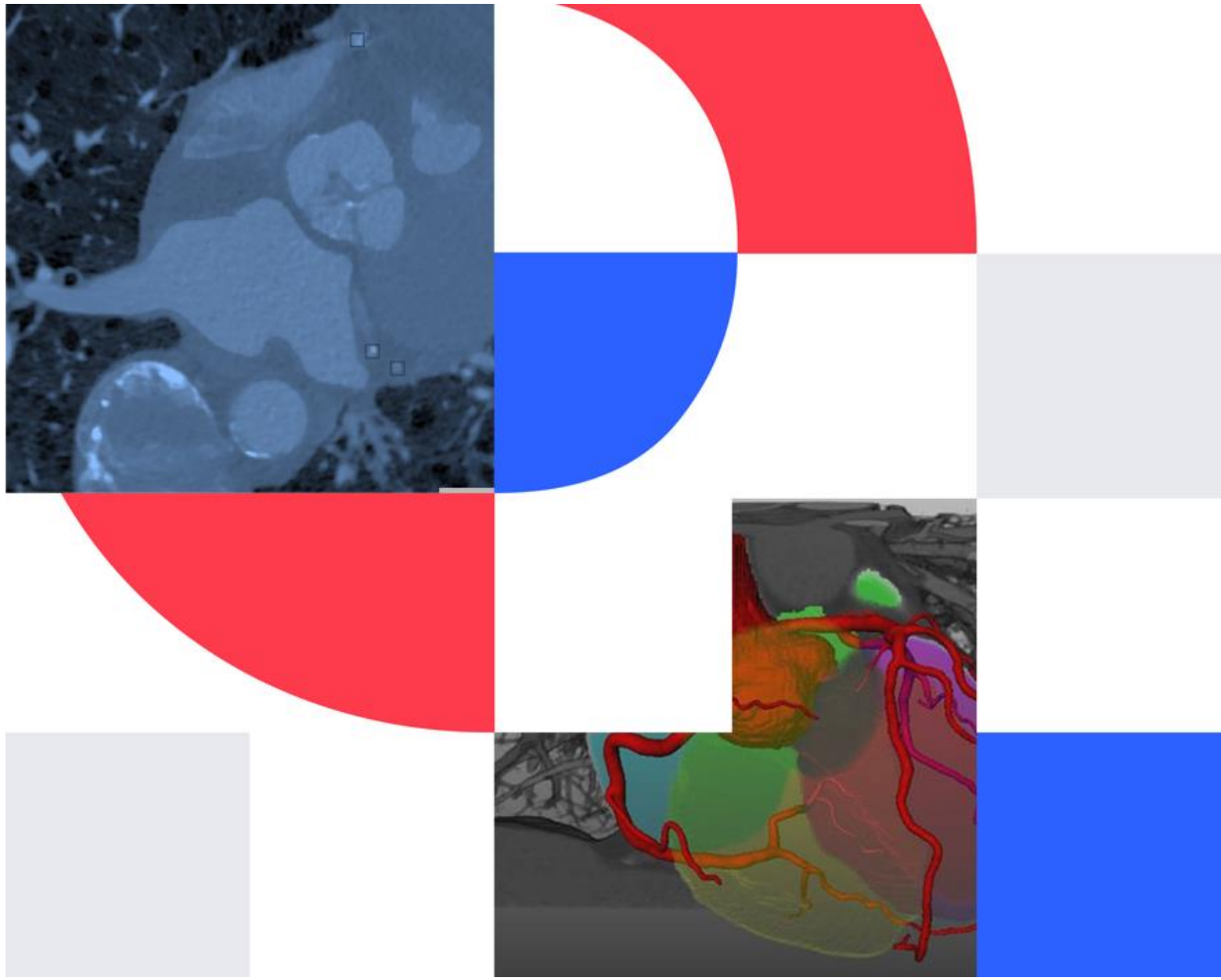
AI for early detection of CVD risk in breast cancer patients using CT scans

Sanyog Vyawahare



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Breast Cancer Survivors

- Increased long-term risk of cardiovascular disease (CVD)[1]
- Pre-existing conditions
  - Role in later stages
- Early detection:
  - CT scans used for treatment planning
  - Plaque in arteries

1. Koric, A., Chang, C. P., Mark, B., Rowe, K., Snyder, J., Dodson, M., ... & Hashibe, M. (2022). Cardiovascular disease risk in long-term breast cancer survivors: A population-based cohort study. *Cancer*, *128*(14), 2826-2835.

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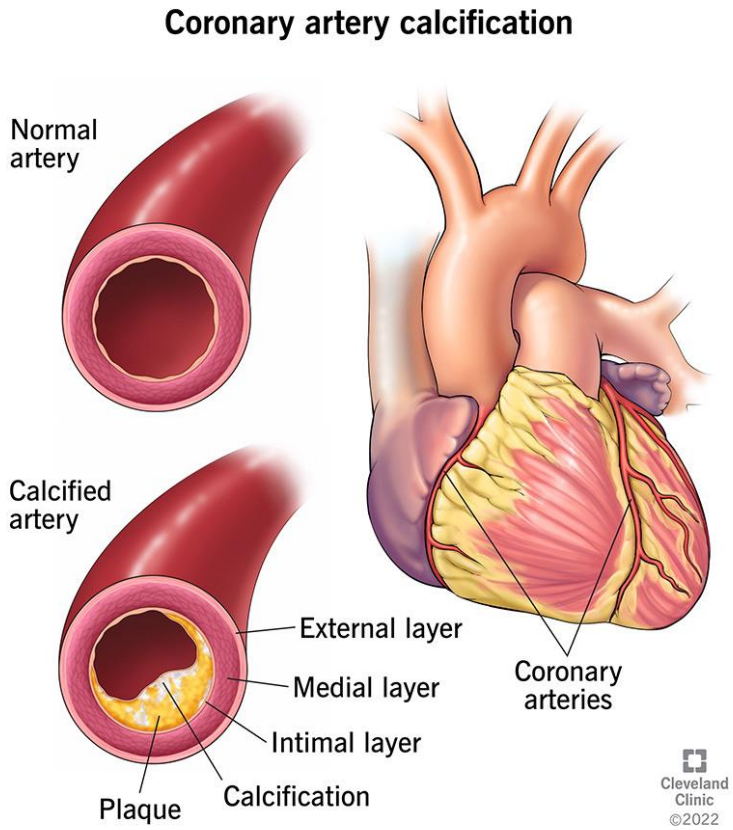
Atherosclerosis

Atherosclerosis:
- Gradual buildup of plaque in the walls of the arteries

Plaque:
- Plaque (fat and cholesterol)
- Hardens over time (~5 years)

Arteries
- Location of artery
- Different risk



Calcium collecting in coronary arteries.[1]

1. Image obtained from my.clevelandclinic.org

CT Scans

CT Scan:

- Shows a detailed picture of body without invasive test.

Calcium on CT Scans

- Appears as bright white area

Calcium Score

- Amount of calcium present
- Performed for coronary arteries
- Indicator for increased CVD risk

Motivation

ARTILLERY Project

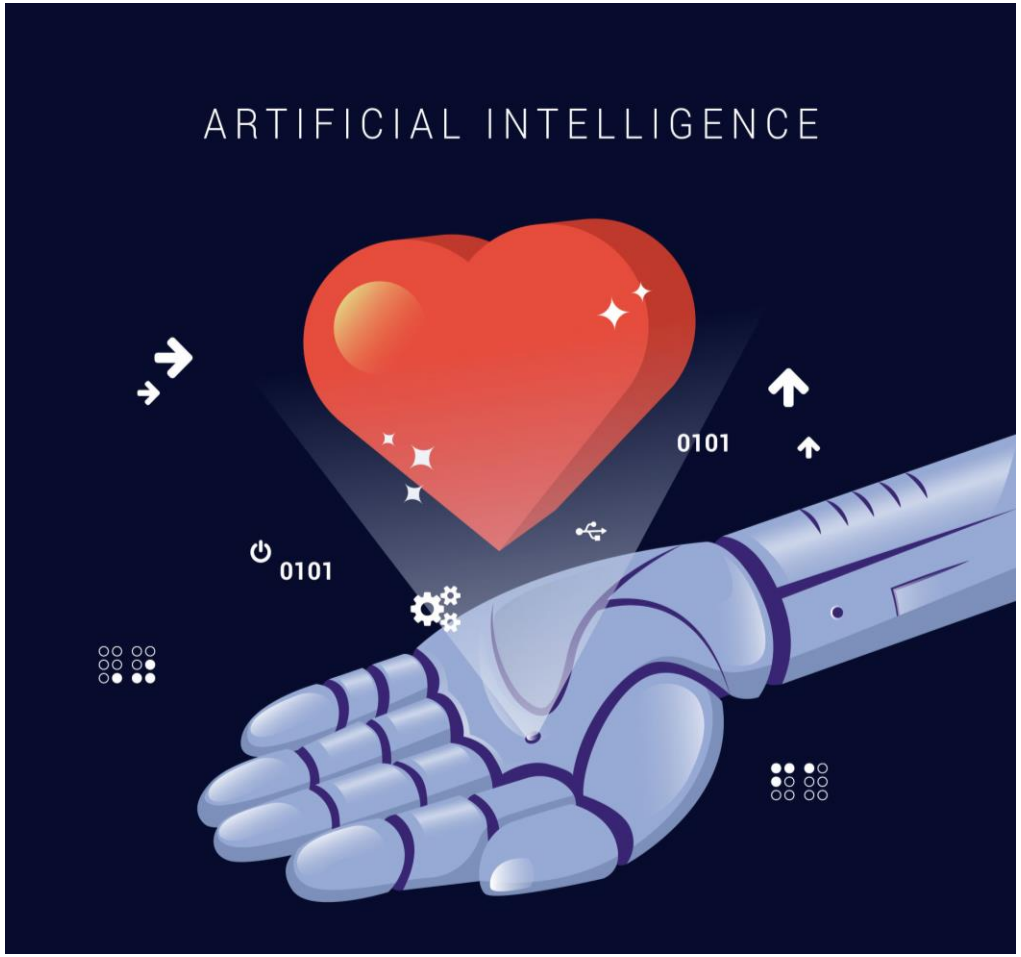
- Breast cancer patients' health
- Chronic disease risk factors
- Develop AI system for risk prediction

Implementing AI

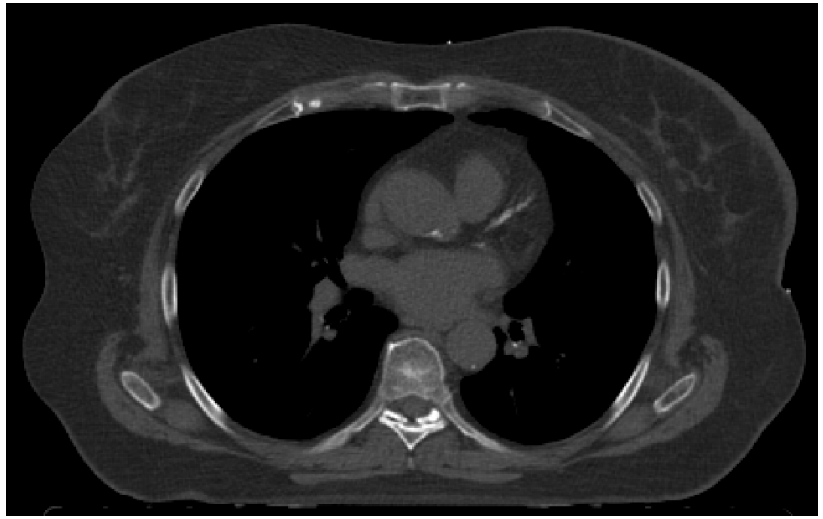
- Faster, consistent and accurate

Opportunistic assessment

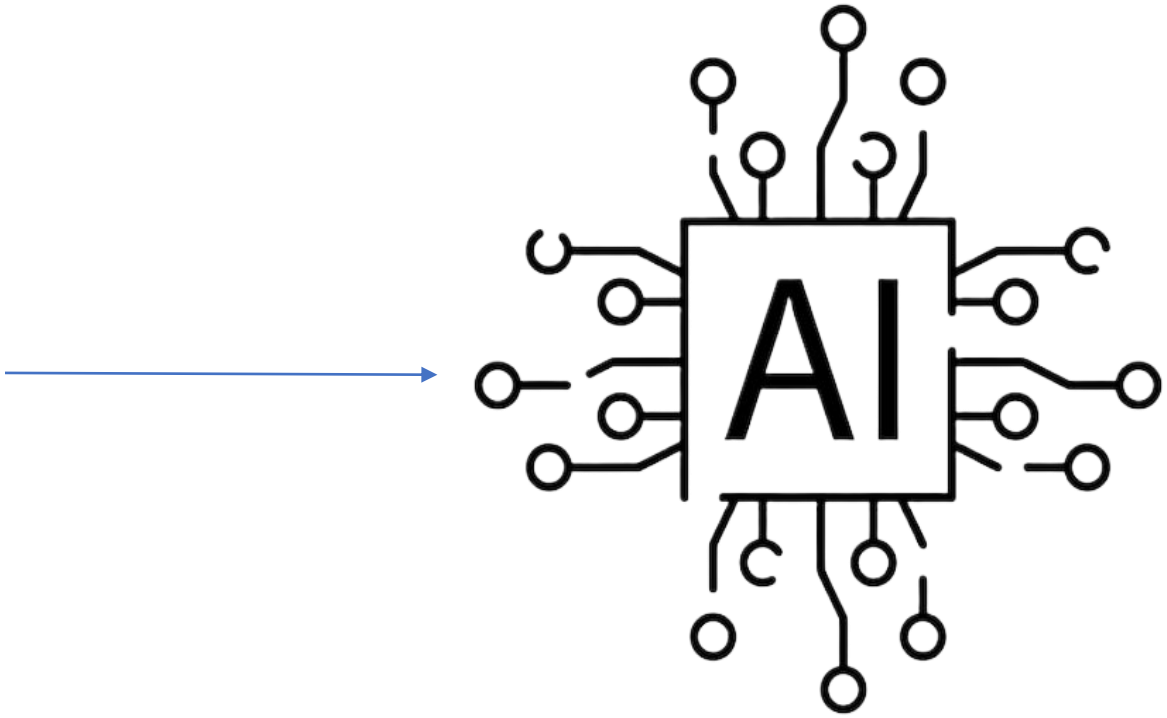
- Decision support system



Automating Calcium Scoring



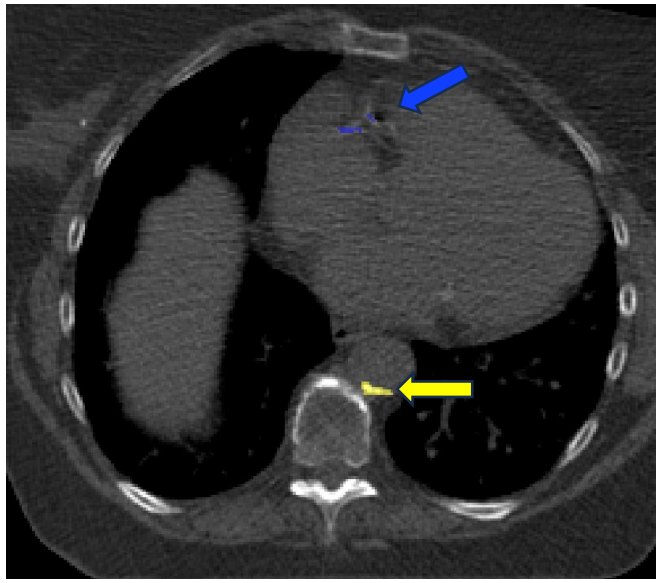
Radiotherapy planning CT



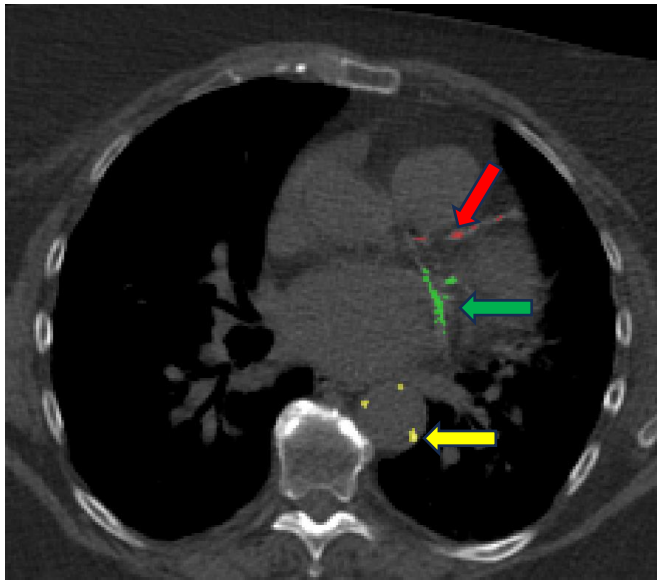
Automating Calcium Scoring

Data

- Radiotherapy Planning CT scans
- Annotations for calcium



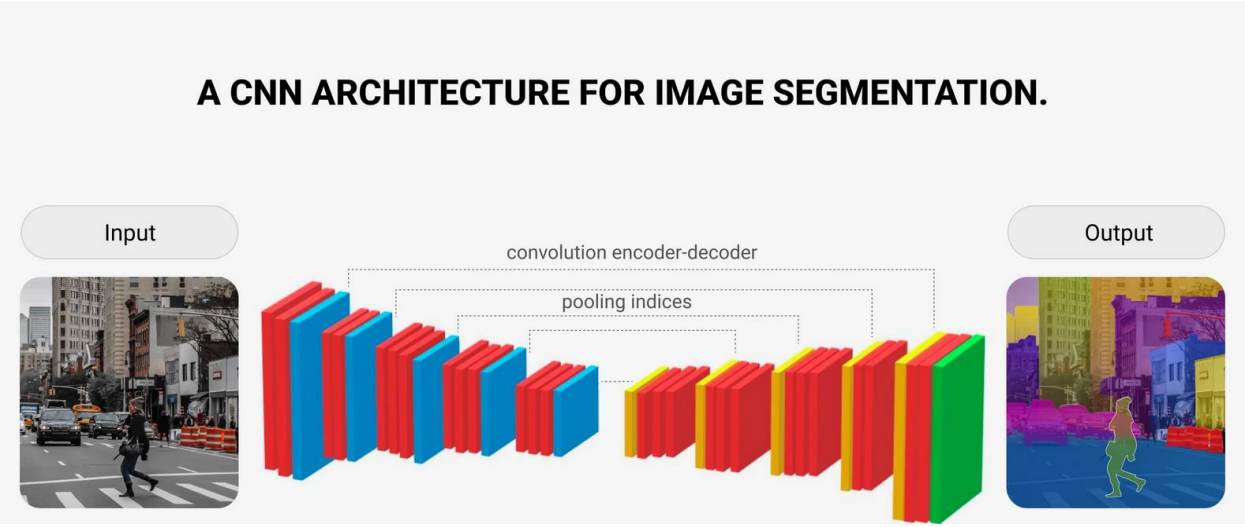
Calcium annotation in CT scan for Right Coronary artery (Blue) and Aorta (Yellow)



Calcium annotation in CT scan for Left anterior descending (Red), Left circumflex artery (Green) and Aorta (Yellow)

Automating Calcium Scoring

- Use convolution neural networks (CNNs)
  - Designed to process and analyze visual information (Images)
- Learn characteristics of data
  - Calcium vs Background (Organs and bones)
  - Categories of calcium
    - Coronary calcifications
    - Aortic calcifications
    - Cardiac valve calcifications



Example of convolutional neural network (CNN) used for identifying different objects in an image.[1]

1. Image obtained from (https://mindy-support.com)

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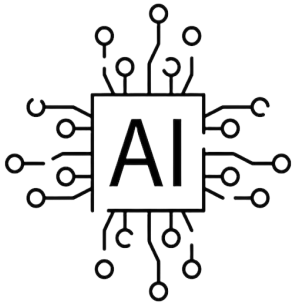
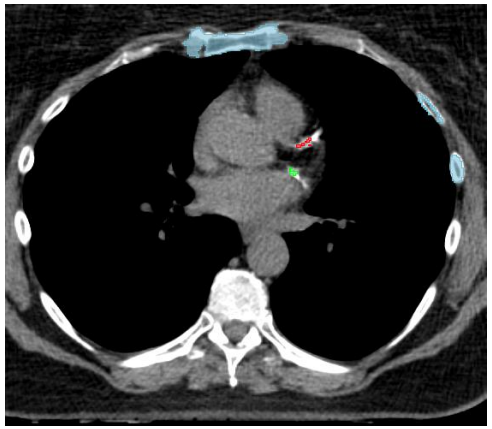
Learning



Input image slice



Iteration 1

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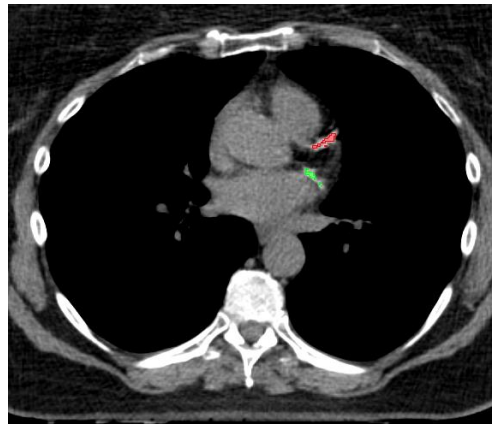
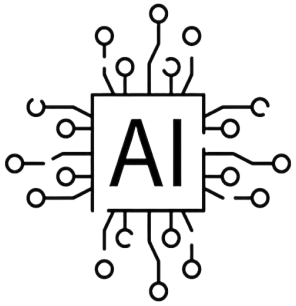
Iteration N

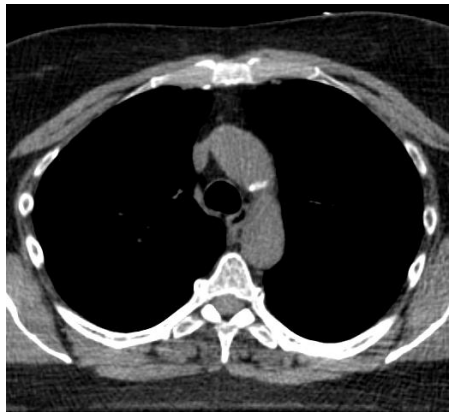
Compare



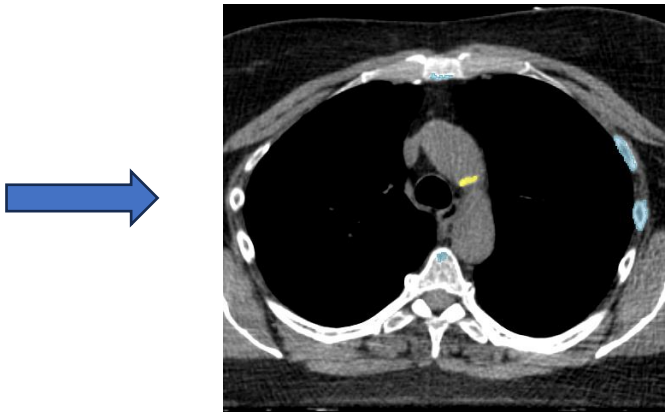
Reference calcium

Learning





Input image slice



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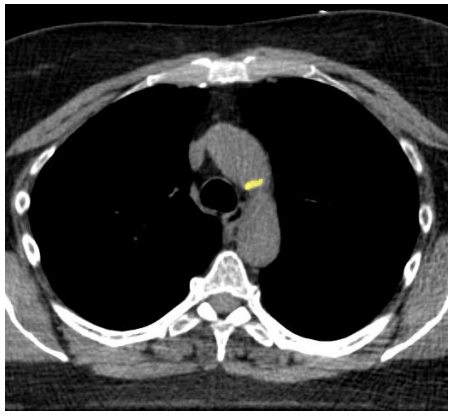
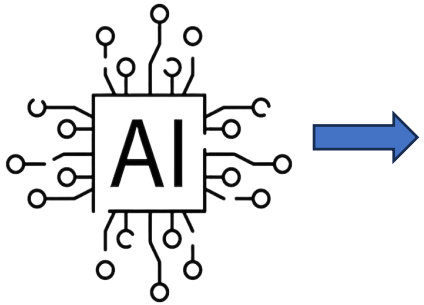
Iteration N

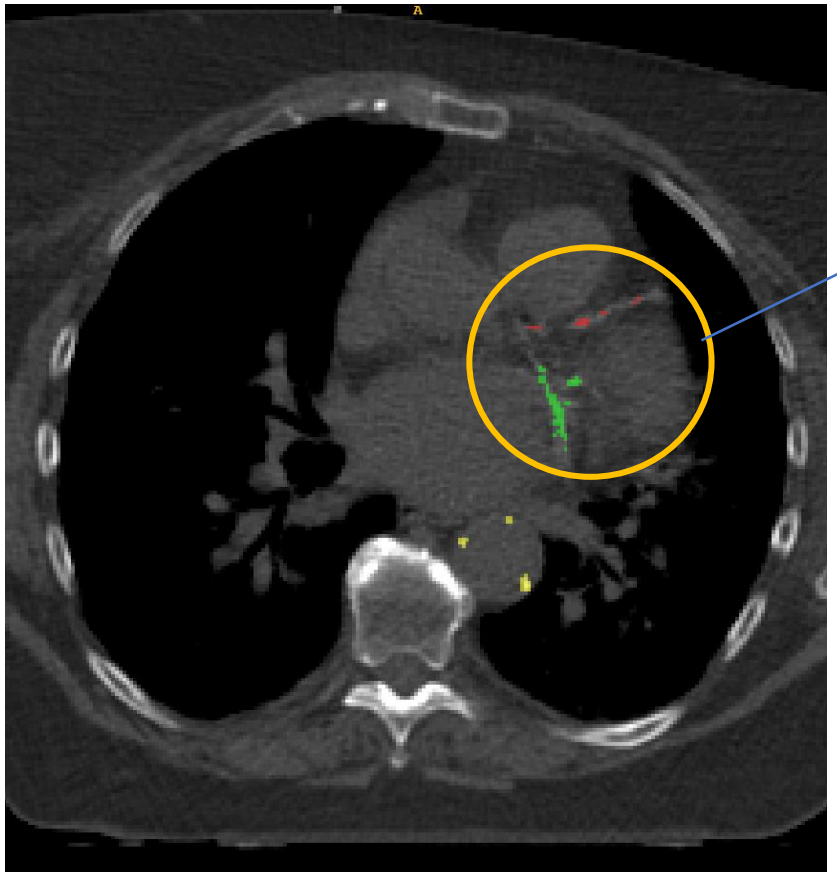
Compare



Reference calcium

Automated Calcium Scoring





Radiotherapy planning CT

Calcium score

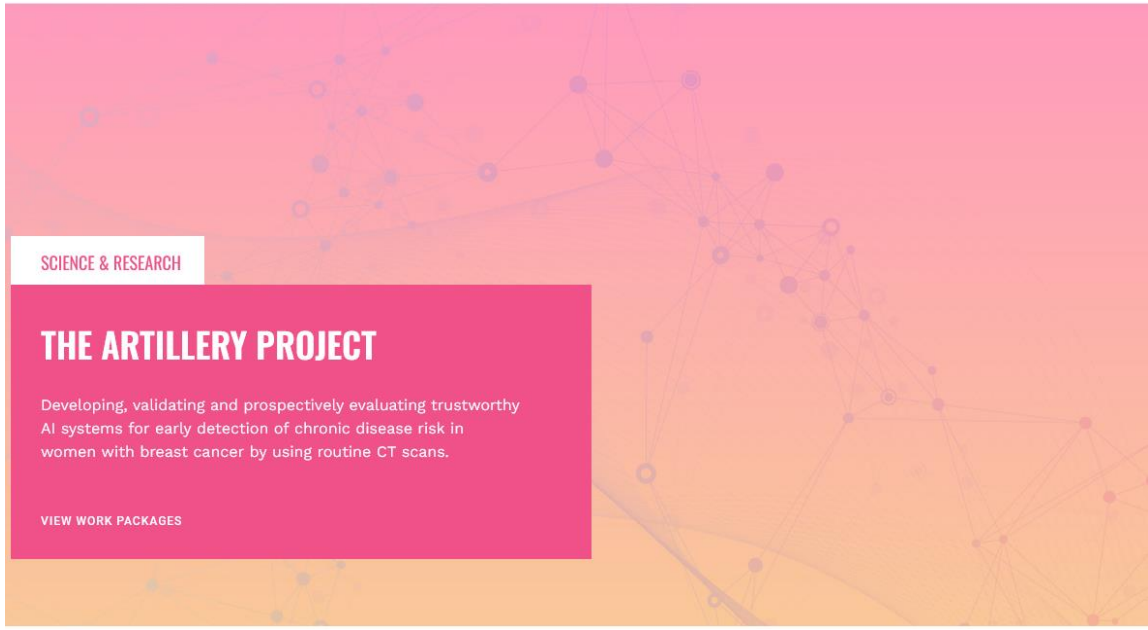
Patients at high risk

Treatment planning

Long-term care

Summary

- Investigate the role of pre-existing condition
  - Radiotherapy planning CTs
- Automatic AI models to detect calcium
  - Calcium scoring
- Early intervention
  - Enable personalized preventive strategy
- ARTILLERY project & UMBELLA study
  - Other chronic disease risk
  - Improved treatment and diagnosis



GOALS

We aim to deliver trustworthy AI systems for early detection of chronic disease risk in women with breast cancer that are technically robust, and of clinical benefit and thus relevant for patients and health care professionals.

READ MORE →

The ARTILLERY Project: https://artillery-project.eu/

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