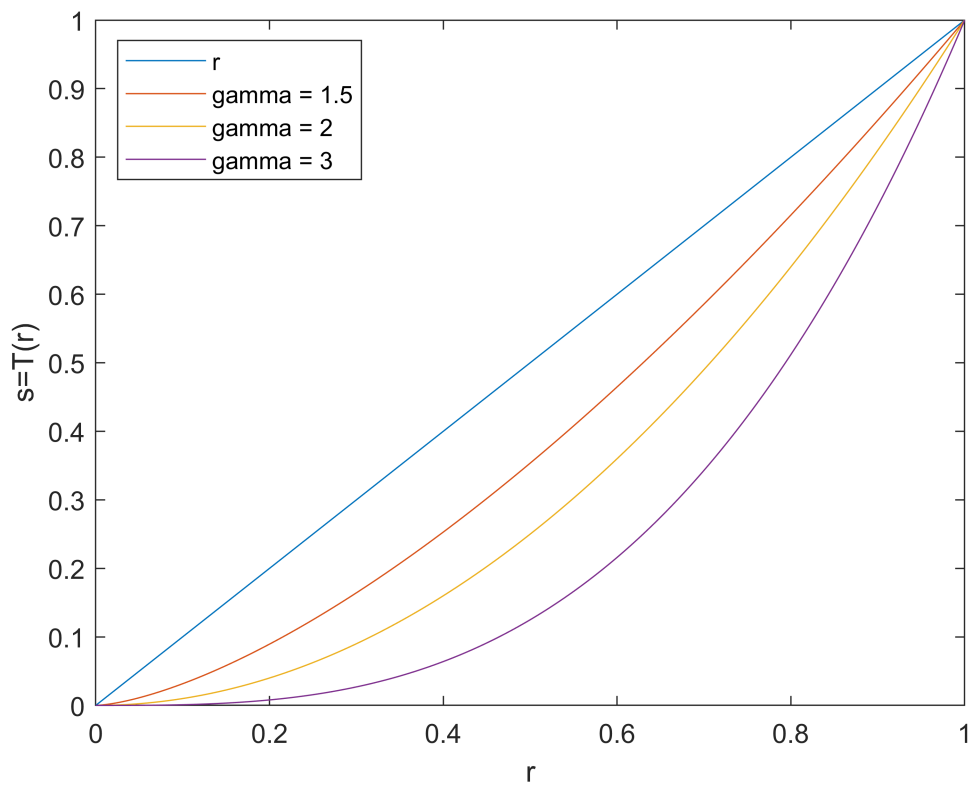
c=1;
Gamma=[1.5 2 3];

%x1=double(x);
% y=c*(x1.^Gamma(1));           % s=c*(r^ ?)
% y1=c*(x1.^Gamma(2));
% y2=c*(x1.^Gamma(3));

s10 = clipMap(c*(r.^Gamma(1)),0,1);
s11 = clipMap(c*(r.^Gamma(2)),0,1);
s12 = clipMap(c*(r.^Gamma(3)),0,1);

figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s10);
plot(r,s11);
plot(r,s12);
legend('r','gamma = 1.5','gamma = 2','gamma = 3','Location','northwest');

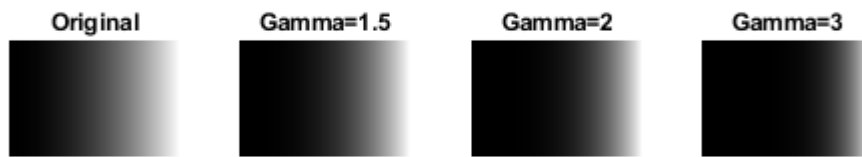
```

Aplikace na obrazek

```
map10 = createMap(s10);
map11 = createMap(s11);
map12 = createMap(s12);
```

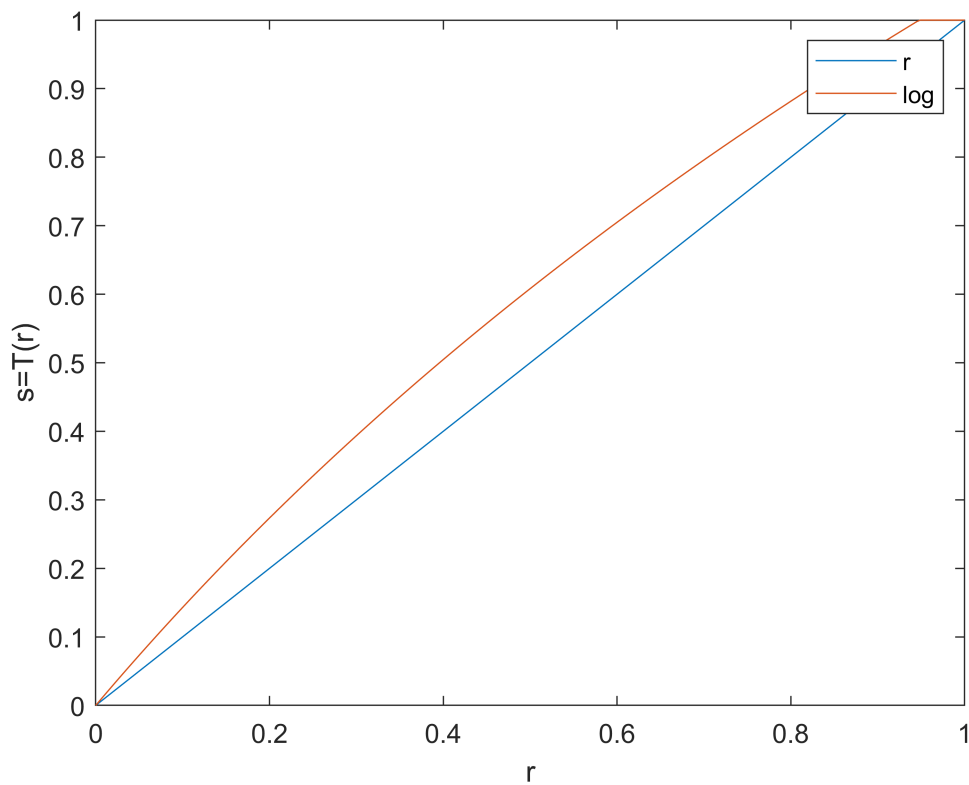
```
figure
subplot(1,4,1)
imshow(f)
title('Original')
subplot(1,4,2)
imshow(f,map10)
title('Gamma=1.5')
subplot(1,4,3)
imshow(f,map11)
title('Gamma=2')
subplot(1,4,4)
imshow(f,map12)
title('Gamma=3')
```



Logaritmicka transformace

```
c = 1.5;
s6 = clipMap(c*log(1+r),0,1);

figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s6);
legend('r','log','Location','northeast');
```

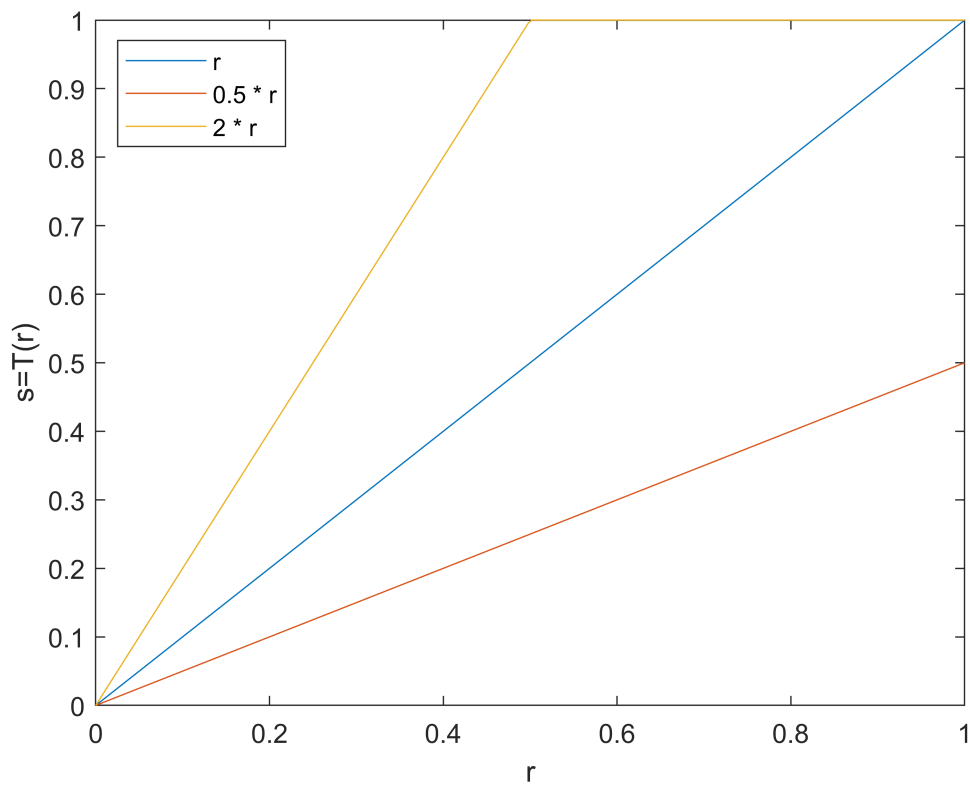


Změna kontrastu

```
f = imread('pastelky_gray.png');
c1 = 0.5;
c2 = 2;

s3 = clipMap(c1*r,0,1);
s4 = clipMap(c2*r,0,1);

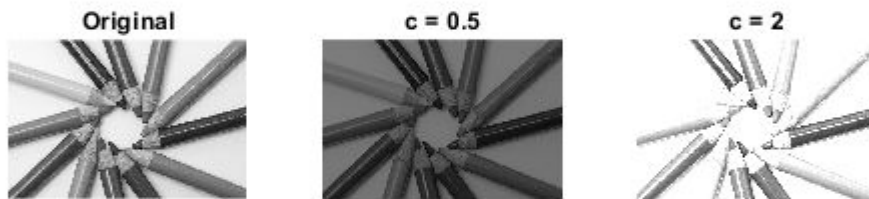
figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s3);
plot(r,s4);
legend('r','0.5 * r','2 * r','Location','northwest');
```



Aplikace zmeny kontrastu

```
map3 = createMap(s3);  
map4 = createMap(s4);
```

```
figure  
subplot(1,3,1)  
imshow(f)  
title('Original')  
subplot(1,3,2)  
imshow(f,map3)  
title('c = 0.5')  
subplot(1,3,3)  
imshow(f,map4)  
title('c = 2')
```



Roztazeni kontrastu

```
%imadjust
I = imread('pastelky_lc.png');
J = imadjust(I);

figure
subplot(1,2,1)
imshow(I);
title('Original')
subplot(1,2,2)
imshow(J);
title('imadjust')
```

Original

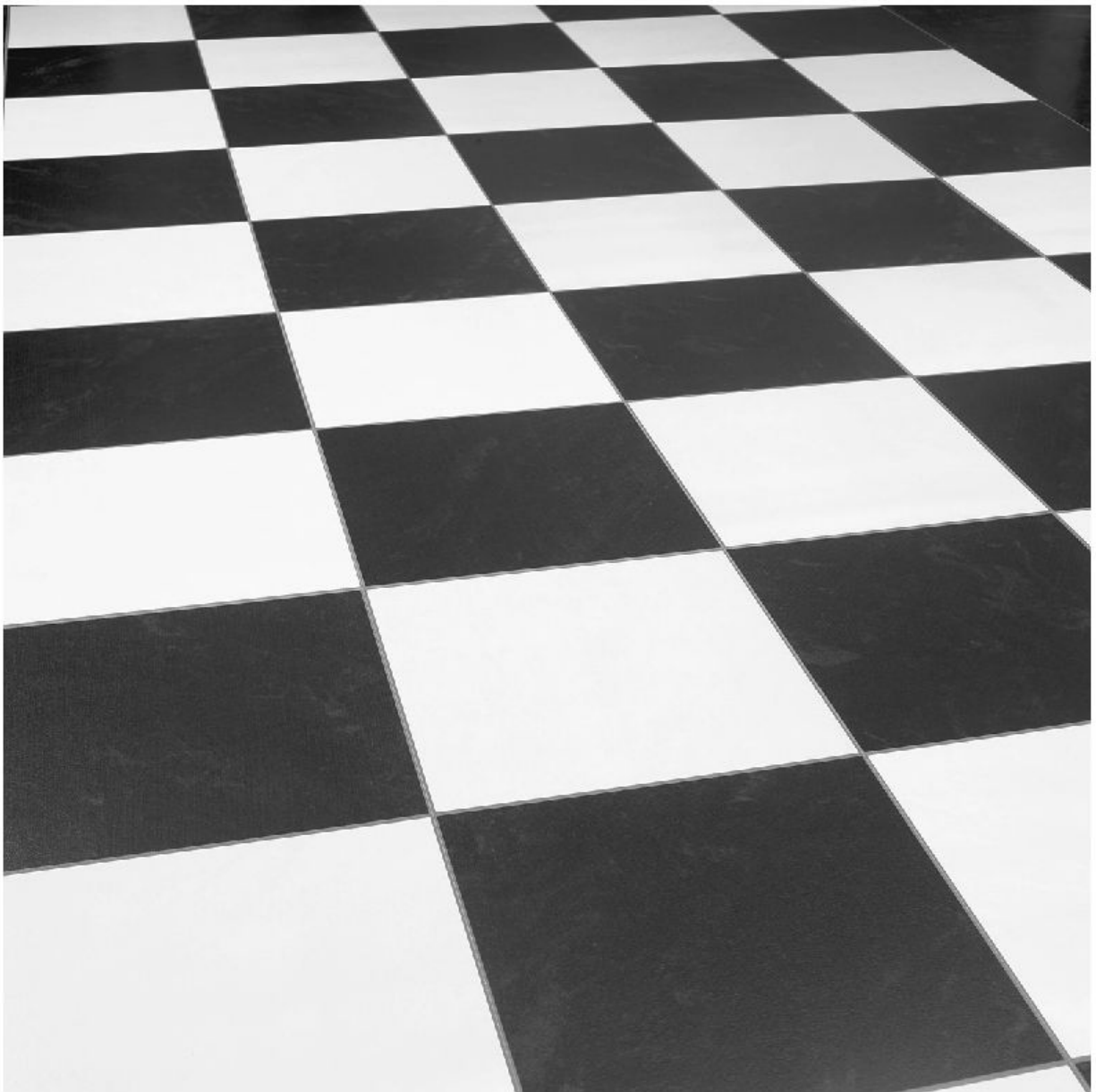


imadjust



Prahování

```
I = rgb2gray(imread('chess.jpg'));  
  
figure,  
imshow(I);
```



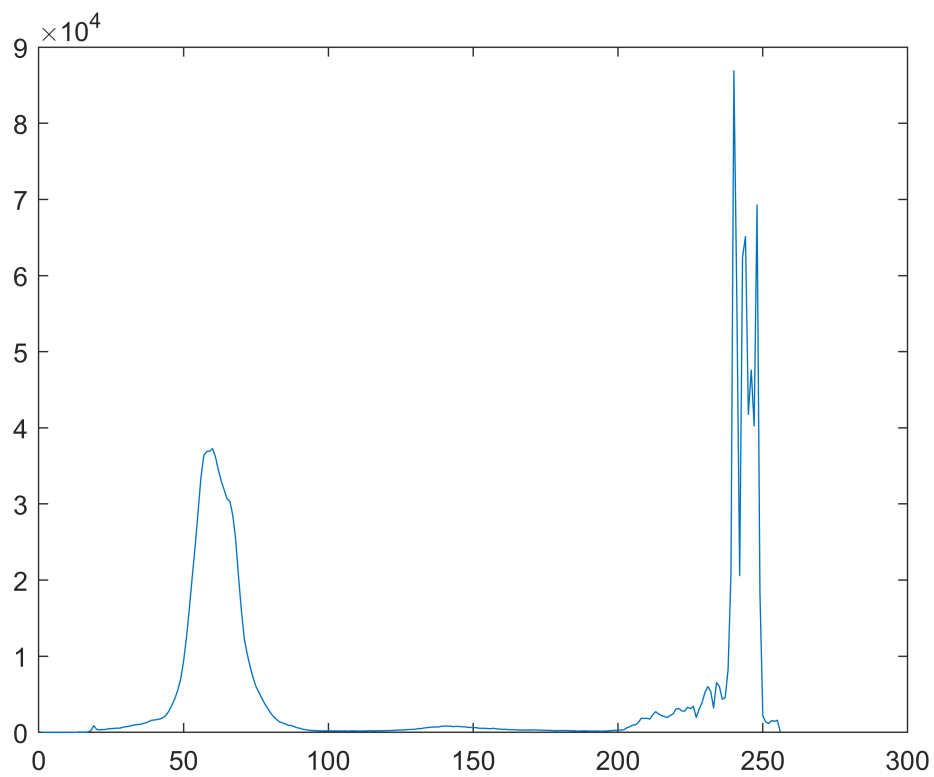
Experimentální výběr prahu

```
J = I>150;  
  
figure,  
subplot(1,2,1)  
imshow(I);  
subplot(1,2,2)  
imshow(J);
```



Prah na zaklade znalosti histogramu obrazku

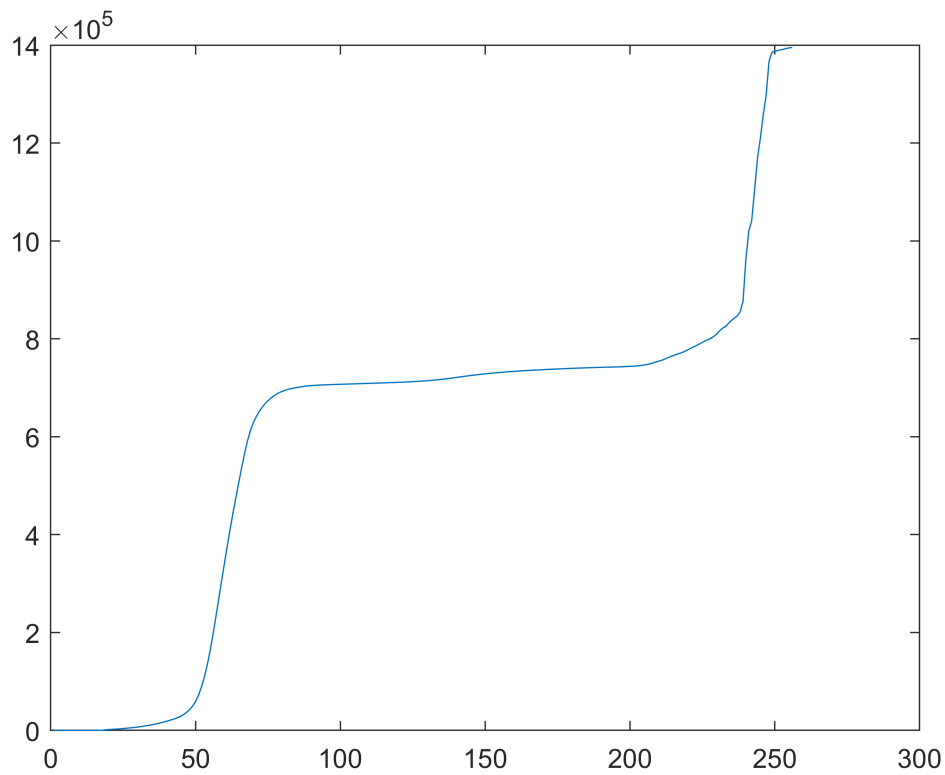
```
histogramI = imhist(I);  
  
figure,  
plot(histogramI);
```

Kumulativní histogram

```
[pocet,X] = imhist(I);  
cumh = cumsum(pocet);
```

```
figure,  
plot(cumh);
```



prah 50%

```
velikost = size(I,1) * size(I,2);
prah = round(velikost/2);
prah_index = find(cumh>=prah,1,'first');
display(prah_index);
```

```
prah_index = 83
```

```
J = I>prah_index;
```

```
figure,
subplot(1,2,1)
imshow(I);
subplot(1,2,2)
imshow(J);
```

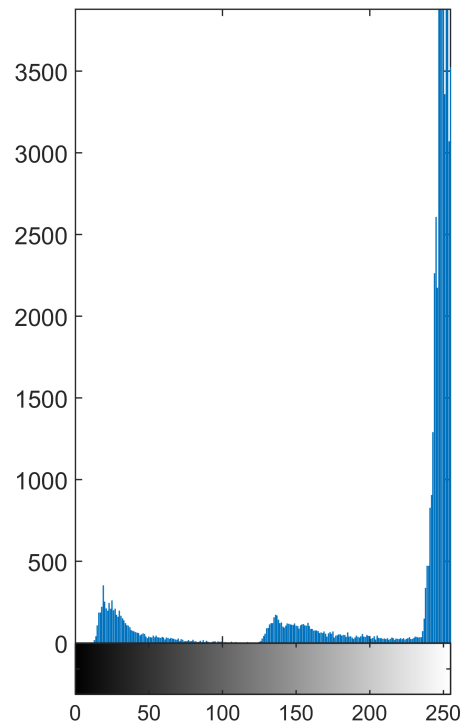
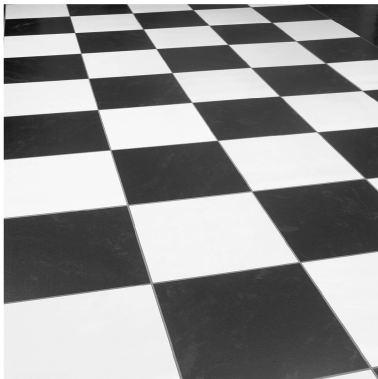


Vicenasobne prahovani

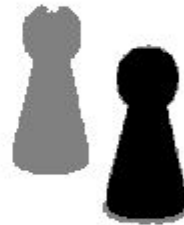
```
% g(x,y)      = a pro f(x,y) > T1 (pozadí)
%              = b pro f(x,y) <= T1 a f(x,y) > T2 (objekt 1)
%              = c pro f(x,y) <= T2 (objekt 2)
% většinou je a=1, b = 0.5 a c = 0
```

```
f2 = rgb2gray(imread('figurka2.jpg'));
```

```
imhist(f2);
```

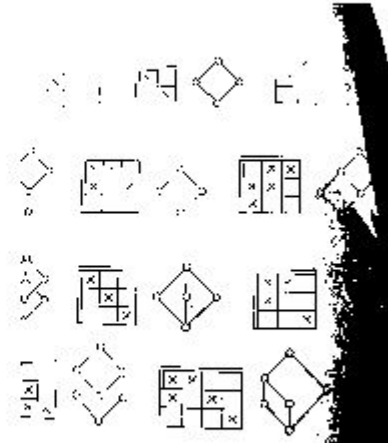
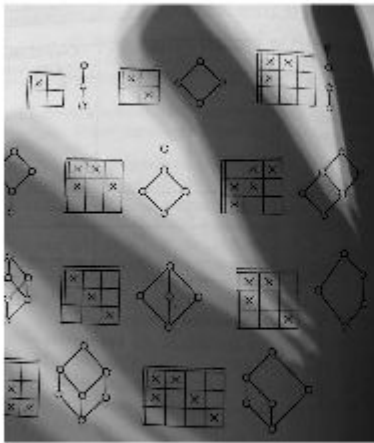


```
T1 = 220;  
T2 = 100;  
g2 = 0.5*(f2 >T1) + 0.5*(f2>T2);  
  
figure,  
subplot(1,2,1)  
imshow(f2);  
subplot(1,2,2)  
imshow(g2);
```



Lokalni prahovani

```
f3 = imread('lokalni.jpg');  
T = 46;  
  
g3 = f3 > T;  
  
figure,  
subplot(1,2,1), imshow(f3);  
subplot(1,2,2), imshow(g3);
```

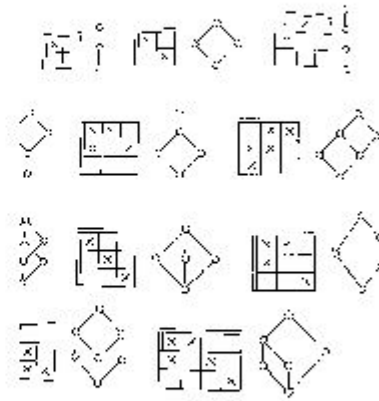
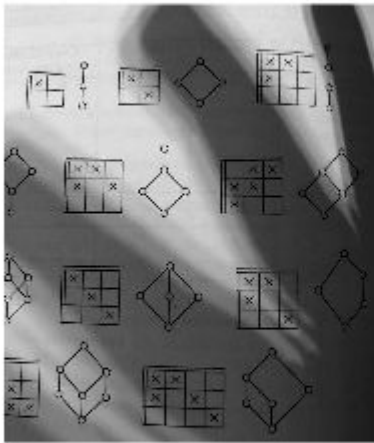


Pro každý bod počítáme prahovou hodnotu v závislosti na okolních bodech. jak funguje výběr automatického prahu je nad rámec kurzu

```
f4=im2double(f3);
nhood = ones(3)/9;
g_std = stdfilt(f4);
g_mean = imfilter(f4,nhood);

a=0.3;
b=1-a;
T = a*g_std + b*g_mean;

g4 = f4 > T;
subplot(1,2,1), imshow(f4);
subplot(1,2,2), imshow(g4);
```



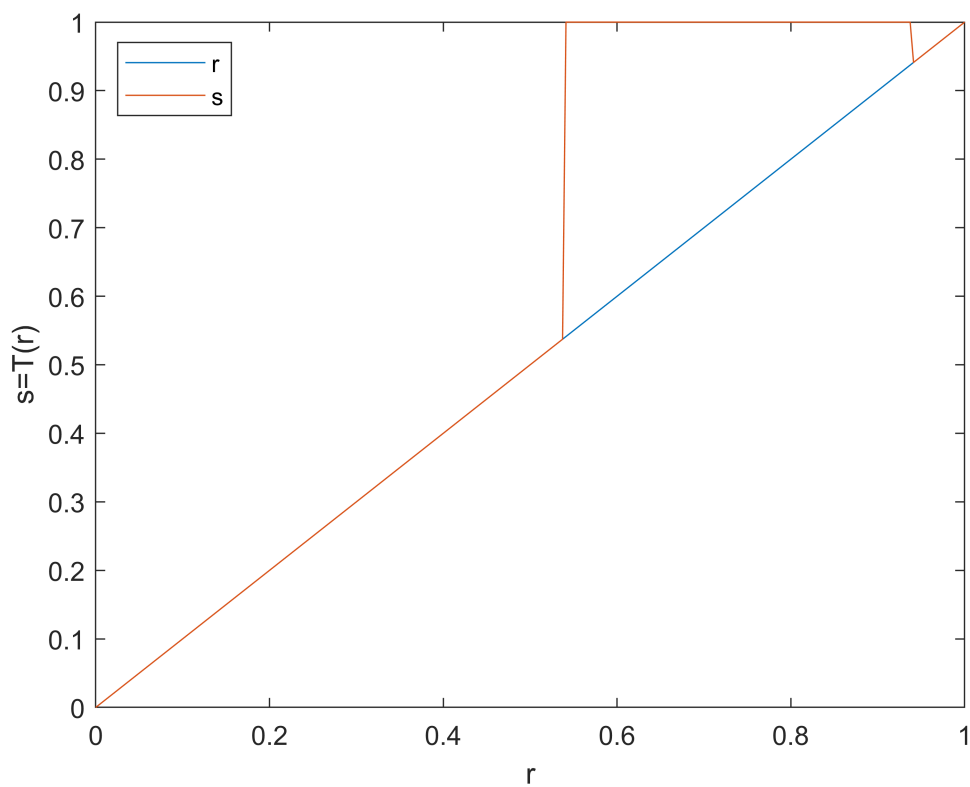
Ořezávání hodnot intenzity

```
f = imread('pastelky_gray.png');
%J = I;
%J(J >= 140 & J<=240) = 255;

r1 = 0.54;
r2 = 0.94;

s13 = r;
s13(s13 >= r1 & s13<=r2) = 1;

figure,
plot(r,r);
xlabel('r');
ylabel('s=T(r)');
xlim([0,1]);
hold on;
plot(r,s13);
legend('r','s','Location','northwest');
```



Aplikace na obrazek

```
map13 = createMap(s13);

figure
subplot(1,2,1)
imshow(f);
title('Original')
subplot(1,2,2)
imshow(f,map13);
title('Intensity-level slicing')
```




Ořezávání bitů

```
I = imread('pastelky_gray.png');
```

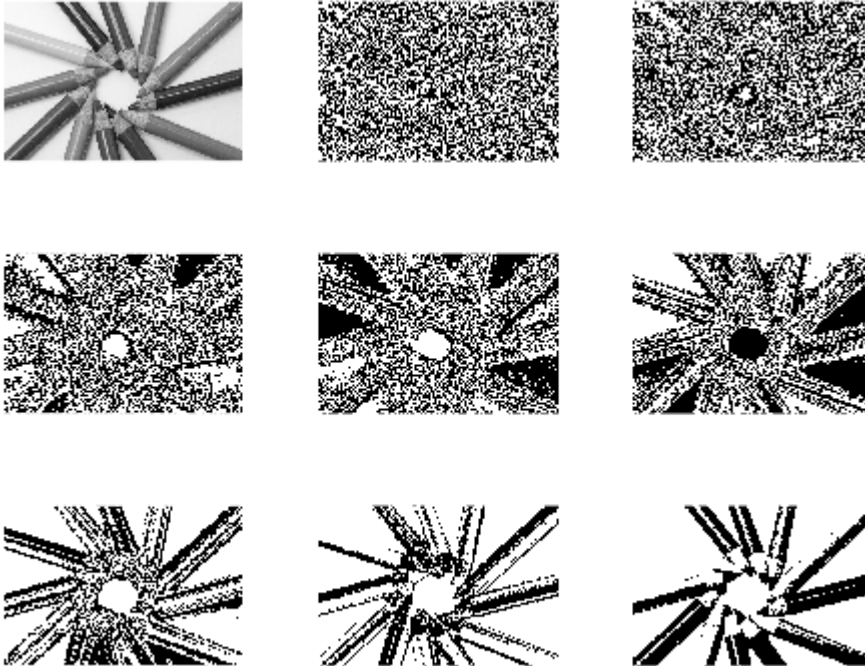
```
I1 = bitand(I,1);
I2 = bitand(I,2);
I3 = bitand(I,4);
I4 = bitand(I,8);
I5 = bitand(I,16);
I6 = bitand(I,32);
I7 = bitand(I,64);
I8 = bitand(I,128);
```

```
figure
subplot(3,3,1)
imshow(I,[])
subplot(3,3,2)
imshow(I1,[])
subplot(3,3,3)
imshow(I2,[])
subplot(3,3,4)
imshow(I3,[])
subplot(3,3,5)
imshow(I4,[])
subplot(3,3,6)
imshow(I5,[])
subplot(3,3,7)
```

```

imshow(I6,[])
subplot(3,3,8)
imshow(I7,[])
subplot(3,3,9)
imshow(I8,[])

```



Skládání obrázků

```

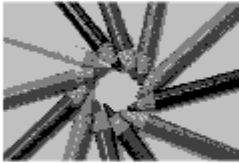
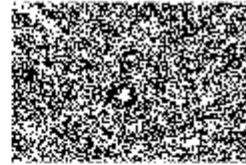
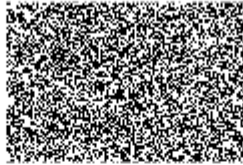
J1 = I8 + I7;
J2 = I8 + I7 + I6;
J3 = I8 + I7 + I6 + I5;

```

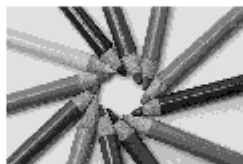
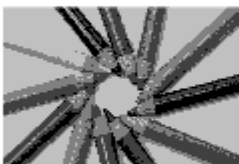
```

subplot(1,3,1)
imshow(J1);

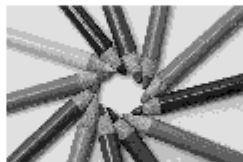
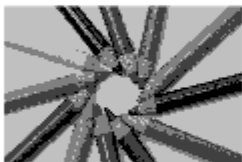
```



```
subplot(1,3,2)  
imshow(J2);
```



```
subplot(1,3,3)
imshow(I3);
```



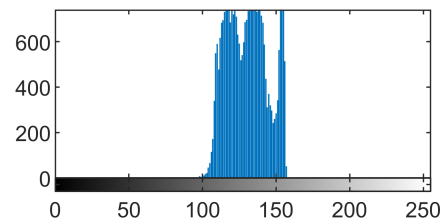
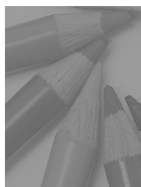
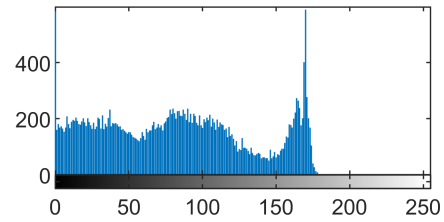
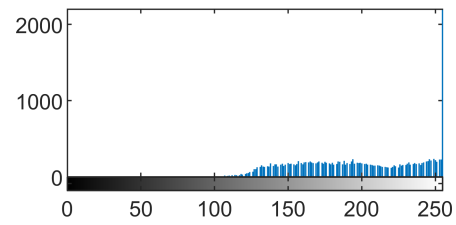
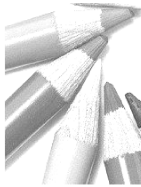
Vyrovnávání histogramu

```
I1 = imread('p1.png');
I2 = imread('p2.png');
I3 = imread('p3.png');
```

```
figure,
subplot(3,2,1)
imshow(I1);
subplot(3,2,2)
imhist(I1)
```

```
subplot(3,2,3)
imshow(I2);
subplot(3,2,4)
imhist(I2)
```

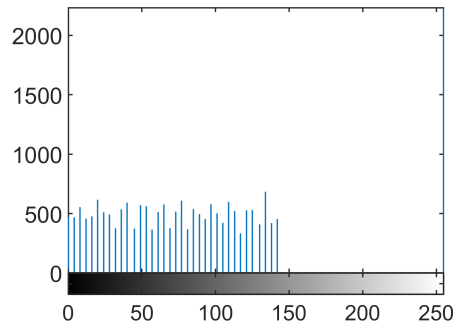
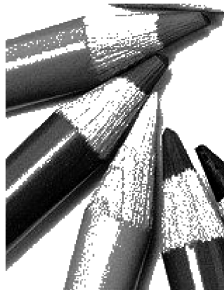
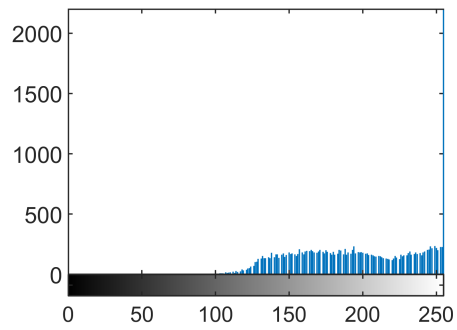
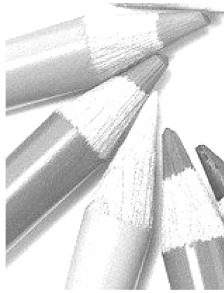
```
subplot(3,2,5)
imshow(I3);
subplot(3,2,6)
imhist(I3)
```



Obrazek p1.png

```
% J = histeq(I);  
J1 = histeq(I1);
```

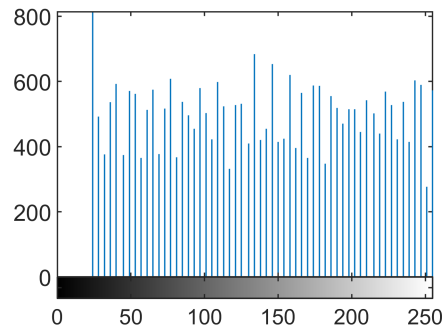
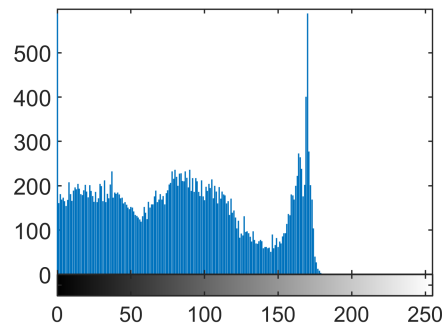
```
figure,  
subplot(2,2,1)  
imshow(I1);  
subplot(2,2,2)  
imhist(I1)  
subplot(2,2,3)  
imshow(J1);  
subplot(2,2,4)  
imhist(J1)
```



Obrazek p2.png

```
J2 = histeq(I2);
```

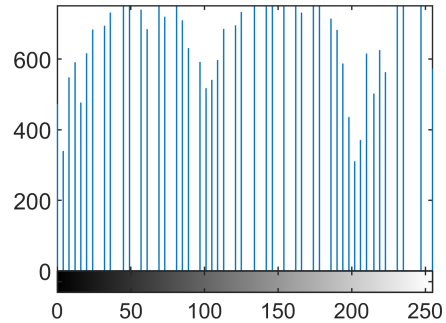
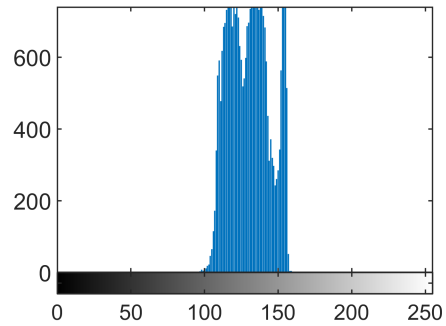
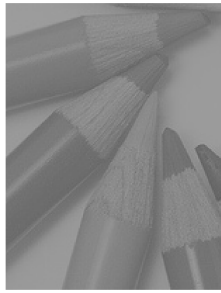
```
figure,  
subplot(2,2,1)  
imshow(I2);  
subplot(2,2,2)  
imhist(I2)  
subplot(2,2,3)  
imshow(J2);  
subplot(2,2,4)  
imhist(J2)
```



Obrazek p3.png

```
J3 = histeq(I3);
```

```
figure,
subplot(2,2,1)
imshow(I3);
subplot(2,2,2)
imhist(I3)
subplot(2,2,3)
imshow(J3);
subplot(2,2,4)
imhist(J3)
```

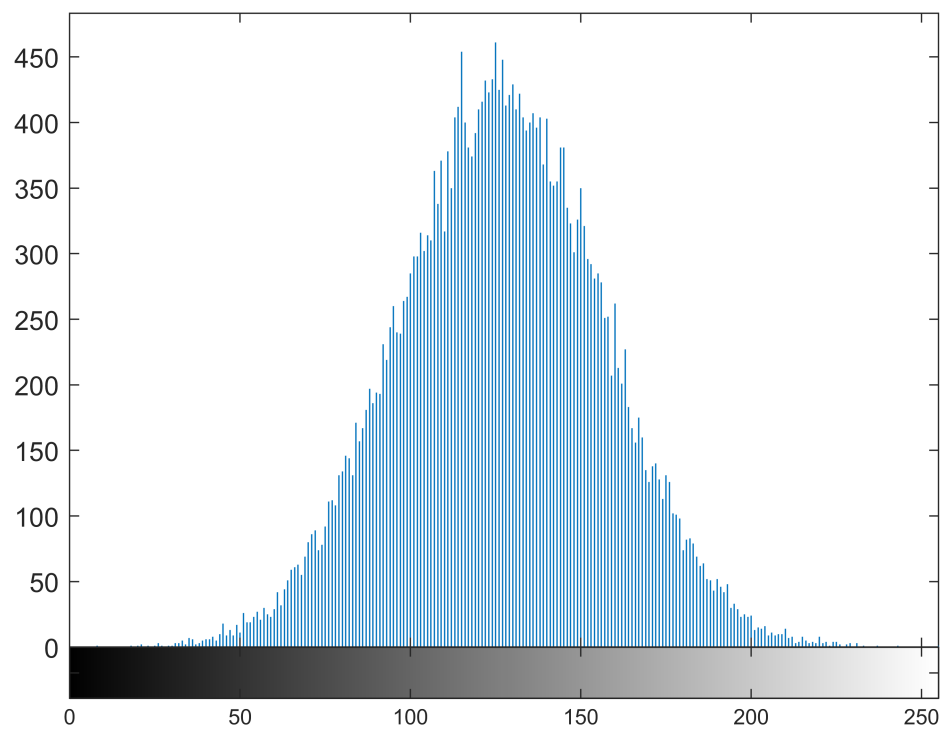


Specifikace histogramu

Vytvoření histogramu

```
I2 = imread('p3.png');
spechistobr = randn(size(I2));
minimum = min(min(spechistobr));
spechistobr = spechistobr + (0-minimum);
maximum = max(max(spechistobr));
spechistobr = 255*(spechistobr/maximum);
spechistobr = uint8(round(spechistobr));
```

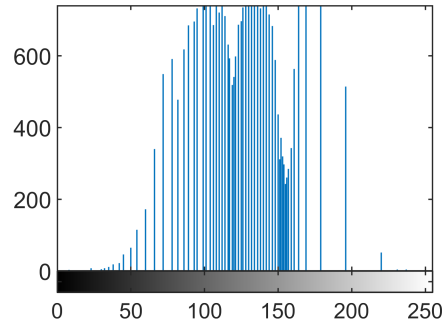
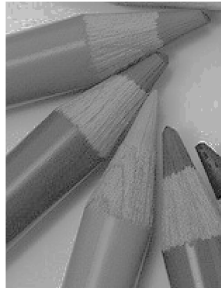
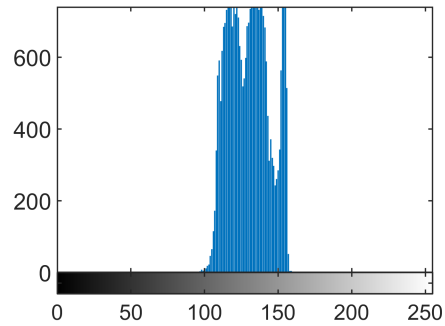
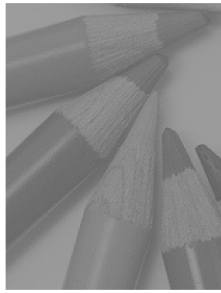
```
figure,
imhist(spechistobr)
```

Specifikace histogramu

```
[COUNTS,X] = imhist(spechistobr);
Jspec = histeq(I2, COUNTS);
```

```
figure,
subplot(2,2,1)
imshow(I3);
subplot(2,2,2)
imhist(I3)
subplot(2,2,3)
imshow(Jspec);
subplot(2,2,4)
imhist(Jspec)
```



Barevné obrázky

Změna jasu

```
f_rgb = im2double(imread('pastelky.png'));
f_hsv = rgb2hsv(f_rgb);
c = 0.5;
g_rgb = f_rgb;
g_hsv = f_hsv;

g_rgb(:,:,1) = g_rgb(:,:,1) + c;
g_rgb(:,:,2) = g_rgb(:,:,2) + c;
g_rgb(:,:,3) = g_rgb(:,:,3) + c;

g_hsv(:,:,3) = f_hsv(:,:,3) + c;

figure,
subplot(1,3,1)
imshow(f_rgb);
title('original')
subplot(1,3,2)
imshow(g_rgb)
title('RGB')
subplot(1,3,3)
imshow(hsv2rgb(g_hsv));
title('HSV')
```



color slicing

```

im = imread('pastelky.png');
W = 0.2;
R = 0.1;
a = [0.81, 0.08, 0.11];

[m,n,o] = size(im);
out1 = im;
out2 = im;

c = zeros(1,3);
for i = 1 : m
    for j = 1 : n
        c(1) = im(i,j,1);
        c(2) = im(i,j,2);
        c(3) = im(i,j,3);
        if(any((abs(c-a))>(W/2)))
            %(abs(im(i,j,:)-a))>W/2
            out1(i,j,:) = [0.5,0.5,0.5];
        end
        if(sum((c-a).^2) > R^2)
            out2(i,j,:) = [0.5,0.5,0.5];
        end
    end
end
end

```

```

%unique(out1)
figure,
subplot(1,3,1)
imshow(im);
title('original')
subplot(1,3,2)
imshow(out1)
subplot(1,3,3)
imshow(out2);

```



Maticové úpravy

```

% sepia
M = [0.393 0.349 0.272 0 0;
0.769 0.686 0.534 0 0;
0.189 0.168 0.131 0 0;
0 0 0 1 0;
0 0 0 0 1];

% swap
% M = [0 0 1 0 0;
% 0 1 0 0 0;
% 1 0 0 0 0;
% 0 0 0 1 0;
% 0 0 0 0 1];

% černá a bílá
% M = [1.5 1.5 1.5 0 0;

```

```

% 1.5 1.5 1.5 0 0;
% 1.5 1.5 1.5 0 0;
% 0 0 0 1 0;
% -1 -1 -1 0 1];

% polaroid
% M = [1.438 -0.062 -0.062 0 0;
% -0.122 1.378 -0.122 0 0;
% -0.016 -0.016 1.483 0 0;
% 0 0 0 1 0;
% -0.03 0.05 -0.02 0 1];

% červená složka
% M = [1.5 0 0 0 0;
% 0 0.5 0 0 0;
% 0 0 0.5 0 0;
% 0 0 0 1 0;
% 0 0 0 0 1];

im = double(imread('pastelky.png'));

inputRed = im(:,:,1); %// barevná složka
inputGreen = im(:,:,2);
inputBlue = im(:,:,3);

% Aplikace na jednotlivé složky
outputRed = (inputRed * M(1,1)) + (inputGreen * M(2,1)) + (inputBlue * M(3,1)) + M(5,1);
outputGreen = (inputRed * M(1,2)) + (inputGreen * M(2,2)) + (inputBlue * M(3,2)) + M(5,2);
outputBlue = (inputRed * M(1,3)) + (inputGreen * M(2,3)) + (inputBlue * M(3,3)) + M(5,3);

% Sjednocení složek
out = uint8(cat(3, outputRed, outputGreen, outputBlue));

imshow(out);

```

