KONWOLUCJA - PRZEKSZTAŁCENIA KONTEKSTOWE

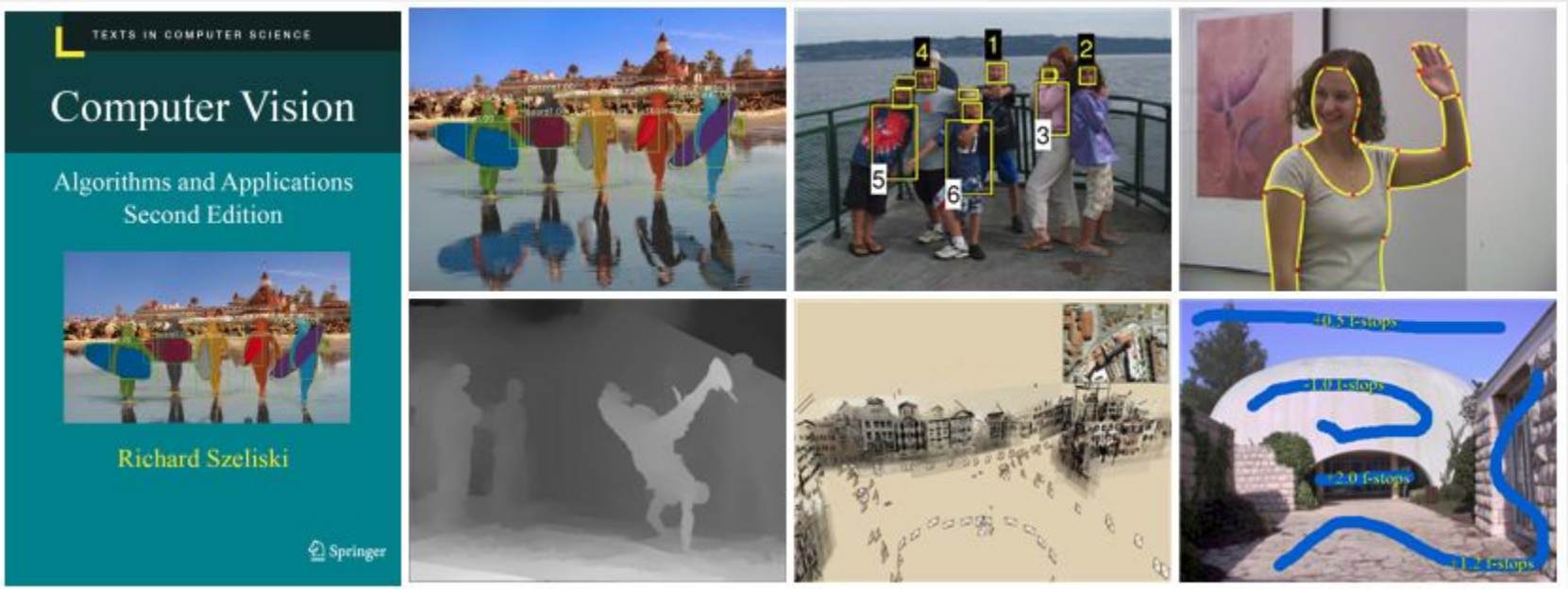
14.11.2023 Computer Vision Seminar 23/24

Agenda

1. Przekształcenia punktowe z przykładami
2. Przekształcenia kontekstowe
3. Na czym polega konwolucja?
4. Padding, stride
5. Popularne filtry
6. Przetwarzanie binarne

Szeliski rozdział 3: Image processing

Computer Vision: Algorithms and Applications, 2nd ed.



https://szeliski.org/Book/ https://www.cs.cornell.edu/courses/cs5670/2023sp/lectures/lectures.html

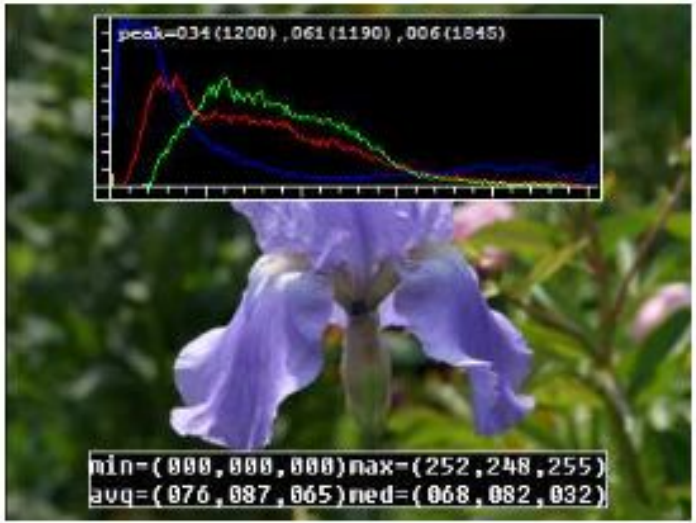
Zdjęcie jako funkcja - przekształcenia

As with any function, we can apply operators to an image

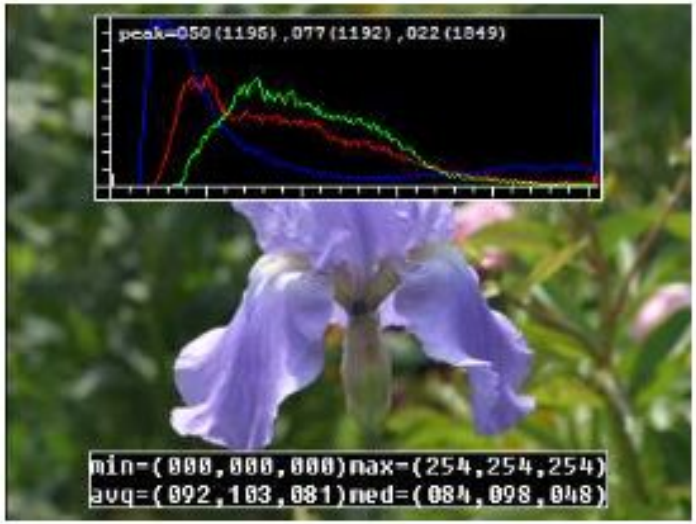
$g(x,y) = f(x,y) + 20$

$g(x,y) = f(-x,y)$

Przekształcenia punktowe



Obraz oryginalny



Jasność + 16

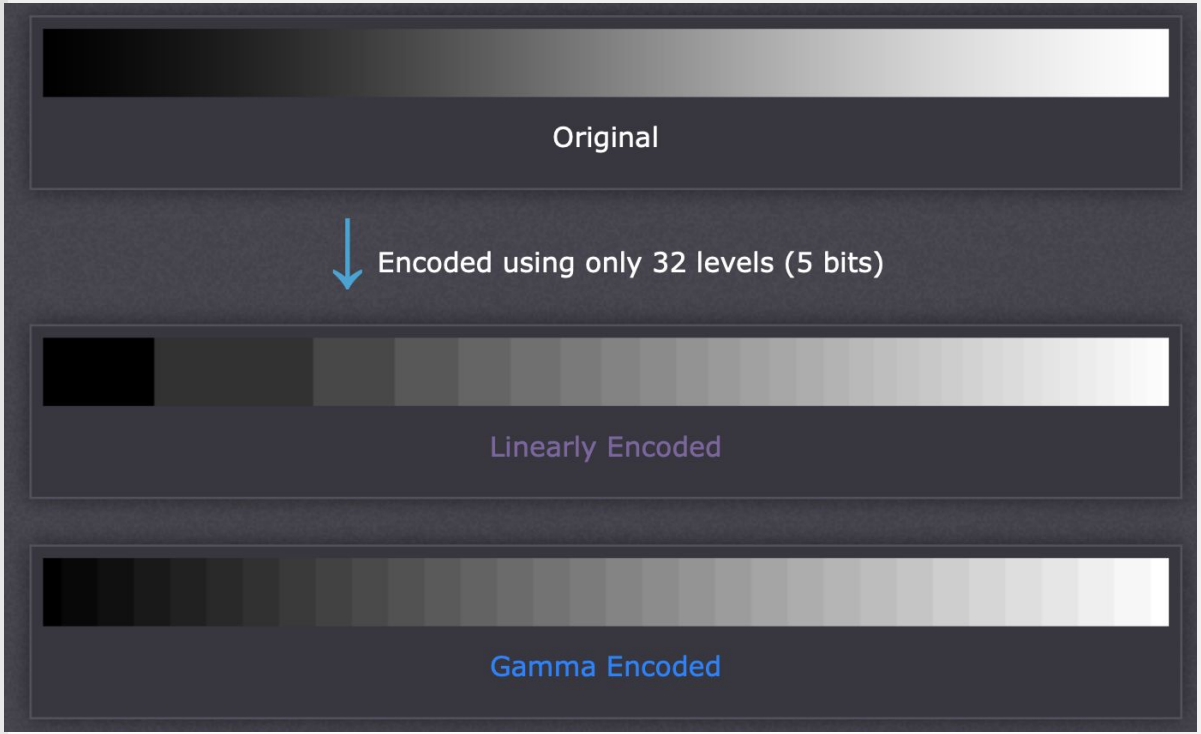
Przekształcenia punktowe

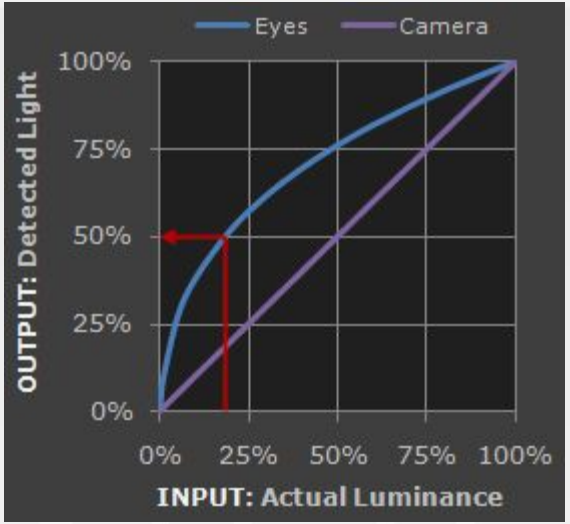
- Najprostsze przekształcenia
- Na podstawie wartości pikseli (plus ew. globalnych cech)
- Modyfikacja wartości funkcji *f*
- Relacje geometryczne pozostają bez zmian

$$g(i,j) = h(f(i,j)).$$

https://www.cambridgeincolour.com/tutorials/gamma-correction.htm

Korekcja gamma

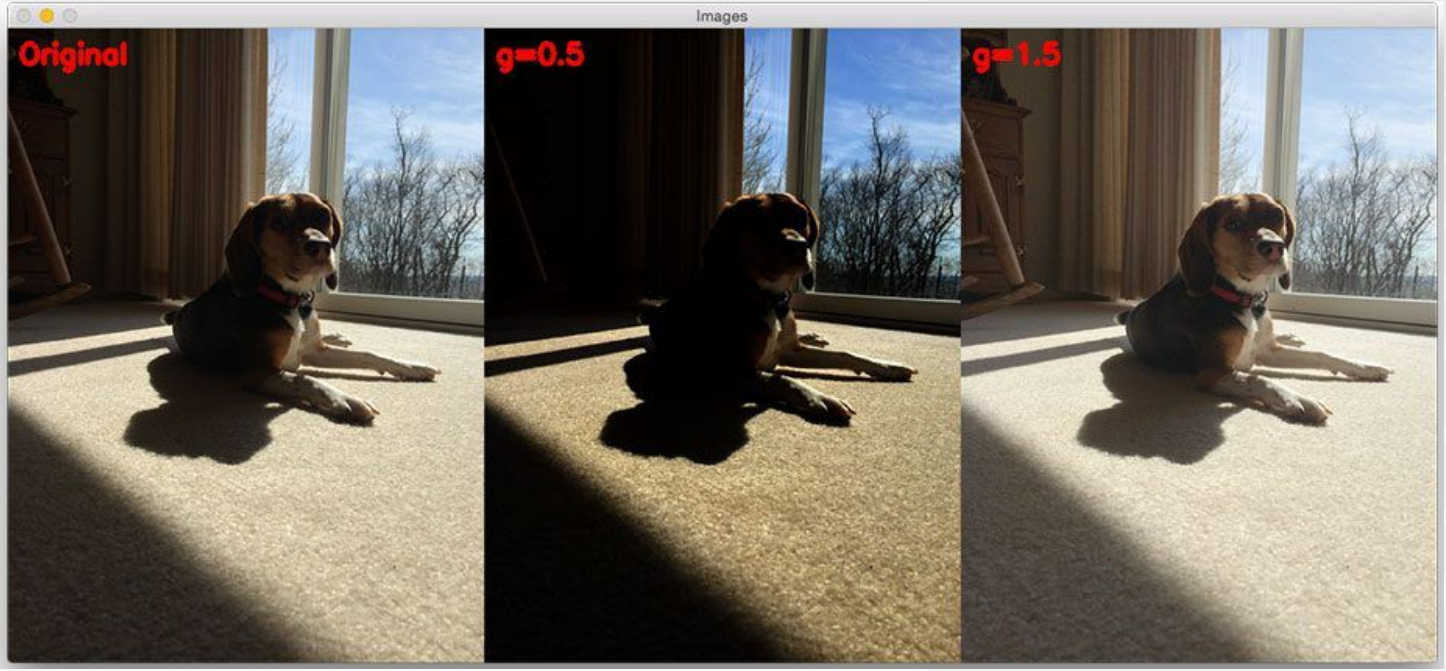




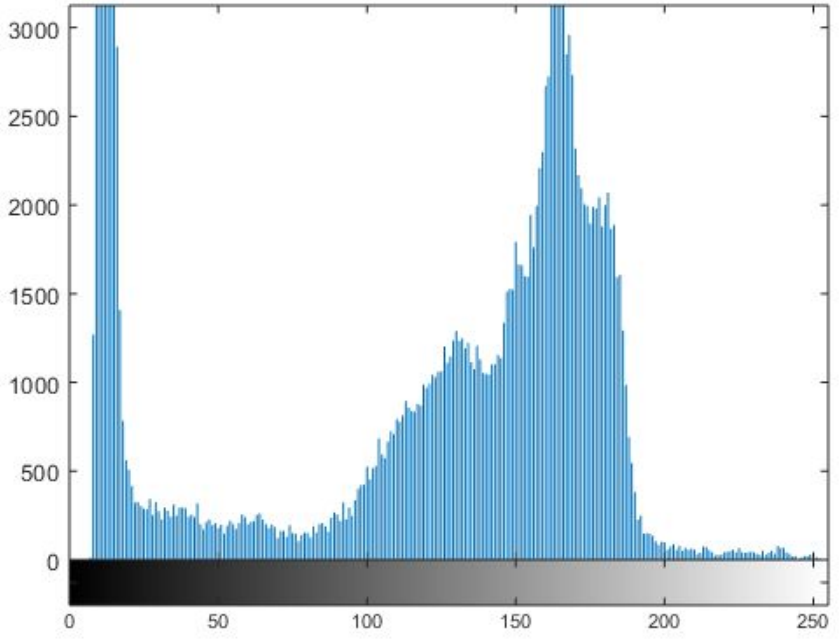
Korekcja gamma

Korekcja gamma

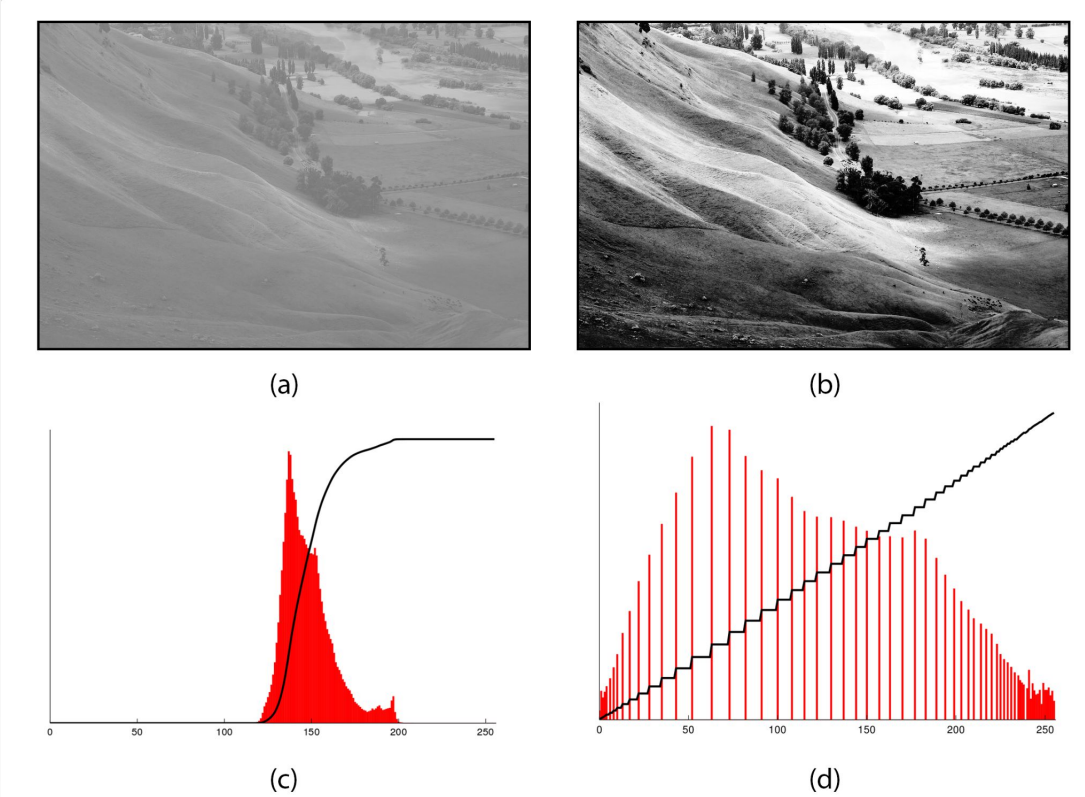
$$g(\mathbf{x}) = [f(\mathbf{x})]^{1/\gamma},$$



Histogram



Wyrównywanie histogramu



GHOST
Group of Horribly Optimistic Statisticians

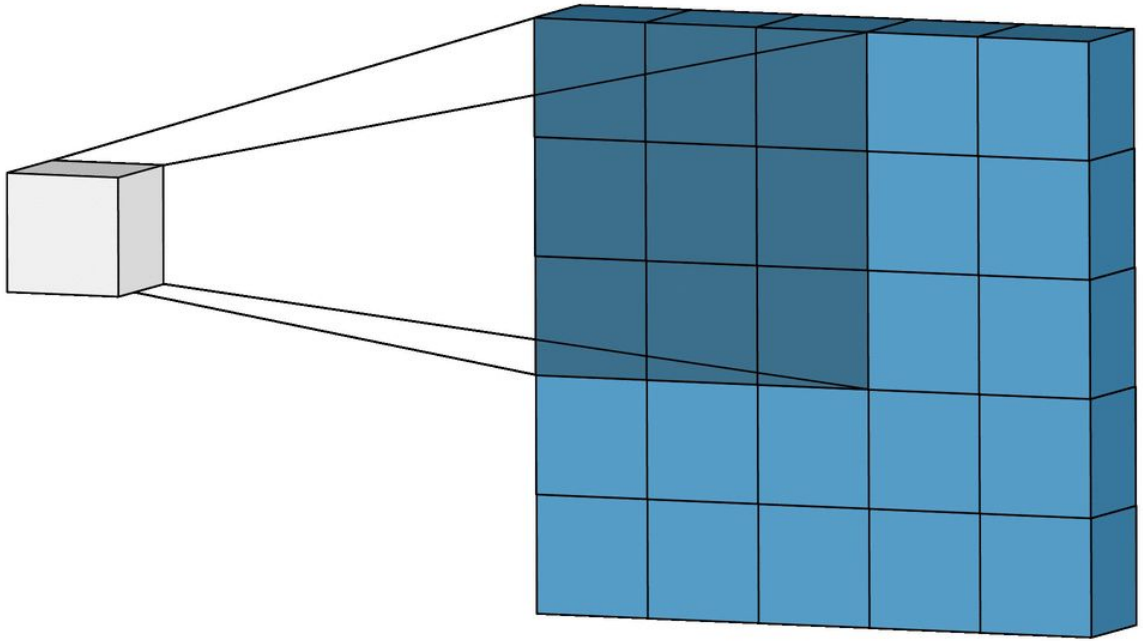
Me when the teacher asks me to come to the front and solve the problem on the whiteboard:

Na czym polega konwolucja (splot)?

- Działanie określone dla dwóch funkcji, dające w wyniku inną funkcję,
- Operacja podobna do *korelacji wzajemnej*

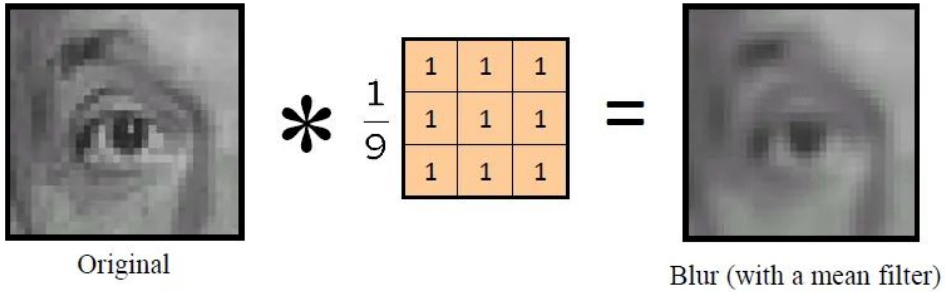
$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau) g(t - \tau)\, d\tau$$

To convolve a kernel with an input signal:
flip the signal, move to the desired time,
and accumulate every interaction with the kernel



https://towardsdatascience.com/intuitively-understanding-convolutions-for-deep-learning-1f6f42faee1

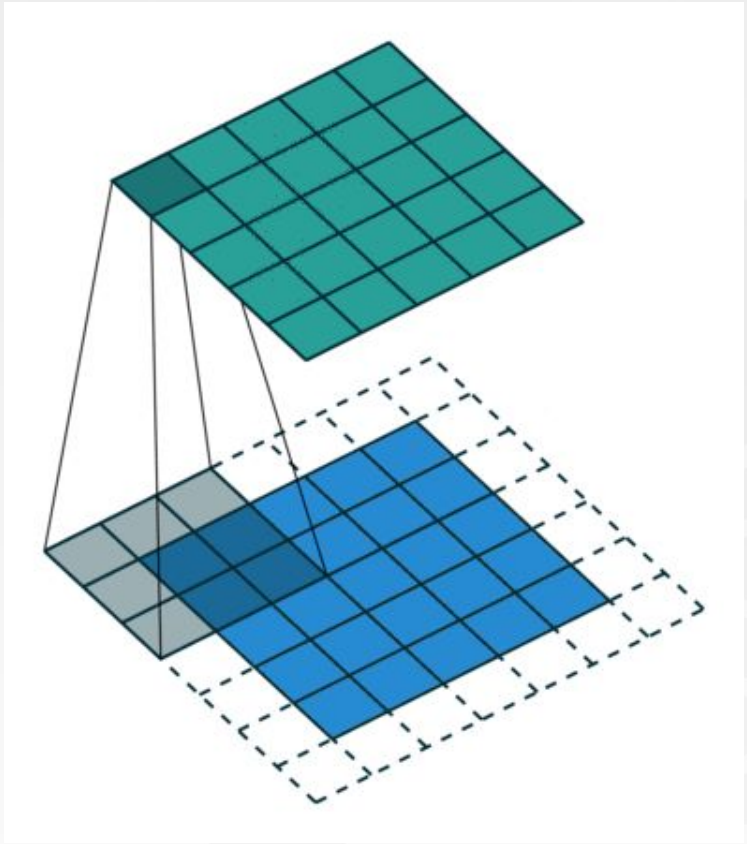
Splot dyskretny w dwóch wymiarach



https://jeheonpark93.medium.com/vc-convolution-based-image-denoising-sharpening-332bbe6293ff

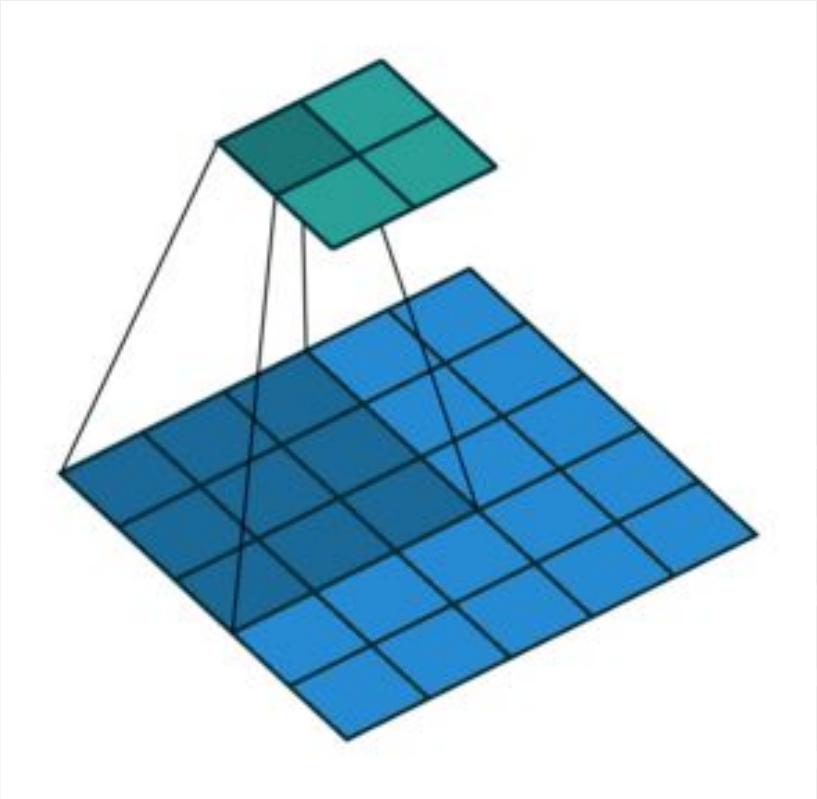
$$g(i,j) = \sum_{k,l} f(i-k, j-l)h(k,l) = \sum_{k,l} f(k,l)h(i-k, j-l),$$

Padding (wypełnienie)



https://towardsdatascience.com/intuitively-understanding-convolutions-for-deep-learning-1f6f42faee1

Stride
(krok)



https://towardsdatascience.com/intuitively-understanding-convolutions-for-deep-learning-1f6f42faee1

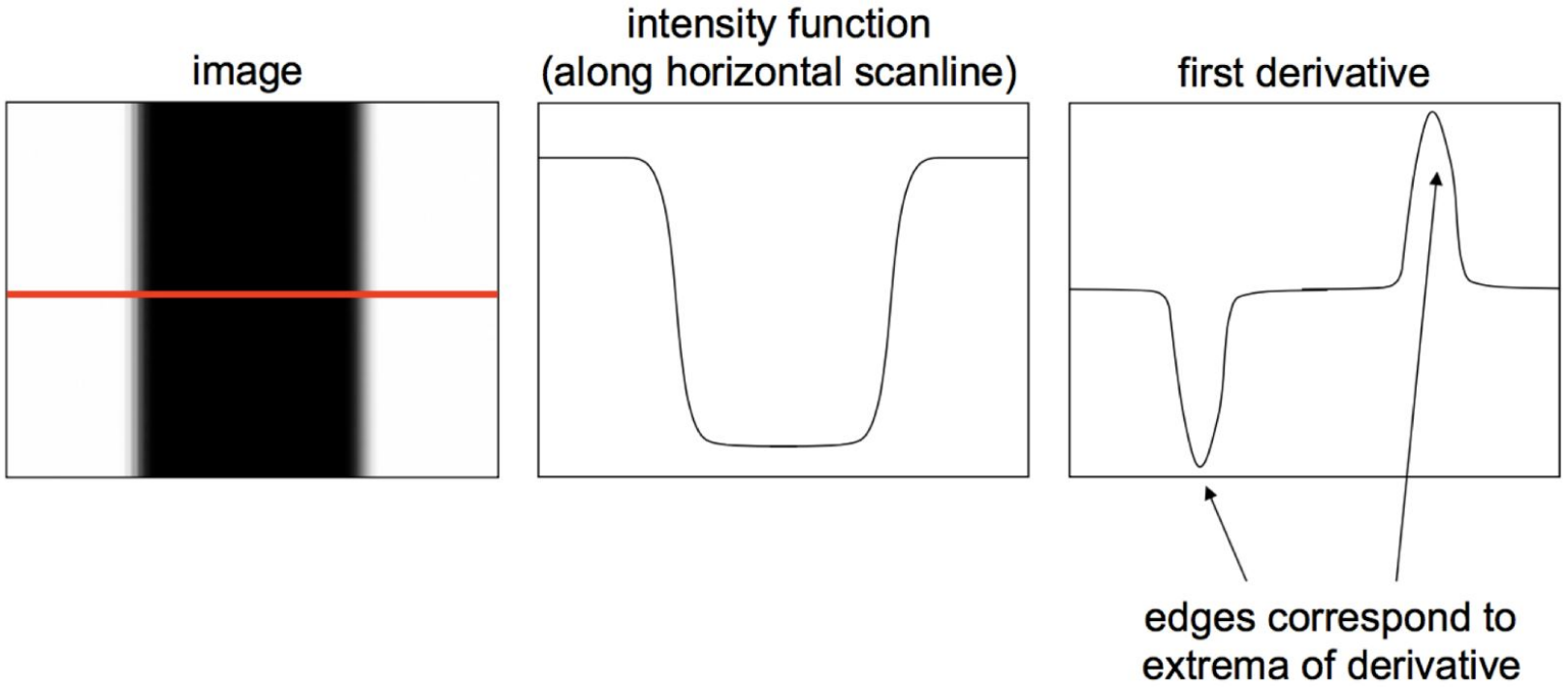


image
intensity function
(along horizontal scanline)
first derivative
edges correspond to
extrema of derivative

Sobel

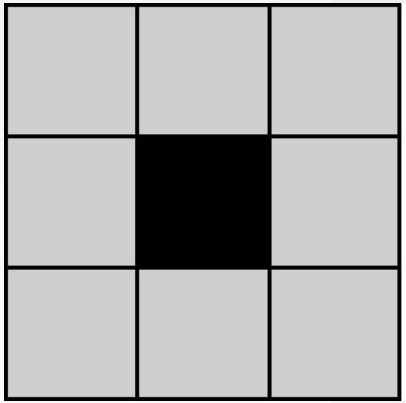
$$\mathbf{G}_x = \begin{bmatrix} +1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix} * \mathbf{A} \quad \text{and} \quad \mathbf{G}_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * \mathbf{A}$$

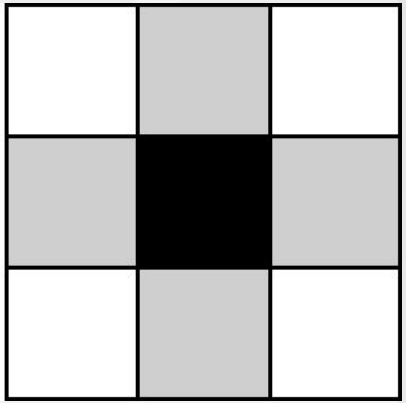
Przetwarzanie binarne

Progowanie (thresholding)

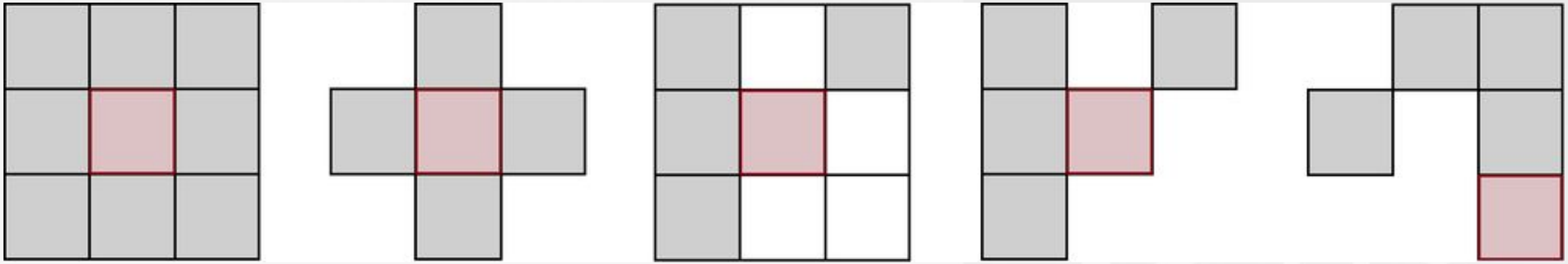
$$\theta(f,t) = \begin{cases} 1 & \text{if } f \geq t, \\ 0 & \text{else,} \end{cases}$$

Sąsiedztwo ośmiospójne i czterospójne

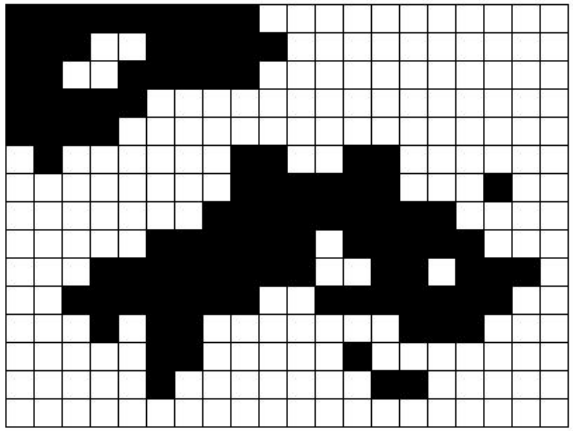


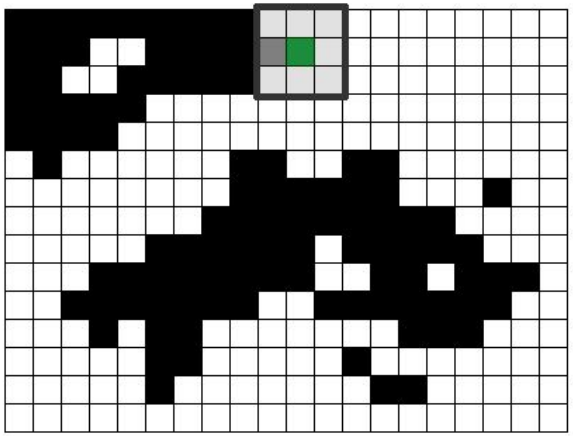


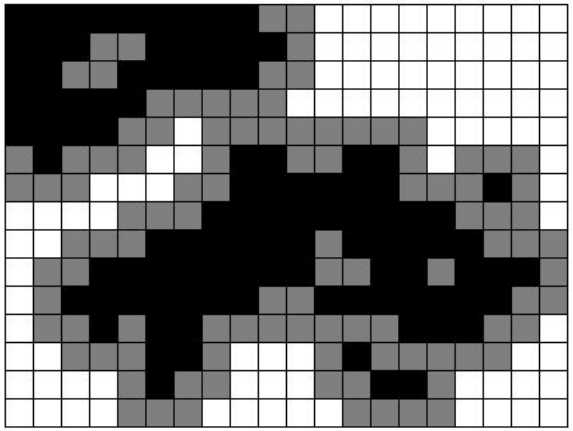
Przykładowe elementy strukturalne



Operacje morfologiczne - Dylatacja

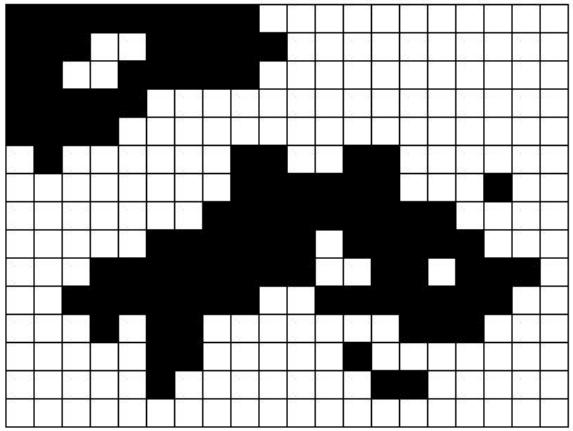


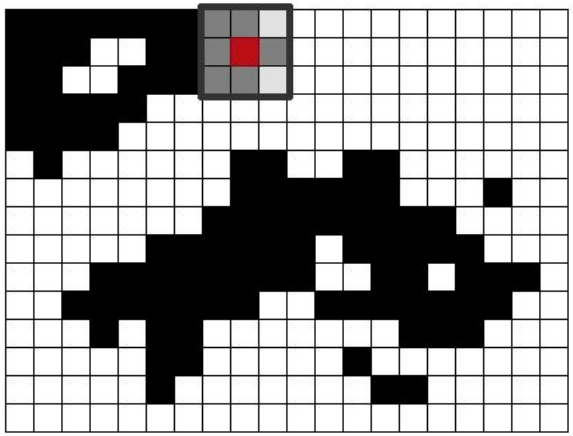


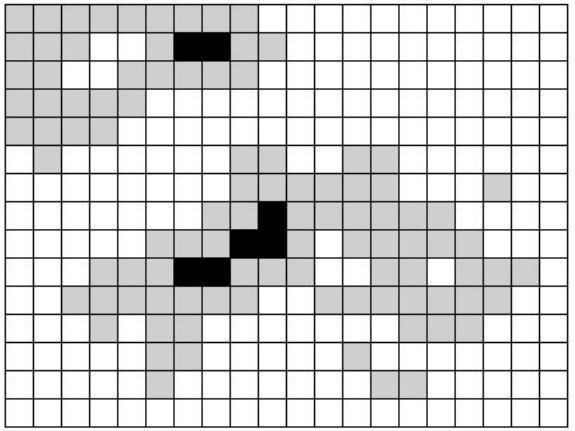


https://pl.wikipedia.org/wiki/Cyfrowe_przetwarzanie_obraz%C3%B3w_binarnych#Obraz_binarny

Operacje morfologiczne - Erozja







https://pl.wikipedia.org/wiki/Cyfrowe_przetwarzanie_obraz%C3%B3w_binarnych#Obraz_binarny

Materiały

- Intuitive Guide to Convolution

https://betterexplained.com/articles/intuitive-convolution/

- Image Kernels Explained Visually

https://setosa.io/ev/image-kernels/

- Intuitively Understanding Convolutions for Deep Learning

https://towardsdatascience.com/intuitively-understanding-convolutions-for-deep-learning-1f6f42faee1