

Értékünk AZ **EMBER**

Humánerőforrás- fejlesztési Operatív Program

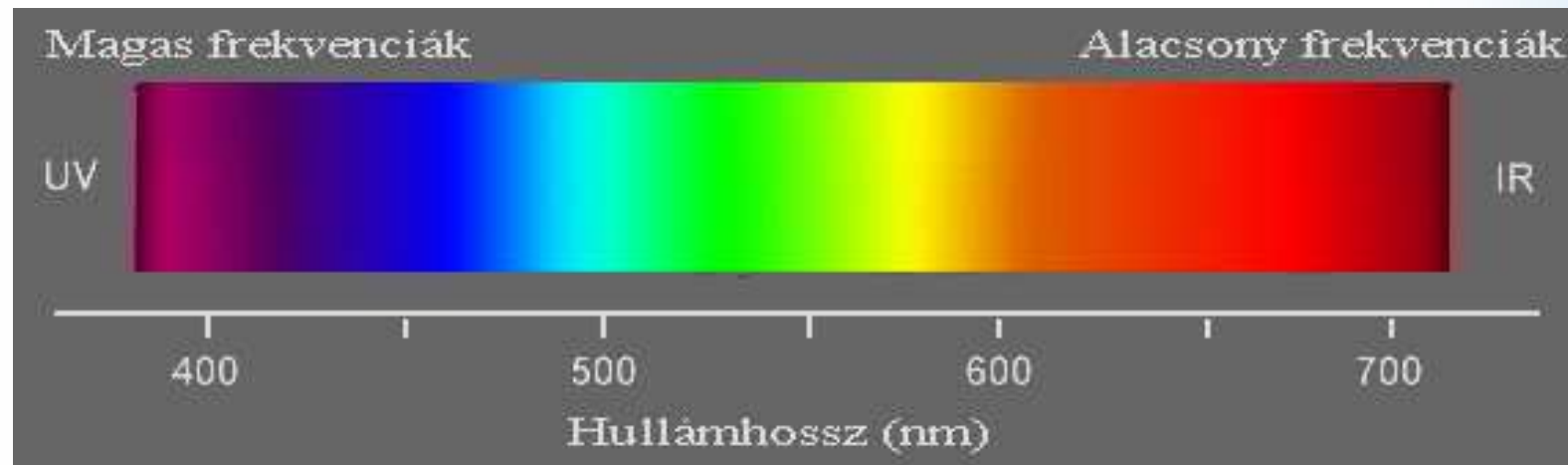
Képfeldolgozás 1. Az emberi látás

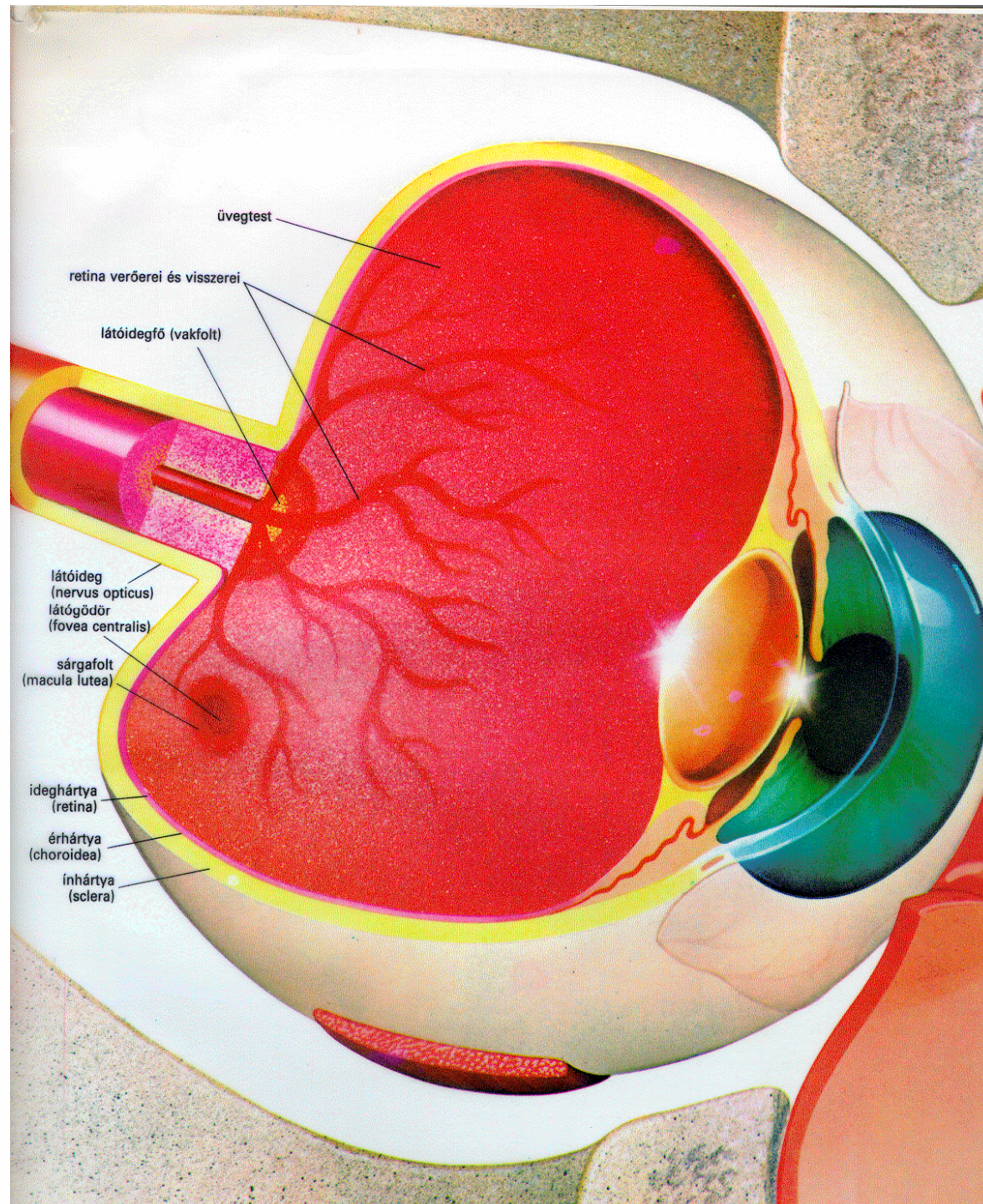
Czap László

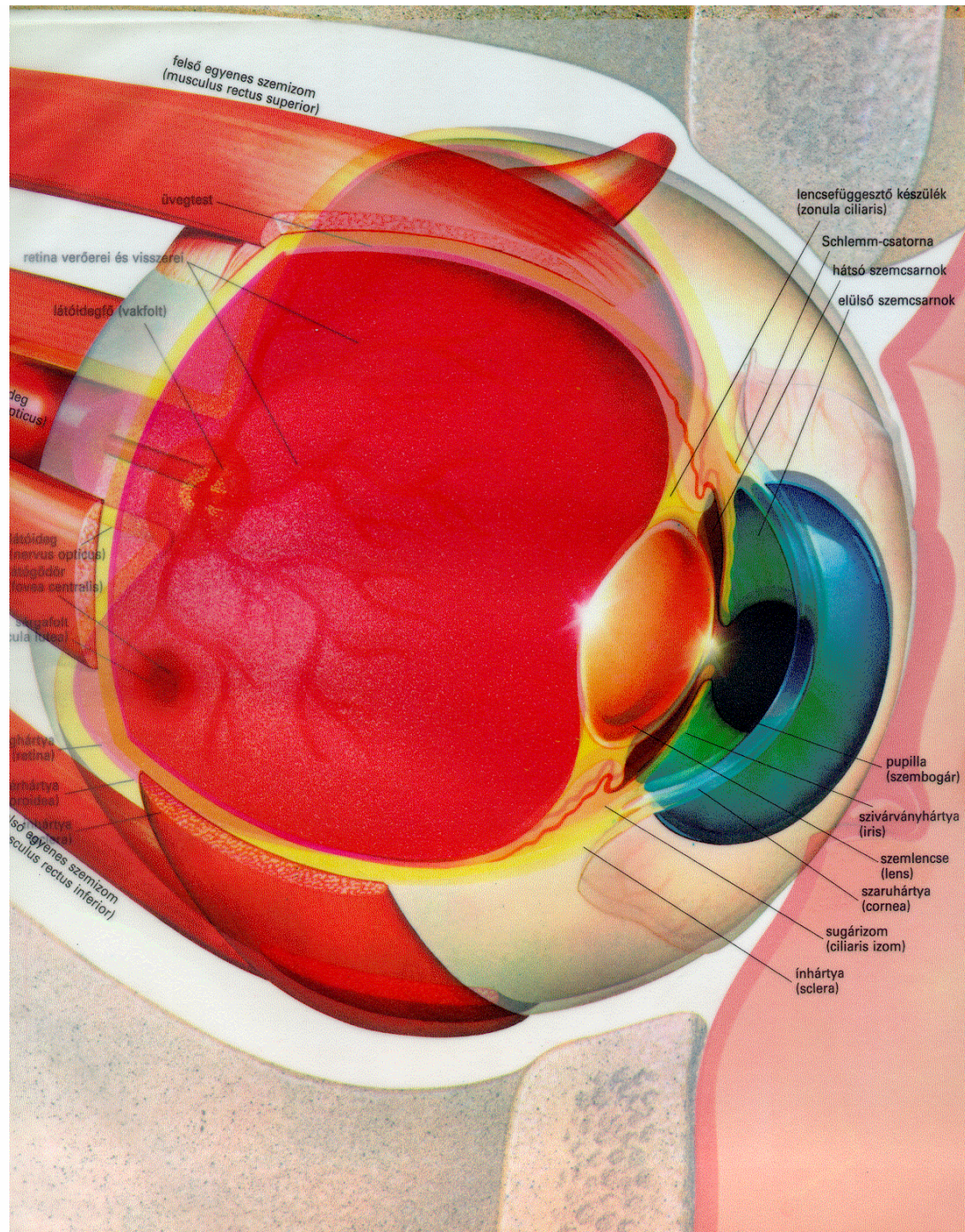
Magyarország célba ér

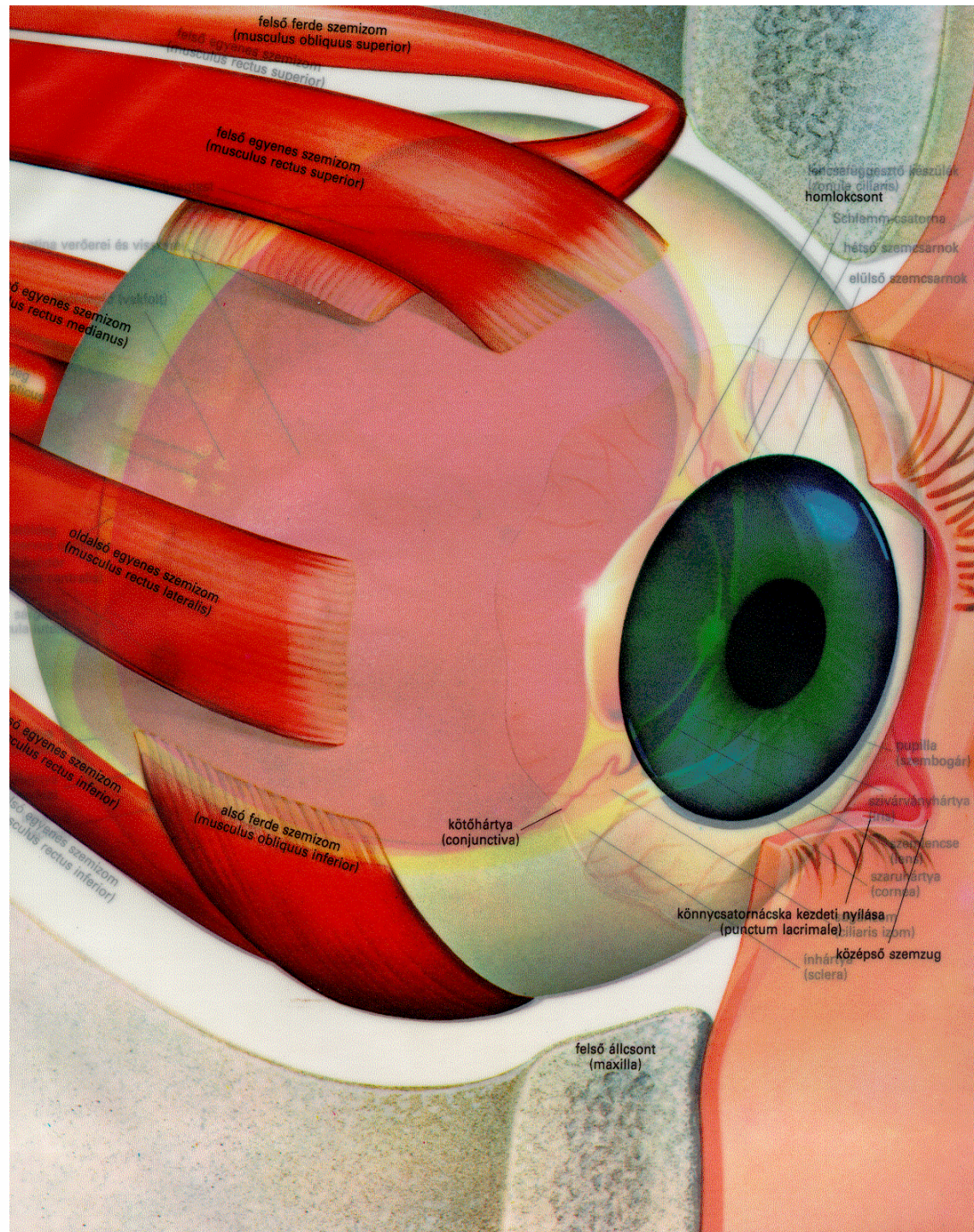


A látható fény hullámhossztartománya

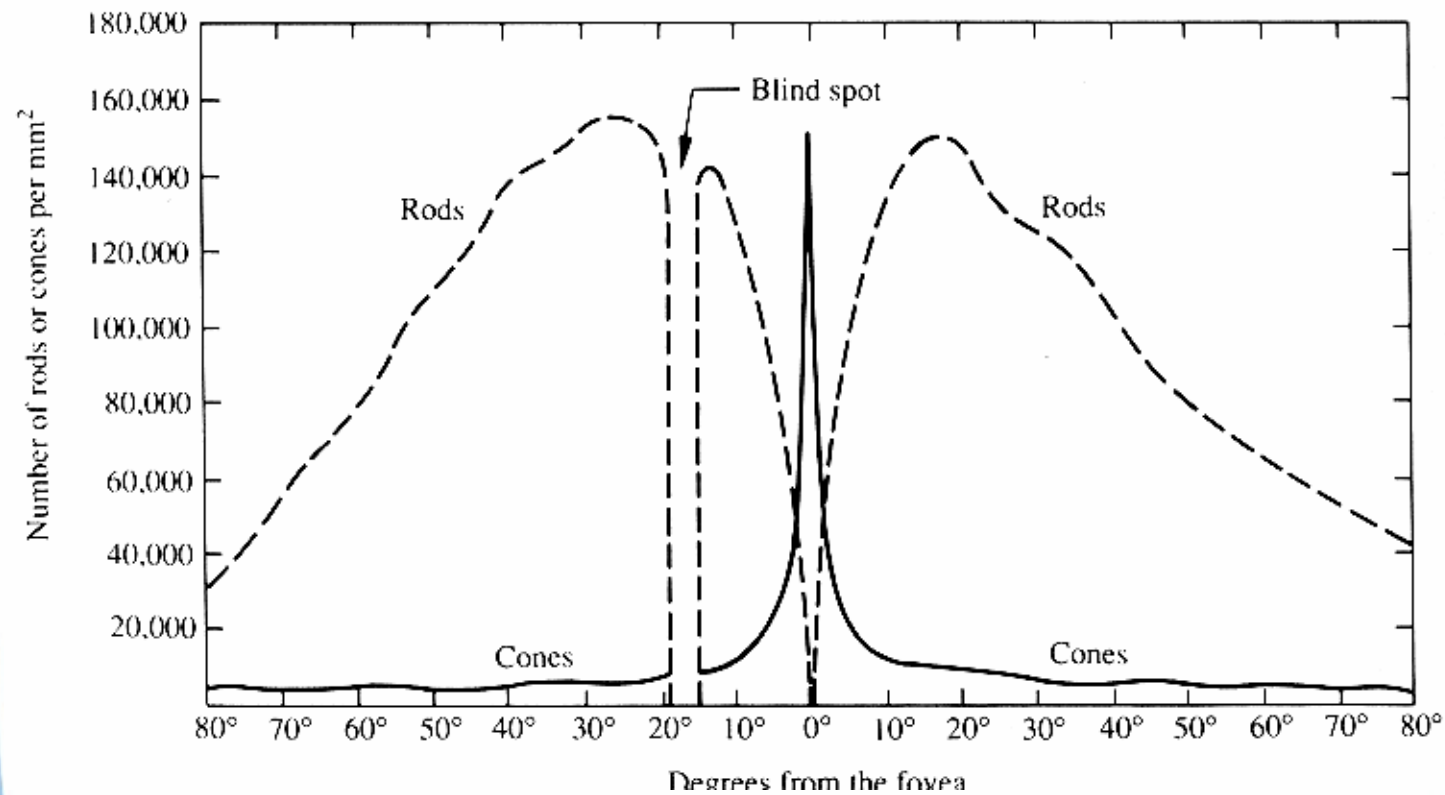




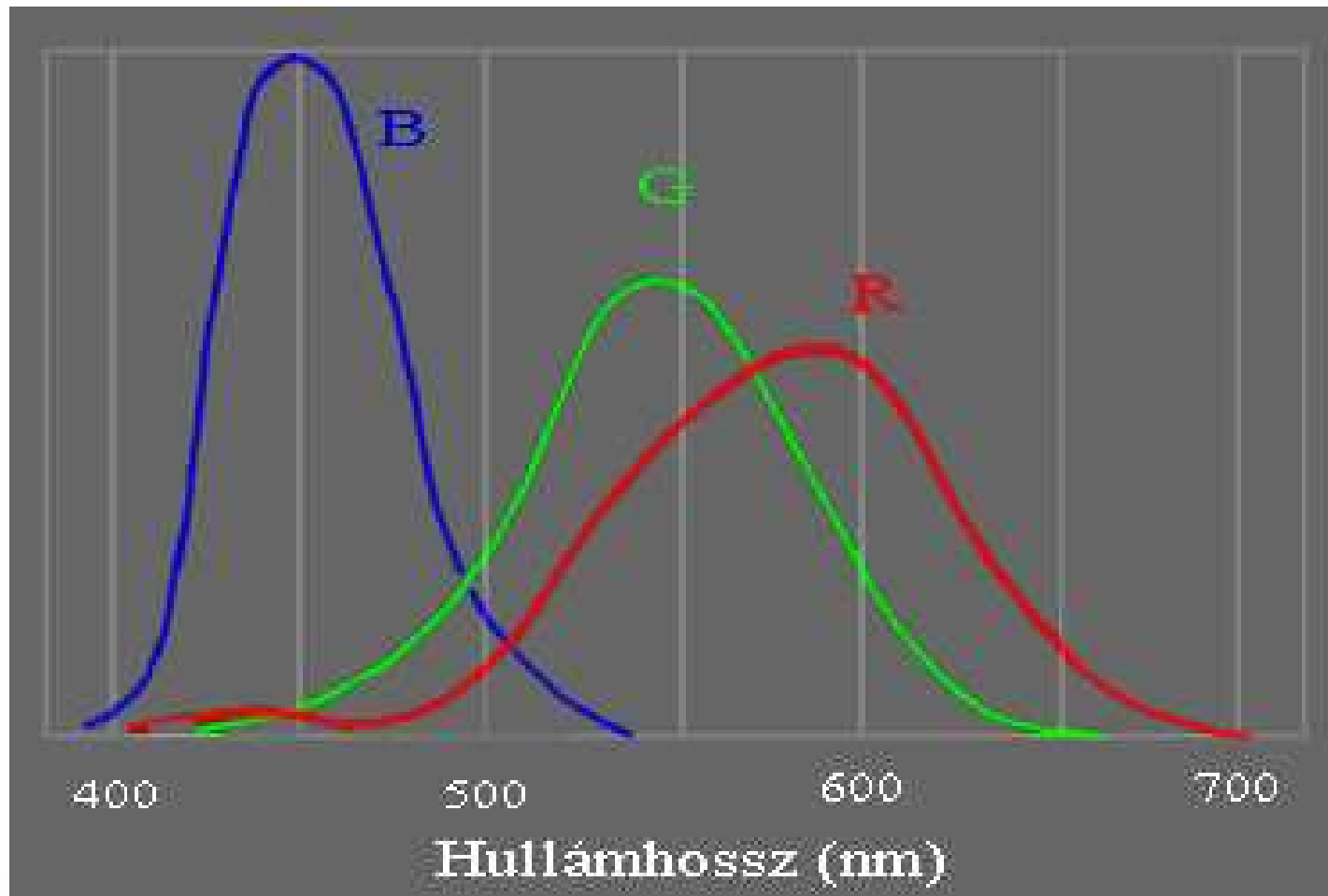




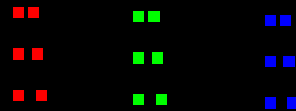
A csapok és pálcikák eloszlása

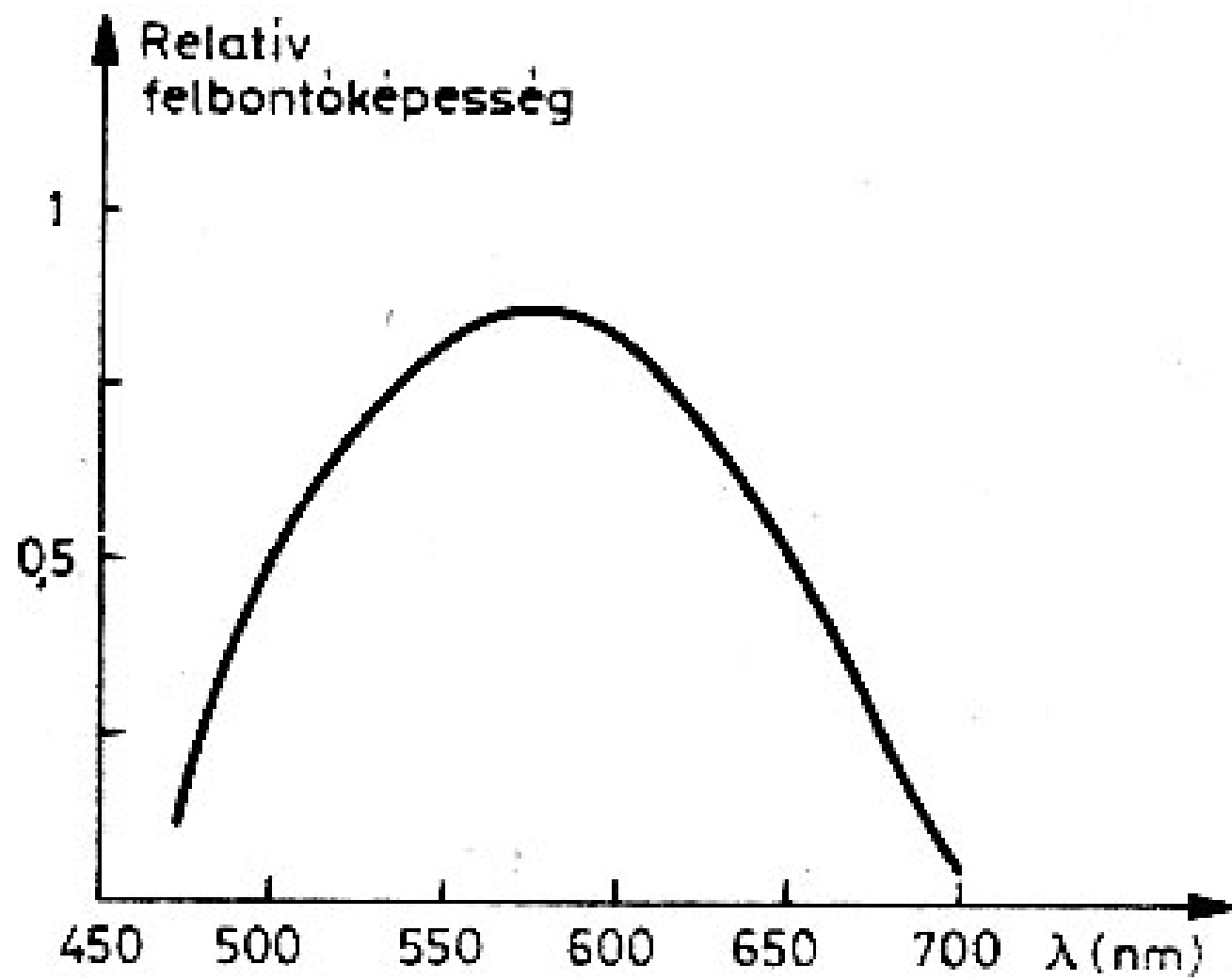


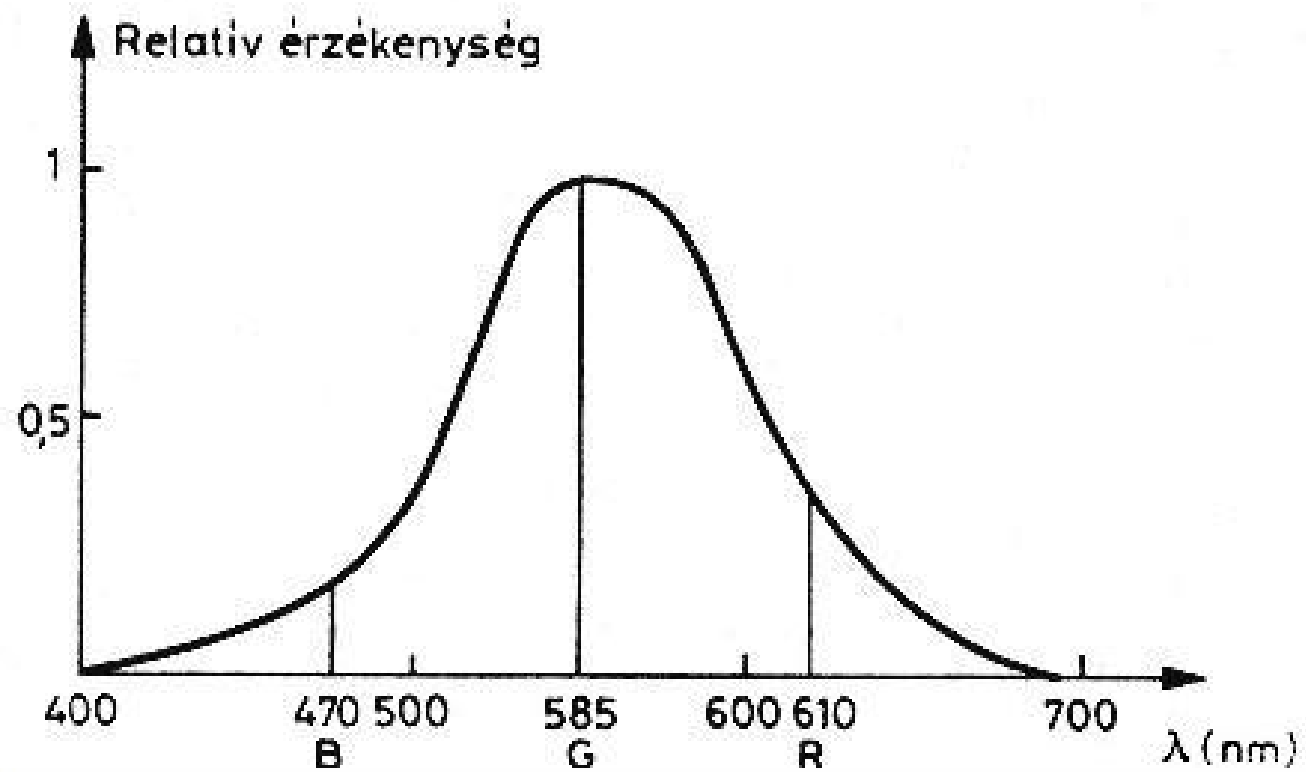
A csapok érzékenysége



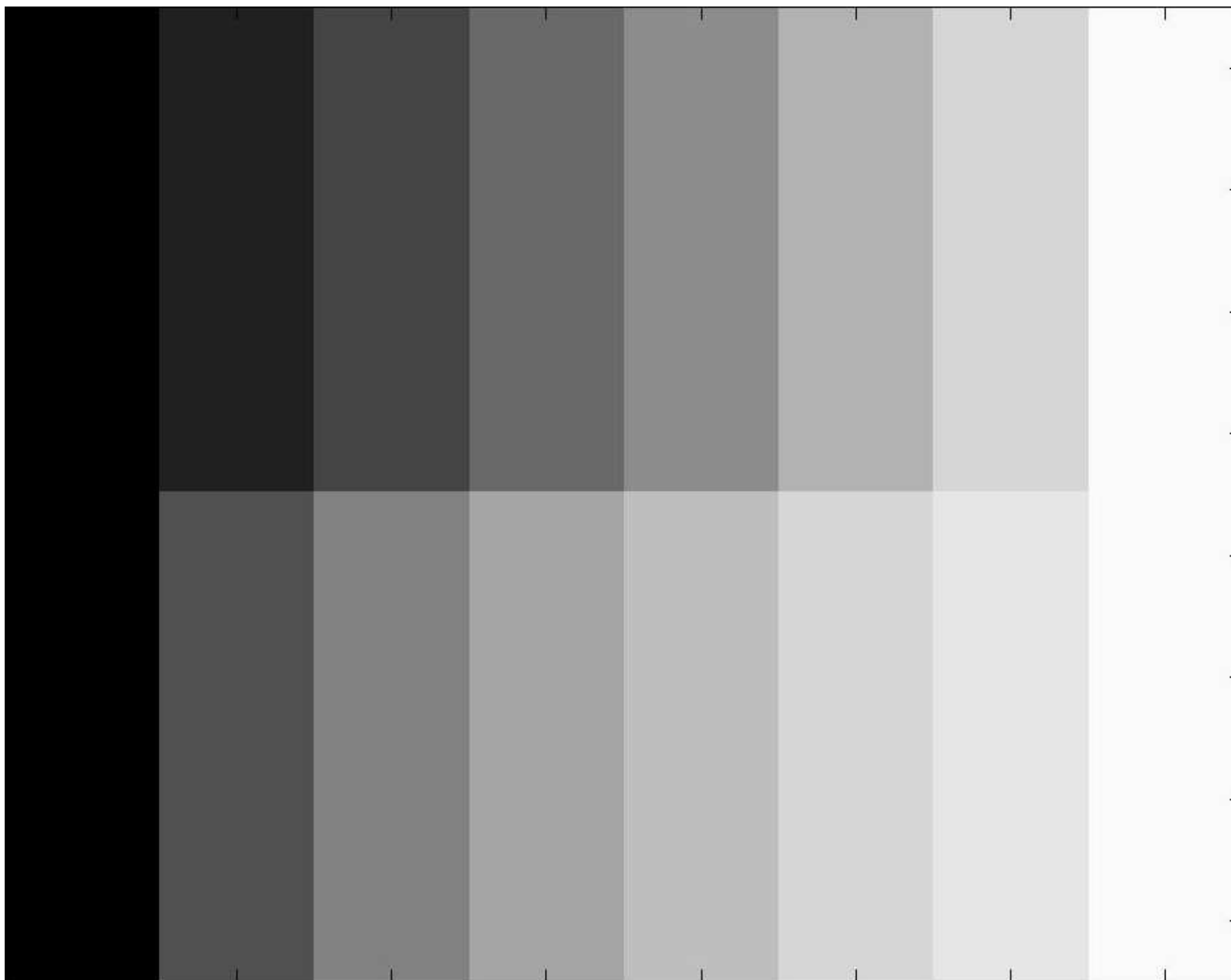
Nézze messziről!
A kék összemosódott?



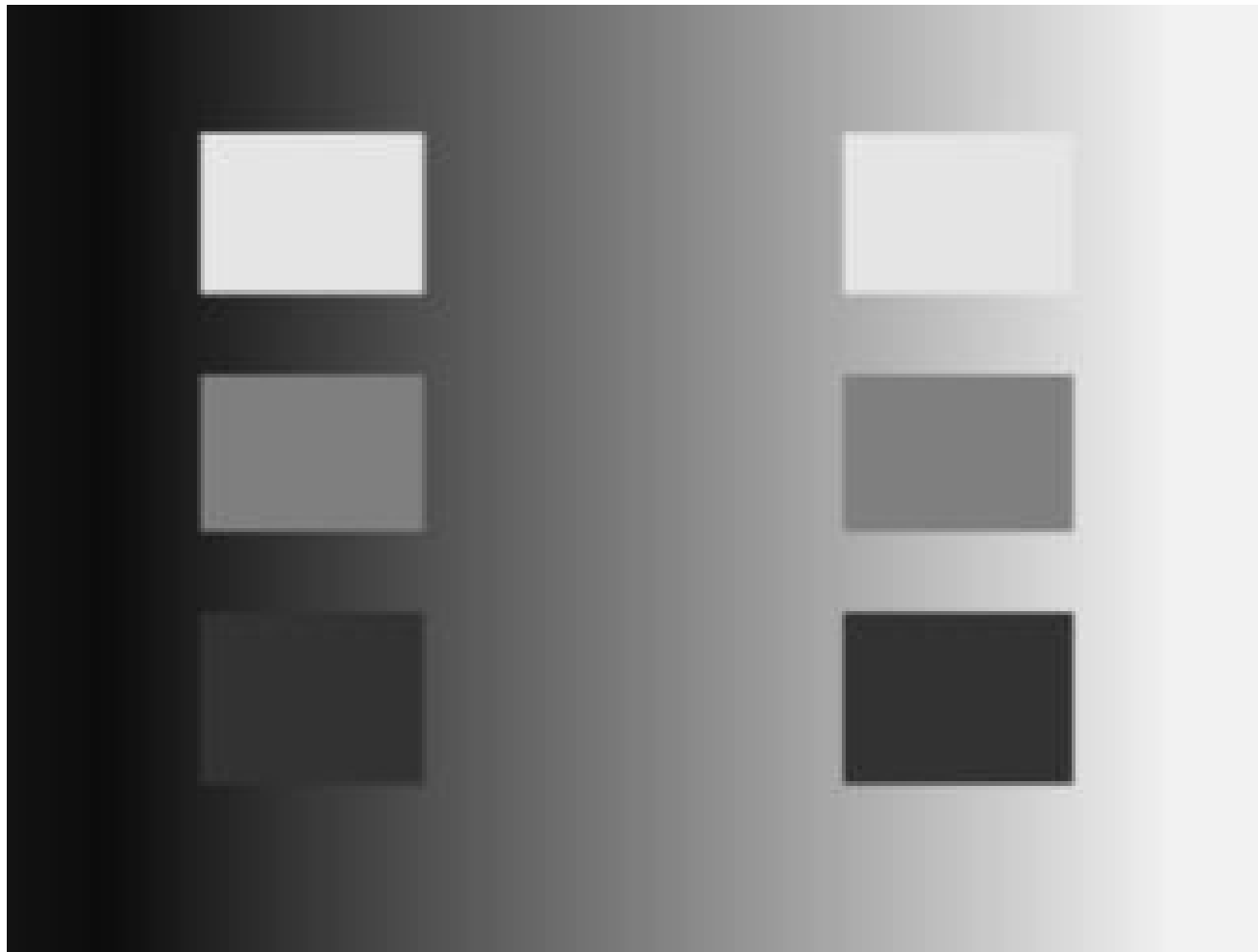




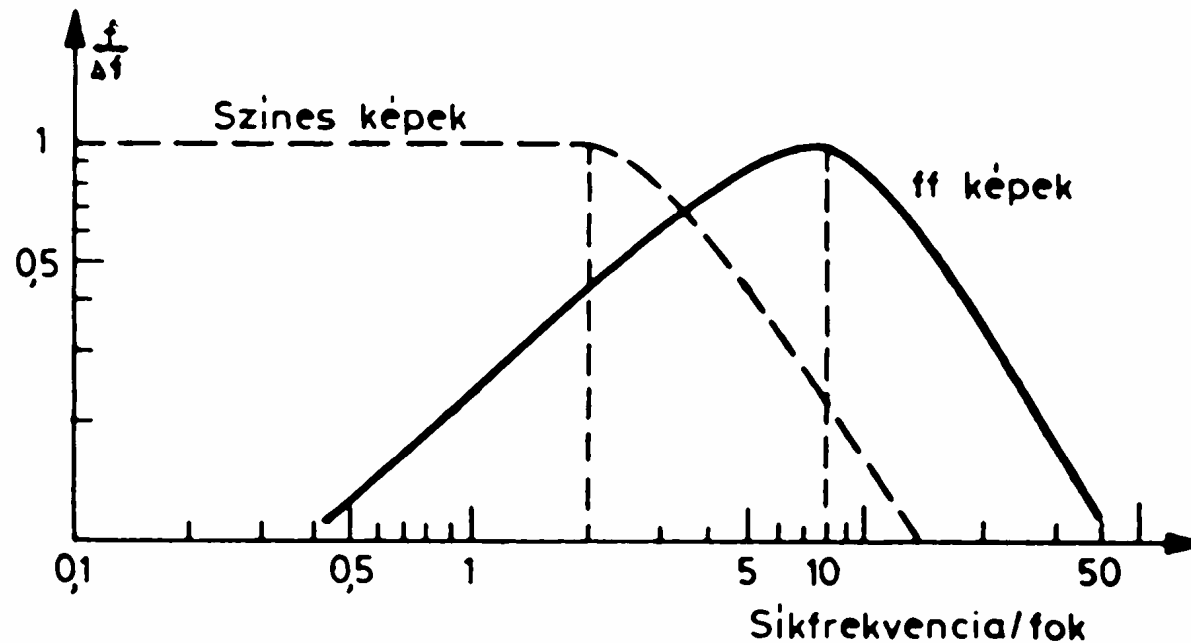
Lineáris és logaritmikus világosság skála



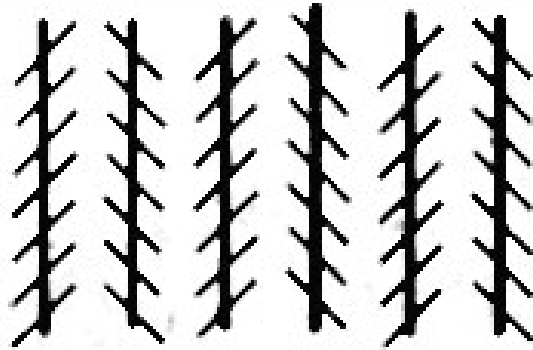
Melyik négyszög sötétebb?



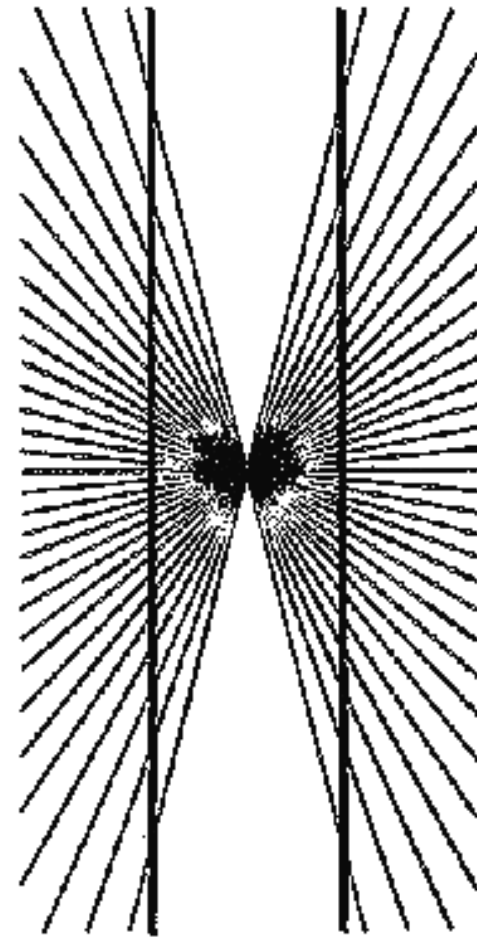
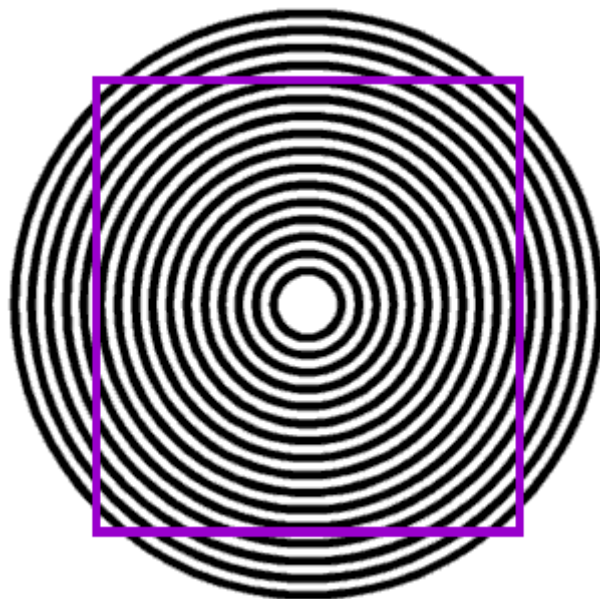
Síkfrekvenciás érzékenységünk



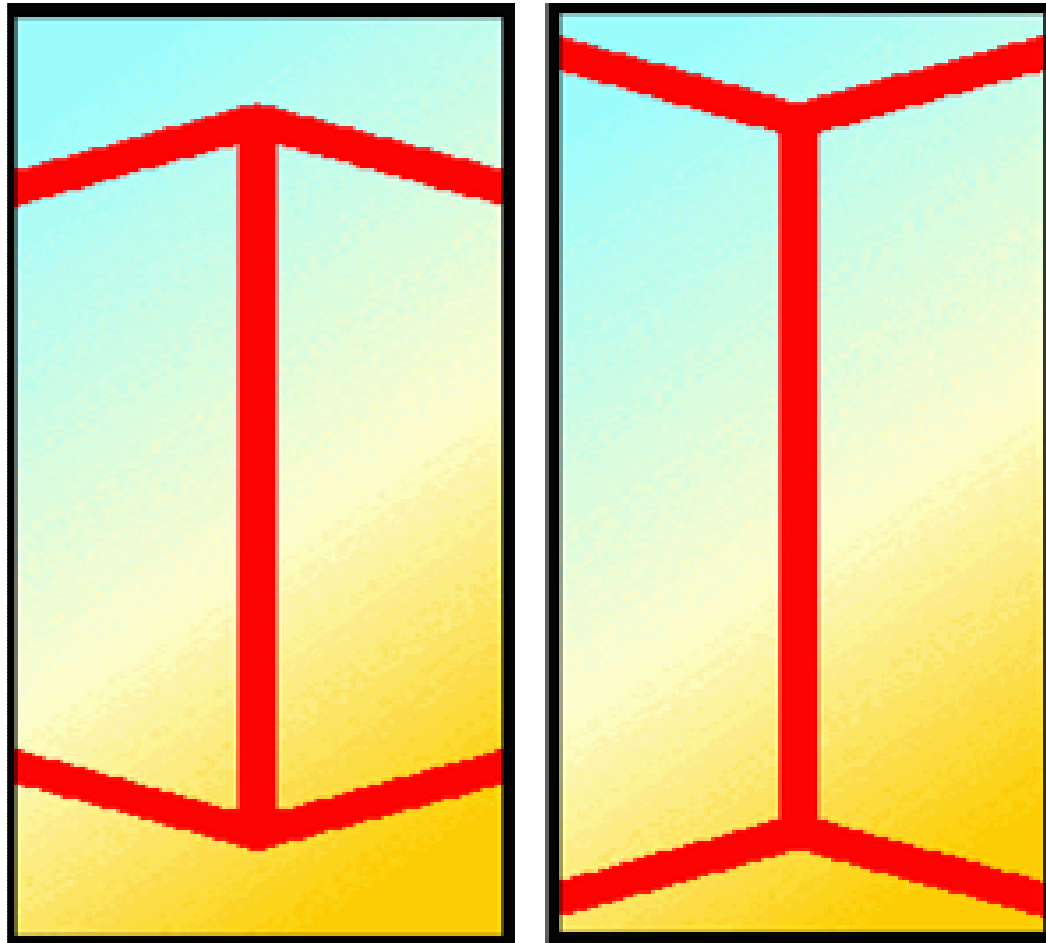
Egyenes? Görbe? Ferde?



b)

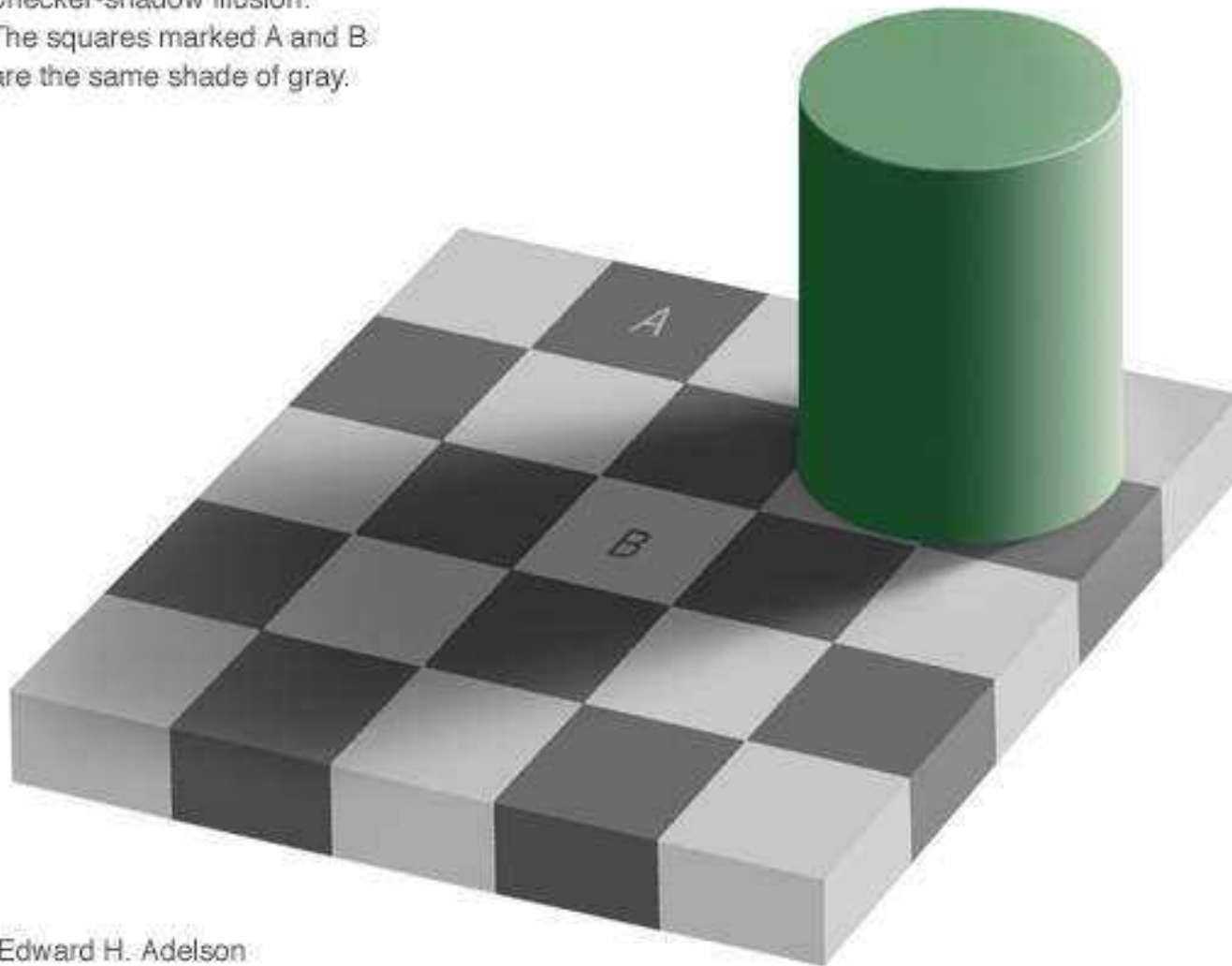


Melyik hosszabb?



Az A vagy a B sötétebb?

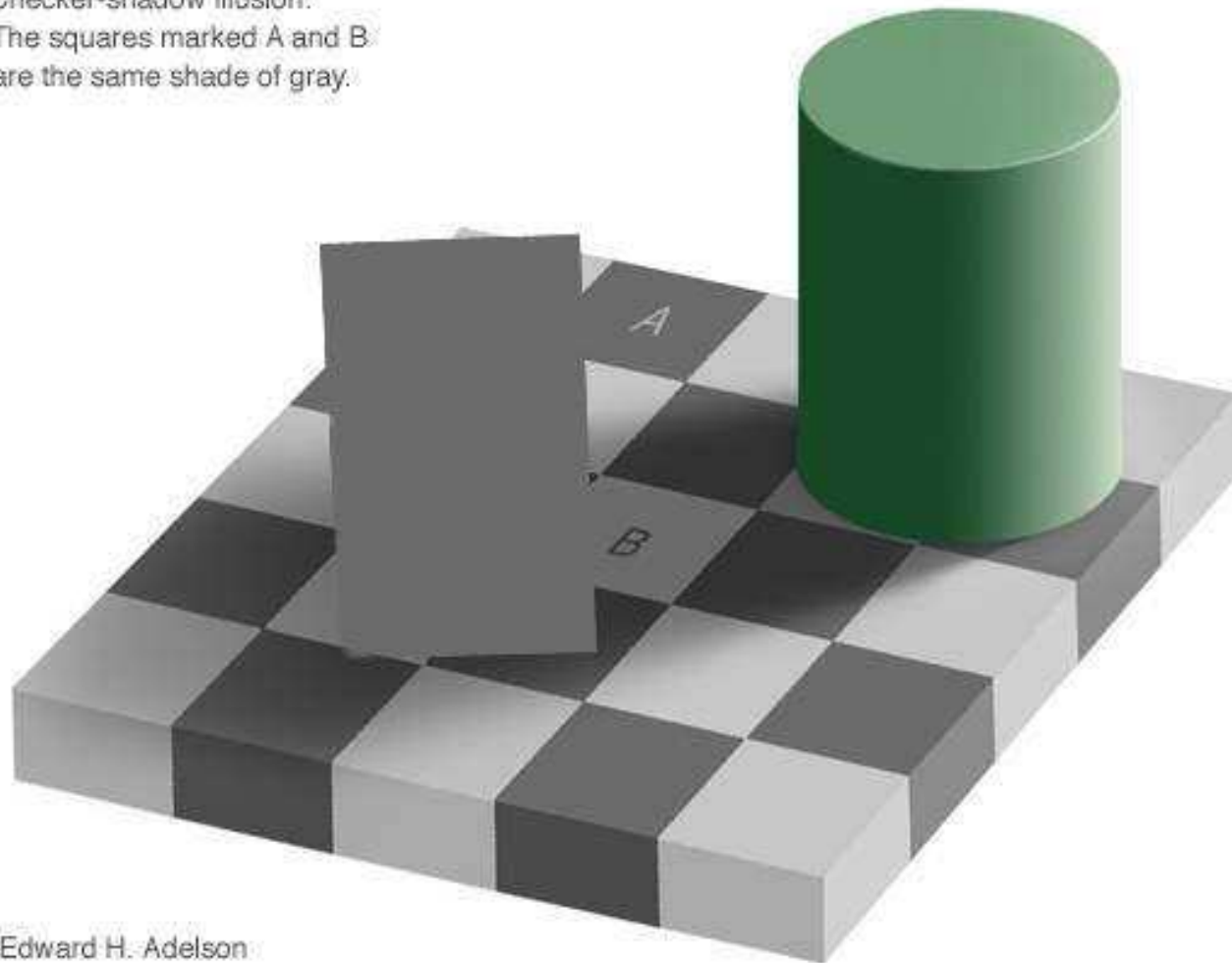
Checker-shadow illusion:
The squares marked A and B
are the same shade of gray.



Edward H. Adelson

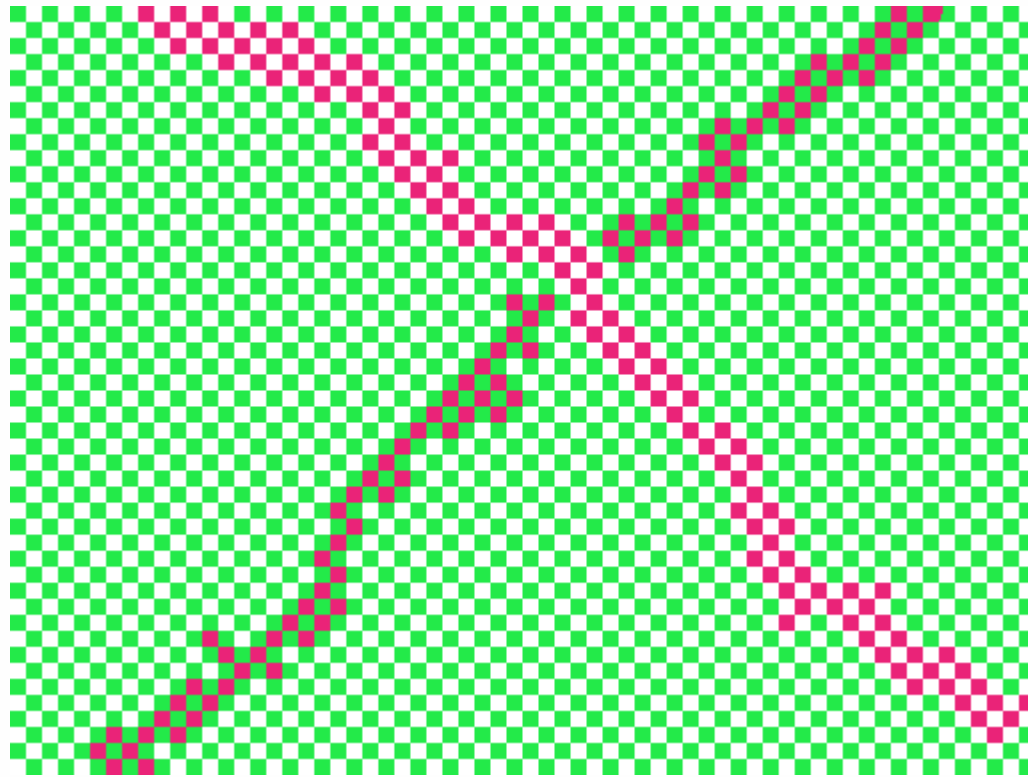
Biztos?

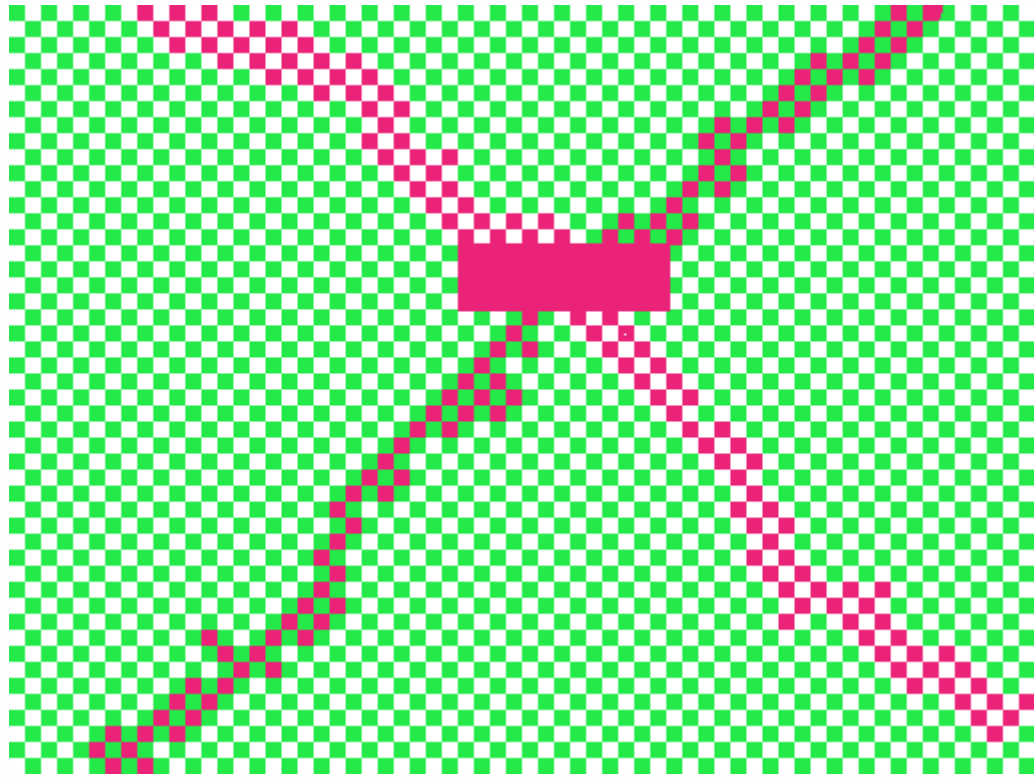
Checker-shadow illusion:
The squares marked A and B
are the same shade of gray.



Edward H. Adelson

Piros? Ciklámen?





A sötét, vagy a világos a tárgy?



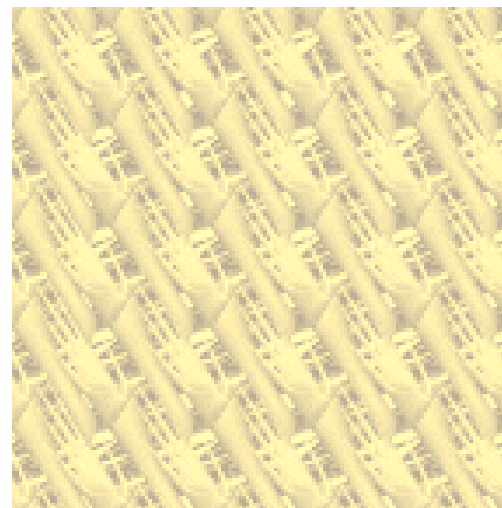
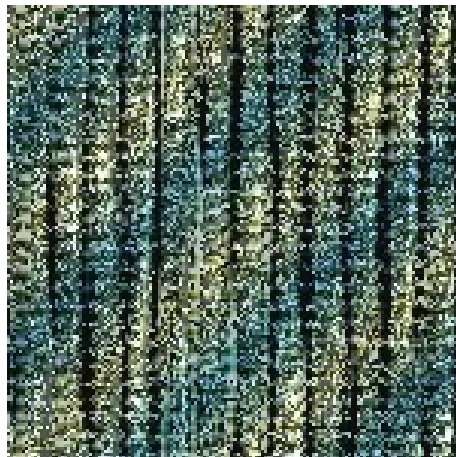
Mi itt a háttér?

STAIN

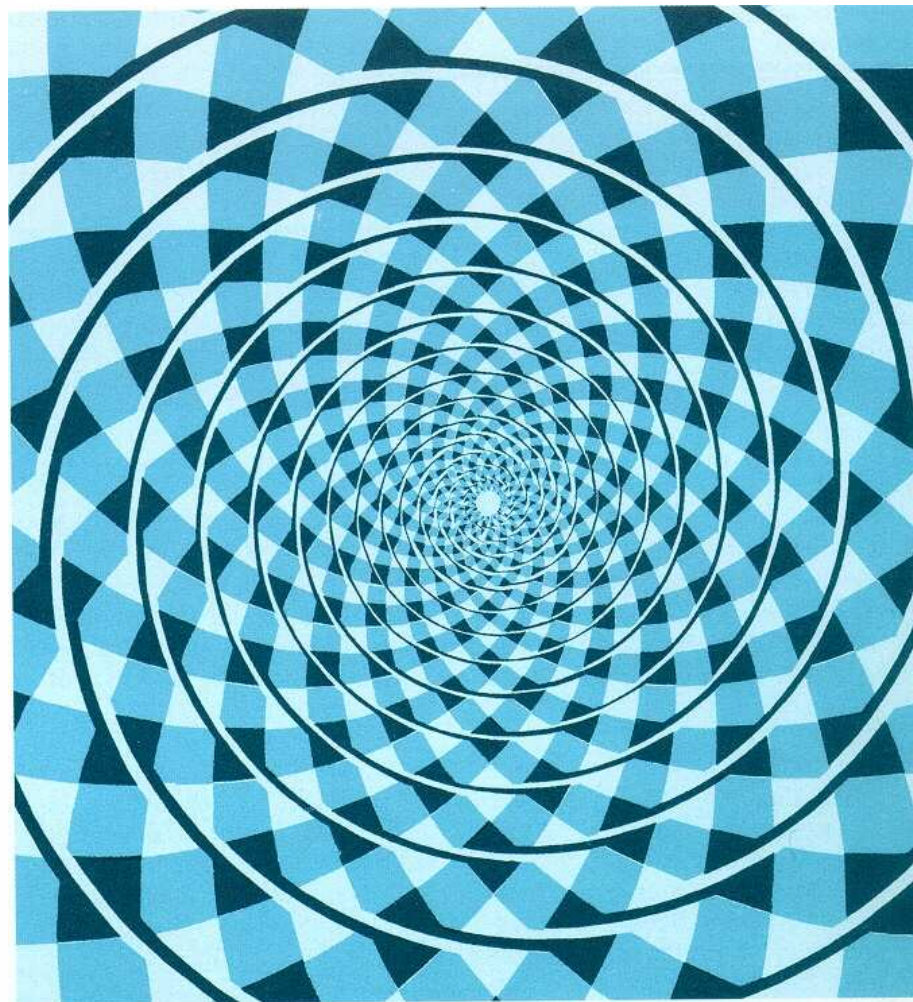
HYSTON

1999-2000 2001-2002

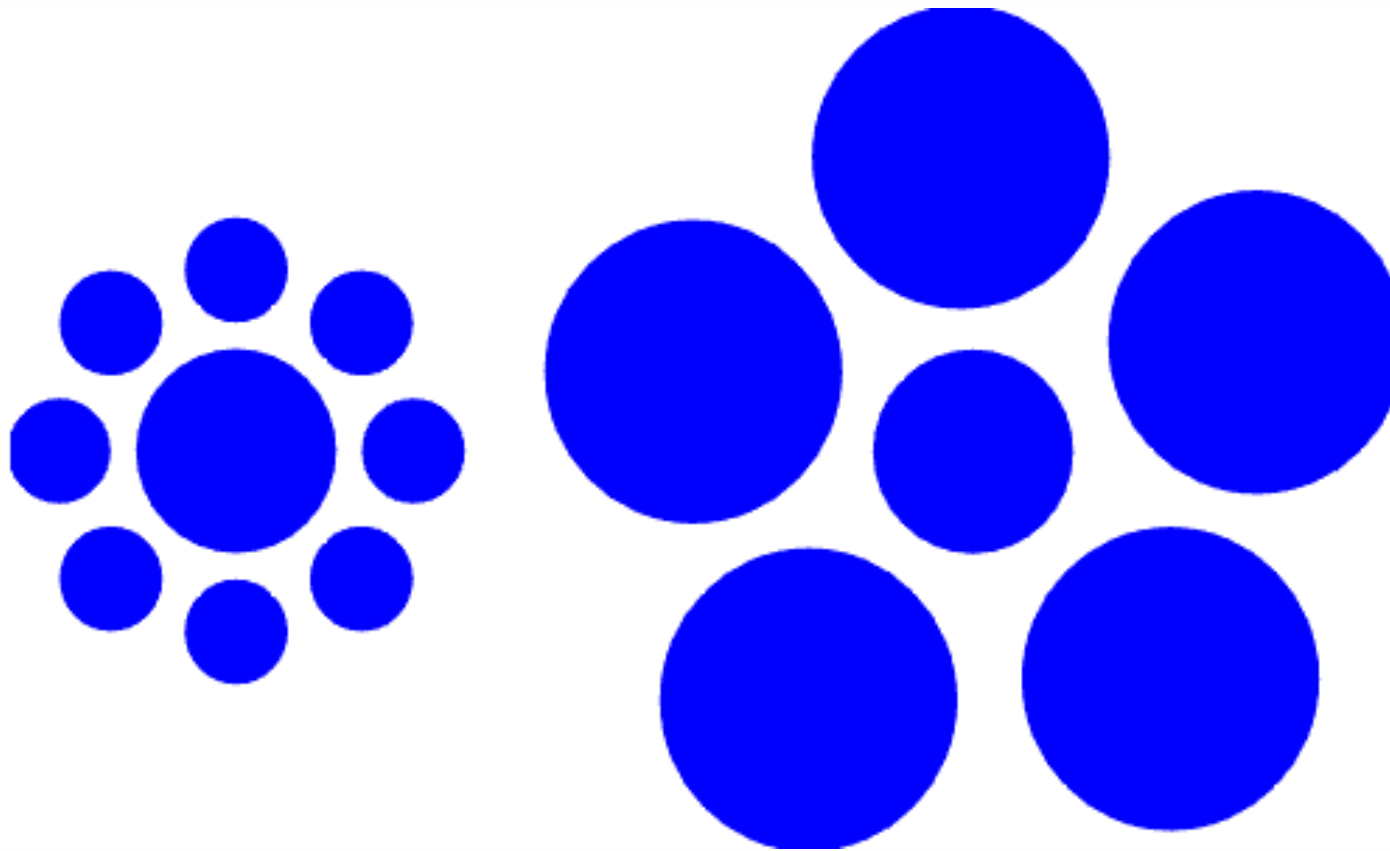
Textúrák

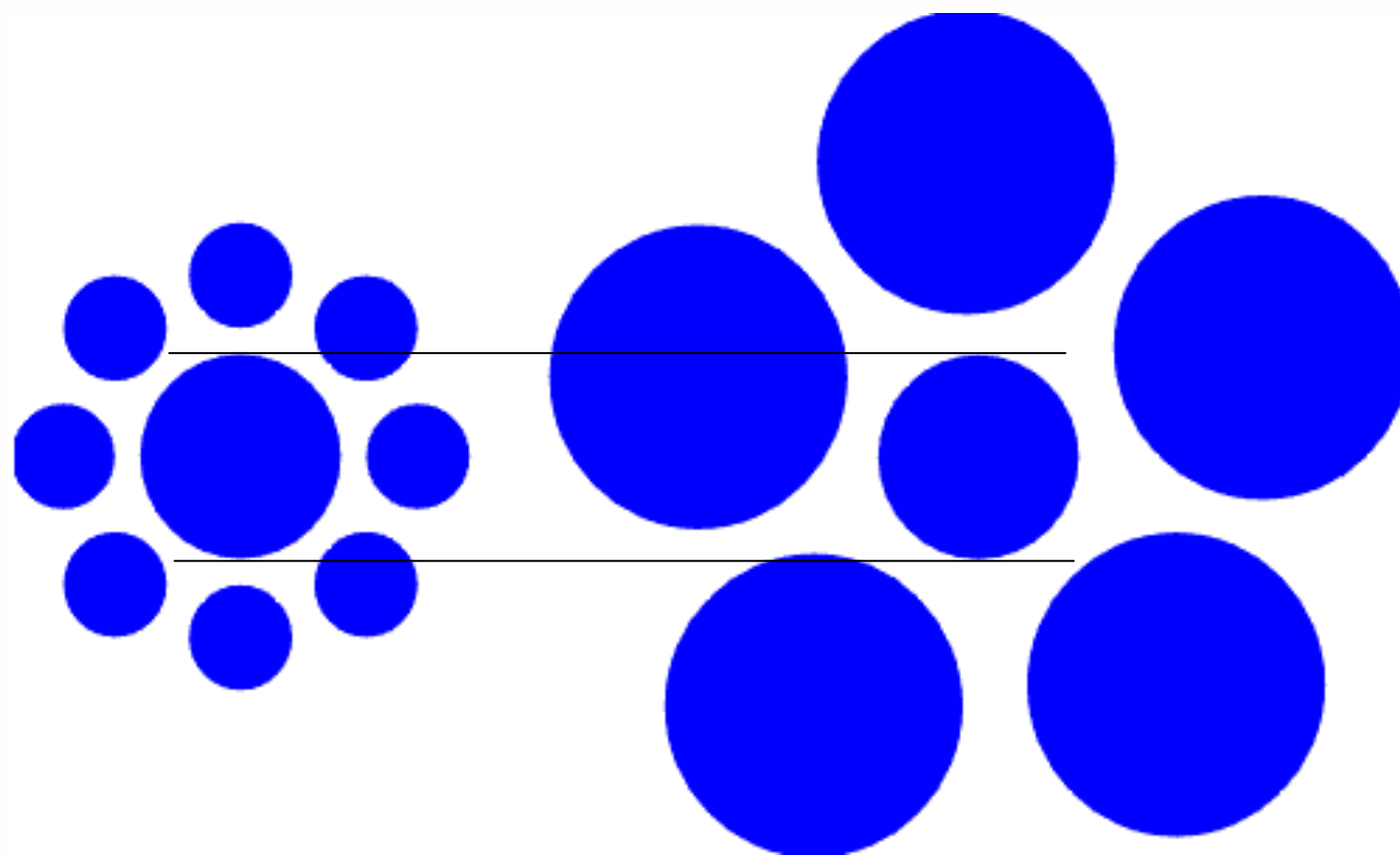


Spirál?

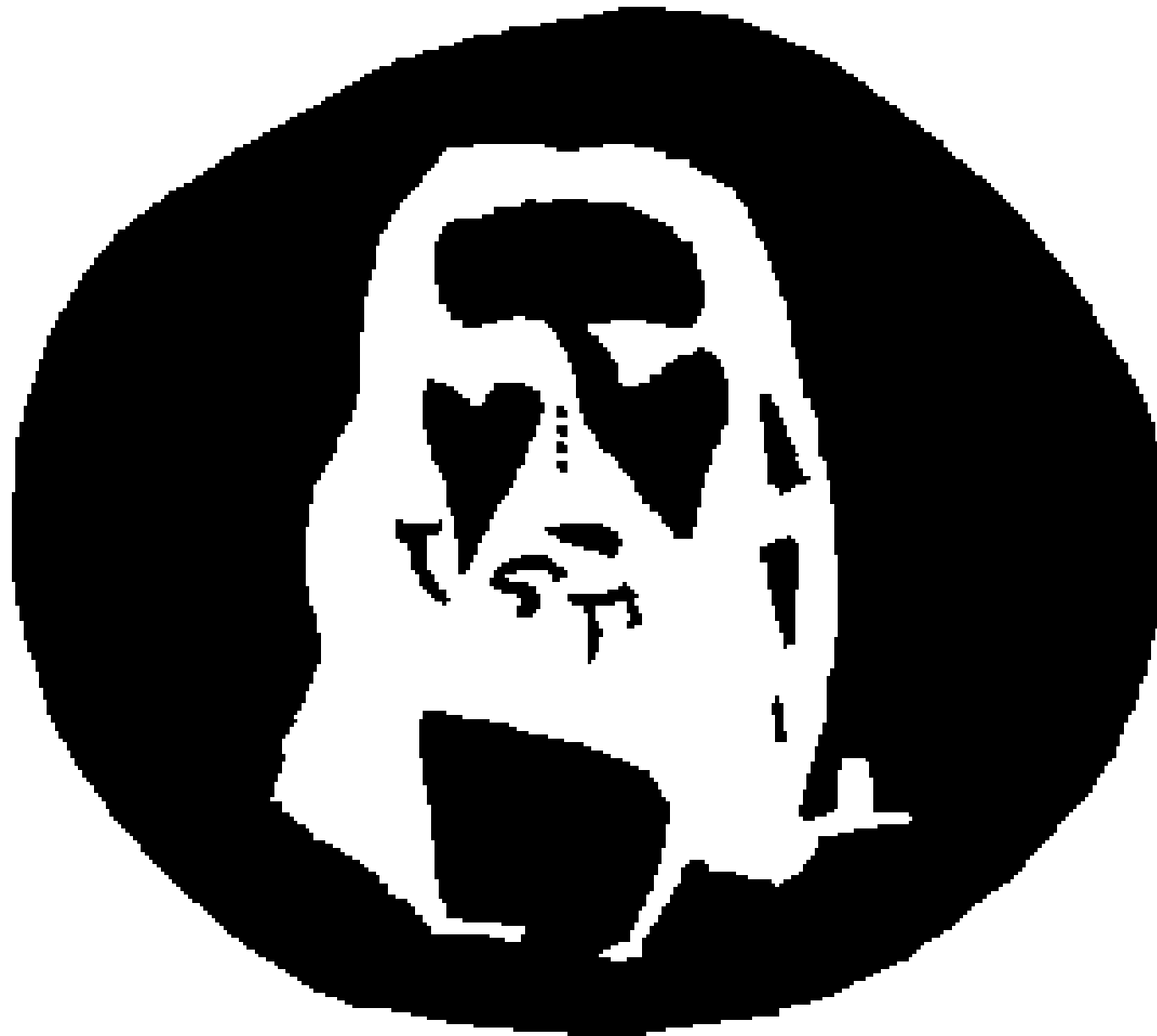


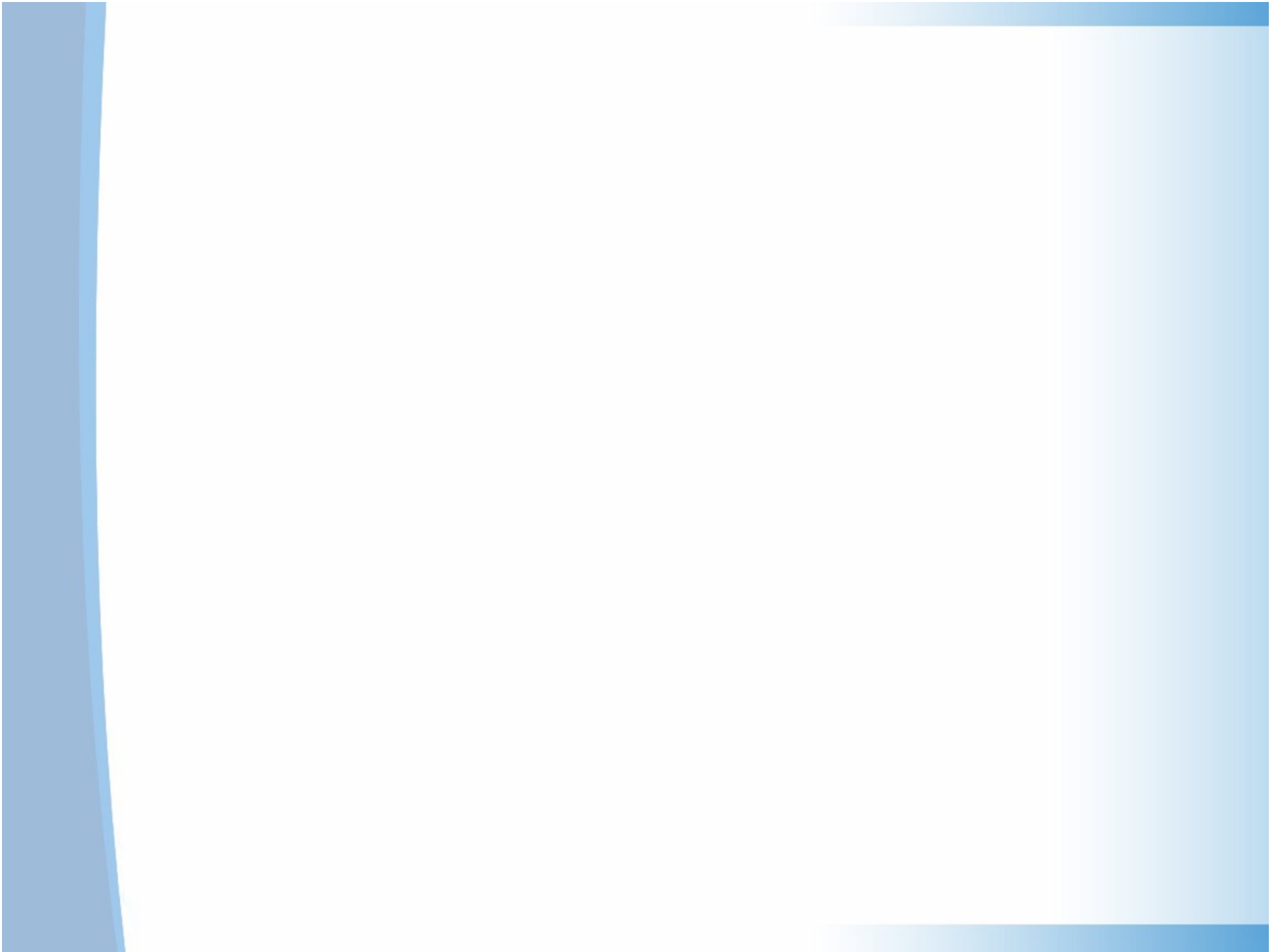
Melyik középső kör nagyobb?

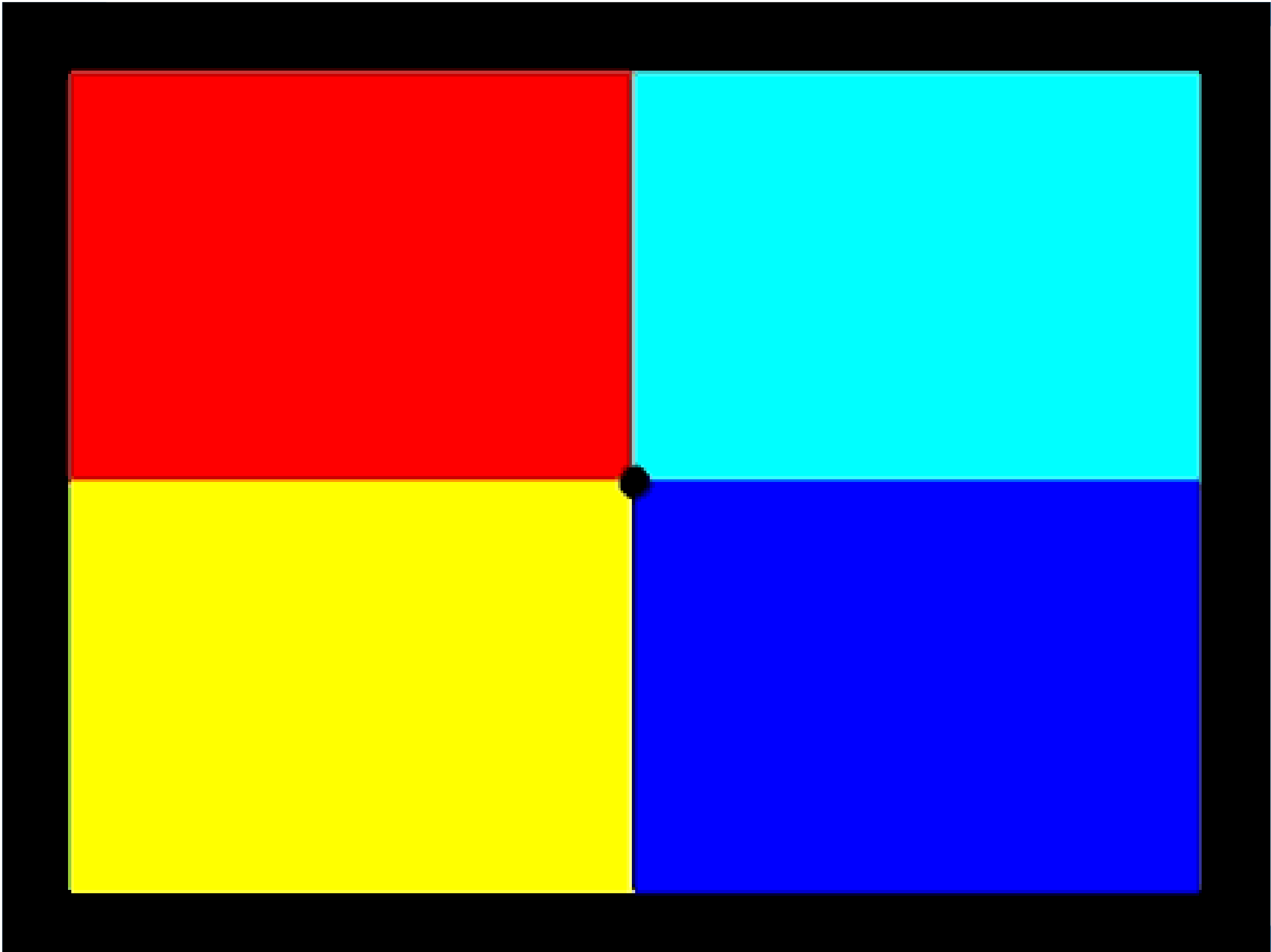




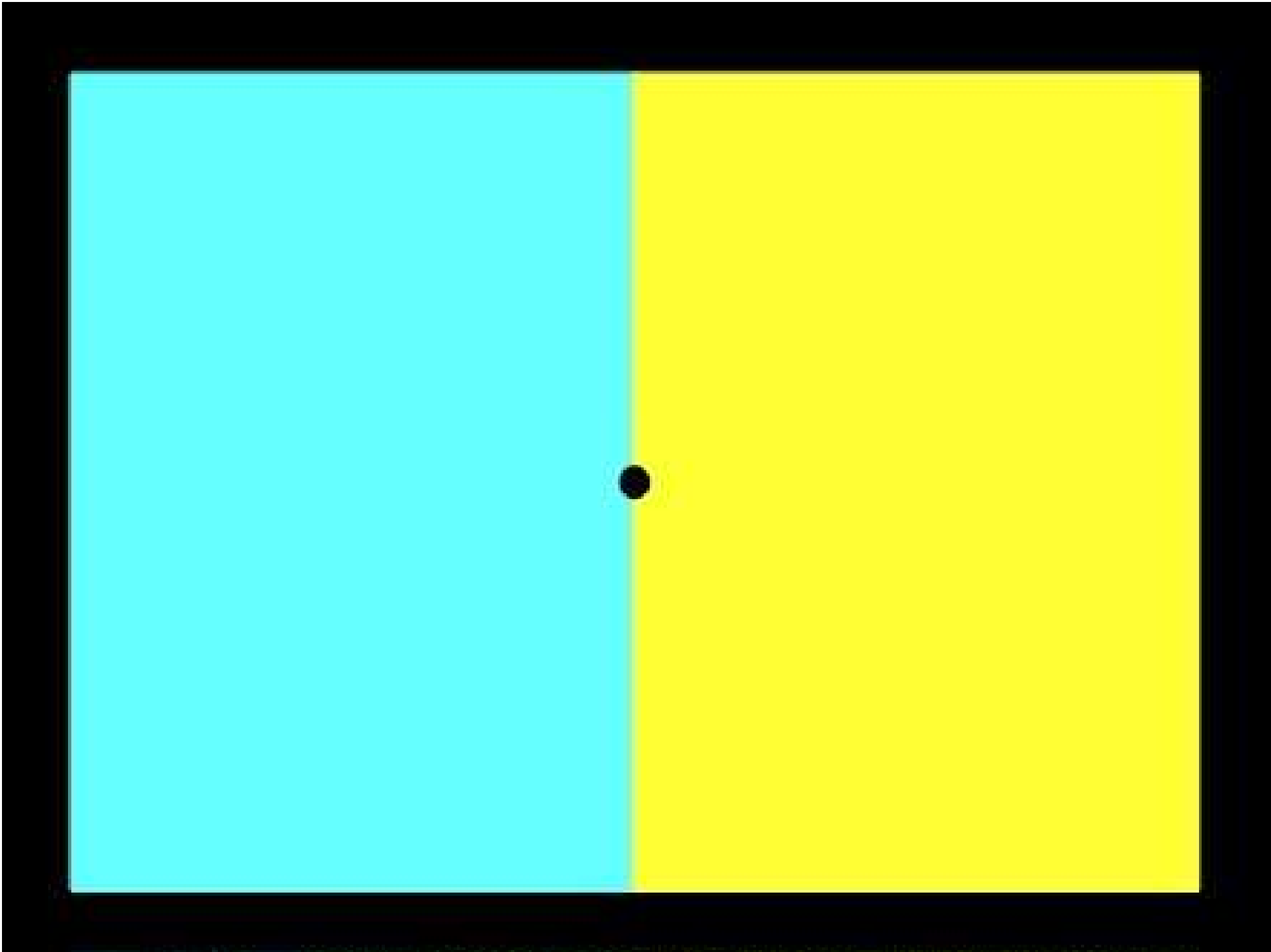
Nézze 20-30 másodpercig
a kép közepét, utána váltson!







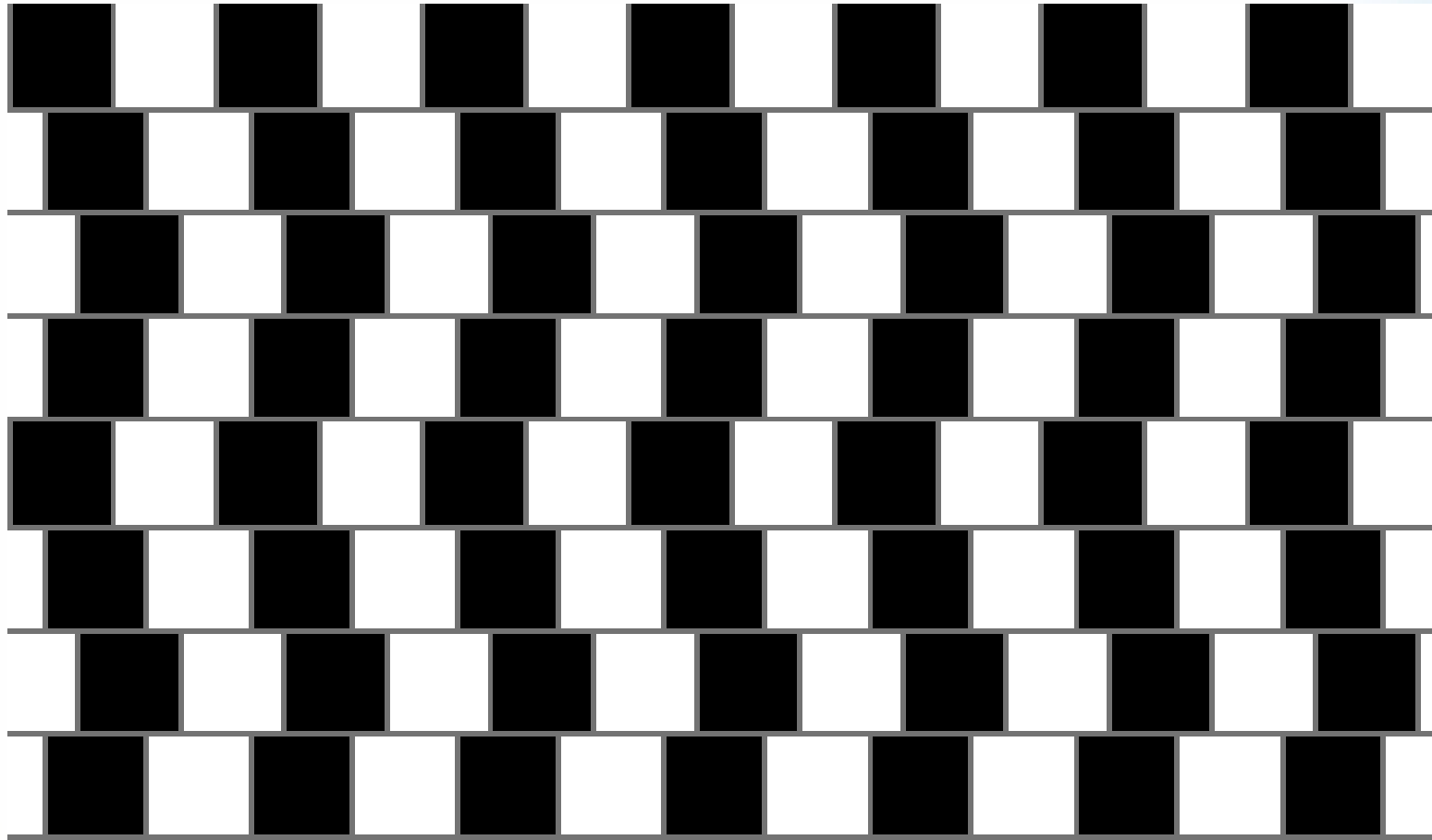


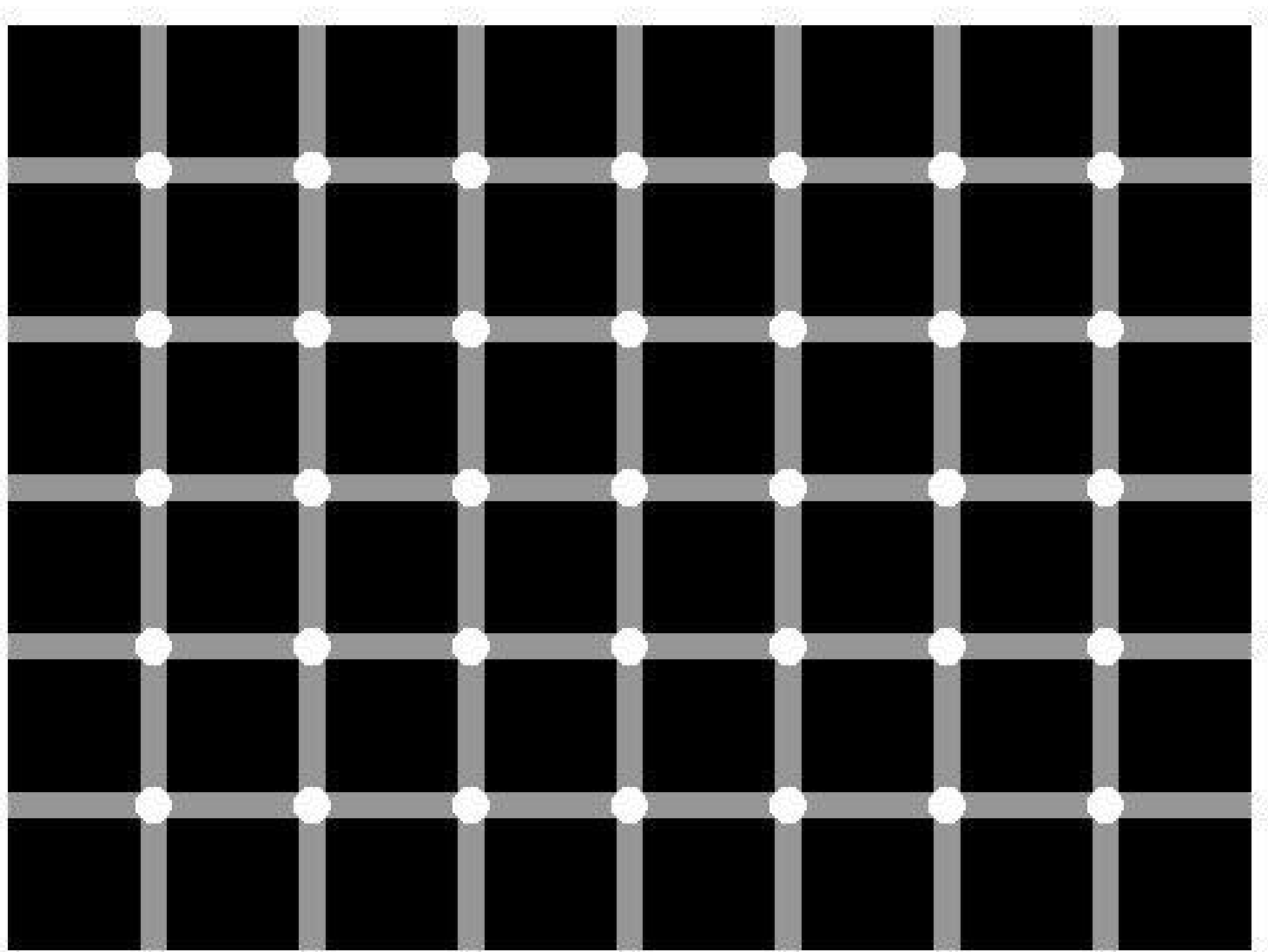




Elhívna randevúra?

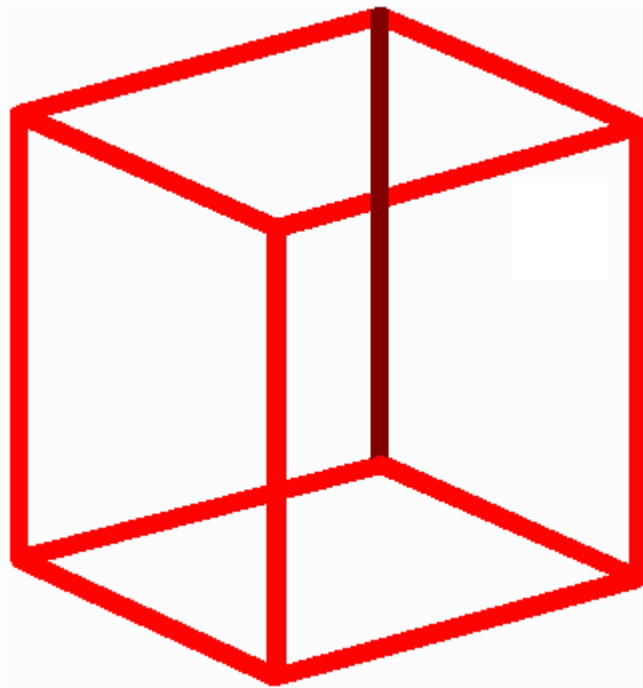




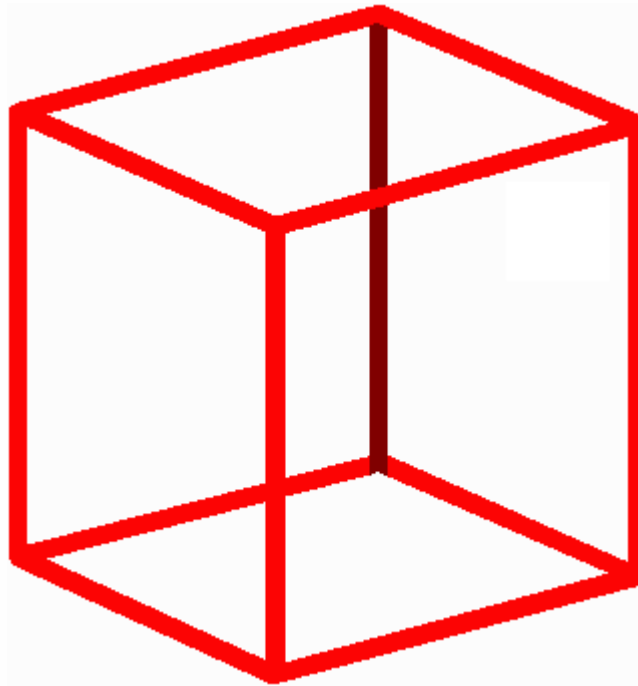




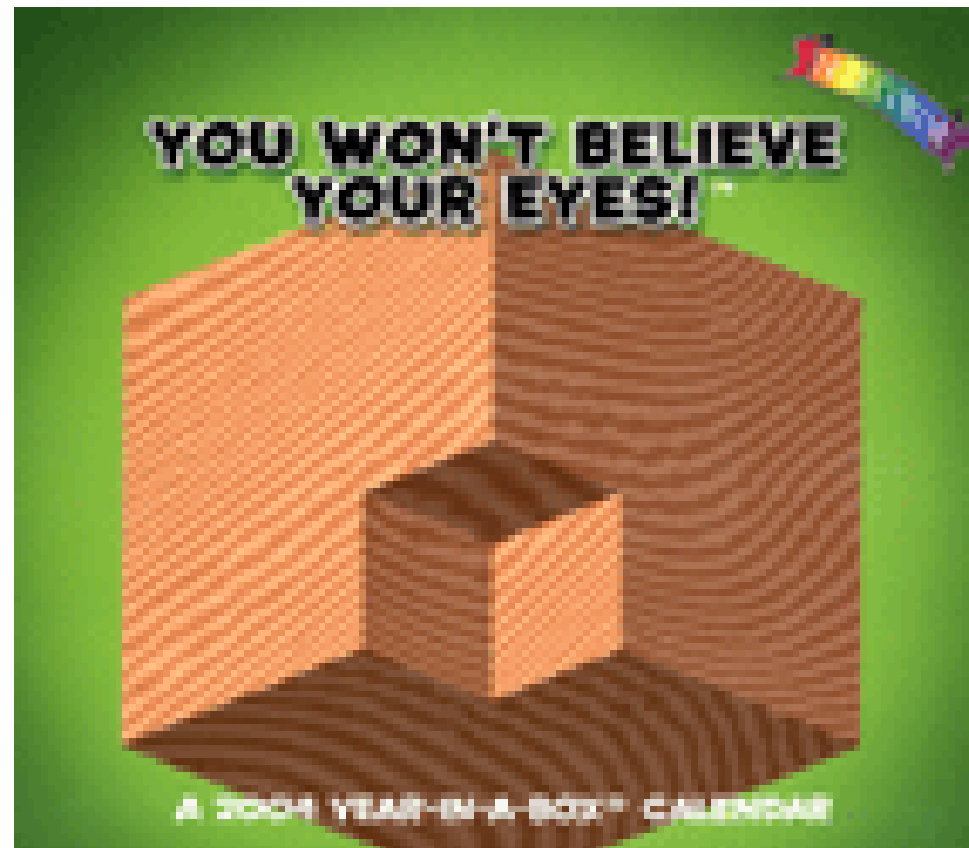
A sötét él van elől



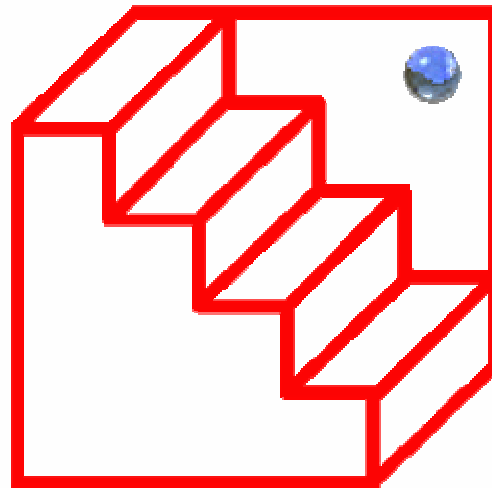
A sötét él van hátul

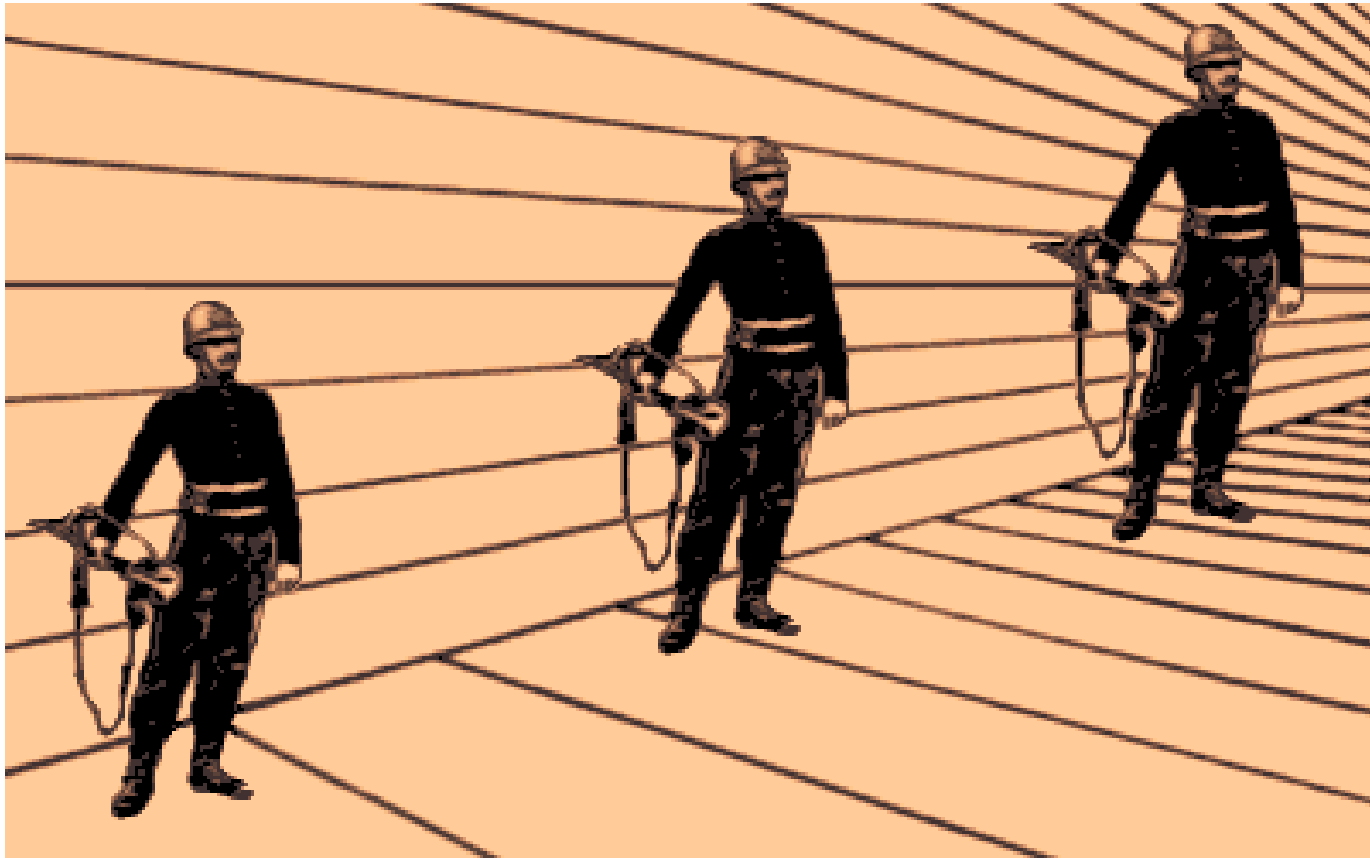


Hiányzik a kis kocka,
vagy kiemelkedik?



Alulról vagy felülről
látjuk a lépcsőt?

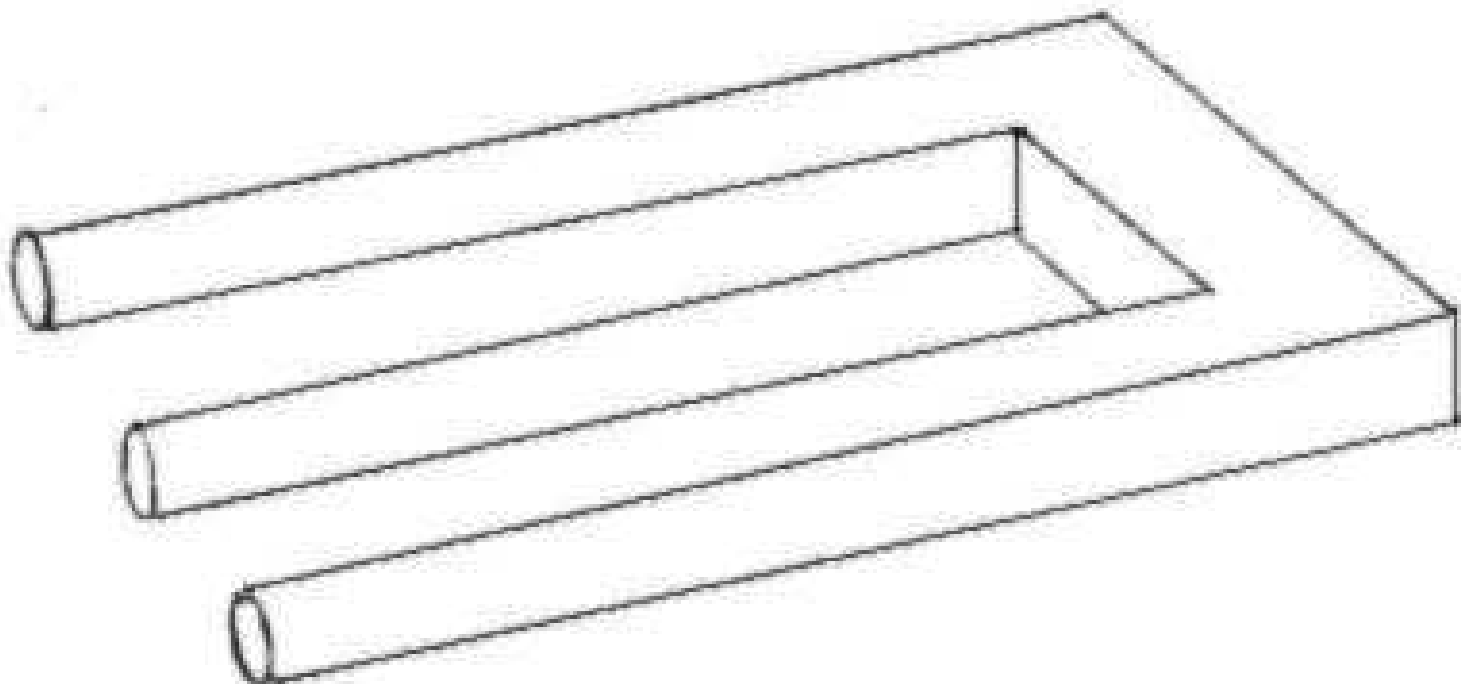




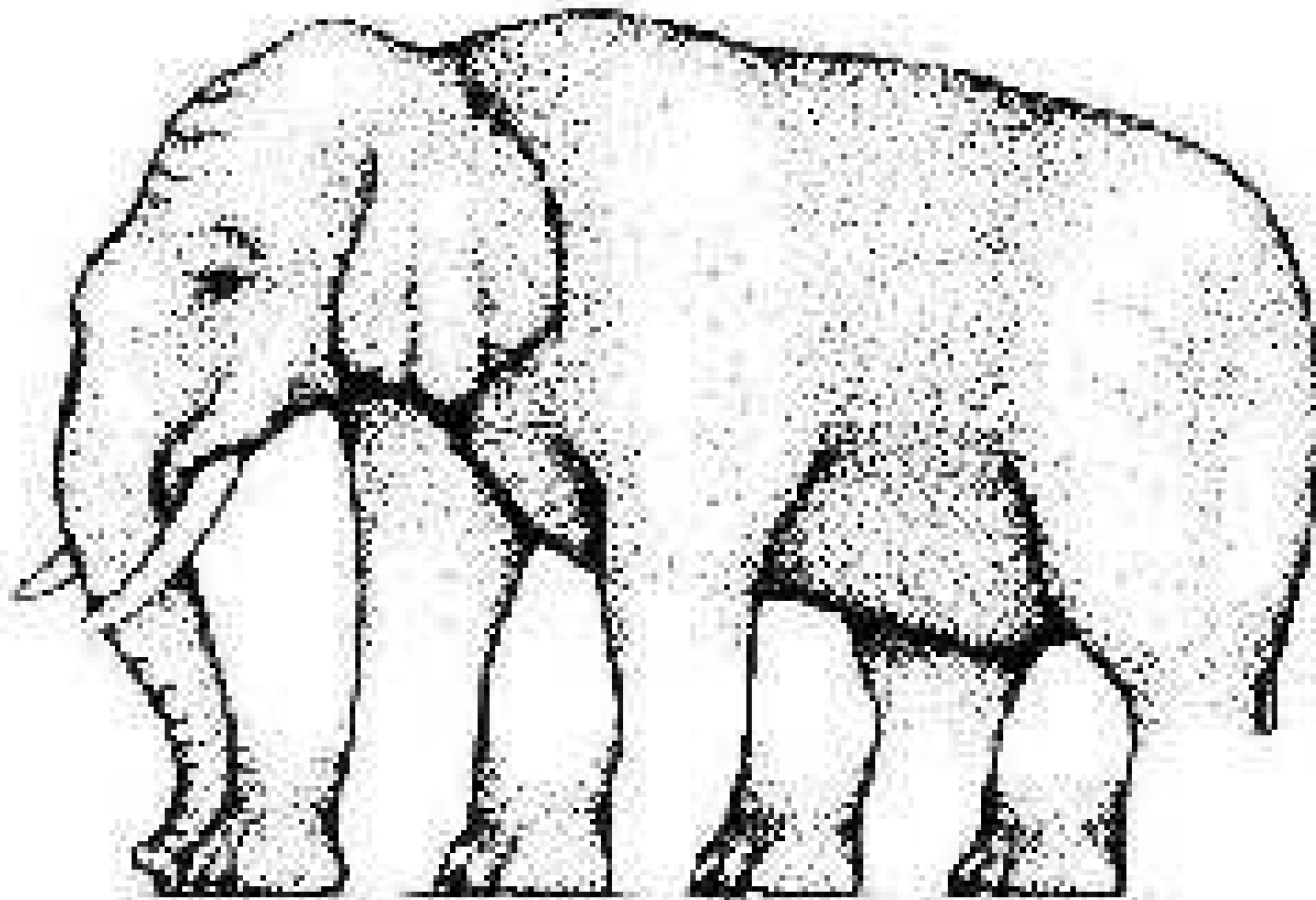


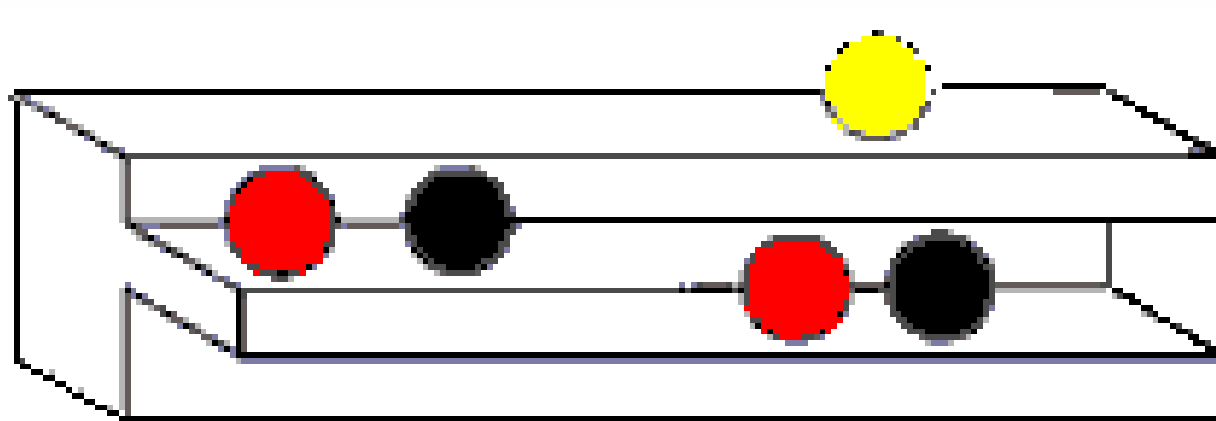


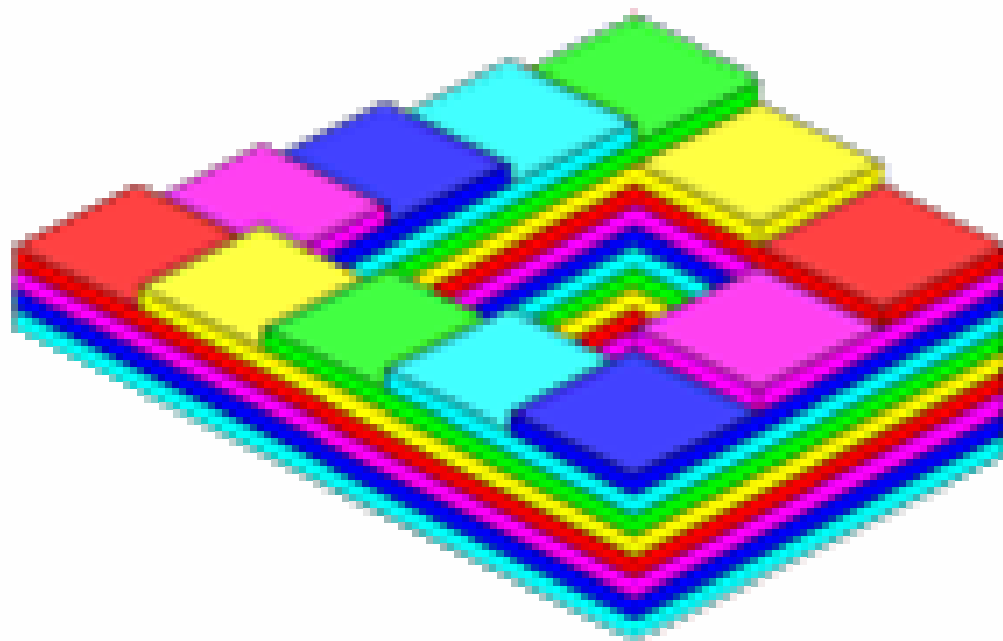




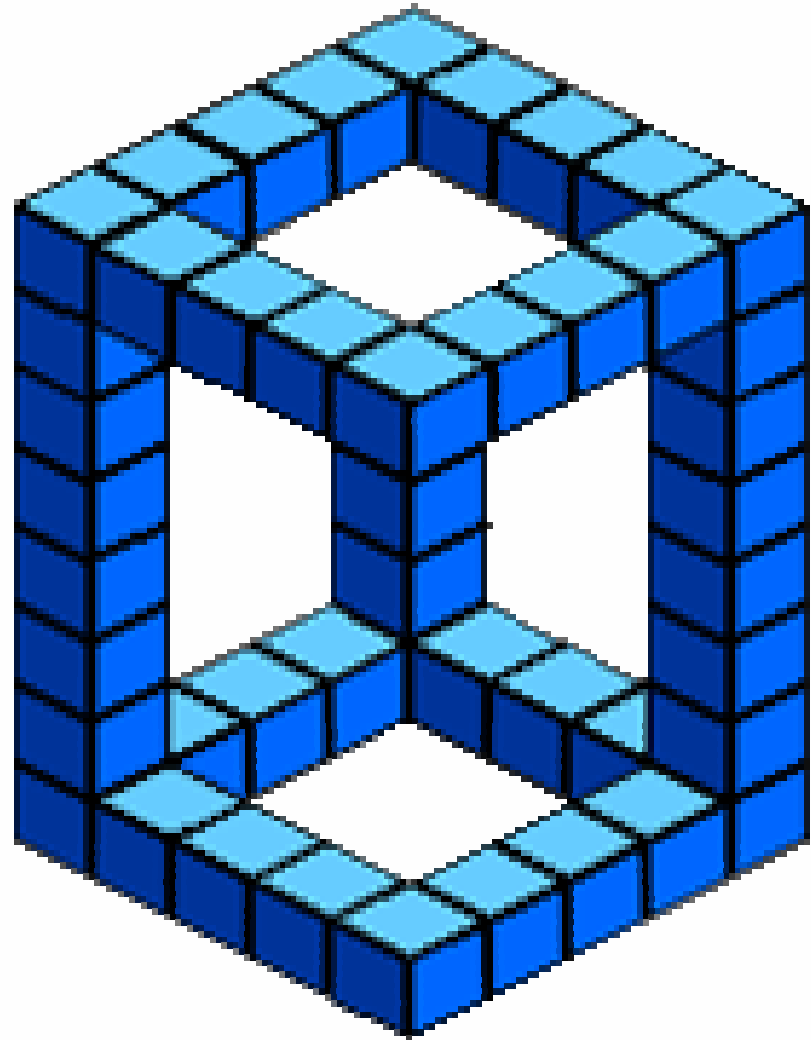
















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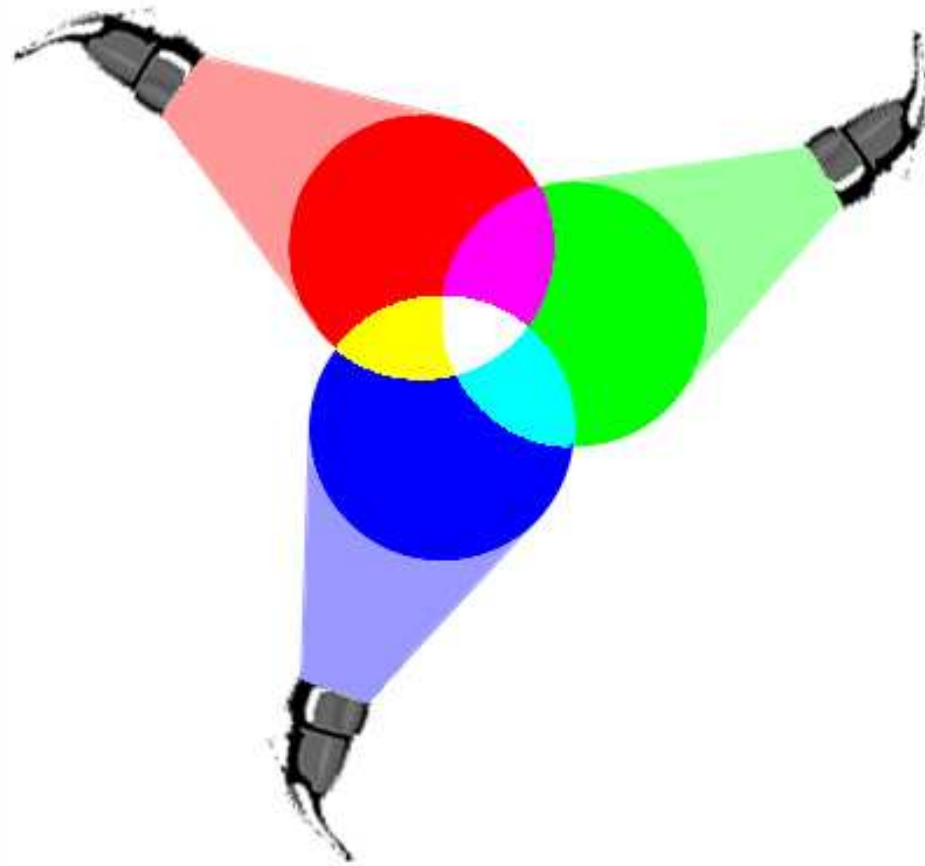
Képfeldolgozás 2. Színrendszerek

Czap László

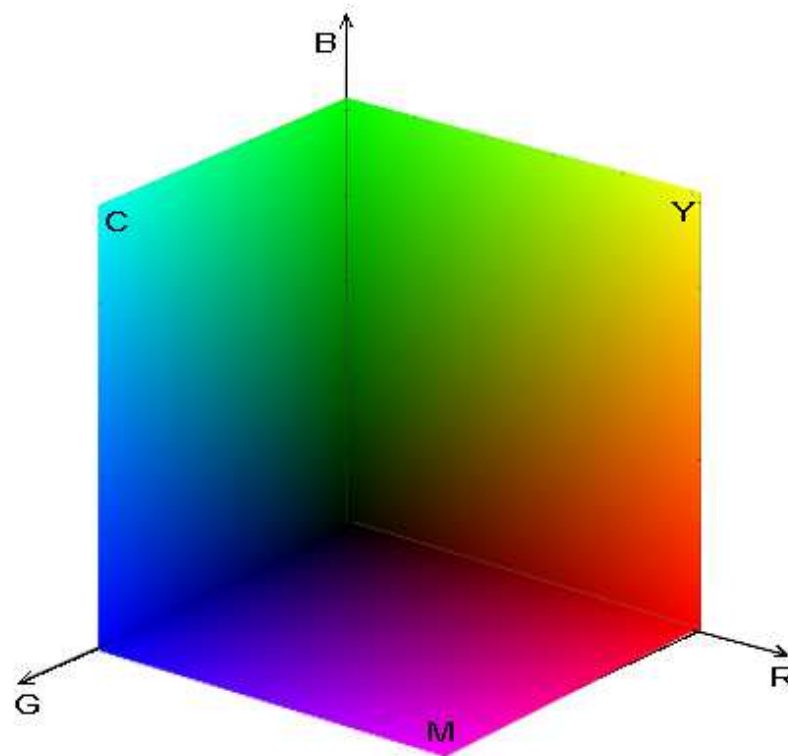
Magyarország célba ér

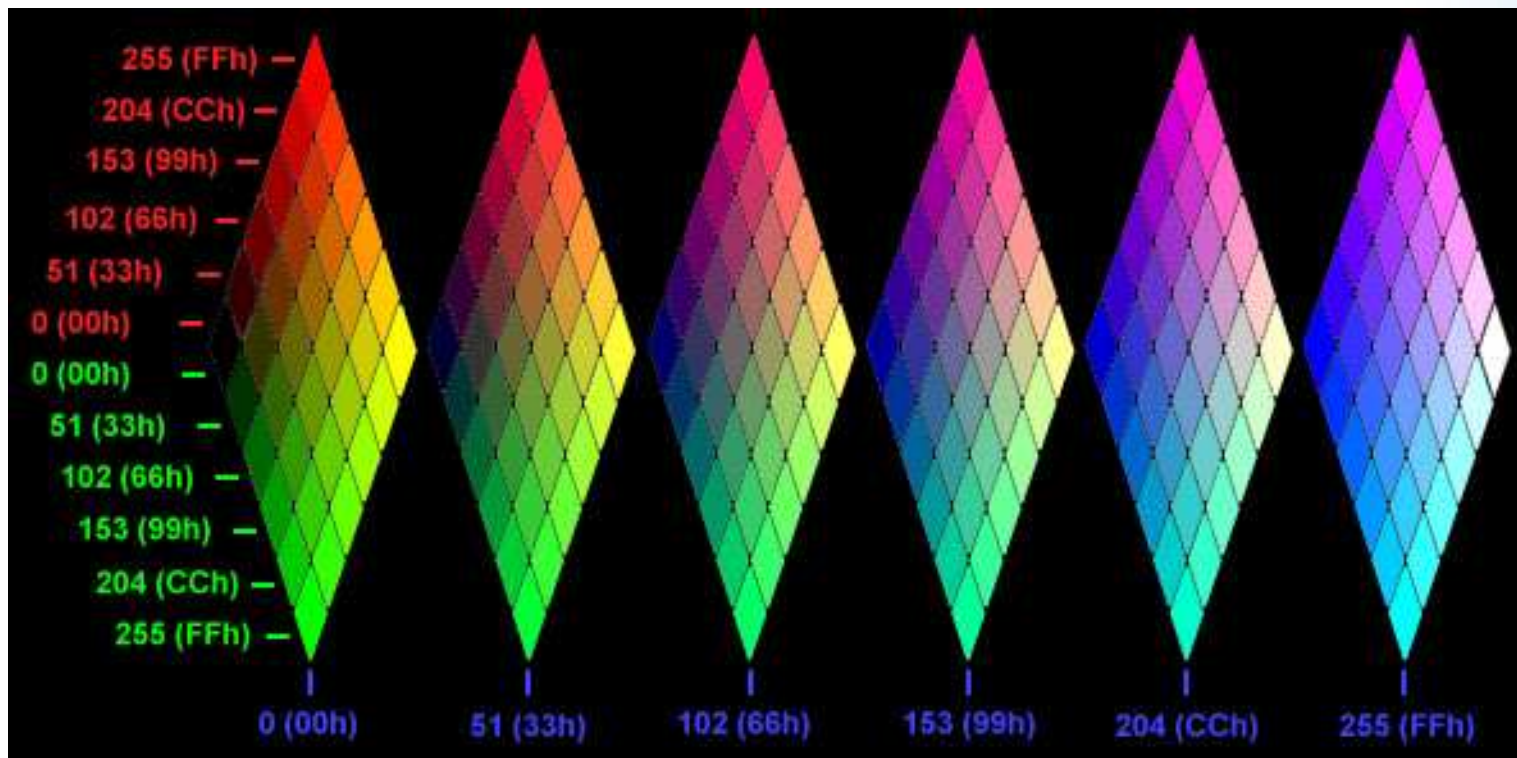


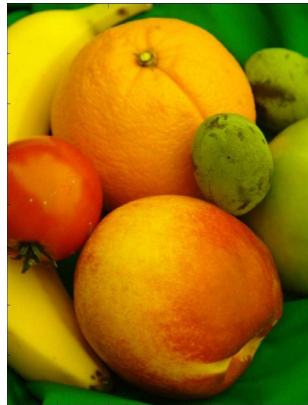
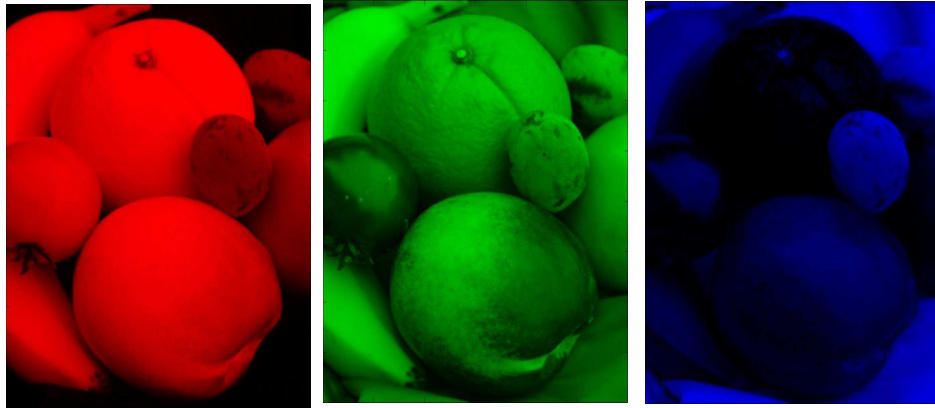
RGB, additív színrendszer



Az additív színkeverés

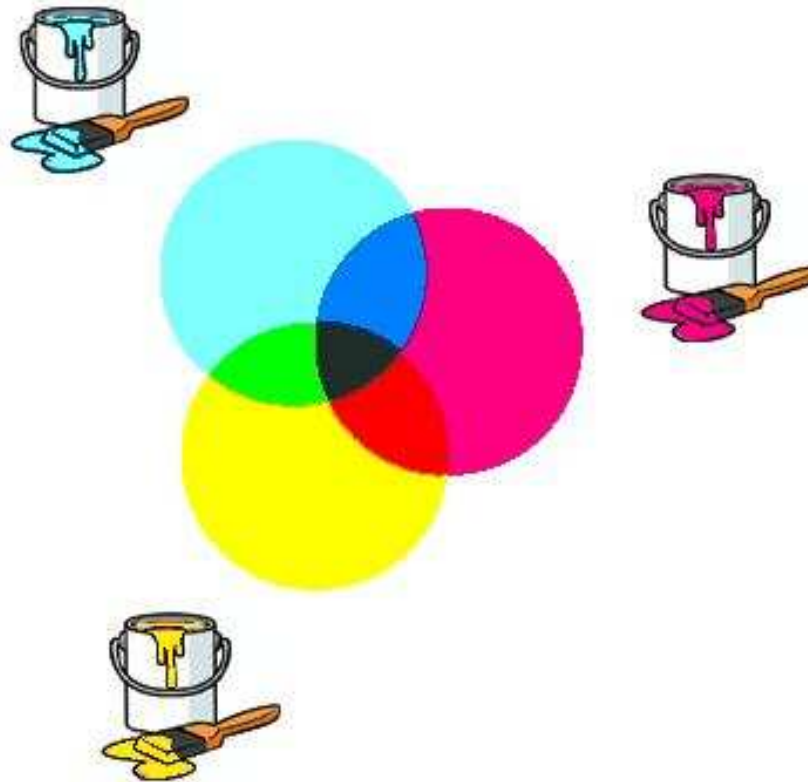




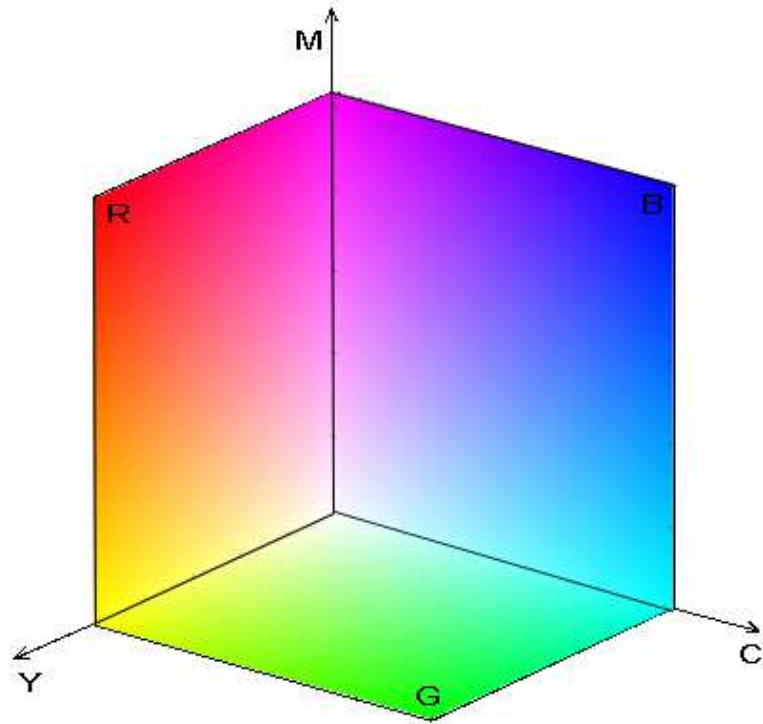


R, G, B
R+G, R+G+B

A CMY, szubtraktív színrendszer



A szubtraktív színkeverés



CMY és CMYK

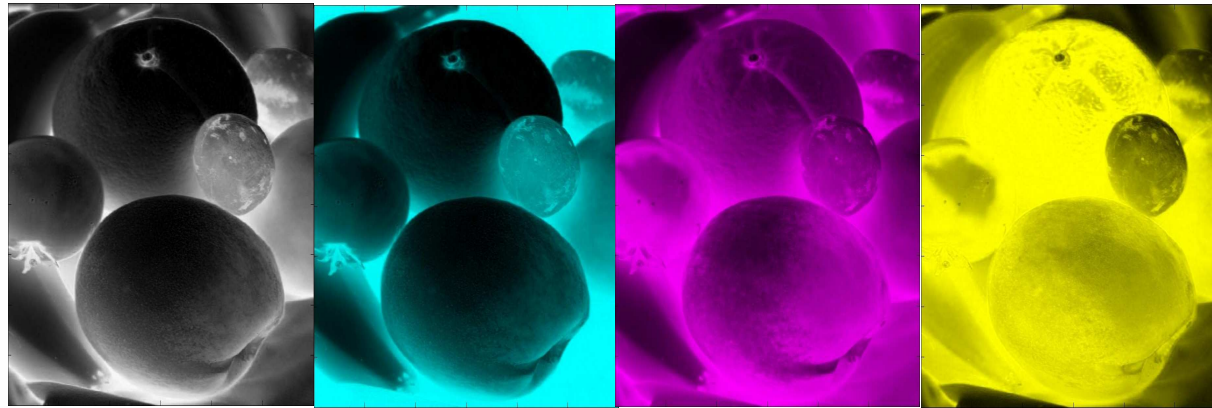
$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = 255 - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$K = k = \min(C, M, Y)$$

$$c = C - K$$

$$m = M - K$$

$$y = Y - K$$



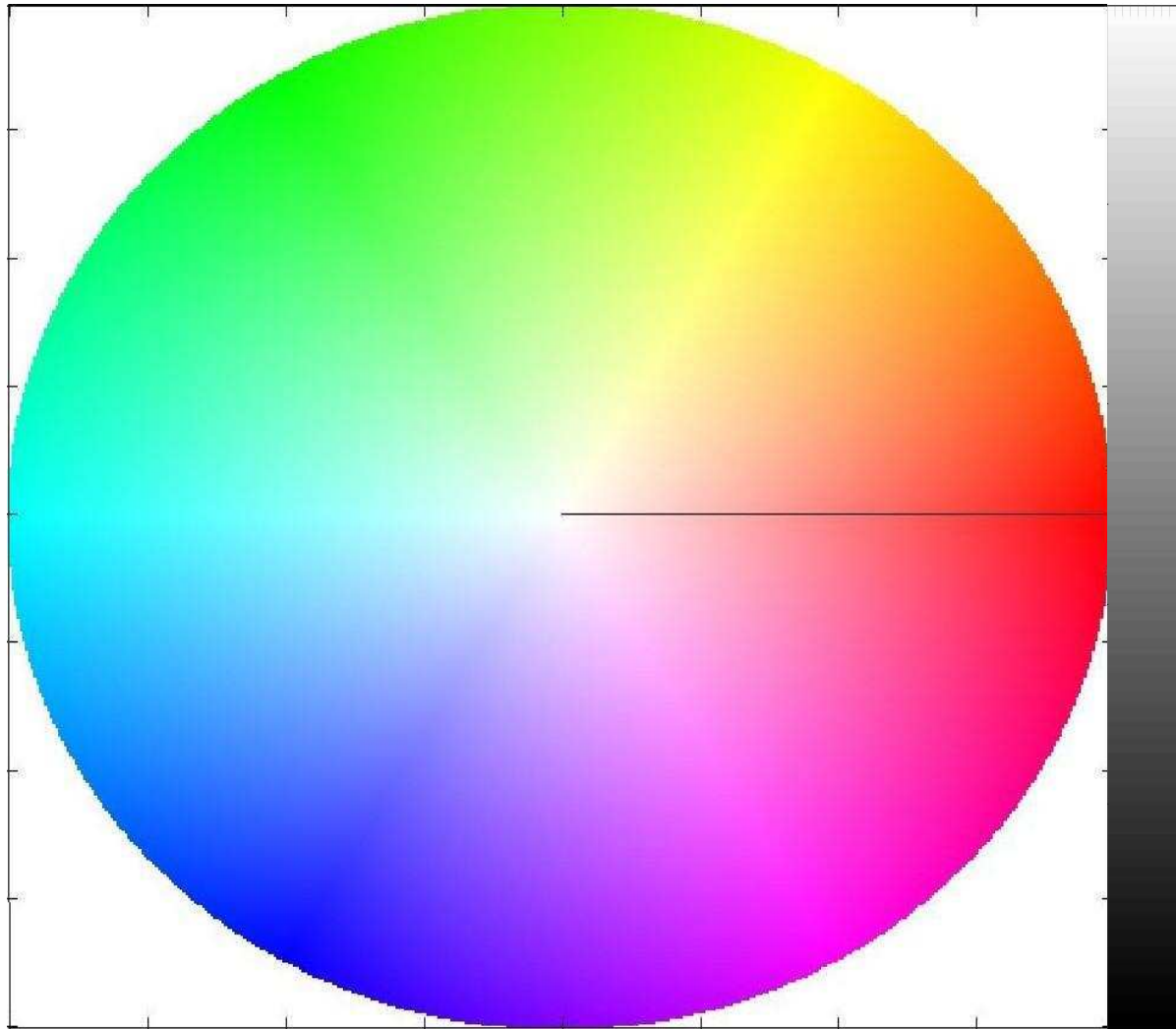
K, C, M, Y. És nyomtatva:

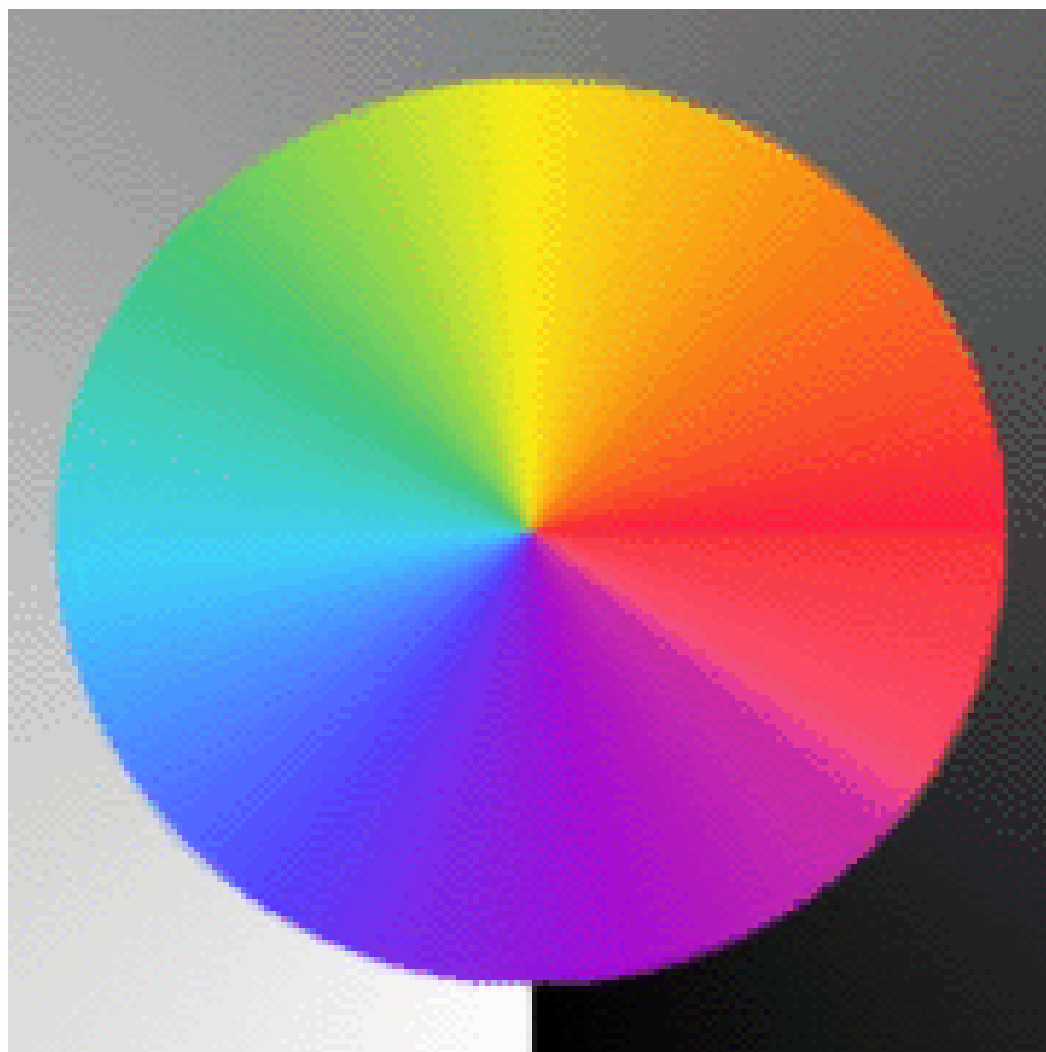
K, KC, KCM, KCMY

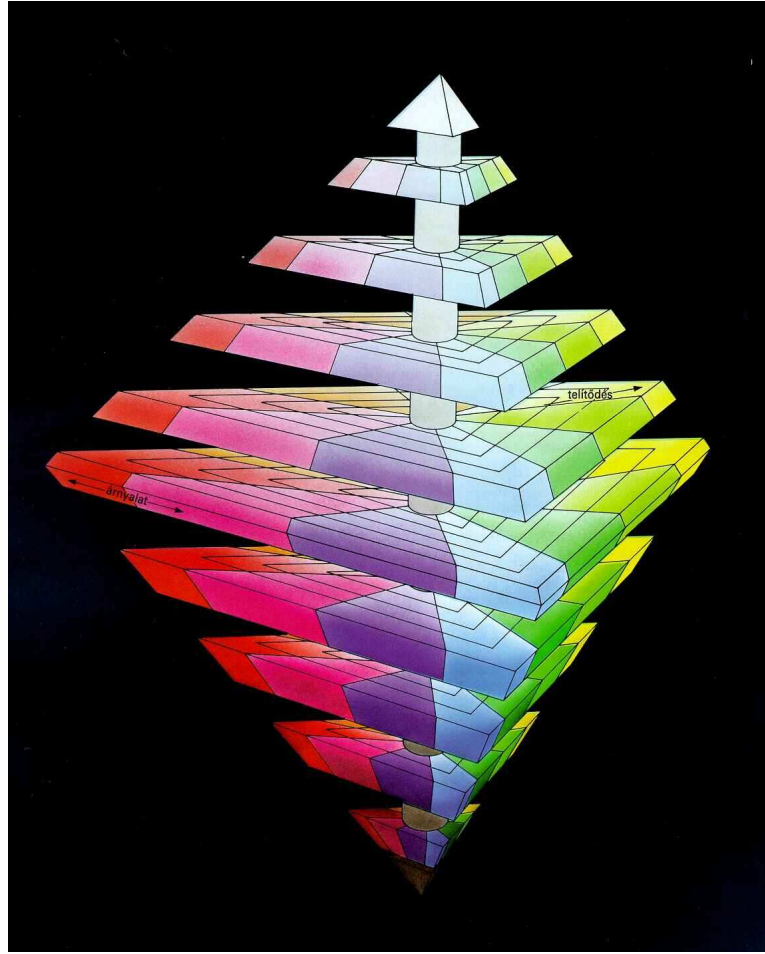
Az YUV színrendszer

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0,299 & 0,587 & 0,114 \\ -0,299 & -0,587 & 0,886 \\ 0,701 & -0,587 & -0,114 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

A HSV színrendszer







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Képfeldolgozás 3.

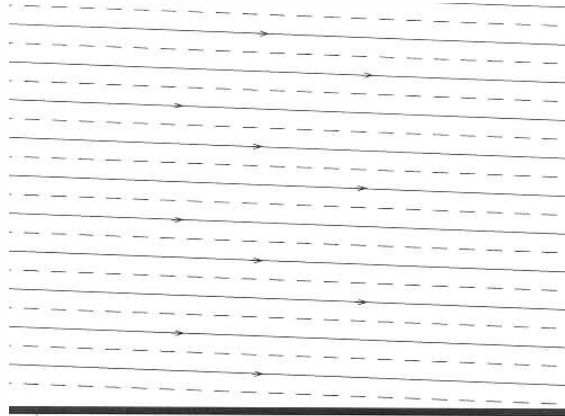
A képmegjelenítés és képfelvétel eszközei

Czap László

Magyarország célba ér



A váltott soros letapogatás

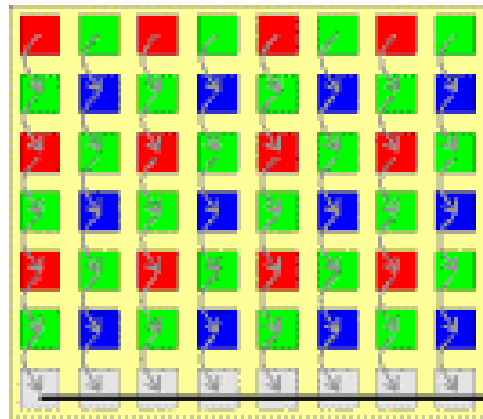




Gamma korrekció

eredeti kép, $\gamma+$ (*RGB*), $\gamma-$ (*RGB*),
 $\gamma-$ (*R*), $\gamma+$ (*G*), $\gamma+$ (*B*)

CCD kamera



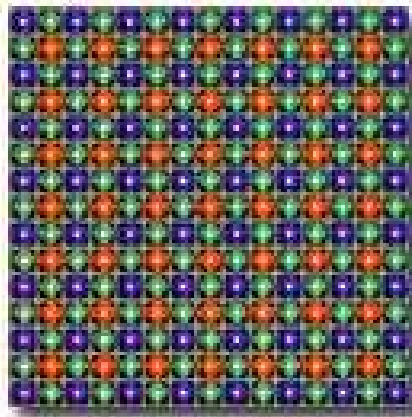
Utolsó sor olvasása

Első sor olvasása

Erősítő

CMOS kamera

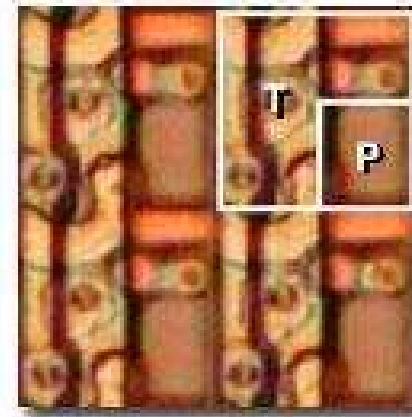
Bayer szűrő



Színszűrők



Fotódiódák



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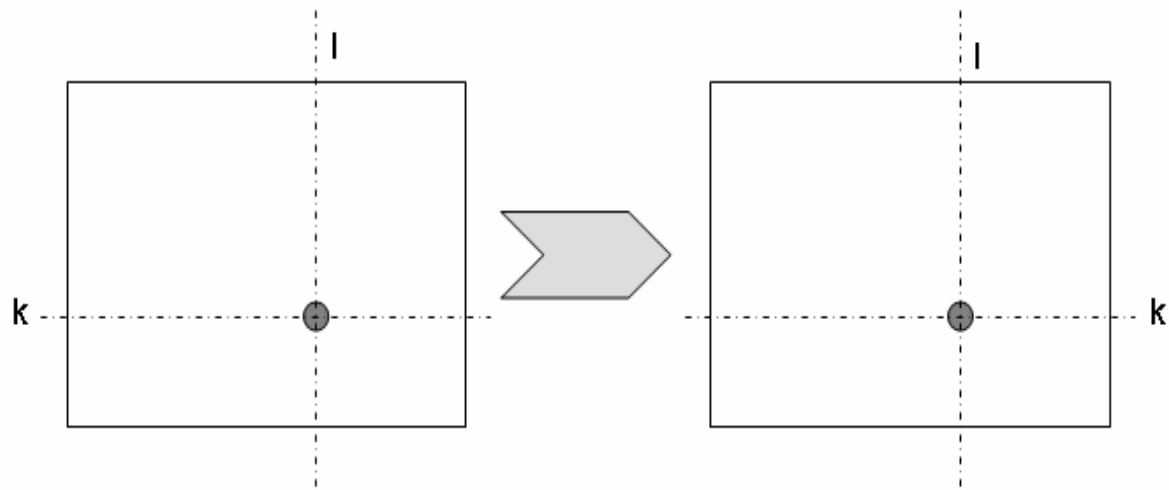
Képfeldolgozás 4. Képfeldolgozási műveletek

Czap László

Magyarország célba ér



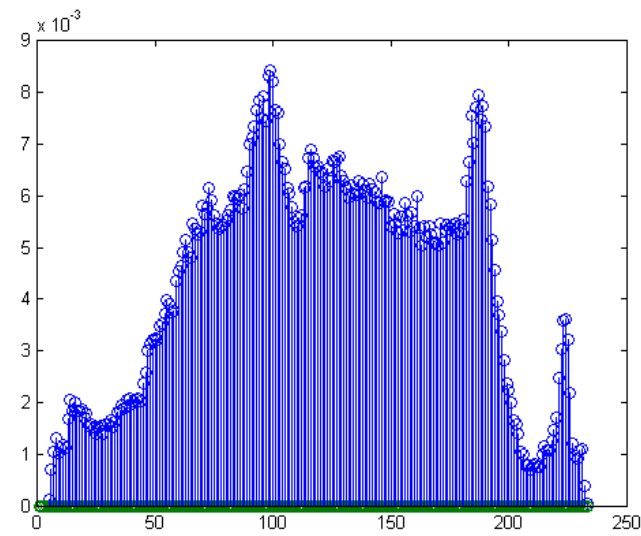
Pont-pont műveletek



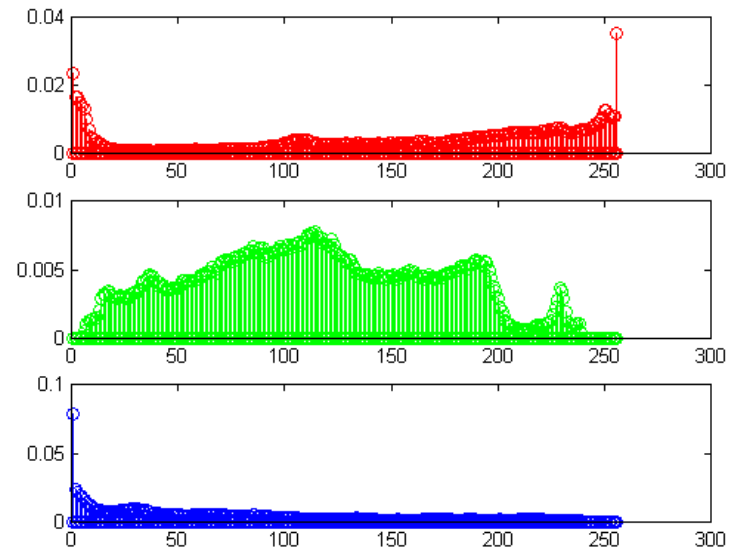
pont \rightarrow pont

Hisztogram

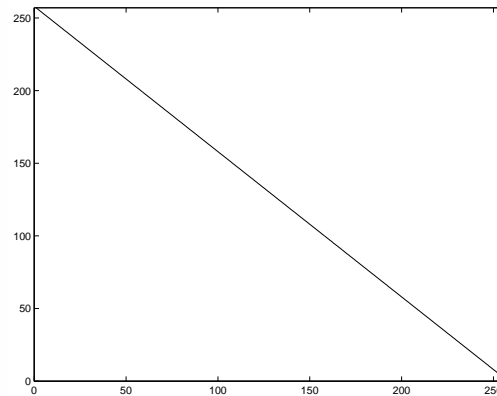
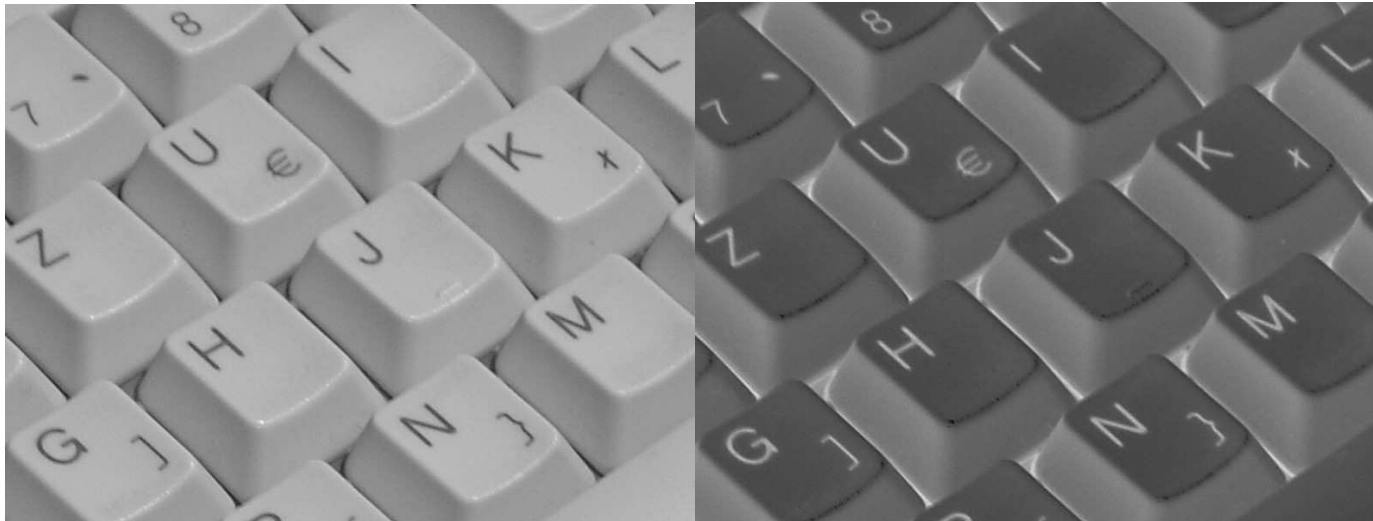
$$Hq = \frac{Nq}{N}$$



Színes kép hisztogramja



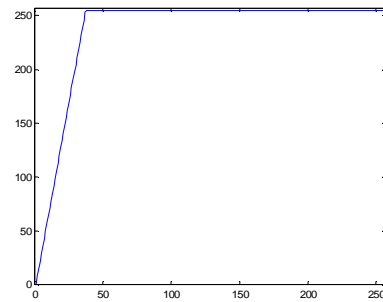
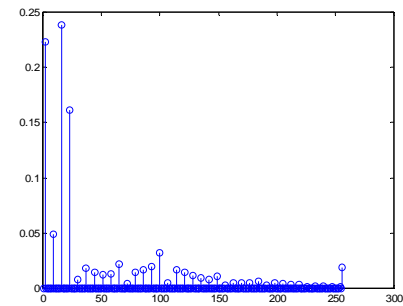
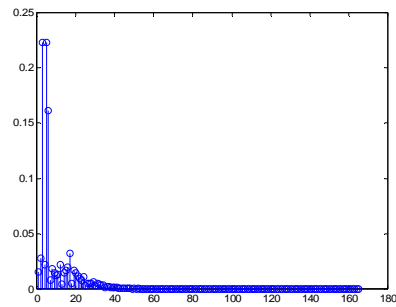
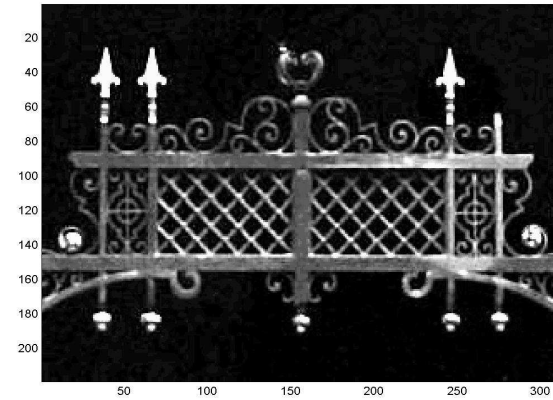
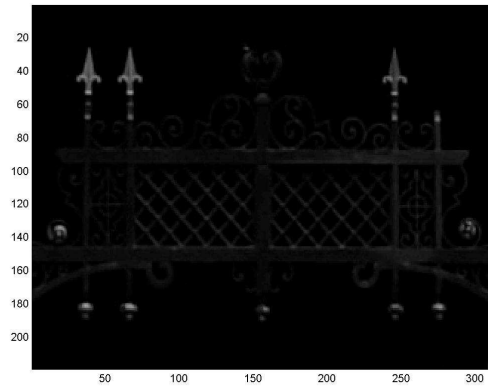
Invertálás (negatív)



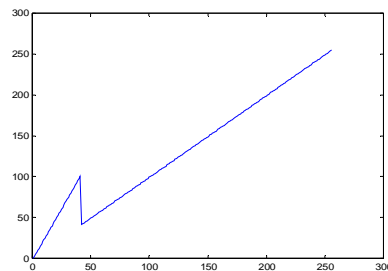
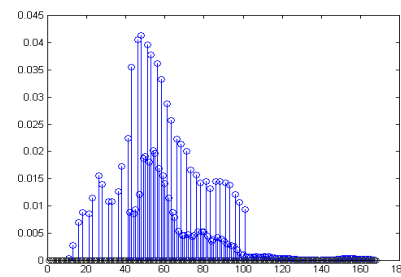
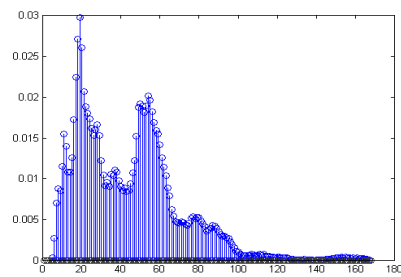
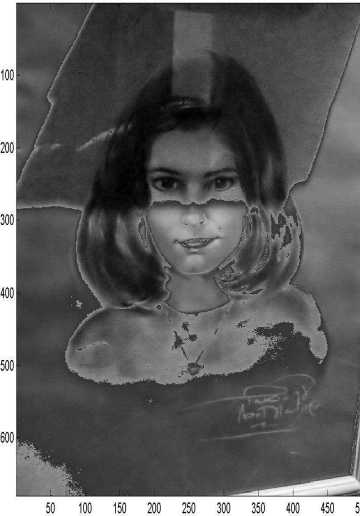
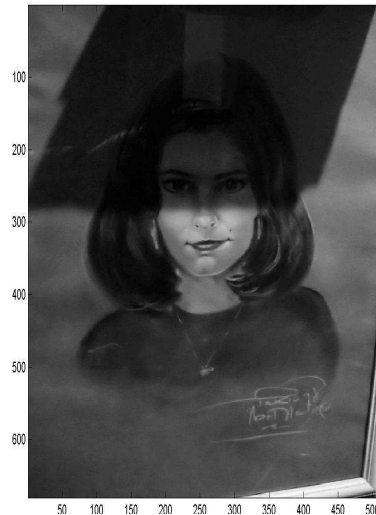
Színes kép negatívja



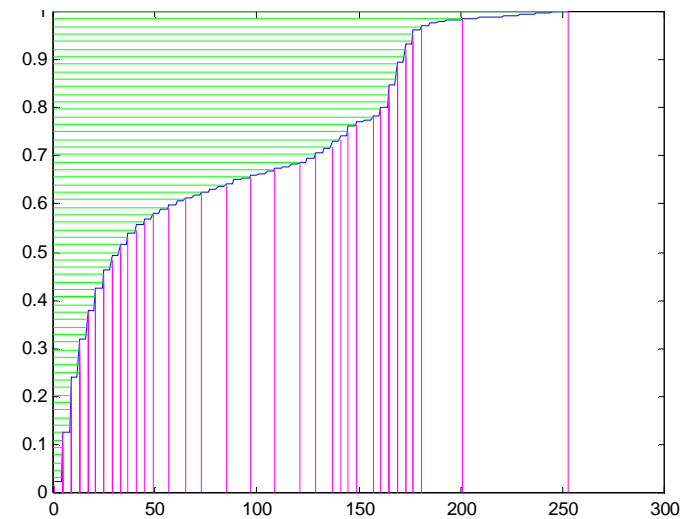
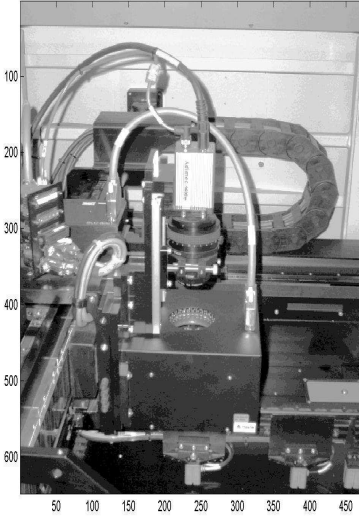
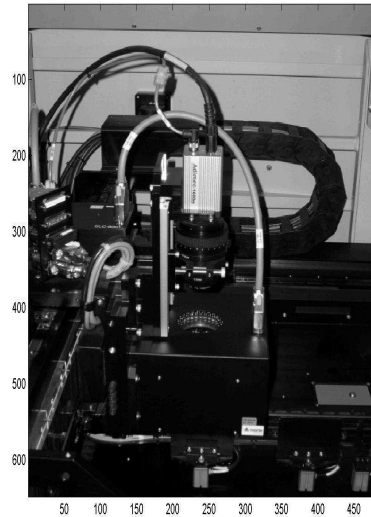
Hisztogram nyújtás

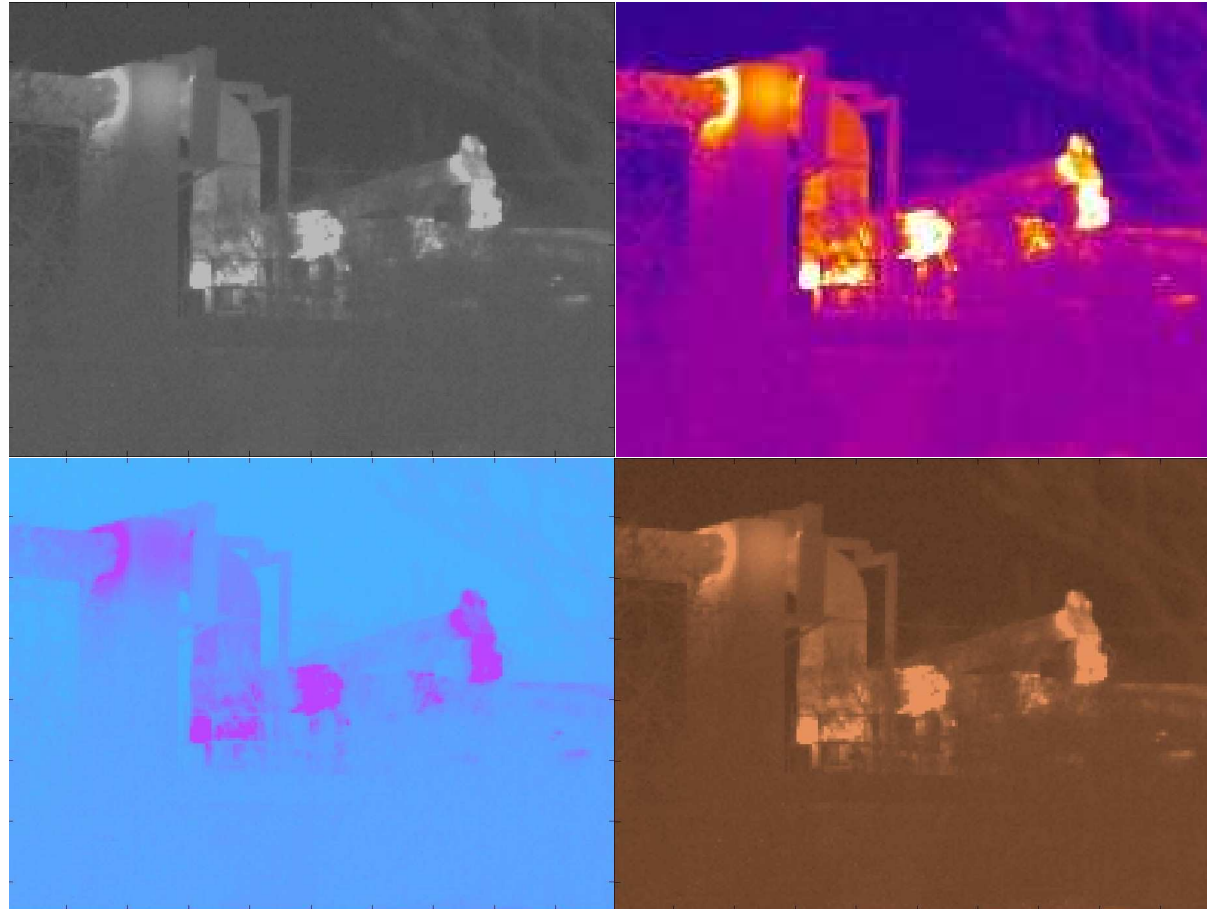


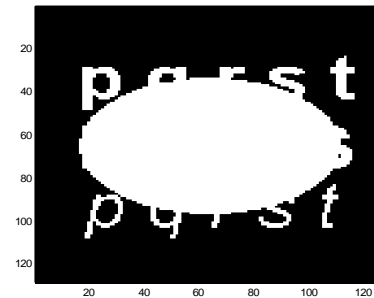
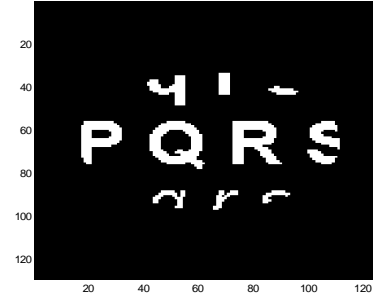
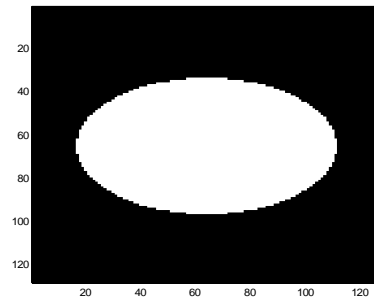
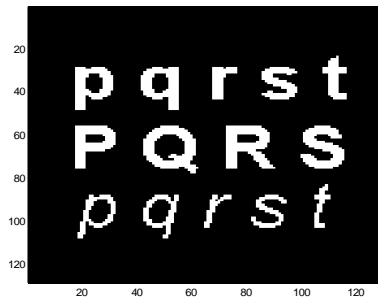
Hisztogram részleges nyújtása



Hisztogram kiegyenlítés





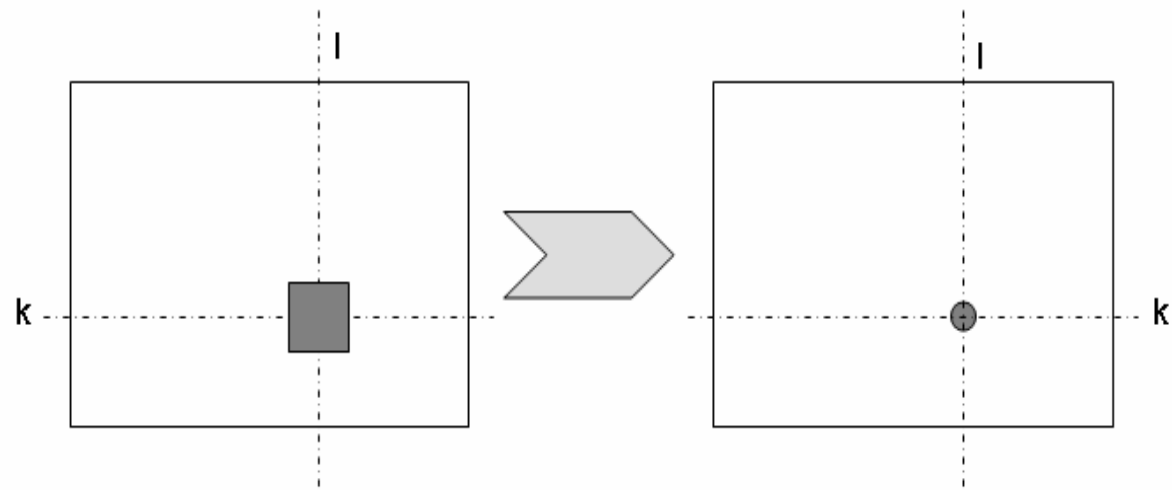


Logikai műveletek bináris képeken.

$i_1, i_2, i_1 \text{ÉS} i_2,$

$i_1 \text{ÉS} (\text{NEM } i_2), \text{ e.}, i_1 \text{VAGY } i_2, \text{ f.}, i_1 \text{XVAGY } i_2$

Lokális műveletek



lokális

Konvolúció

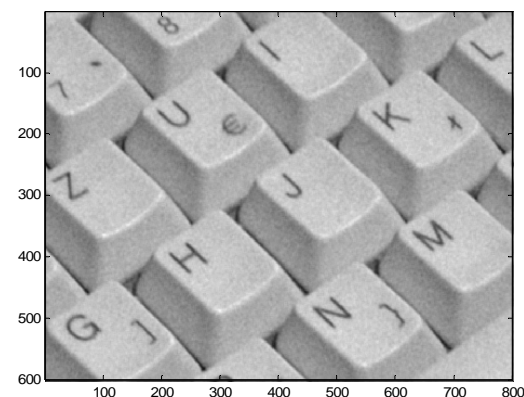
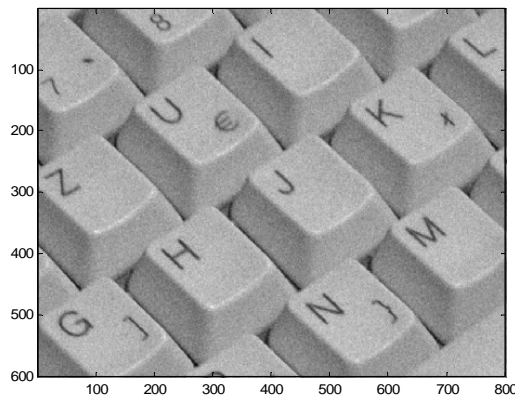
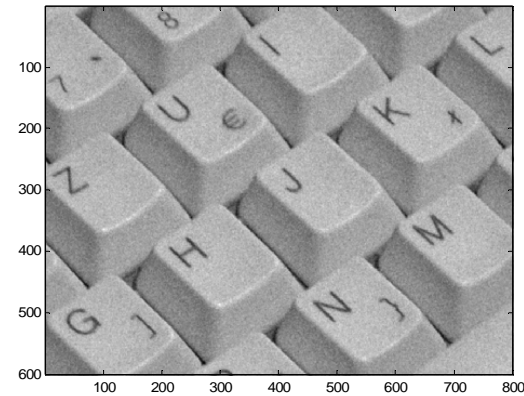
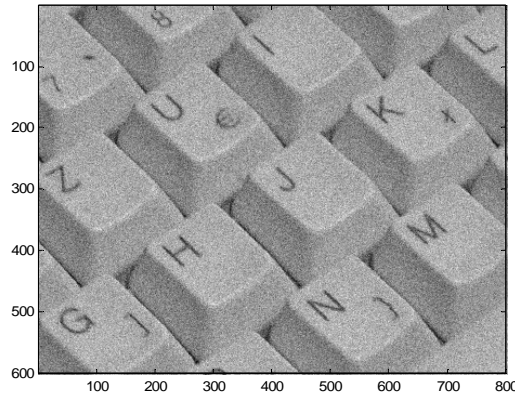
$$q(k,l) = \sum_{r=-R}^R \sum_{s=-S}^S t(r,s)g(k+r,l+s)$$

Zajszűrés

$$z_1 = \frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

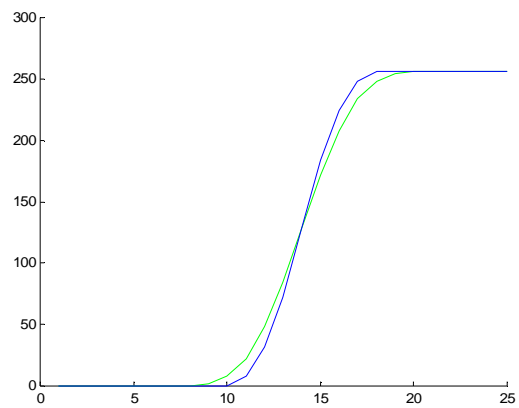
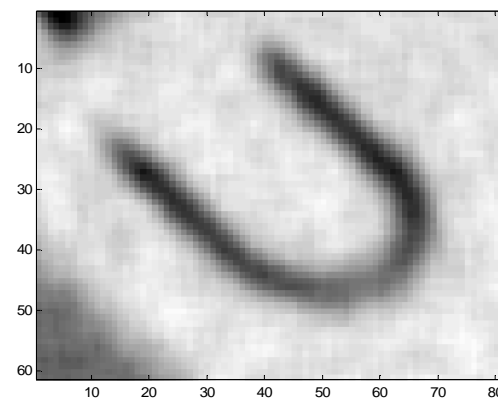
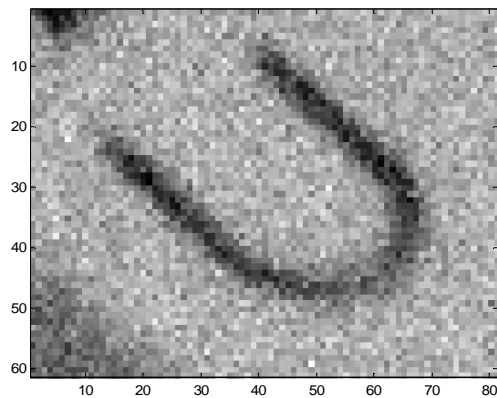
$$z_2 = \frac{1}{16} \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

$$z_3 = \frac{1}{25} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$



eredeti zajos kép, $i \otimes z_1$
 $i \otimes z_2$, d., $i \otimes z_3$

A zajszűrés mellékhatása



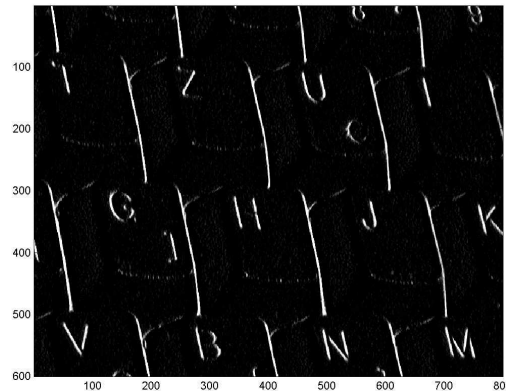
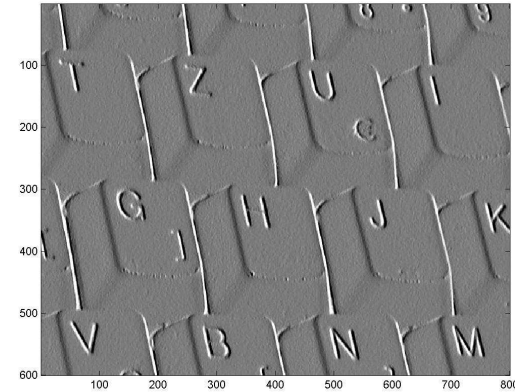
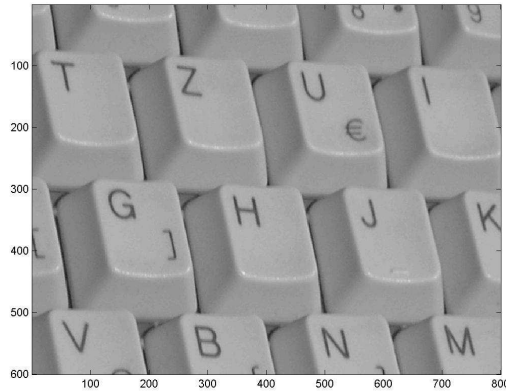
Élkiemelés

Laplace operátorokkal

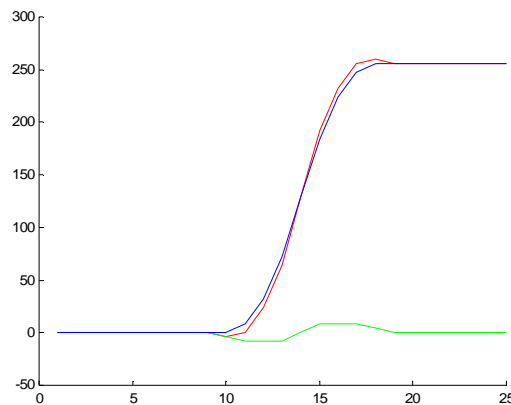
$$l_4 = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

$$l_8 = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Bipoláris és unipoláris ábrázolás



Élesítés a képsíkban



Gradiens számításon alapuló élkiemelés

Roberts operátorok

$$r_1 = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$r_2 = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$$R_1 = i \otimes r_1$$

$$R_2 = i \otimes r_2$$

$$Gr = \sqrt{R_1^2 + R_2^2}$$

$$\Phi = \arctg \frac{R_1}{R_2}$$

Élkiemelés Roberts operátorral



További élkkiemelő operátorok

Prewitt

$$p_1 = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

$$p_2 = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

Sobel

$$s_1 = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

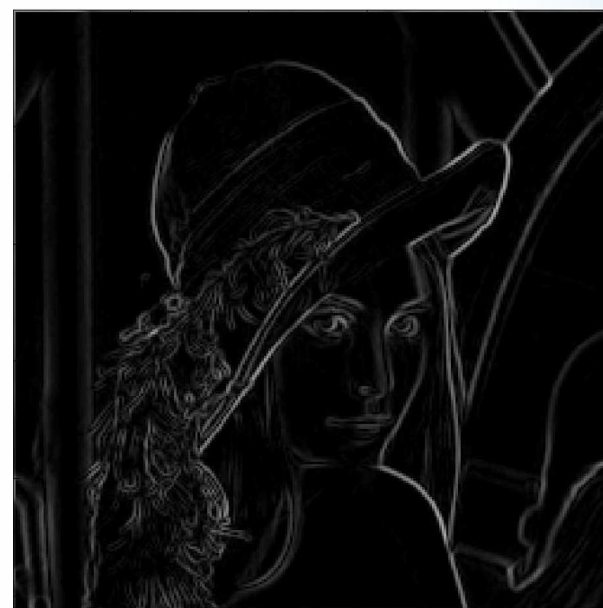
$$s_2 = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

Élkiemelés eredménye

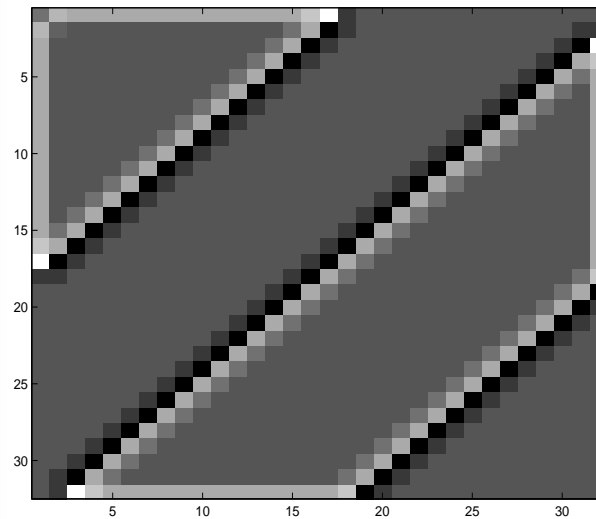
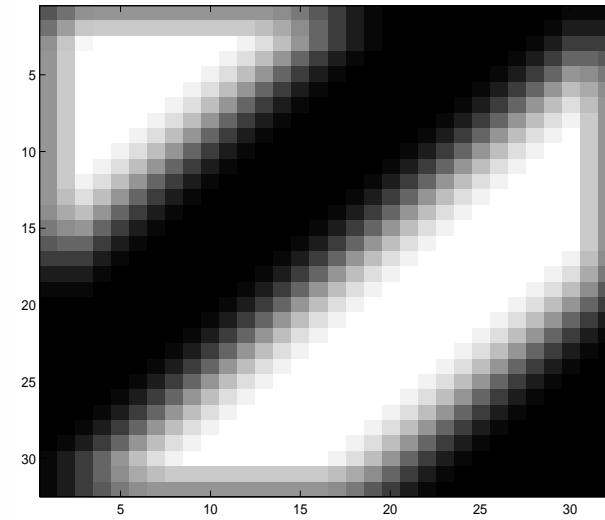
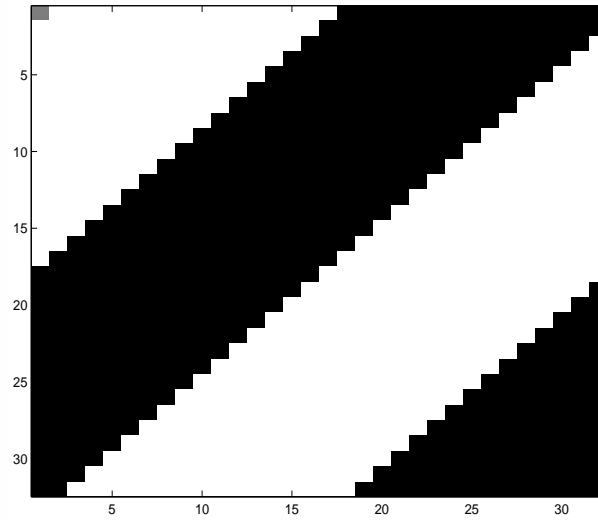
Prewitt



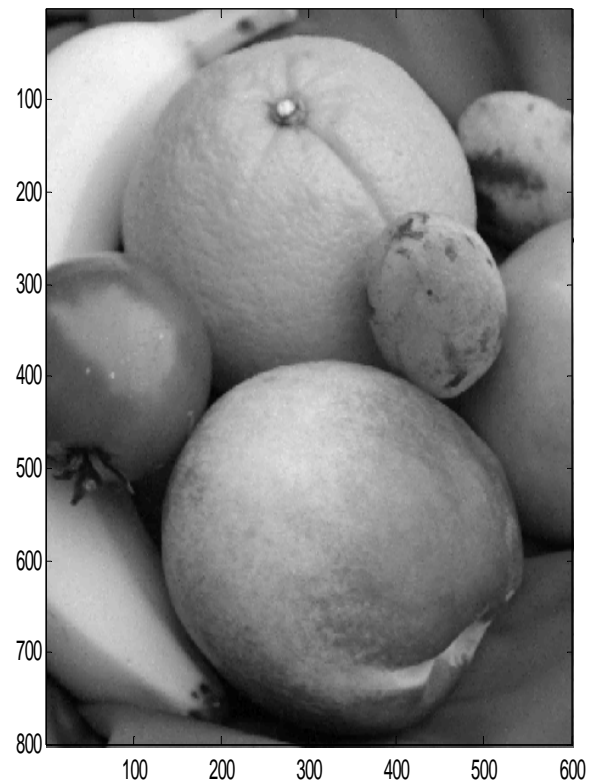
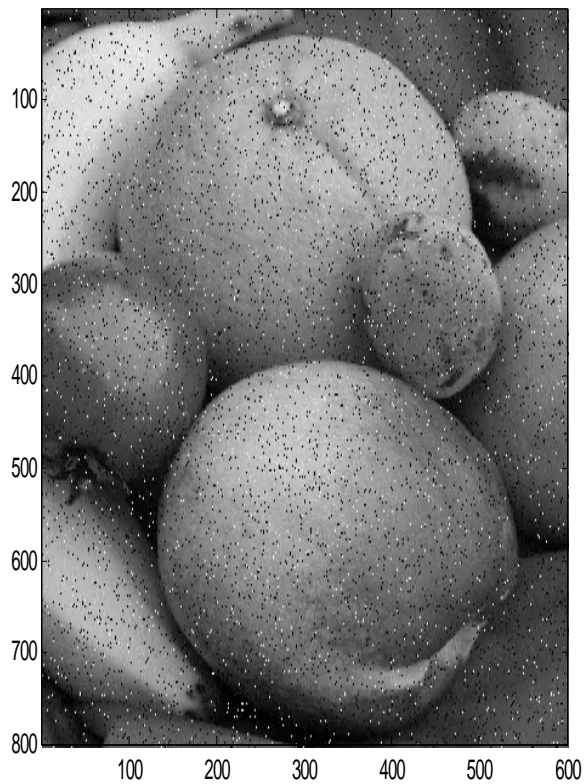
Sobel



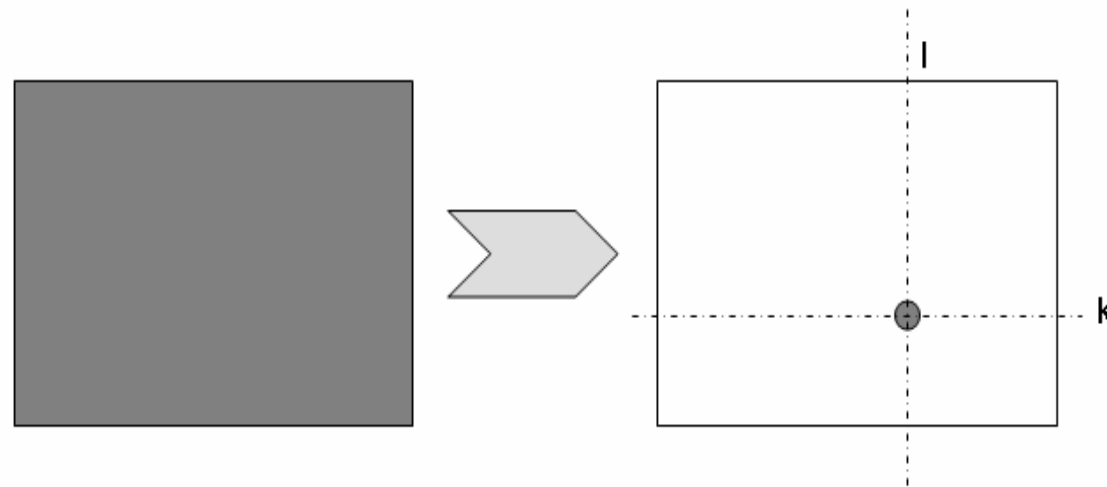
A kép széleinél vigyázni kell!



Medián szűrés



Műveletek a síkfrekvencia tartományban



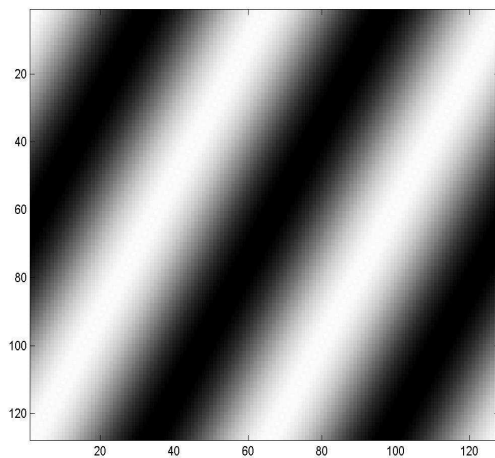
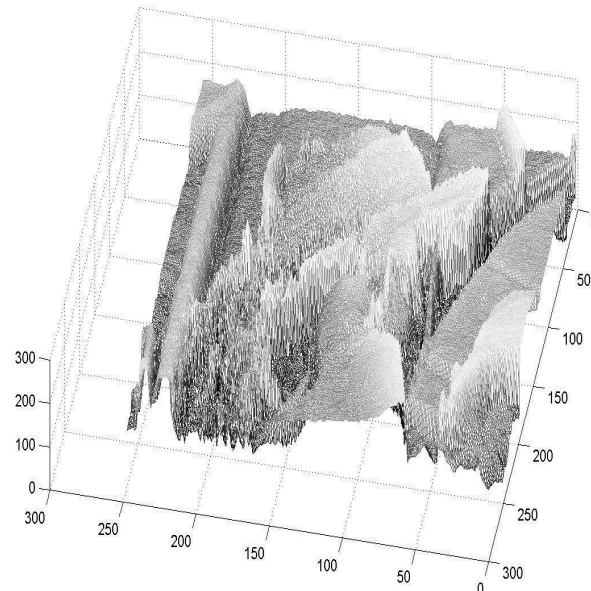
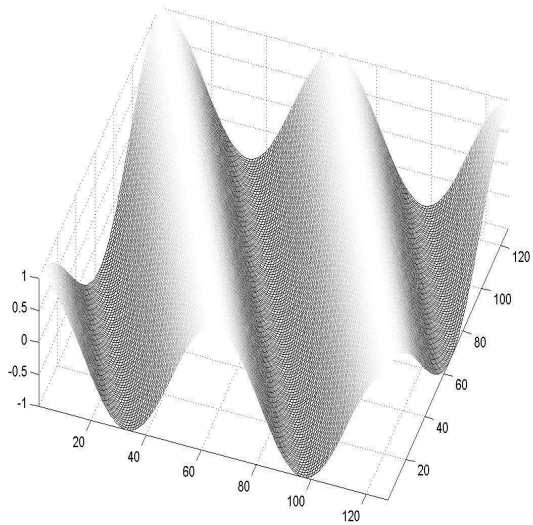
globális

Kétdimenziós diszkrét Fourier transzformáció

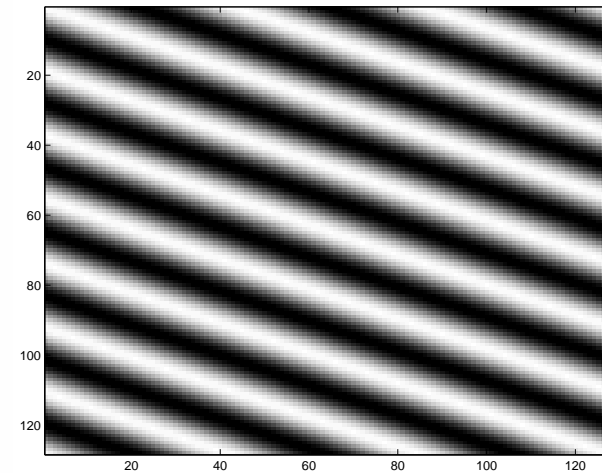
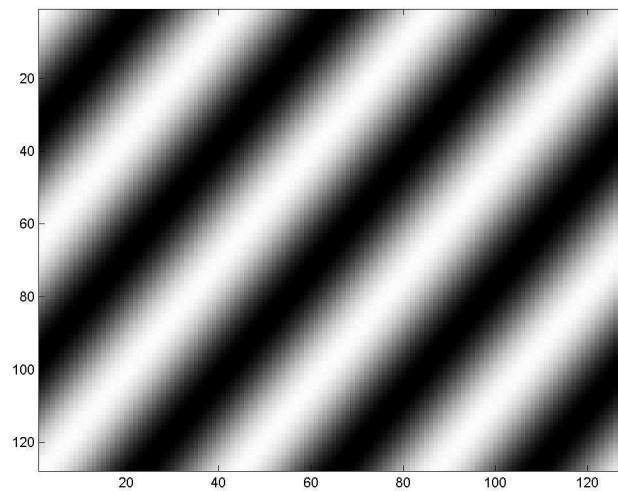
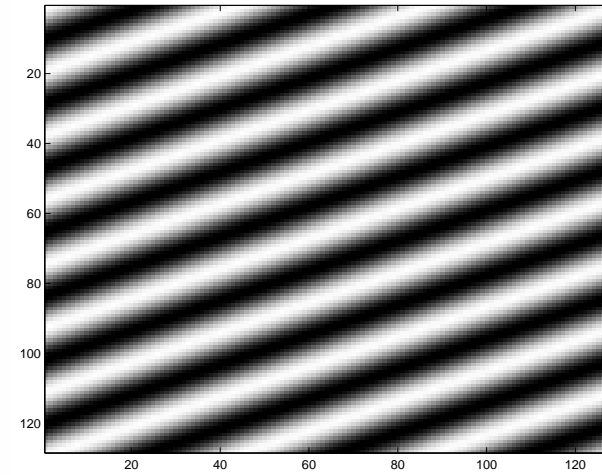
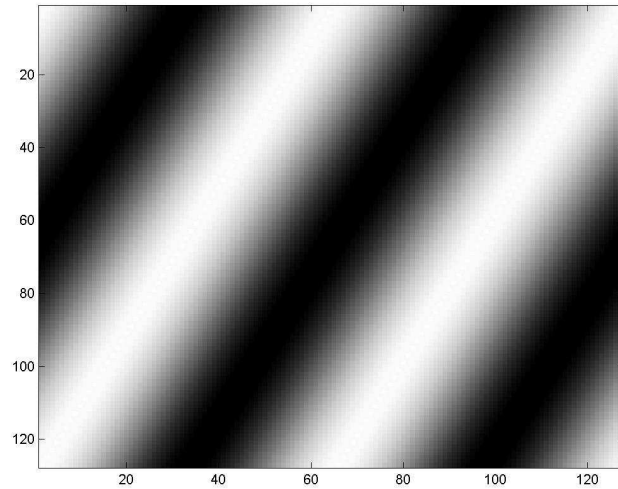
$$G(m, n) = \sum_{k=0}^{M-1} \left[\sum_{l=0}^{N-1} g(k, l) e^{-j l n \frac{2\pi}{M}} \right] e^{-j k m \frac{2\pi}{N}}$$

$$g(k, l) = \frac{1}{N} \sum_{m=0}^{M-1} \left[\frac{1}{M} \sum_{n=0}^{N-1} G(m, n) e^{j l n \frac{2\pi}{M}} \right] e^{j k m \frac{2\pi}{N}}$$

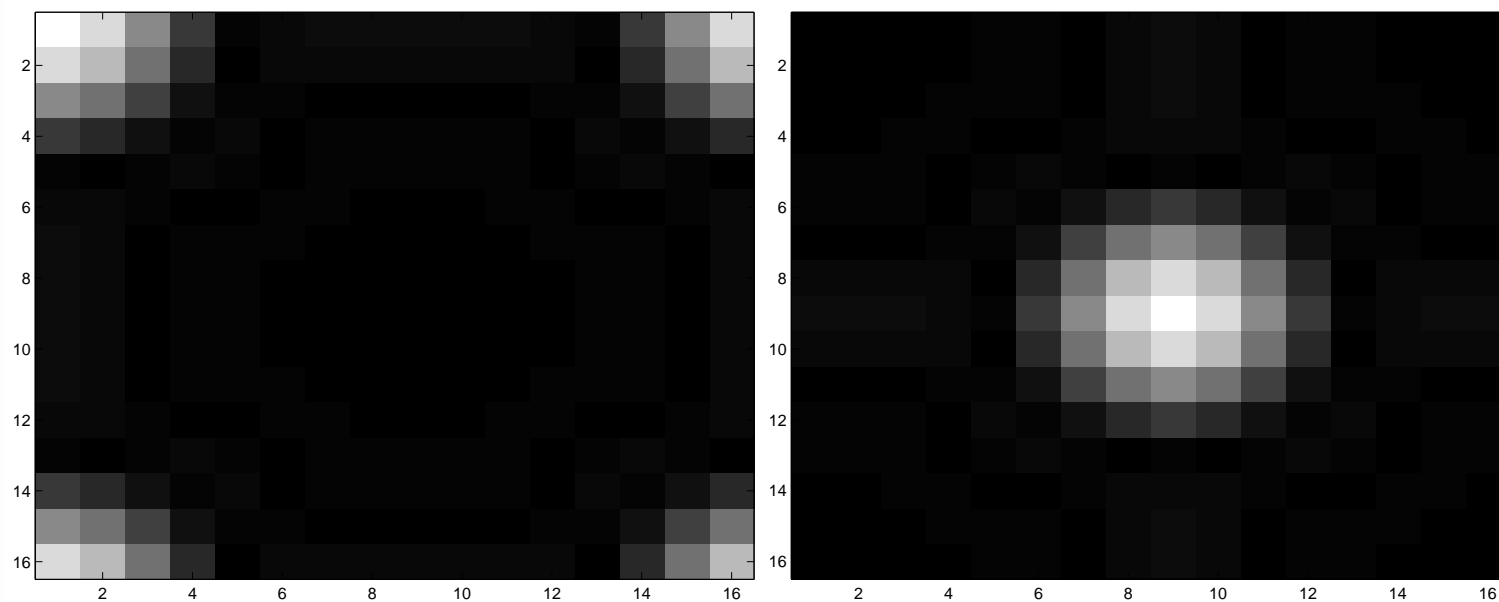
Térfüggvények-síkfüggvények



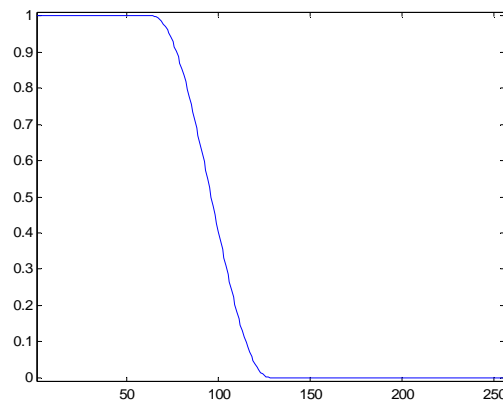
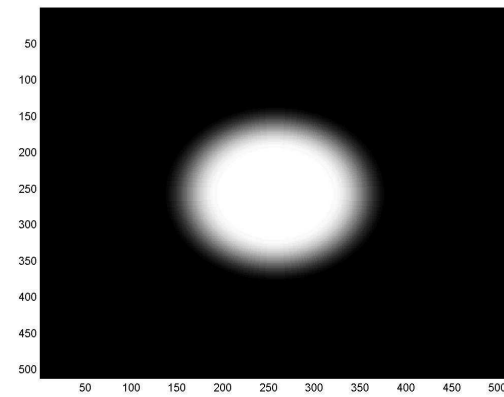
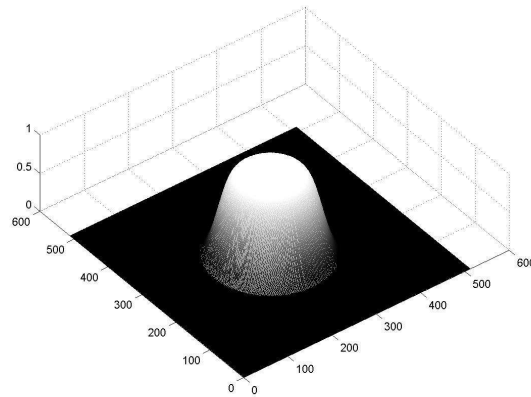
Bázisfüggvények



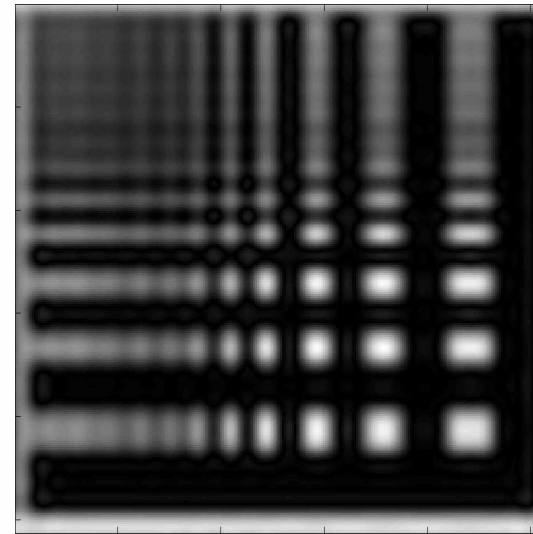
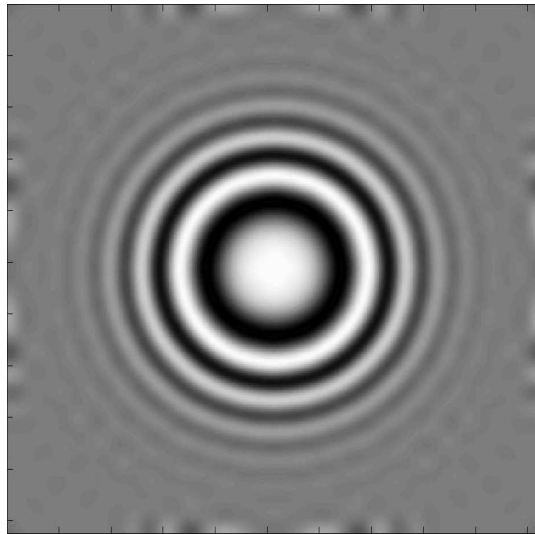
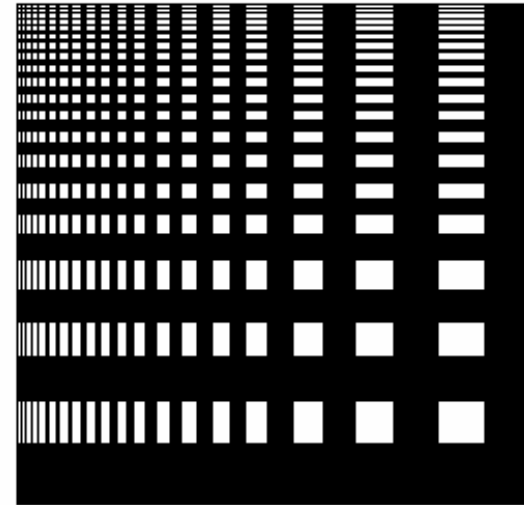
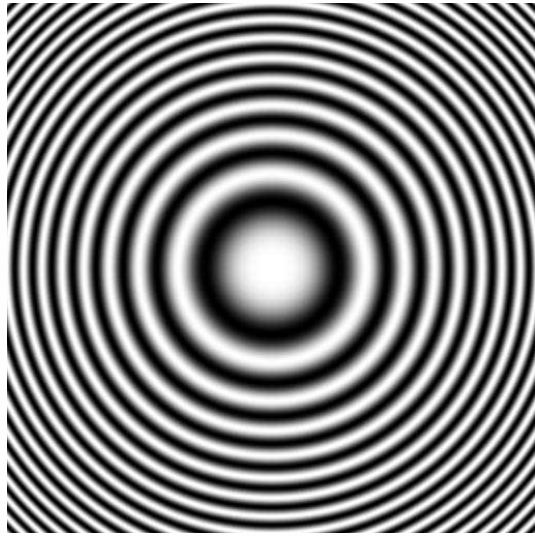
Síknegyedek cseréje



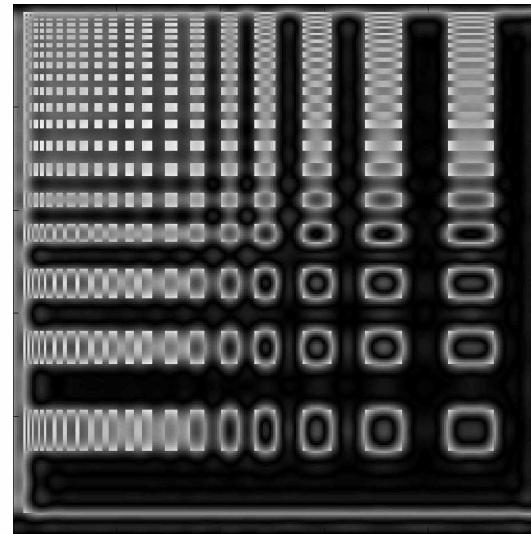
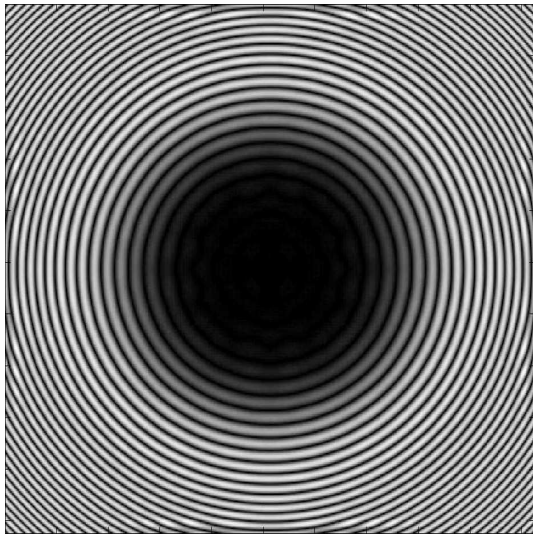
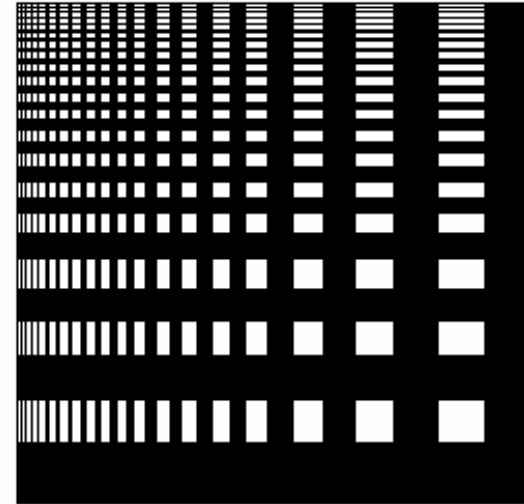
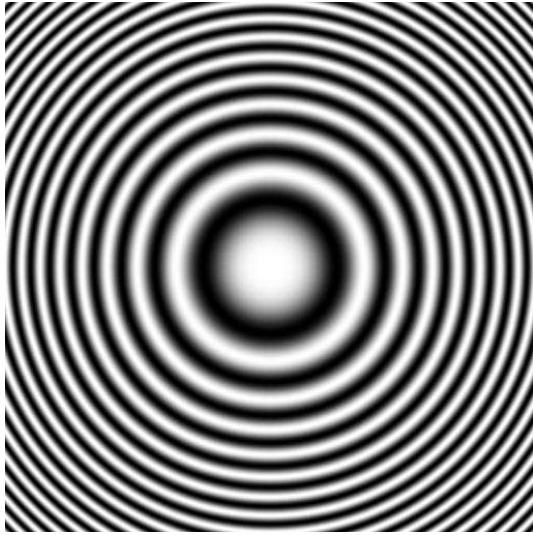
A szűrőkarakterisztika ábrázolási módjai



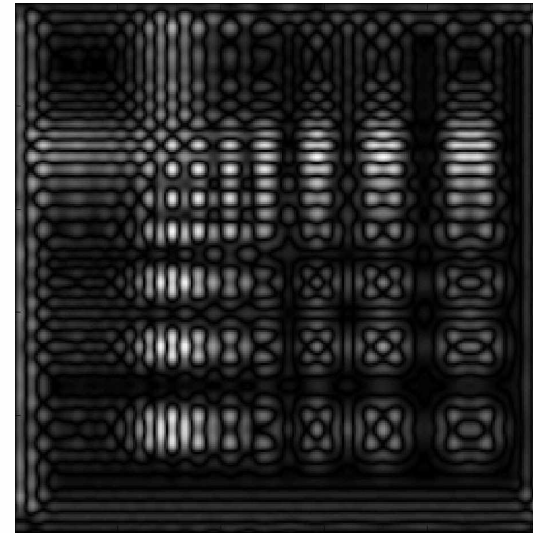
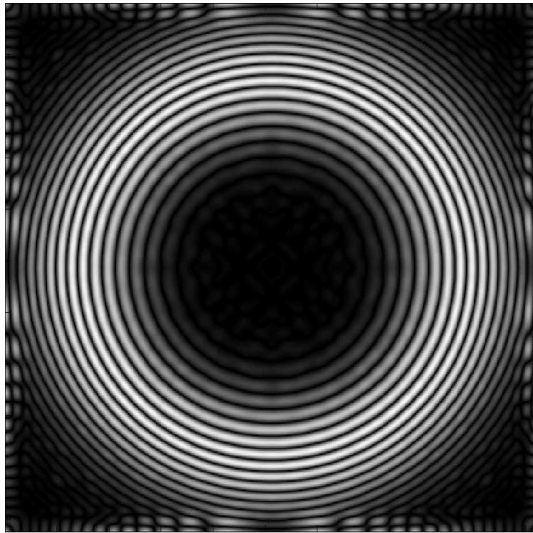
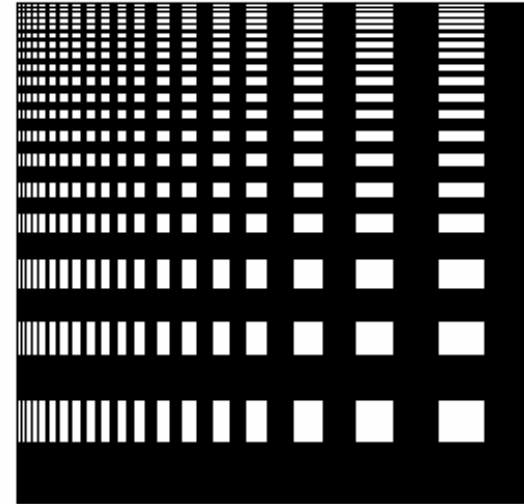
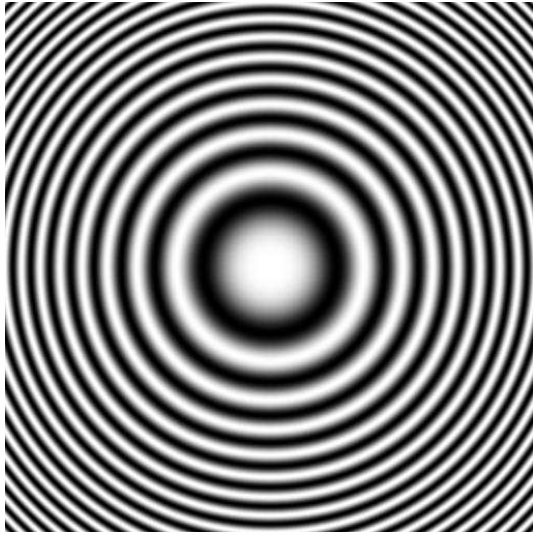
Aluláteresztő szűrés



Felüláteresztő szűrés



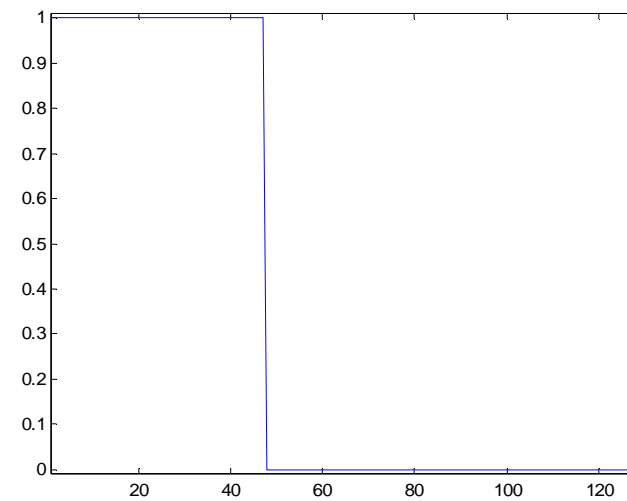
Sáváteresztő szűrés



Zajszűrés



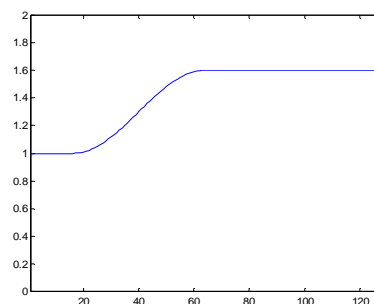
Nagy meredekségű szűrő hatása



Élkiemelés



Élesítés



Értékünk AZ **EMBER**

Humánerőforrás- fejlesztési Operatív Program

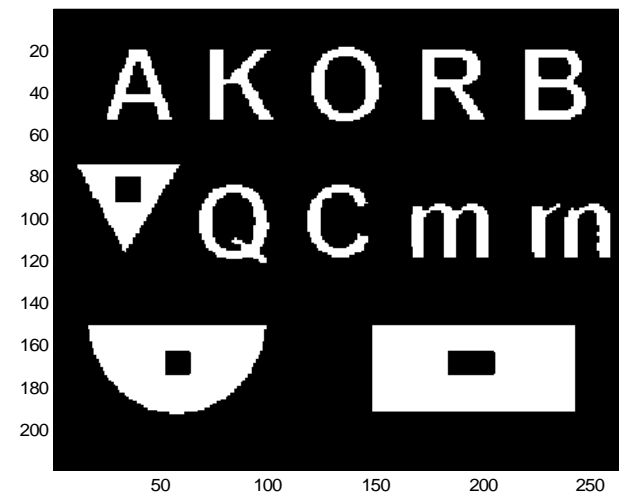
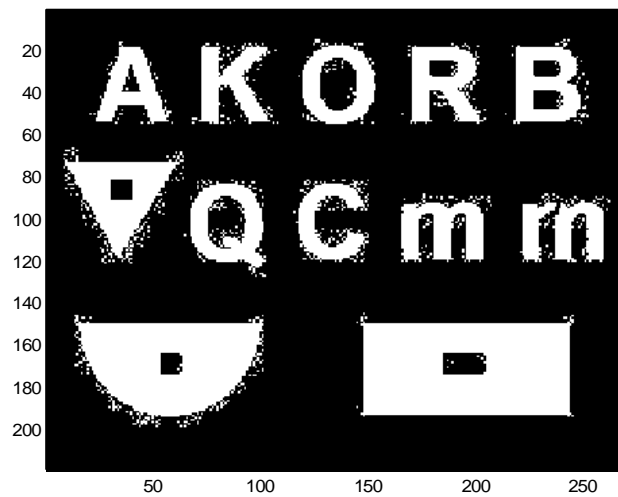
Képfeldolgozás 5. Morfológiai műveletek

Czap László

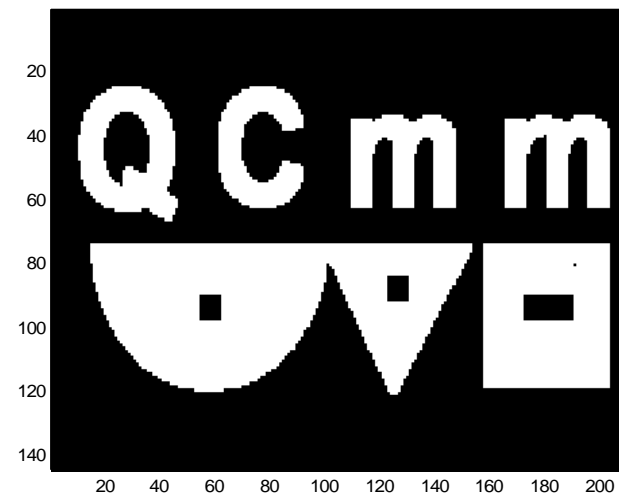
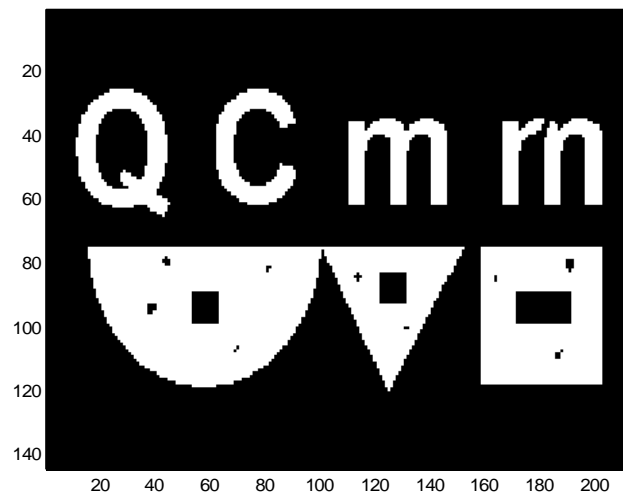
Magyarország célba ér



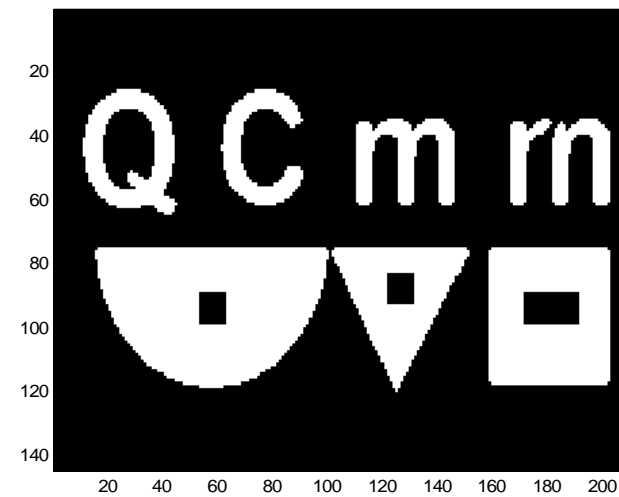
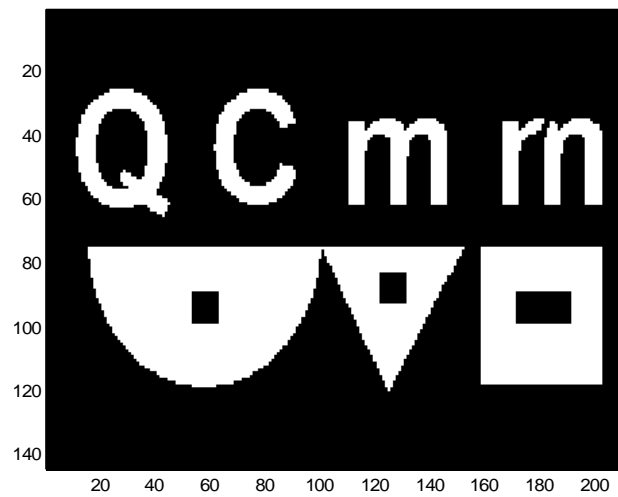
Erózió



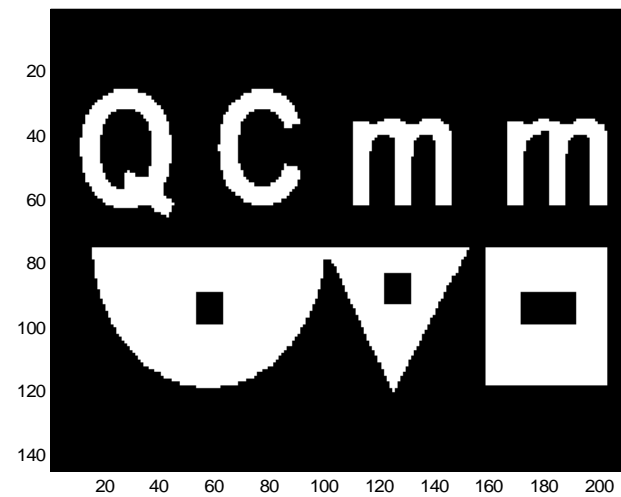
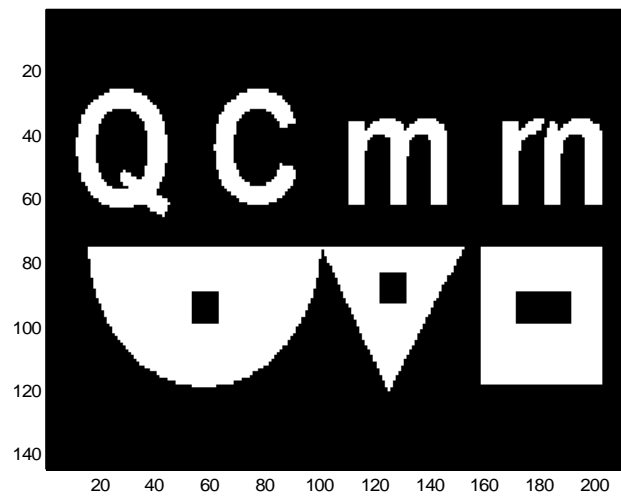
Dilatáció



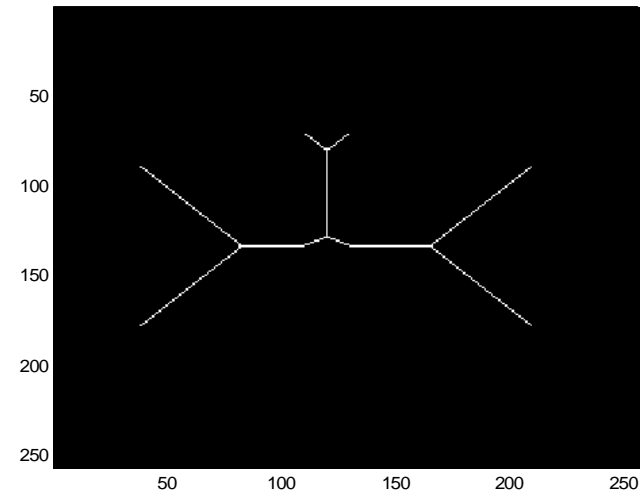
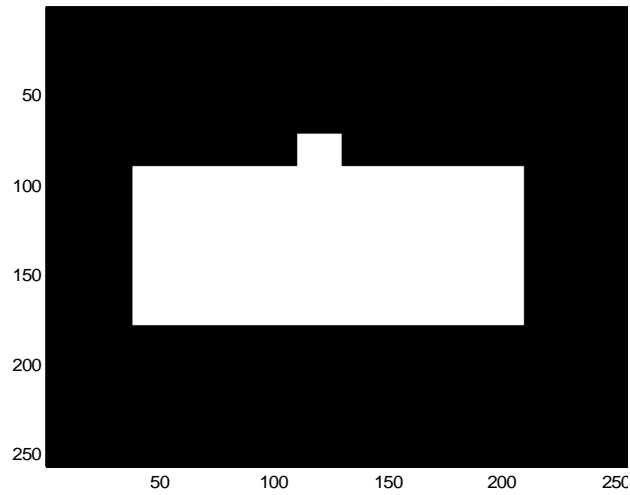
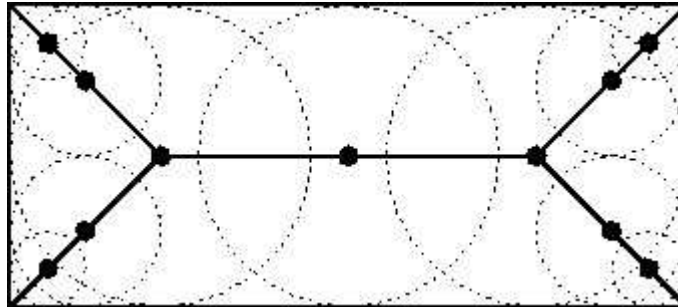
Nyitás



Zárás



Skeleton



Vékonyítás

