

Morfologie a tvarové charakteristiky

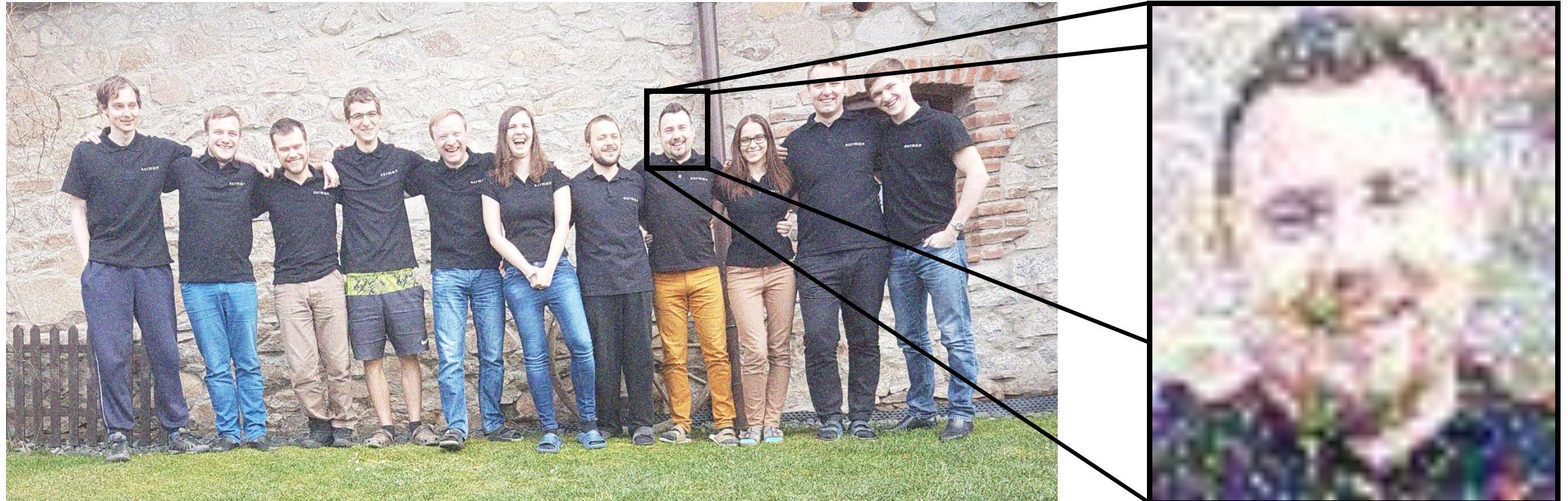
Strojové vidění a zpracování obrazu
BI-SVZ

Šum v obrazu (noise)

KDY?



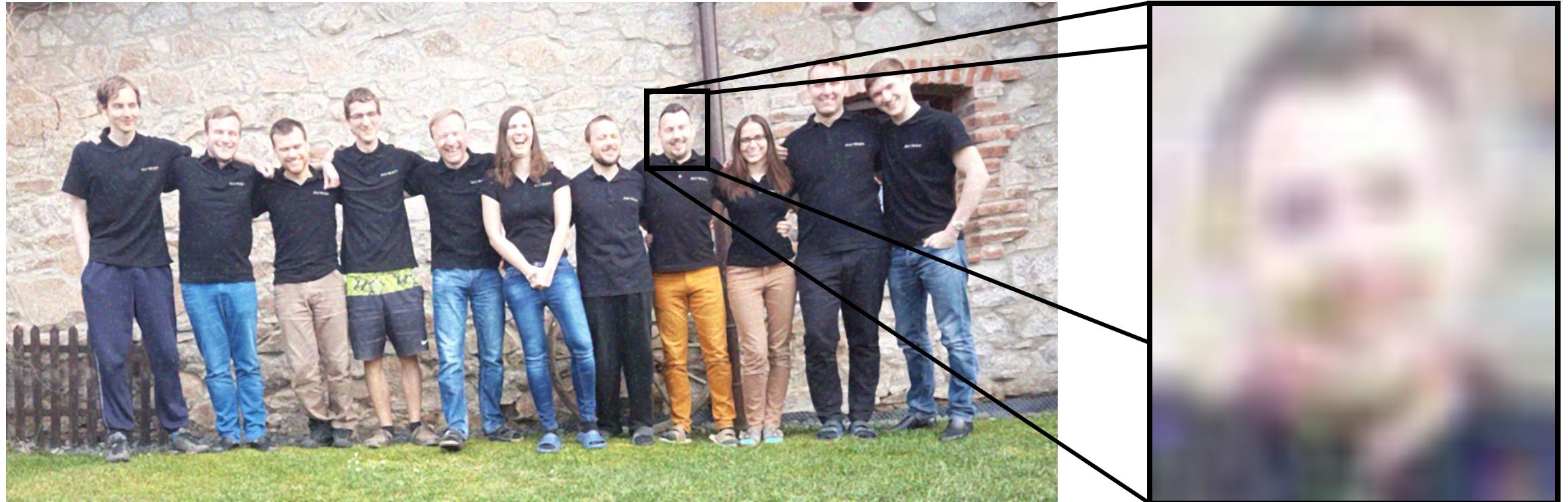
Šum v obrazu – Gaussian noise



Aditivní šum s Gaussovým rozložením

- Nejčastější typ
- Náhodné přičtení hodnot k hodnotám pixelů

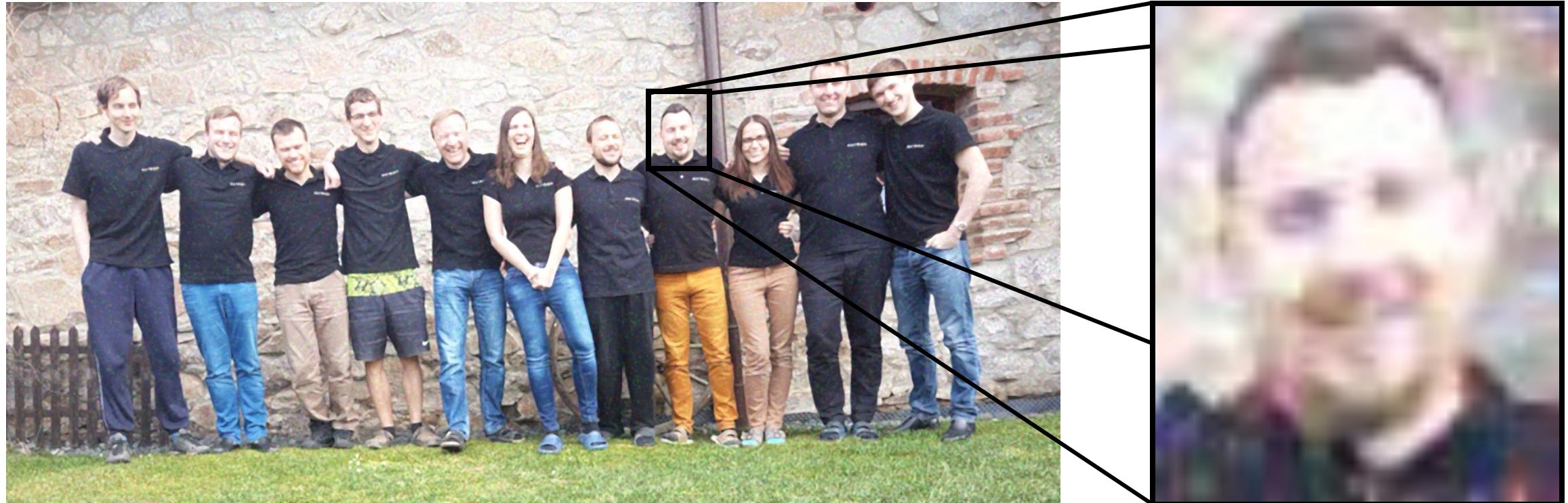
Šum v obrazu – Gaussian noise



Odstanění

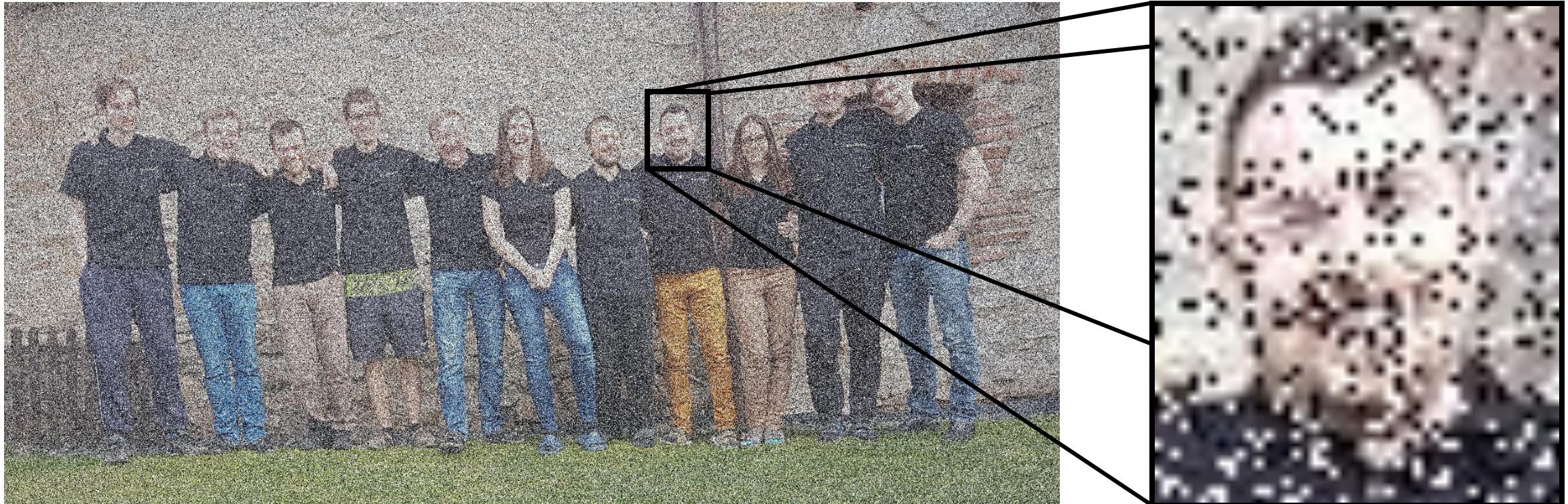
- Rozmazáním
- Průměrováním

Šum v obrazu – Gaussian noise



Odstrani
• Mediánem

Šum v obrazu – Salt&Pepper noise



Náhodný šum 0 nebo 255

- Vadný senzor
- Saturace světločivné buňky

Šum v obrazu – Salt&Pepper noise



Odstanění

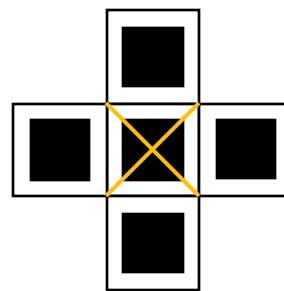
- Mediánem

Morfologie v biologii

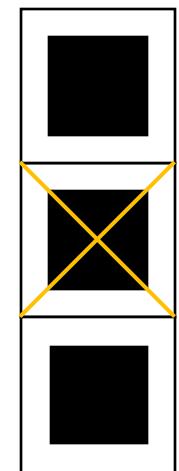
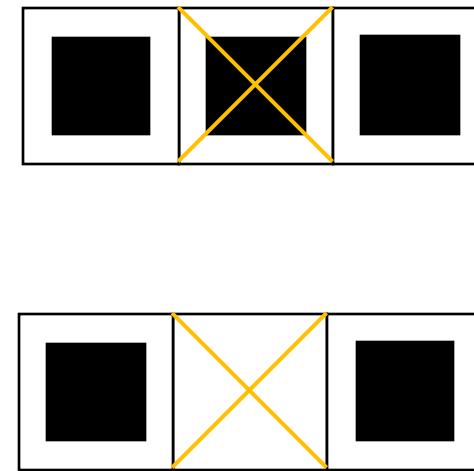
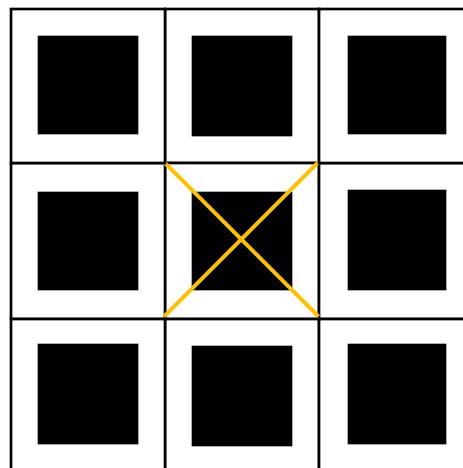
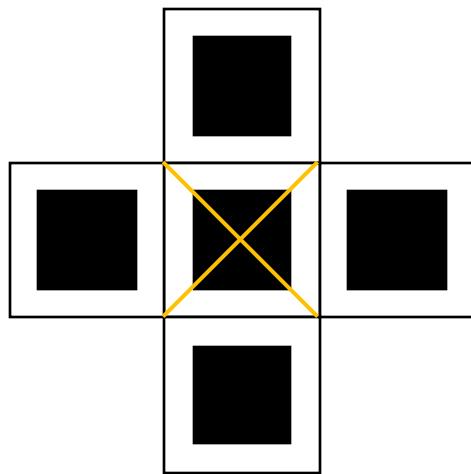
Studium velikosti, tvaru a vnitřní struktury zvířat, rostlin a mikroorganismů a hledání souvislostí mezi jejich vnitřními částmi.

Morfologie ve zpracování obrazu

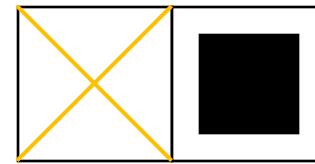
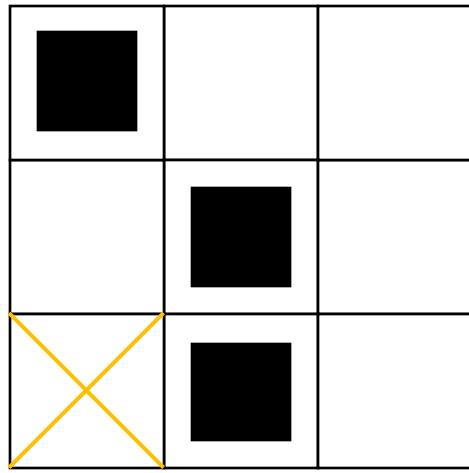
Způsob, jak odhalit a získat znalosti z diskrétního obrazu pomocí jeho postupné analýzy malou sondou – strukturním elementem.



Strukturní element

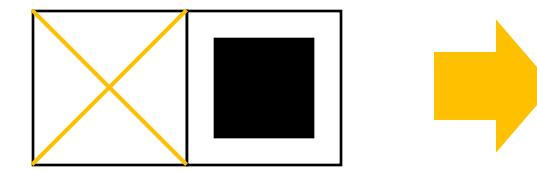
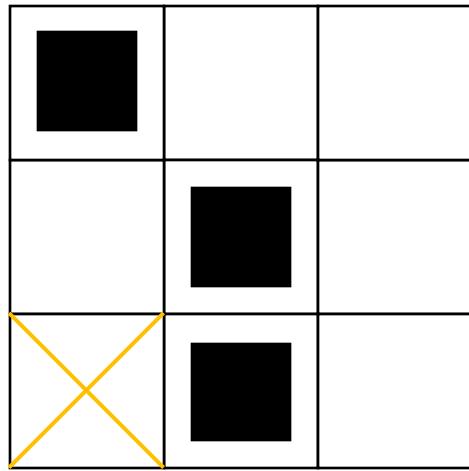


Strukturní element – porovnávání

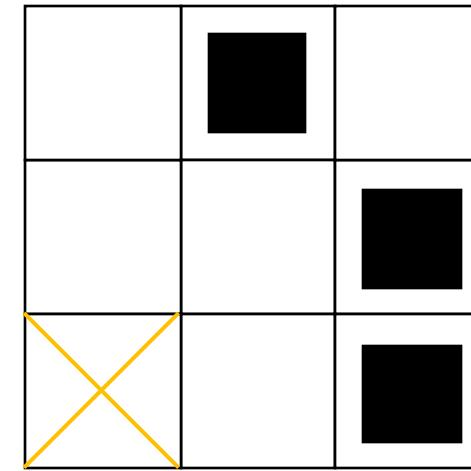


Postupný posun po obrázku a zjišťování,
zda v počátku SE je objekt (1)

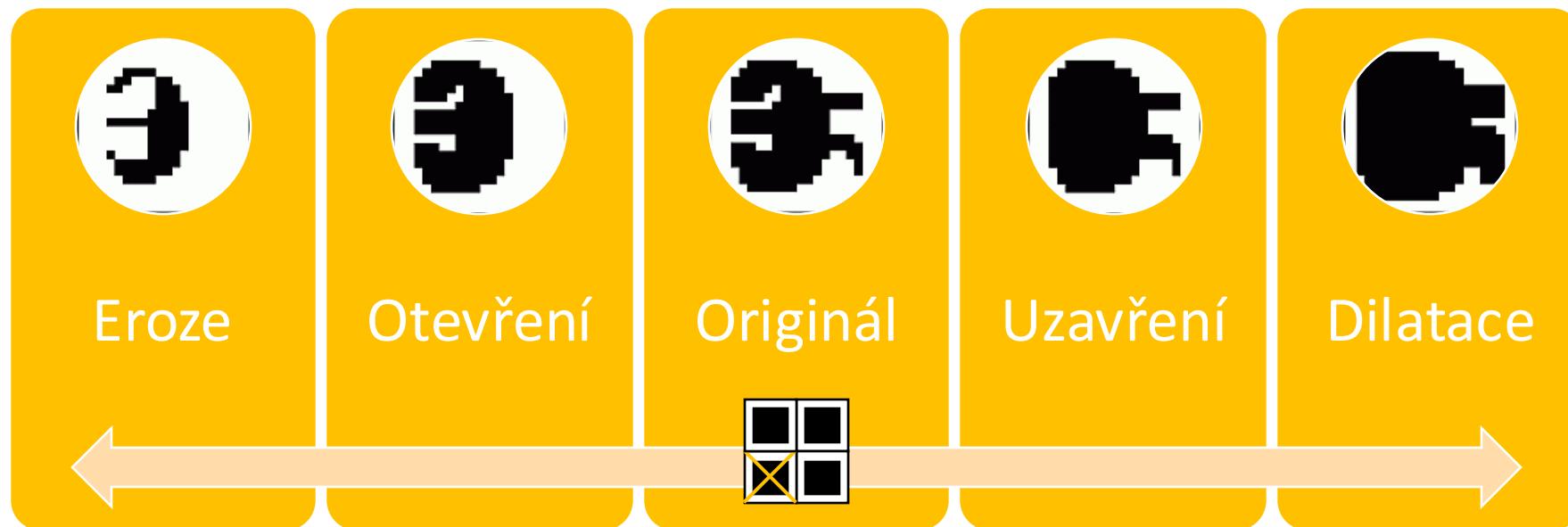
Strukturní element – porovnání



= SE posun doprava



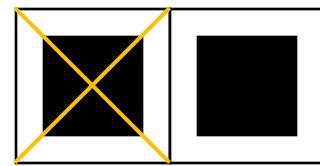
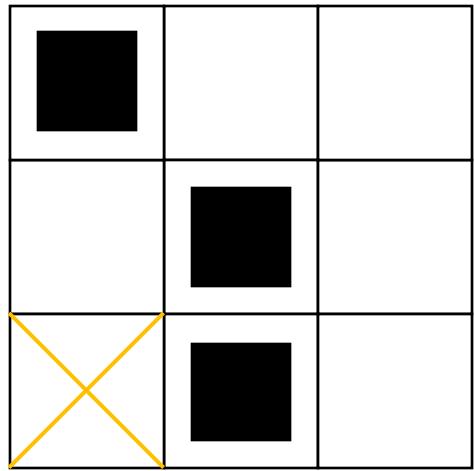
Metody binární morfologie



SMITH, W. *Digital signal processing: scientist and engineer's guide*. Vyd. 1. California: California Technical Publishing, 1997, 626 s. ISBN 09-660-1763-3.

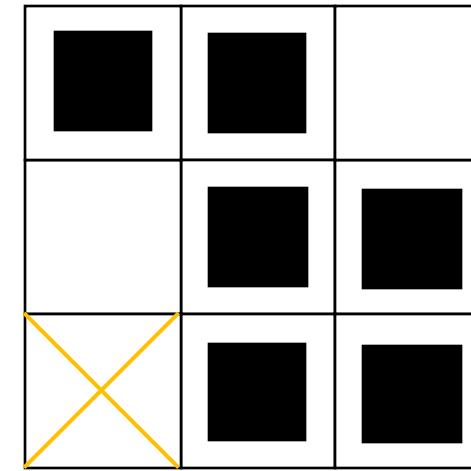
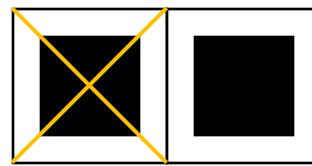
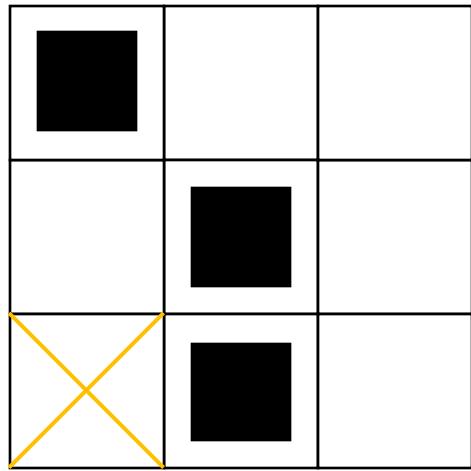
Dilatace

- Expanze objektu



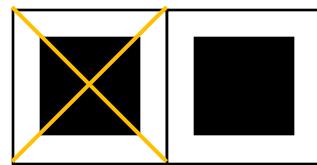
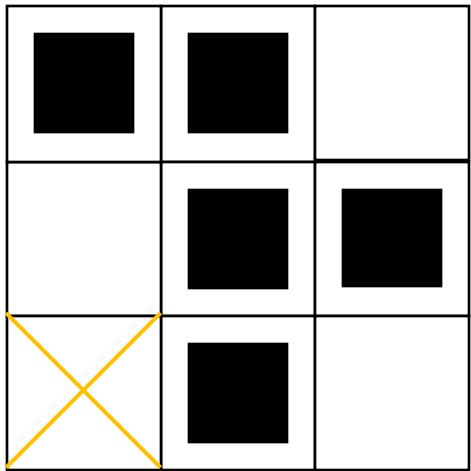
Dilatace

- Expanze objektu



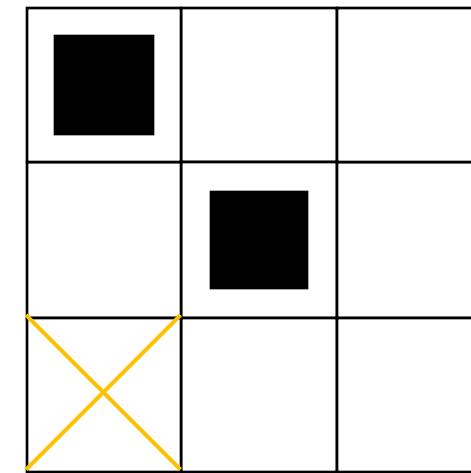
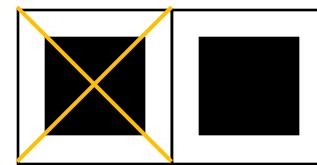
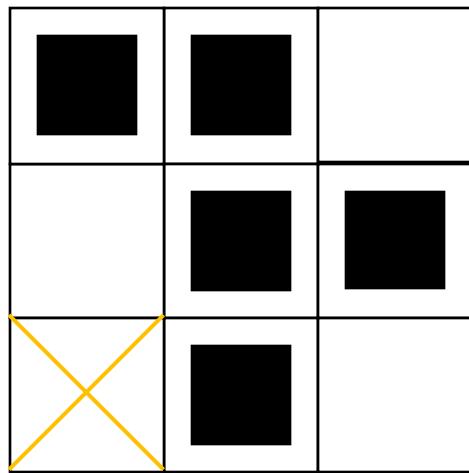
Eroze

- Kontrakce objektu
- Oddělení objektů

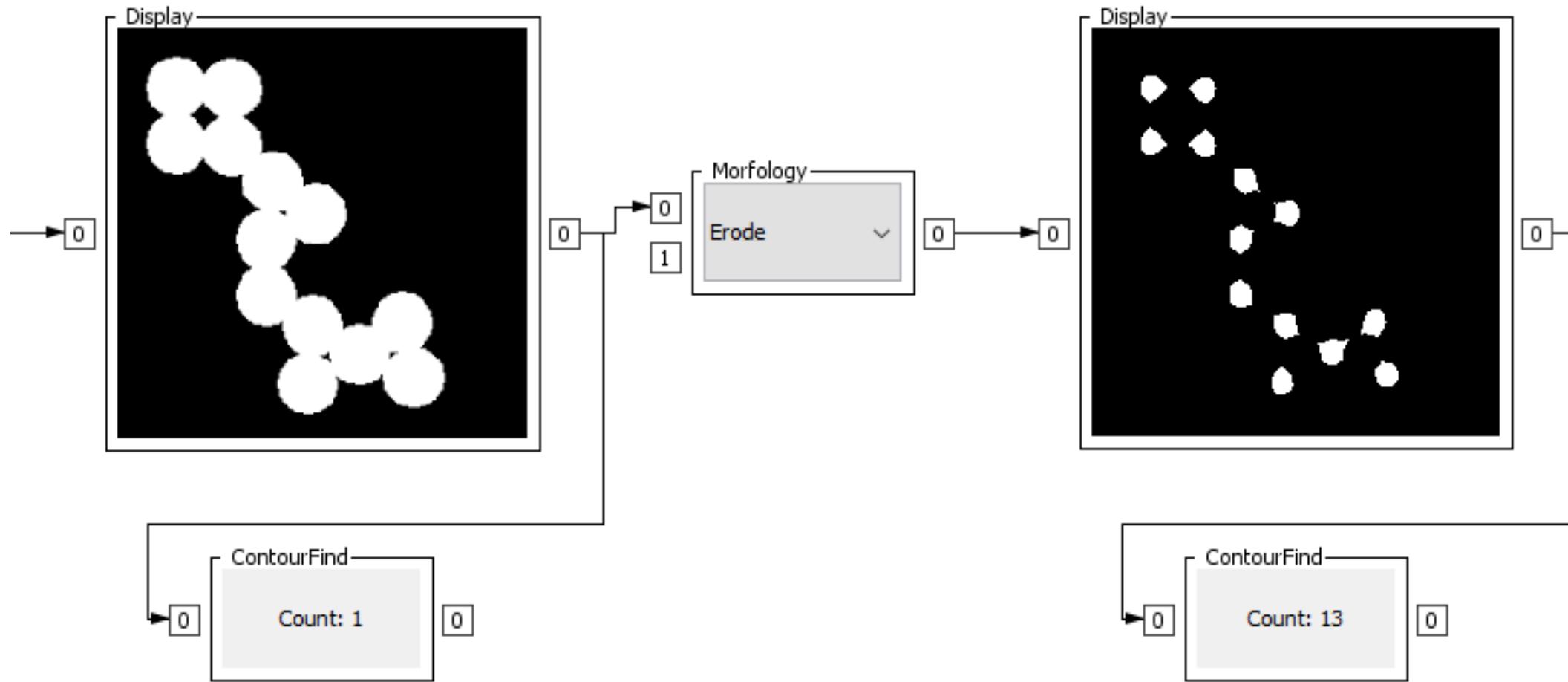


Eroze

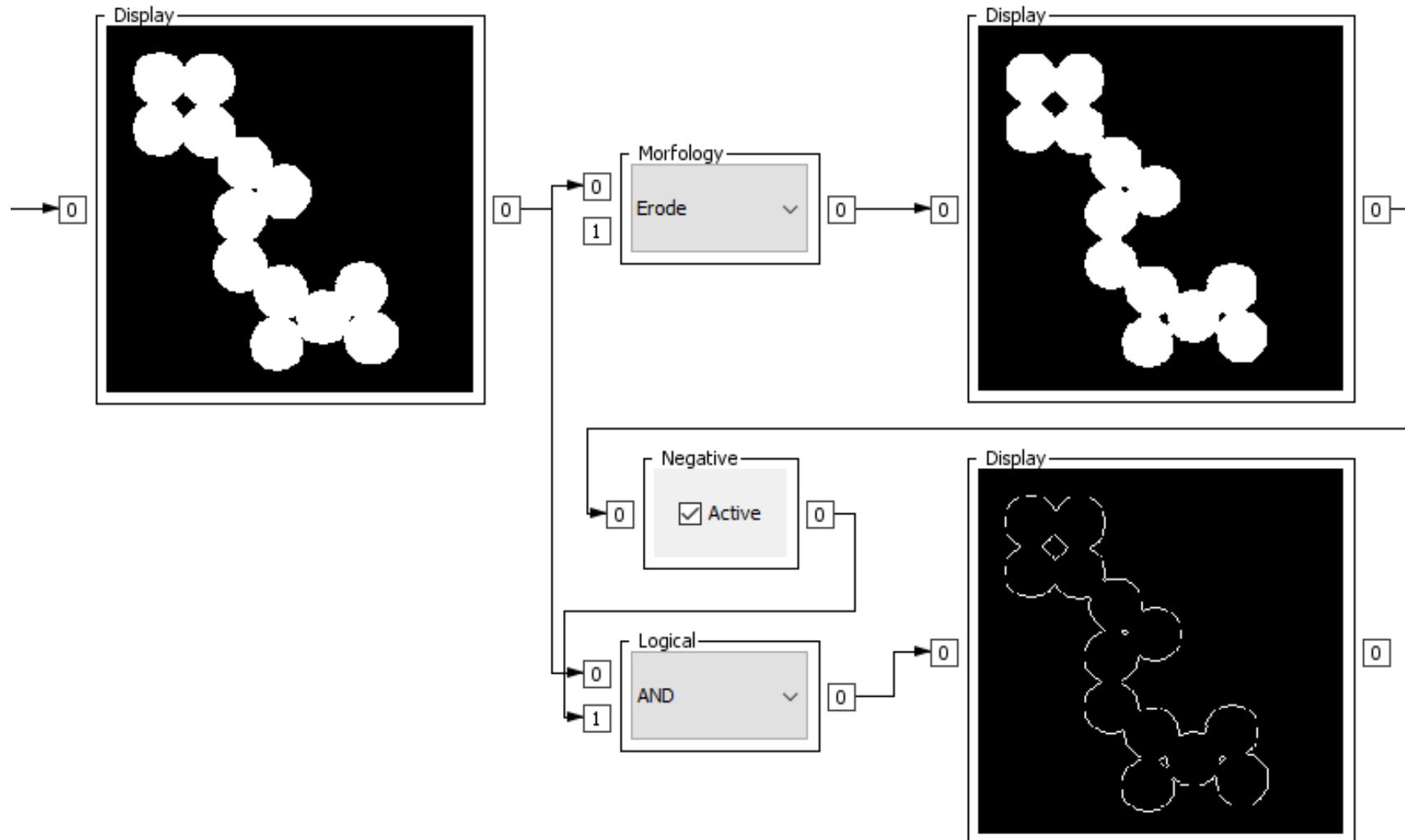
- Kontrakce objektu
- Oddělení objektů



Eroze

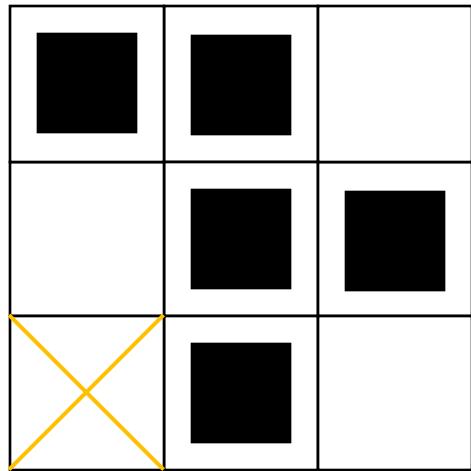


Eroze – zisk kontur

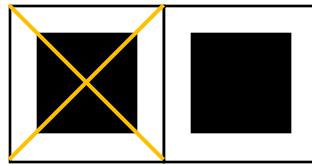


Otevření

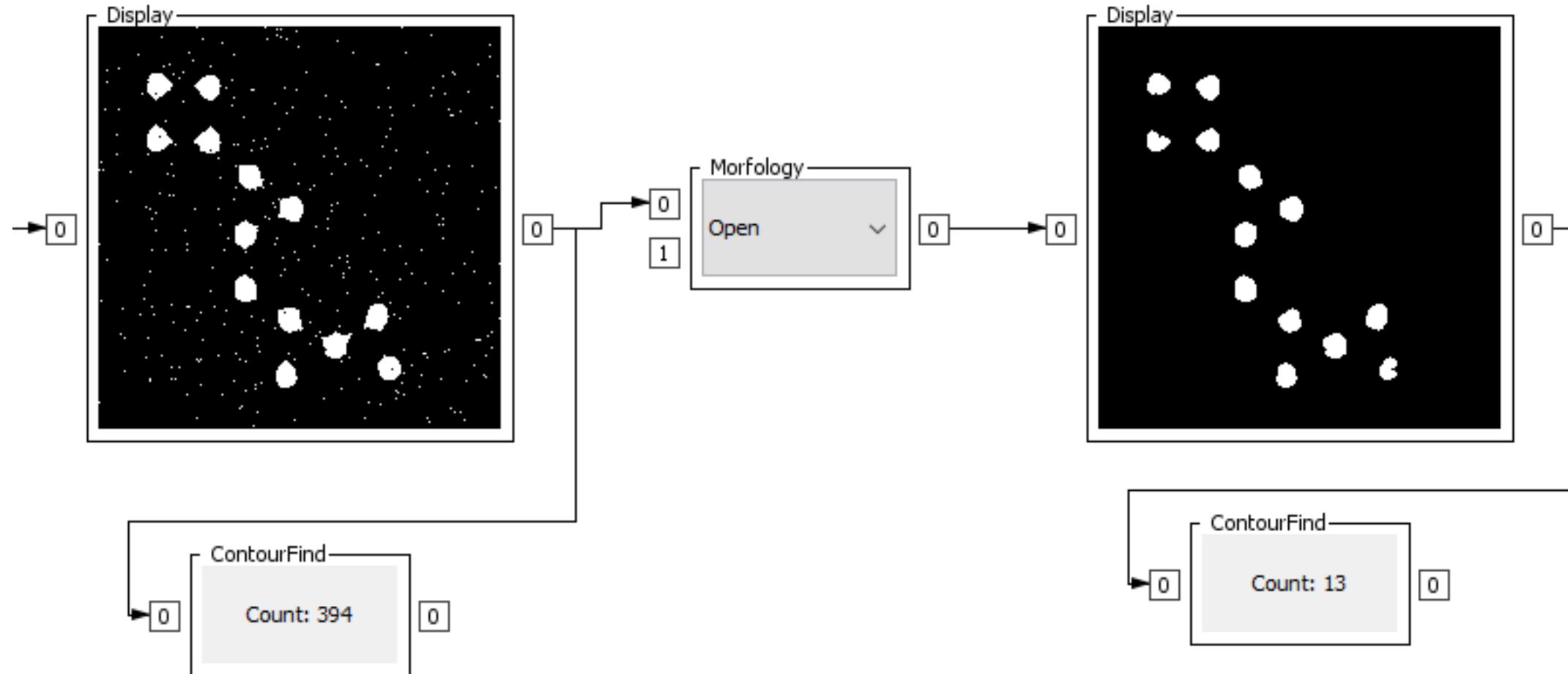
- Zbavení se šumu
- Nejdřív eroze, potom dilatace



o

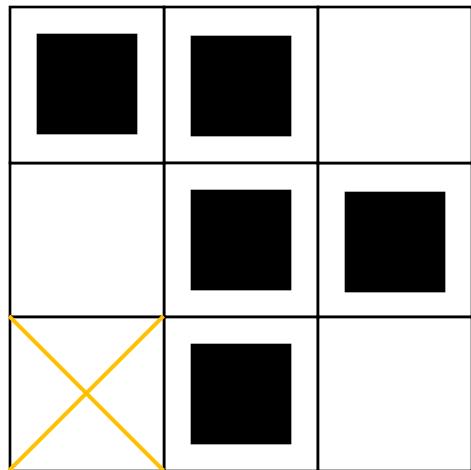


Otevření

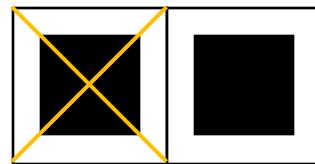


Uzavření

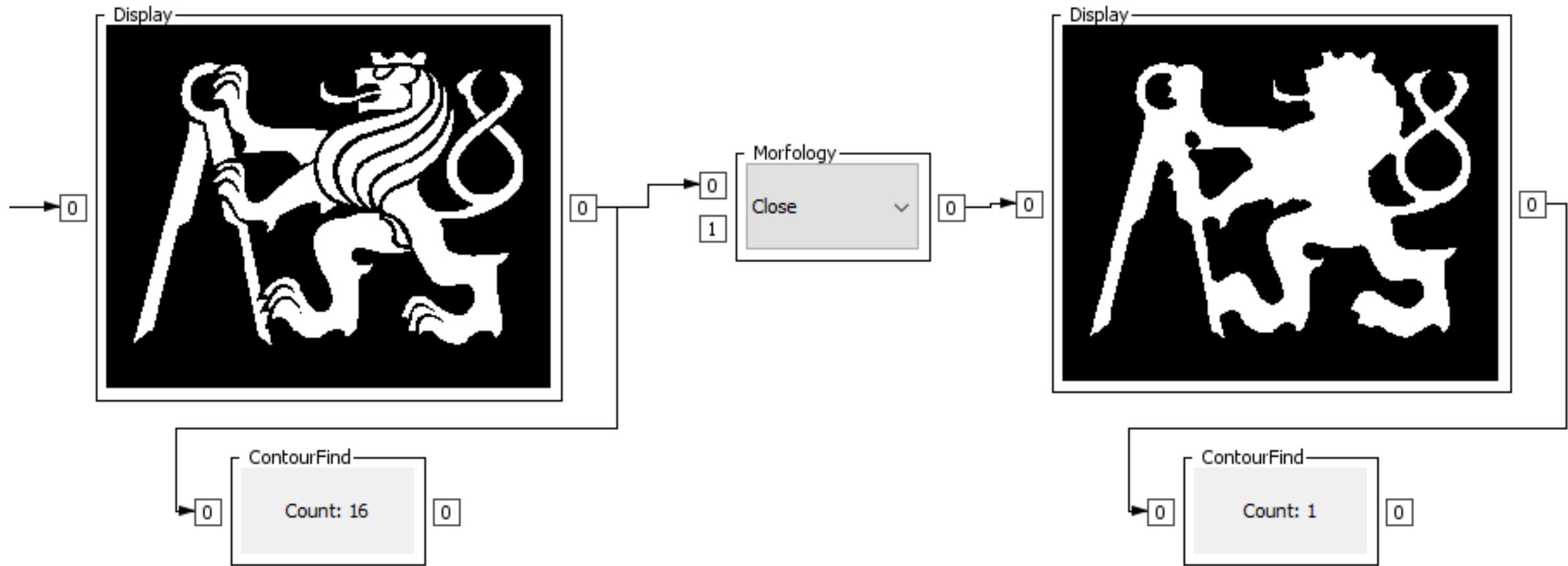
- Spojení objektů, zaplnění děr,
- Nejdřív dilatace, potom eroze



•



Uzavření



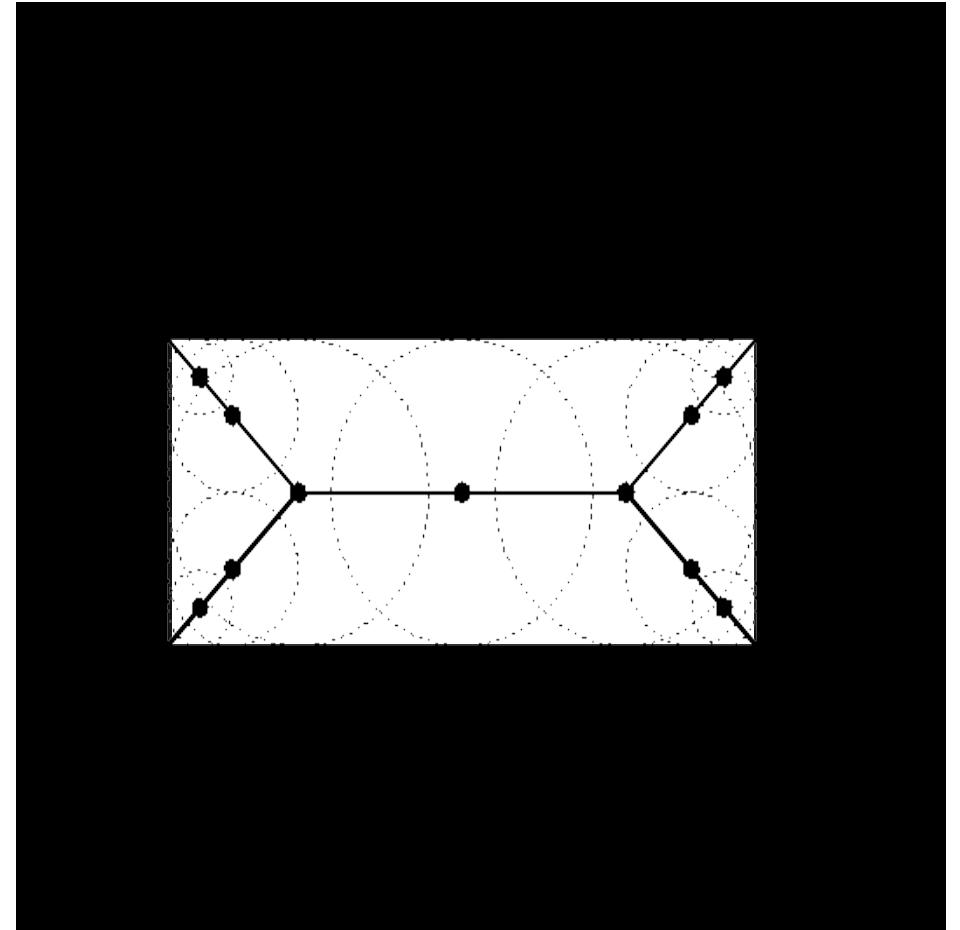
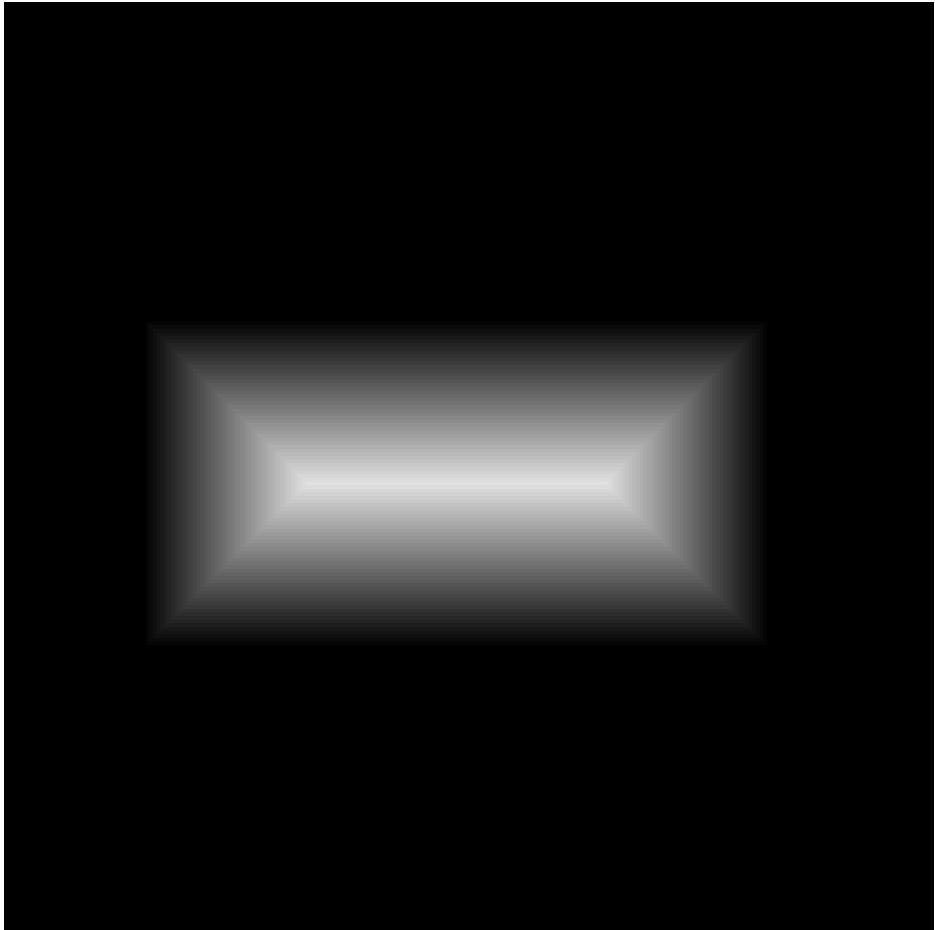
Skeletonizace

- Vytvoření binárního skeletonu
- Spojení středů největších vepsaných kruhů
- Vzdálenostní transformace × Tenčení
- Aproximace přímkami
 - Geometrie objektu
- Detekce konců

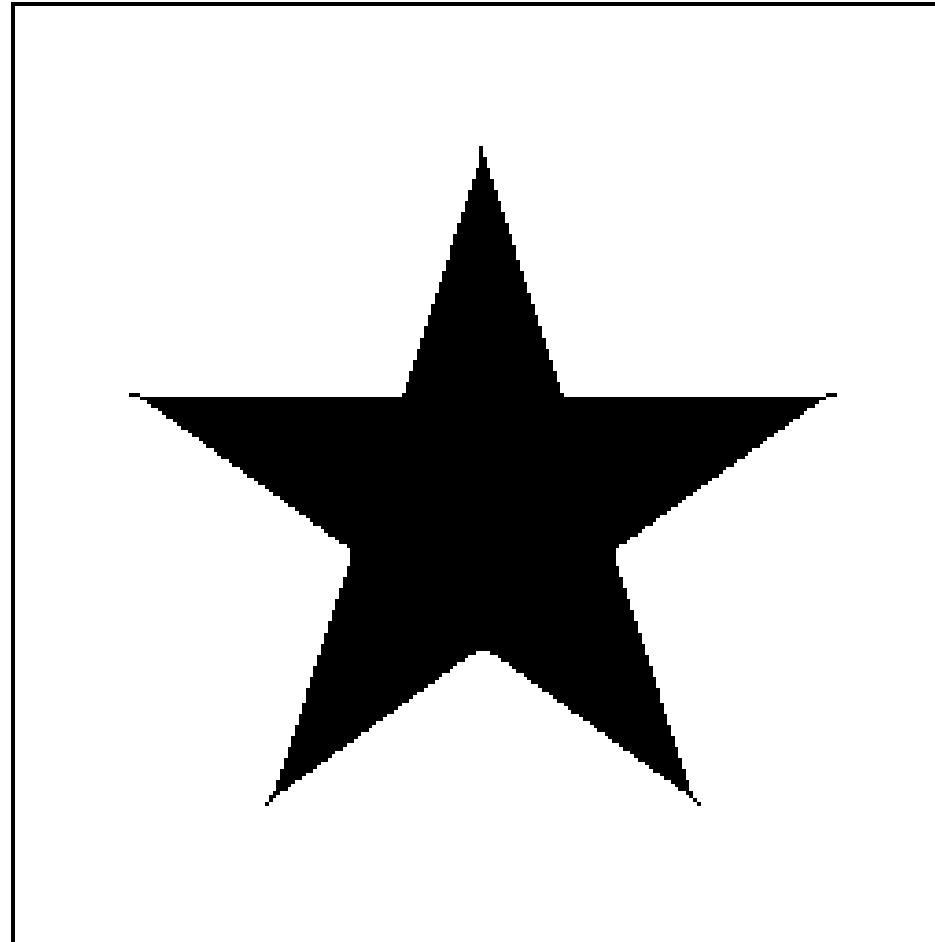


<https://stock.adobe.com/cz/images/cartoon-illustration-of-human-skeleton-of-dead-businessman-sitting-in-front-of-computer/166967190>

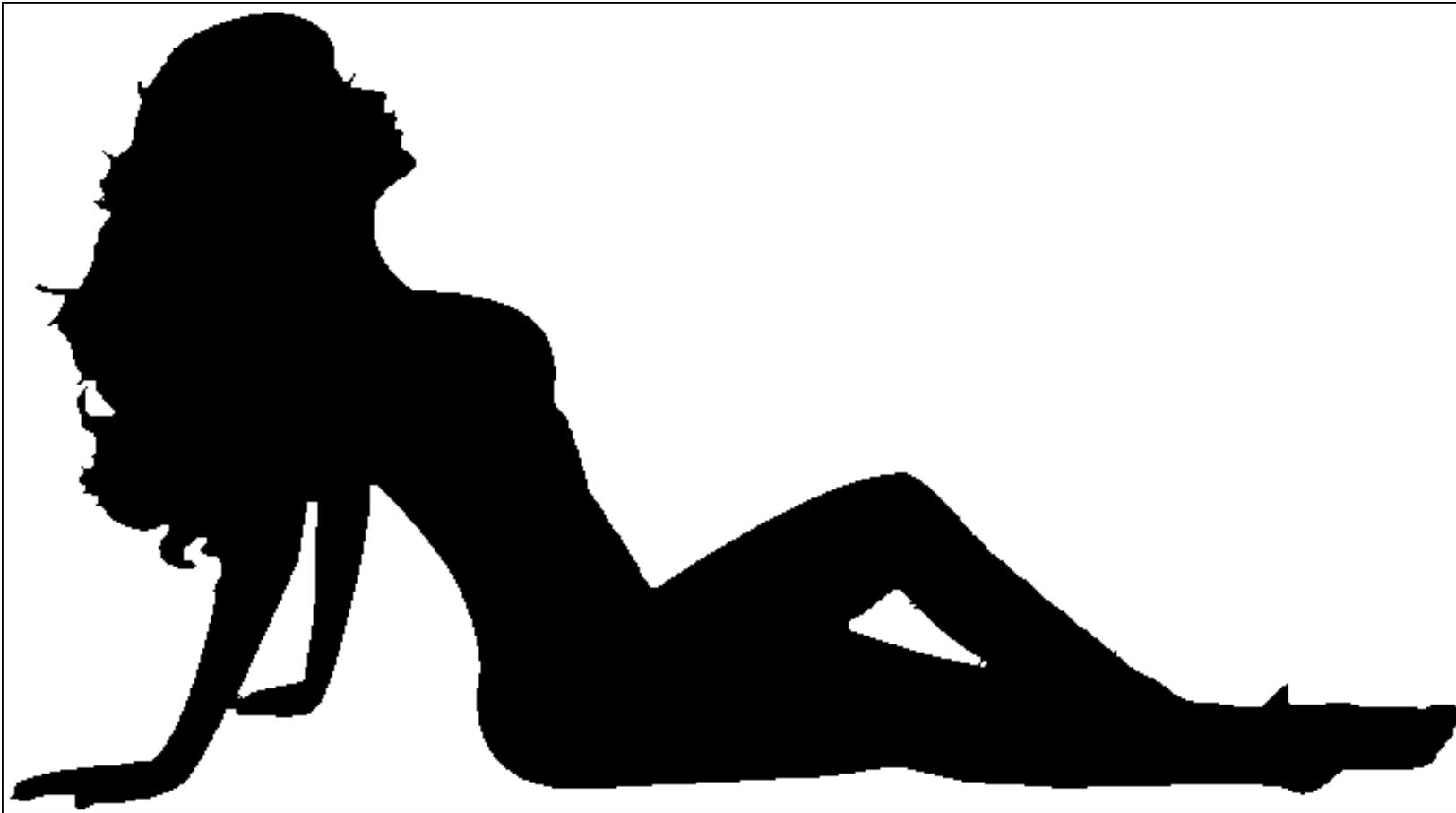
Vzdálenostní transformace



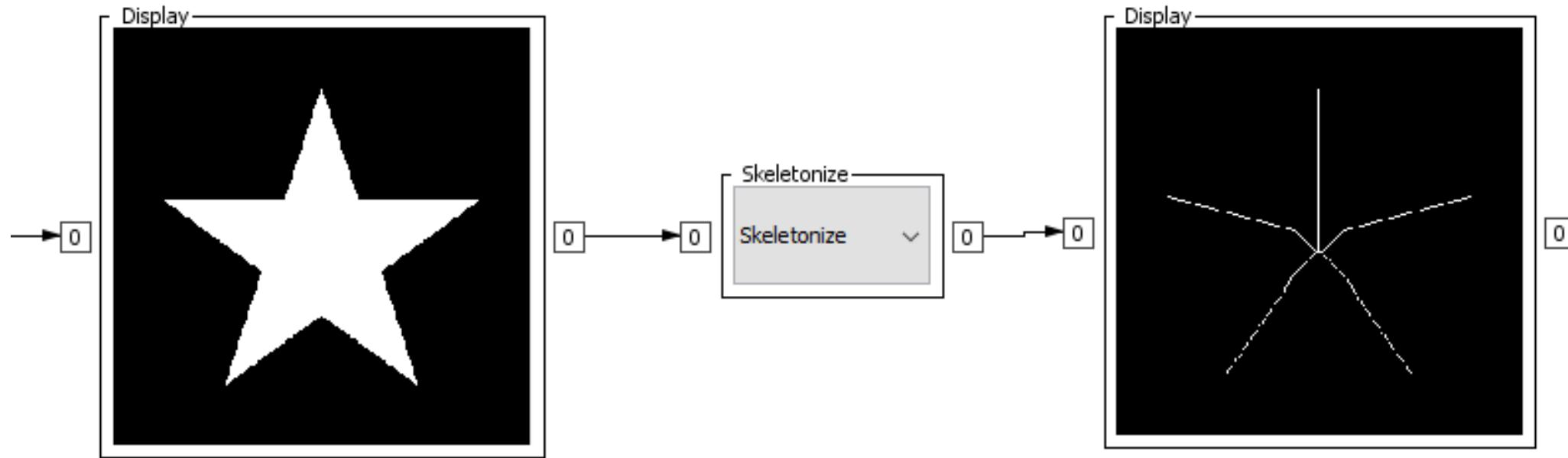
Tenčení (thinning)



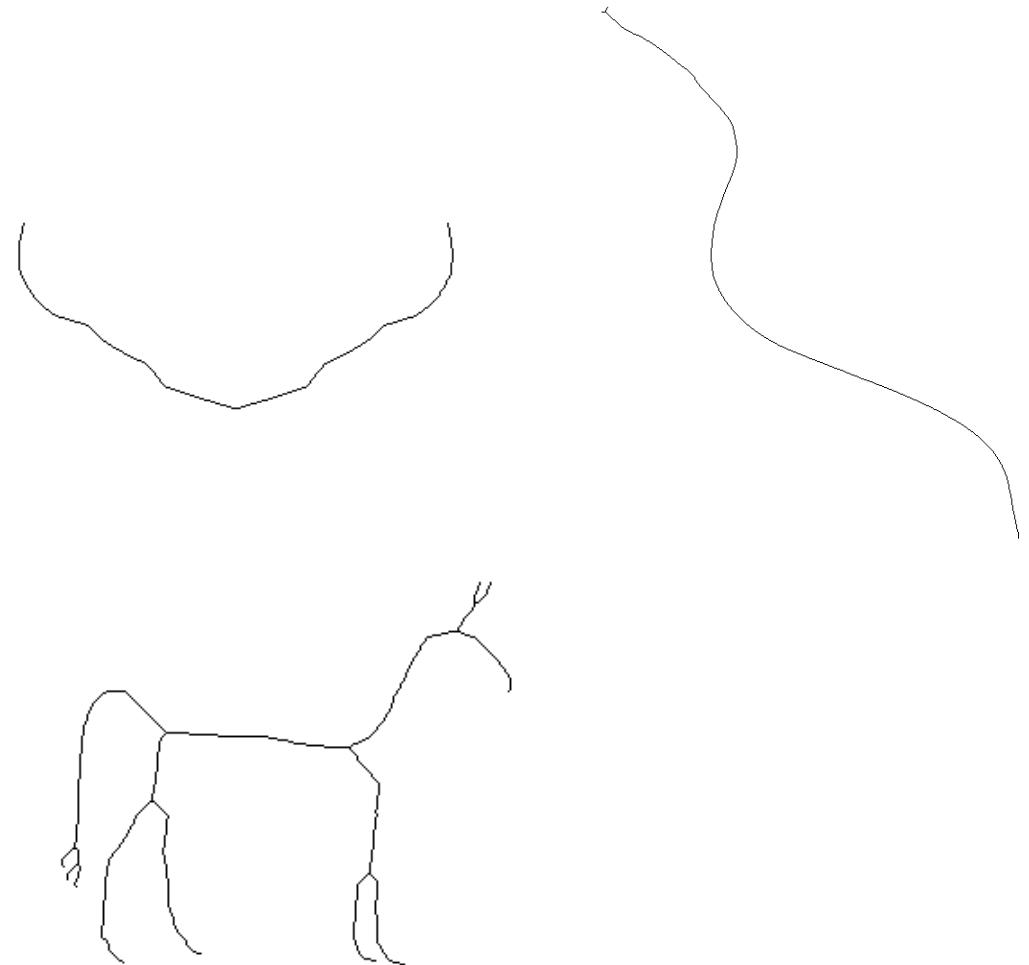
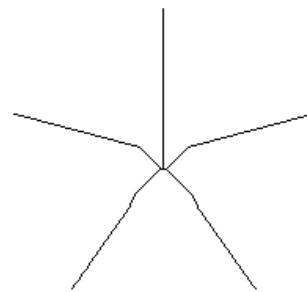
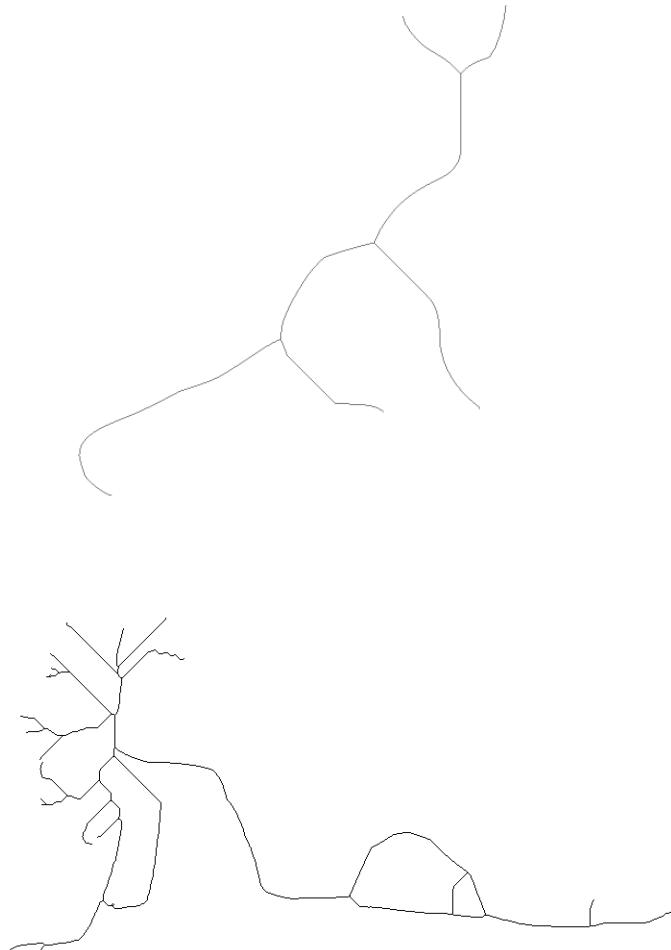
Tenčení (thinning)



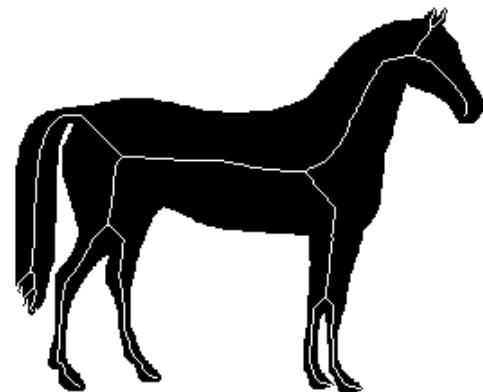
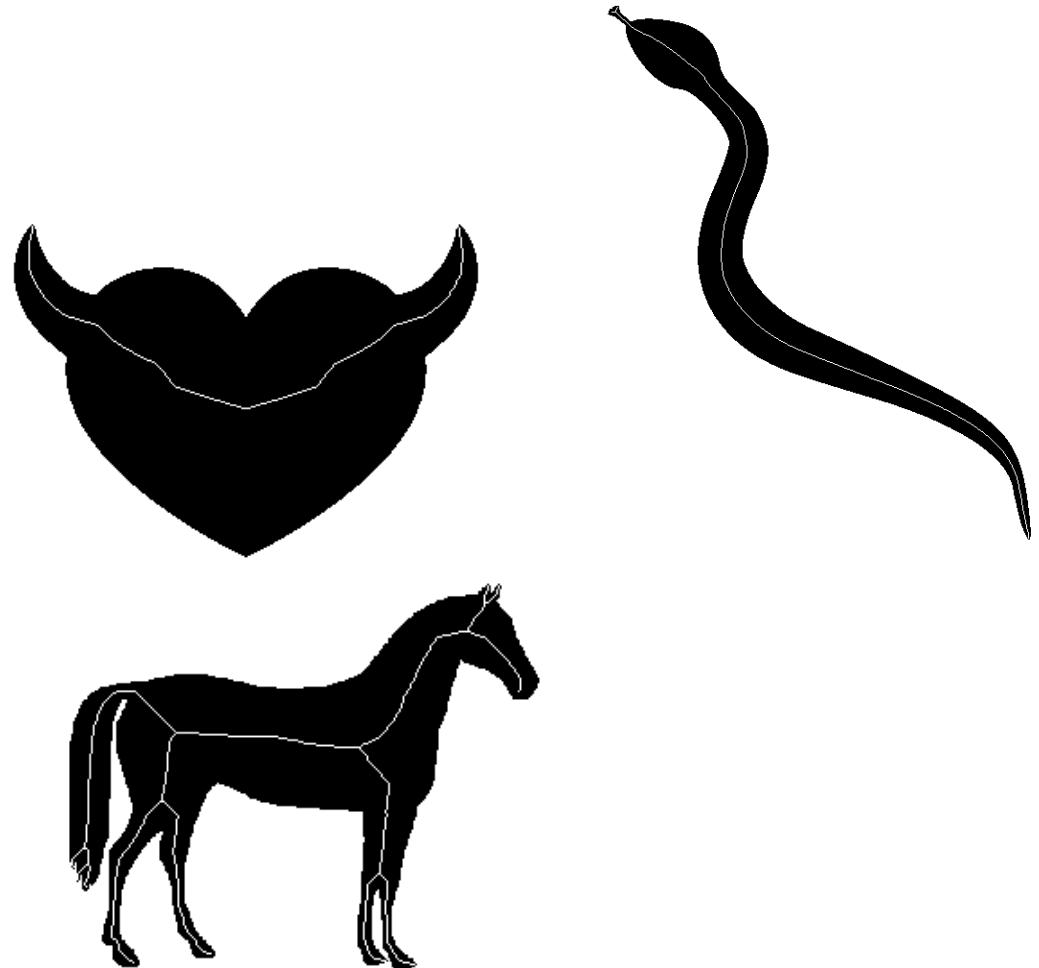
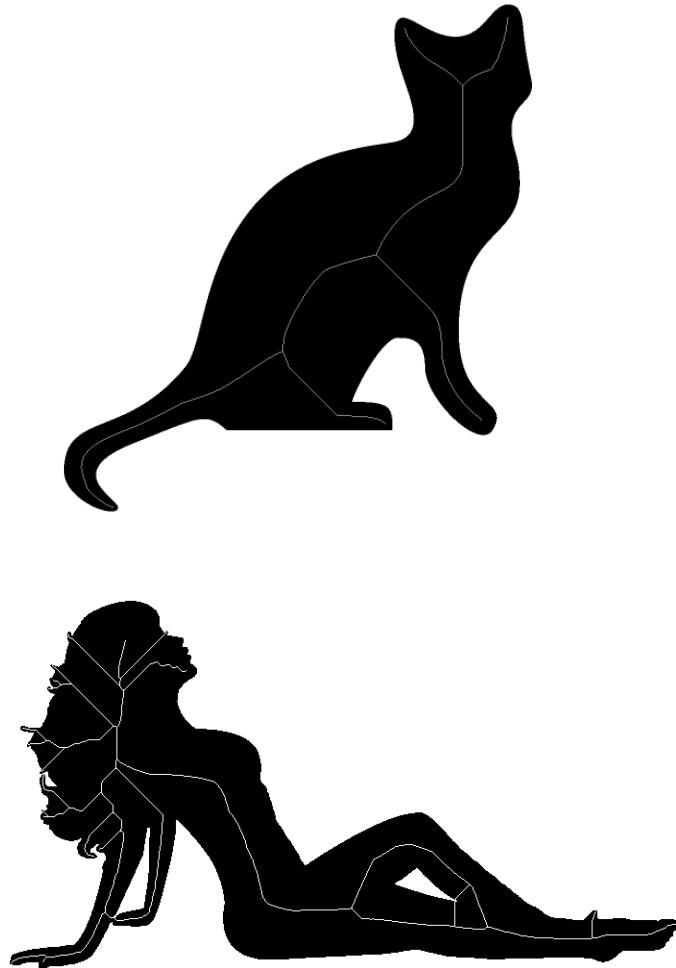
Skeletonizace (medial-axis transform)



Skeletonizace

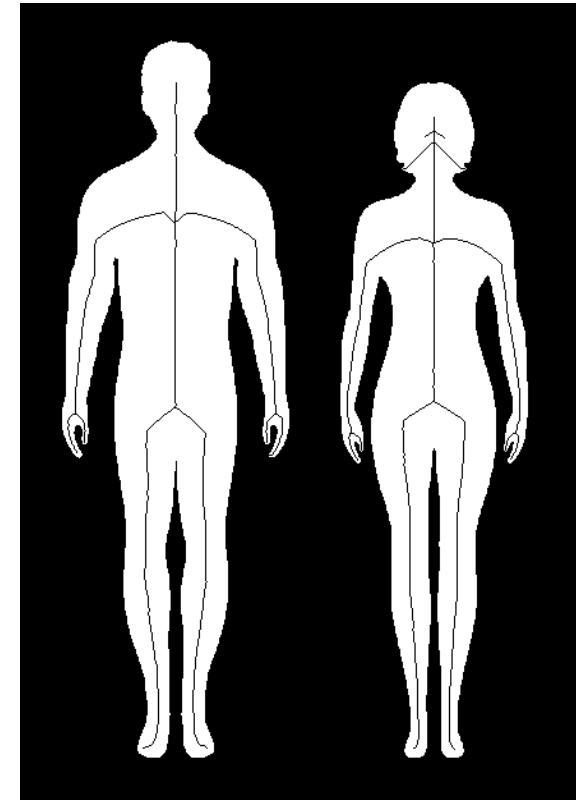
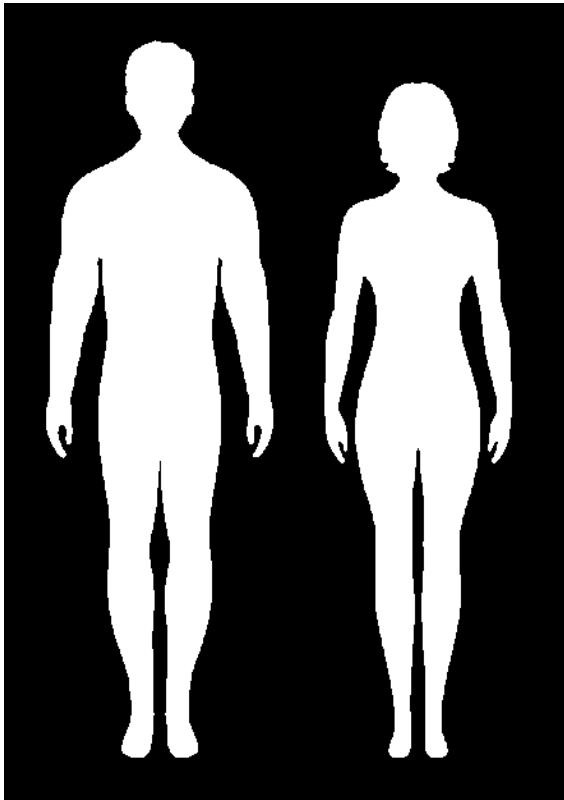


Skeletonizace



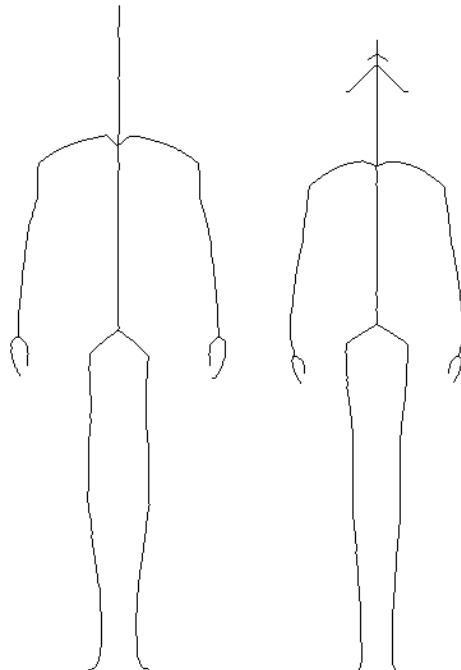
Pruning

- Ořezání volných konců



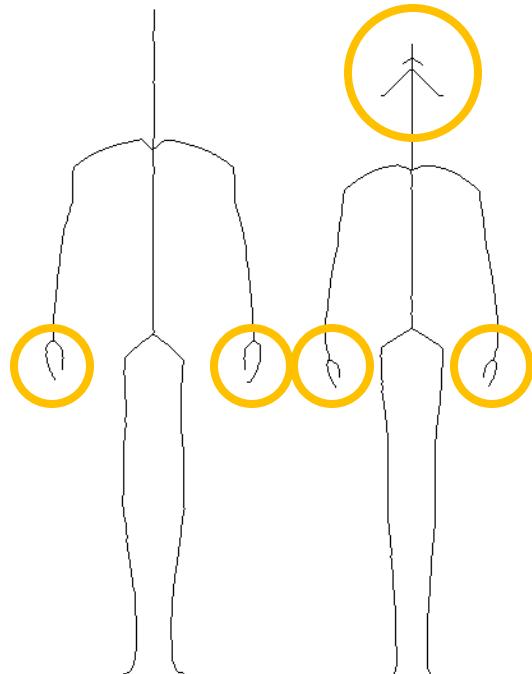
Pruning

- Ořezání volných konců



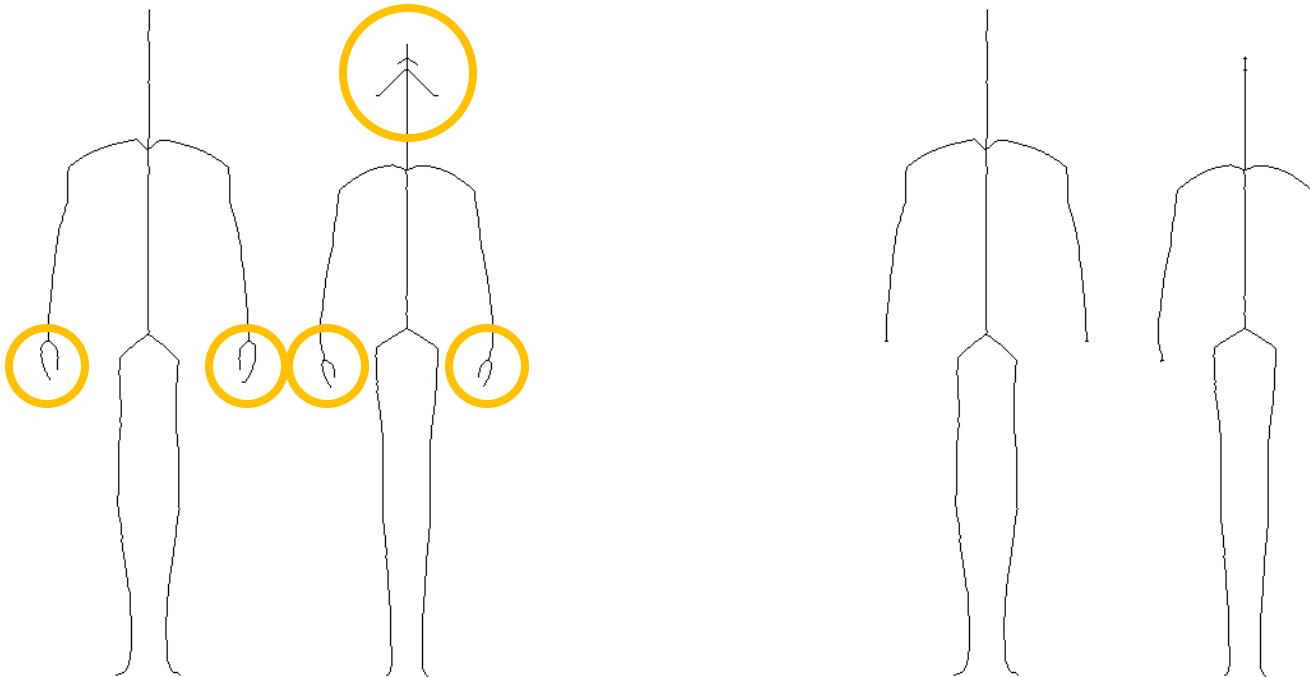
Pruning

- Ořezání volných konců



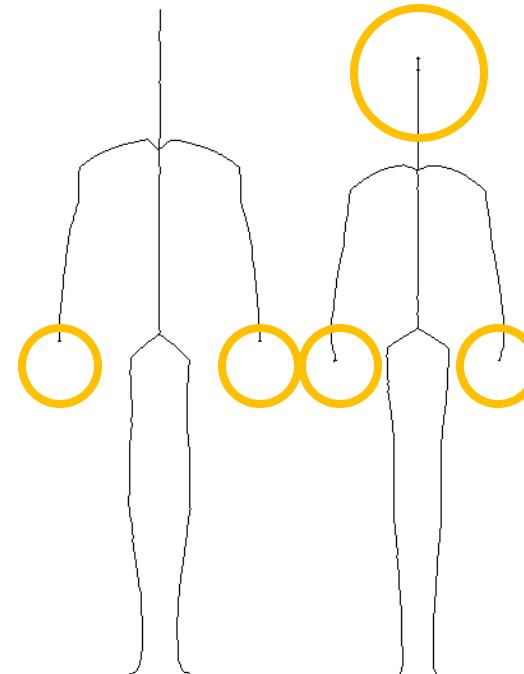
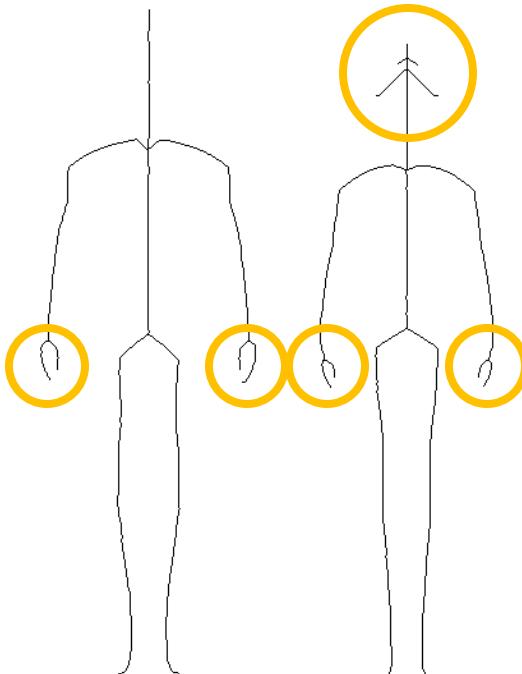
Pruning

- Ořezání volných konců



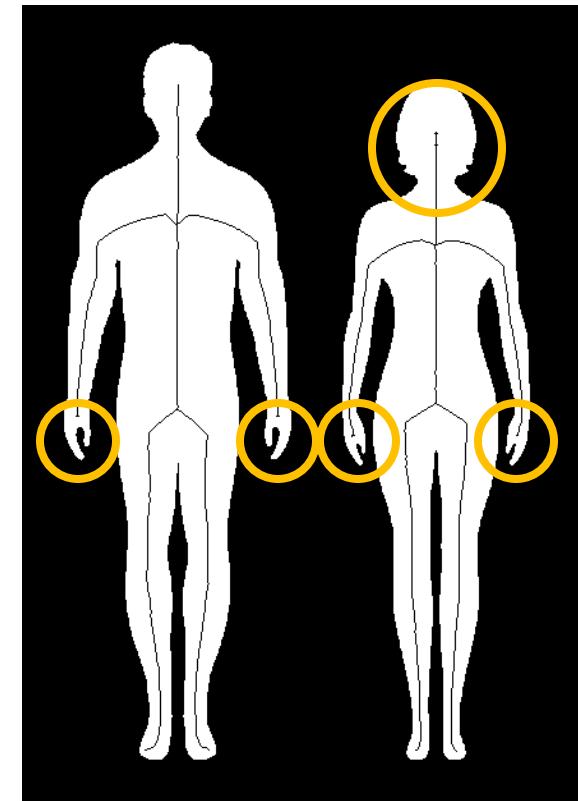
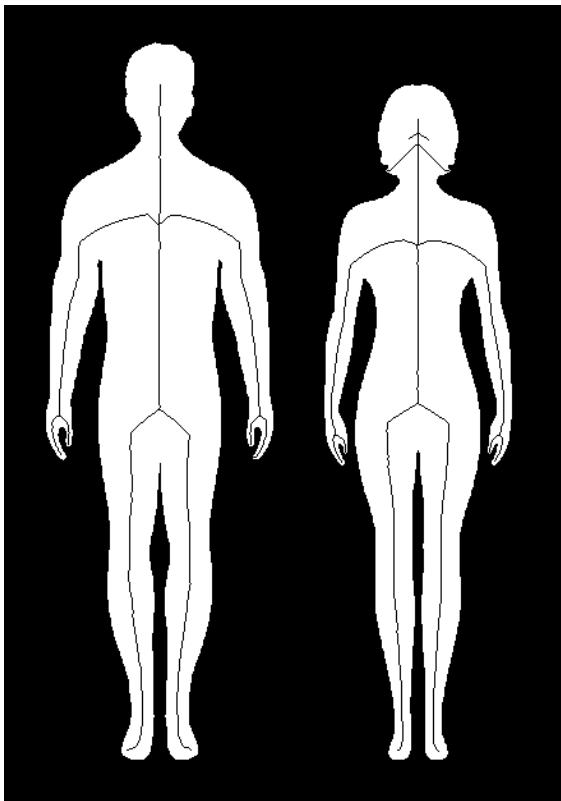
Pruning

- Ořezání volných konců

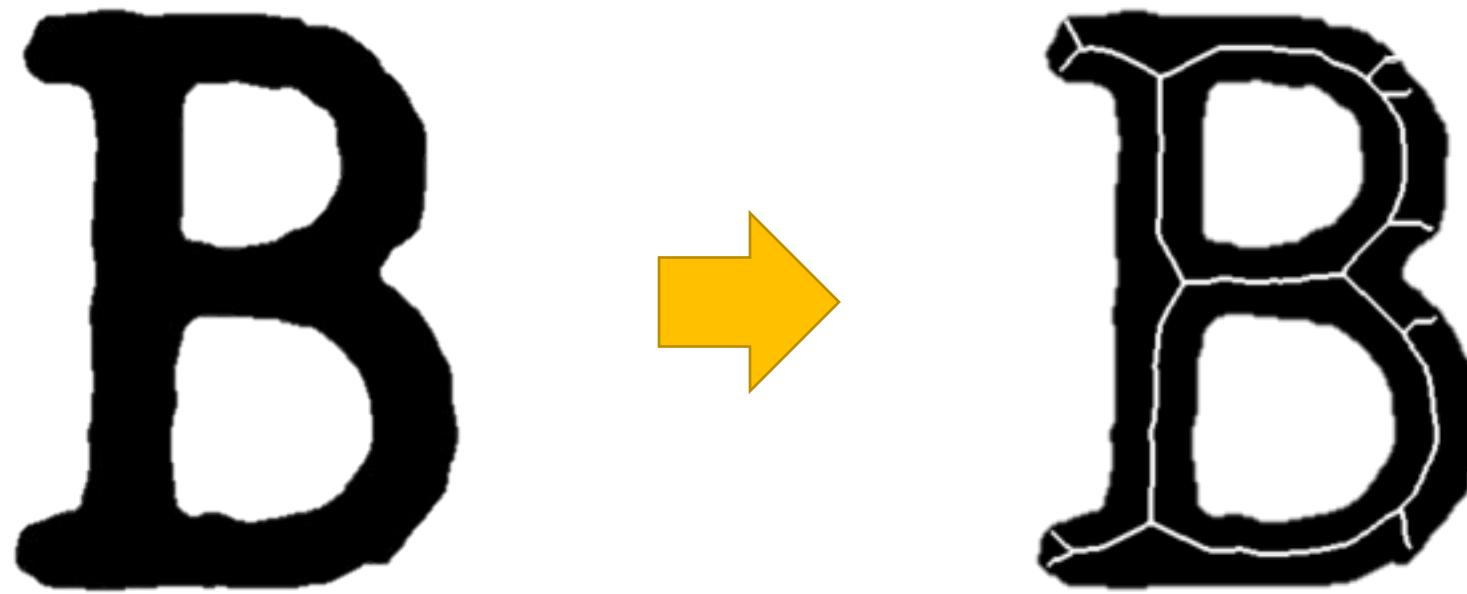


Pruning

- Ořezání volných konců

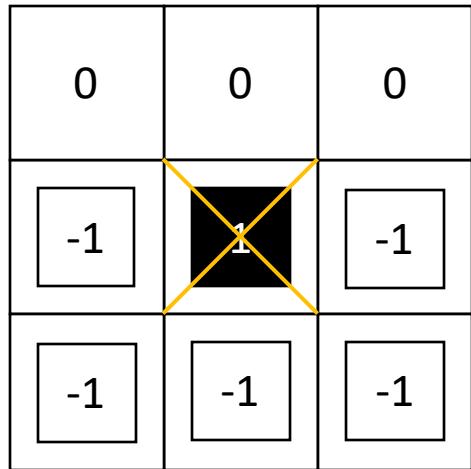


Zpracování textu (typický příklad)



Hit-or-miss transformace

- Detekce koncových bodů skeletonu



Speciální případ pro opencv

- 0 : nezájem
- 1 : popředí
- -1 : pozadí

Hit-or-miss transformace

- Detekce koncových bodů skeletonu

0	0	0
-1	1	-1
-1	-1	-1

0	-1	-1
0	1	-1
0	-1	-1

-1	-1	-1
-1	1	-1
0	0	0

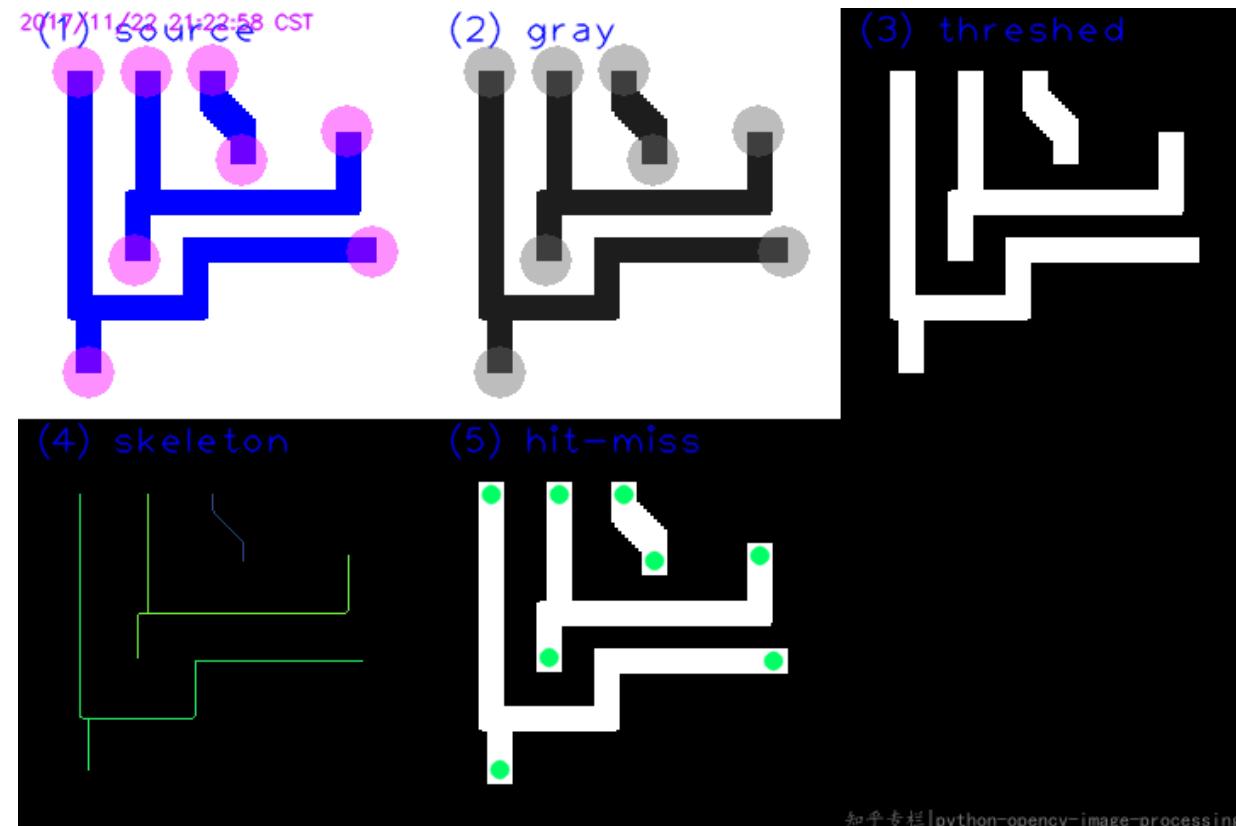
-1	-1	0
-1	1	0
-1	-1	0

Speciální případ pro opencv

- 0 : nezájem
- 1 : popředí
- -1 : pozadí

4x

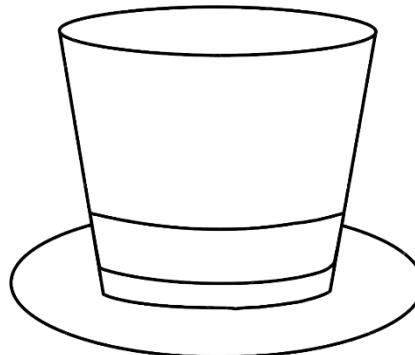
Hit-or-miss transformace



<https://stackoverflow.com/a/47430038/1398955>

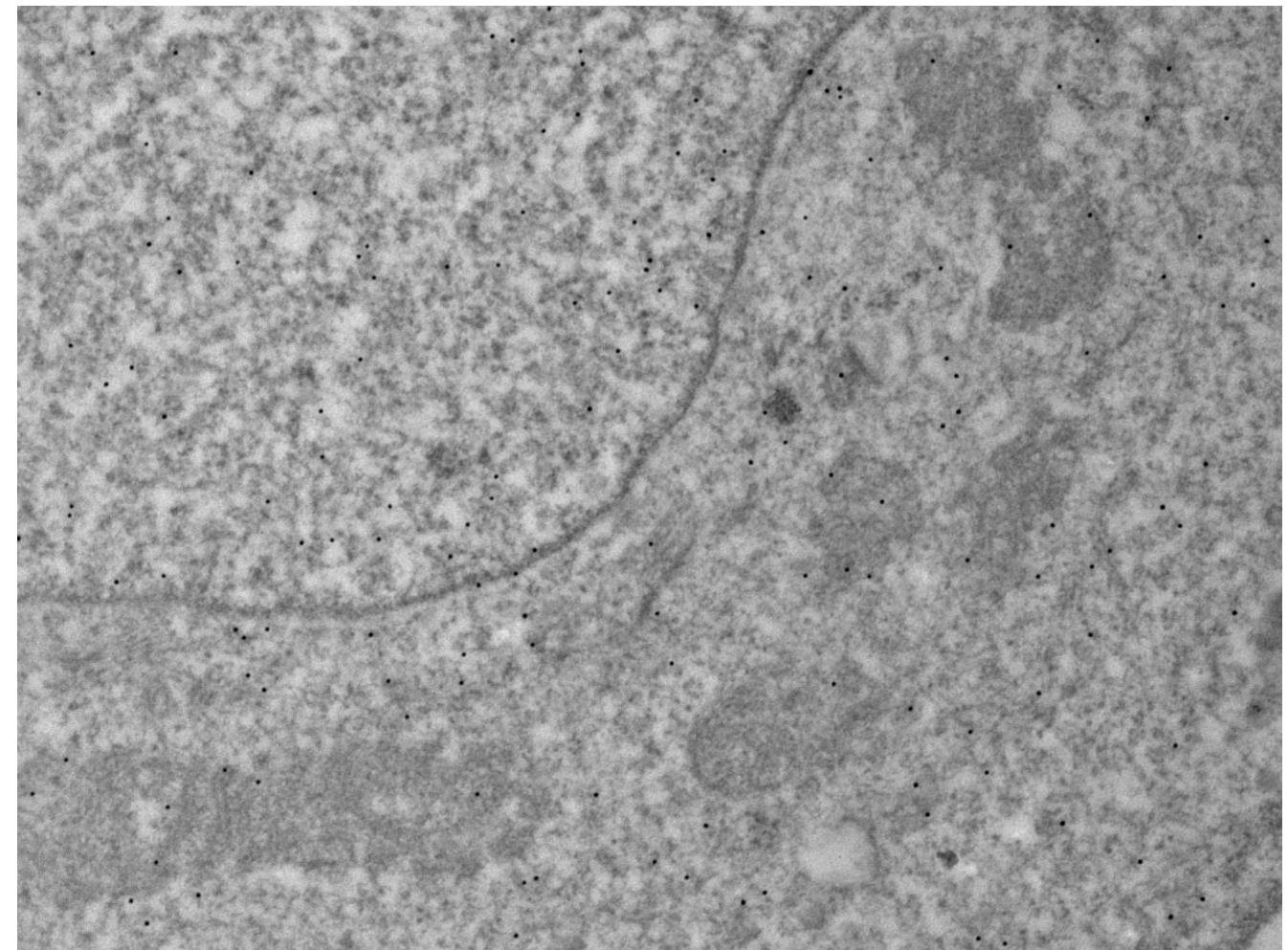
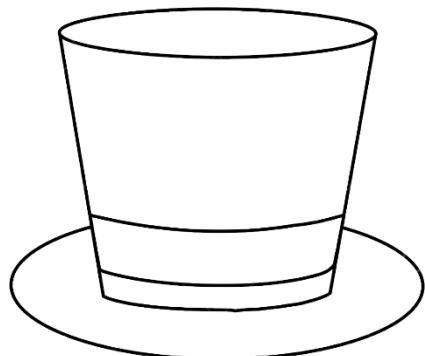
Metody šedotónové morfologie

- Lze použít již zmíněné metody
- Nově
 - Top-hat transformace
 - Black-hat transformace

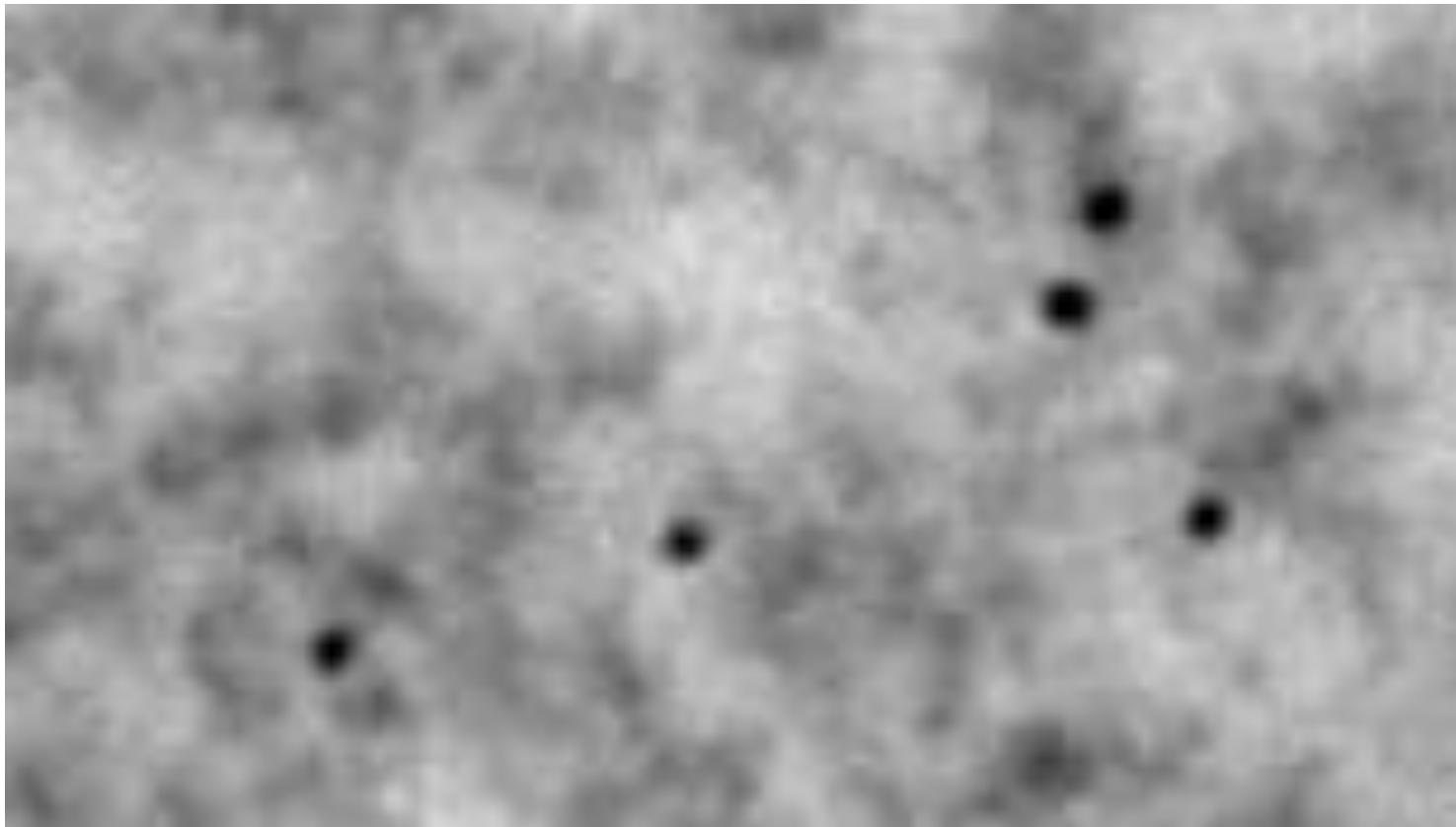


Metody šedotónové morfologie

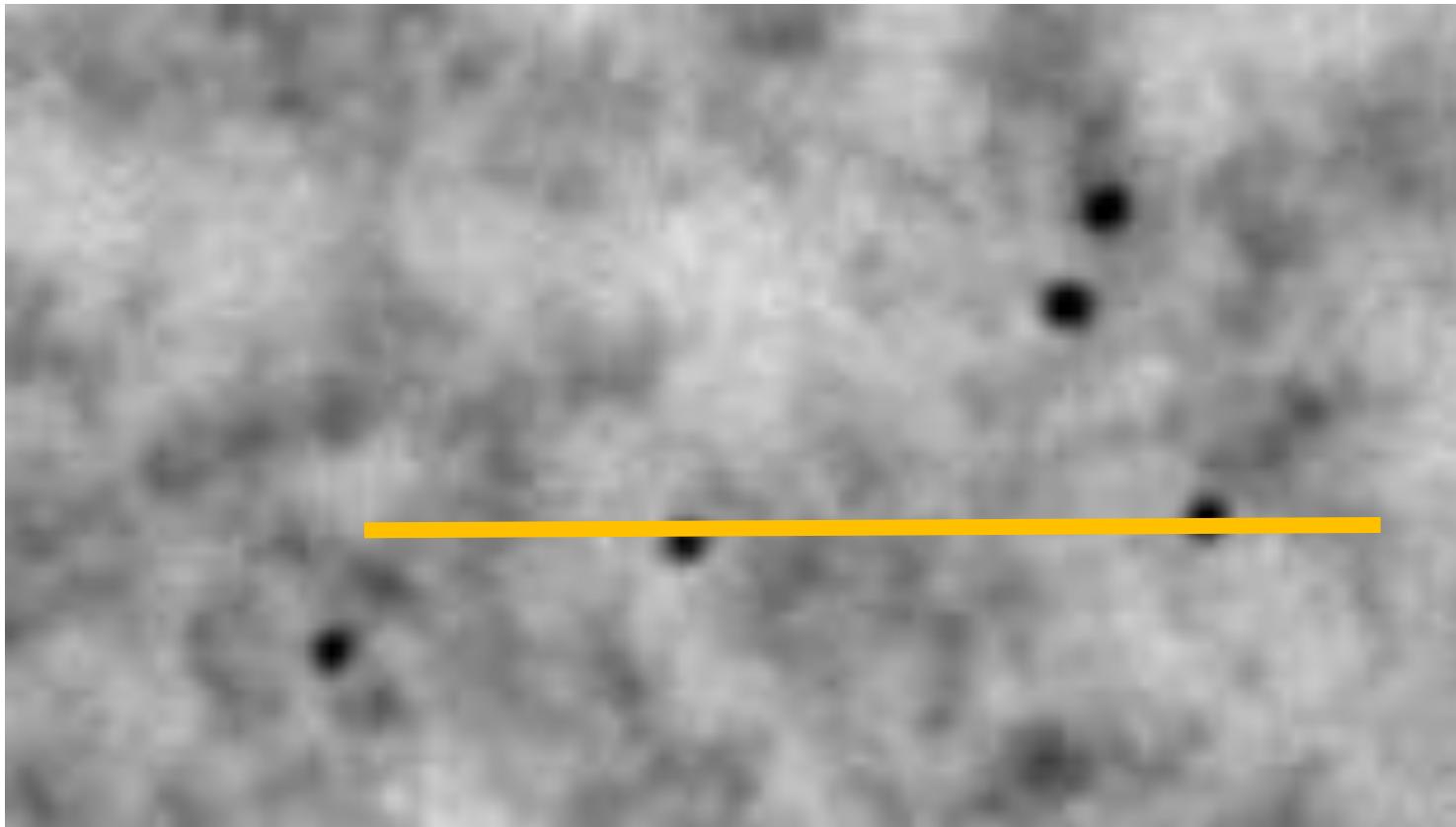
- Lze použít již zmíněné metody
- Nově
 - Top-hat transformace
 - Black-hat transformace



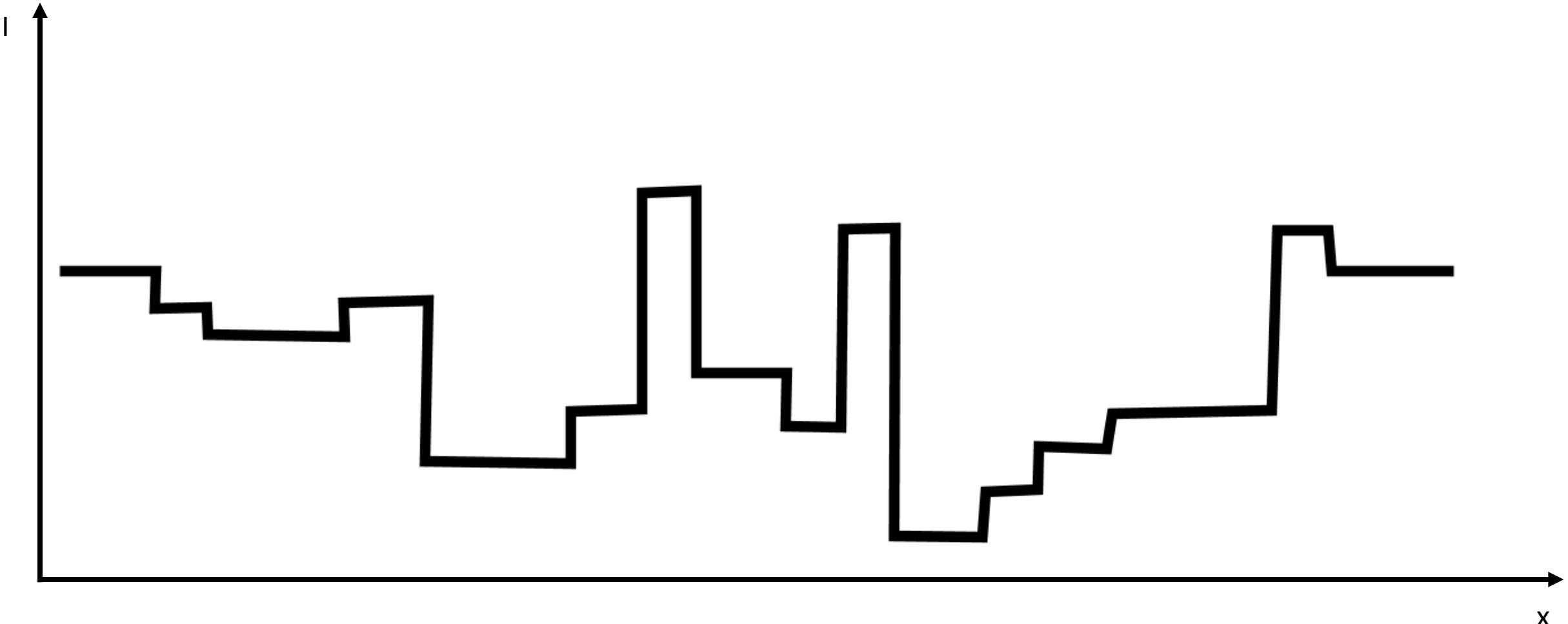
Top-hat transformace



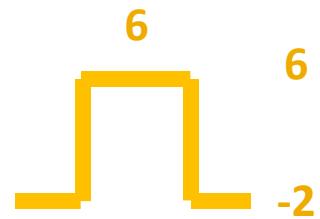
Top-hat transformace



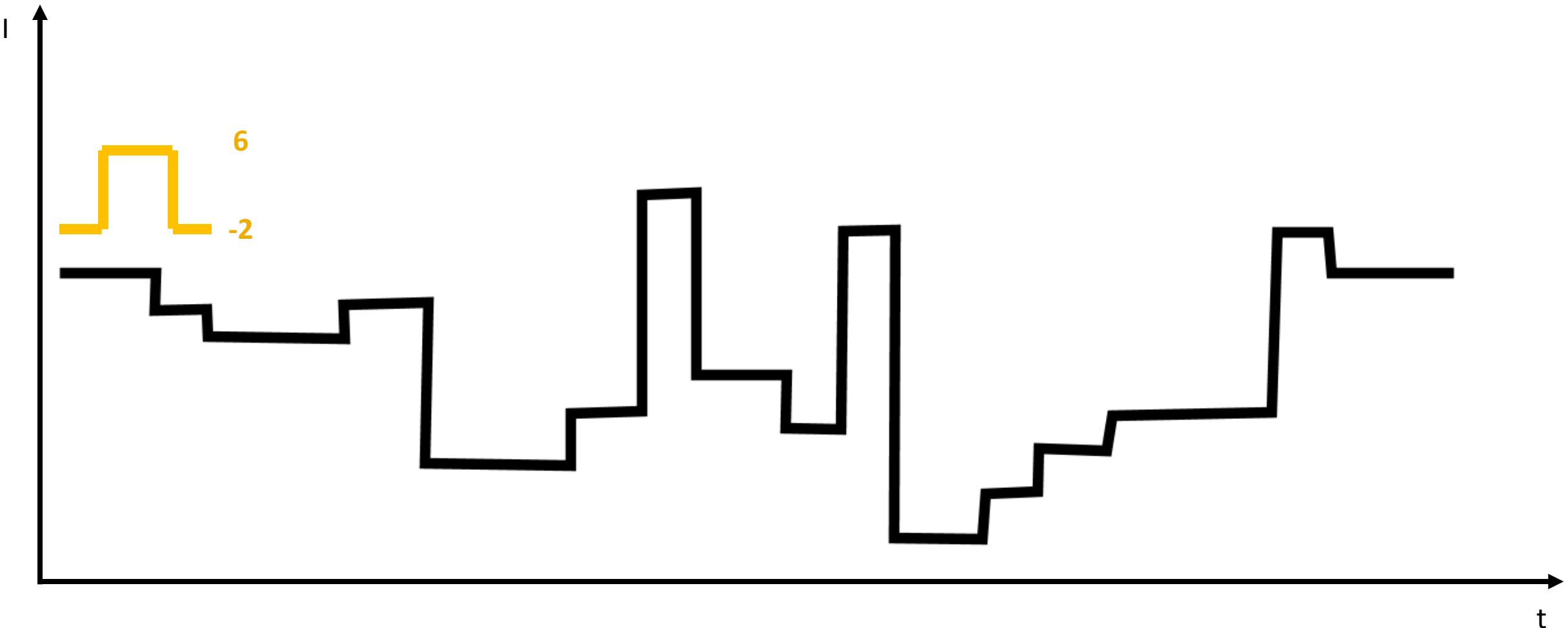
Top-hat transformace



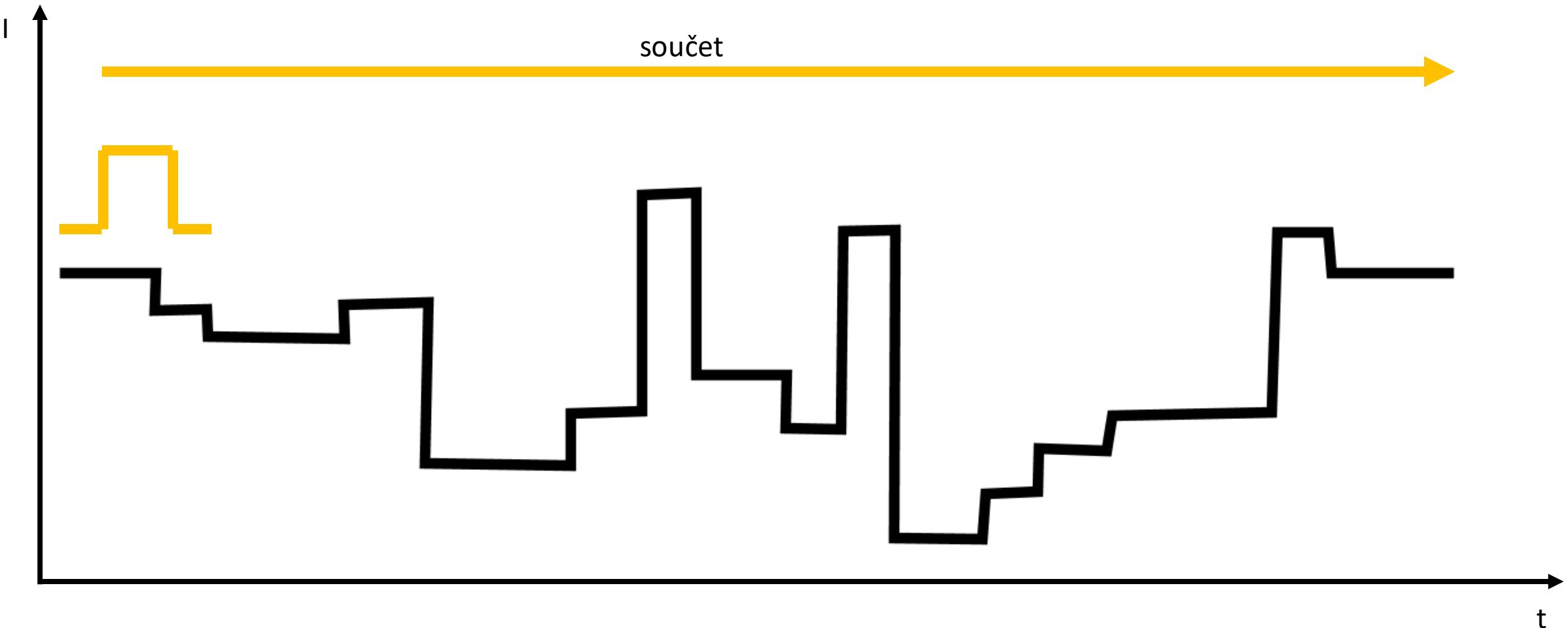
Top-hat transformace



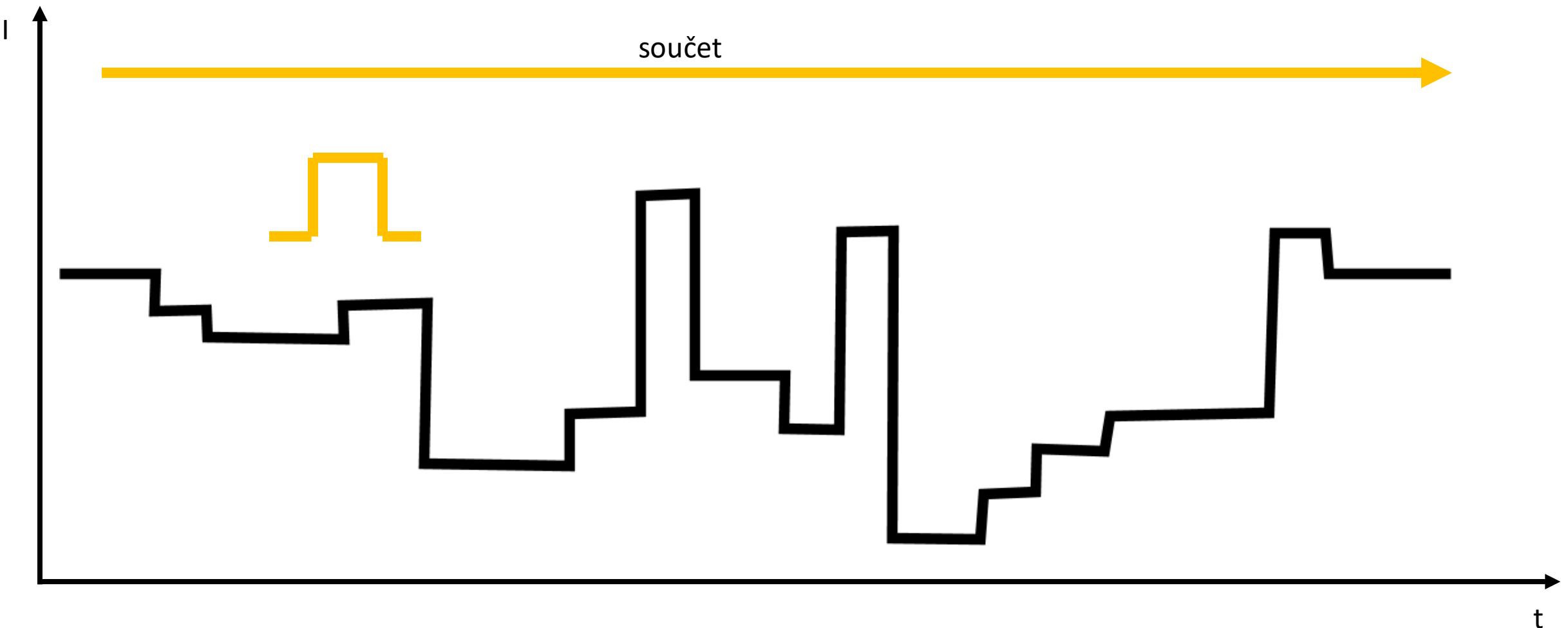
Top-hat transformace



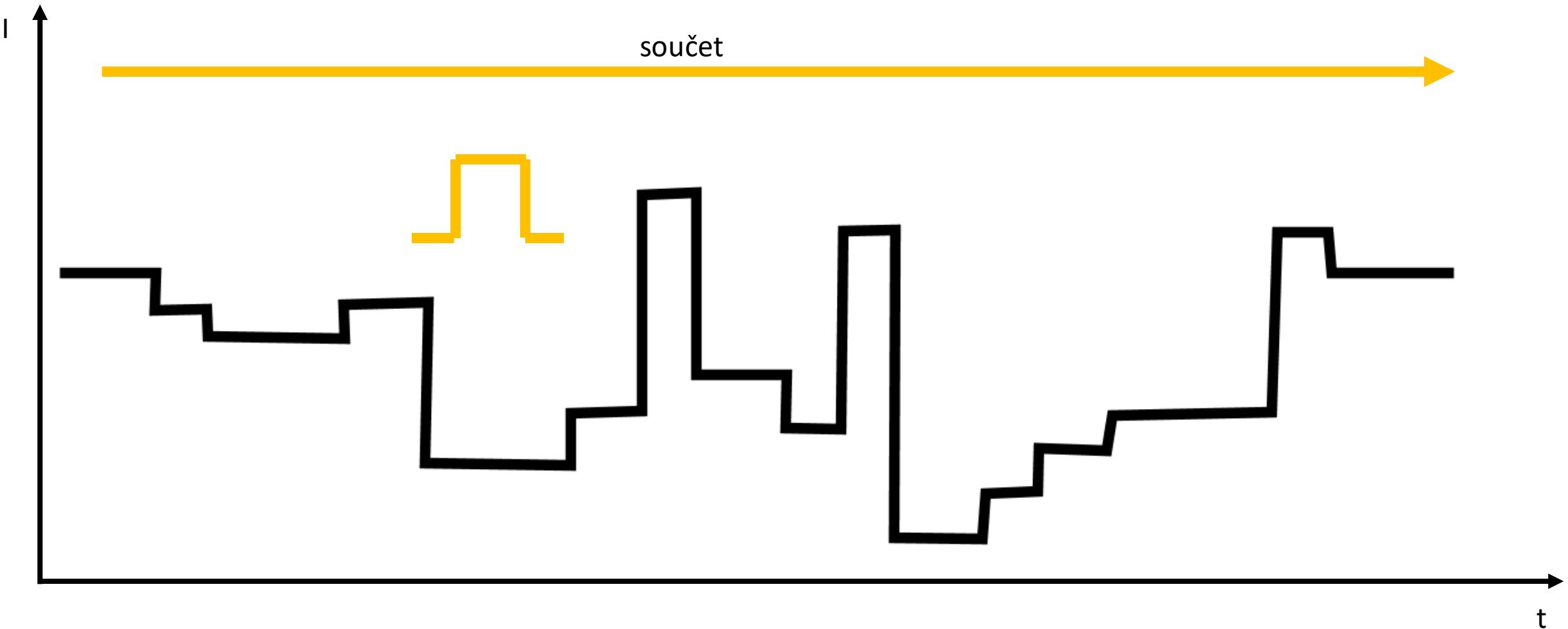
Top-hat transformace



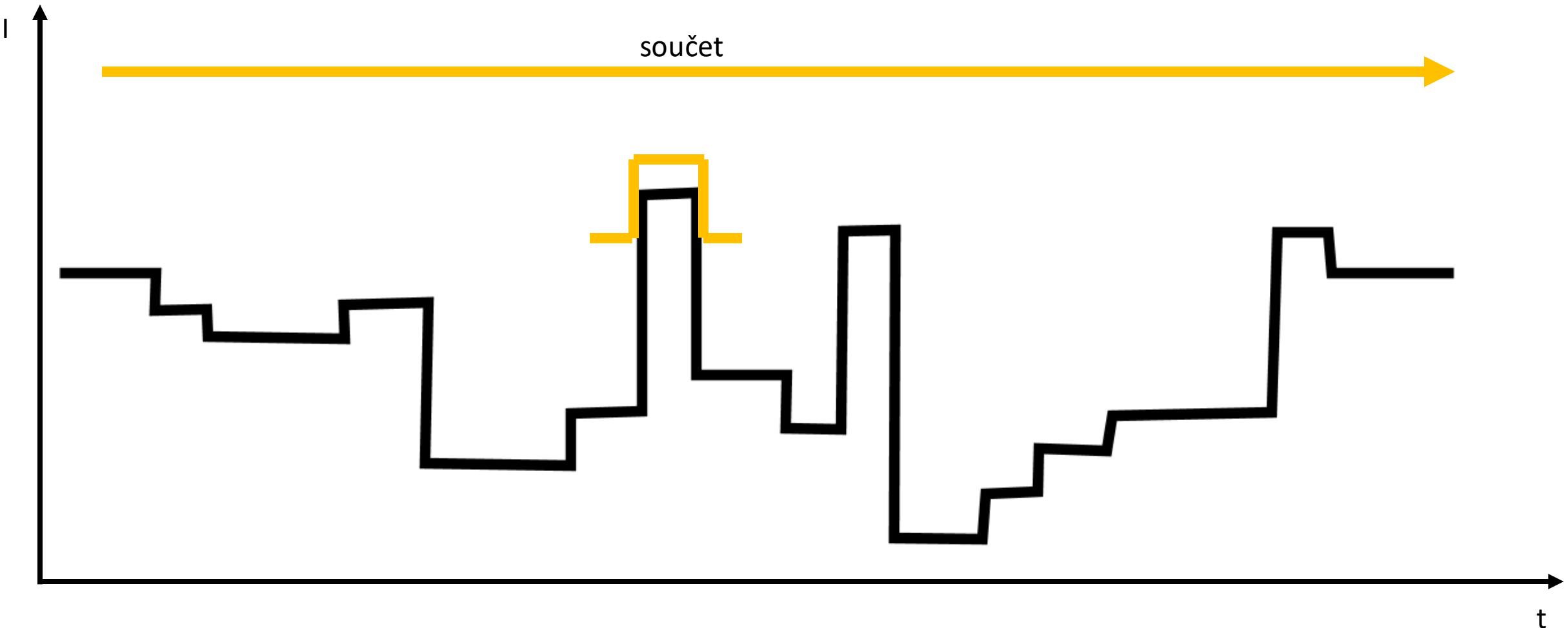
Top-hat transformace



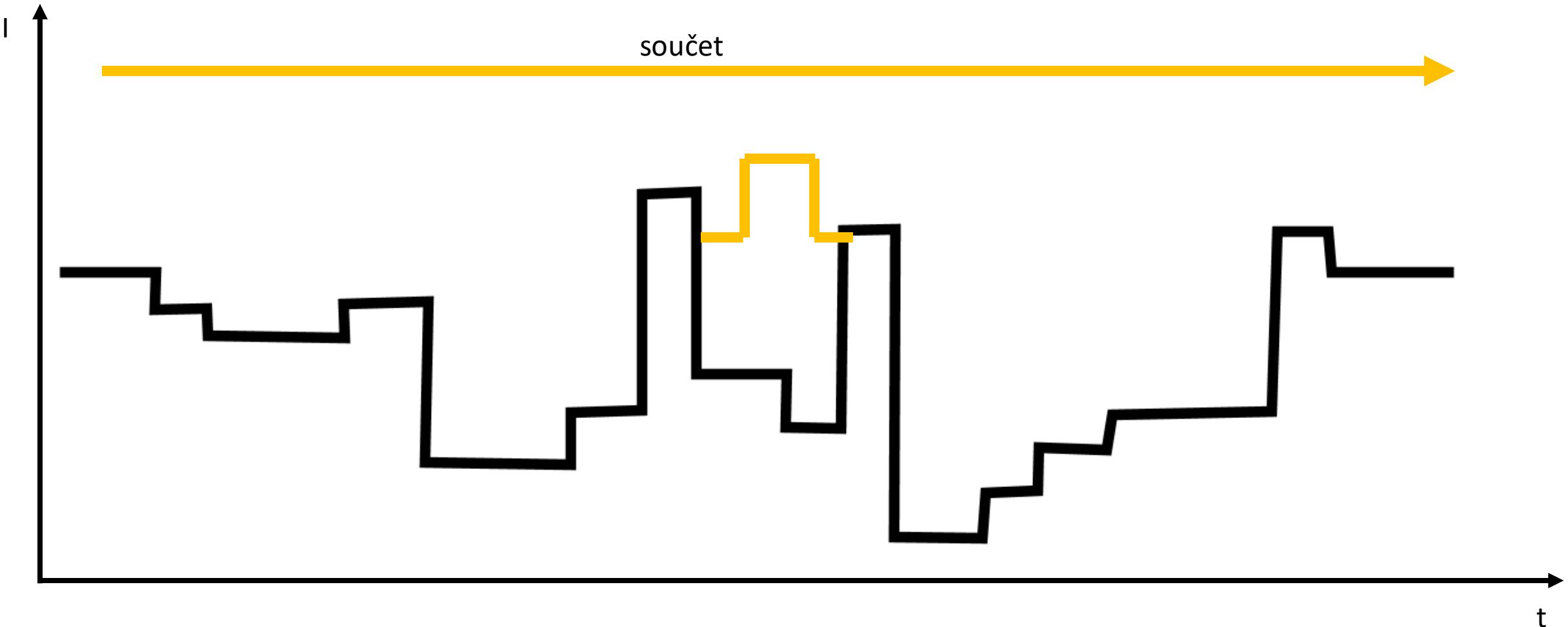
Top-hat transformace



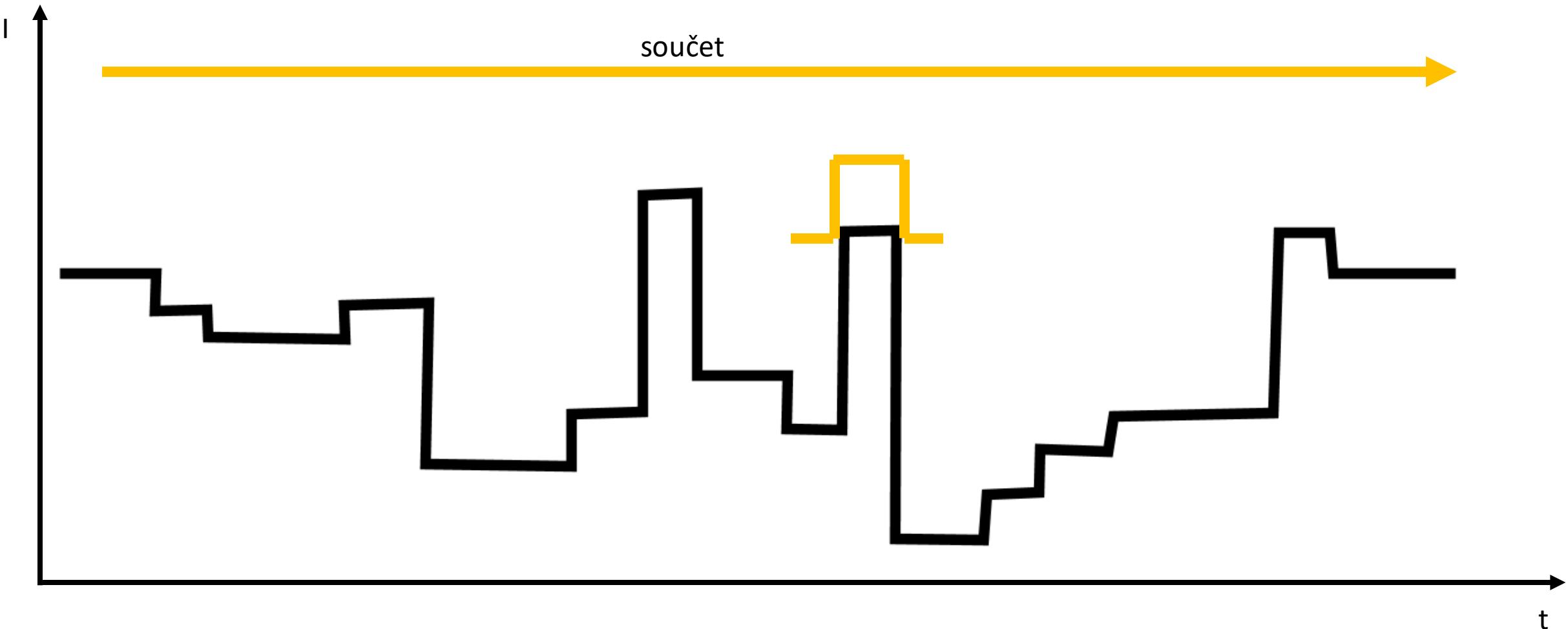
Top-hat transformace



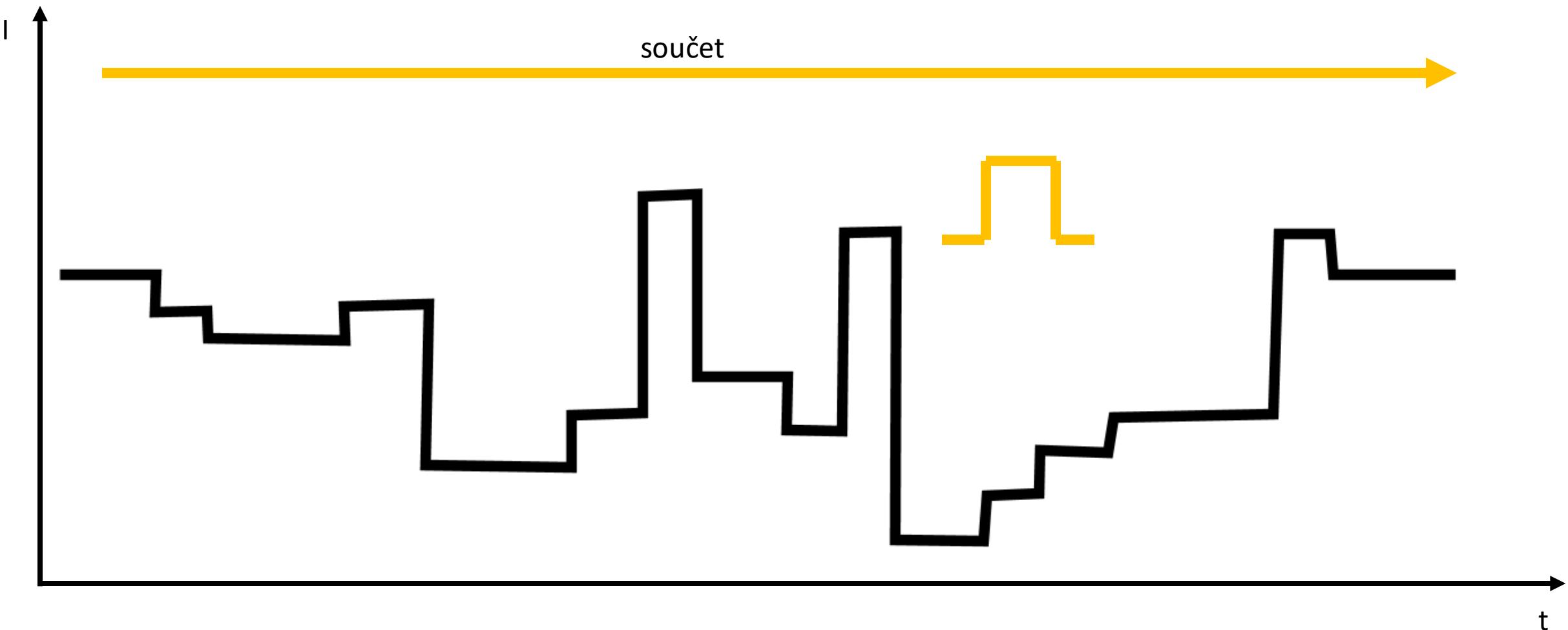
Top-hat transformace



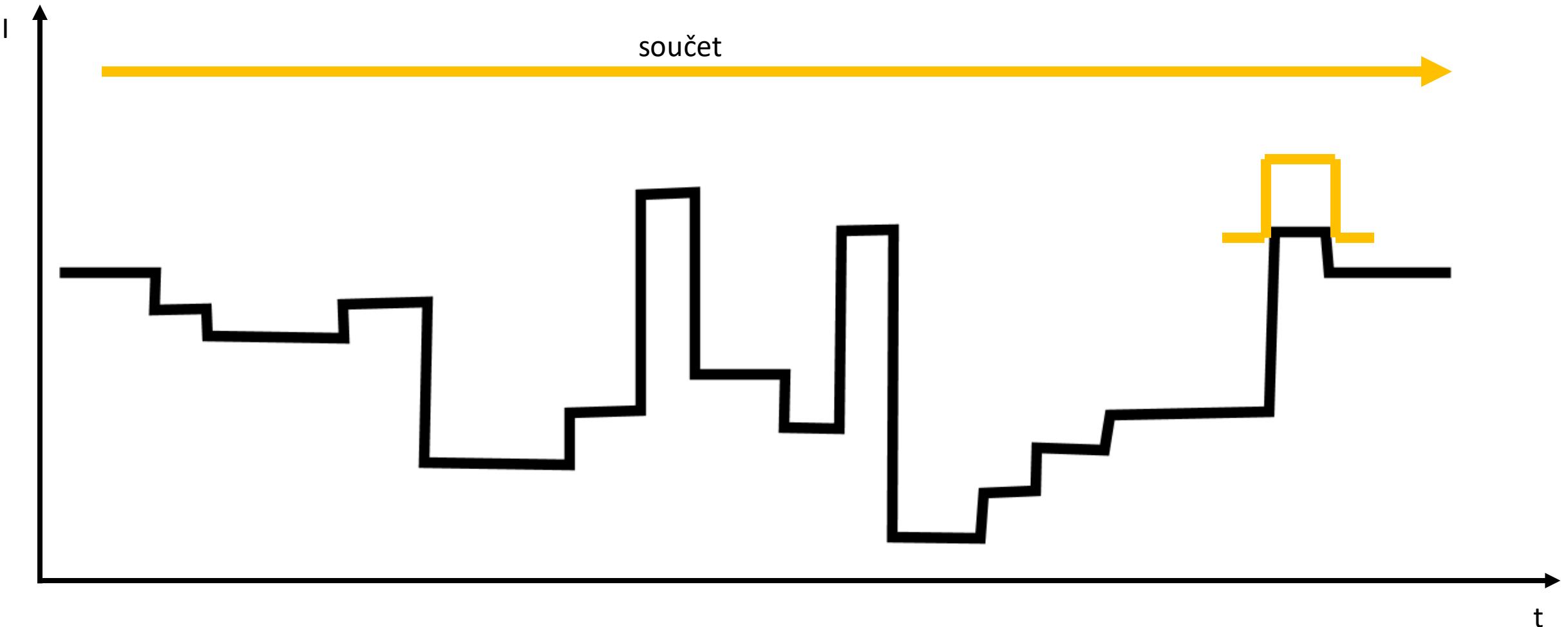
Top-hat transformace



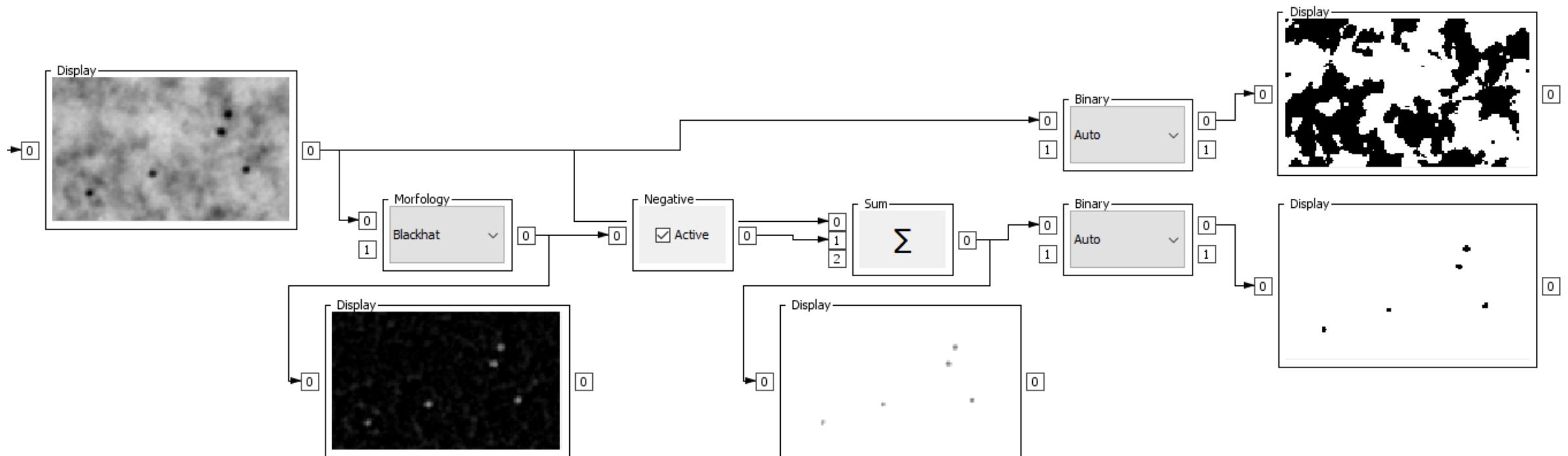
Top-hat transformace



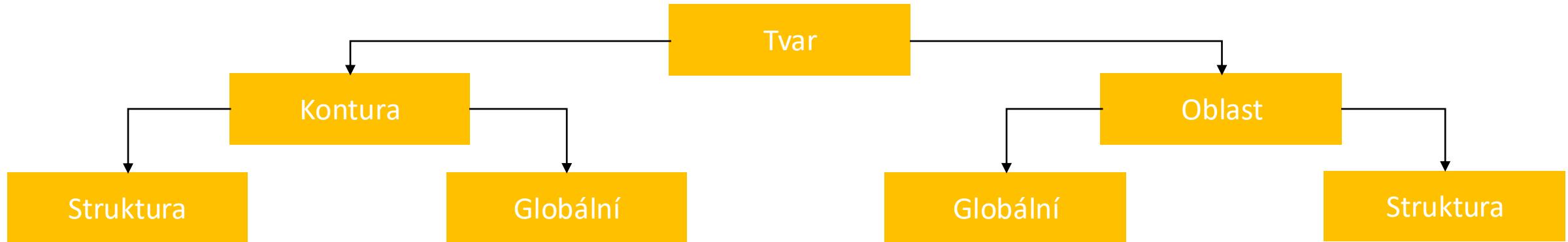
Top-hat transformace



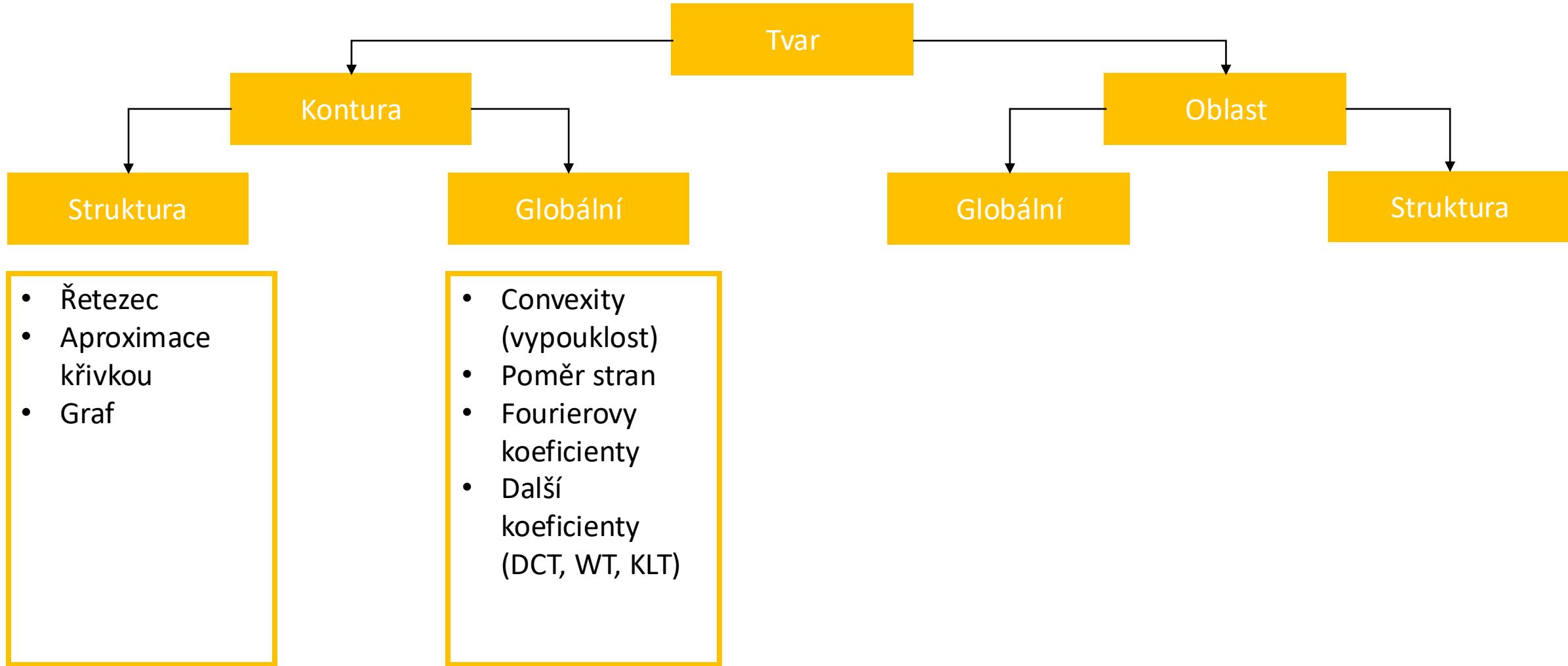
Top-hat / black-hat (bottom-hat)



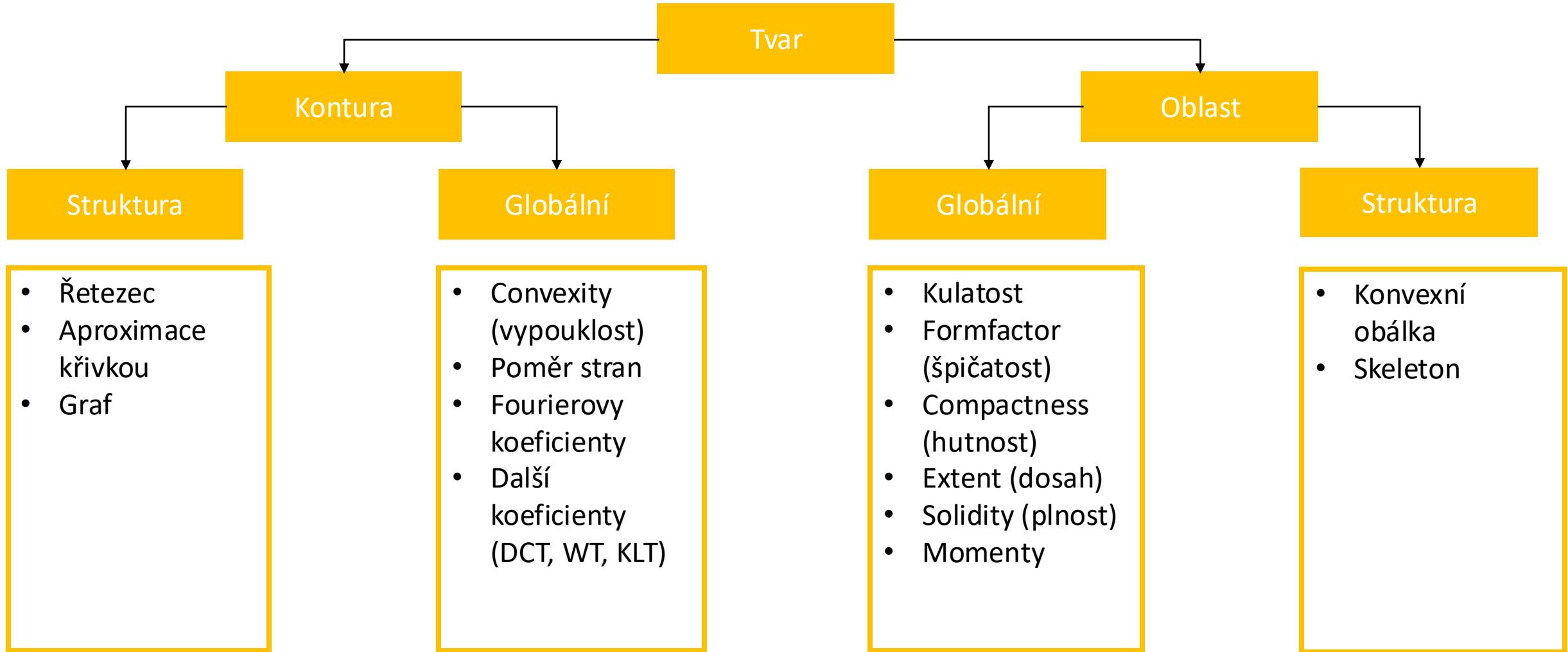
Tvarové charakteristiky



Tvarové charakteristiky



Tvarové charakteristiky



Tvarové charakteristiky – vybrané

```
def form_factor(area, perimeter):
```

```
    return (4 * PI * area) / (perimeter * perimeter)
```

```
def roundness(area, max_diameter):
```

```
    return (4 * area) / (PI * max_diameter * max_diameter)
```

```
def aspect_ratio(min_diameter, max_diameter):
```

```
    return min_diameter / max_diameter;
```

```
def convexity(perimeter, convex_perimeter):
```

```
    return convex_perimeter / perimeter
```

```
def solidity(area, convex_area):
```

```
    return area / convex_area
```

```
def compactness(area, max_diameter):
```

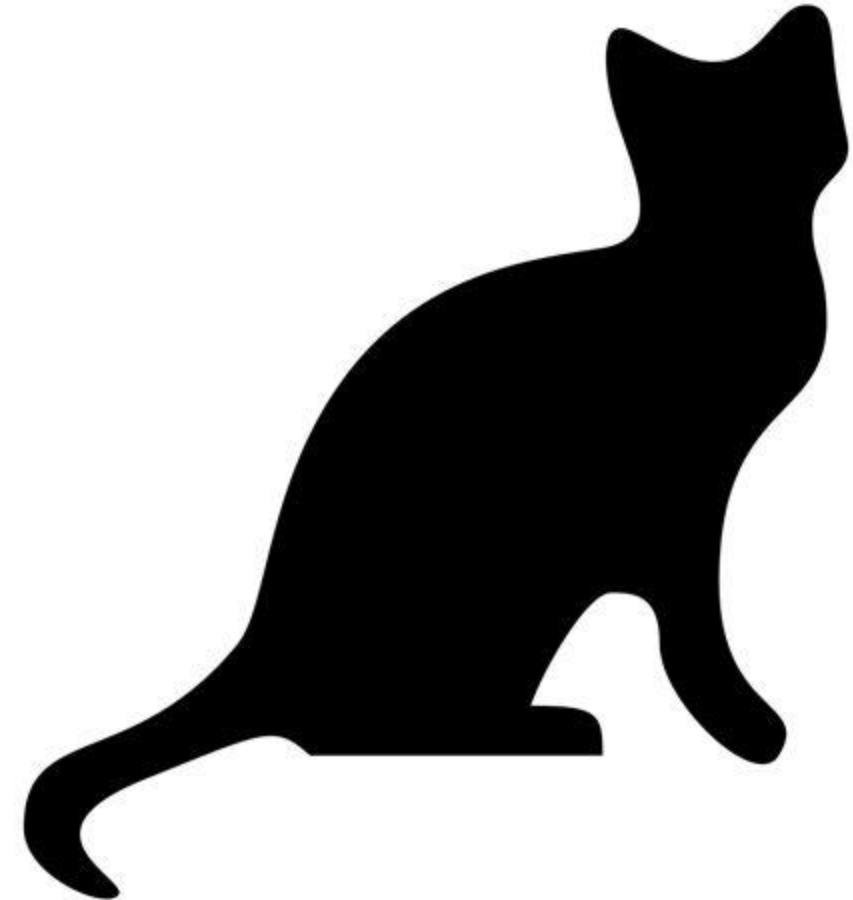
```
    return sqrt(4 / PI * area) / max_diameter;
```

```
def extent(area, bounding_rectangle_area):
```

```
    return area / bounding_rectangle_area
```

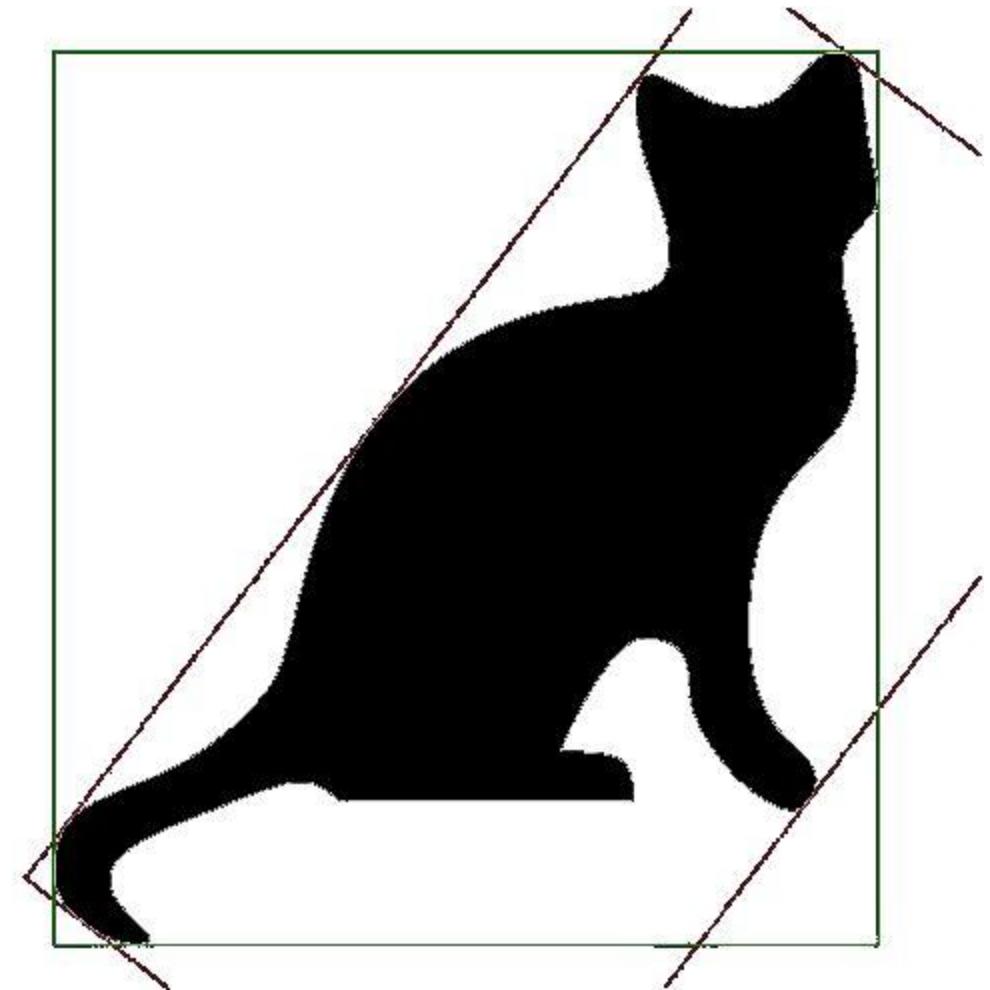
Tvarové charakteristiky

- Průměr (větší menší)
- Šířka, Výška
- Obvod, Obsah



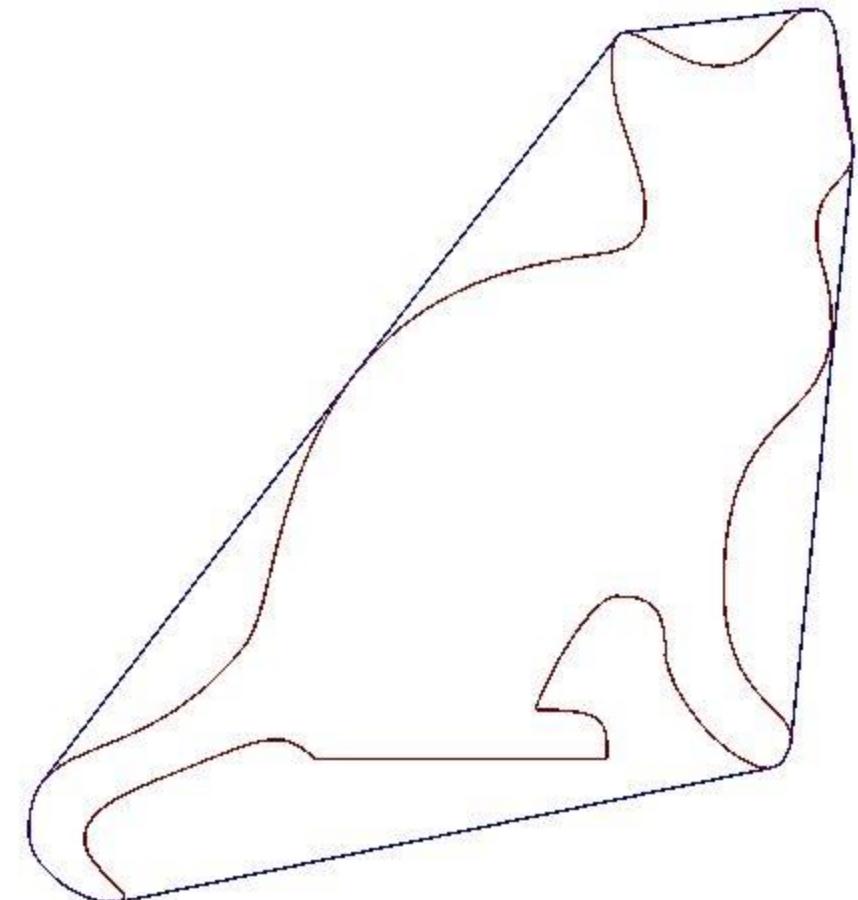
Tvarové charakteristiky

- Průměr (větší menší)
 - Šířka, Výška
 - Obvod, Obsah
-
- Bounding box
 - Minimal enclosing rectangle



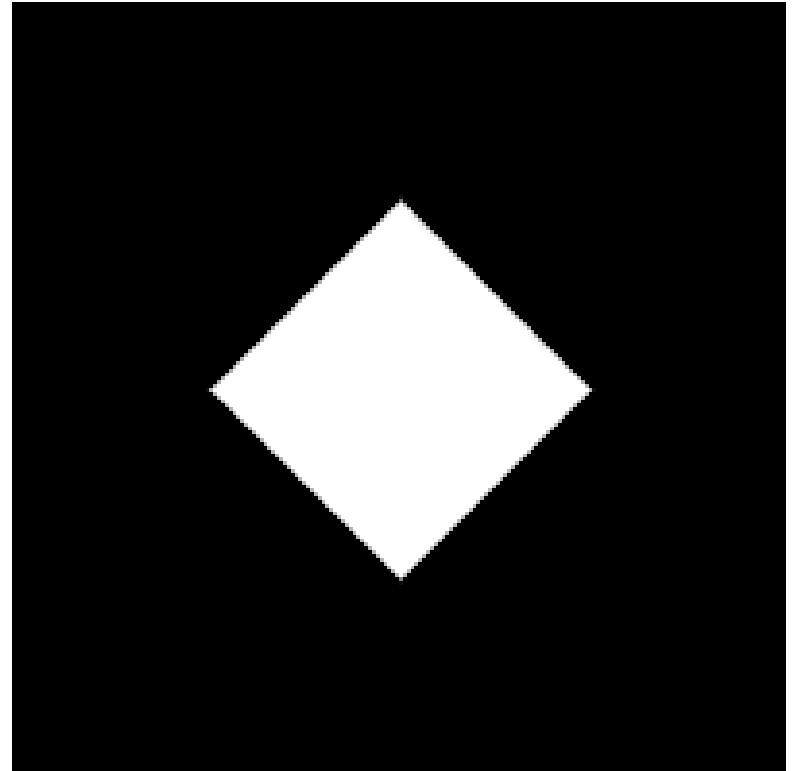
Tvarové charakteristiky

- Průměr (větší menší)
 - Šířka, Výška
 - Obvod, Obsah
-
- Kontura
 - Konvexní obálka



Tvarové charakteristiky

- Průměr (větší menší)
- Šířka, Výška
- Obvod, Obsah



Tvarové charakteristiky

- Průměr (větší menší)
 - Šířka, Výška
 - Obvod, Obsah
-
- Min enclosing circle
 - Min enclosing ellipse

