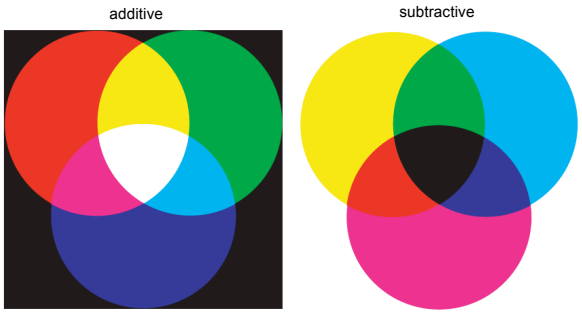
Modern Image Generation

From continuous real world to a meaningful image (on computer):

1. Sampling Continuous Information
   - Information and sampling technique varies widely for each modality- Topic for later lectures
   - Computer can only hold discrete chunks of data
   - Pixel = a single picture element; Voxel = a single volume element
2. Quantizing Samples
   - Each discrete chunk must be represented by certain number of bits
3. **Visualization Techniques of quantized, sampled image volumes - Image Visualization**

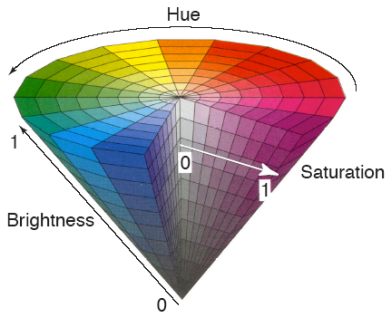
Intro to Color



Reflected colors add up
Primary colors reflect only "one" light
Reflect green+blue+red light = white light
-- As add together, reflect more light

Reflected colors subtract
Primary colors absorb only "one" light
-- As add together, absorb more light

Intro to Color



Hue: dominant wavelength of light (color)

Saturation: intensity of specific hue (high saturation is a vivid color)

Brightness: luminance of visual target, amount of light

Intro to Color

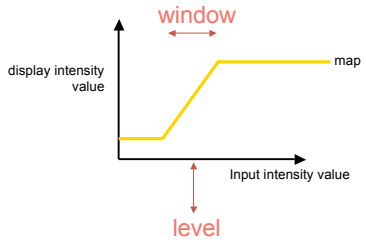
- Chromatic light needs three descriptors
  - Humans basically have 3 types of "cone cells" in their eyes receptive to 3 primary colors
- Achromatic light needs only one: Intensity
  - Achromatic light has a saturation equal to 0%
  - Medical images are generally just intensity based (single descriptor)

Intro to Color

Colormaps: map an intensity value to a set display value or color.

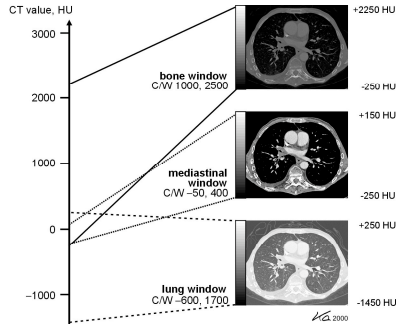
- ex. Pixel1 have intensity value = 296
- Map_1(pixel1) = R100, G100, B0 => pixel looks yellow

Linear colormap for single color: described by window and level

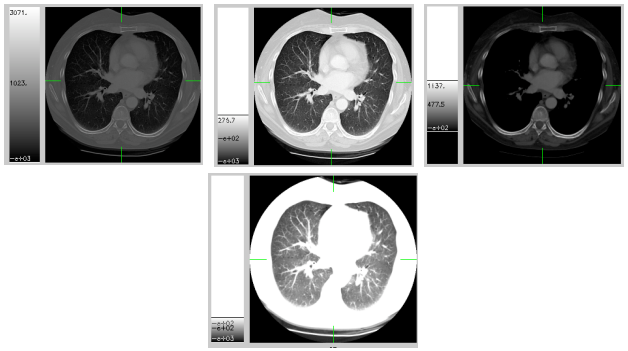


Colormaps - CT example

- Reader selects preset viewing window to level and window the colormap for particular intensity values

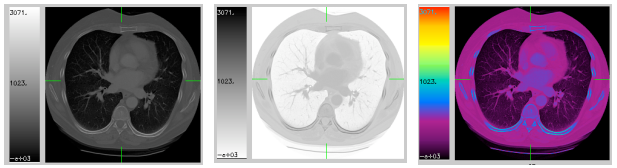


Colormaps

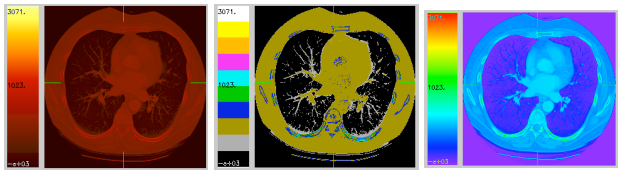


Colormaps offer flexibility over how image data is displayed
ImageJ Example

Colormaps

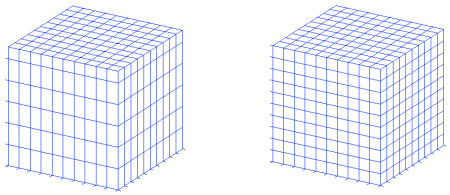


Intensity values in this image range from -1024 to 3071. How many bits per pixel?



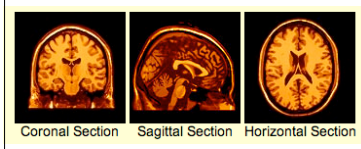
3D Visualization
(general information)

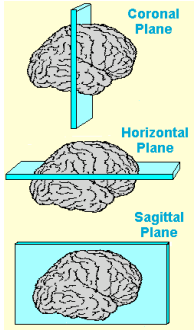
- Anisotropic vs. Isotropic
  - Isotropic allows for true 3D visualization



3D Visualization
(general information)

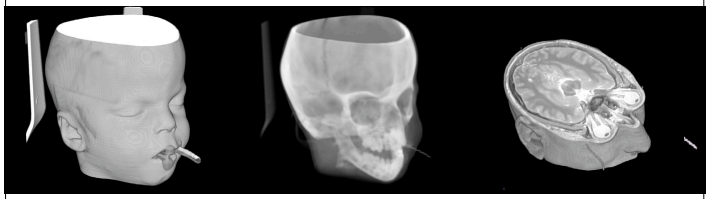
- Isotropic vs Anisotropic
- Multiplanar reformat
  - Coronal (Y,Z plane)
  - Sagittal (X, Z Plane)
  - Axial or Transaxial (X,Y Plane)
    (Osirix Demo)





3D Visualization
(general information)

- 3D information can be viewed many different ways: Following images are from same 3D CT data set

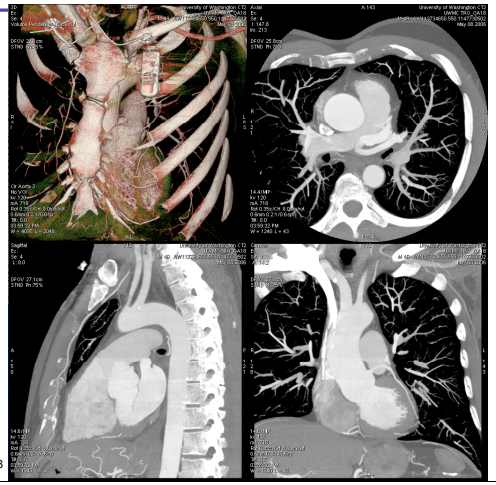


3D Visualization
(general information)

Common Options:

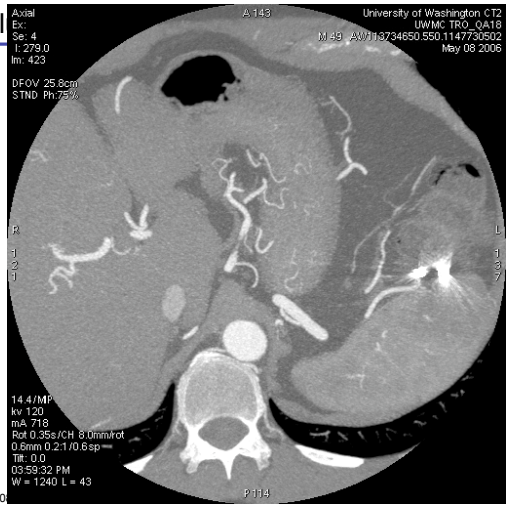
1. Multiplanar Reformat (arguably the most important in diagnostic imaging)
2. MIP (maximum intensity projection)
3. Surface Shading
4. Volume Rendering (extensions to surface shading)

Volume Visualization



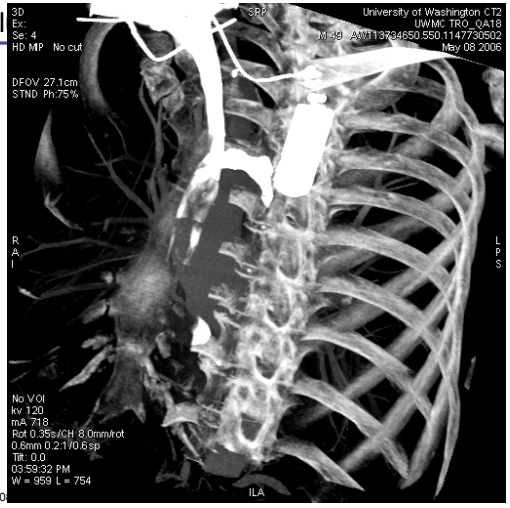
Alessio - BIO508

Vol



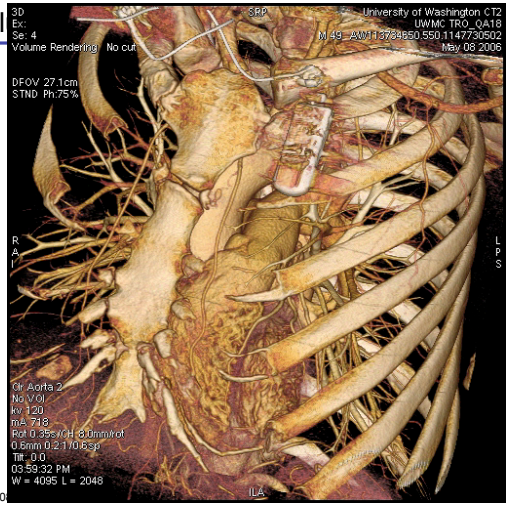
Alessio - BIO50

Vol



Alessio - BIO50

Vol



Alessio - BIO50

Assignment for Next Class

- Read chapters 1 and 4
- Find 2 medical images of abnormal anatomy or physiology (pathology) formed from the next lecture's modality (x-ray radiographs)
  - Place these images in a document
  - Write 1-2 brief sentences describing each image.
  - Write 1-2 brief sentences describing differences between the images