Some figures from Steve Seitz, and Gonzalez et al.

15-463: Computational Photography
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Image Processing

image filtering: change **range** of image

\[ g(x) = h(f(x)) \]

image warping: change **domain** of image

\[ g(x) = f(h(x)) \]
Image Processing

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Point Processing

The simplest kind of range transformations are these independent of position x,y:

\[ g = t(f) \]

This is called point processing.

What can they do?
What’s the form of \( t \)?

**Important:** every pixel for himself – spatial information completely lost!
Basic Point Processing

**FIGURE 3.3** Some basic gray-level transformation functions used for image enhancement.
Negative

FIGURE 3.4
(a) Original digital mammogram.
(b) Negative image obtained using the negative transformation in Eq. (3.2-1).
(Courtesy of G.E. Medical Systems.)
FIGURE 3.5
(a) Fourier spectrum.
(b) Result of applying the log transformation given in Eq. (3.2-2) with $e^1 = 1$. 
Power-law transformations

\[ s = cr^\gamma \]

**Figure 3.6** Plots of the equation \( s = cr^\gamma \) for various values of \( \gamma \) (\( c = 1 \) in all cases).
Image Enhancement

**FIGURE 3.9**
(a) Aerial image.
(b)–(d) Results of applying the transformation in Eq. (3.2-3) with $c = 1$ and $y = 3.0, 4.0, \text{ and } 5.0$, respectively. (Original image for this example courtesy of NASA.)
Contrast Stretching

**FIGURE 3.10**
Contrast stretching. (a) Form of transformation function. (b) A low-contrast image. (c) Result of contrast stretching. (d) Result of thresholding. (Original image courtesy of Dr. Roger Heady, Research School of Biological Sciences, Australian National University, Canberra, Australia.)
Image Histograms

FIGURE 3.15 Four basic image types: dark, light, low contrast, high contrast, and their corresponding histograms. (Original image courtesy of Dr. Roger Hdrdy, Research School of Biological Sciences, Australian National University, Canberra, Australia.)
Histogram Equalization

FIGURE 3.17 (a) Images from Fig. 3.15. (b) Results of histogram equalization. (c) Corresponding histograms.
Limitations of Point Processing

Q: What happens if I reshuffle all pixels within the image?

A: It’s histogram won’t change. No point processing will be affected…