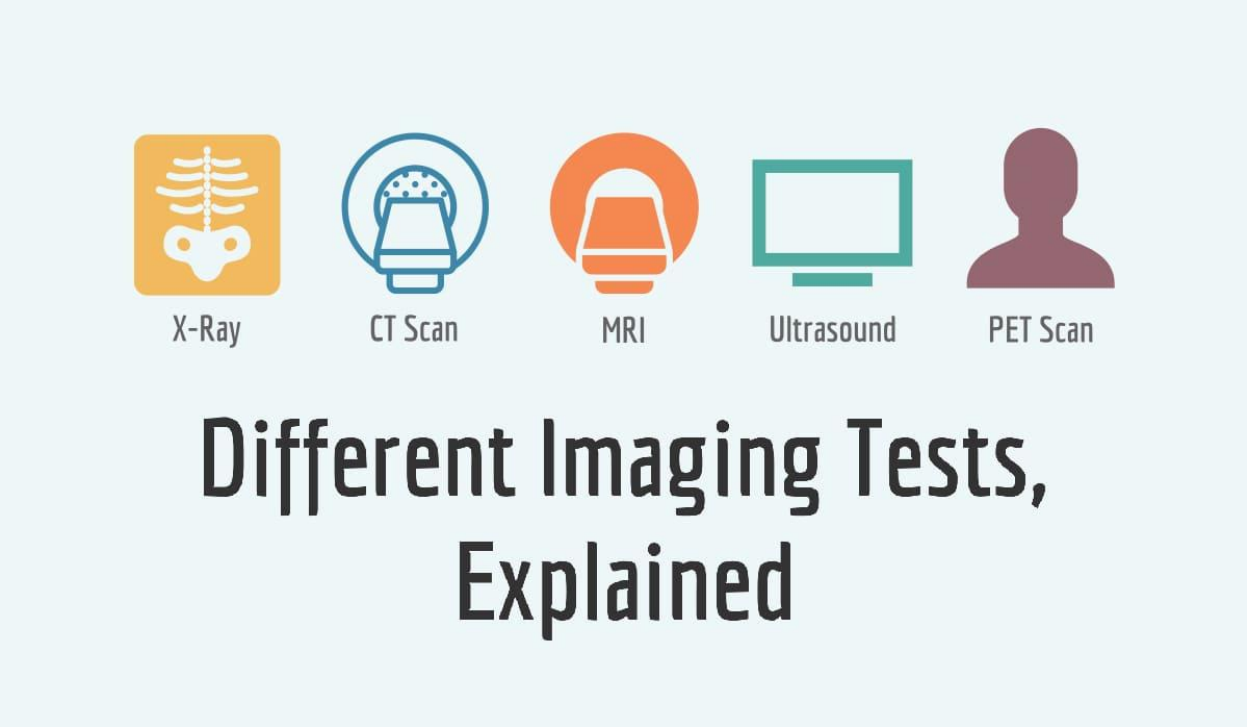
Healthcare Information System

Lab1: Radiological information system (RIS)

Different Types of Imaging Tests: Sorting Out the Differences

If your doctor has ordered a medical imaging exam for you, you might have questions about the type of scan or test you will be having. Technologists use modalities (different types) to gather the right images for your radiologist to examine. If you're getting a scan to see if you have a concussion, for instance, CT would be the modality for your exam. On the other hand, if you are getting a mammogram, X-ray would be the modality in use.

At UVA Radiology and Medical Imaging, we use each modality to perform multiple types of imaging tests to diagnose multiple kinds of conditions. Each modality is unique in terms of the images it gathers, equipment it uses, and conditions it helps radiologists diagnose. Learn more about our five most common modalities for our various types of imaging tests: X-ray, CT, MRI, ultrasound, and PET.



Different Imaging Tests, Explained

UVA Radiology and Medical Imaging


X-Ray


CT Scan


MRI


Ultrasound


PET Scan

X-Ray

X-rays are quick, painless tests that produce images of the structures inside your body, especially bones.

What to Expect
You will lie, sit, or stand while the x-ray machine takes images. You may be asked to move into several positions.

Duration
10-15 minutes

Imaging Method
ionizing radiation

Used to Diagnose:
- bone fractures
- arthritis
- osteoporosis
- infections
- breast cancer
- swallowed items
- digestive tract problems

CT Scan

CT scans use a series of x-rays to create cross-sections of the inside of the body, including bones, blood vessels, and soft tissues.

What to Expect
You will lie on a table that slides into the scanner, which looks like a large doughnut. The x-ray tube rotates around you to take images.

Duration
10-15 minutes

Imaging Method
ionizing radiation

Used to Diagnose:
- injuries from trauma
- bone fractures
- tumors and cancers
- vascular disease
- heart disease
- infections
- used to guide biopsies

MRI

MRIs use magnetic fields and radio waves to create detailed images of organs and tissues in the body.

What to Expect
You lie on a table that slides into the MRI machine, which is deeper and narrower than a CT scanner. The MRI magnets create loud tapping or thumping noises.

Duration
45 minutes - 1 hour

Imaging Method
magnetic waves

Used to Diagnose:
- aneurysms
- Multiple Sclerosis (MS)
- stroke
- spinal cord disorders
- tumors
- blood vessel issues
- joint or tendon injuries

Ultrasound

Ultrasound uses high-frequency sound waves to produce images of organs and structures within the body.

What to Expect
A technician applies gel to your skin, then presses a small probe against it, moving it to capture images of the inside of your body.

Duration
30 minutes - 1 hour

Imaging Method
sound waves

Used to Diagnose:
- gallbladder disease
- breast lumps
- genital/prostate issues
- joint inflammation
- blood flow problems
- monitoring pregnancy
- used to guide biopsies

PET Scan

PET scans use radioactive drugs (called tracers) and a scanning machine to show how your tissues and organs are functioning.

What to Expect
You swallow or have a radiotracer injected. You then enter a PET scanner (which looks like a CT scanner) which reads the radiation gives off by the radiotracer.

Duration
1.5 - 2 hours

Imaging Method
radiotracers

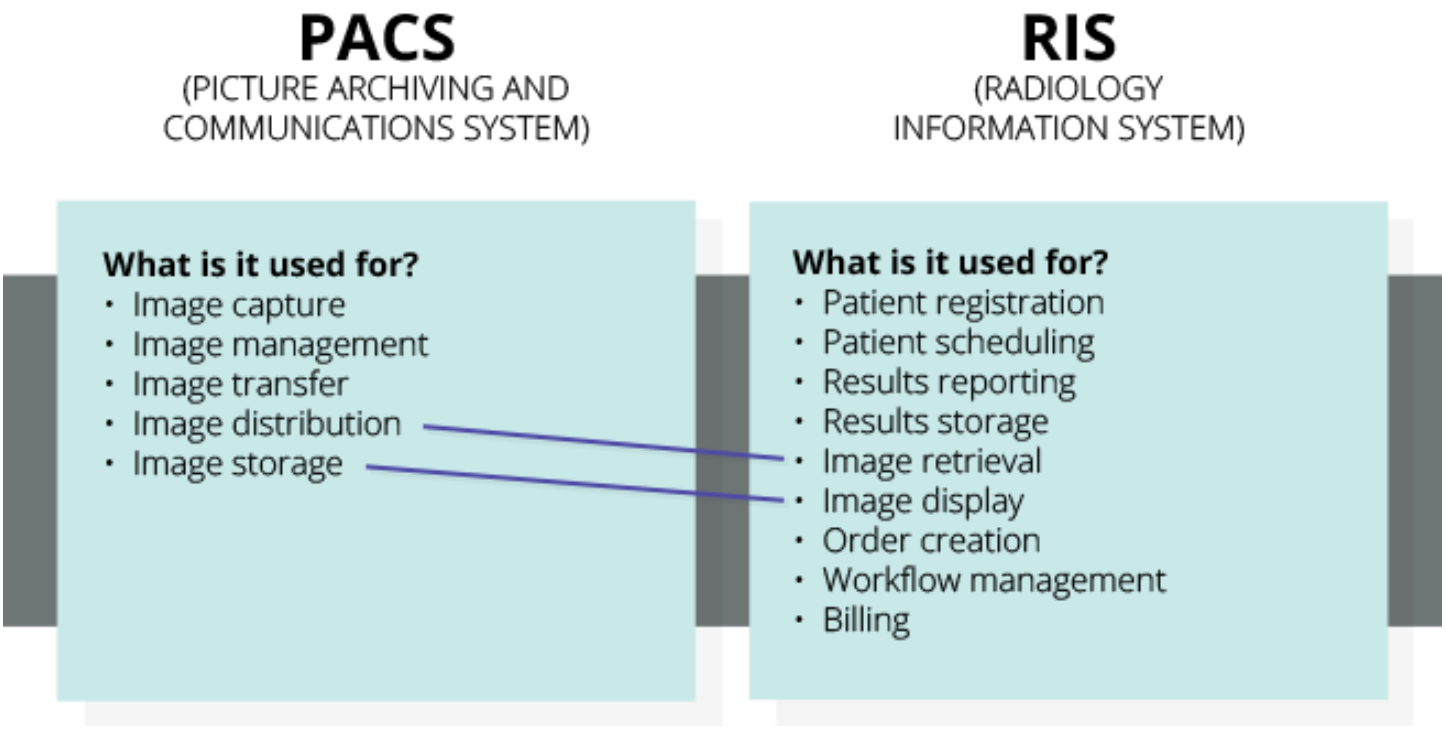
Used to Diagnose:
- cancer
- heart disease
- coronary artery disease
- Alzheimer's Disease
- seizures
- epilepsy
- Parkinson's Disease

What is a PACS?

PACS stands for picture archiving and communication system. Generally, a PACS carries out all operations directly related to radiology images – including image capture, management, transfer, distribution, and storage.

PACS images are saved in a DICOM format for easy transferability and HIPAA compliance and security. Through its picture archival, images from any timeframe can easily be pulled up and reviewed.

PACS are often integrated with a RIS directly or can easily transfer information to a RIS. Once transferred to the RIS, the image can be associated with a patient.



What is a DICOM?

DICOM — Digital Imaging and Communications in Medicine — is the international standard for medical images and related information. It defines the formats for medical images that can be exchanged with the data and quality necessary for clinical use.

DICOM is implemented in almost every radiology, cardiology imaging, and radiotherapy device (X-ray, CT, MRI, ultrasound, etc.), and increasingly in devices in other medical domains such as ophthalmology and dentistry. With hundreds of thousands of medical imaging devices in use, DICOM is one of the most widely deployed healthcare messaging Standards in the world. There are literally billions of DICOM images currently in use for clinical care.

Python offers a powerful module, **pydicom** to work with the DICOM files such as medical images, reports, and radiotherapy objects. **pydicom** reads modify and write data in DICOM files.

Run the following command in the command prompt:

```
1 !pip install dicom
```

pydicom enables us to work with DICOM files, in this article we will discuss the mechanism of viewing the DICOM file using pydicom and matplotlib. For reading the DICOM files we use pydicom package and to view the result we use matplotlib.

Approach

- Import module
- Read DICOM file using **pydicom.data.data_manager.get_files()** method

Syntax :

pydicom.data.data_manager.get_files(base,pass_dicom)[0]

Parameter:

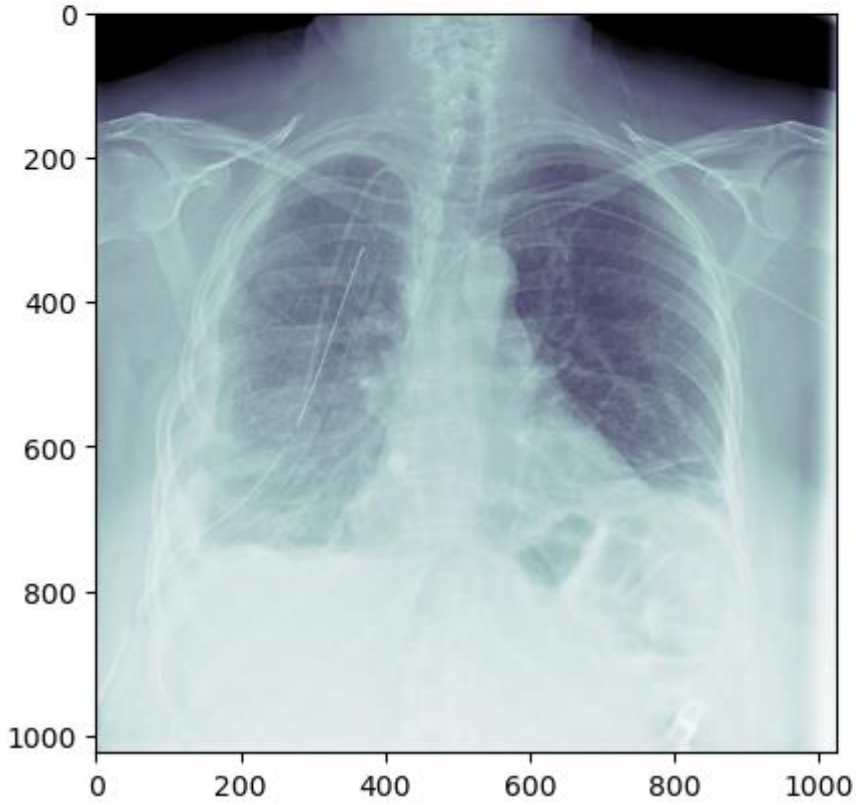
Base : is base directory to recursively search as a string.

Pattern : By default it is "*". It is a string pattern which is used to filter the files.

- Provide 2 arguments: base and pattern
- Display the data as image i.e. on 2D regular raster.
- Display image

Note: Enter the location of the dcm file excluding the file name in the base of the variable name and enter the file name in the pass_dicom variable.

```python
import matplotlib.pyplot as plt
import pydicom
import pydicom.data

# Full path of the DICOM file is passed in base
base = r"C:\Users\LENOVO\Downloads\archive (2)"
pass_dicom = "exampleDICOM.dcm" # file name is 1-12.dcm

# enter DICOM image name for pattern
# result is a list of 1 element
filename = pydicom.data.data_manager.get_files(base, pass_dicom)[0]

ds = pydicom.dcmread(filename)

plt.imshow(ds.pixel_array, cmap=plt.cm.bone) # set the color map to bone
plt.show()

```



Here are some common DICOM attributes:

1. **Patient Information**:
    - Patient Name (**PatientName**)
    - Patient ID (**PatientID**)
    - Patient's Birth Date (**PatientBirthDate**)
    - Patient's Sex (**PatientSex**)
    - Patient's Age (**PatientAge**)
    - Patient's Position (**PatientPosition**)
2. **Study Information**:
    - Study Instance UID (**StudyInstanceUID**)
    - Study Date (**StudyDate**)
    - Study Time (**StudyTime**)
    - Accession Number (**AccessionNumber**)
    - Study Description (**StudyDescription**)
3. **Series Information**:
    - Series Instance UID (**SeriesInstanceUID**)
    - Modality (**Modality**)
    - Series Date (**SeriesDate**)
    - Series Time (**SeriesTime**)
    - Series Description (**SeriesDescription**)
4. **Image Information**:
    - SOP Instance UID (**SOPInstanceUID**)
    - Image Type (**ImageType**)
    - Rows (**Rows**)
    - Columns (**Columns**)

- Pixel Spacing (**PixelSpacing**)
- Bits Allocated (**BitsAllocated**)
- Bits Stored (**BitsStored**)
- Pixel Representation (**PixelRepresentation**)

5. **Pixel Data**:
    - Pixel Data (**PixelData**)

```
# Load a DICOM file
ds = pydicom.dcmread("exampleDICOM.dcm")

# Access and print some DICOM attributes
print("Patient Name:", ds.PatientName)
print("Patient ID:", ds.PatientID)
print("Modality:", ds.Modality)
print("Rows:", ds.Rows)
print("Columns:", ds.Columns)
```

```
Patient Name: 5d2ea647-162e-4e4e-b894-e97f1f22871d
Patient ID: 5d2ea647-162e-4e4e-b894-e97f1f22871d
Modality: CR
Rows: 1024
Columns: 1024
```