Applied Medical Image Processing

File Formats Subtypes

File Format Subtypes

File formats in the medical imaging field are developed to standardize images that are generated by different modalities and/or vendors. This would facilitate post-processing steps.

Examples of medical image file formats are:

1. Analyze
2. NIFTI
3. MinC
4. DICOM

Analyze File Format

Version 7.5 which was originally developed in 1980 by Mayo Clinic.

- It was designed for multi-dimensional data such as 3D and 4D images.

- It contains two binary files, a header file (hdr) that has a fixed size of 348 bytes and contains metadata such as array sizes, voxel size, data type, and so forth, and the voxel information is stored in an image file (.img) as a raw binary data.

- This file format does not support some data types such as unsigned 16-bits.

- More importantly, this file format does not store any information about the image orientation, hence other file formats were developed to address these shortcomings.

NIFTI (Neuroimaging Informatics Technology Initiative)

This file format was developed @ year 2000 by a committee at National Institute of Health (NIH).

- Provides image orientation to avoid left-right ambiguity.

- Supports more data types.

- Stores files as header/image (.hdr, img) combination or as a single file with (.nii) extension or nii.gz (compressed).
  - Header size for .hdr file is 348 bytes and for nii file is 352 bytes.

- NIFTI-2 was developed in 2011 to allow managing larger data size. Details of this file format is well documented and maintained by a website.

MinC and DICOM

- MinC
  - Developed at Montreal Neurological Institute (MNI) which has version 1 and version 2.
  - It has limited usage in software developed by MNI itself.
- DICOM (Digital Imaging and Communication in Medicine)
  - Widely used by scanners and contain many information
  - Image size, format
  - Acquisition parameters
  - Patient information

DICOM Header

Permeable	• 128 bytes • Byte 0 -127
DICM	• D: Byte 128 • I: Byte 129 • C: Byte 130 • M: Byte 131
Data Elements	• Tag (group Number, element number) • Value Representation (VR) • Value Length (VL) • Value Field (VF)
Pixel Data	

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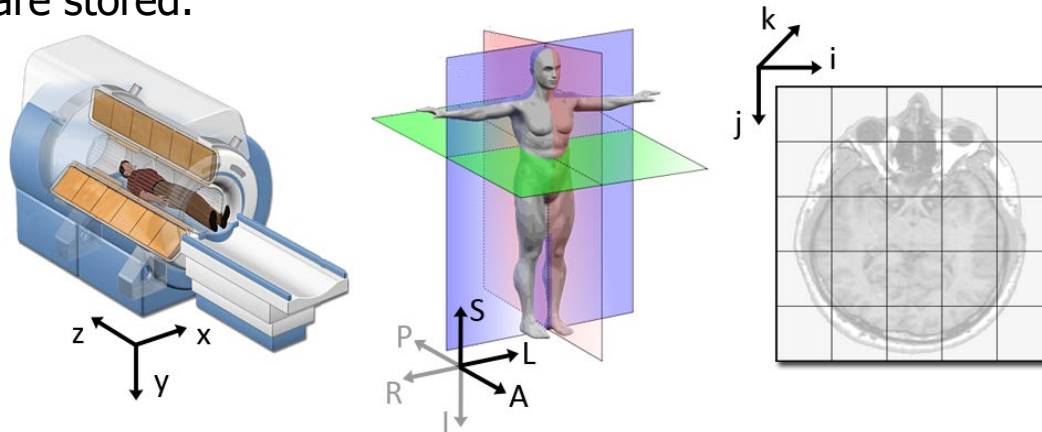of ENGINEERING

Data Elements

- Value Representation (name, meaning, format)
  - DA, date, 8 characters

- VL and VF: In DICOM, value length is always even.
  - If it represents a single character such as sex in (0010,0040) tag, it can take values such as, 'M', F' ,' or o'' for other which are odd values and needed to be padded with space.
  - If the values are single number, then they will be padded with null.

Coordinate System

An important issue while working with medical images is to understand differences among coordinate systems and how they are related to each other.

- **World** coordinate systems are defined in the space of scanner.

- **Anatomical** coordinate systems are defined relative to the patient's anatomy using planes such as sagittal, normal, and axial.

- **Image** coordinate systems represent indices for row, column, and slice, in which pixel data are stored.

https://www.slicer.org/wiki/Coordinate_systems

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