UNIVERSITÀ DEGLI STUDI DI PADOVA

Contrast stretching and thresholding

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Agenda

- Tuning the contrast of an image
- Selecting and highlighting image elements

Contrast stretching & thresholding

- Single-pixel operations can be used for a variety of applications
- Example:
  - Enhance contrast
  - Apply a threshold to an image
    - Pixels divided into black/white

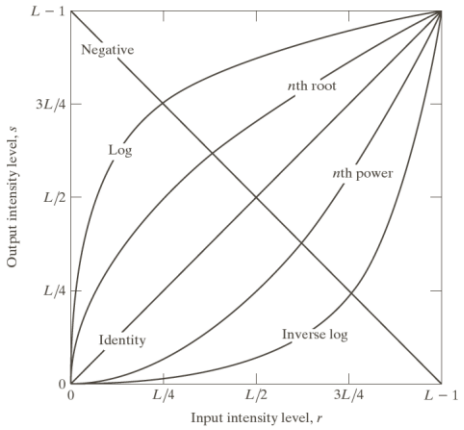
Measuring contrast

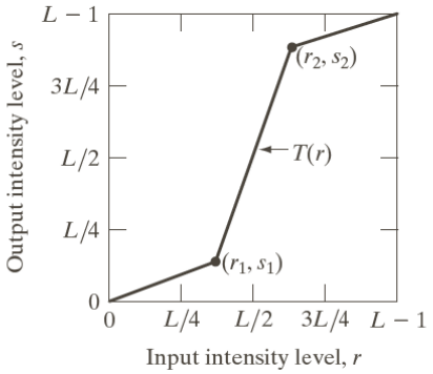
- Recall the definition of contrast
  - Contrast – difference between highest and lowest intensity level in the image
- Other measurements may be used
  - E.g.: RMS Contrast

$$RMSC = \sqrt{\frac{1}{MN}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}\left(I(i,j)-\bar{I}\right)^2}$$

Contrast stretching

- Contrast stretching is used to enhance the contrast of an image
  - A single-pixel operation like gamma/log/…
  - Defined by a set of segments
    - Depending on the specific image we are dealing with





Contrast stretching

- Contrast stretching is used to enhance the contrast of an image
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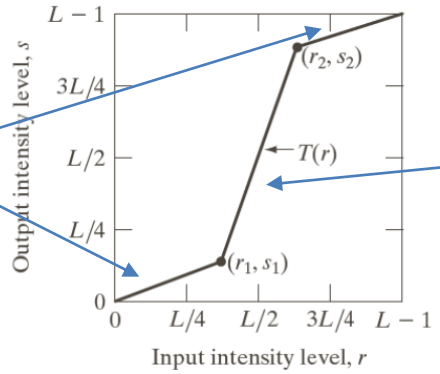
What happens when the angular coefficient is low?



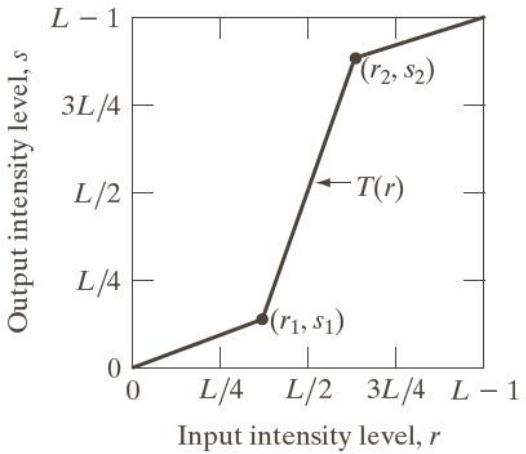
What happens when the angular coefficient is high?

Contrast stretching

- How would you apply contrast stretching to this image?

Contrast stretching & thresholding

Contrast stretching & thresholding



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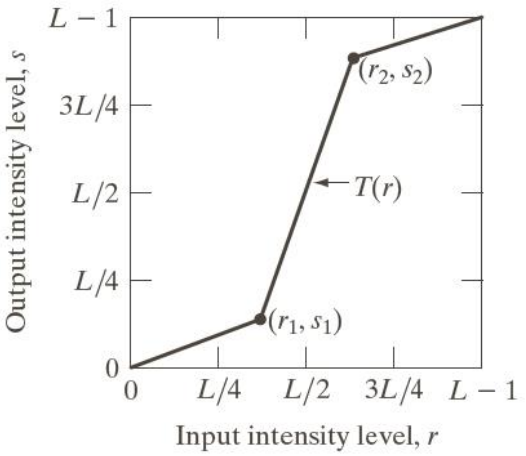
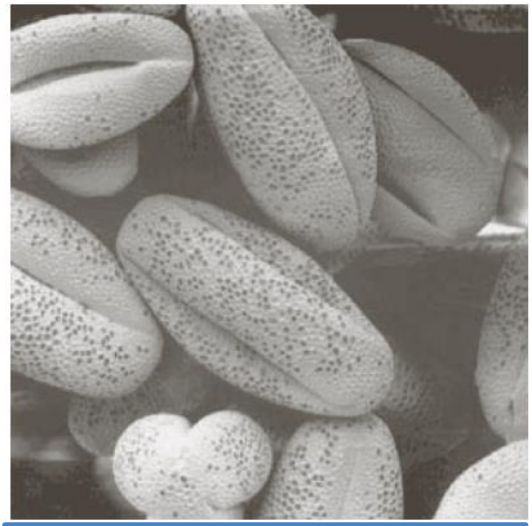


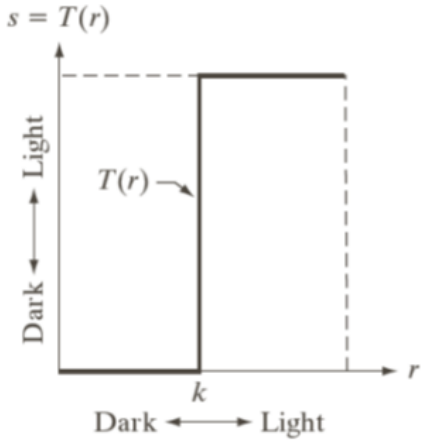


Contrast stretching

Thresholding

- Thresholding is another single-pixel operation defined based on:
  - A threshold Th
    - Comparison for the input pixel
  - A low value L_L and a high value L_H
    - Output pixel values if the original value is higher or lower than the threshold

$$T(r) = \begin{cases} L_L & if\ r \leq Th \\ L_H & if\ r > Th \end{cases}$$



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  - A threshold Th
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  - A low value L_L and a high value L_H
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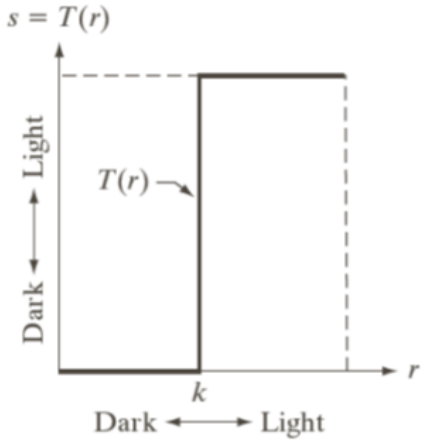
- Let's apply the threshold to the previous example



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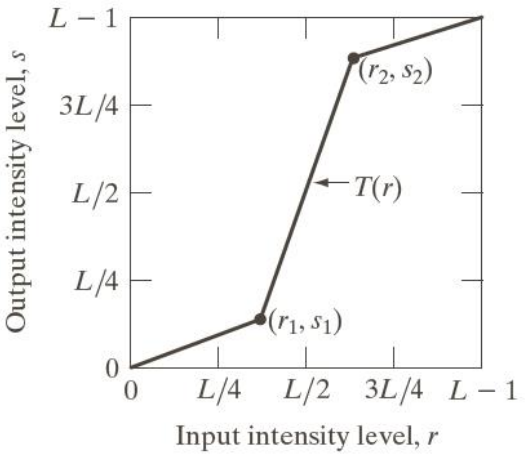

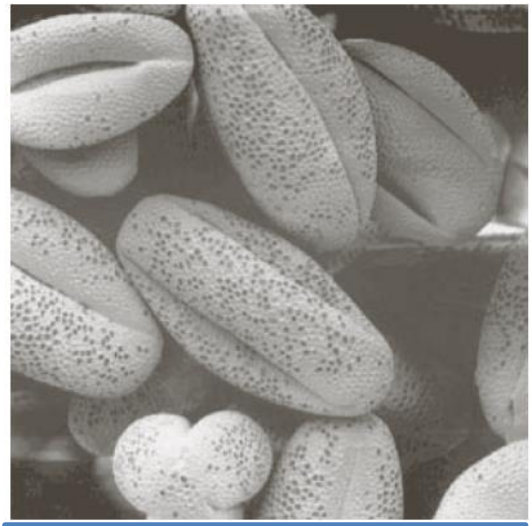

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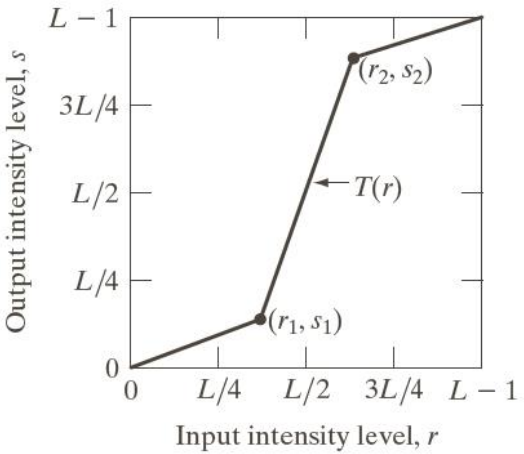
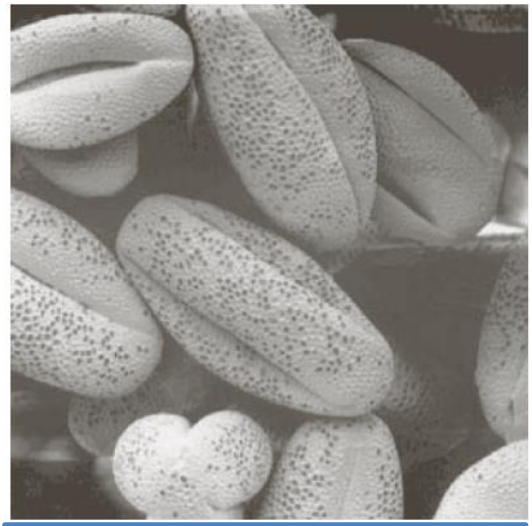
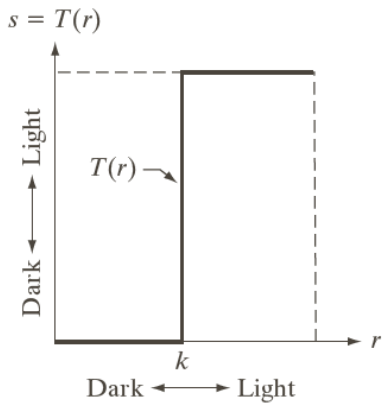




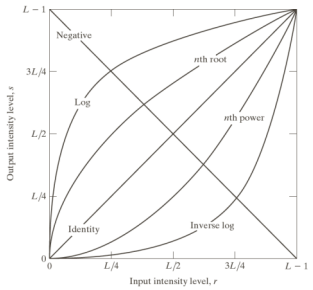


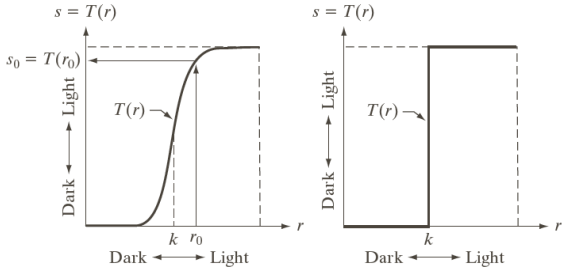
Contrast stretching

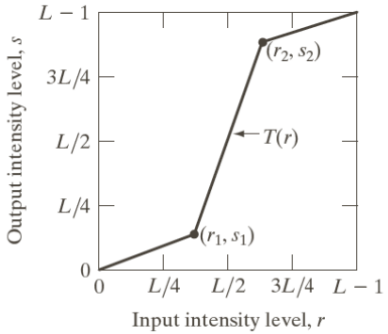
Thresholding

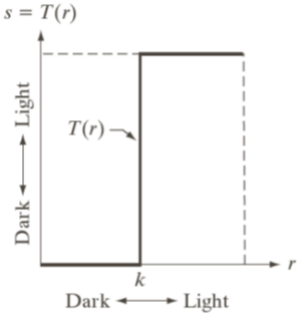
Single-pixel operations

- Recap of the transformations analyzed so far
  - Negative
  - Logarithm
  - Gamma
  - Contrast stretching
  - Thresholing









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