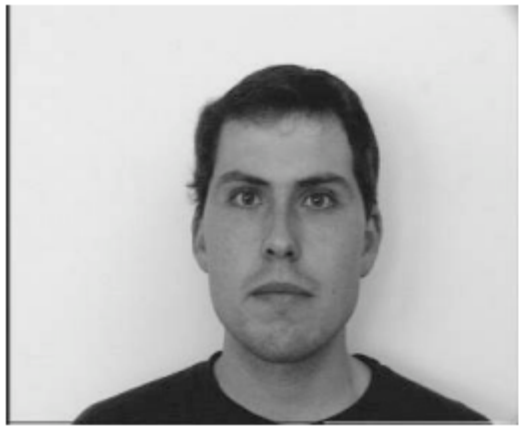
Eşikleme

Samsun – 2011

Genel

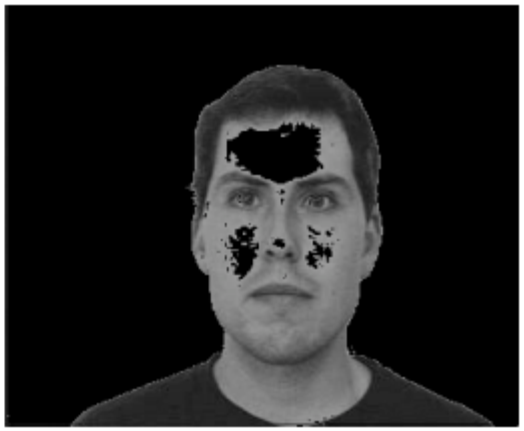
- Eşikleme, en basit bölütleme yöntemidir
- Gri ölçekli resimden BW elde edilir
- Resmi nesne ve arkaplan olarak ikiye böl
- Sınır değere eşik denir

Gri-seviye eşikleme



Original image
Peter $f(x,y)$

Thresholded
Peter $m(x,y)$



$f(x,y) \cdot m(x,y)$

$$m(x,y) = \begin{cases} 1 \; if \quad f(x,y) > T \\ 0 \; if \quad f(x,y) \leq T \end{cases}$$

Yinelemeli algoritma

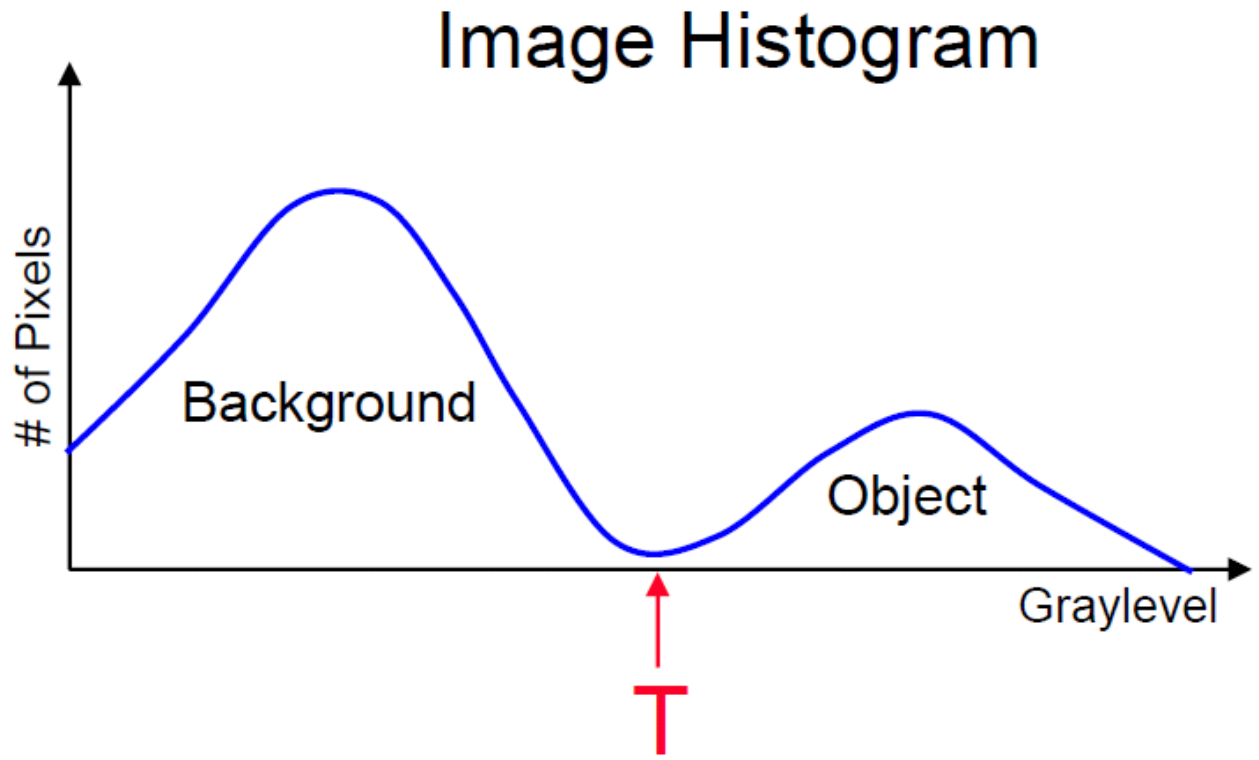
1. Başlangıç için rasgele bir T değeri seç
2. Bu T ile bölütle ve nesne-arkaplan piksellerini belirle: G1 ve G2
3. G1 ve G2'nin ortalamasını hesapla: m1,m2
4. Yeni T değerini hesapla: T=(m1+m2)/2
5. 2. adımla devam et.
   - Durmak için |T-T_yeni| eşik değerinden küçük oluncaya değin devam et

- K-means algoritmasının özel durumudur

Çeşitleri

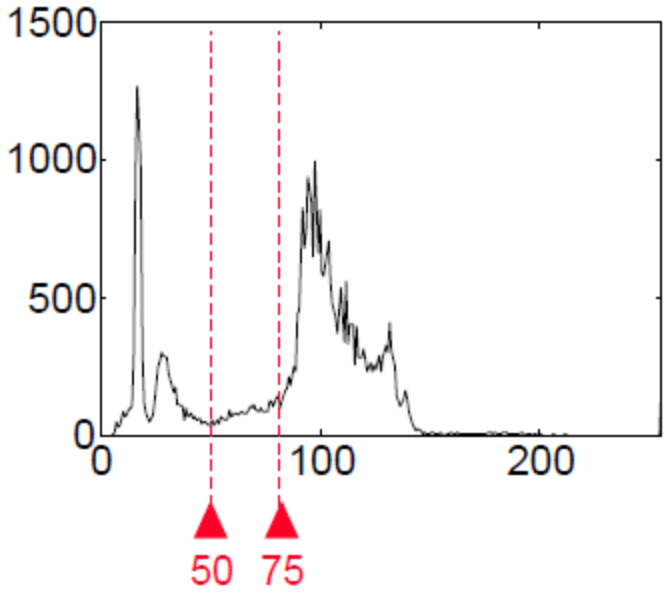
- Histogram temelli
- Kümeleme temelli
- Entropy tabanlı
- Nesne özellikleri temelli
- Uzaysal yöntemler
- Global/Yerel yöntemler
- Adaptive

Histogram temelli

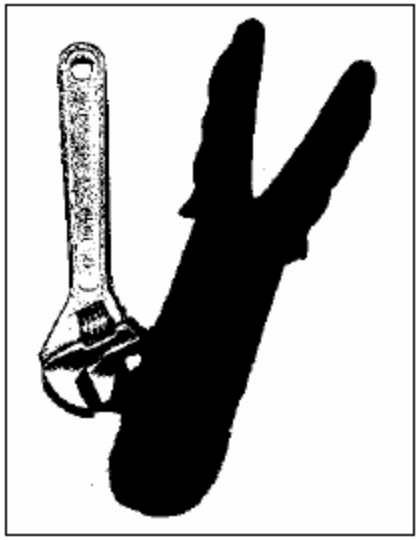


Original

Histogram



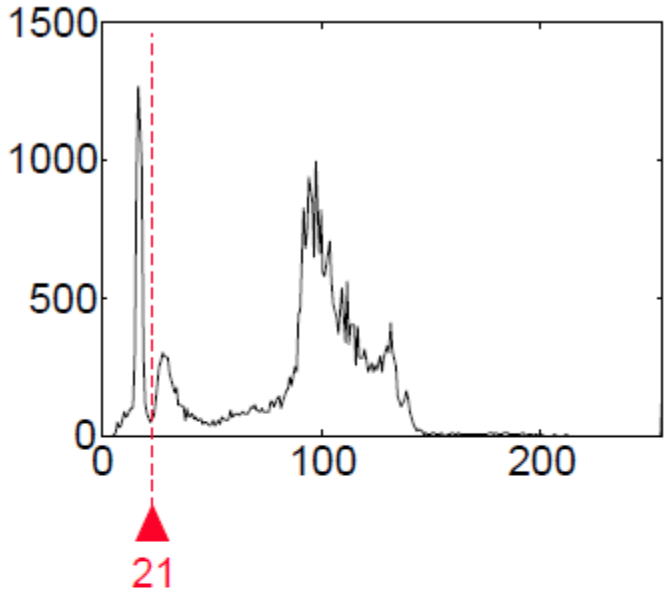
Threshold = 50

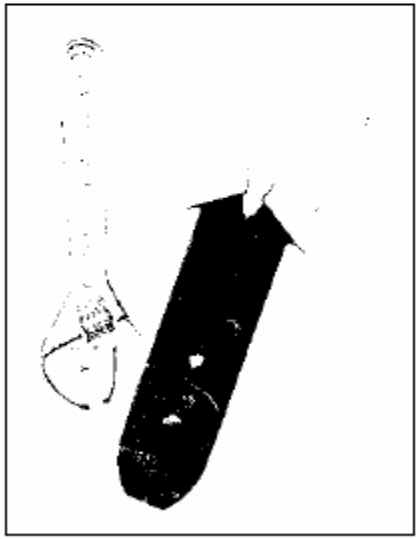


Threshold = 75

Original

Histogram

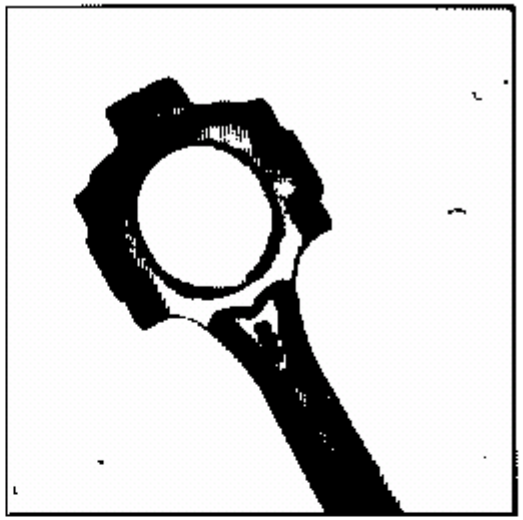




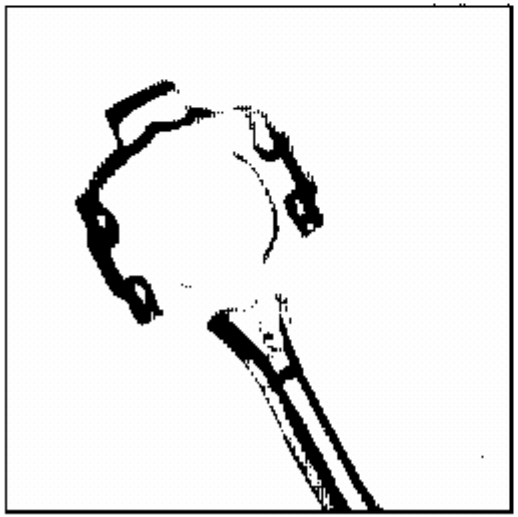
Threshold = 21

Original Image

Thresholded Image

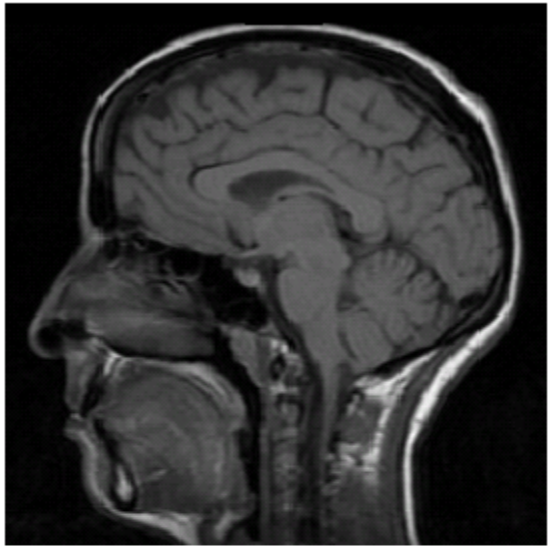


Threshold too low



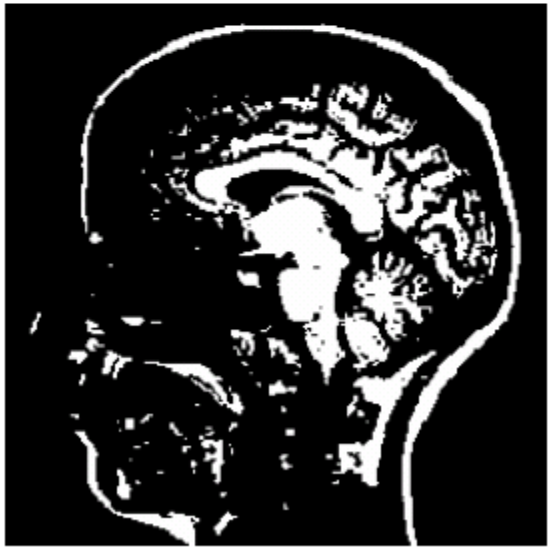
Threshold too high

Original Image



Threshold = 80

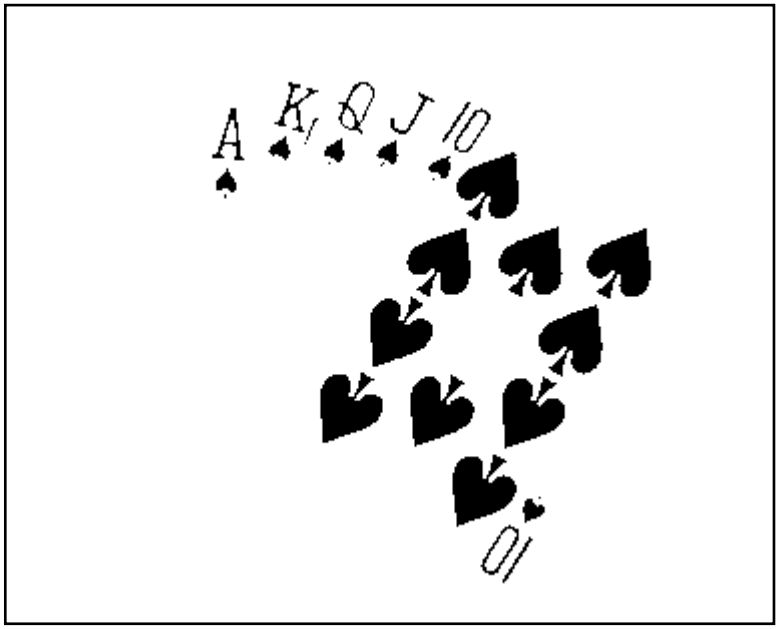
Threshold = 71

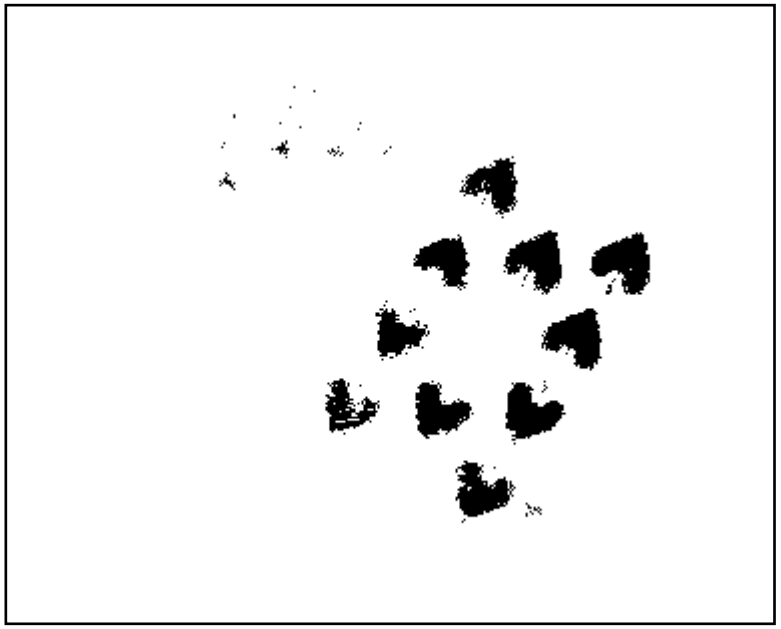


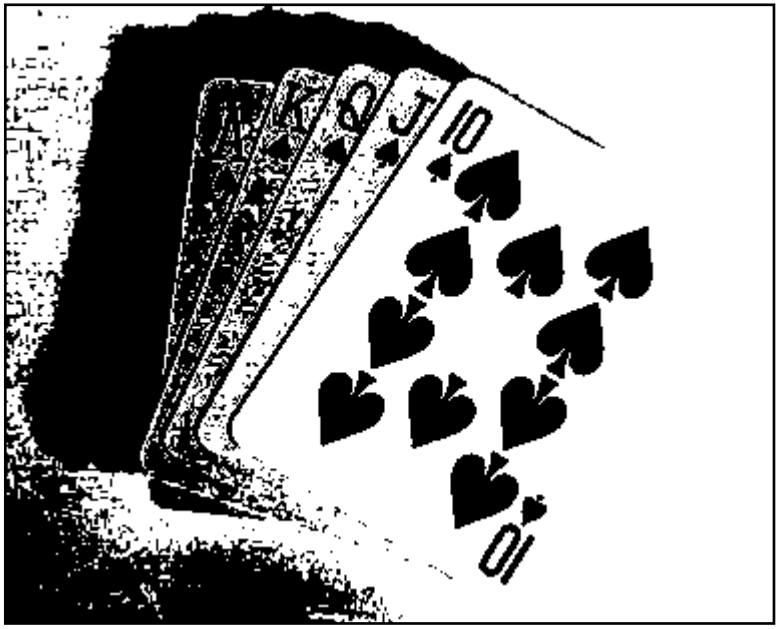
Threshold = 88

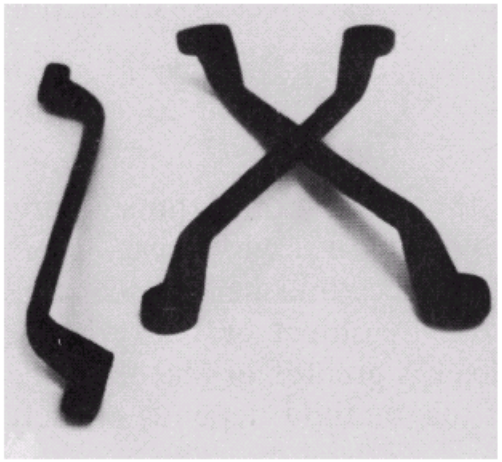
Örnek

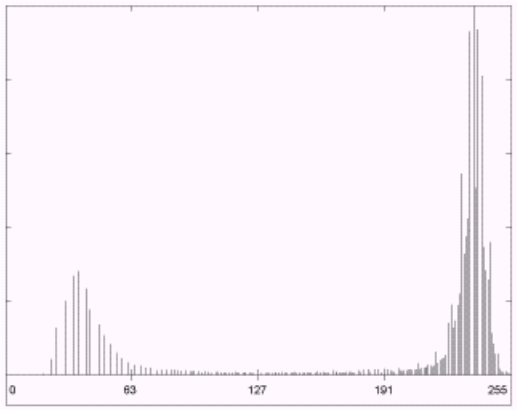

A
K
Q
J
10

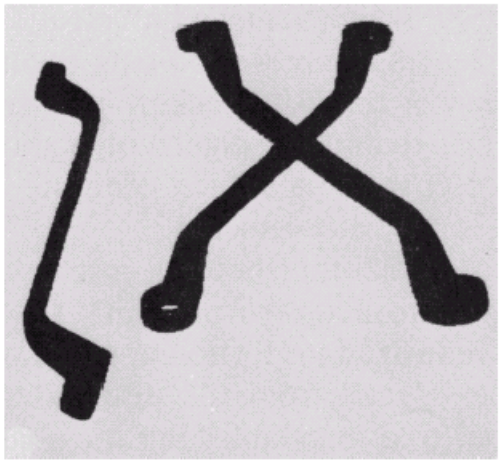

A
K
Q
J
10

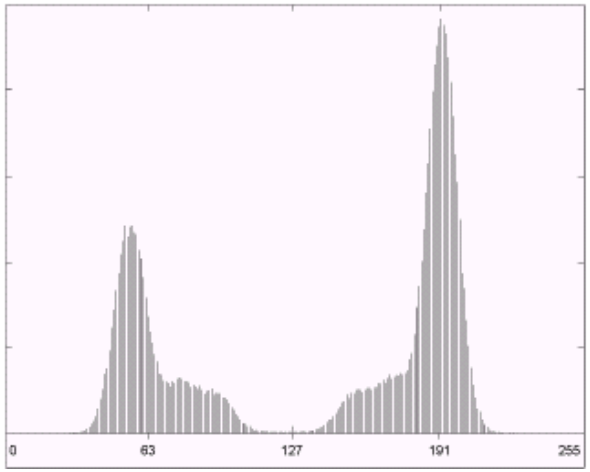


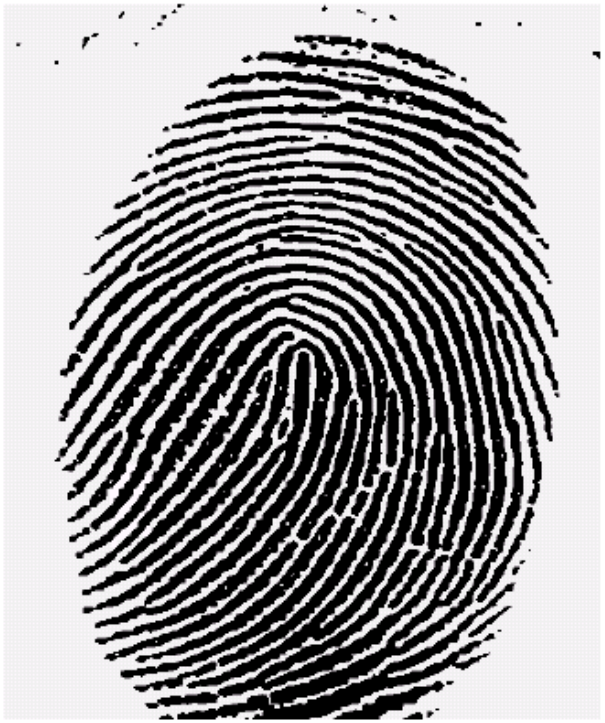

K
Q
J
10



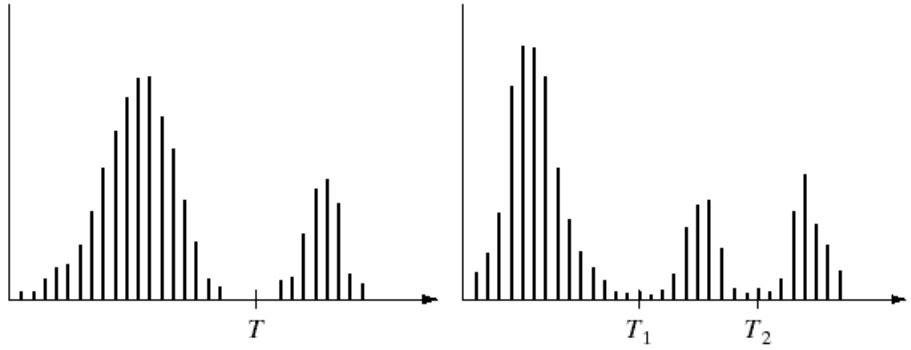

0
63
127
191
255



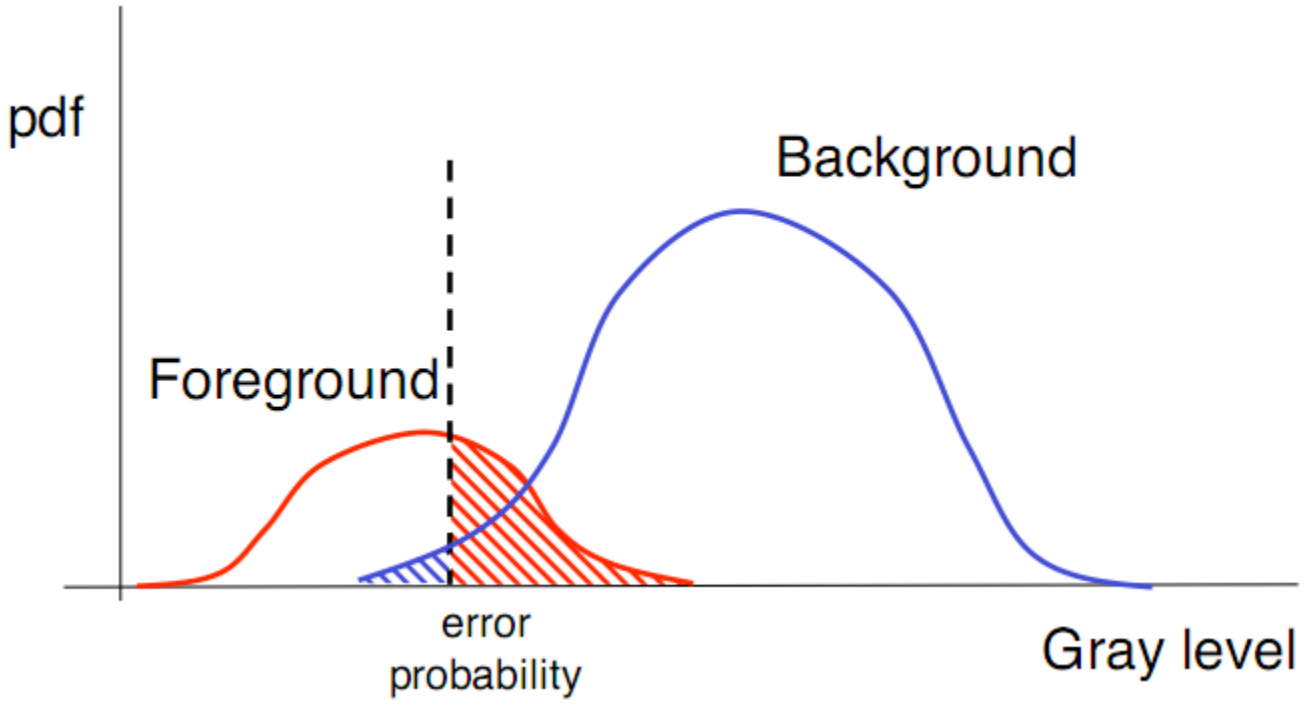

0
63
127
191
255



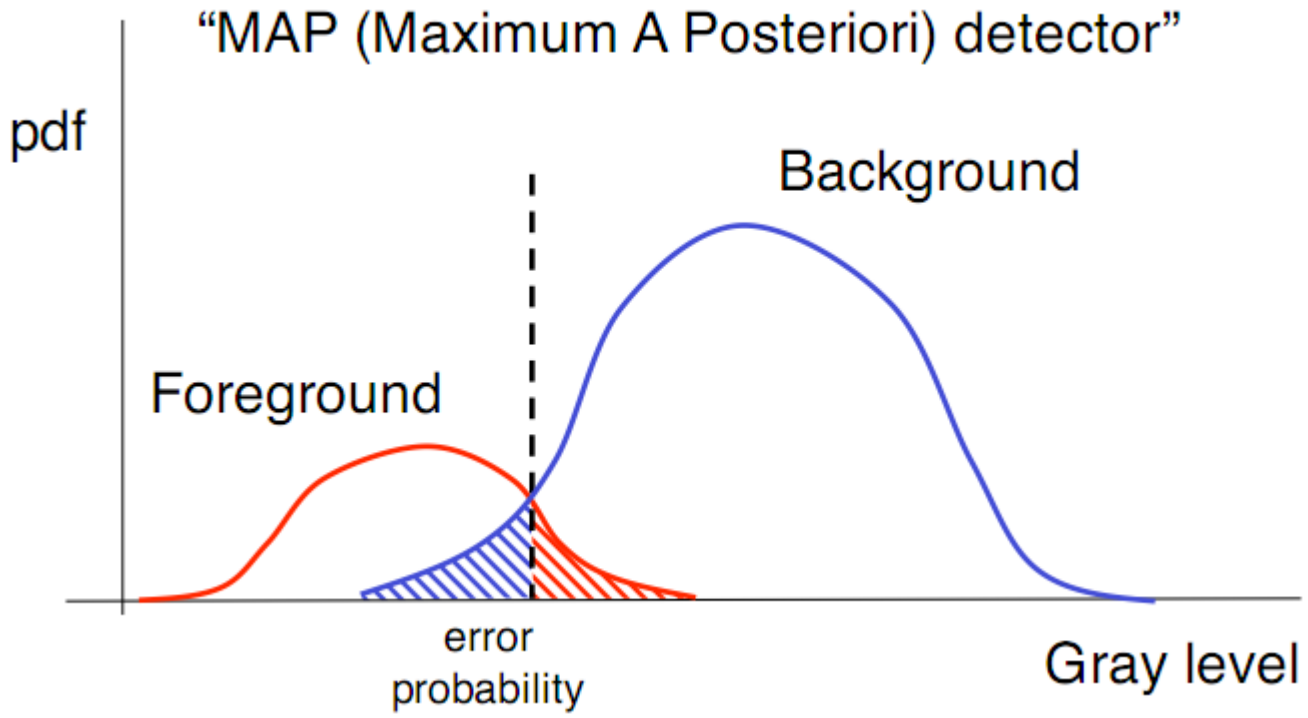
Eşikleme aralığı



Eşiklemede hata olasılığı



Eniyi eğiticili eşikleme



Uydurulan gauss ların kesişimi

Eğiticisiz eşikleme

- **Fikir**: ön- ve arka-plan için sınıf-içi varyansı minimum edecek T'yi bul

$$\sigma^2_{within}(T) = \frac{N_{Fgrnd}(T)}{N}\sigma^2_{Fgrnd}(T) + \frac{N_{Bgrnd}(T)}{N}\sigma^2_{Bgrnd}(T)$$

- Ya da sınıflar arası maksimize eden T'yi bul

$$\sigma^2_{between}(T) = \sigma^2 - \sigma^2_{within}(T)$$

$$= \left(\sum_{x,y} f^2(x,y) - \mu^2\right) - \frac{N_{Fgrd}}{N}\left(\sum_{x,y\in Fgrnd} f^2(x,y) - \mu^2_{Fgrnd}\right) - \frac{N_{Bgrnd}}{N}\left(\sum_{x,y\in Bgrnd} f^2(x,y) - \mu^2_{Bgrnd}\right)$$

$$= -\mu^2 + \frac{N_{Fgrnd}}{N}\mu^2_{Fgrnd} + \frac{N_{Bgrnd}}{N}\mu^2_{Bgrnd} = \frac{N_{Fgrnd}}{N}\left(\mu_{Fgrnd} - \mu\right)^2 + \frac{N_{Bgrnd}}{N}\left(\mu_{Bgrnd} - \mu\right)^2$$

$$= \frac{N_{Fgrnd}(T)\cdot N_{Bgrnd}(T)}{N^2}\left(\mu_{Fgrnd}(T) - \mu_{Bgrnd}(T)\right)^2$$

[Otsu, 1979]

Eğiticisiz eşikleme

- **Algoritma**: maksimize edecek T'yi ara

$$\sigma^2_{between}(T) = \frac{N_{Fgrnd}(T) \cdot N_{Bgrnd}(T)}{N^2} \left(\mu_{Fgrnd}(T) - \mu_{Bgrnd}(T)\right)^2$$

- Karmaşıklığı düşük özyineli versiyonu:

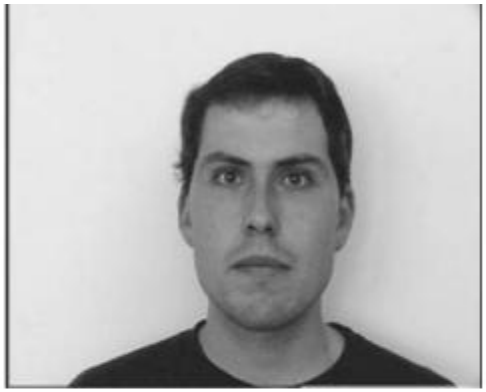
$$N_{Fgrnd}(T+1) = N_{Fgrnd}(T) + n_T$$

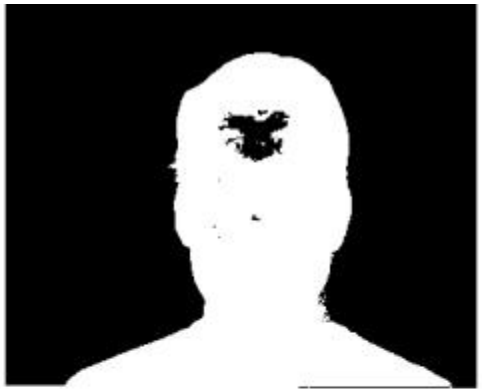
$$N_{Bgrnd}(T+1) = N_{Bgrnd}(T) - n_T$$

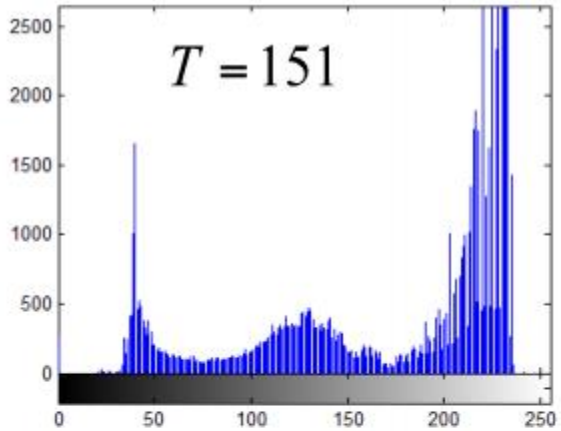
$$\mu_{Fgrnd}(T+1) = \frac{\mu_{Fgrnd}(T) N_{Fgrnd}(T) + n_T T}{N_{Fgrnd}(T+1)}$$

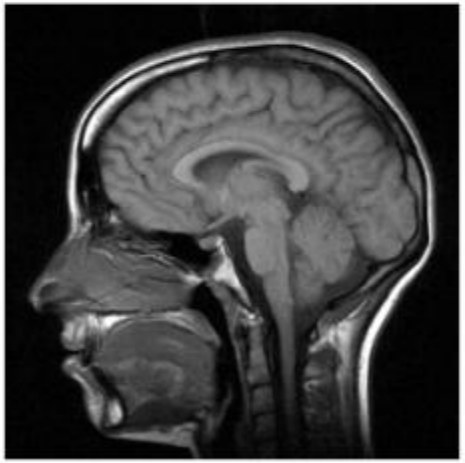
$$\mu_{Bgrnd}(T+1) = \frac{\mu_{Bgrnd}(T) N_{Bgrnd}(T) - n_T T}{N_{Fgrnd}(T+1)}$$

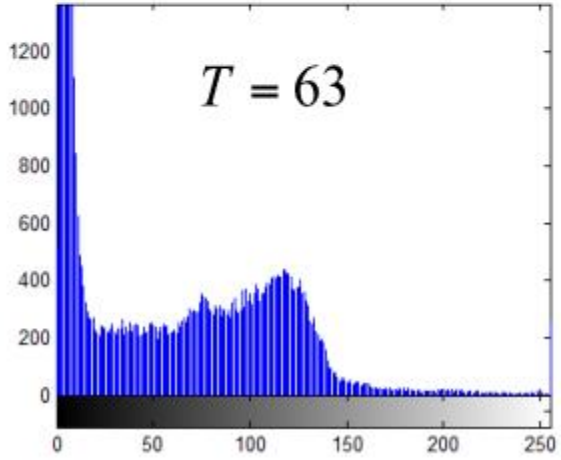
Eğiticisiz eşikleme





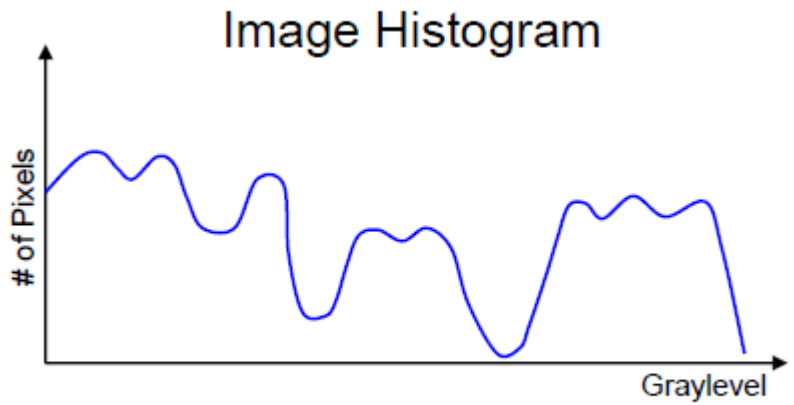




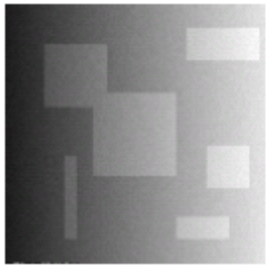


Adaptive eşikleme

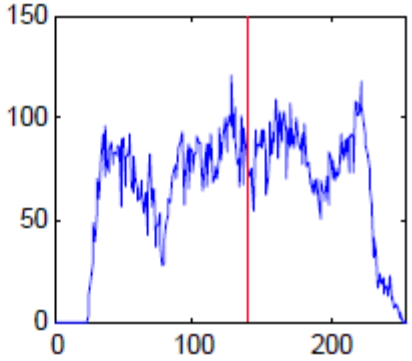
- İşler her zaman bu kadar kolay değildir
  - Farklı gri seviyelere sahip çok sayıda nesne olabilir
  - Arkaplanın gri seviyesi değişkenlik gösterir
  - Resim gürültü içerebilir



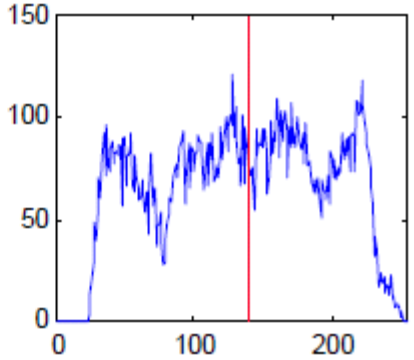
Original



Histogram

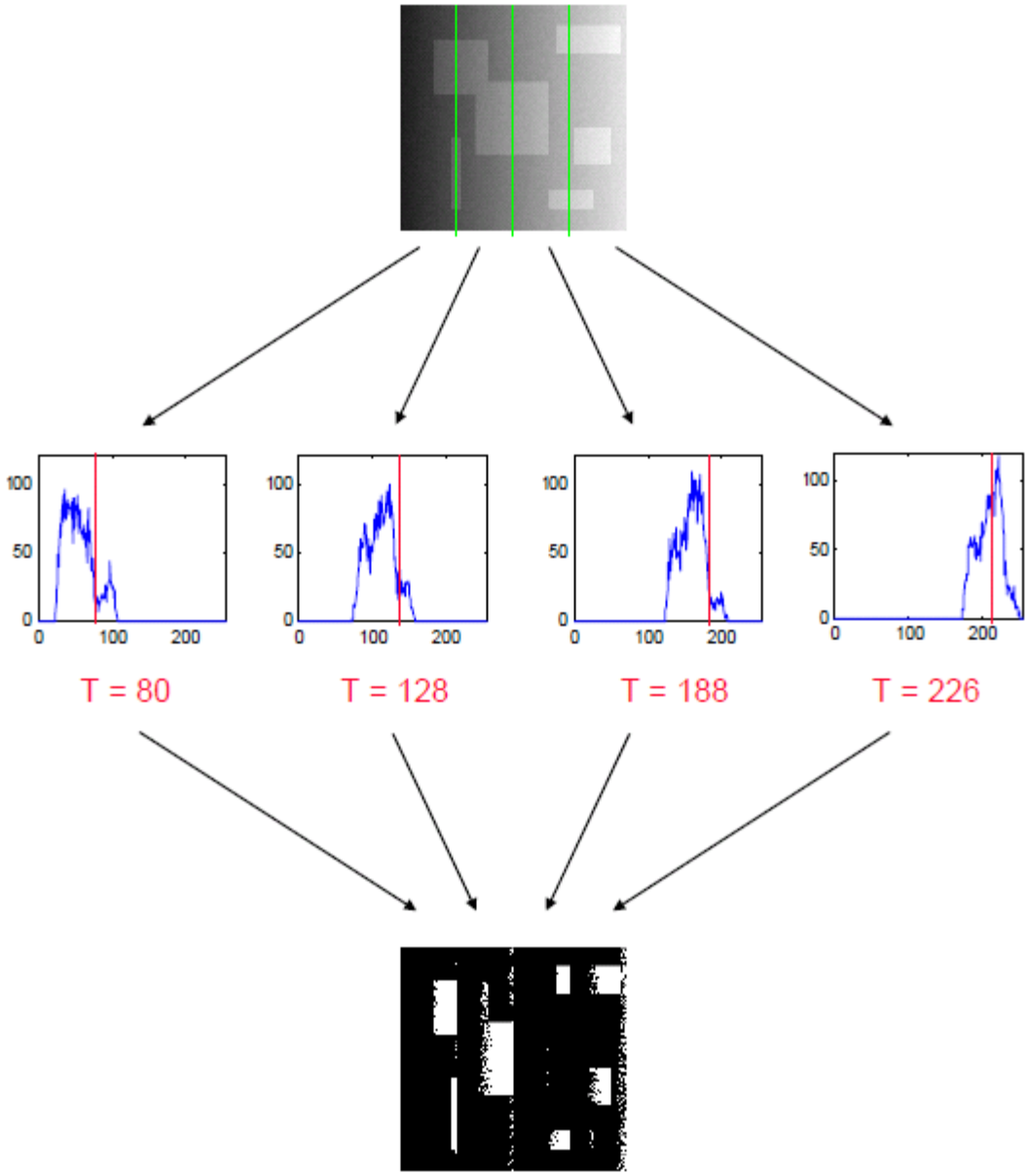


Single Global Threshold



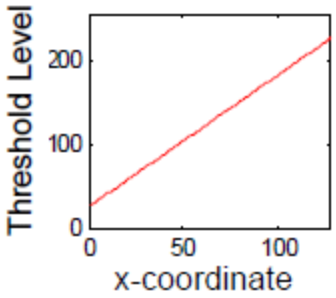
T = 128

Divide image in to regions. Perform thresholding independently in each region.

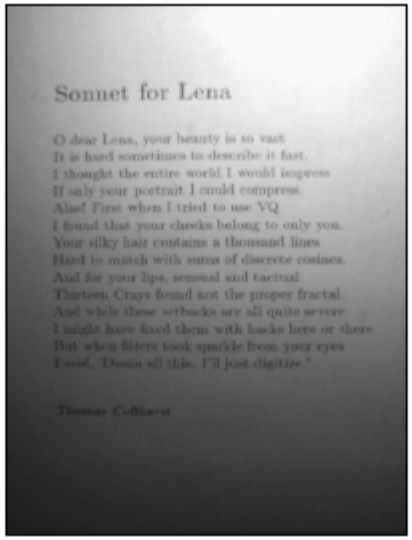


Every pixel in image is thresholded according to the histogram of the pixel neighborhood.

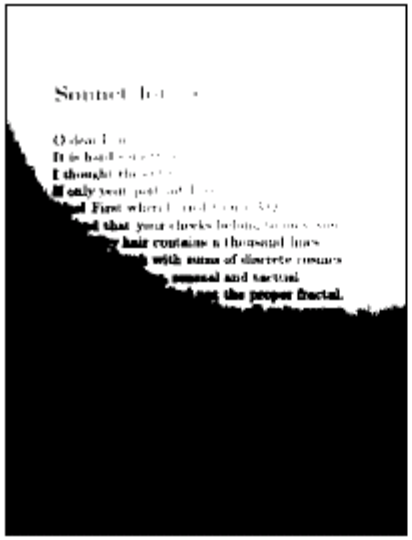
T =



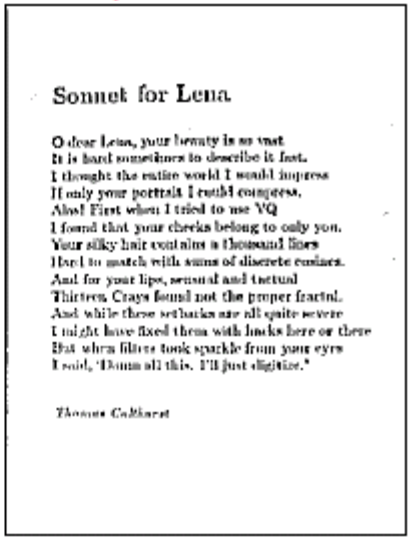
Original



Global Threshold

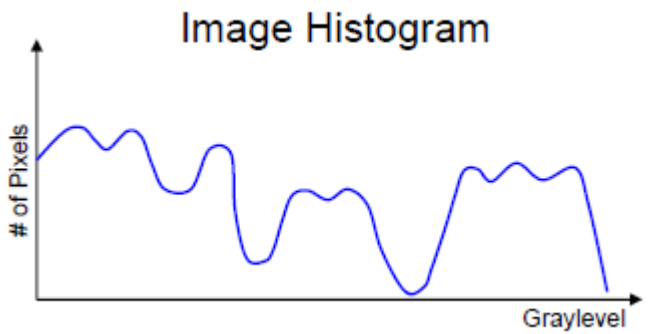


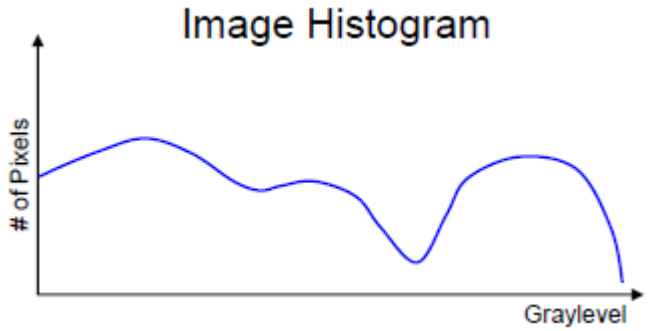
Adaptive Threshold

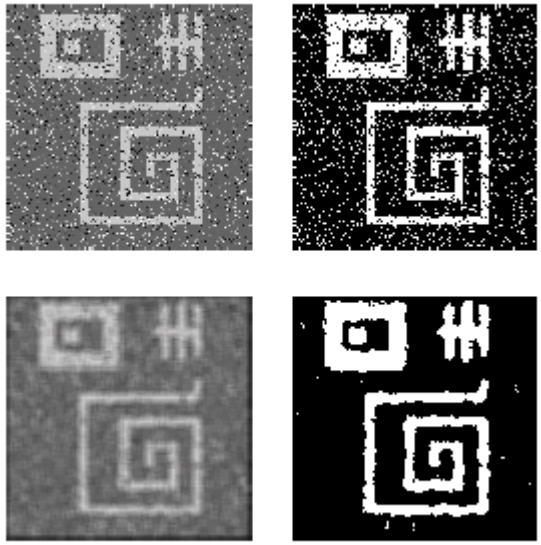


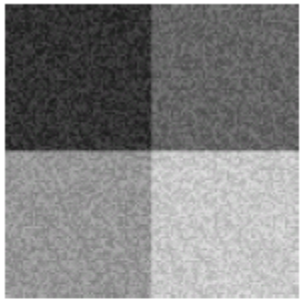
Gürültülü durum

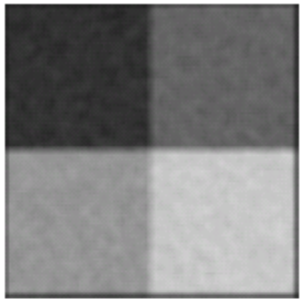
- Gürültü varsa önce onu gider
  - Görüntüyü filtrele/smooth et
  - Histogramı değil
- Ardından eşikleme yap

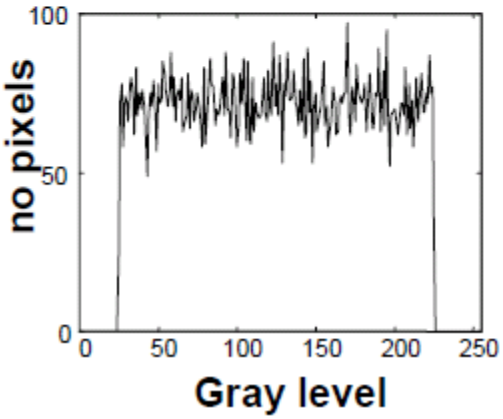


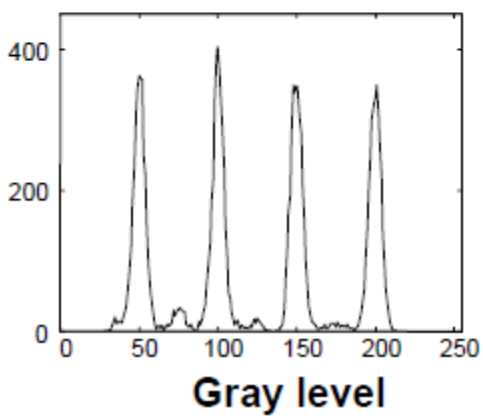




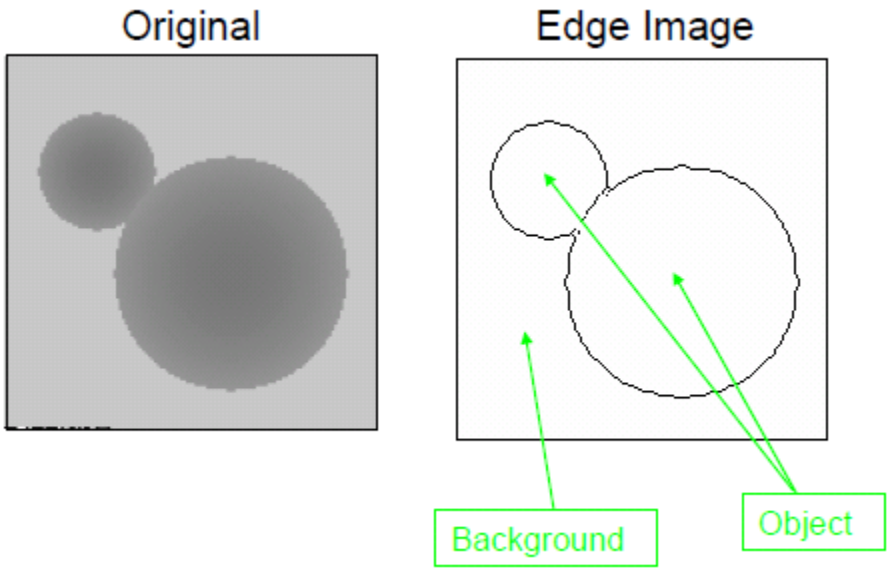


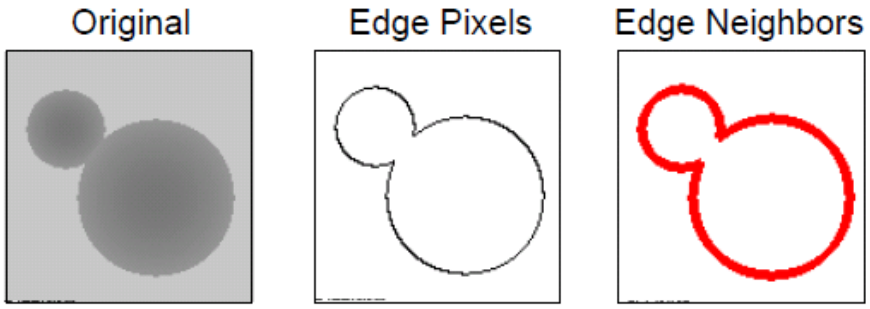


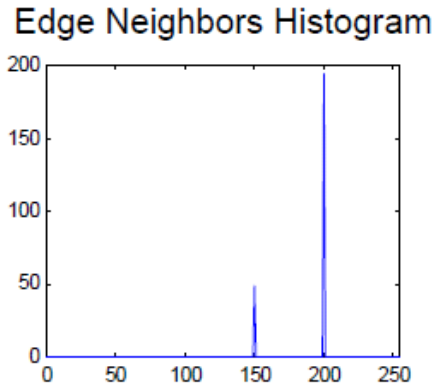

no pixels
100
50
0
0
50
100
150
200
250
Gray level


400
200
0
0
50
100
150
200
250
Gray level

Kenar tabanlı eşikleme

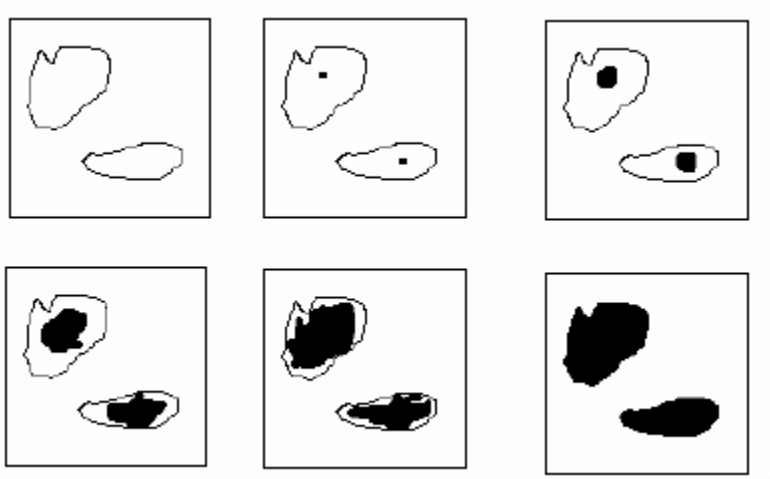


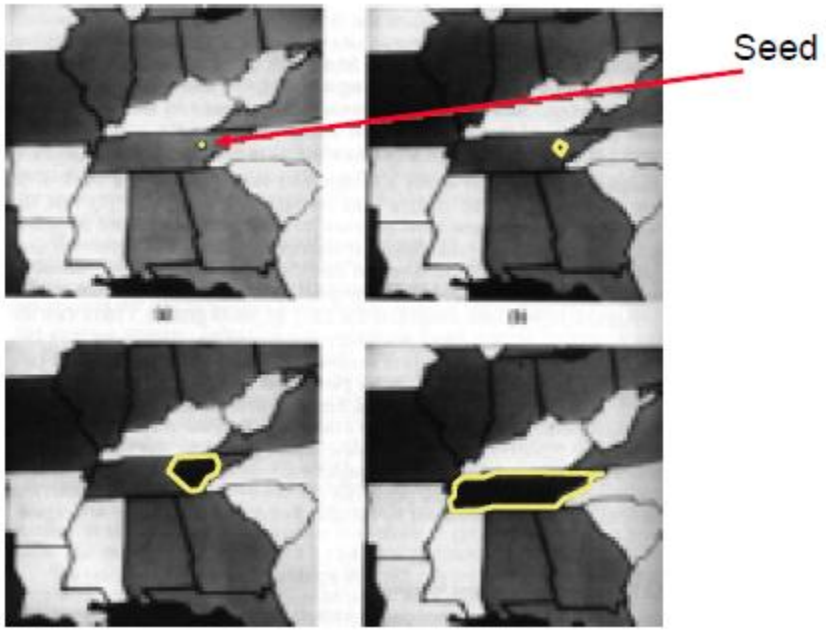

Original
Edge Pixels
Edge Neighbors


Edge Neighbors Histogram
200
150
100
50
0
0
50
100
150
200
250

Region growing

- Tanım
  - S: bölge içi pikselleri
  - Q: kontrol edilecek pikseller kuyruğu
- Algoritma
  - S=0; Q = {(x0,y0)}
  1. Q'dan P piksellerini çıkart
  2. P'yi S'ye ekle
  3. P'nin P^ komşuluğundakilerin her birisi için
     - S'nin elemanı olmayan ve P'ye **benzeyen** P^ leri Q'ya ekle
  4. Q boşalıncaya kadar devam et

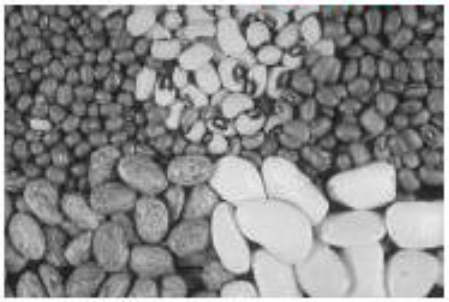


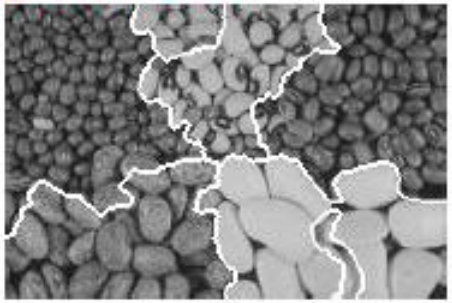

Seed

Color Segmentation

Benzerlik ölçüsü?

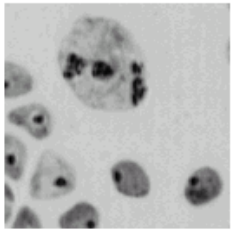
Texture Segmentation



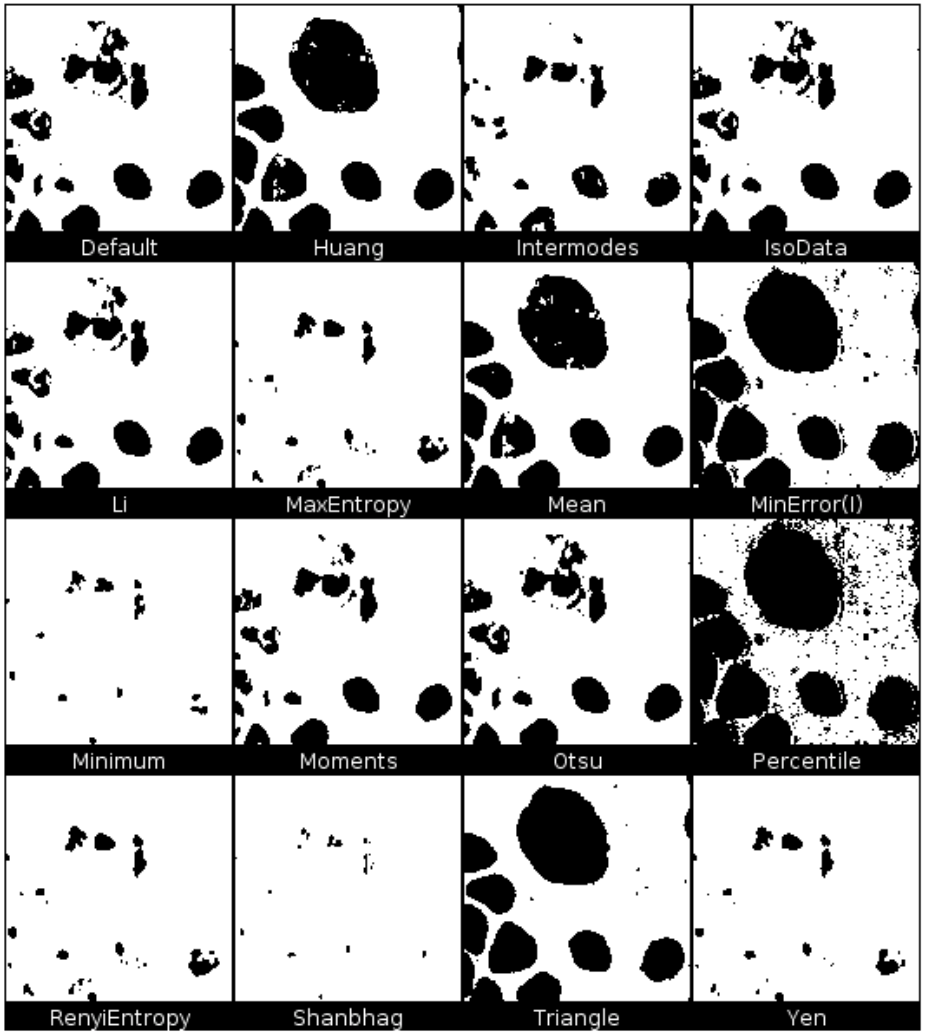


Color + Texture Segmentation

Karşılaştırma

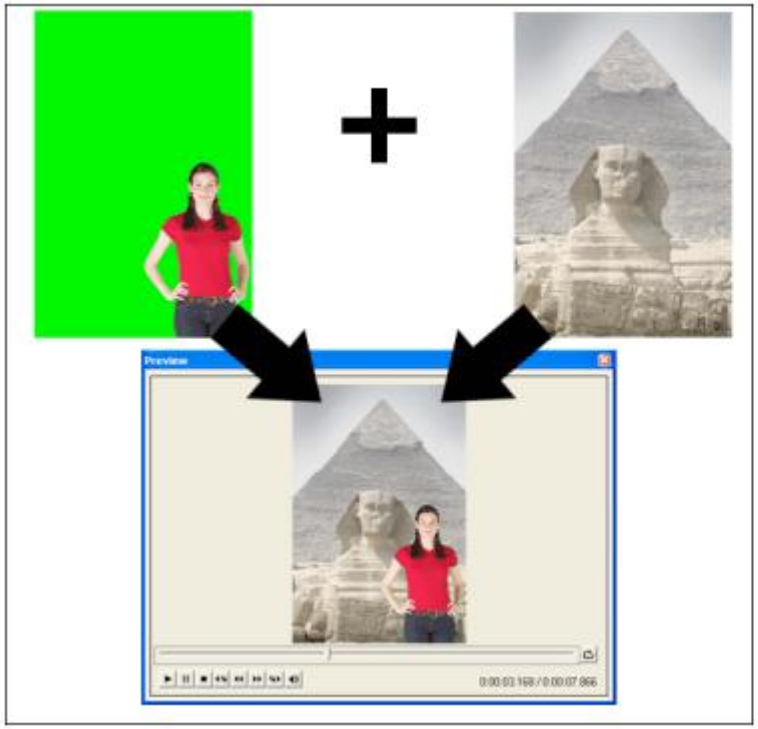


Original image

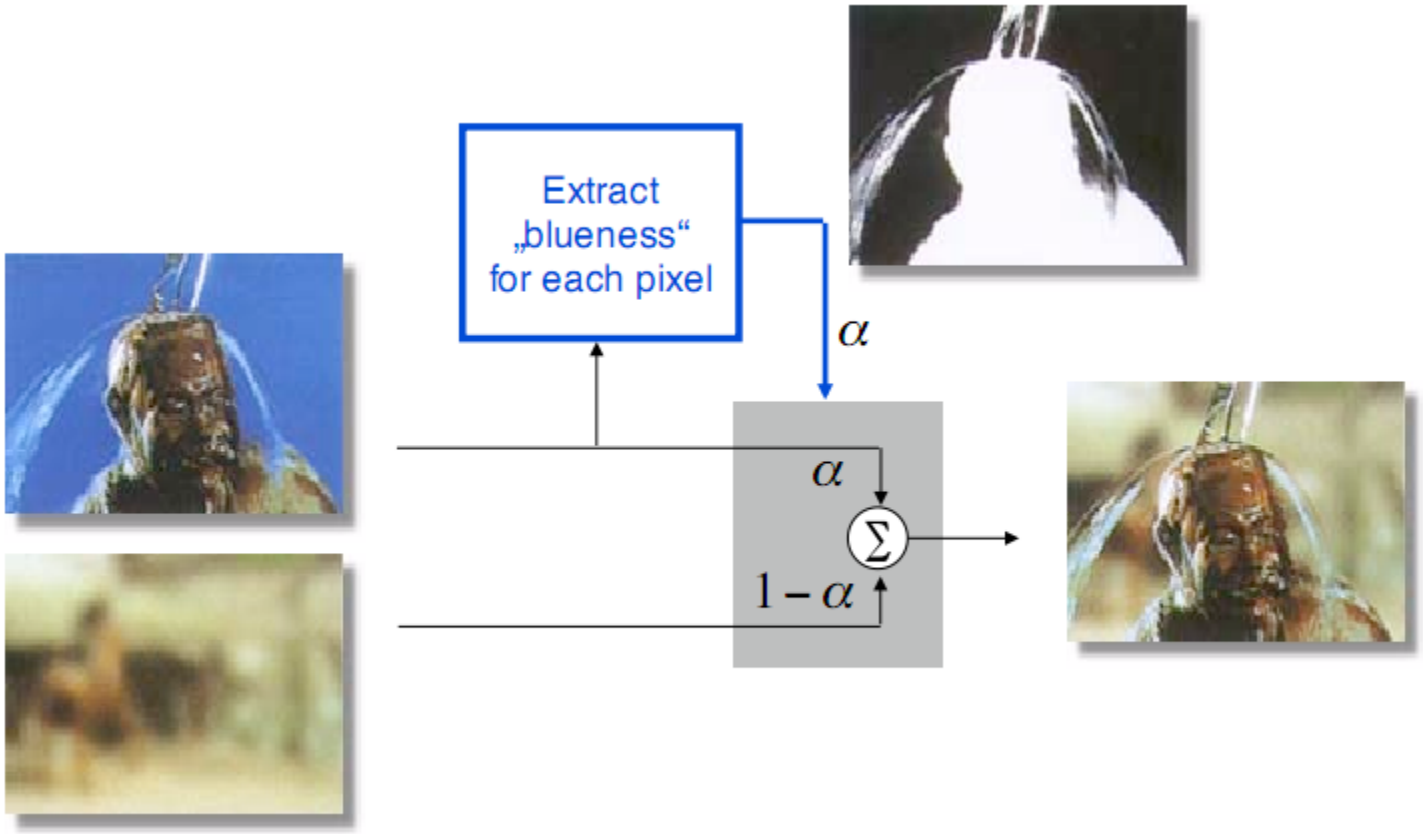


Mavi perde

- Renge bölütleme daha gürbüzdür
- Mavi perde önünde çekim yap

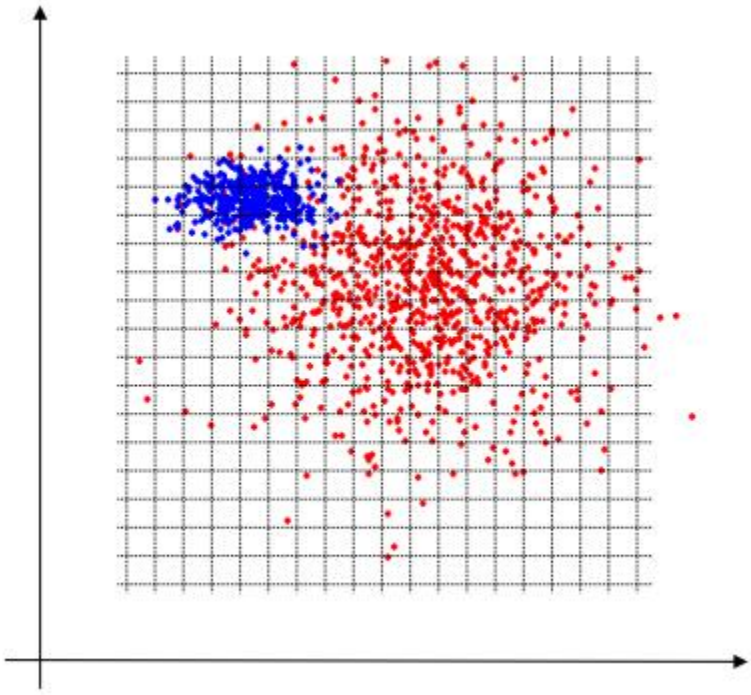


Yumuşak chroma keying



Çok boyutlu MAP (Max.Post.)

- Elle, eğitim kümesinde kategorileri etiketle
- Dar bölgelere sahip n-boyutlu uzayı bölümle
- Her bir bölge ve eğitim kümesindeki her bir sınıf için görünme sıklığını hesapla
- Test verisi için bölgeyi belirle, daha olası olduğu kategoriyi/sınıfı algıla



MAP: RGB-uzayı

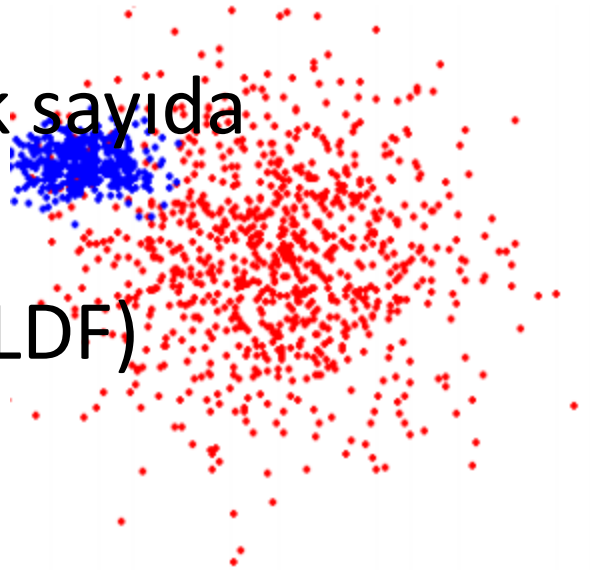
Original image

Skin color detector

LDF (Linear Disc.Function)

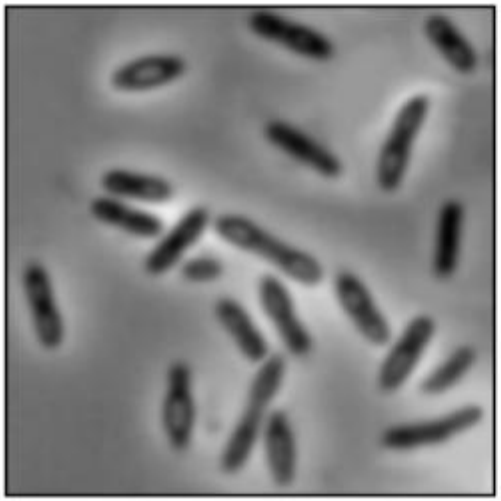
$$\sum_i w_i f_i + w_0 \geq 0 \quad ?$$

- N-bileşenli fi resmini iki kategoriye bölütlemek için üstteki eşitliği test et
- Kategoriler n-boyutlu uzayda hiper düzlemle ayrılmış
- Kritik aşama wi'leri bulmak. Çok sayıda yöntem var
- Doğruların ara kesiti yaklaşımı (LDF)



Bölge etiketleme ve sayma

- Resimde kaç bakteri var?



Original *Bacteria* image

after thresholding

- Aynı nesneye ait pikselleri söyle(label)
- Her bir nesne kaç pikselden oluşur (count)

4’lü-8’li komşuluk

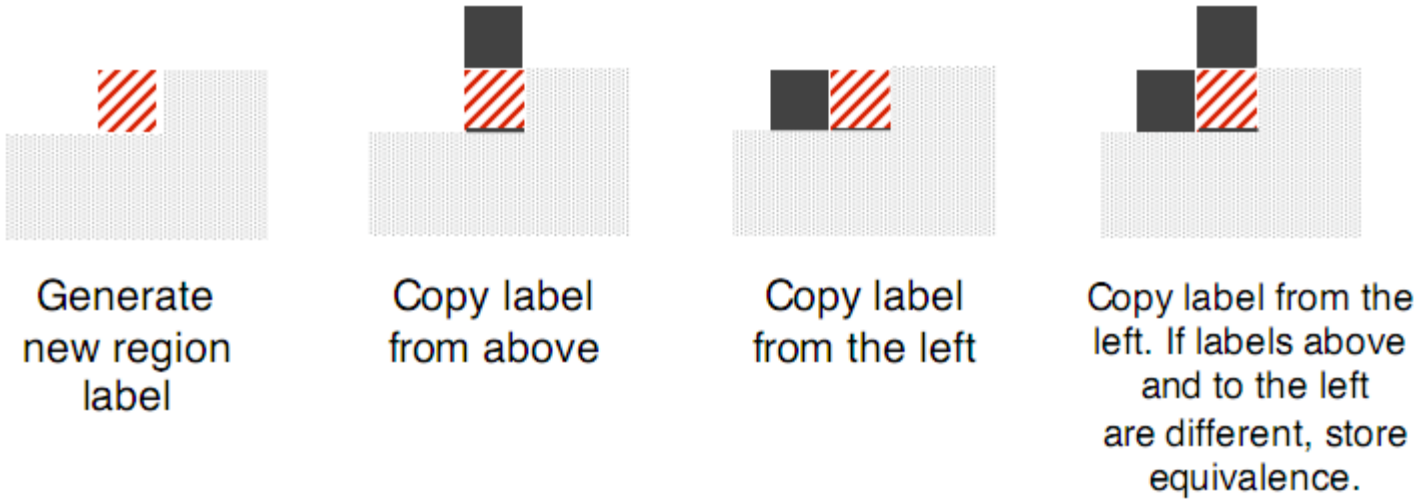
- Bölge birbirine dokunan pikseller topluluğudur
- Dokunma = piksel komşuluğu = N4,N8

4-neighborhood

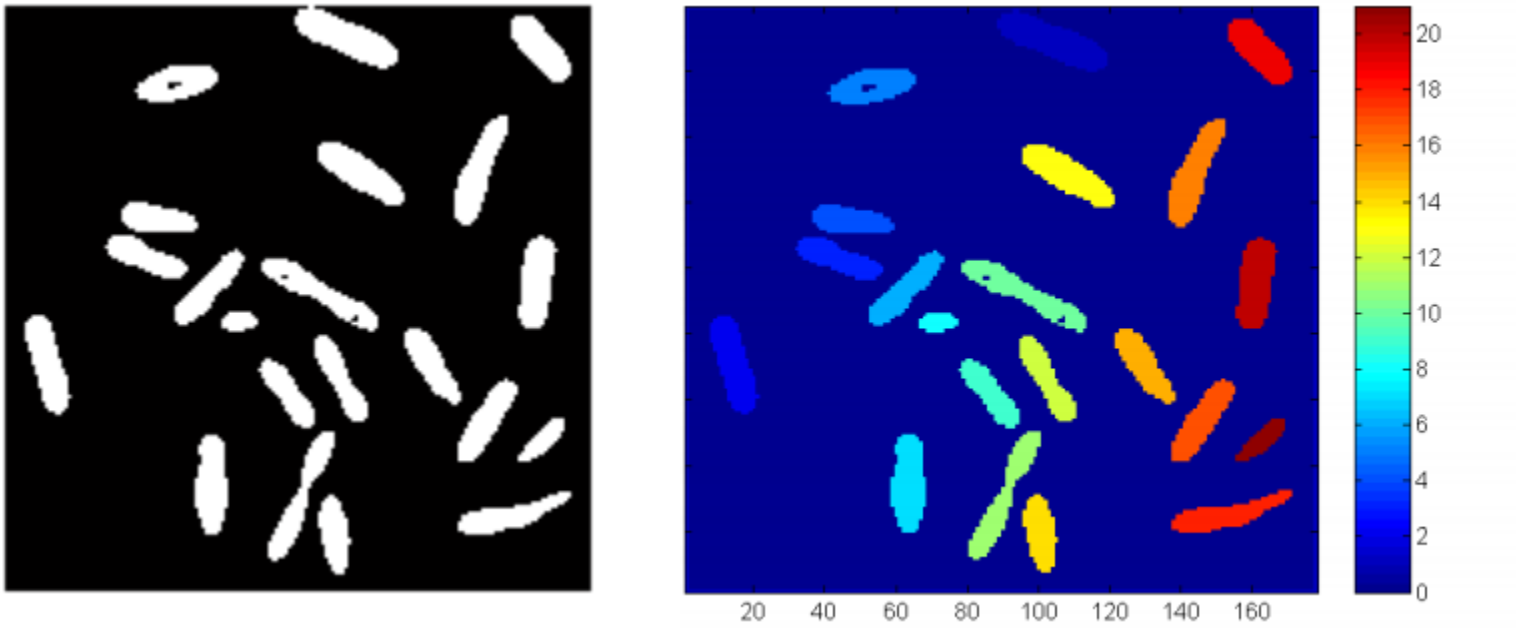
8-neighborhood

Bölge etiketleme

- Tüm pikselleri tara: soldan-sağa, üstten-alta
- 0 değerliler için bir şey yapma
- 1 değerli pikseller için aşağıdakilerden birisi olacak



Örnek: bölge etiketleme



Bölge sayma

- Her bir bölgenin boyutunu ölçme
- Counter(label)=0 ile başla
- 1 değerli pikseller için counter(label(x,y))++

Küçük alanlı bölgeleri sil

- Tüm pikselleri tara
- Counter(label(x,y)) < S olanları sıfırla

Boşluk doldurma

- NOT; etiketle; küçük boyutluları uzaklaştır; NOT