CS 335
Graphics and Multimedia

Introduction to
Digital Image Processing
Digital Image Processing

- History of imaging: photography
  - Film records “image”
  - Chassis and lens construct physical model

- Digital imaging
  - Electronic device measures “image”
  - Sampled, discrete “image” is stored and manipulated
What is a Digital Image?

- The picture element
  - Pict (picture) el (element) = Pixel
- Spatial dimensions
  - rows and columns
- Bands
  - greyscale
  - color (RGB or other color space)
  - spectral response
Issues

- **Sampling (digitization):** converting the sensed image to a digital representation:
  - spatial resolution
  - color response
  - intensity sampling

- **Encoding:** storing the digitized image in host memory and/or secondary storage
  - lossy versus lossless coding
  - time/space tradeoffs
Images we view are typically created from the *visible spectrum*
The Electromagnetic Spectrum

Other wavelengths can be used to create images:

- **x-rays**
- **ultraviolet**
- **x-rays**
- **infrared**
Multi-Band Imaging

- Multiple sensors view the same scene
- The variety of images, each from a different band, are registered
- The various bands give different information about the scene
- The collection of bands forms a complex “image” of the scene
Rendering Images

- “Natural” images versus “synthetic” images
- Most issues still the same:
  - sampling and “aliasing”
  - camera model for image formation is mathematical, not a physical device
  - Image storage and manipulation
What is Image Processing?

- General term for the variety of techniques that exist for manipulating, and modifying images
- An physical process
  - performed in certain media with chemicals, etc.
- A mathematical process
  - Digital image processing operates on digitized images
Typical DIP Examples

- Color enhancement
- Contrast stretching
- Touch-up
- Edge detection
- High-pass/low-pass filtering
- Histogram manipulation
- Restoration
Core Image Processing Algorithms

- Color enhancement
  - color mapping, histogram manipulation
- Spatial techniques
  - neighborhood operations
- Frequency domain techniques
  - filtering, reconstruction
- Geometric operations
  - scaling, stretching, warping
Image Processing: Task-Driven

Robot vision
(mars rover)

Tracking

Pattern Recognition