



Intelligenza artificiale in medicina

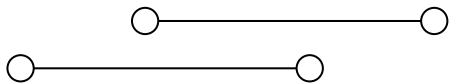


Giulia Raffaella De Luca, PhD Student

"La scienza raccontata da chi la fa"

Forlimpopoli, 14 marzo 2025

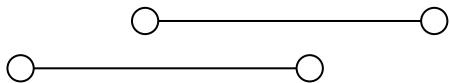




Un mix “letale”

- 1 dose generosa di curiosità

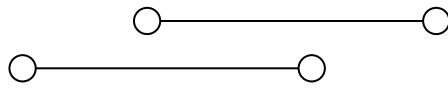




Un mix “letale”

- 1 dose generosa di curiosità
- 1 pizzico di codardia





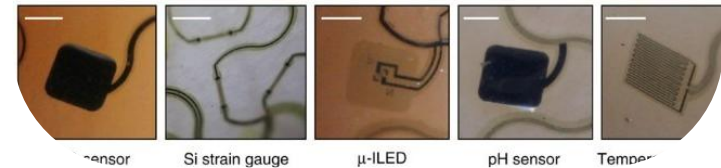
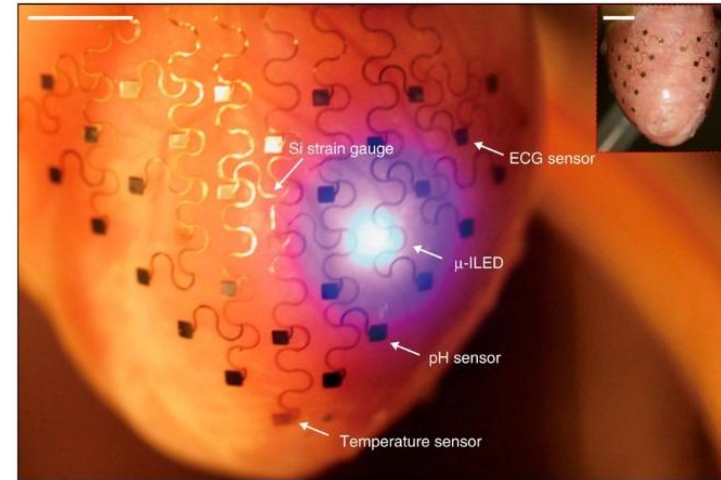
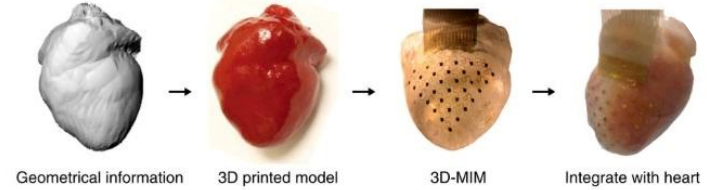
Un mix “letale”

- 1 dose generosa di curiosità
- 1 pizzico di codardia
- Caso q.b.



3D multifunctional integumentary membranes for spatiotemporal cardiac measurements and stimulation across the entire epicardium.

Xu et al., Nature Communications (2014)

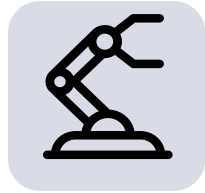




Ingegneria Biomedica



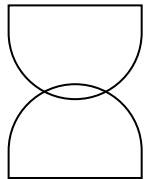
In due parole



Ingegneria

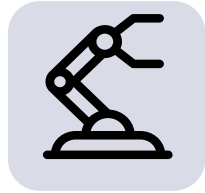


Biomedica





In due parole

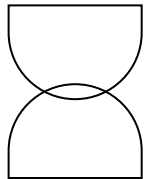


Ingegneria

- Analisi matematica, Algebra e geometria
- Fisica
- Informatica
- Controlli automatici
- Elettronica, Elettrotecnica
- Comportamento meccanico dei materiali
- ...

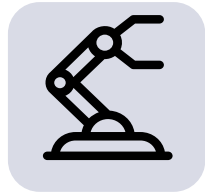


Biomedica





In due parole



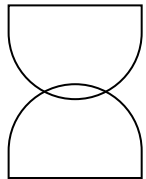
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- ...



Biomedica

- Fisiologia
- Bioingegneria
- Biomeccanica
- Biomateriali
- Ingegneria Clinica
- Strumentazione Biomedica
- ...

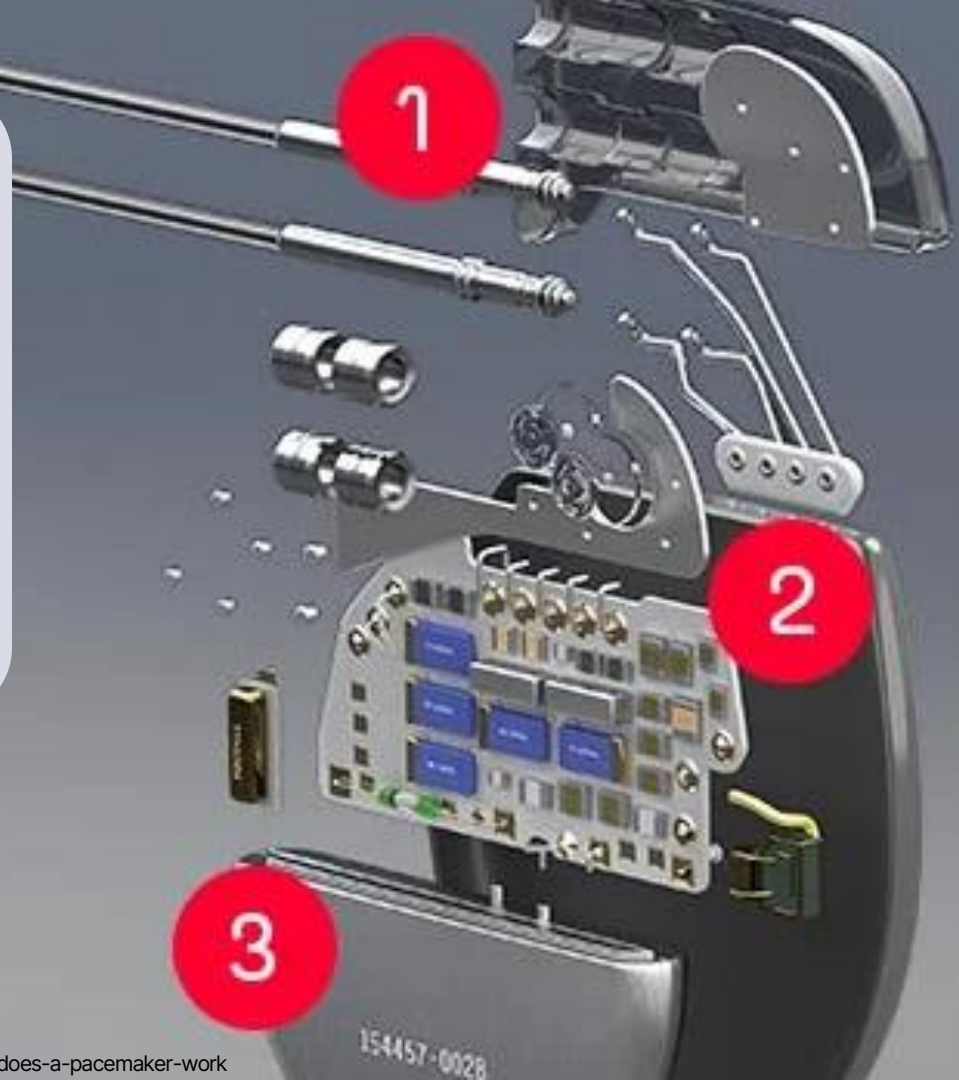


Il pacemaker



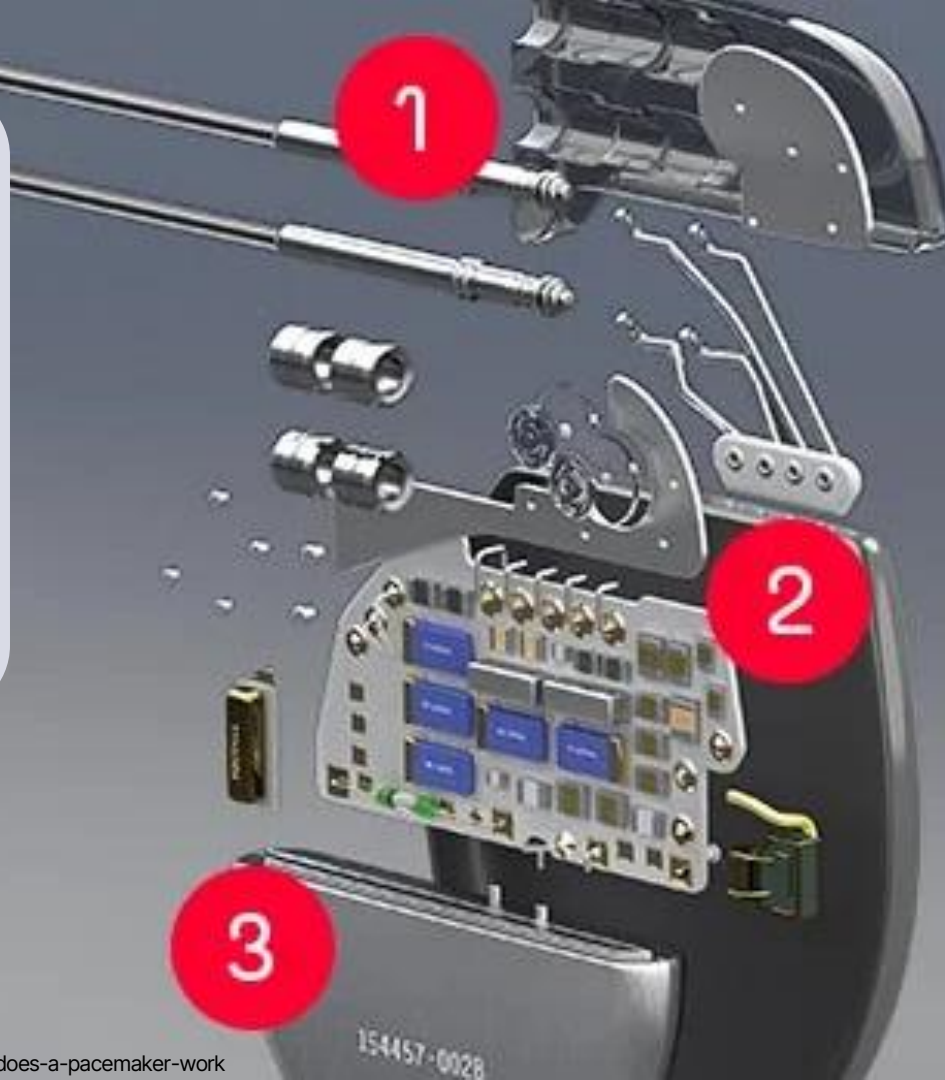
Il pacemaker

1. Leads (con elettrodi)



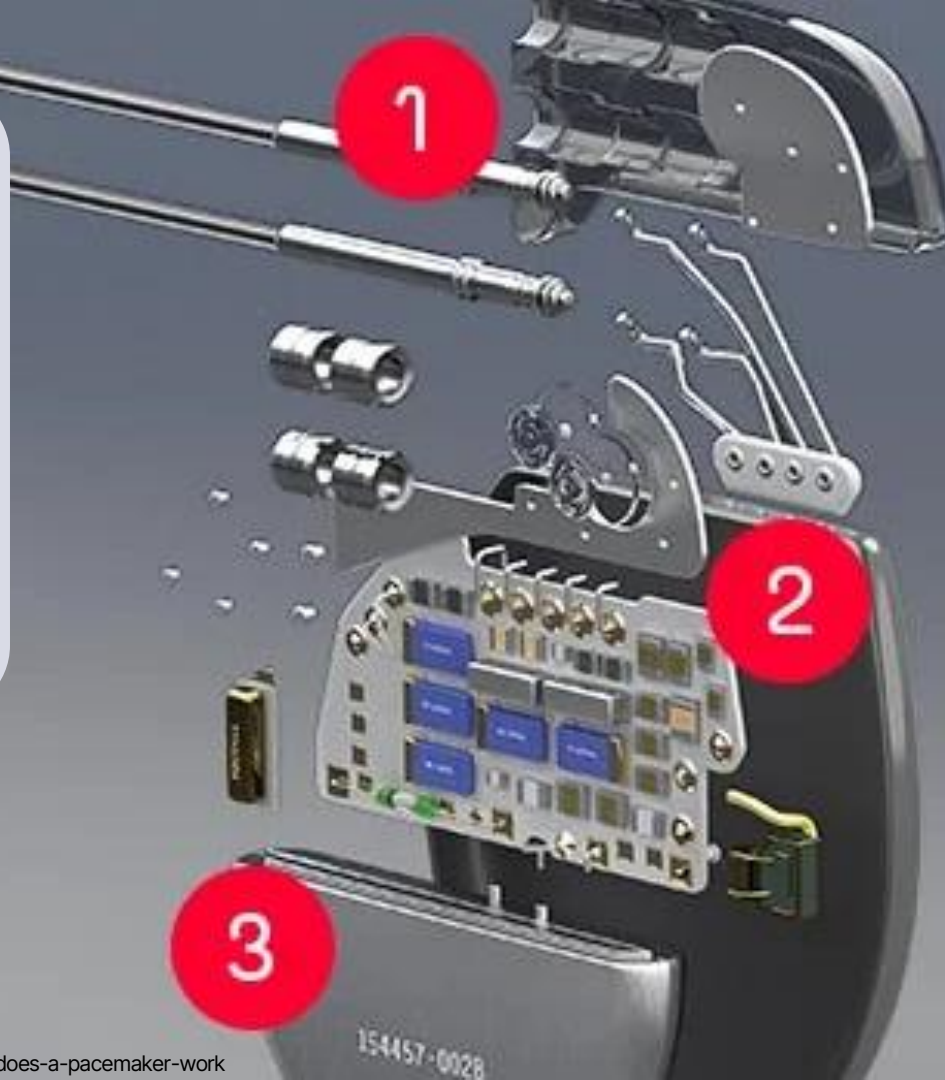
Il pacemaker

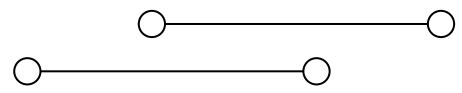
1. Leads (con elettrodi)
2. «Pacemaker box»



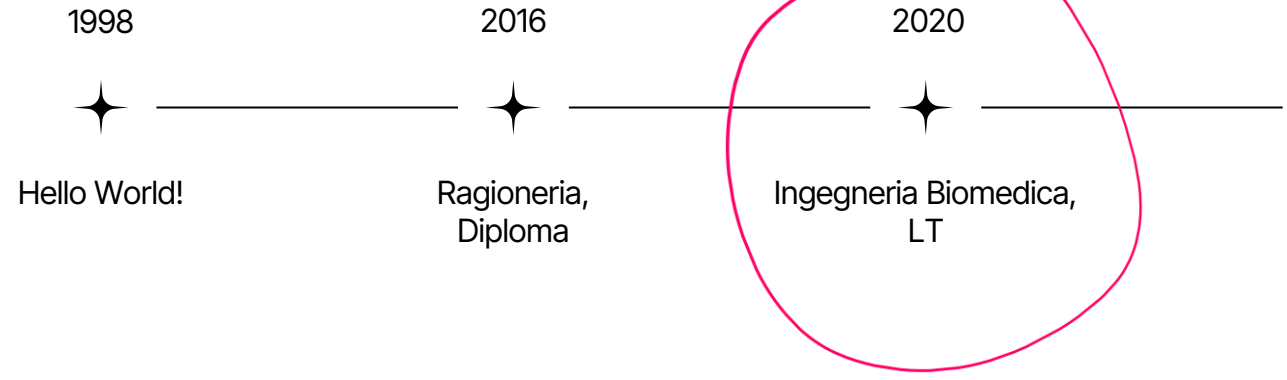
Il pacemaker

1. Leads (con elettrodi)
2. «Pacemaker box»
3. Batteria





Dove sono?



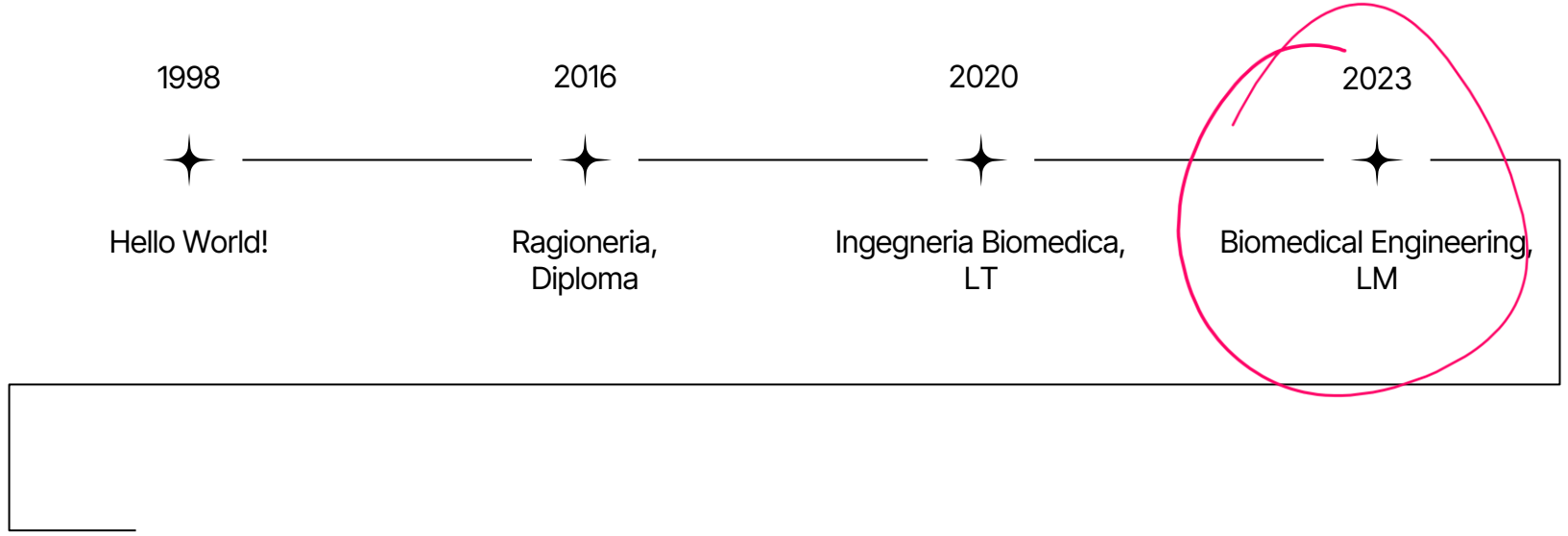
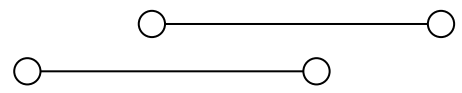
DOSIMETRIA E RADIOPROTEZIONE: LE NOVITÀ INTRODOTTE DALLA DIRETTIVA 2013/59/EURATOM E IL SUO RECEPIMENTO IN ITALIA

CORSO DI LAUREA IN INGEGNERIA BIOMEDICA
Elaborato in INGEGNERIA CLINICA

Relatore: Prof.ssa Cristiana Corsi Presentata da: Giulia Raffaella De Luca

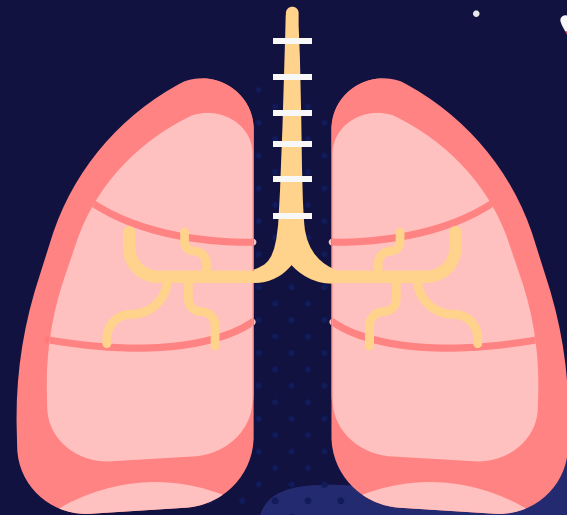


Dove sono?

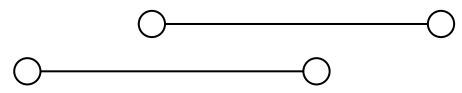


+ Patient Stratification in Lung Cancer Screening using SmileGAN

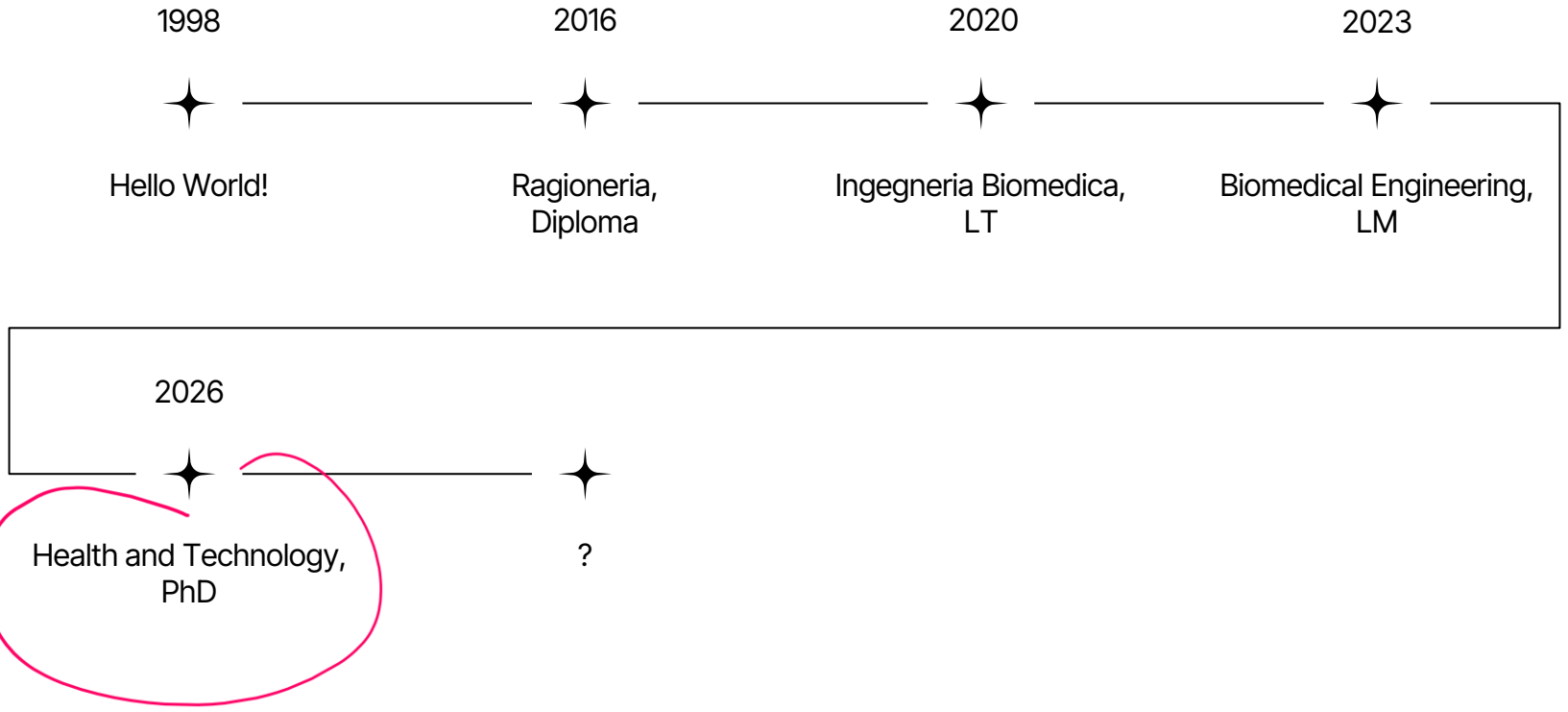
LM-21 Biomedical Engineering
Alma Mater Studiorum – Università di Bologna



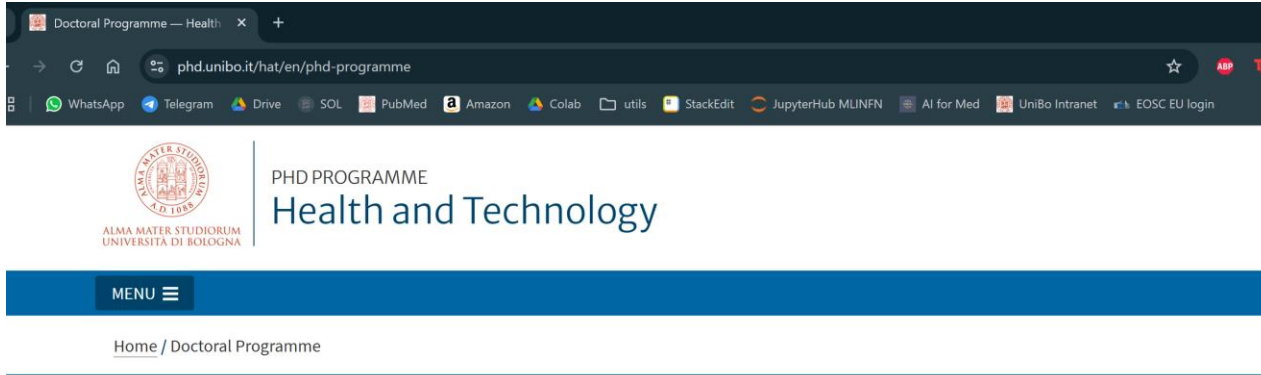
Presented by
Giulia Raffaella De Luca
Supervisor
Prof. Stefano Diciotti
Co-supervisor
Dr. Matteo Lai



Dove sono?



Health and Technology PhD

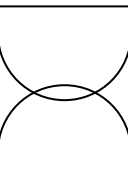


Doctoral Programme

MISSION & VISION

The mission of the Doctoral programme in Health and Technology is to promote a more translational biomedical technological research and drive a wider adoption of advanced biomedical technologies in the clinical and industrial practice.

Our vision is that of strongly interdisciplinary PhD programme, where every single project is supervised by a technology expert and a biomedical expert, and aims to produce results well beyond the current state of the art.





In (più di) due parole



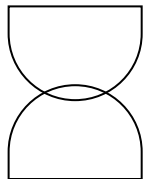
Ingegneria

→ Intelligenza Artificiale



Biomedica

→ Screening del Tumore Polmonare



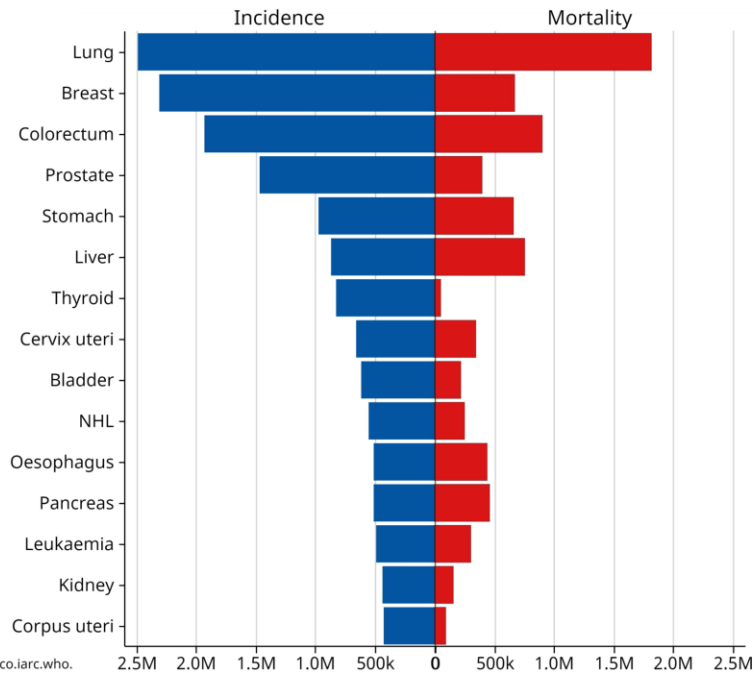


In (più di) due parole

Absolute numbers, Incidence and Mortality, Both sexes, in 2022

World

(Top 15 cancer sites)

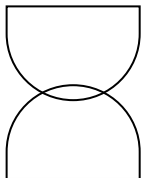


Cancer TODAY | IARC - <https://gco.iarc.who>.

Data version : Globocan 2022

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Number (in millions)





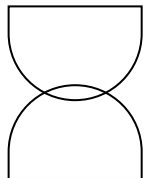
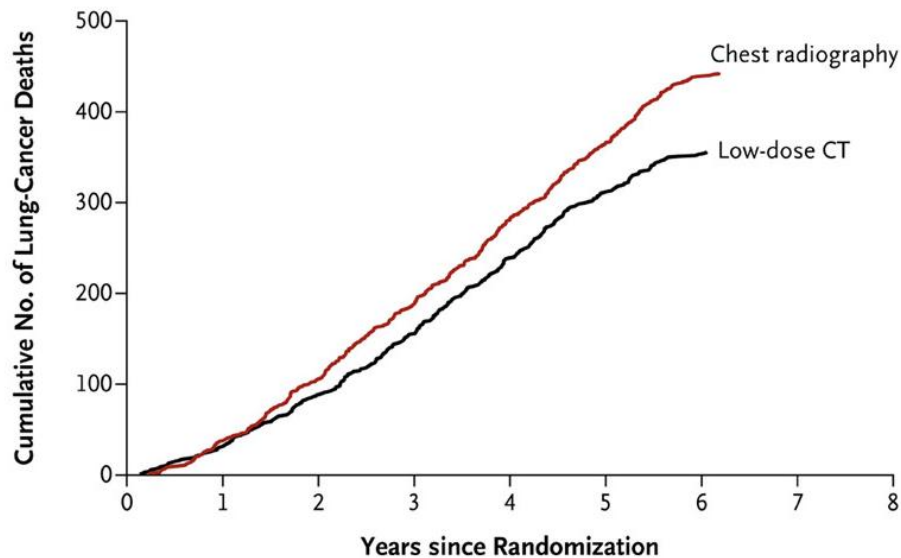
In (più di) due parole



Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

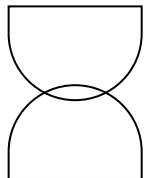
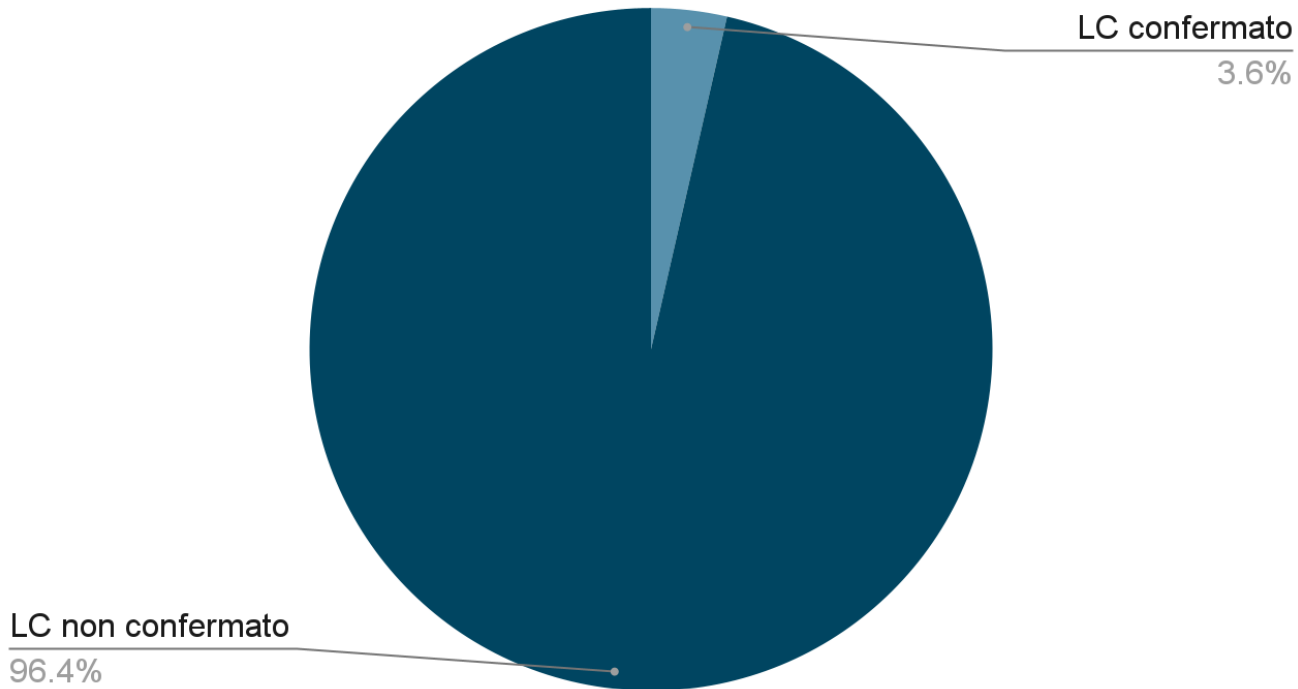
B Death from Lung Cancer





In (più di) due parole

Follow-up dei dispositivi allo screening nel gruppo "CT a bassa dose"



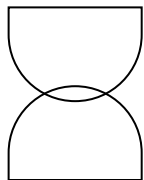
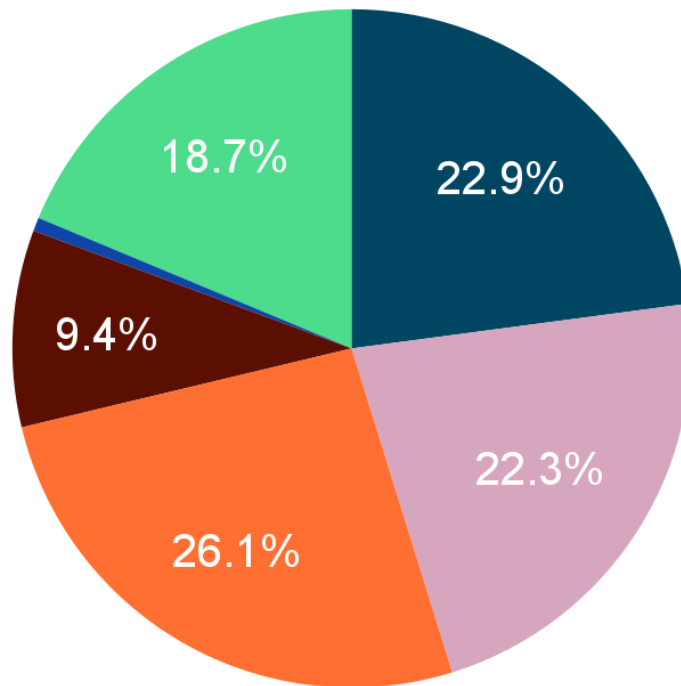


In (più di) due parole



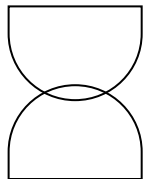
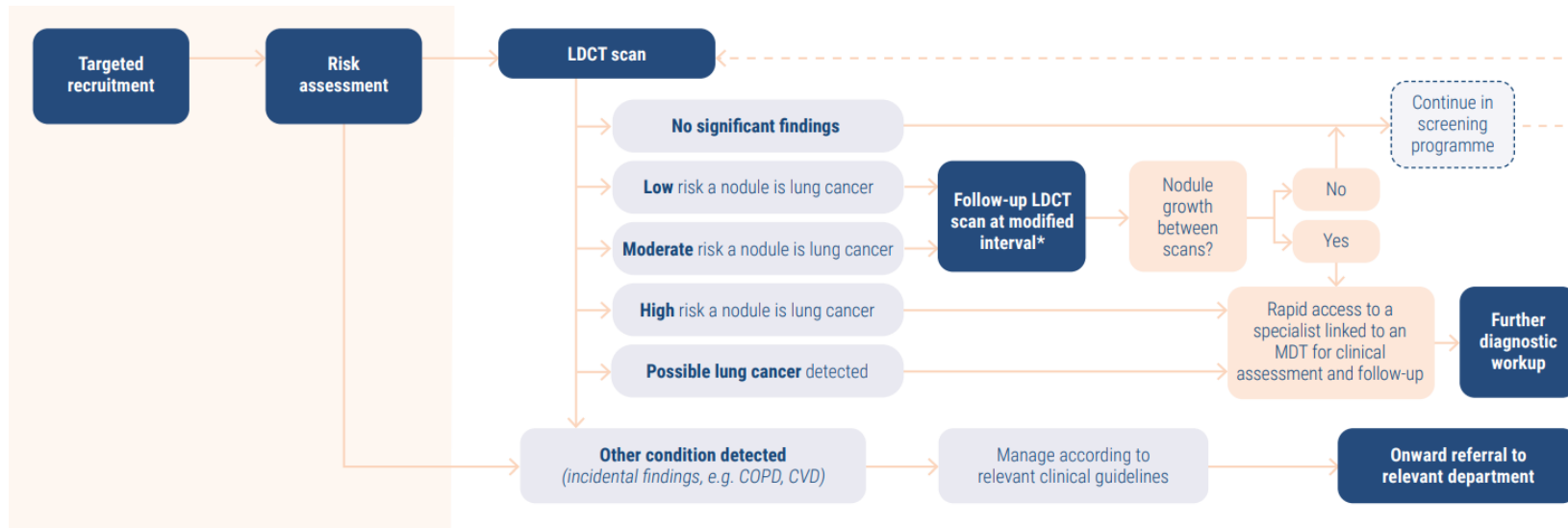
Cause di morte nel gruppo "CT a bassa dose"

- Neoplasia polmonare
- Altra neoplasia
- Malattia cardiovascolare
- Malattia respiratoria
- Complicazioni di procedure medico-chirurgiche
- Altro



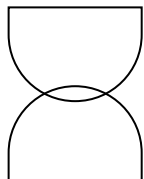
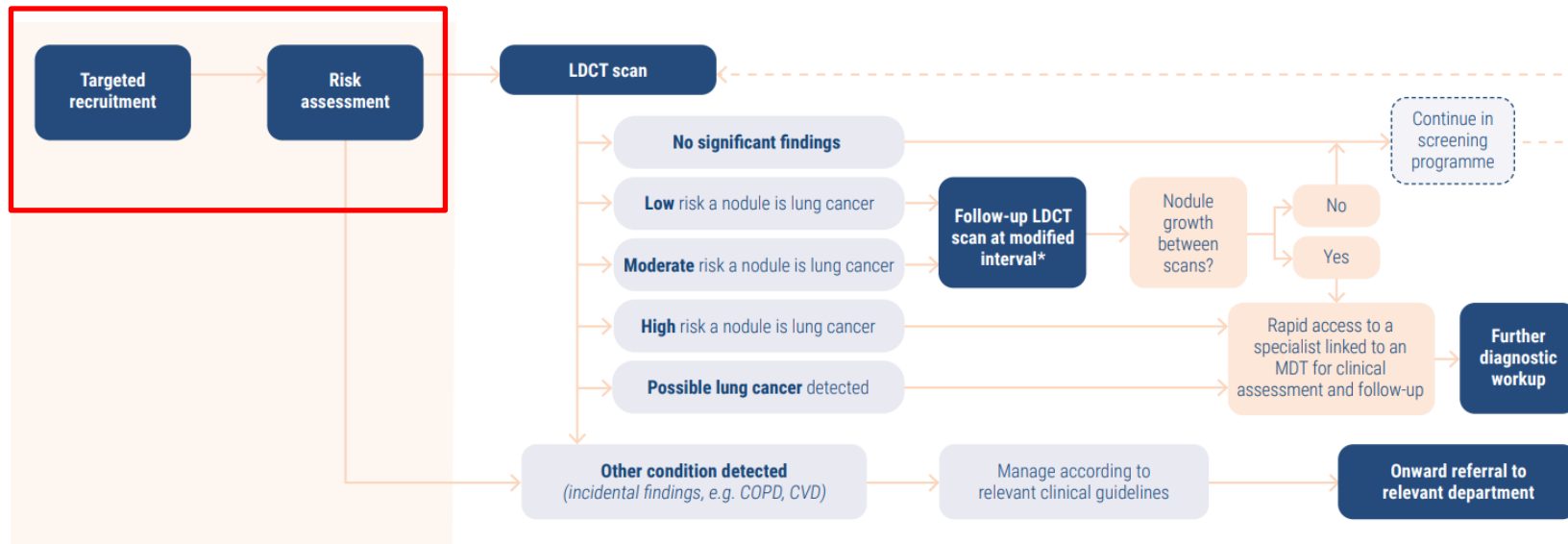


In (più di) due parole



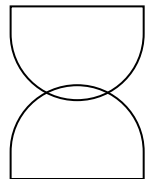
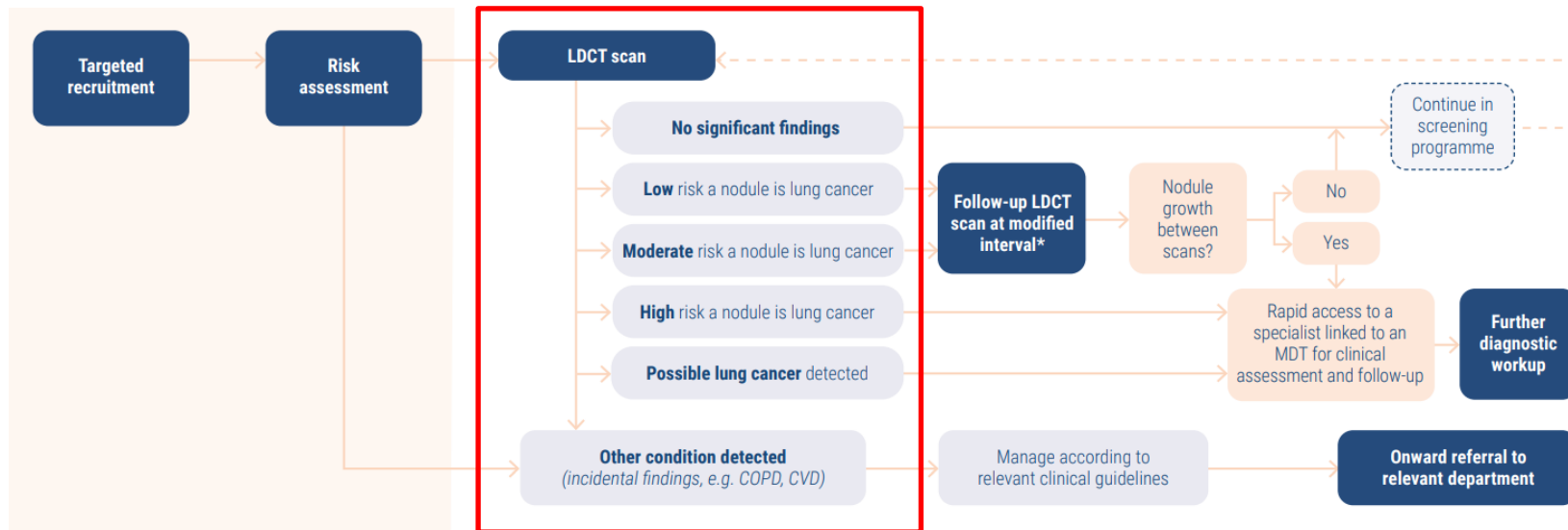


In (più di) due parole



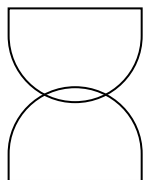
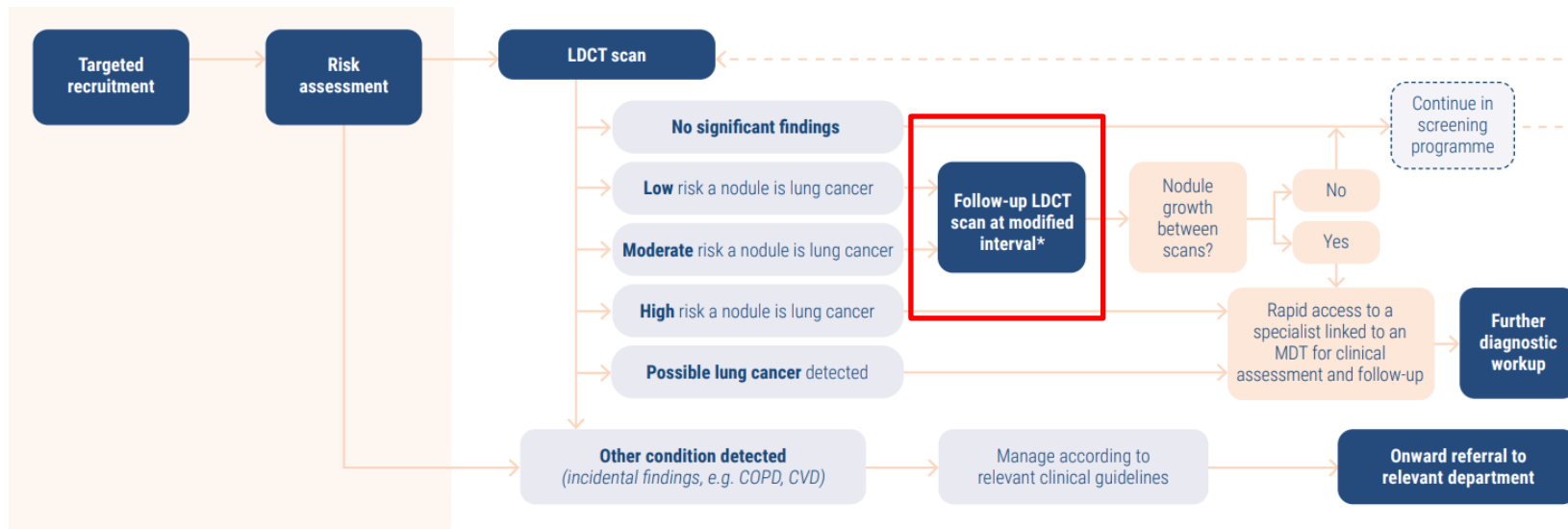


In (più di) due parole

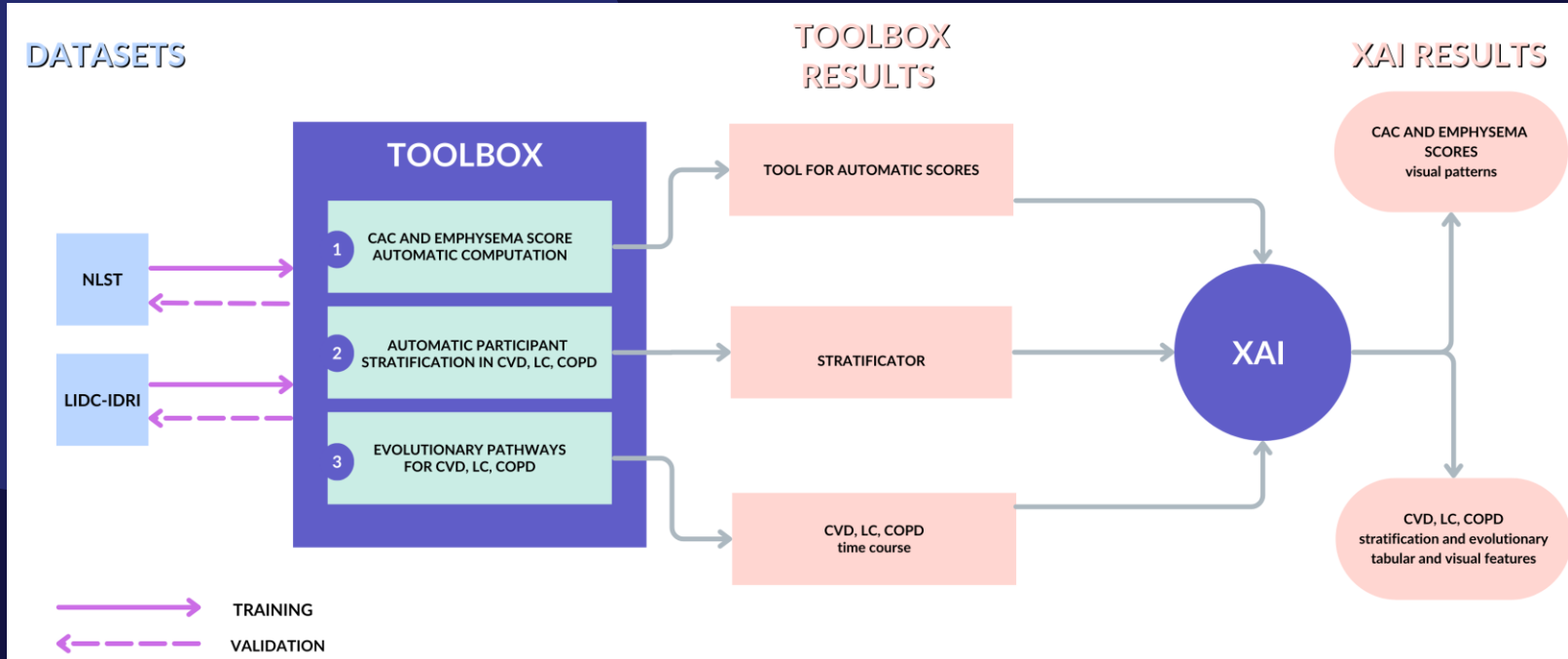


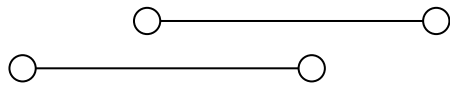


In (più di) due parole



A deep clustering framework for personalized post-test risk stratification in lung cancer screening

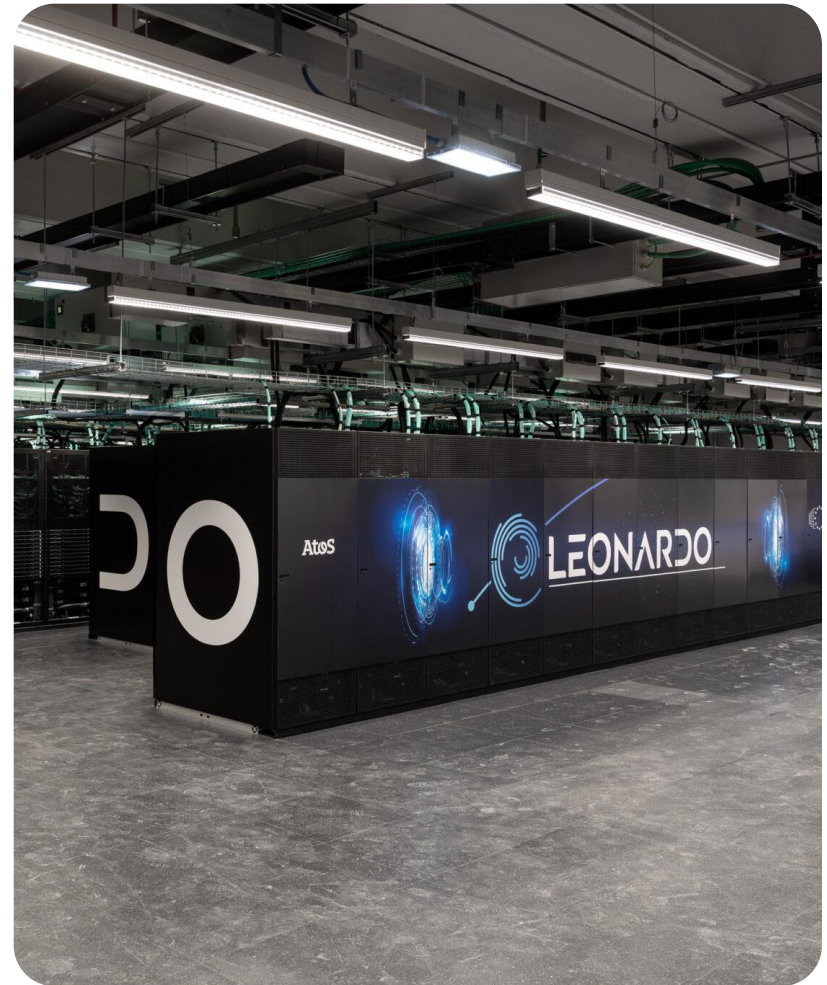
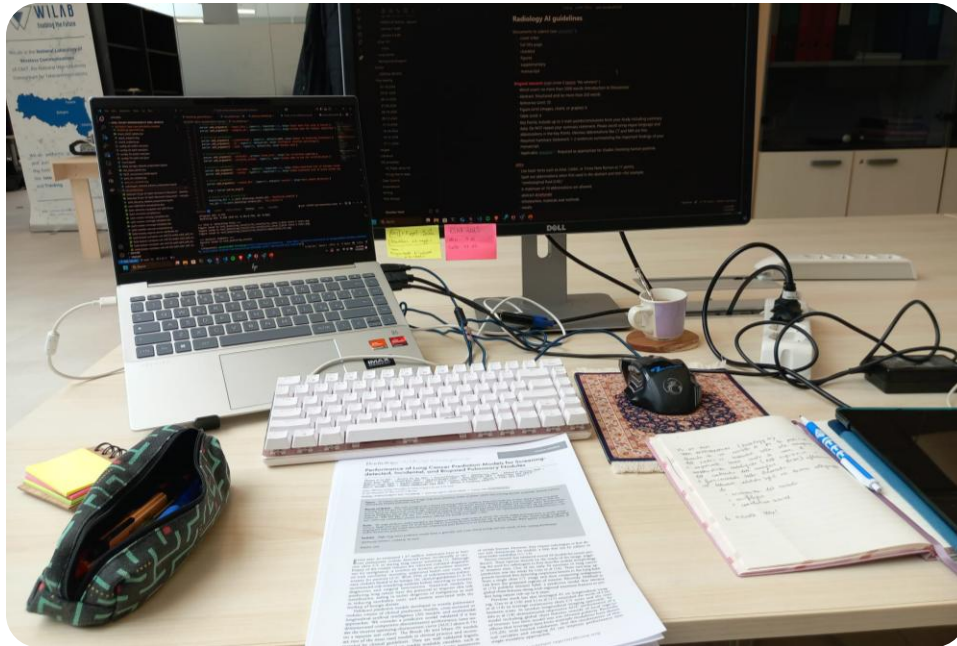




Hardware

Dipende dalla 'potenza di calcolo':

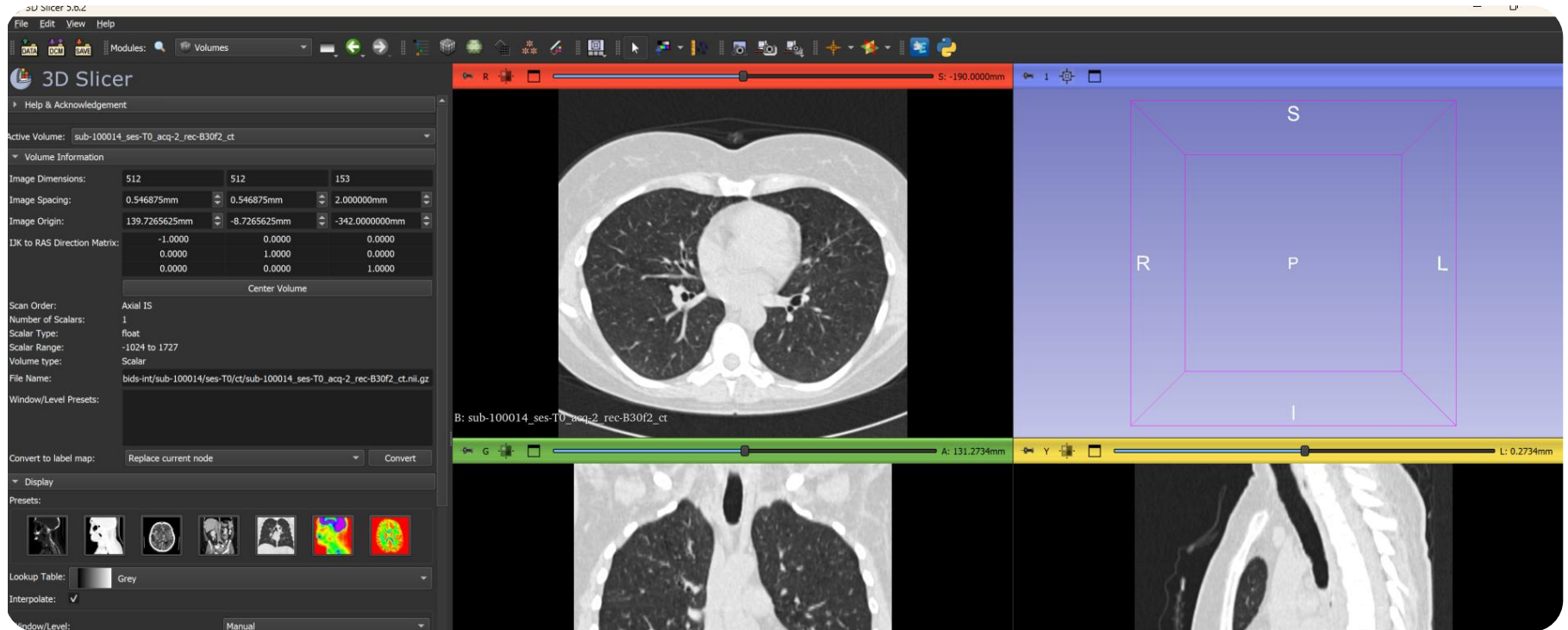
- Personal computer
- High Performance Computing (HPC)

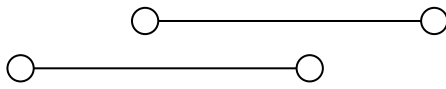




Software

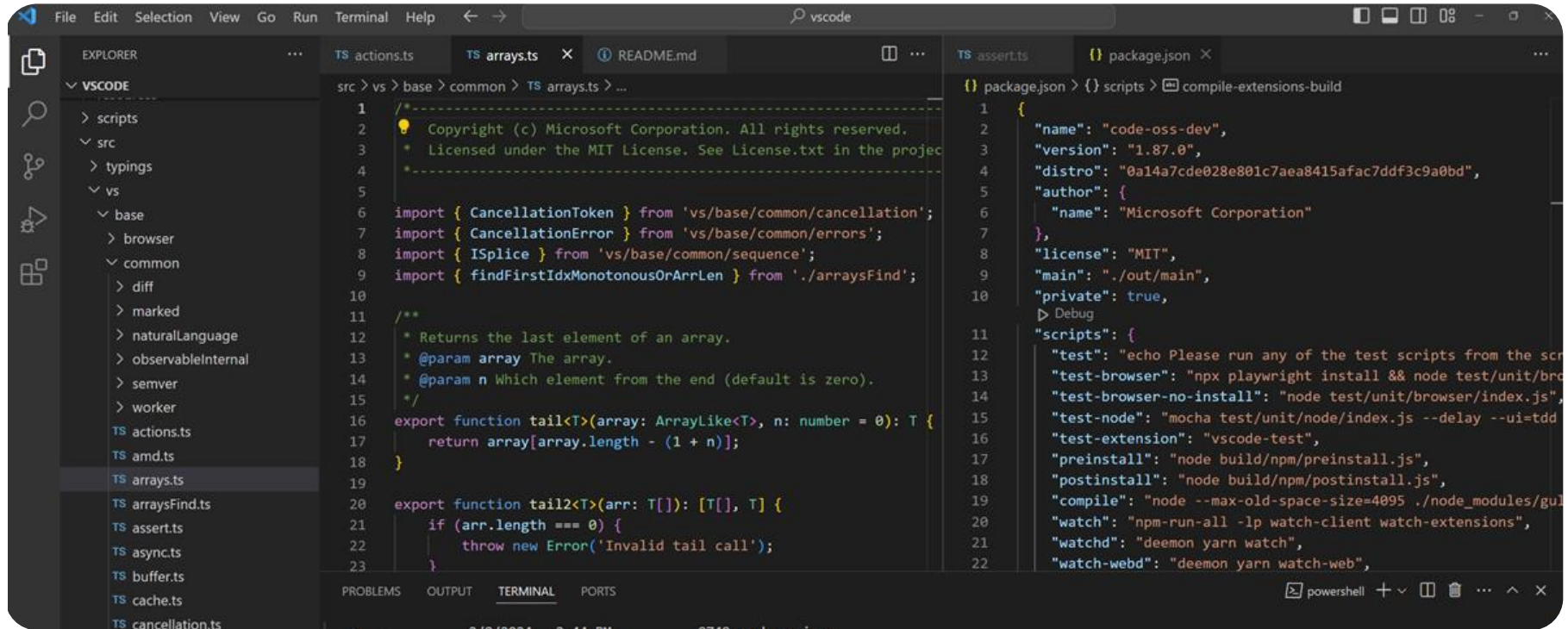
- Visualizzazione immagini mediche (MicroDicom, ImageJ, Slicer)





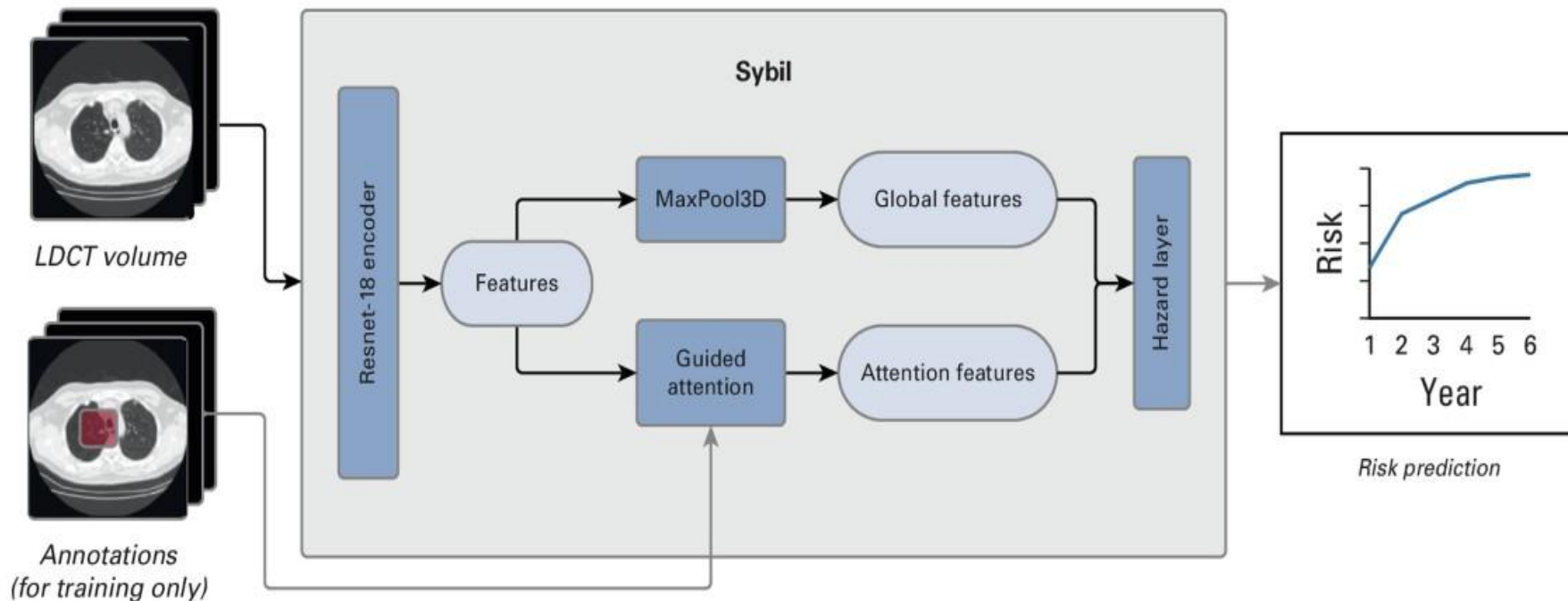
Software

- Editor di codice di programmazione (VS Code)



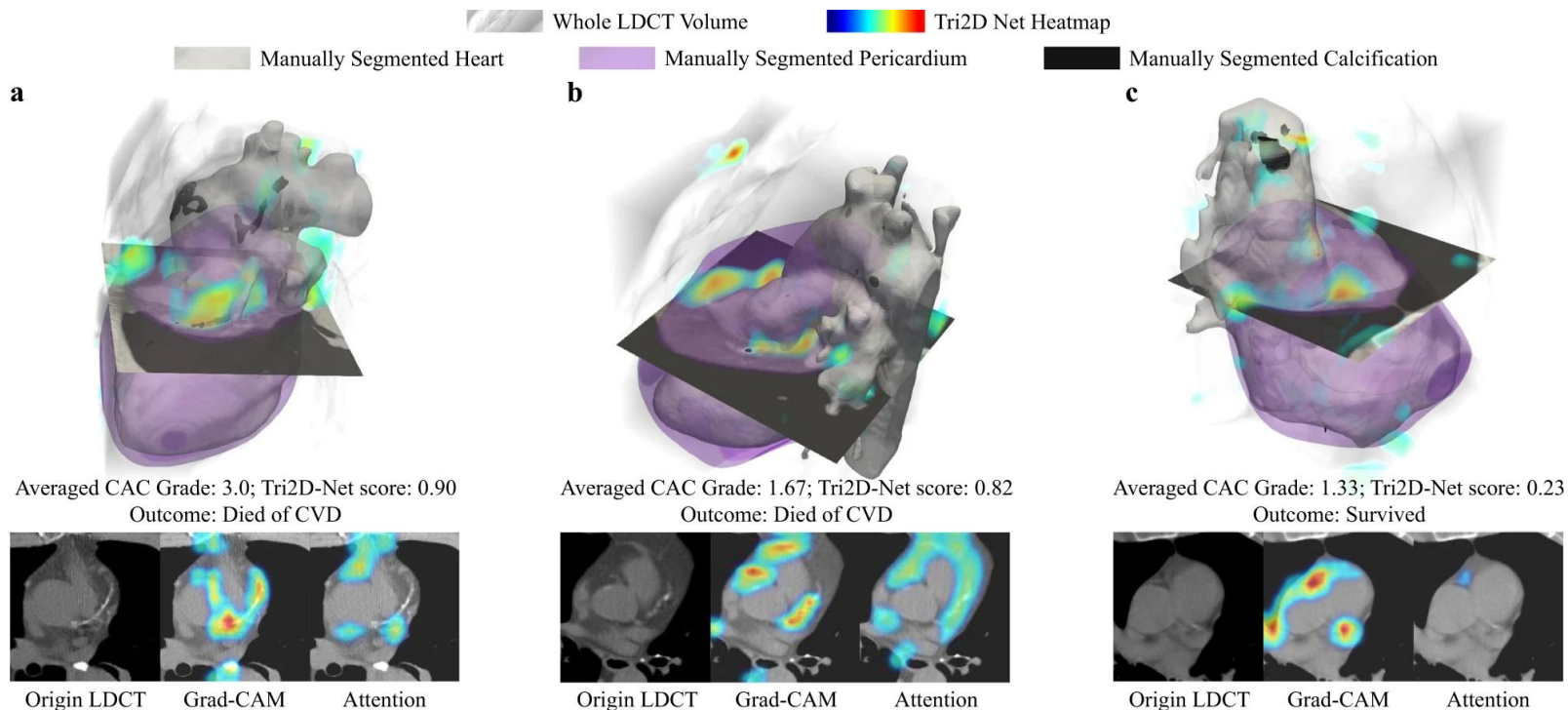
Sybil

Predice la **probabilità di tumore al polmone** da 1 a 6 anni prendendo solo una TC in ingresso



CVD-risk-estimator

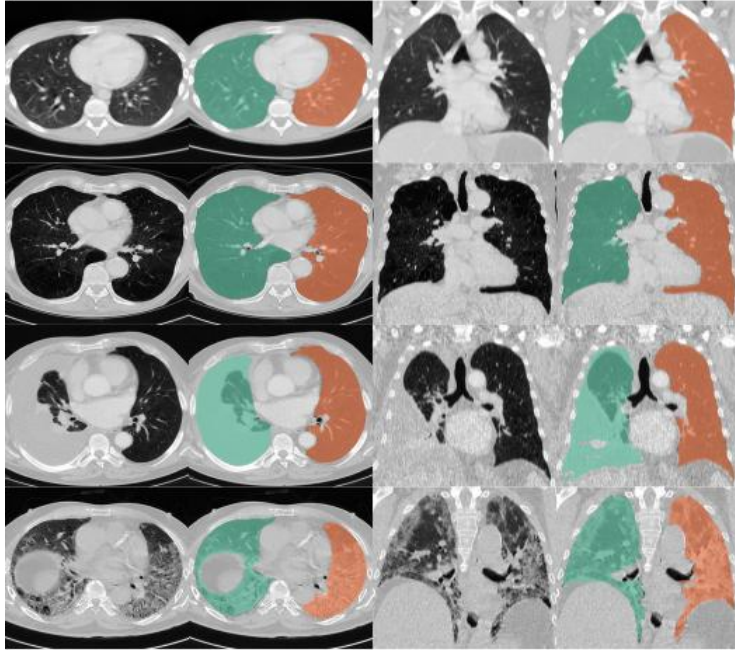
Predice la **probabilità di evento cardiovascolare** entro 1 anno con una sola TC in ingresso



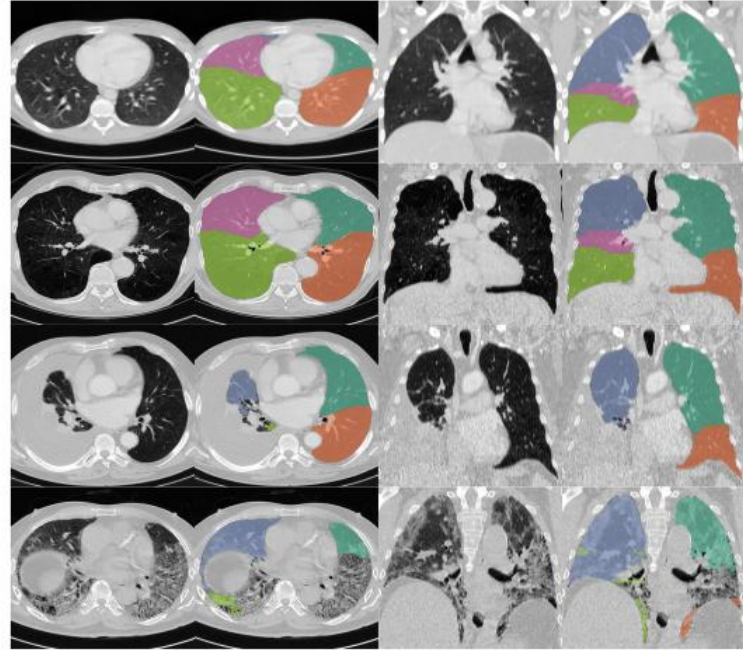
Lungmask

Estrae la **maschera dei polmoni** a partire da una TC

U-net(R231)

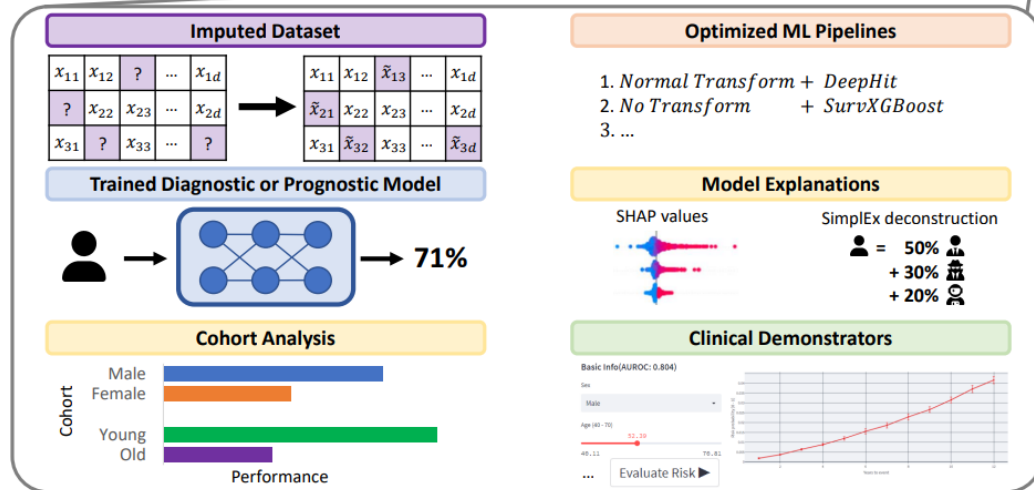
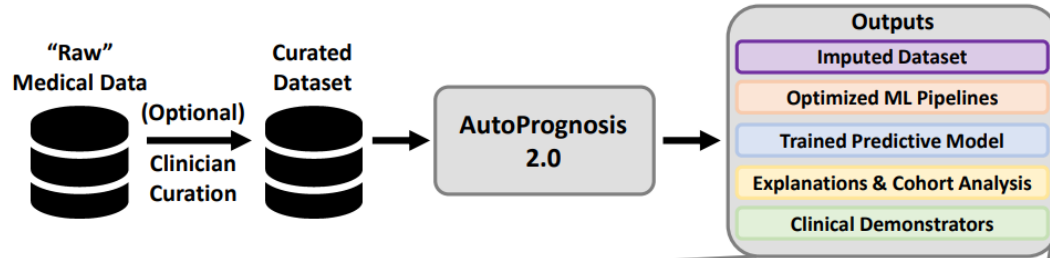


U-net(LTRCLobes)



Autoprognosis 2.0

AutoML per la costruzione automatica di modelli di predizione del rischio clinico



MAISI (nvidia)

Modello diffusivo per la generazione di immagini mediche sintetiche



The screenshot displays the NVIDIA MAISI web interface. On the left, a configuration panel is visible with the following sections:

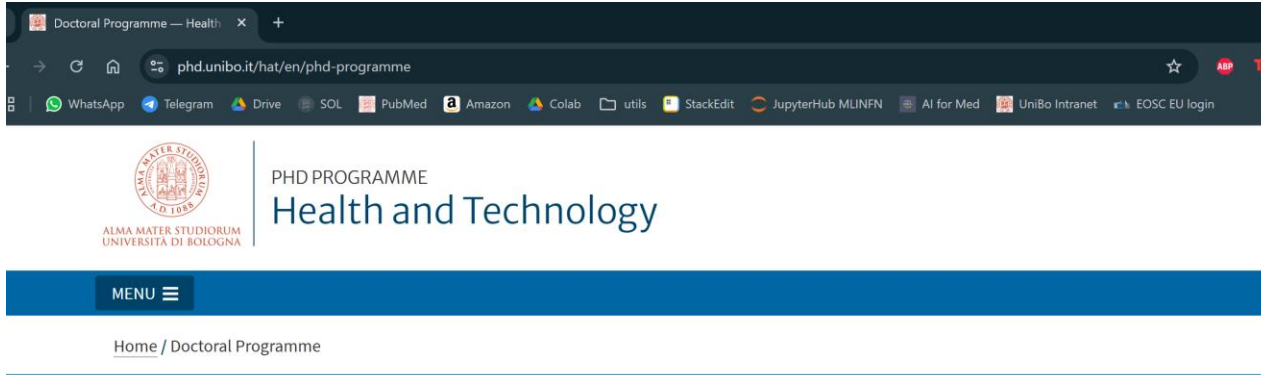
- Body Region:** Set to "Anatomy Scale".
- Body Region:** "Generate image and label by providing body region and anatomy" with a "View Anatomy Regions" link.
- Body Regions:** A dropdown menu showing "Chest".
- Anatomies:** A set of radio buttons for selecting anatomical regions: "left lung upper lobe", "left lung lower lobe", "right lung lower lobe", "right lung upper lobe", and "right lung middle lobe".
- Resolution and output spacing:** Includes "X,Y Dimensions" (set to 256) and "Z Dimension" (set to 256).
- Output coronal and sagittal spacing:** A slider set to 1.5.
- Output axial spacing:** A slider set to 1.5.

At the bottom of the configuration panel are "Reset" and "Run" buttons. On the right, a 3x3 grid of images is shown:

- Top-left: "Axial" CT scan image.
- Top-right: "Anatomy Labels" panel.
- Middle-left: "Coronal" CT scan image.
- Middle-right: "Sagittal" CT scan image.

Each image panel has a "Preset" button. The interface also includes a search bar at the top right and a footer with governing terms.

Health and Technology PhD

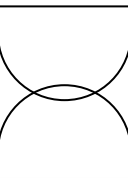


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Health and Technology PhD



Health

Prof. Mario Mascalchi

SSD: MED/50 - SCIENZE
TECNICHE MEDICHE
APPLICATE

Dipartimento di Scienze
Biomediche, Sperimentali
e Cliniche "Mario Serio" -
Università di Firenze



Health and
Technology
PhD Candidate

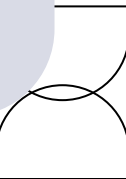


Technology

Prof. Stefano Diciotti

SSD: ING-INF/06
BIOINGEGNERIA
ELETTRONICA E
INFORMATICA

Dipartimento di Ingegneria
dell'Energia Elettrica e
dell'Informazione
"Guglielmo Marconi" -
Università di Bologna



Health and Technology PhD



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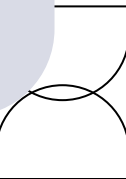


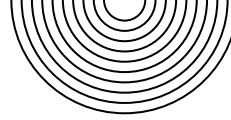
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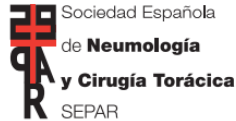
Il primo articolo non si scorda mai

G Model

ARBRES-3687; No. of Pages 9

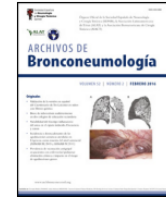
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Archivos de Bronconeumología xxx (xxxx) xxx–xxx



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Review Article

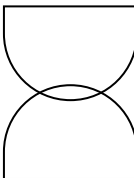
The Pivotal Role of Baseline LDCT for Lung Cancer Screening in the Era of Artificial Intelligence

Giulia Raffaella De Luca^a, Stefano Diciotti^{a,b,1}, Mario Mascalchi^{c,*,1}

^a Department of Electrical, Electronic, and Information Engineering "Guglielmo Marconi" – DEI, University of Bologna, 47522 Cesena, Italy

^b Alma Mater Research Institute for Human-Centered Artificial Intelligence, University of Bologna, 40121 Bologna, Italy

^c Department of Experimental and Clinical Biomedical Sciences "Mario Serio", University of Florence, 50139 Florence, Italy





Gli scienziati
studiano qualcosa

La peer-review



Gli scienziati
descrivono i risultati
in un articolo



L'editor del giornale
riceve l'articolo, dà un
primo giudizio e inoltra
ai revisori



I revisori leggono
l'articolo e inoltrano i
commenti all'editor



L'editor del giornale
inoltra i commenti agli
scienziati



Se l'articolo
(revisionato) va bene
ad editor e revisori,
viene pubblicato



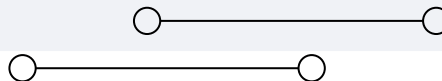
Grazie!

Domande?

giulia.r.deluca@gmail.com



*AI For Medicine
Research Group*



Consigli



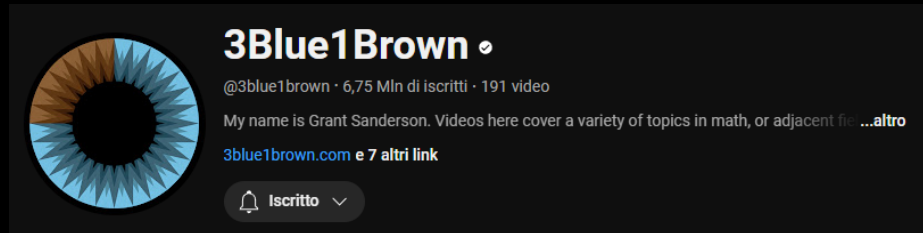
Benjamín Labatut
Maniac
2023 / pp. 361
Adephi



Matteo Bordone
Geniale (podcast)
in collaborazione con FAIR



Melanie Mitchell
L'intelligenza artificiale
2022 / pp. 332
Einaudi



Playlist: Neural networks