جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

قسم الانظمة الطبية الذكية
المرحلة الثالثة

Subject : Medical image processing

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Lec 1:Medical imaging – Introduction and analysis

➢ OVERVIEW

- **Image processing** aims to improve the quality of the image so that it is easily interpreted by humans or machines. Image processing techniques transform images into other images. So, the input is the image, and the output is also an image, but the output image has better quality than the input image

- **Medical image processing** is similar in concept to biomedical signal processing in various dimensions. This includes analysis, improvement, and appearance on medical imaging .

OVERVIEW

- **Medical image processing** encompasses the use and exploration of 3D image datasets of the **human body**, obtained most commonly from a Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) scanner to diagnose pathologies or guide medical interventions such as surgical planning, or for research purposes

Advantages of **medical image processing**

- The main benefit of medical image processing is that

1. It allows for in-depth, but non-invasive exploration of internal anatomy.
2. 3D models of the anatomies of interest can be created and studied to improve Treatment outcomes for the patient,
3. Develop improved medical devices and drug delivery systems.
4. achieve more informed diagnoses.

MIP techniques and tasks

- Medical image processing involves the use of various techniques and technologies to enhance, analyze, and interpret medical images
- Medical image processing (MIP) remains a challenge . MIP roughly contains seven common tasks

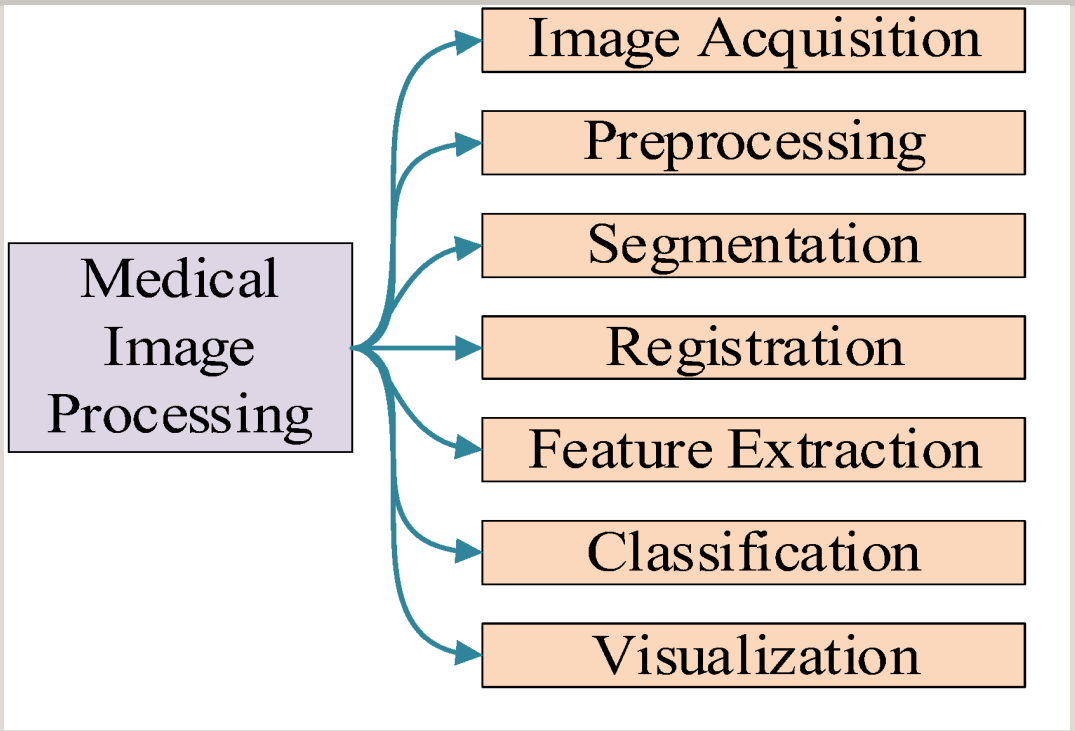


Image acquisition

- **Image acquisition** involves acquiring medical images from various medical image types such as X-rays, CT scans, MRI scans, and ultrasound scans
- In the simplest terms, image acquisition is the process of capturing visual information from the real world and converting it into a digital image that computers can process.

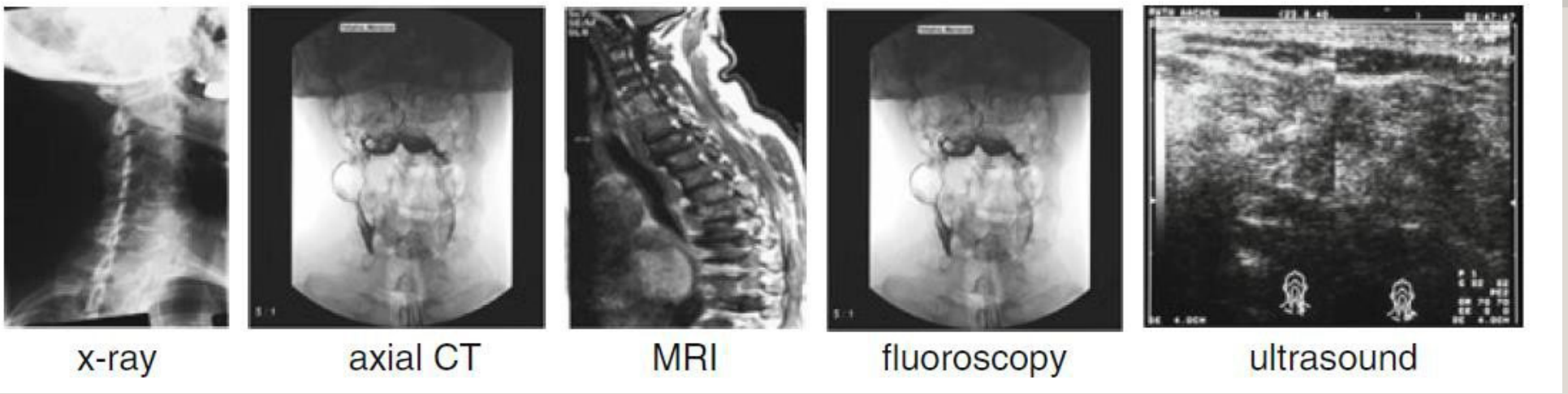
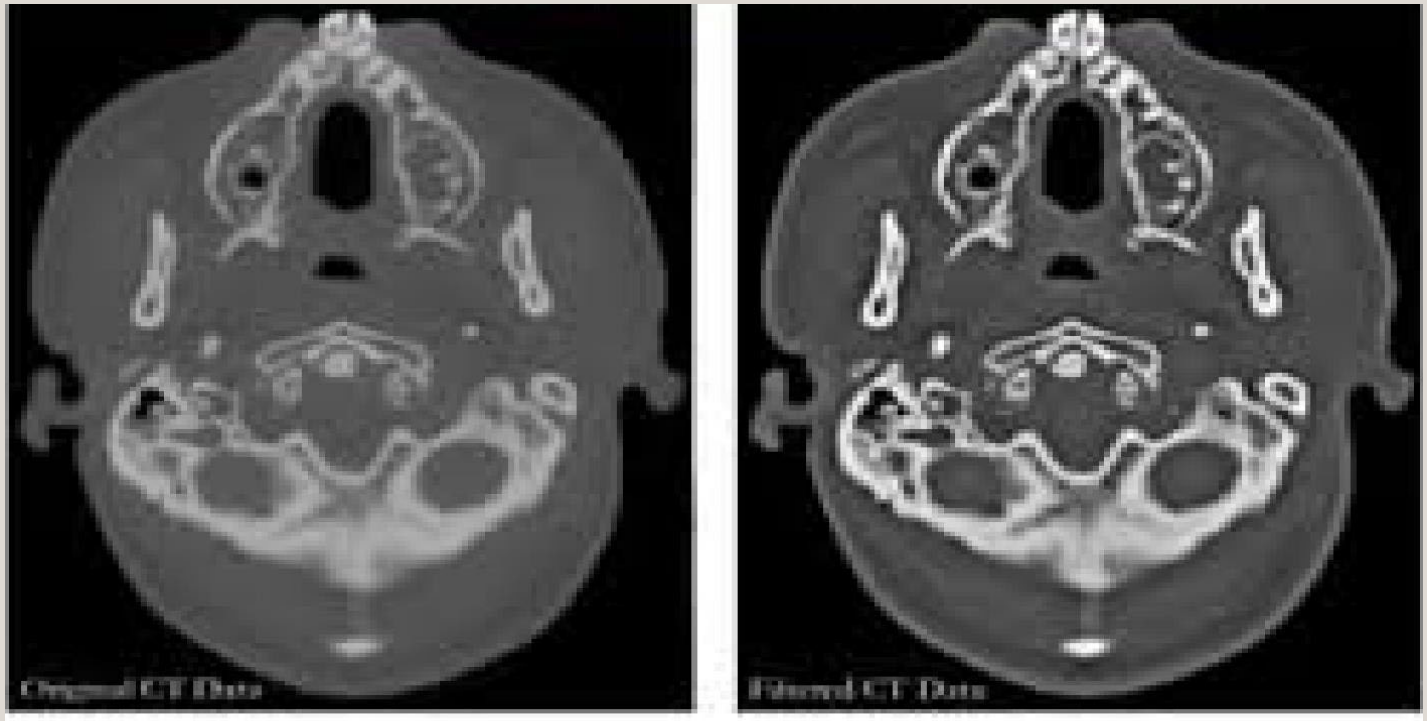

a
b
c
d
e
x-ray
axial CT
MRI
fluoroscopy
ultrasound

Image preprocessing

- **Image preprocessing** is process of preparing data for a target workflow. The main goals of medical image preprocessing are to reduce image acquisition artifacts and to standardize images across a data set. Your exact preprocessing requirements depend on the modality and procedure used to acquire data, as well as your target workflow

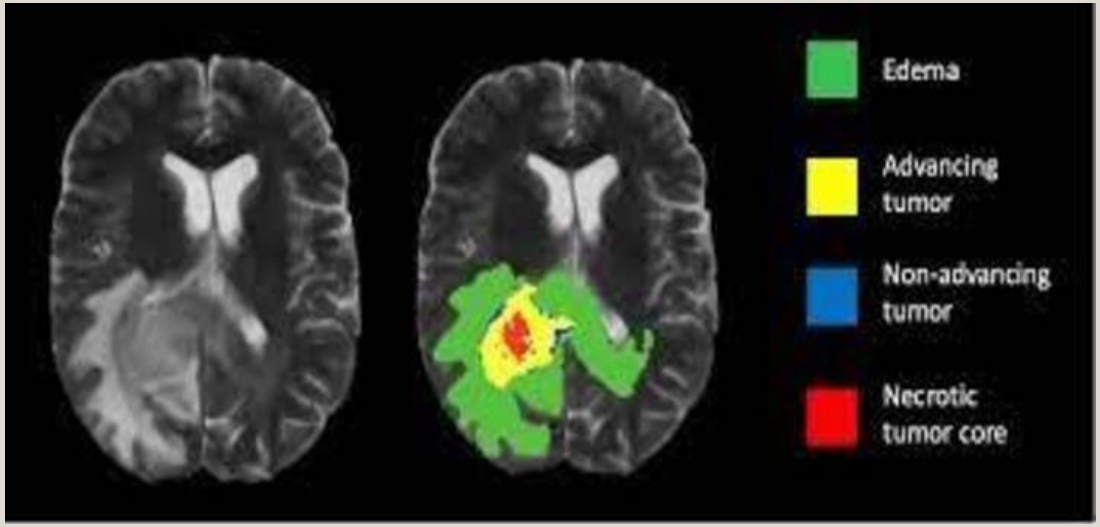
- **Preprocessing** helps to clean and enhance medical images by removing noise, correcting distortion, and enhancing contrast
- Techniques like filtering, histogram equalization, and contrast adjustment are used to improve the visibility of structures within the image.

PREPROCESSING



Segmentation

- **Segmentation** is the process of separating the region of interest from the background and separating different structures within the image. This process involves partitioning the image into different regions or segments to isolate areas of interest, such as tumors or organs.

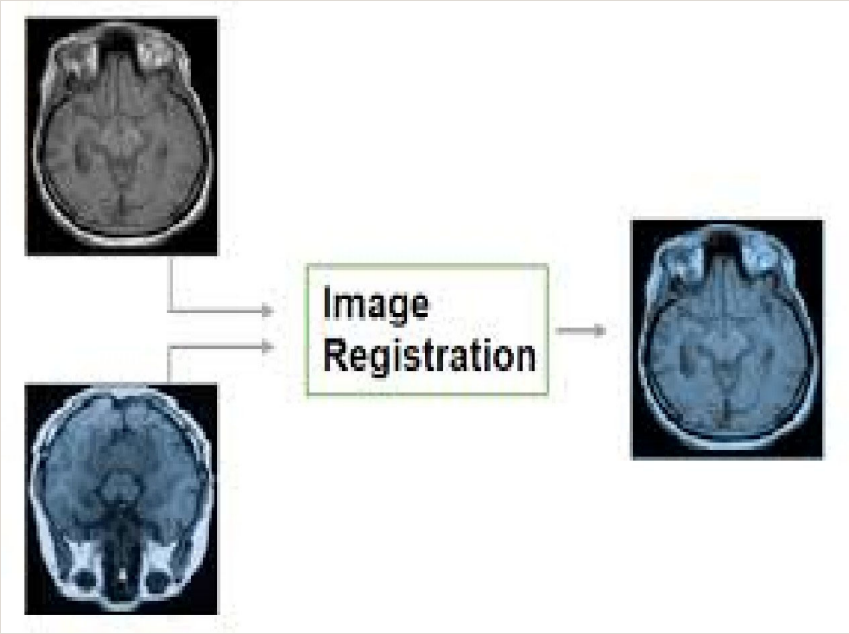


Segmentation

- Segmentation in medical imaging is a powerful way of identifying objects, segmenting pixels, grouping them, and using this approach for labeling to train computer vision models.
- We can use image segmentation as a time and cost-effective approach to labeling and annotation to improve accuracy and outputs.

Registration

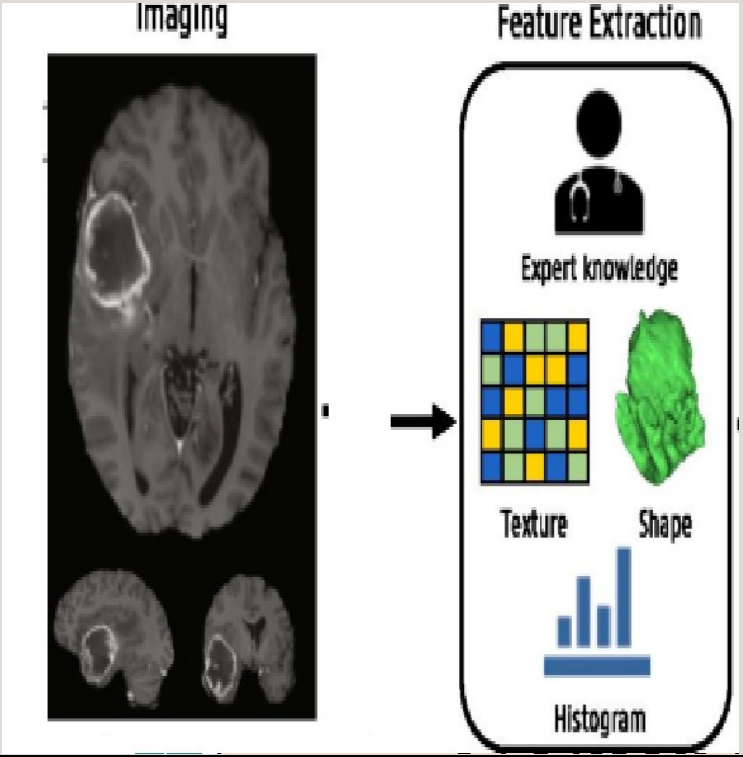
- **Registration** also known as image fusion or image matching , aligns different medical images of the same or different modalities to create a composite image that provides a more comprehensive view of the anatomy and pathology.
- This allows for accurate comparison, analysis, and interpretation of medical data. It is widely used in various clinical and research applications, such as diagnosis, treatment planning, and monitoring disease progression.



Feature extraction

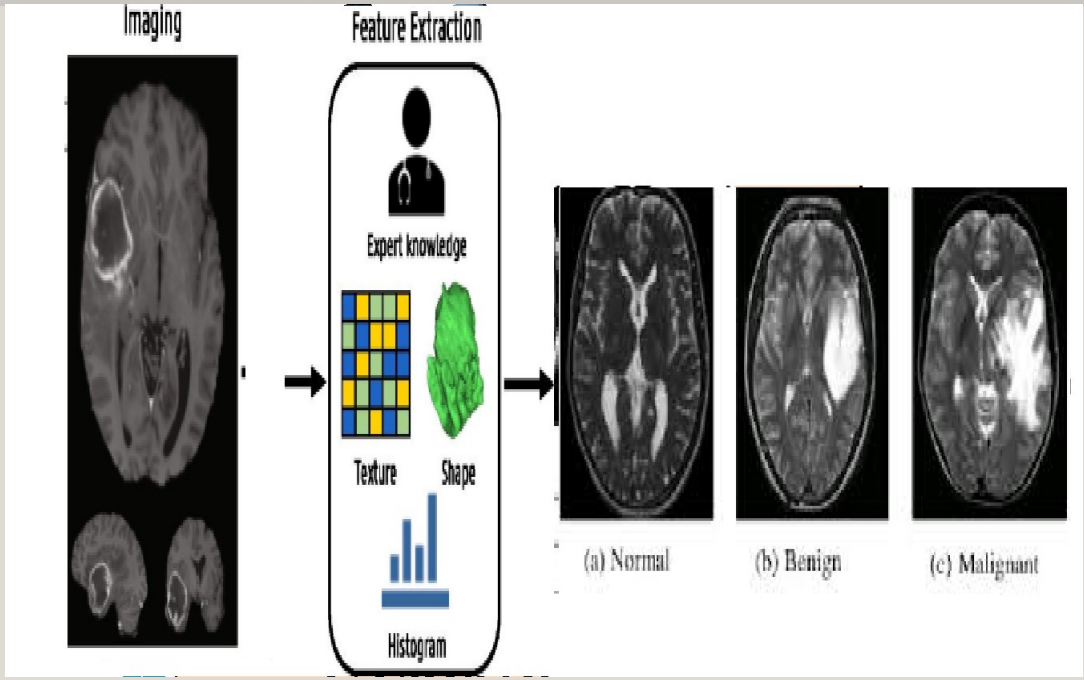
- **Feature extraction** extracts important features from medical images, such as various structures' size, shape, texture, and intensity. It`s goal is Transforming raw data into numerical features that can be processed while preserving the information in the original data set.

- These features are used to establish correspondences between images, making it easier to align them accurately, then applying machine learning directly to the raw data.

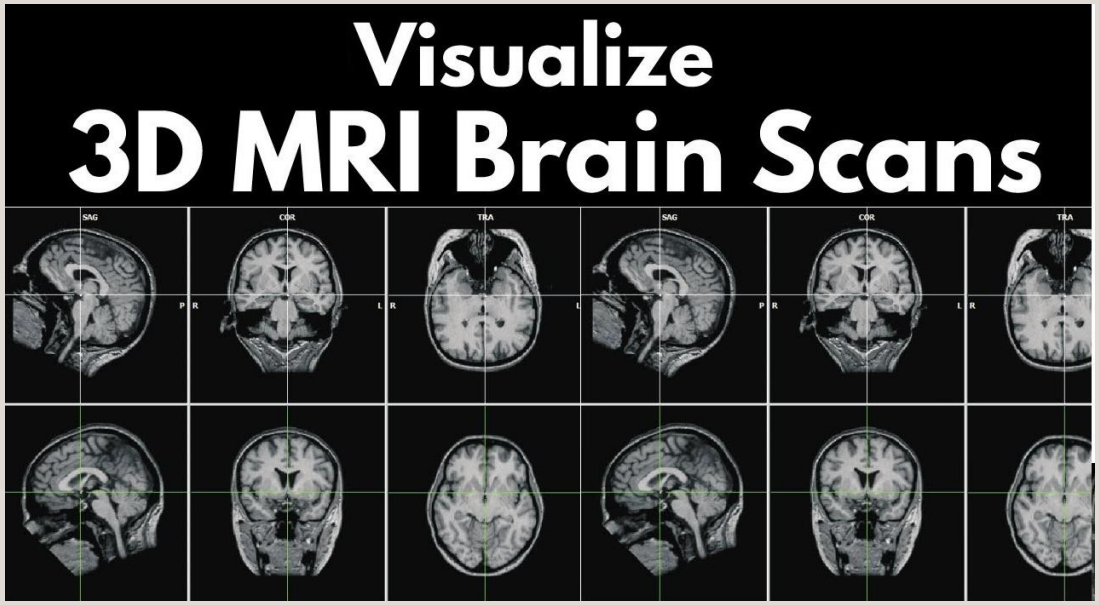


Classification

- **Classification** In medical imaging, it refers to the process of classifying images or image areas into specified groups based on their features. This is an important topic in medical diagnostics, as classification algorithms assist in disease identification, treatment planning, and research.



Visualization



- **Visualization** builds visual representations of medical images in 2D or 3D to aid diagnosis, treatment planning, and research such as Brain Tumor Analysis

➢MEDICAL IMAGING APPLICATIONS

- Medical imaging is important in healthcare because it allows for the observation of interior body structures and processes, assisting in correct diagnosis, treatment planning, and monitoring. The following are major applications

✓Diagnostic Applications e.g. (Cancer Detection)

✓Interventional and Treatment Applications (Surgical Planning)

✓Monitoring and Follow-Up(Monitors tumor size during cancer therapy)

✓Research and Educational Applications (Simulations with imaging data for training in surgery or diagnostics.)

CONT.

- ✓ Applications by Imaging Modality (Visualizing heart chambers and blood flow using Ultrasound)
- ✓ Specialized Applications

1. Pediatrics (Fetal MRI for prenatal diagnosis) .
2. Forensic Medicine (Post-mortem imaging for autopsies using CT or MRI)
3. Telemedicine (Remote diagnostics using digital imaging and AI tools)
4. Artificial Intelligence in Imaging (Automated diagnosis (e.g., detecting diabetic retinopathy from fundus images).
5. Predictive modeling and risk assessment.