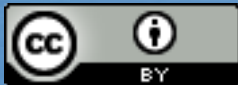


# Methods In Medical Image Analysis

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# What Are We Doing?

- Theoretical & practical skills in medical image analysis
  - Imaging modalities
  - Segmentation
  - Registration
  - Image understanding
  - Visualization
- Established methods and current research
- Focus on *understanding* & *using* algorithms

# Why Is *Medical* Image Analysis Special?

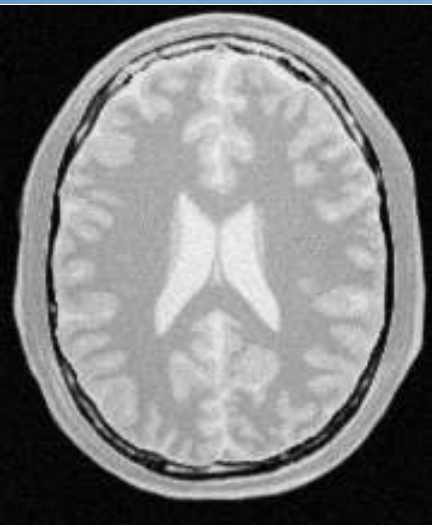
- Because of the *patient*
- Computer Vision:
  - Good at detecting irregulars, e.g. on the factory floor
  - But no two patients are alike—everyone is “irregular”
- Medicine is war
  - Radiology is primarily for reconnaissance
  - Surgeons are the marines
  - Life/death decisions made on insufficient information
- Success measured by patient recovery
- You’re not in “theory land” anymore

# What Do I Mean by *Analysis*?

- Different from “Image Processing”
- Results in identification, measurement, &/or judgment
- Produces numbers, words, & actions
- Holy Grail: *complete image understanding* automated within a computer to perform diagnosis & control robotic intervention
- State of the art: segmentation & registration

# Segmentation

- Labeling every voxel
- Discrete vs. fuzzy
- How good are such labels?
  - Gray matter (circuits) vs. white matter (cables).
  - Tremendous oversimplification
- Requires a model



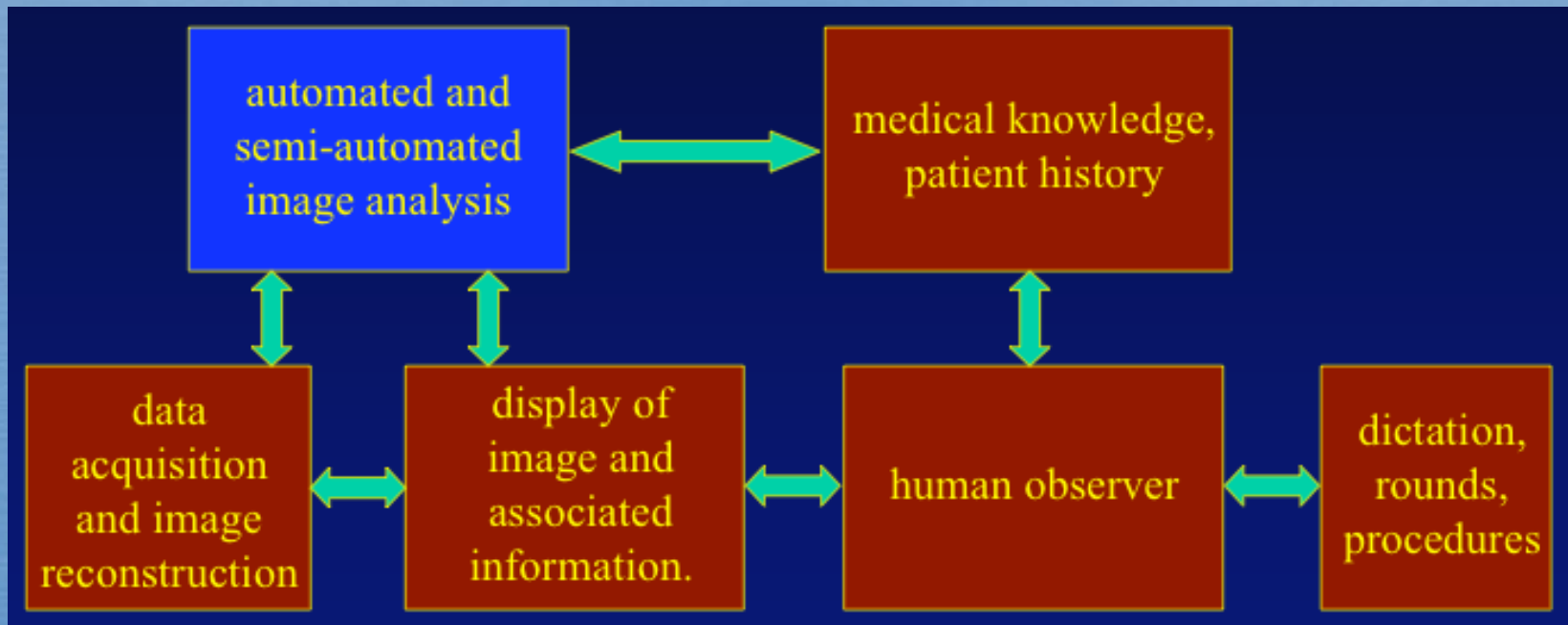
# Registration

- Image to Image
  - same vs. different imaging modality
  - same vs. different patient
  - topological variation
- Image to Model
  - deformable models
- Model to Model
  - matching graphs

# Visualization

- *Visualization* used to mean *to picture in the mind*.
- Retina is a 2D device
- Analysis needed to visualize surfaces
- Doctors prefer slices to renderings
- Visualization is required to reach visual cortex
- Computers have an advantage over humans in 3D

# Model of a Modern Radiologist





# How Are We Going to Do This?

- The Shadow Program
  - Observe & interact with practicing radiologists and pathologists at UPMC
- Project oriented
  - C++ &/or Python with ITK
    - New ITKv4!
  - National Library of Medicine Insight Toolkit
  - A software library developed by a consortium of institutions including CMU and UPitt
  - Open source
  - Large online community
  - [www.itk.org](http://www.itk.org)

# The Practice of Automated Medical Image Analysis

- A collection of recipes, a box of tools
  - Equations that function: crafting human thought.
  - ITK is a library, not a program.
- Solutions:
  - Computer programs (fully- and semi-automated).
  - Very application-specific, no general solution.
  - Supervision / apprenticeship of machines

# Anatomical Axes

- Superior = head
- Inferior = feet
  
- Anterior = front
- Posterior = back
  
- Proximal = central
- Distal = peripheral

