Artificial Intelligence/based systems development and integrated solutions for the social and health protection network

Angelo Lasala, Sara Mazzucato, Andrea Bandini, Silvestro Micera and Sara Moccia

Ital-IA, 29-31 maggio 2023

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Ital-IA
ITALIA INTELLIGENZA ARTIFICIALE
Terzo Convegno Nazionale
Pisa 29-31 Maggio 2023
cini National Lab AIIS

Outline

I. Predictive models in medicine from EHR analysis

II. Medical image analysis for supporting clinicians

Bioelectronics Area

Translational Neural Engineering Lab

Artificial Intelligence for Medical Image Analysis Lab

PROXIMITYCARE
Vicini per la salute

Garfagnana, Media Valle del Serchio, Versilia: dove inizia la salute del futuro

- AIM: Promoting the improvement of social and health services in the "*internal areas*" of the province of Lucca
  - --> pilot experimentation in *Garfagnana, Mediavalle del Serchio* and *Alta Versilia* which can then be **replicated** also in other areas
- Three specific areas of intervention:
  1. connectivity and **digital**
  2. health, social and health services and social capital
  3. **innovative technological solutions**

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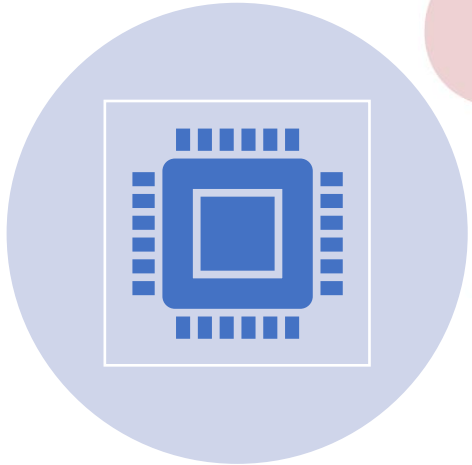
Predictive models in medicine from EHR analysis

Sara Mazzucato

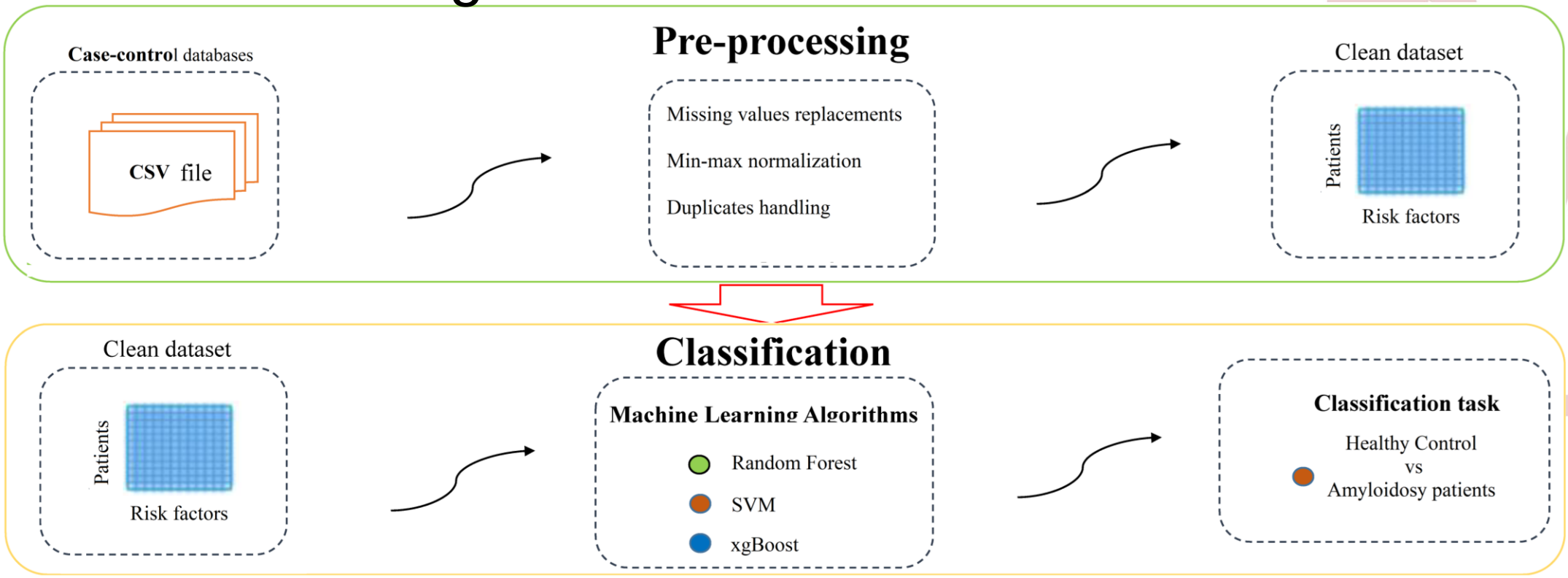
Proximity Project Aims

To facilitate the automatic filling of electronic health records (**EHRs**) given unstructured text from general practitioners



To develop predicting algorithms for **early screening** of the population

Classification of patients with cardiac amyloidosis using machine learning models on Italian EHR*



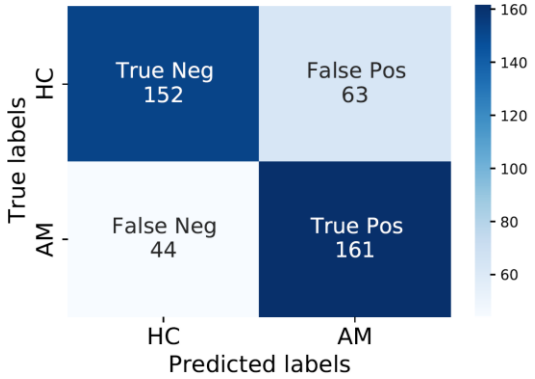
*accepted at the *Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (EMBC'23) to be held in Sydney, 24-28 July 2023

Classification of patients with cardiac amyloidosis using machine learning models on Italian EHR*

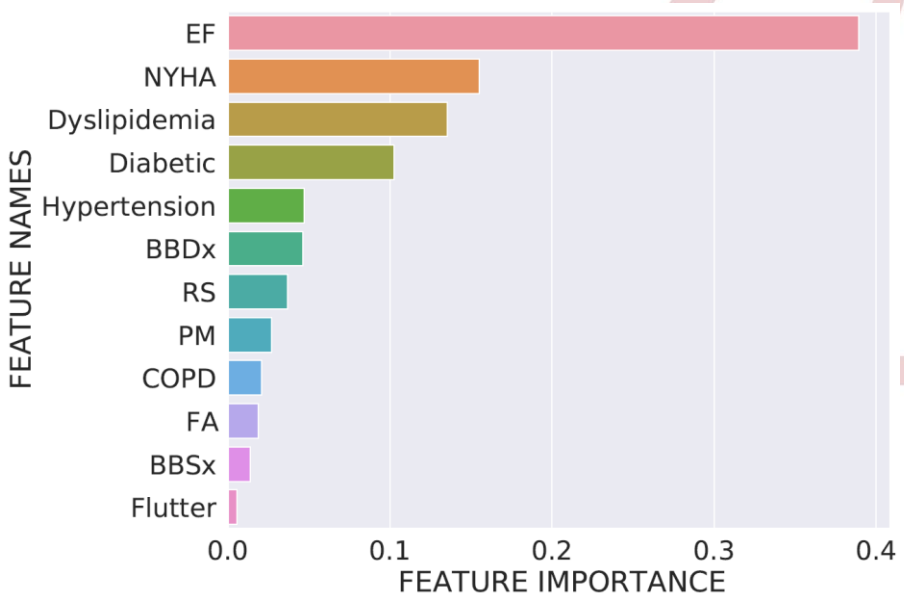
Precision, Recall and F1 of the classifiers

	RF	SVM	XGB
P	0.72 (0.68, 0.75)	0.64 (0.57, 0.68)	0.72 (0,69, 0.77)
R	0.76 (0.57, 0.81)	0.61 (0.54, 0.69)	0.78 (0.75, 0.80)
F1	0.73 (0.71, 0.75)	0.61 (0.58, 0.68)	0.74 (0.72, 0.77)

Confusion matrix of RF



Feature importance of RF



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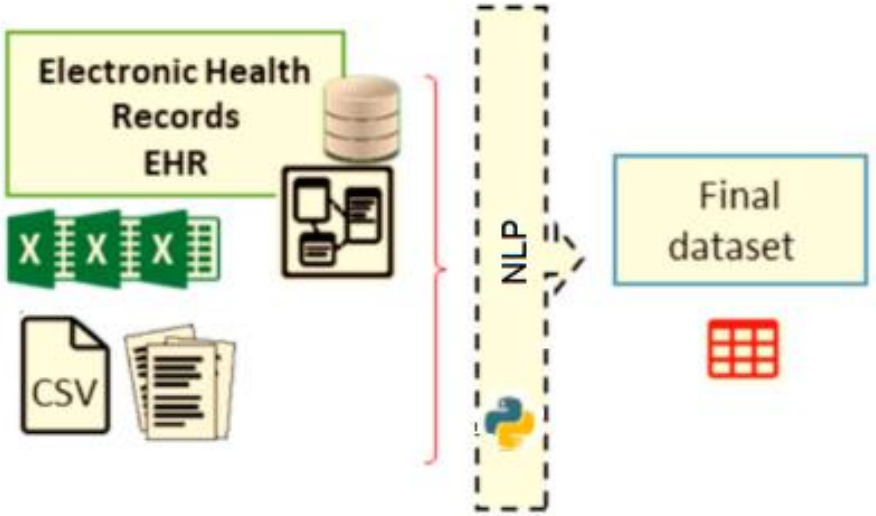
Natural Language Processing for EHR

- Natural language processing (**NLP**) is a form of machine learning which enables the processing and analysis of free text.
- NLP&Healthcare:
  - **prediction** of patient outcomes
  - diagnostic models for **early**-stage disease detection
  - **personalized** medicine



E	#	LOSS TRANS...	LOSS NER	ENTS_F	ENTS_P	ENTS_R	SCORE
0	0	443.83	682.09	0.00	0.00	0.00	0.00
2	200	22863.53	29181.67	62.14	59.45	65.09	0.62
5	400	836.81	1737.57	73.17	69.23	77.59	0.73
8	600	547.74	1036.56	80.75	78.46	83.19	0.81
11	800	353.19	684.22	76.07	72.37	80.17	0.76
14	1000	520.75	535.82	68.98	65.50	72.84	0.69
17	1200	258.53	337.69	74.19	69.70	79.31	0.74
19	1400	170.67	229.74	72.90	66.55	80.60	0.73
22	1600	122.87	165.67	75.52	72.80	78.45	0.76
25	1800	78.17	125.84	71.34	68.38	74.57	0.71
28	2000	61.96	73.69	75.05	71.94	78.45	0.75
31	2200	37.11	51.61	75.31	72.05	78.88	0.75

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Medical image analysis for supporting clinicians

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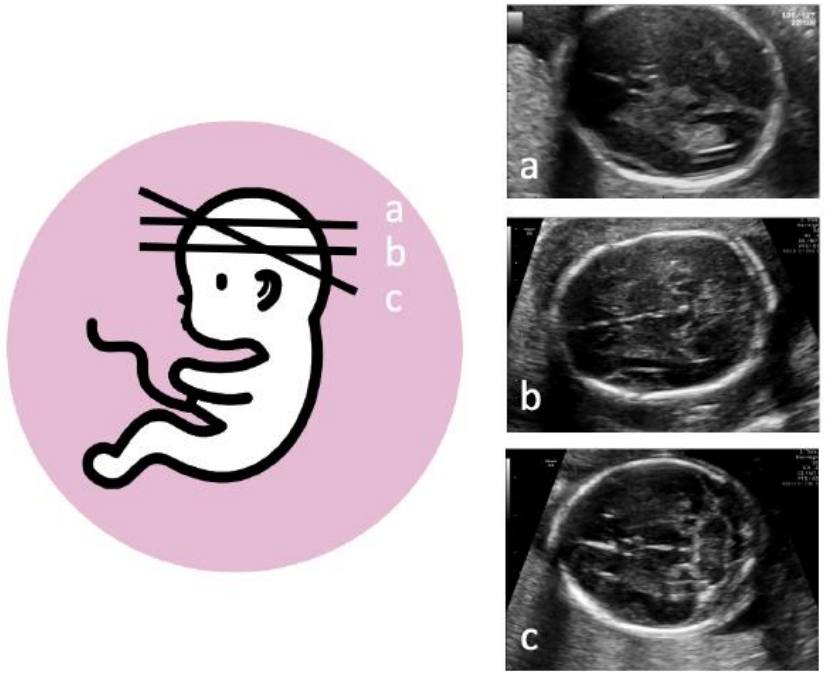
Ultrasound aquisition

- Ultrasound (US) aquisition is extensively used due to its
  - low-cost
  - portability
  - non-invasive nature
- Useful for different applications
  - gynacology
  - cardilogical desease
  - ...

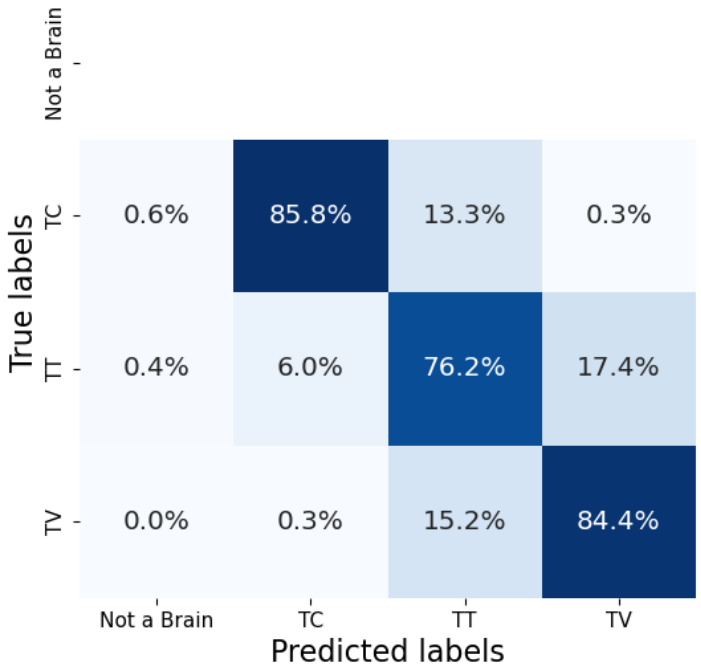
Fetal Head Standard Planes detection



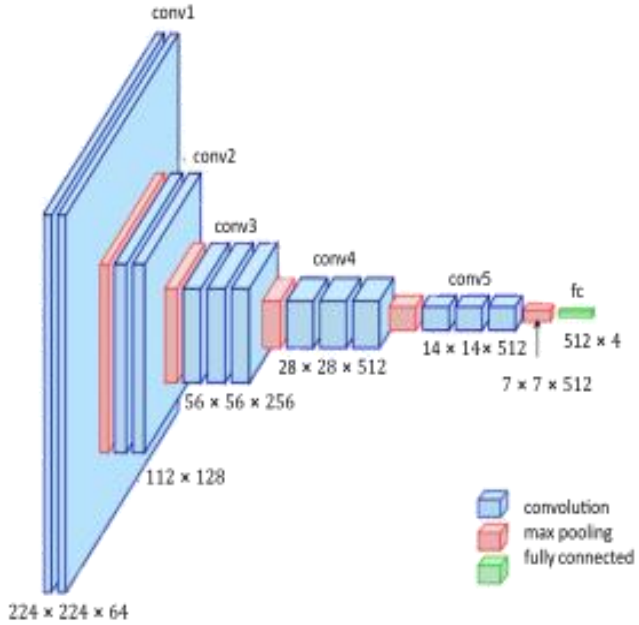
- FHSPs is of fundamental importance to achieve better **reproducibility** biometric assessments
- The goal is the **automatic identification** of FHSPs

Reference: Burgos-Artizzu, X.P., Coronado-Gutiérrez, D., Valenzuela-Alcaraz, B. *et al.* Evaluation of deep convolutional neural networks for automatic classification of common maternal fetal ultrasound planes. *Sci Rep* **10**

Fetal Head Standard Planes detection



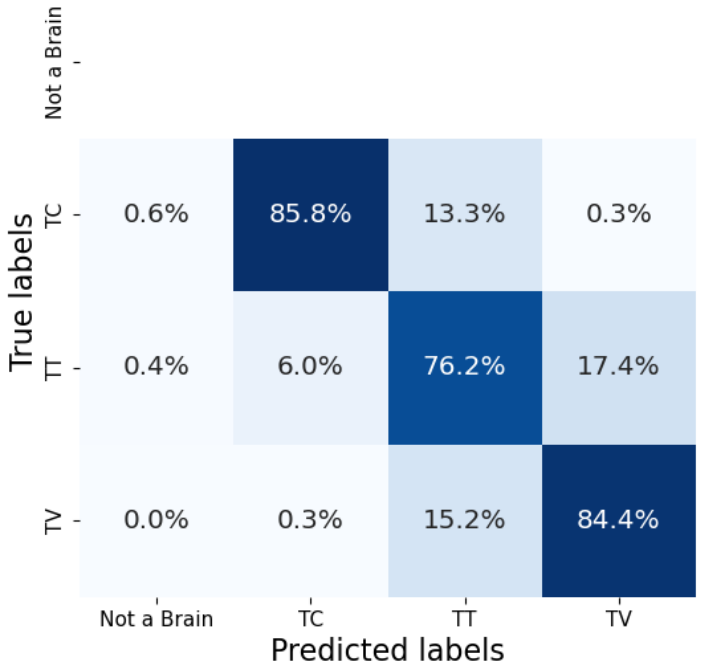
224 × 224 × 3 pixels

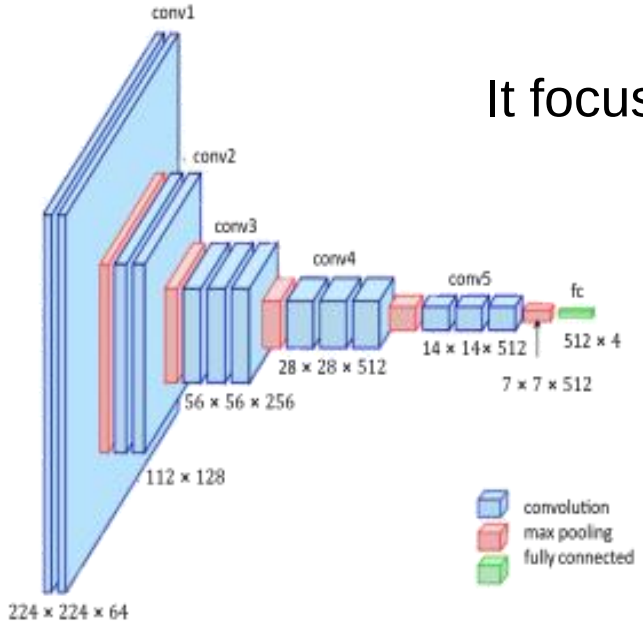


Output

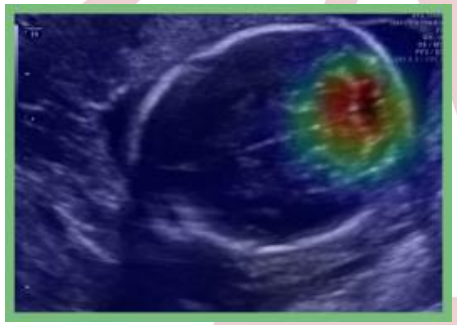
Trans-cerebellum

Fetal Head Standard Planes detection*





It focuses on the **cerebellum**



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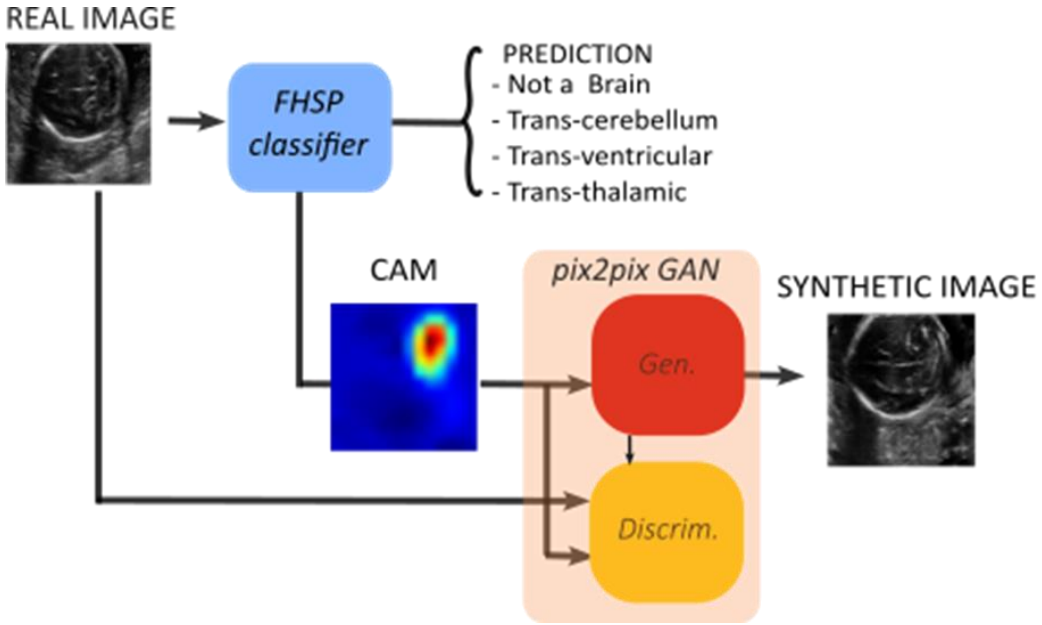
Synthetic generation*

- The goal is to map the Class Activation Map (**CAM**) to **real US image**



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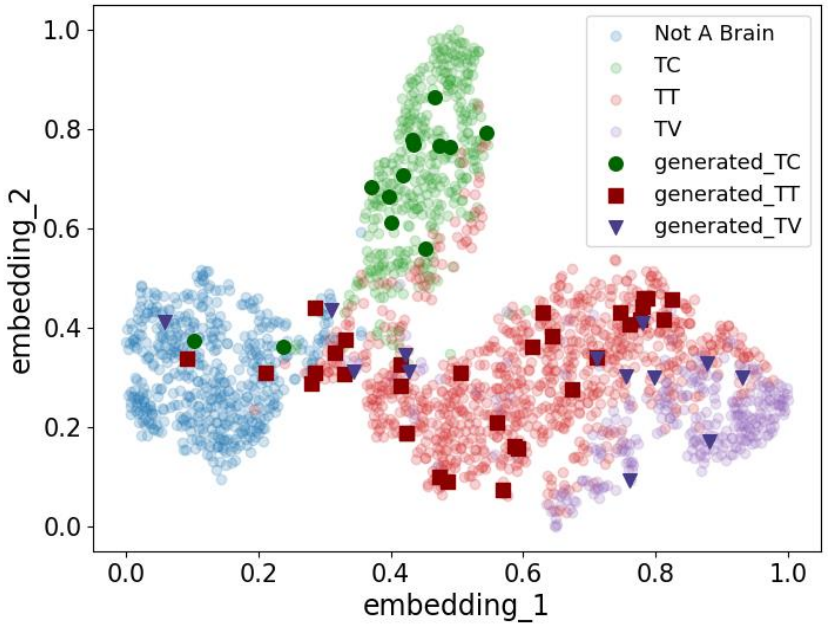

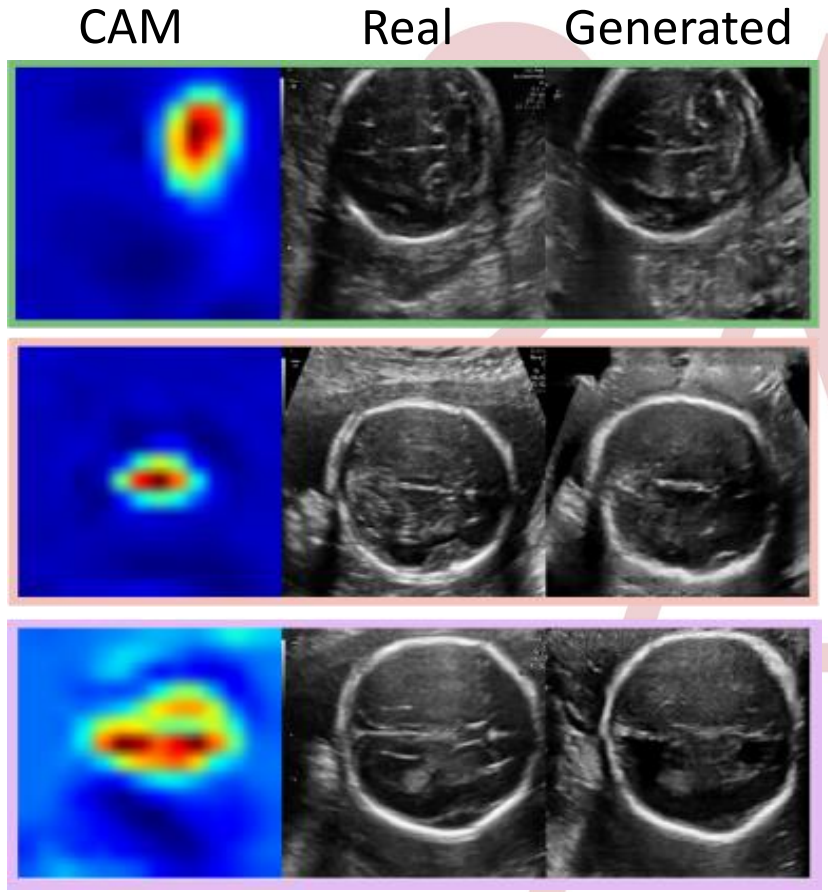

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Future work

- Predictive models in medicine from EHR analysis
  - Automatic feature selection
  - Longitudinal data to develop ML tools
  - NLP to create predictive algorithms for detecting amyloidosis
  - Expand dataset extending to the medical records of general practitioners in the *Garfagnana* area
- Medical image analysis for supporting clinicians
  - Improve the quality of generalization
  - Extent the proposed approach to cardiac aquisition
  - Deploy the model on robotic platforms

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