

CS 376A  
Digital Image Processing

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# Today's Topics

- Questions / Comments?
- Morphology extended to grayscale
- Color image processing
  - Pseudocolor images
  - Color slicing
  - Color image processing

Fixing tonal problems

Histograms

# Morphology extended to grayscale

- Structuring element can have values that are negative, positive or zero
  - note: a cell containing 0 is different from a cell that is not considered
- Dilation
  - Output pixel is the largest among the sum of the corresponding pixel in the image and the structuring element value
- Erosion
  - Output pixel is the smallest among the corresponding pixel in the image minus the structuring element value
- These are generalizations of the binary versions of the operators.

# grayscale original



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dilated w/ 5x5 all cells = 10



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eroded w/ 5x5 all cells = 10



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# Color Image Processing

- pseudocolor (aka false color) images
- If have 1 grayscale/intensity image, then a simple way is to do intensity slicing (assign different ranges of intensities different colors)
- many uses of this, many of which boil down to human eye can distinguish among many more different colors than it can different intensities (gray values)
- If have multiple spectral images from frequencies outside the visible light range can combine them in a variety of ways --- e.g. assign 3 different spectral images to the R, G and B channels of an RGB image.

# Color Image Processing

- Let's see some examples of pseudocolor images
  - Are the features of the image more visually apparent to the human eye?



# Color Image Processing

- Bit plane slicing
  - 0-255 in 1 byte (8 bits)

# Color Image Processing

- Color slicing
  - Select a range of colors and only “show” the pixels in that range
  - can have the selected range be the only ones visible
  - or can use it as a region mask --- label all those pixels one label and process that region in some way separate from the rest of the pixels.
  - Let's look at the RGB color cube first to discuss

# Color Image Processing

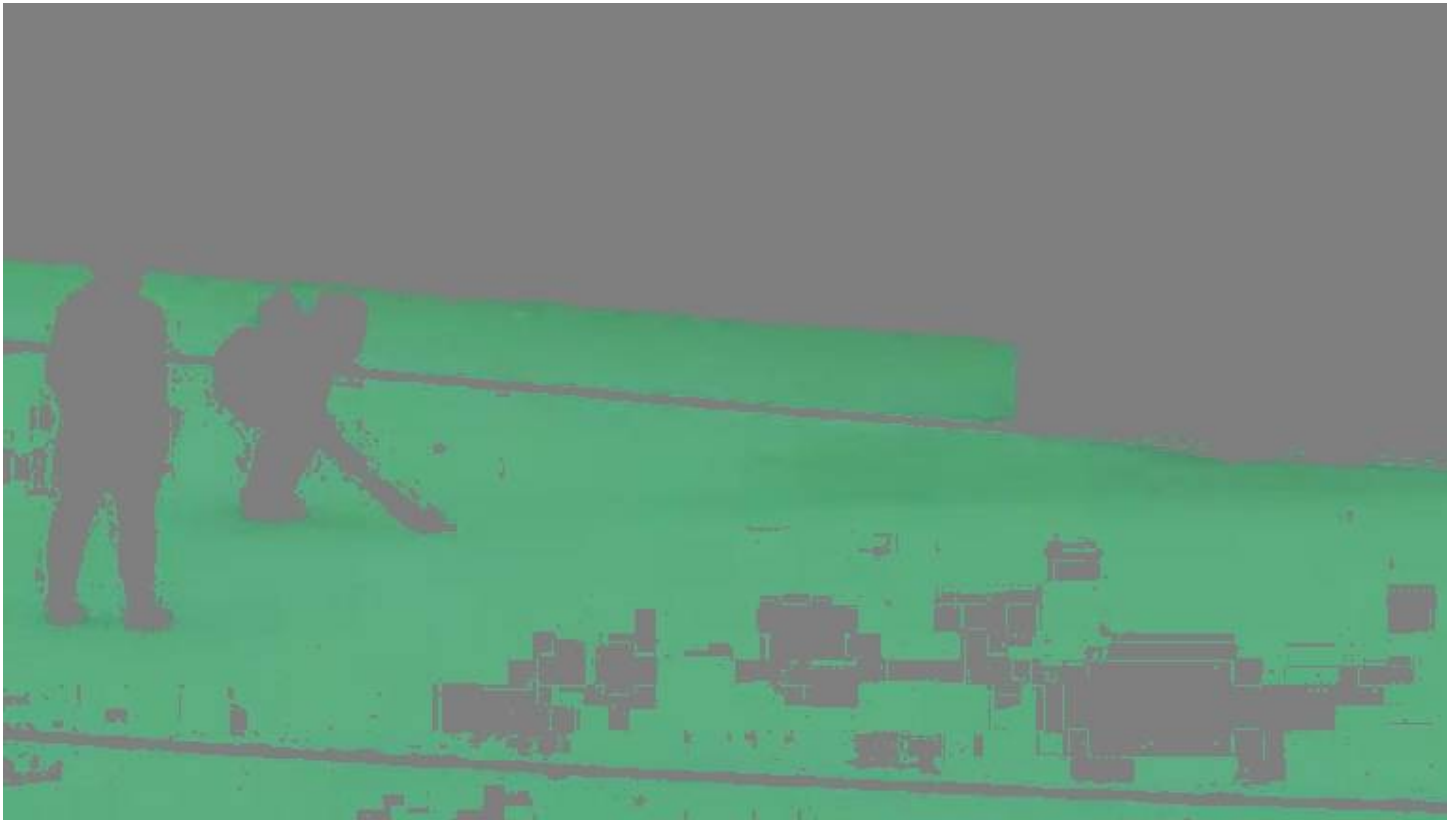
Example image (found via search Skidmore on google images)



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# Color Image Processing

Result of color slicing within  $\pm 15$  of  $RGB = 80, 160, 120$  --- I determined the value by examining some of the pixels on the field using gimp



# Color Image Processing

- Notice I didn't get all the pixels I wanted, so let's look at the colors in those places that seem erroneous.
- Let's implement color slicing
  - Parameters
    - Color image (of type `RGBImage`)
    - A color to search for
    - A “color” representing how much to consider as offset

# Color Image Processing

- Tonal problems
  - Image can be overexposed (too light)
  - Image can be underexposed (too dark)
  - Image can be flat
  - Let's see examples of these kinds of images and corrected versions and the mapping functions from color channel in original image to color channel in output image
  - The same mapping function will be applied to each channel (R, G and B)

# Color Image Processing

- Let's implement a method to darken an image by mapping using a function of the input value to the power 2.5
- The graph we saw had the domain and range between 0 and 1 whereas we need 0-255 so we'll make sure to take that into account

# Color Image Processing

- 0-1 (decimal) range to 0-255 (integer)
  - notice some examples:
    - $0 \rightarrow 0$
    - $0.25 \rightarrow 63$
    - $0.5 \rightarrow 127$
    - $1 \rightarrow 255$
- 0-255 (integer) range to 0-1 (decimal)
  - $0 \rightarrow 0$
  - $63 \rightarrow 0.25$
  - $127 \rightarrow 0.5$
  - $255 \rightarrow 1$



# Color Image Processing

- Image manipulation programs (like gimp) have an interactive window to allow you to change the curve and see the results.
- Let's bring up one of those dark images and one of the too light images and experiment a bit with the curves and results (Colors → Curves...)

# Color Image Processing

- What would the mappings for slicing look like?
  - Intensity slicing → pseudocolor
  - Example we did with keeping green ...

# Color Image Processing

- Notice that the mappings that we just discussed were independent of the image data.
- Suppose we wanted to have a mapping be based on the content of an image
  - mapping would be tailored to the content of an image instead of some standard mapping
- Has anyone heard of a histogram? What's a histogram?

# Color Image Processing

- A histogram contains discrete bins across the x-axis and a frequency (or proportion of total frequencies) for each bin on y-axis
- In the case of images
  - bins are individual (or ranges of) intensity values (or ranges of color values)
  - and the frequencies are how many pixels (or proportion of all pixels) correspond to that bin