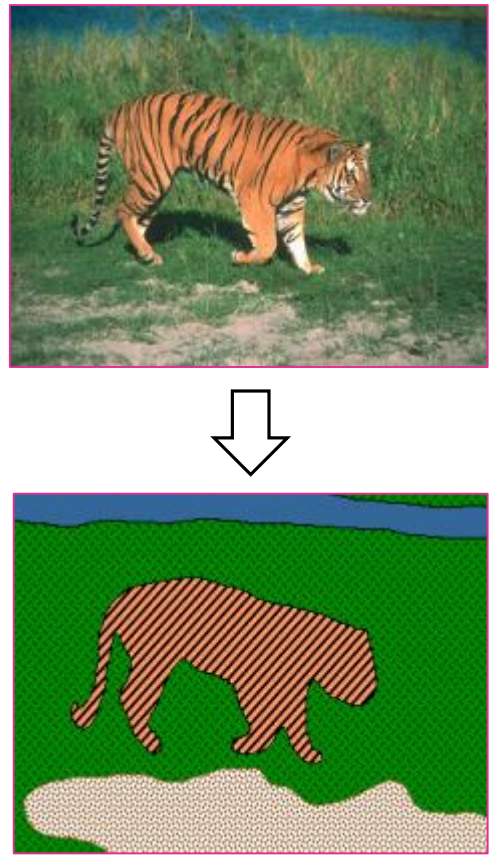
Segmentation:
Thresholding

Dr. Tushar Sandhan

Introduction

- Segmentation
  - aim: partition an image into set of pixels sharing common theme
    - coherent objects
    - flat structures
    - shapes



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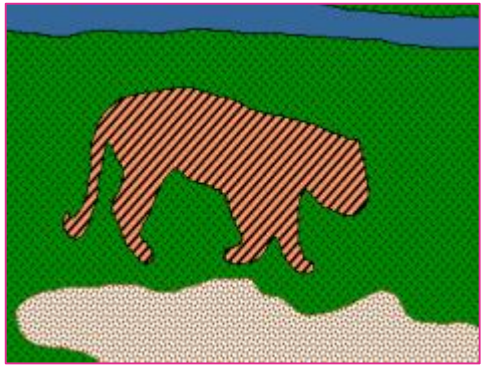

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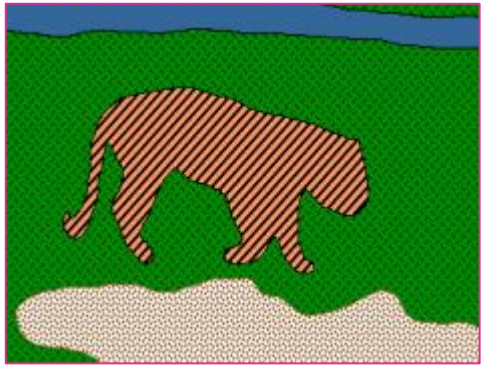

Grouping by HVS

- Gestalt
  - config of things when integrated as to constitute a functional unit, with properties not derived by sum of its parts

  - whole is greater than sum of parts
  - relationship among parts are also imp. & can yield new properties
  - gestalt factors: human psychology for groupism
  - intuitive but difficult for algorithm

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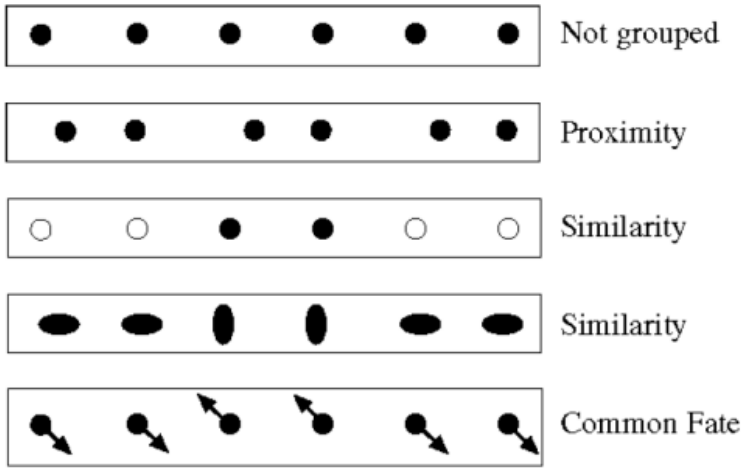

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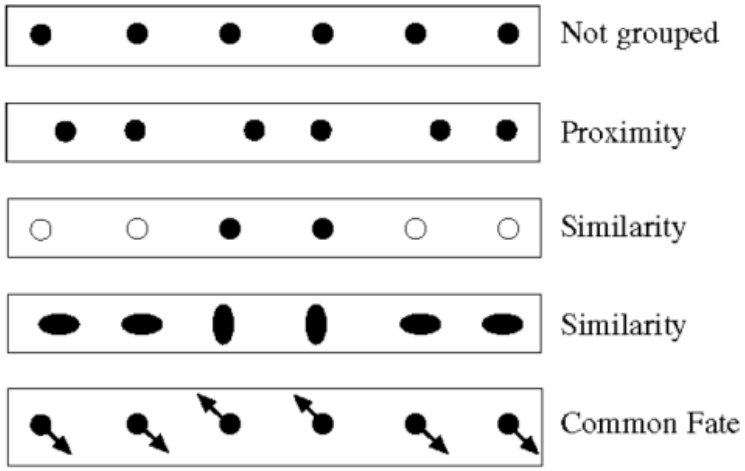

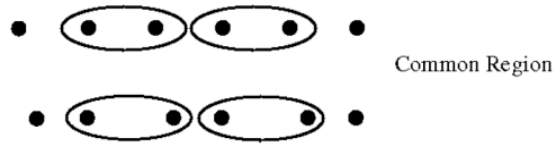

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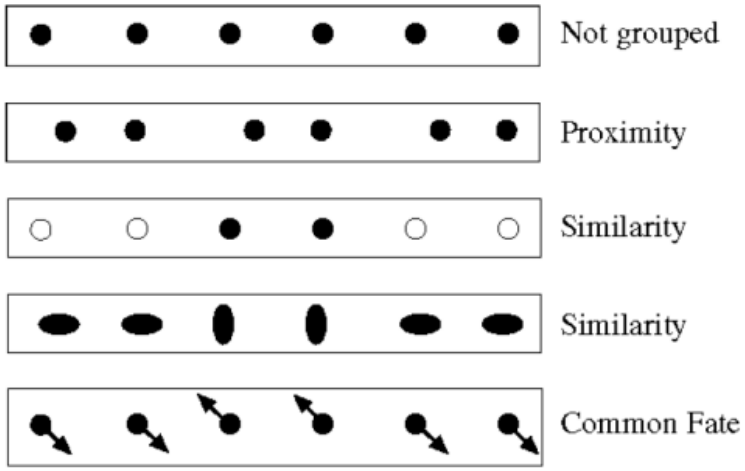

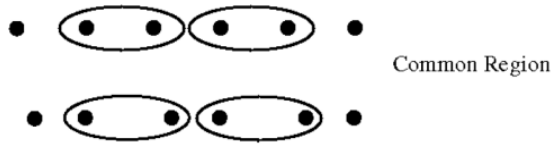

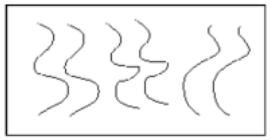

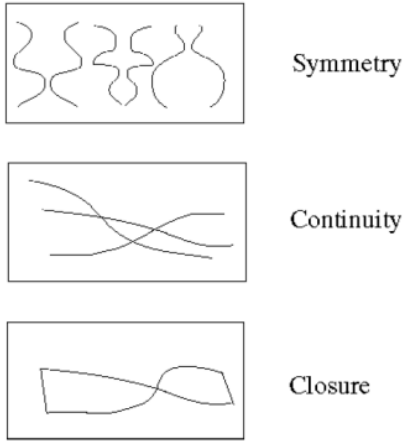

Segmentation: grouping of pixels

- Pixels
  - points in high-dim space
  - gray: 1D
  - colors: 3D
  - location + colors: 5D
  - group pixels into segments or chunks

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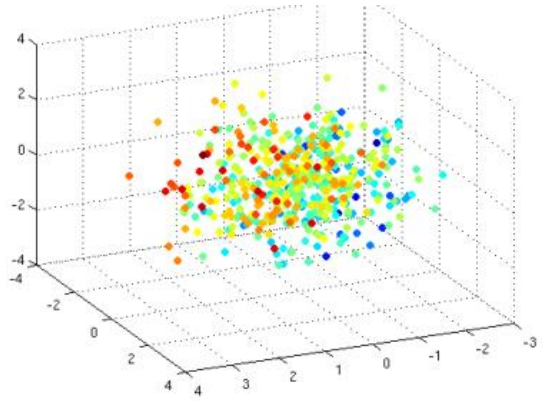

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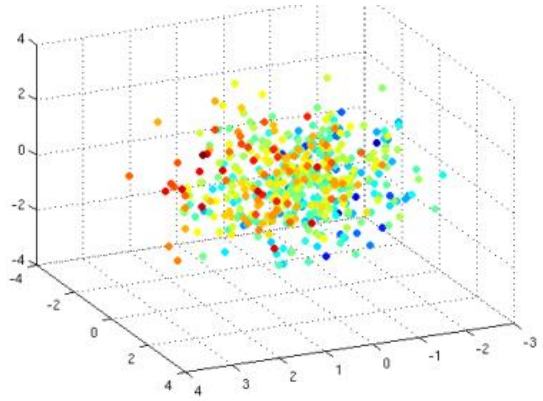

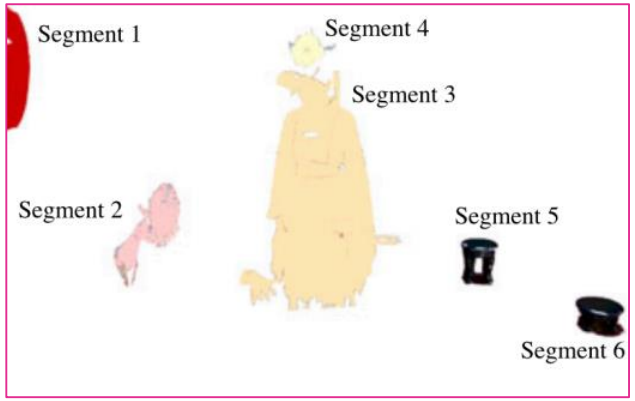

Segmentation methods

- Shape based methods
- Thresholding
- Region based
  - region-growing

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- Machine learning based
  - Unsupervised
    - K-means clustering
    - mean shift clustering
  - Supervised
    - feature detection and learning
- Graph & energy minimization

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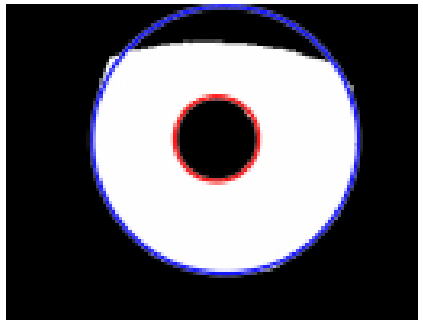

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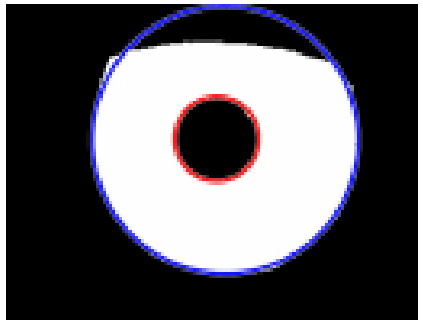

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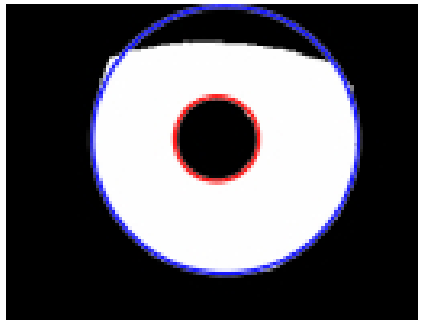

Thresholding

- Binarization or thresholding
  - quick and simple
  - partitions $f(x, y)$ into 2 sets: foreground & background using threshold T
  - can extend to multilevel T
  - assumptions:
    - intensities are different in different regions
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  - e.g. online poker

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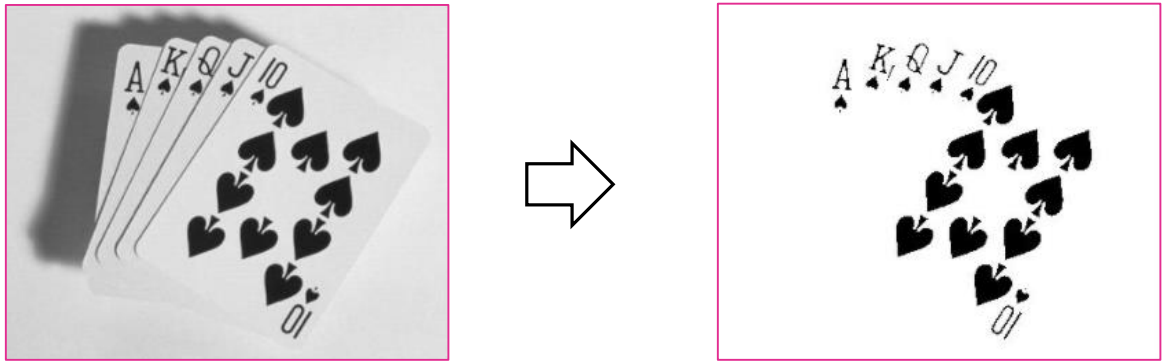

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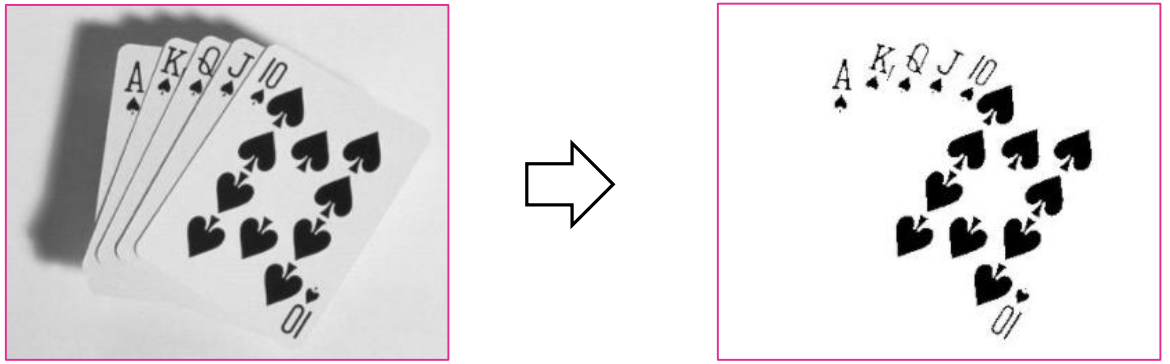

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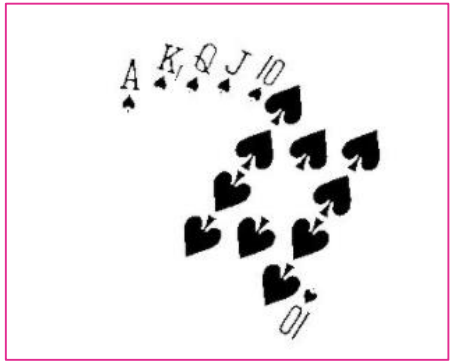

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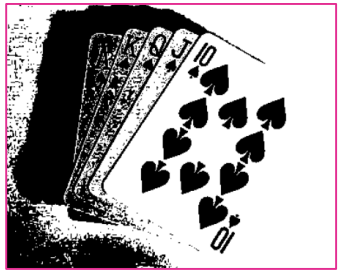

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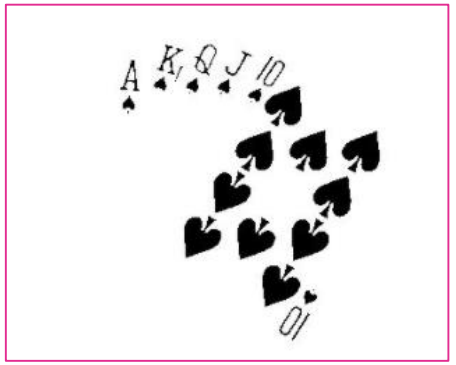

T

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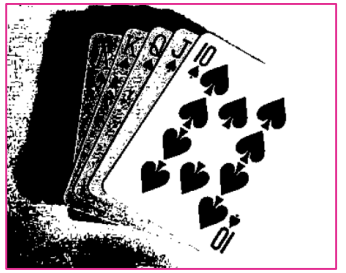

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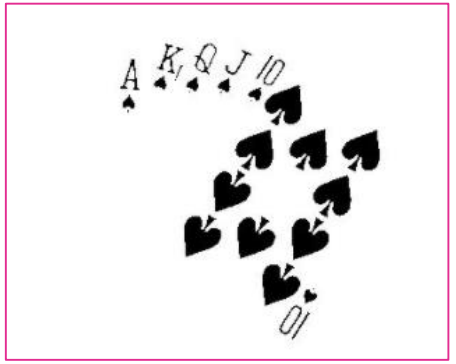

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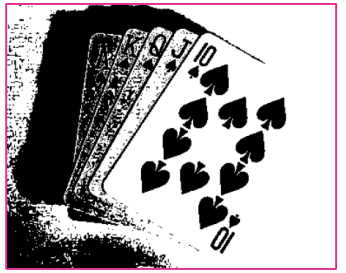
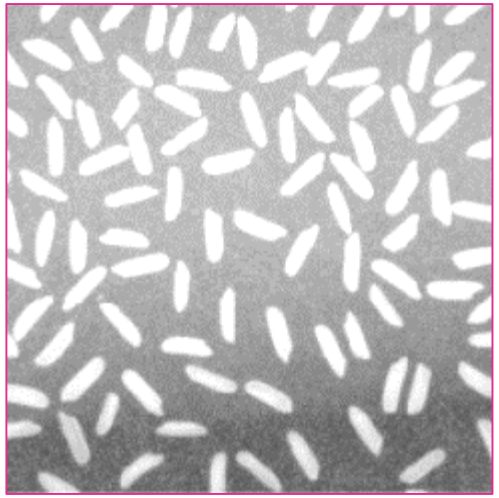


Thresholding

- Global: single T for entire image
- Local: blocking or tiling over the image & use different T for each block
- Adaptive: adjust or select T based on image content



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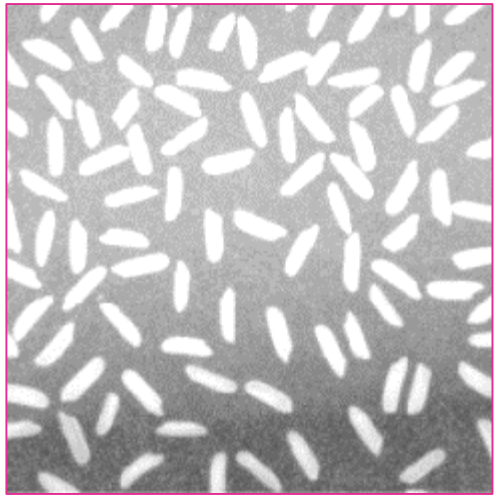

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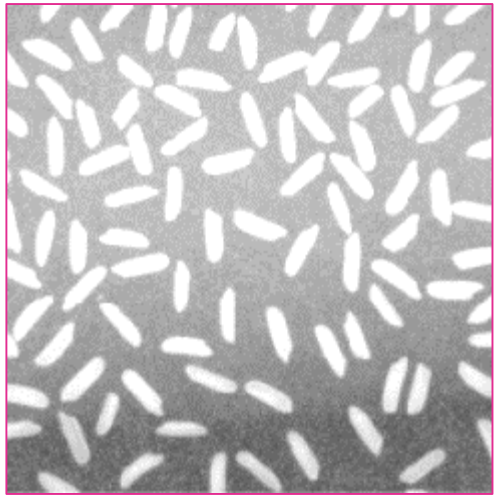

global

local

Thresholding

- Global: iterative adapting threshold

- Initialize threshold $\boldsymbol{T}$

- Loop until converged
  - Partition image using $\boldsymbol{T}$
  - Compute background mean μ_b as the average intensity of all pixels below $\boldsymbol{T}$
  - Compute foreground mean μ_f as the average intensity of all pixels above $\boldsymbol{T}$
  - Update $\boldsymbol{T}$

$$T = \frac{1}{2}(\mu_f + \mu_b)$$

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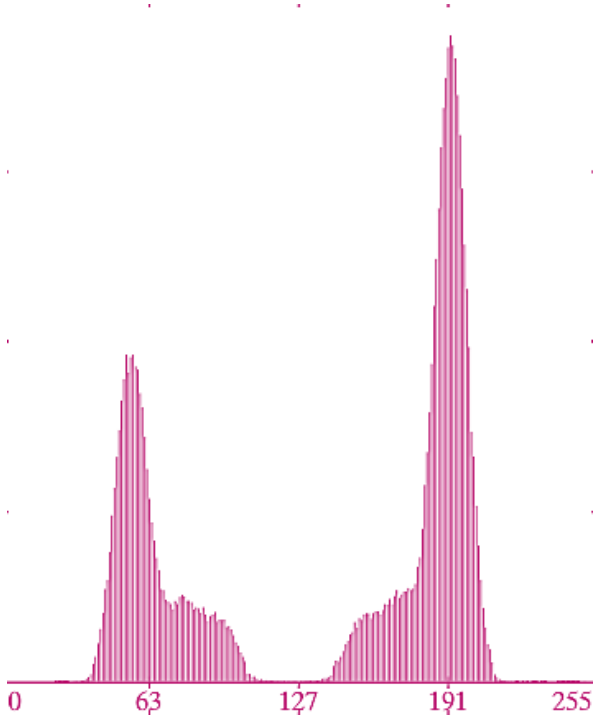

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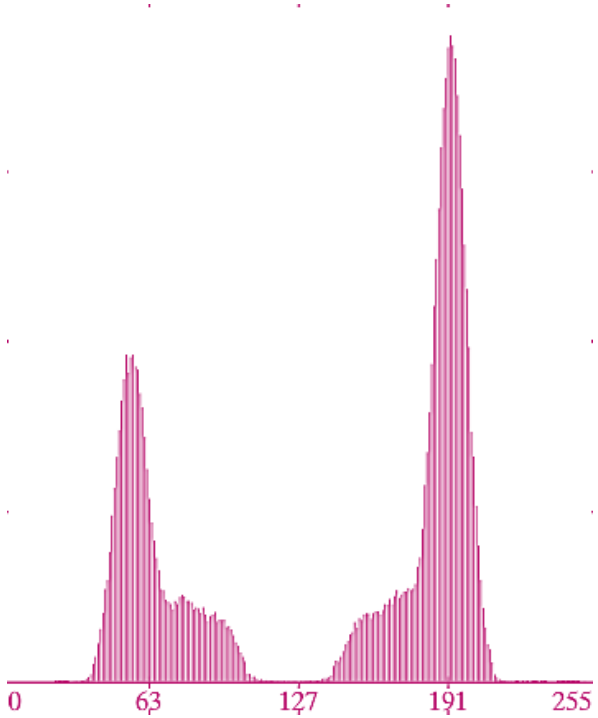

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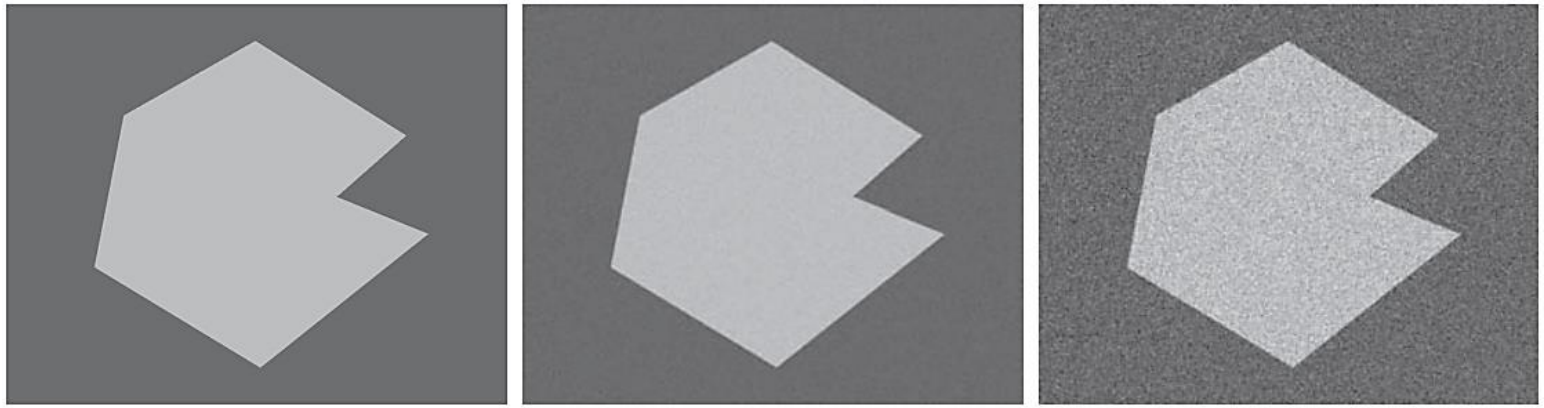

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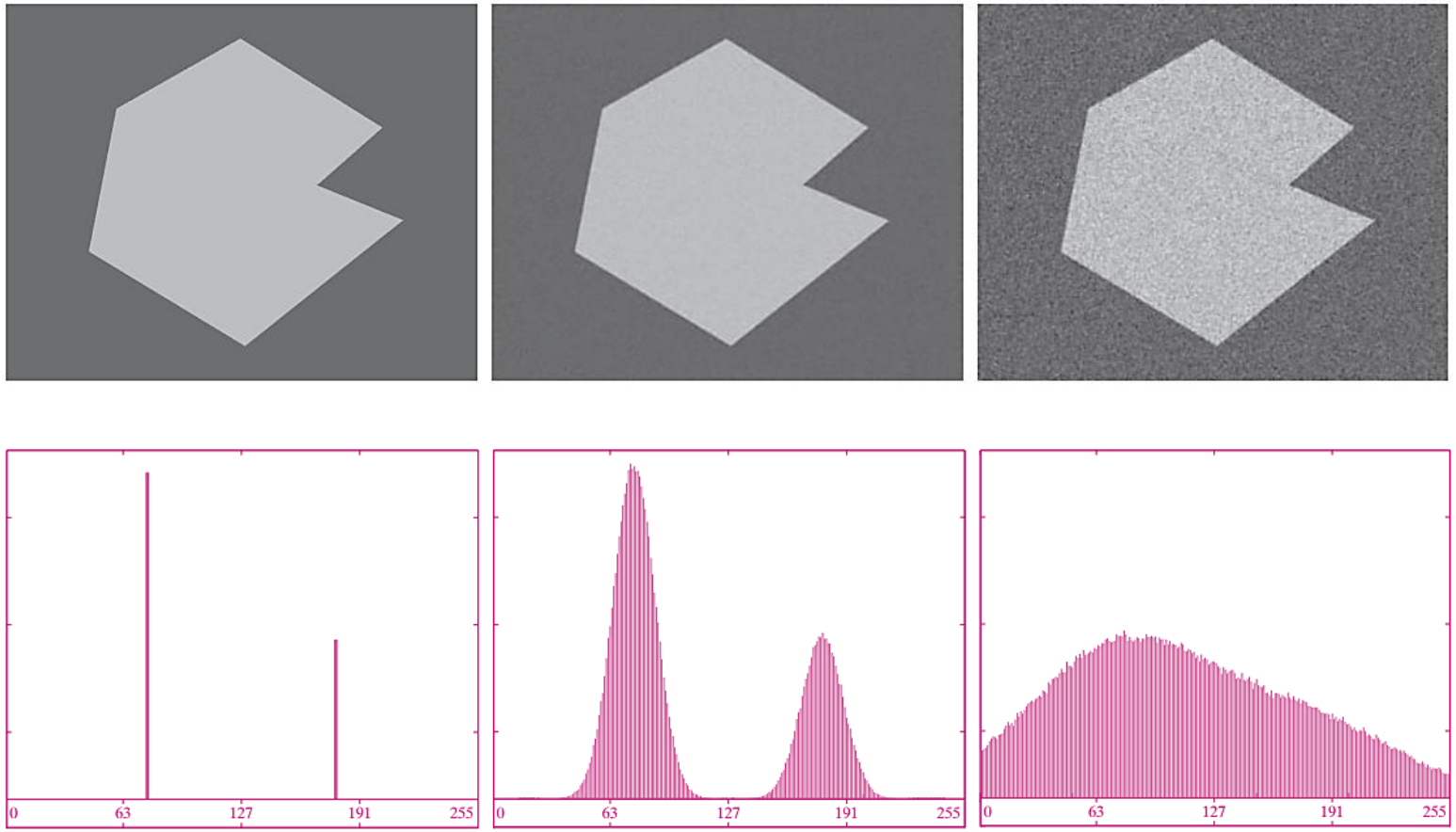

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- Illumination & reflectance

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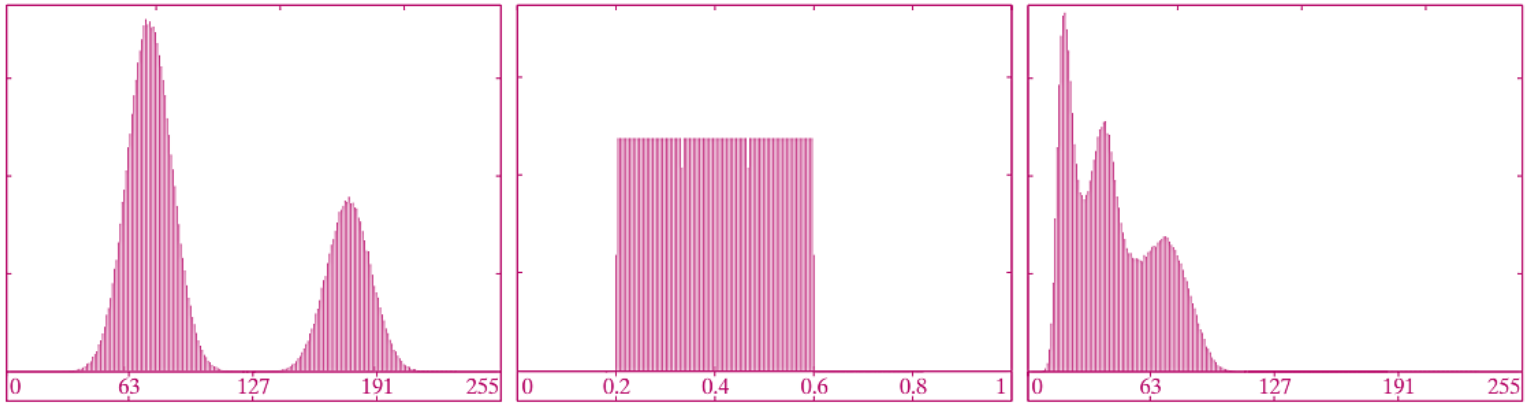

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