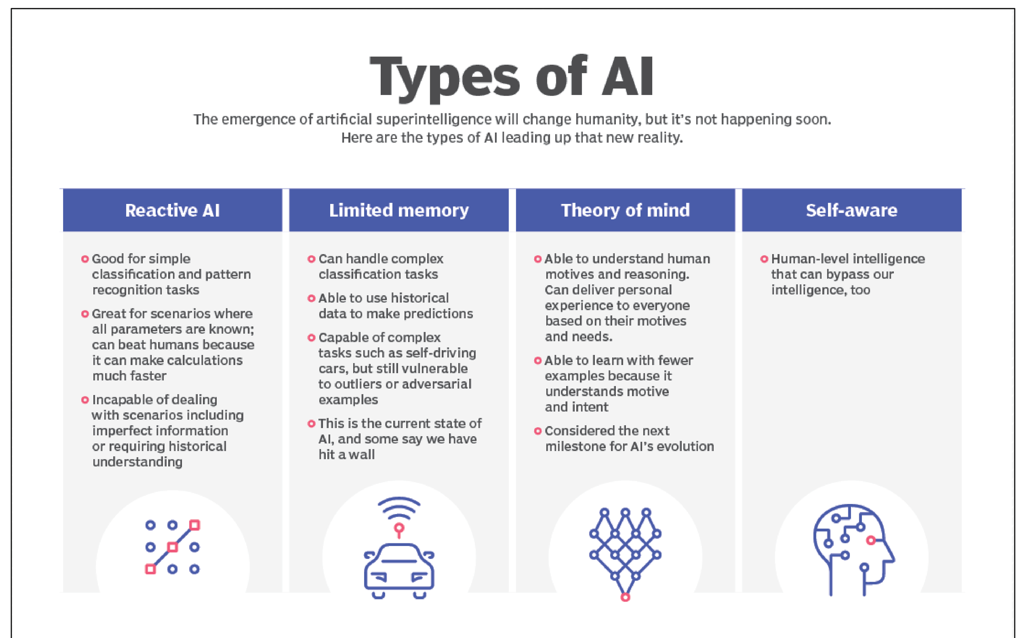
Use of AI in medical imaging

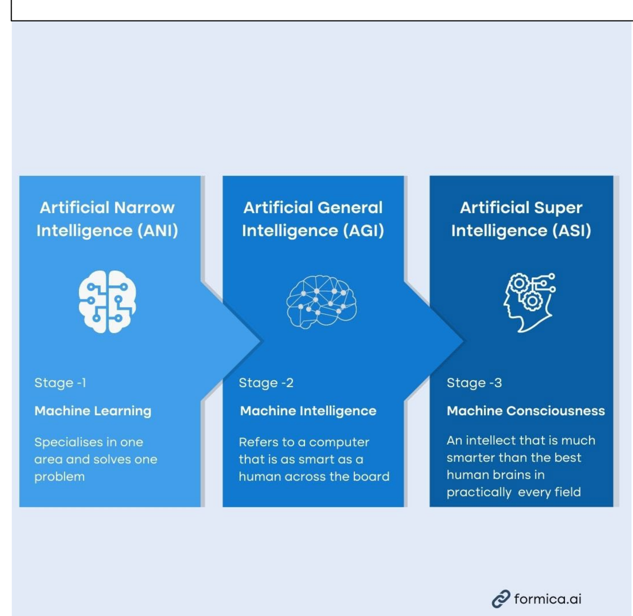
Introduction:

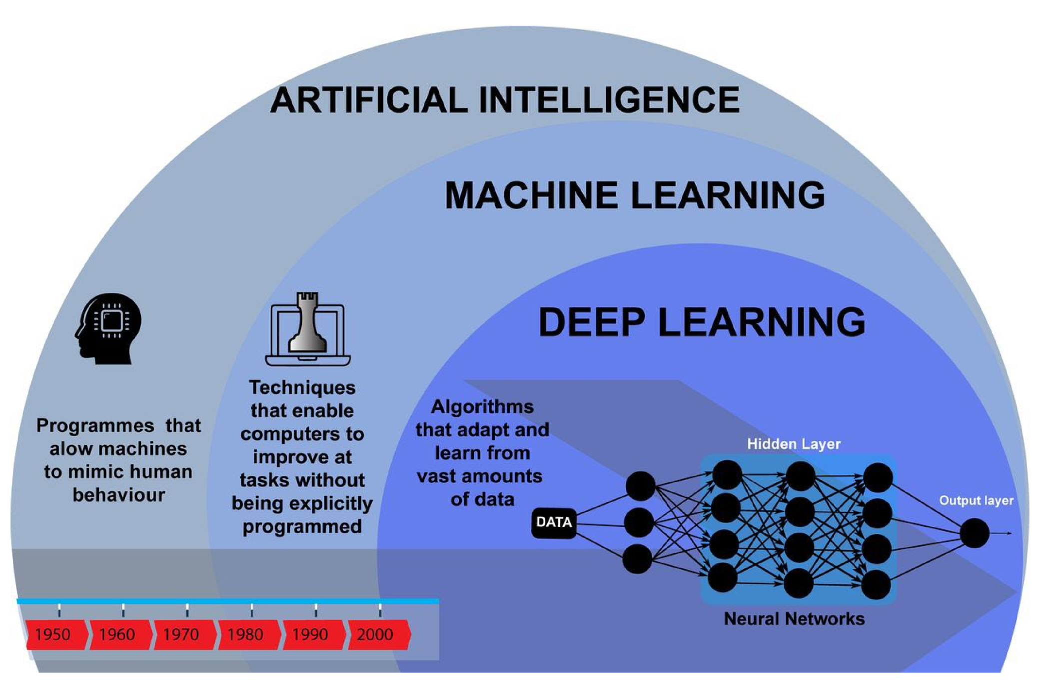
Artificial Intelligence (AI) is the presence of human intelligence in machines providing them with the ability to think like humans and mimic human actions. AI is continuously evolving and has made rapid strides in mimicking human activities. They are classified as weak or strong based on whether they focus on a particular job or complex job. The AI used in the medical imaging is strong AI with algorithms designed to excel to recognize complex patterns in diagnostic images. It can provide automated quantitative assessment of the images. Healthcare is becoming increasingly data intensive. Integration of AI into clinical workflow will help in faster and more accurate reproducible image assessment. Desire for improved efficiency in clinical care has been the primary driver behind the rapid advancement of AI. This poster is intended to raise the awareness on the current use of AI in medical imaging and its pros and cons.

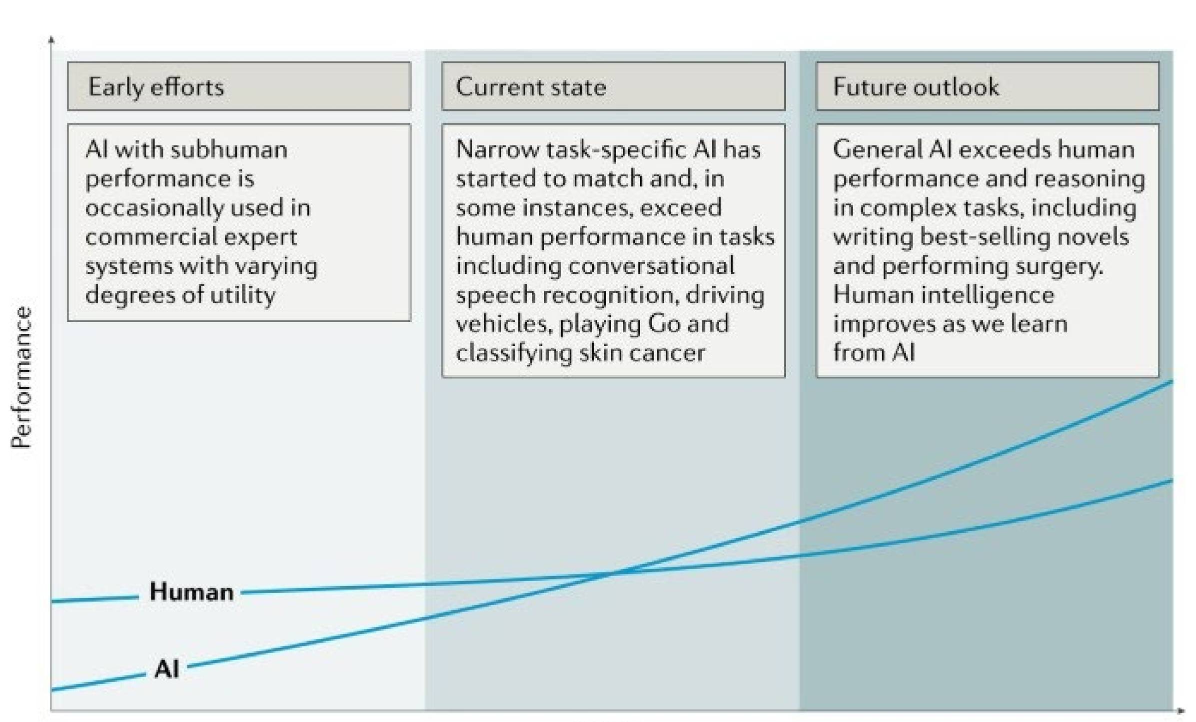
Algorithm

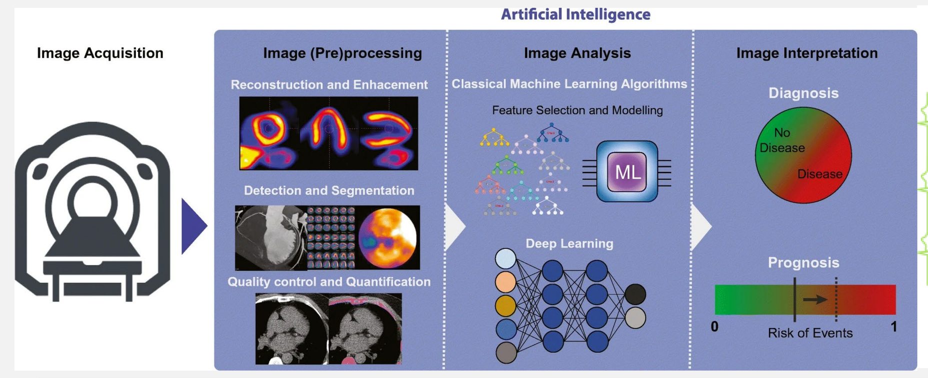
- is a set of well-defined instructions that function as a pathway to achieve result from an established initial situation.
- analogous to human brain and nerve signals.
- with a proper algorithm AI can perform quick analysis of huge amount of data, pattern recognition, efficient assessment, and pathology detection without subjective bias

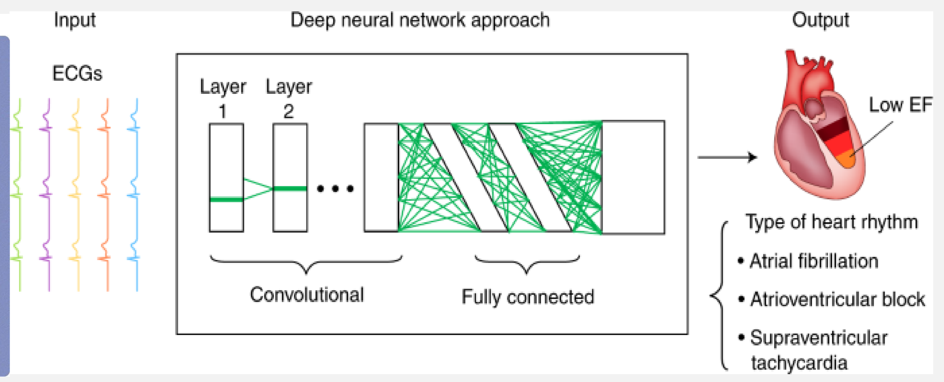


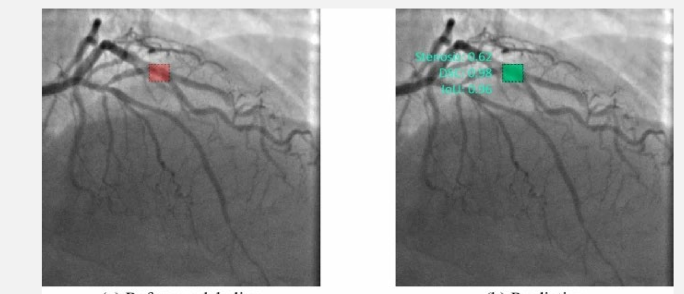






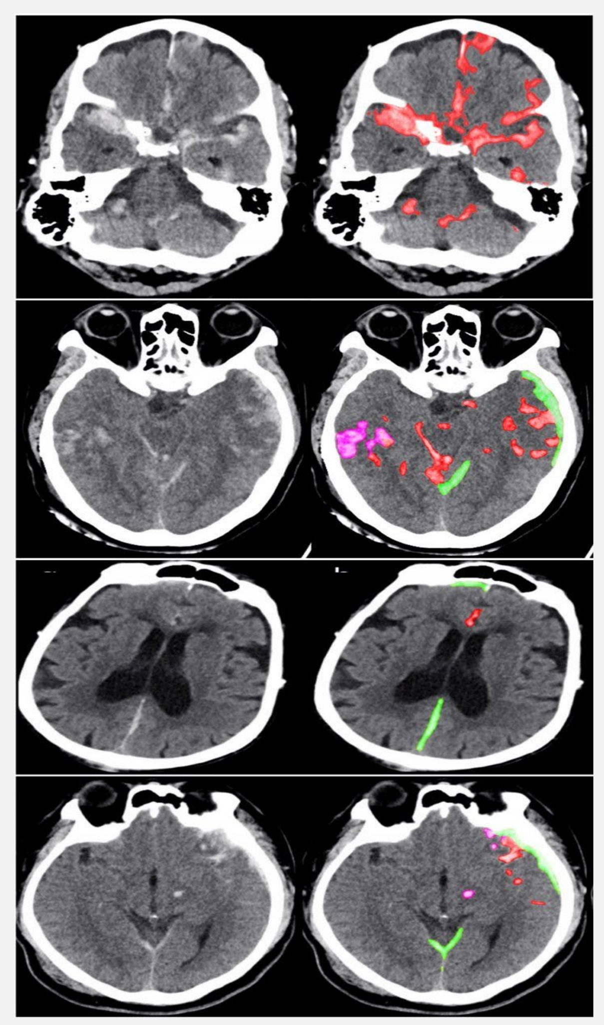





(a) Reference labeling (b) Prediction

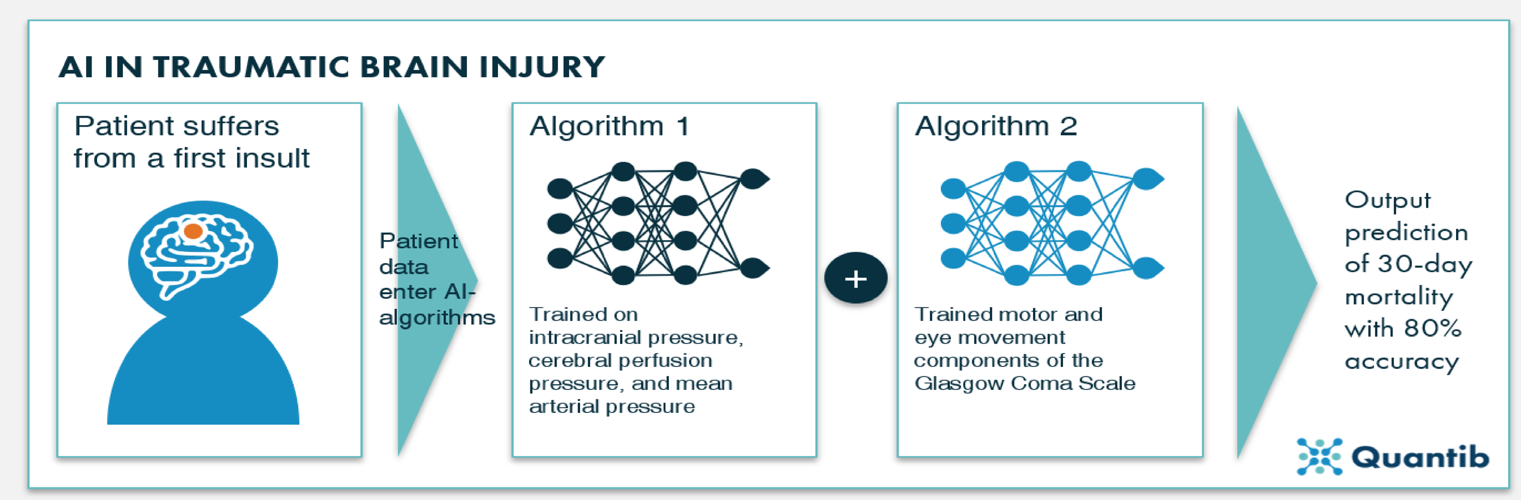
Application in identifying cardiovascular anomalies

- Decreased image reconstruction time for cardiac MRI
- Helped the cardiologists with automated pathology classification in electrocardiography
- Automated image analysis in Invasive Coronary Angioplasty (ICA) for frame selection, segmentation, lesion assessment, and functional assessment of coronary flow (Molenaar et al., 2022).
- Able to identify relevant structures crucial for detecting, localizing, and classifying coronary lesions
- Reduced incidences of subjective interpretation and difficulty in assessing true 3-D stenosis grade caused by three-dimensional (3-D) structures captured in two-dimensional (2-D) (Molenaar et al., 2022) leading to faster diagnosis and treatment
- Automated ICA image analysis for automated segmentation of coronary arteries in coronary angiography with 98% recognition accuracy and 85% sensitivity (Molenaar et al., 2022).
- Real-time coronary stenoses detection with high sensitivity for accurate and faster diagnosis and treatment planning.


A deep learning algorithm recognizes abnormal CT scans of the head in neurological emergencies in 1 second. The algorithm also classifies the pathological subtype of each abnormality: red - subarachnoid hemorrhage, purple - contusion, green - subdural hemorrhage.

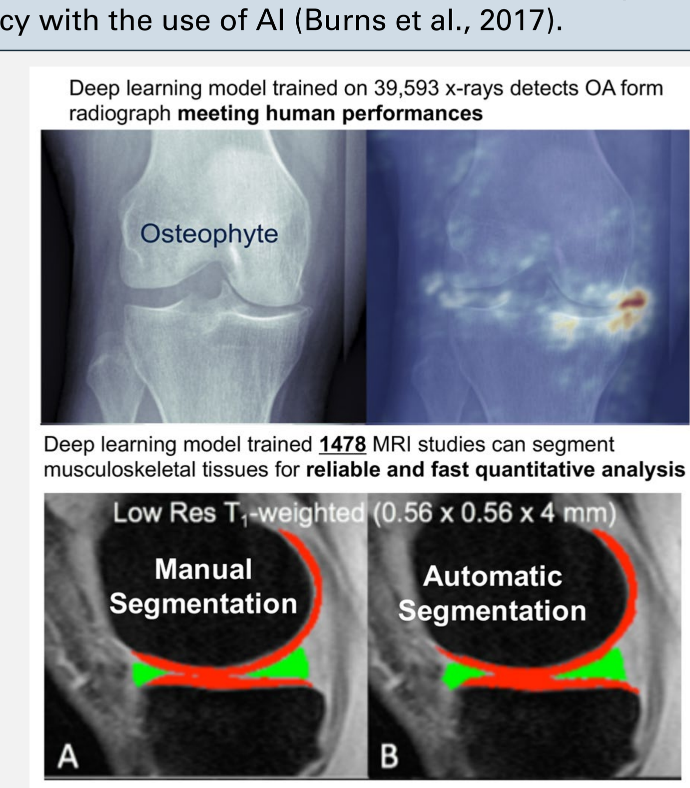
Application in neurology

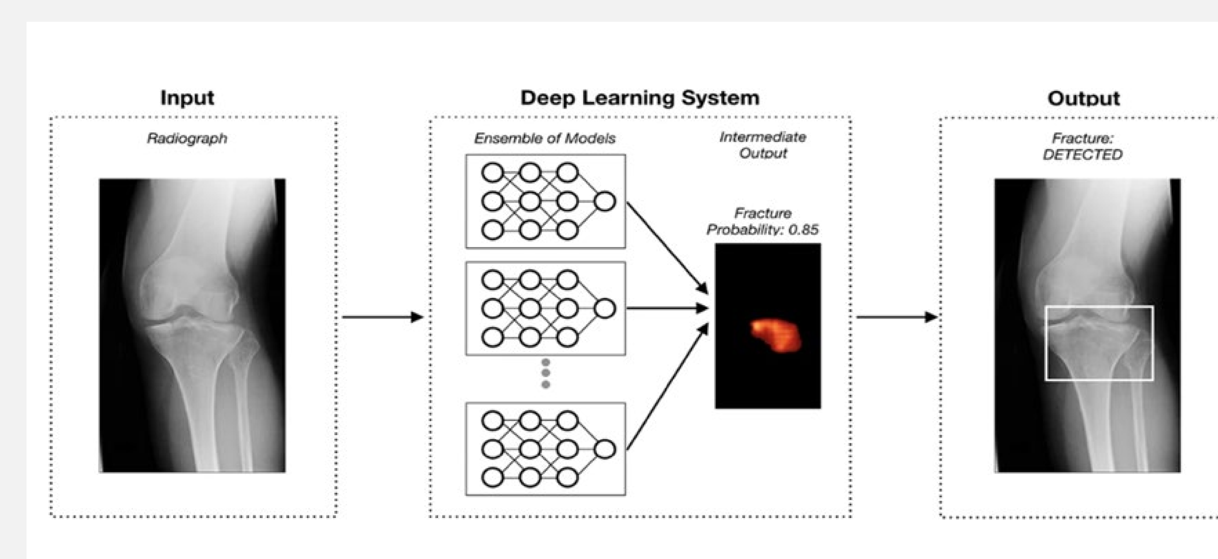
- Automated detection of neurodegeneration through image analysis
- Automated measurement biomarkers of Alzheimer's disease and rate of brain atrophy.
- AI-based CT scans assessments for automated lesion segmentation of hemorrhagic infarcts, or automated detection and quantification of hemorrhagic expansion (Nagamine et al., 2020).
- Early detection of warning signs of ischemia on CT images
- Used in traumatic brain injury (TBI) to lessen the impact of secondary brain injury by controlling intracranial pressure
- Could predict 30-day mortality for TBI patients with 80% accuracy based on variables such as intracranial pressure, arterial pressure, and motor and eye movement components of Glasgow Coma Scale (Raj et al., 2019).



Application in musculoskeletal injuries (MSK injuries)

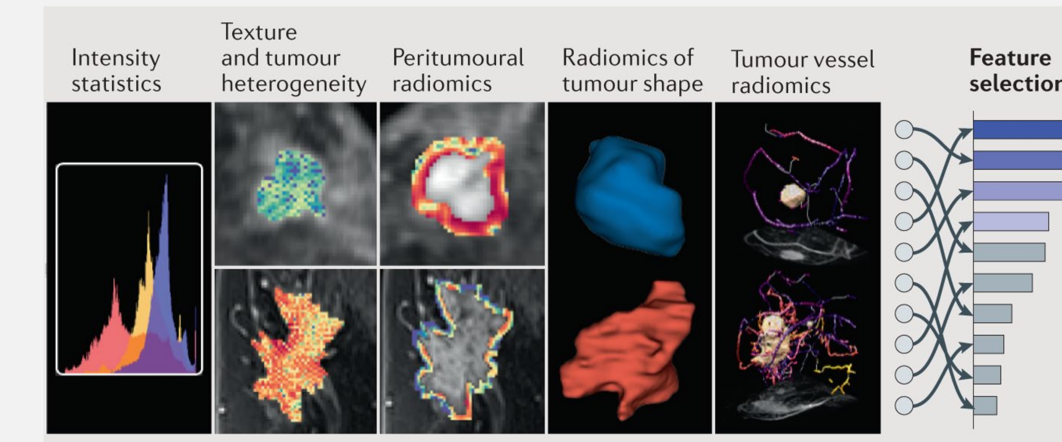
- Improved the image quality, noise reduction, and diagnostic accuracy (Gyftopoulos et al., 2019)
- Accesses the appropriateness of imaging orders to predict the patient's risk at fracture
- Reduction in MRI acquisition time by separating targeted image content from the aliasing artifacts
- Promising results in terms of image quality and diagnostic accuracy when comparing AI accelerated knee MRI to conventional MRI up to four times (Wang et al., 2016)
- Reduces patient doses in CT scans while maintaining diagnostic efficiency and accuracy; consensus of 90% of radiologists (Cross et al., 2017)
- Automated pattern detection and image interpretation to diagnose fractures, bone age and strength, and various pathologies (Gyftopoulos et al., 2019)
- Detection and localization of thoracic and lumbar spine fractures with 95.7% accuracy with the use of AI (Burns et al., 2017).

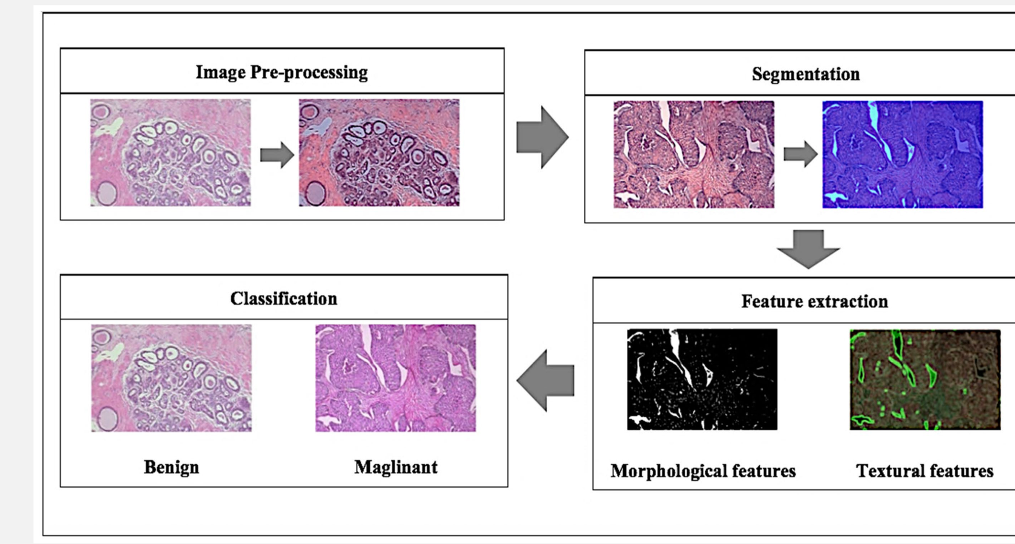




Application on oncology

- Precision in skin lesions annotations (including melanoma) comparable to dermatologists (Shimizu & Nakayama, 2020).
- Rapid and accurate interpretation of mammographs for breast cancer screening
- Able to detect 13 different types of cancers including breast, lung, and colorectal cancer (Shimizu & Nakayama, 2020).
- Able to map out potential cancer cells
- Rapid automated genomic sequencing to detect any mutation leading to suppression of Tumor Necrosis Factor (TNF) or formation of oncogene, and efficient classification of mutation with clinical phenotypes (Shimizu & Nakayama, 2020)
- Enables rapid personalized treatment initiation.





Pros

- Increased diagnosis efficiency
- Reduce imaging time
- No subjective bias
- Automation
- Reduction in patient dose
- Faster and customized treatment

Cons

- Privacy and security concerns
- Lack of interoperability and regulation
- Lack of sample size to reduce skewed results
- High initial implementation cost

References

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