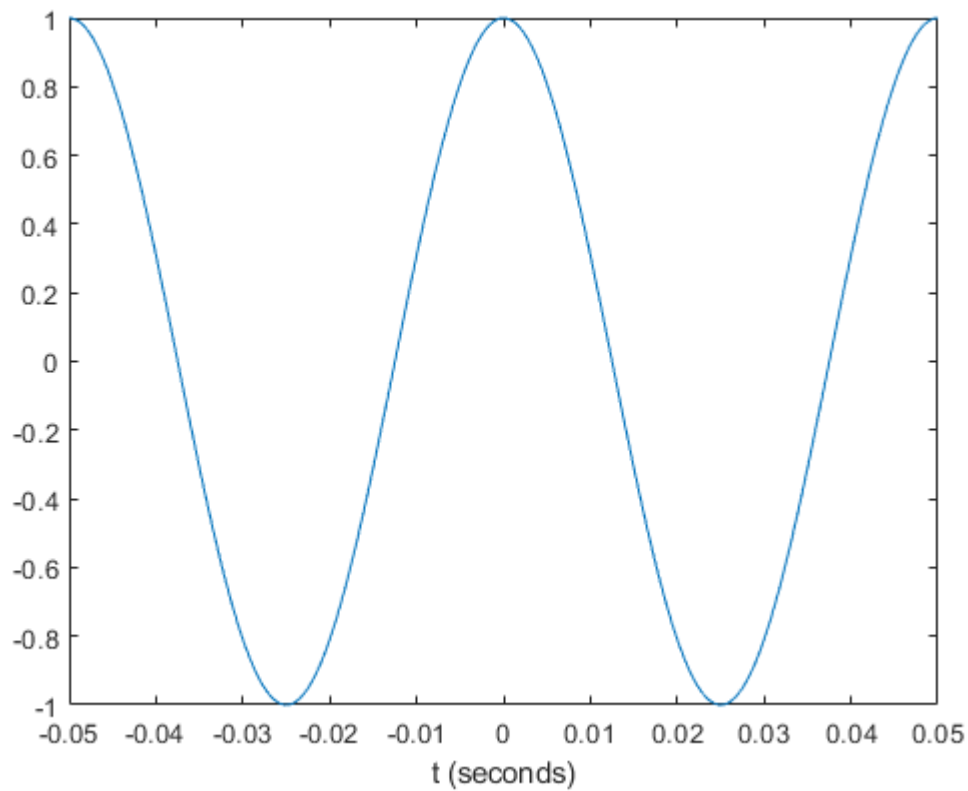


Cviceni 7

Příklad 1

```
f = 20; % Hz
tmin = -0.05;
tmax = 0.05;
t = linspace(tmin, tmax, 400);
x_c = cos(2*pi*f * t);

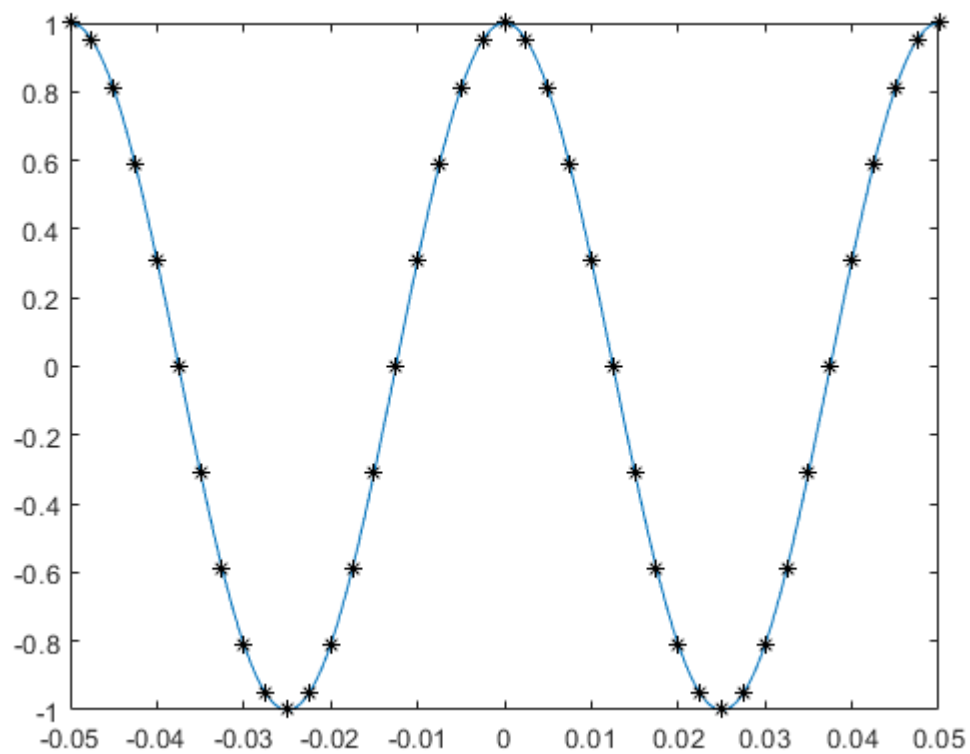
figure,
plot(t,x_c)
xlabel('t (seconds)');
```



Vzorkovani s frekvenci 1/400

```
T = 1/400;
nmin = ceil(tmin / T);
nmax = floor(tmax / T);
n = nmin:nmax;
x1 = cos(2*pi*f * n*T);

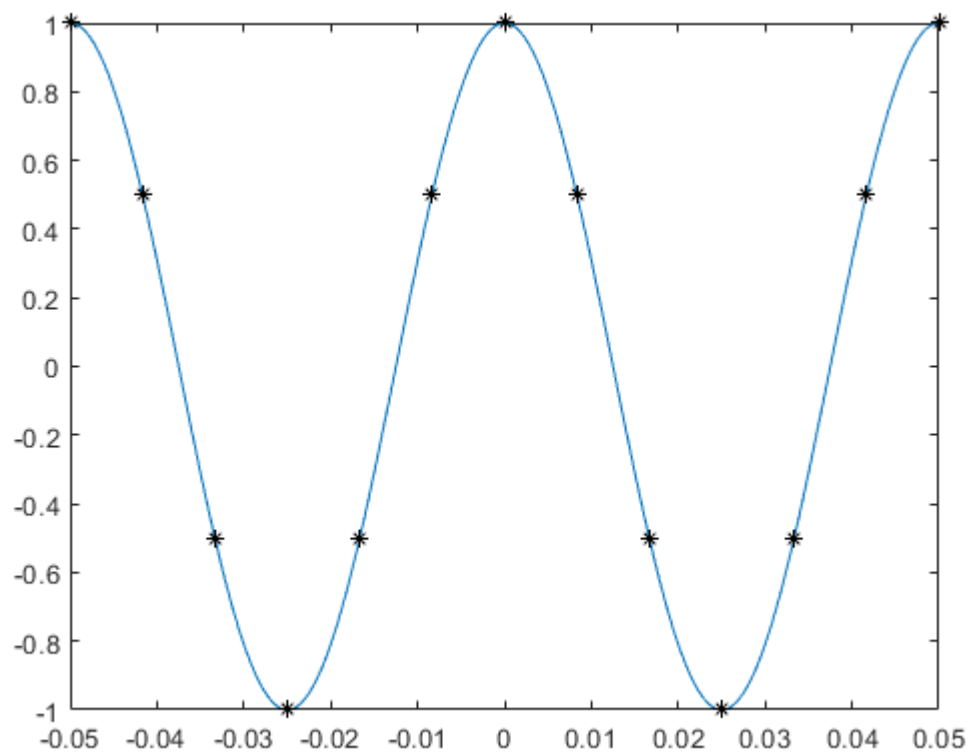
figure,
plot(t, x_c)
hold on
plot(n*T, x1, '*k')
hold off
```



Vzorkovani s frekvenci 1/120

```
T = 1/120;
nmin = ceil(tmin / T);
nmax = floor(tmax / T);
n = nmin:nmax;
x1 = cos(2*pi*f * n*T);
```

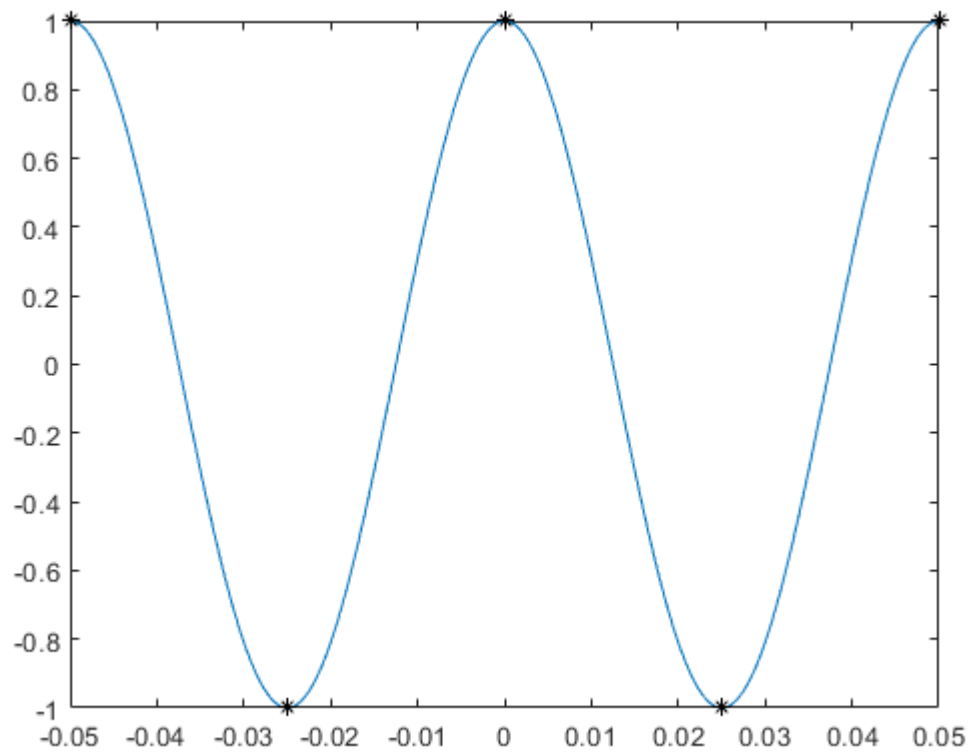
```
figure,
plot(t, x_c)
hold on
plot(n*T, x1, '*k')
hold off
```



Vzorkovani s frekvenci 1/40

```
T = 1/40;
nmin = ceil(tmin / T);
nmax = floor(tmax / T);
n = nmin:nmax;
x1 = cos(2*pi*f * n*T);

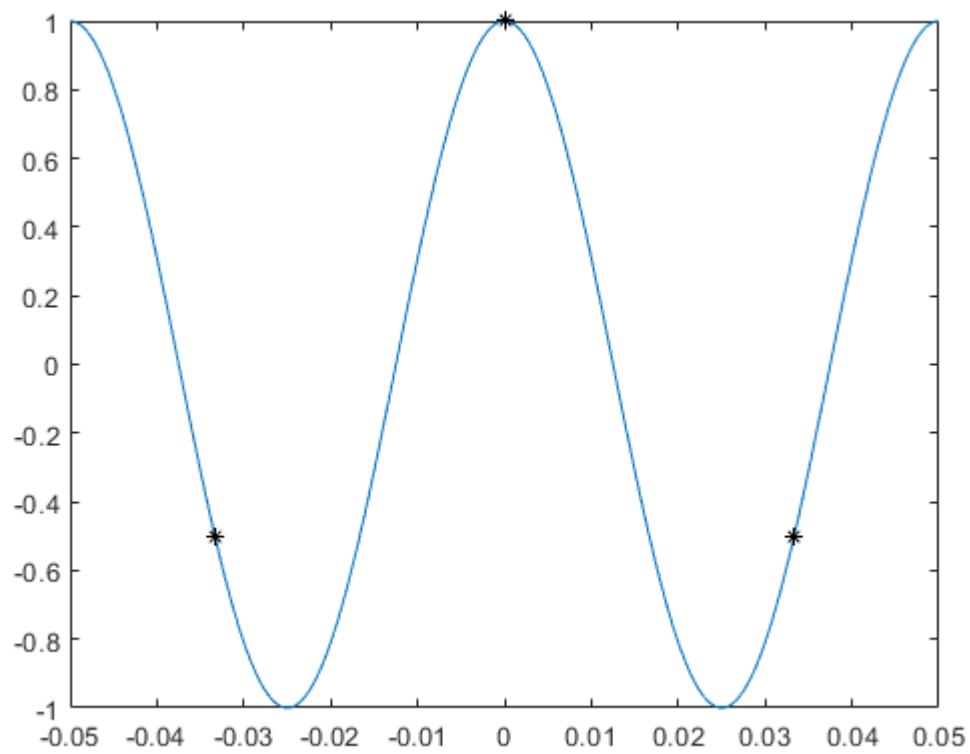
figure,
plot(t, x_c)
hold on
plot(n*T, x1, '*k')
hold off
```



Vzorkovani s frekvenci 1/30

```
T = 1/30;
nmin = ceil(tmin / T);
nmax = floor(tmax / T);
n = nmin:nmax;
x1 = cos(2*pi*f * n*T);
```

```
figure,
plot(t, x_c)
hold on
plot(n*T, x1, '*k')
hold off
```

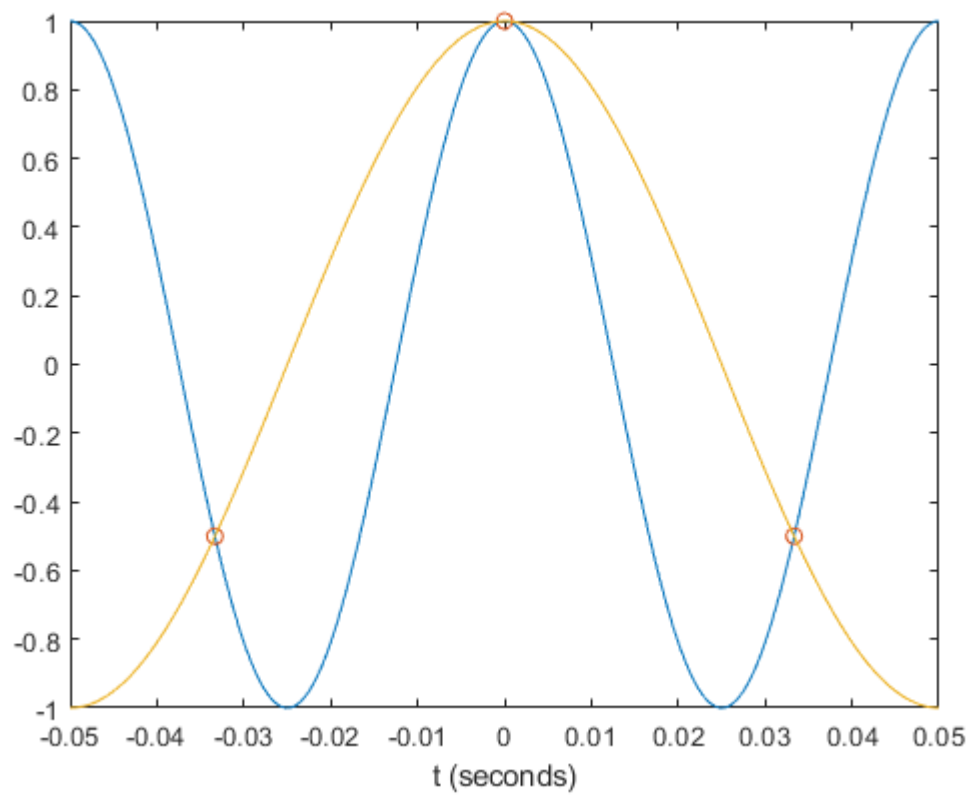


```
f = 20; % Hz
tmin = -0.05;
tmax = 0.05;
t = linspace(tmin, tmax, 400);
x_c = cos(2*pi*f * t);
```

```
figure,
plot(t,x_c)
xlabel('t (seconds)');
```

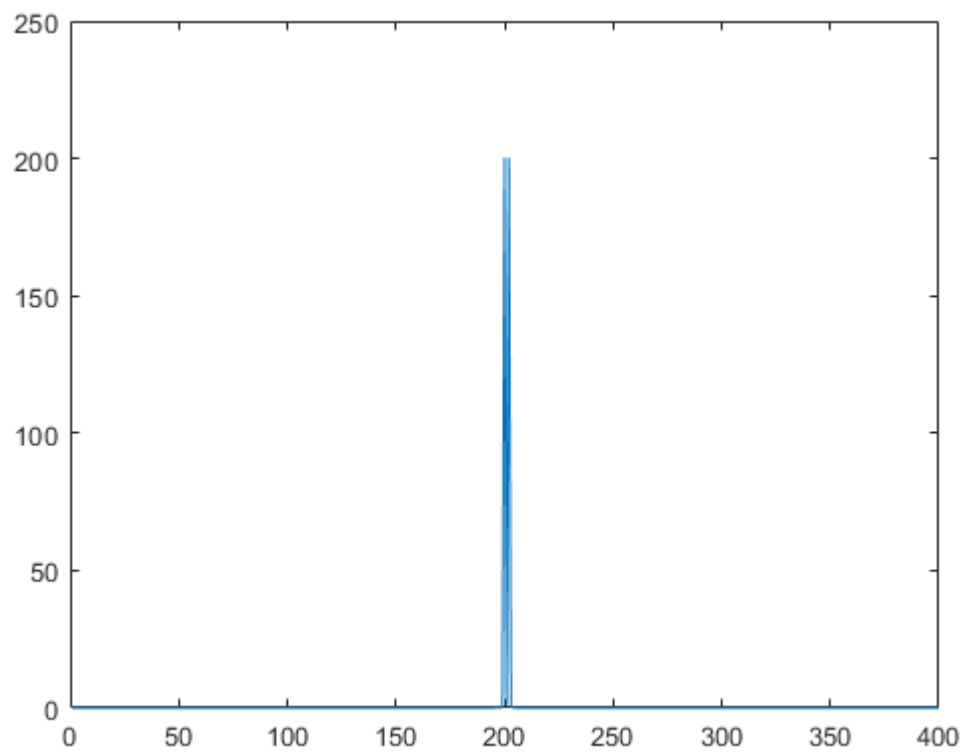
```
T = 1/30;
x_c = cos(2*pi*10 * t);
nmin = ceil(tmin / T);
nmax = floor(tmax / T);
n = nmin:nmax;
x1 = cos(2*pi*f * n*T);
```

```
hold on
plot(n*T, x1, 'o')
plot(t, x_c)
hold off
```



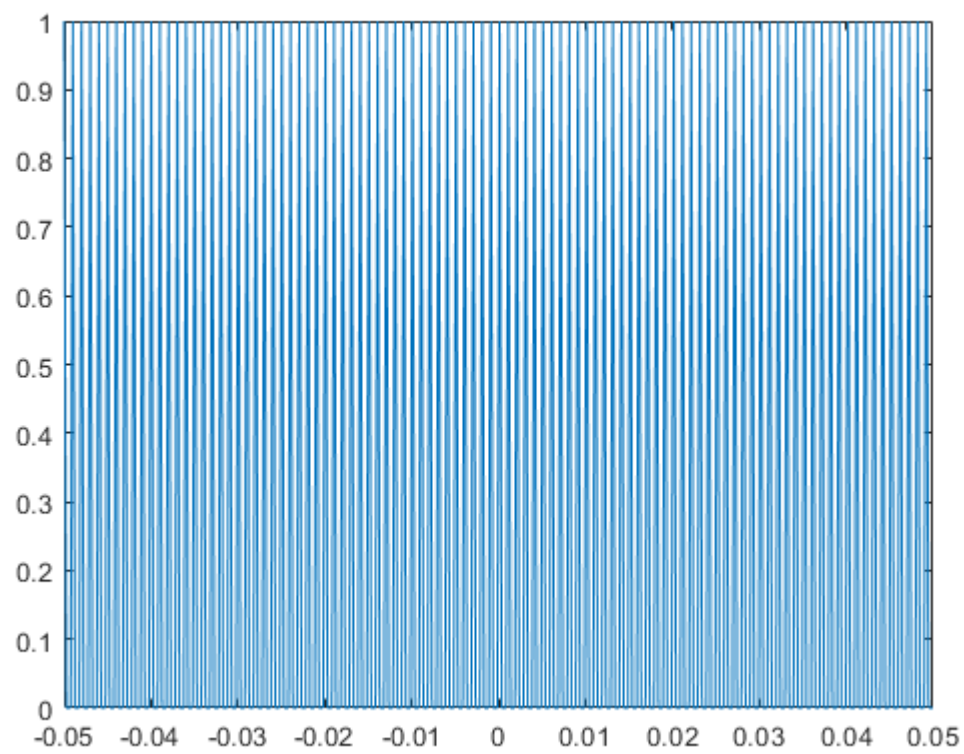
Funkce prevedena do frekvencni domeny

```
F = fft(x_c);  
F_sp = abs(F);  
  
figure,  
plot(fftshift(F_sp));
```

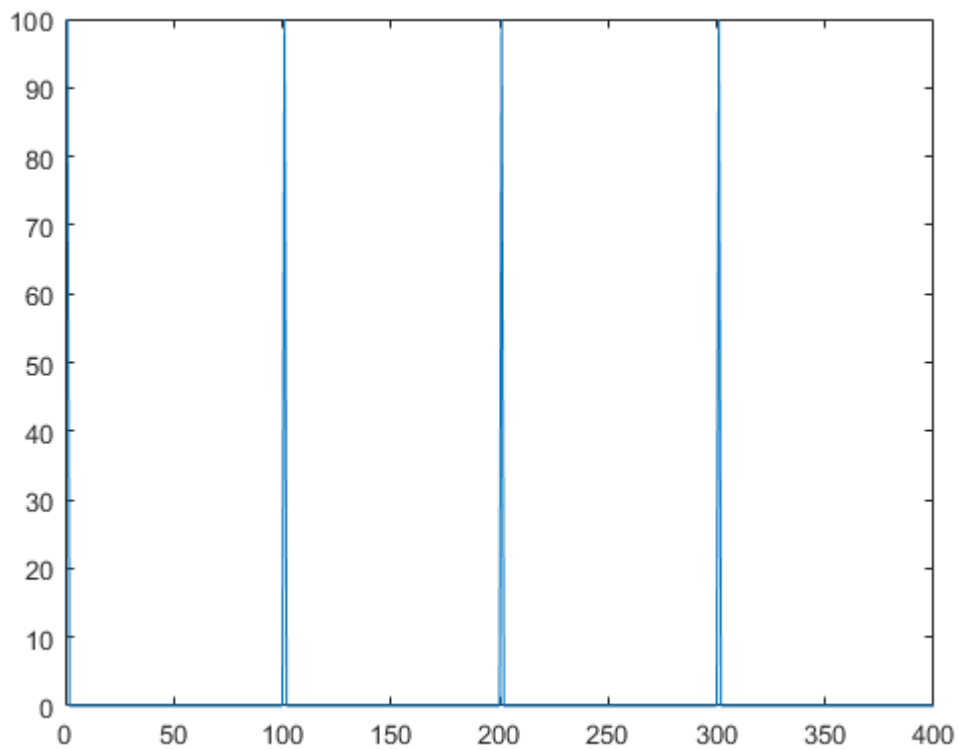


Diracuv pulz

```
f = 4;  
%f = 10;  
tmin = -0.05;  
tmax = 0.05;  
t = linspace(tmin, tmax, 400);  
  
x1 = zeros([1,400]);  
x1(1:f:400) = 1;  
  
figure,  
plot(t, x1);
```



```
F = fft(x1);  
F_sp = abs(F);  
  
figure,  
plot(fftshift(F_sp));
```

Příklad 2 - Časový alias

```
i1 = rgb2gray(imread('Run1.png'));  
i2 = rgb2gray(imread('Run2.png'));  
i3 = rgb2gray(imread('Run3.png'));  
i4 = rgb2gray(imread('Run4.png'));  
i5 = rgb2gray(imread('Run5.png'));  
i6 = rgb2gray(imread('Run6.png'));  
i7 = rgb2gray(imread('Run7.png'));  
i8 = rgb2gray(imread('Run8.png'));
```

```
I = [];  
I = uint8(I);
```

```
% vytvoreni sekvence
```

```
for i = 1 : 8 : 500  
    I(:, :, i) = i1;  
    I(:, :, i+1) = i2;  
    I(:, :, i+2) = i3;  
    I(:, :, i+3) = i4;  
    I(:, :, i+4) = i5;  
    I(:, :, i+5) = i6;  
    I(:, :, i+6) = i7;  
    I(:, :, i+7) = i8;
```

```
end
```

```
figure,  
subplot(1,8,1), imshow(i1);  
subplot(1,8,2), imshow(i2);  
subplot(1,8,3), imshow(i3);  
subplot(1,8,4), imshow(i4);  
subplot(1,8,5), imshow(i5);  
subplot(1,8,6), imshow(i6);  
subplot(1,8,7), imshow(i7);  
subplot(1,8,8), imshow(i8);
```



krok 1

```
figure,  
for i = 1:size(I,3)  
    imshow(I(:,:,i))  
    pause(.1);  
end
```

krok 4

```
figure,  
for i = 3:4:size(I,3)  
    imshow(I(:,:,i))  
    pause(.1);  
end
```

krok 7

```
figure,  
for i = 1:6:size(I,3)  
    imshow(I(:,:,i))  
    pause(.1);  
end
```

krok 10

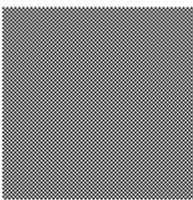
```
figure,  
for i = 1:8:size(I,3)  
    imshow(I(:,:,i))  
    pause(.1);  
end
```

krok 11

```
figure,  
for i = 1:9:size(I,3)  
    imshow(I(:,:,i))  
    pause(.1);  
end
```

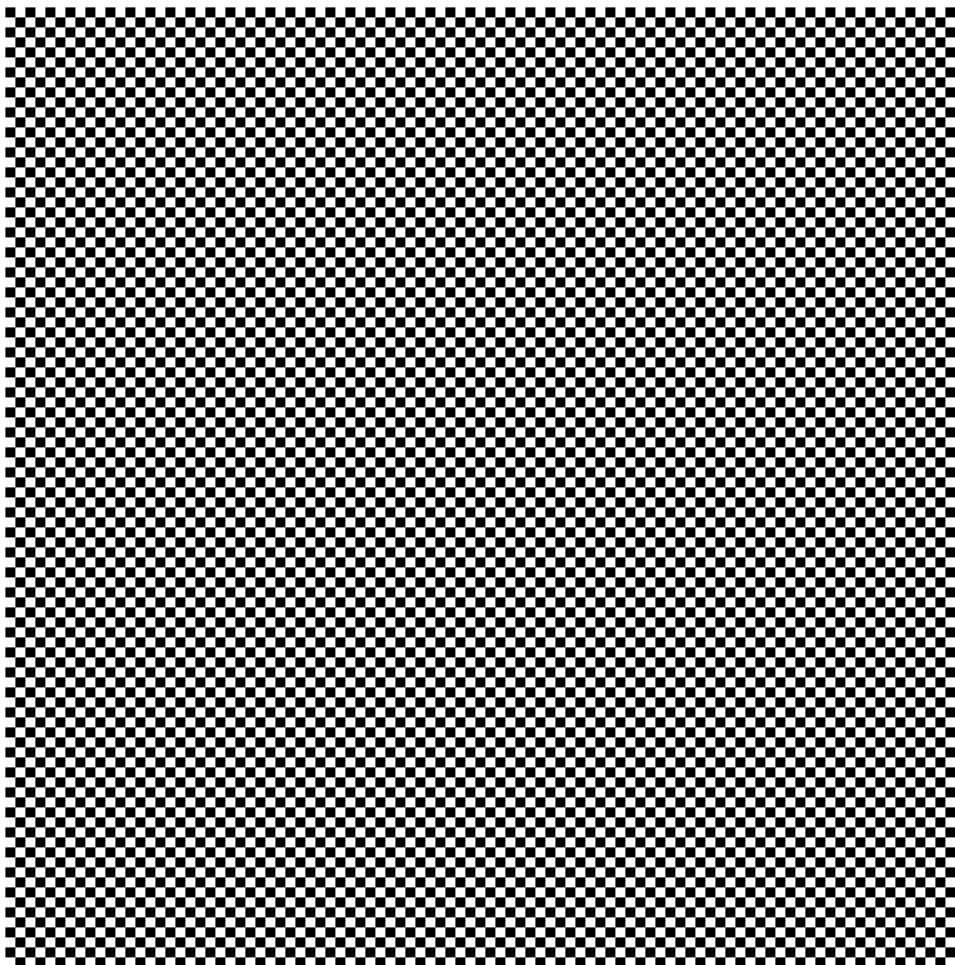
Příklad 3 - šachovnice

```
% generovani obrazku sachovnice  
sachovnice = mat2gray(checkerboard(1,48,48) > 0.5);  
figure,  
imshow(sachovnice);
```



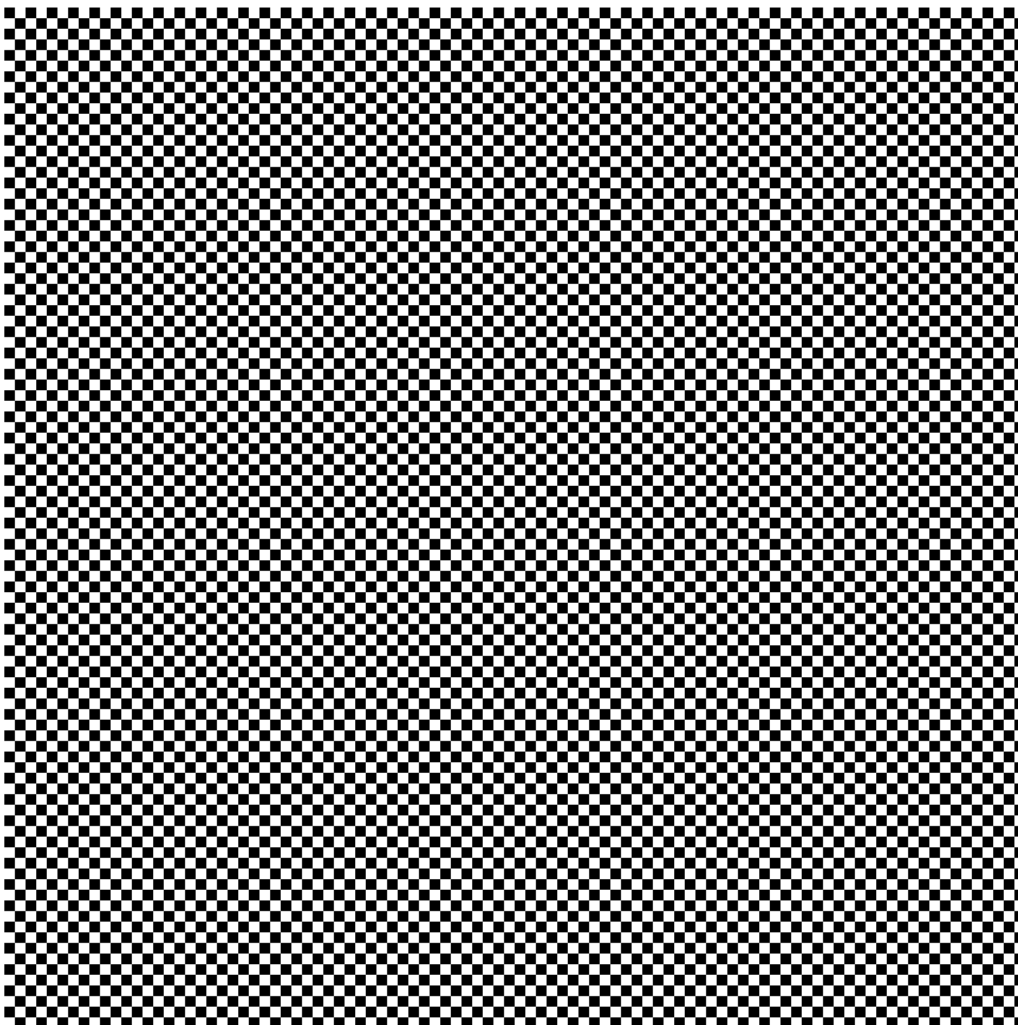
Vzorkovani s krokem 1/6

```
s2 = imresize(sachovnice,6,'nearest');  
figure,  
imshow(s2);
```



Vzorkovani s krokem 1/16

```
s3 = imresize(sachovnice,16,'nearest');  
figure,  
imshow(s3);
```



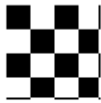
Vzorkovani s krokom 1/0.9174

```
s4 = imresize(sachovnice,0.9174,'nearest');  
figure,  
imshow(s4);
```



Vzorkovani s krokom 1/0.4798

```
s5 = imresize(sachovnice,0.4798,'nearest');  
figure,  
imshow(s5);
```



Vzorkovani s krokom 1/0.5

```
s6 = imresize(sachovnice,0.5,'nearest');  
figure,  
imshow(s6);
```



Priklad 4 - moire

```
I = rgb2gray(imread('alias4.png'));  
figure,  
imshow(I);
```



Mensi vzorkovací frekvence

```
I05 = I(1:2:end,1:2:end);  
figure,  
imshow(I05);
```



Zvetseni vzorkovaného obrazku

```
I1 = uint8(zeros(size(I)));  
I1(1:2:end,1:2:end)=I05;  
I1(1:2:end,2:2:end)=I05;  
I1(2:2:end,2:2:end)=I05;  
I1(2:2:end,1:2:end)=I05;
```

```
figure,imshow(I1);
```




Rozmazani obrazku pred vzorkovanim (mene detailu v obrazku)

```
w = 1/9 * [1 1 1;  
          1 1 1;  
          1 1 1];  
Iblur = imfilter(I,w,'corr','same');  
figure,  
imshow(Iblur);
```



Vzorkovani rozmazaného obrazku

```
I05blur = Iblur(1:2:end,1:2:end);  
figure,  
imshow(I05blur);
```



Zvetseni vzorkovaneho obrazku

```
I1blur = uint8(zeros(size(I)));  
I1blur(1:2:end,1:2:end)=I05blur;  
I1blur(1:2:end,2:2:end)=I05blur;  
I1blur(2:2:end,2:2:end)=I05blur;  
I1blur(2:2:end,1:2:end)=I05blur;  
figure,  
imshow(I1blur);
```



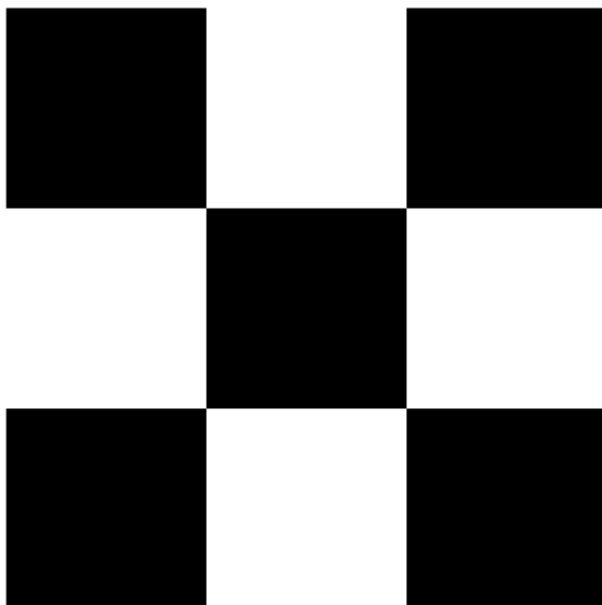
Srovnani obrazku

```
subplot(1,3,1), imshow(I);  
subplot(1,3,2), imshow(I1);  
subplot(1,3,3), imshow(I1blur);
```



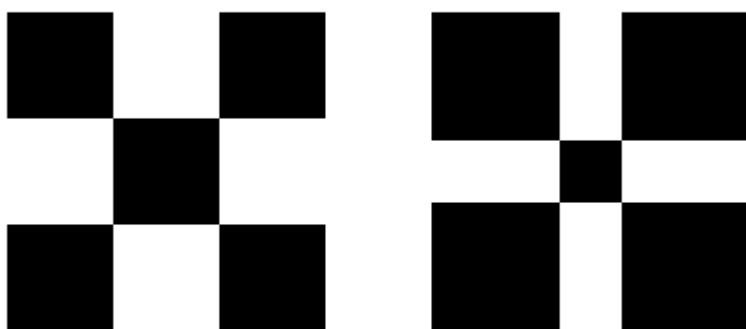
Supersampling

```
C = imread('sachovnice.png');  
figure,  
imshow(C);
```



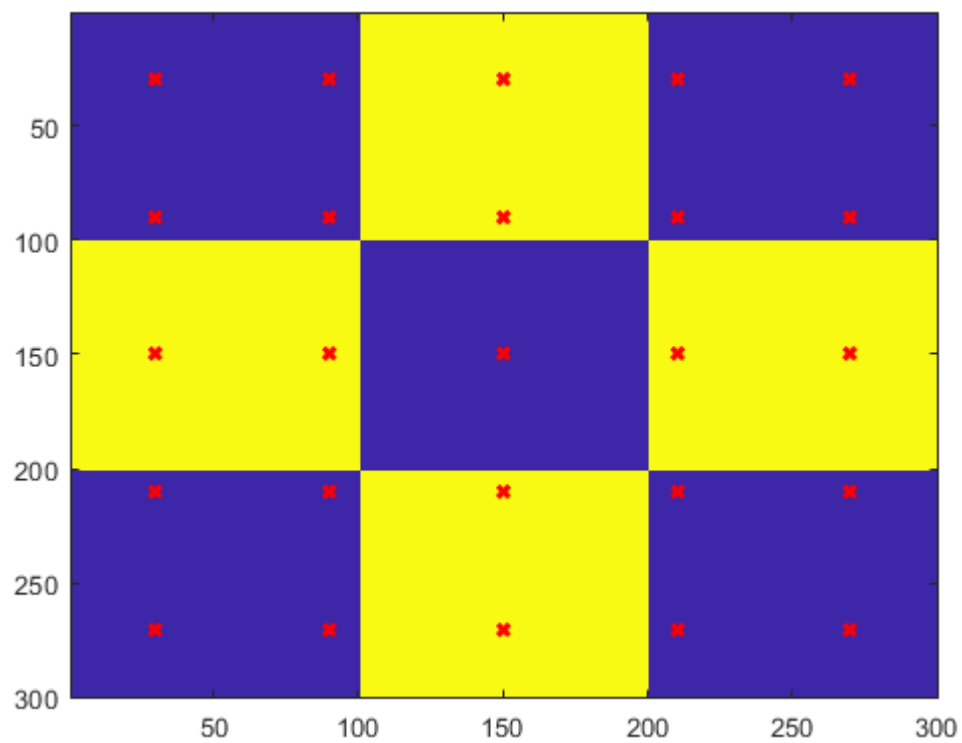
Vzorkovani

```
CC = imresize(C, [5 5], 'nearest');  
CCC = imresize(CC, [300 300], 'nearest');  
  
subplot(1,2,1), imshow(C);  
subplot(1,2,2), imshow(CCC);
```



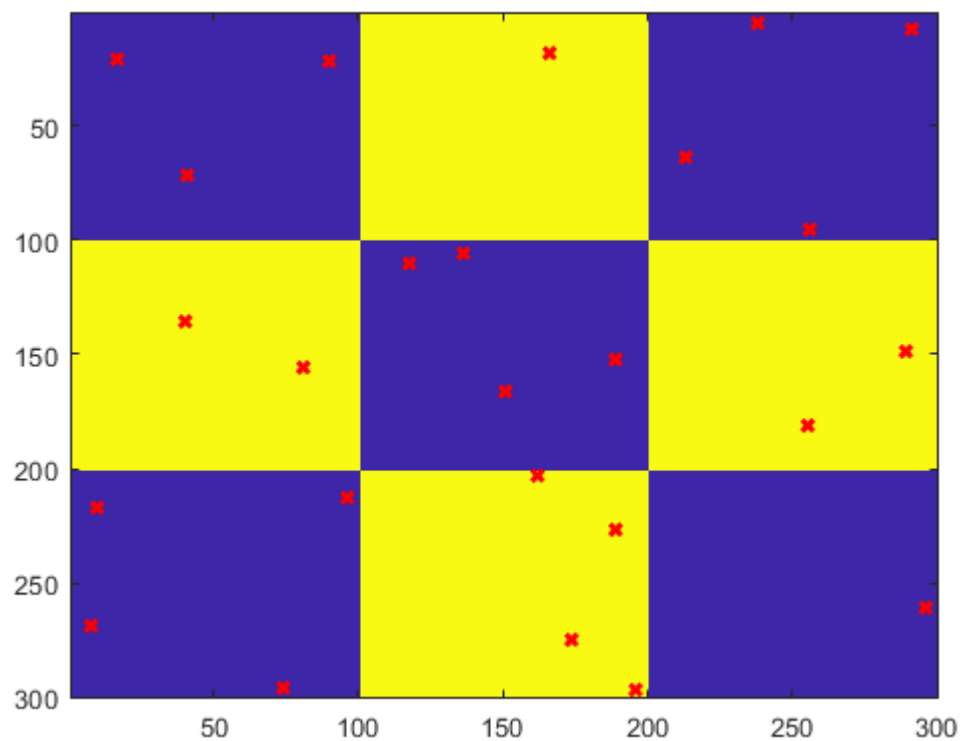
Pravidelne vzorkovani

```
figure,  
[ p_g, v_g ] = Sampling_Grid( C, 20, true );
```



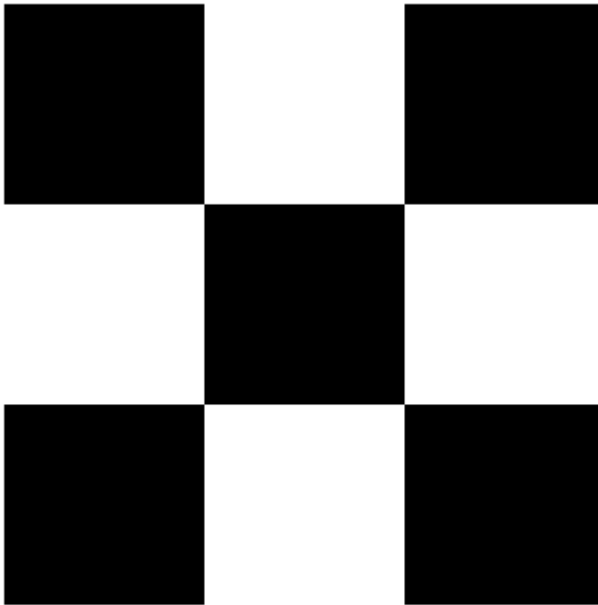
Roztresene vzorkovani

```
figure,  
[ p_j, v_j ] = Sampling_Jittered( C, 20, true );
```

Príklad down sampling na $m_1 \times n_1$ veľikost

```
C = imread('sachovnice.png');  
figure,  
imshow(C);
```



```
[m,n] = size(C);

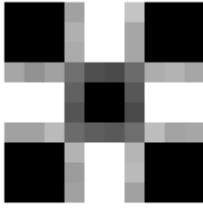
%nova velikost 5x5
m1 = 10;
n1 = 10;

% velikosti oblasti:
mm = floor(m/m1);
nn = floor(n/n1);

k = 100;

vysl = uint8(zeros(m1,n1));
% vytvorim oblast a z ni nahodne vyberu k vzorku a z nich vezmu prumer
for i = 1:m1
    for j = 1:n1
        oblast = C((i-1)*mm + 1 : i*mm, (j-1)*nn + 1 : j*nn);
        %imshow(oblast);
        oblast = oblast(:);
        permutace = randperm(size(oblast,1));
        oblast = oblast(permutace);
        vysl(i,j) = mean(oblast(1:k));
    end
end

figure,
imshow(imresize(vysl,10,'nearest'));
```



UKOL 1

Upravte predchozi priklad tak, aby se misto nahodnych vzorku z oblasti vybraly vzorky v pravidelne mridce velikosti $k \times k$. Uprava se tyka radku 238 - 243. Vyzkousejte vysledek i na jinych obrazcich (pro jednoduchost ctvercovych).

UKOL 2

Upravte predchozi priklad tak, aby se misto nahodnych vzorku z oblasti vybraly vzorky dle algoritmu n - vezi. Uprava se tyka radku 238 - 243. Vyzkousejte vysledek i na jinych obrazcich (pro jednoduchost ctvercovych).

Permutace diagonaly matice $n \times n$

```
n=3;
M = eye(n);

permutace = perms(1:n);

pocet_permutaci = size(permutace,1);

for i = 1 : pocet_permutaci
    disp(M(:,permutace(i,:)));
end
```

```
0    0    1
0    1    0
1    0    0
```

```
0    1    0
0    0    1
1    0    0
```

```
0    0    1
1    0    0
0    1    0
```

```
0    1    0
1    0    0
0    0    1
```

1	0	0
0	0	1
0	1	0
1	0	0
0	1	0
0	0	1