COMPUTERS IN NUCLEAR MEDICINE

- History of computers:
  - 1500 bc, abacus invented
  - 1600ad, Pascal invented calculating machine
  - 1889 Herman Hollerbith invented a machine that processed information from punch cards.
  - 1939 Atanasoff and Berry invented binary system
  - 1961 first minicomputer invented
  - 1971 first microcomputer invented

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- Binary System: 1 or 0
  - information is stored by computers is represented by either 1 or 0.
  - Users enter and receive information to and from the computerin a visual or text format, not in binary system

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- Hardware:
  - CPU: Central processing unit. Regulate system operation. Perform computations, interact with memory to execute programs.
    - CU- control unit
    - ALU- arithmetic logic unit
  - Memory: storage of information with ready access
    - ROM: read only memory.
    - RAM: random access memory.
  - Input/Output: devices that allow users to feed information into computer for processing and receive information after it has been processed.
  - Data Storage: storage space for information while not in use
    - Hard Disk
    - Floppy Disk
    - Optical Disk
    - Magnetic Tape
  - Camera Interface: output from the camera is fed into the computer to make an image and store it.
    - ADC: analog to digital converter.

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- Software:
  - Operating system: software that is designed to control computer components and other software.
  - Programming language: software that allowes users to design more software.
- Image Acquisition:
  - x,y: positioning coordinates of where the count came from
  - z: energy of the count that the camera has detected.
  - Matrix: a grid of coordinates where the counts are stored to make up an image.

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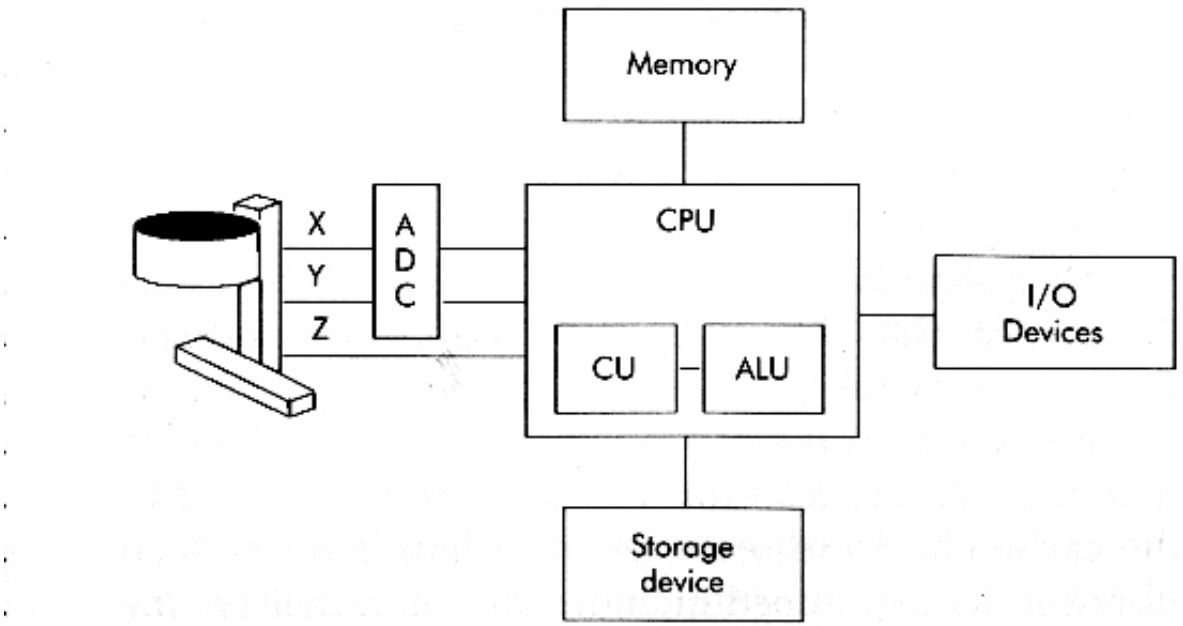

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- Each pixel can store only a limited number of counts. Pixel overflow results when the number of counts exceeds the maximum value a pixel can hold.
- The higher the matrix the more detail is available, the larger the memory space required. Count rate needs to be high enough to produce a good quality image.
- The smaller the matrix the less detail is available, and less memory needed. Count rate may be low and still produce acceptable image.

- Pixel depth: byte mode vs. word mode
  - $2^n - 1$

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- Types of Acquisition:
  - dynamic- ability to image a cine (movie).
  - Static - ability to obtain a single image with high resolution.
  - Gated - imaging according to physiological triggers.
  - SPECT (single photon computed tomography). - imaging 3D image
  - gated SPECT- 3D imaging with physiological triggers.

- Temporal Resolution: ability to capture detail in respect to time when event happens.
- Spacial Resolution: ability to capture detail in respect to spacial detail.

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Image smoothing:

-ability to manipulate images in order to obtain a smoother image.

- eliminates noise
- adds blurriness
- may sometimes define edges better

Most common type of image smoothing is 9-point smooth (3x3 matrix), although other (5x5, 7x7 matrices) could also be used

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Time Activity Curves (TAC)

- quantifications of activity into a curve or a function
- curves may be compared to previous studies to see changes with time
- curves from two same organs may be compared between each other

ROI: region of interest. In order for computer to process data (quantification), a user needs to define where the edges of the organ are. Usually a computer mouse or trackball are used to define an ROI.

Common procedures that require ROI and TAC:

- gastric emptying
- renal scans
- gallbladder ejection fraction
- left ventricle ejection fraction

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Networks: ability to share data, share printers, backup data, present data off-site

1. Token-ring network
2. Star network
3. Bus Network

PACS: picture archival and communications system

1. need for films
2. radiologist can be off-site and still read
3. images can be stored electronically and be readily available