Deep Learning
A practical clinical project

Belnuc AI seminar

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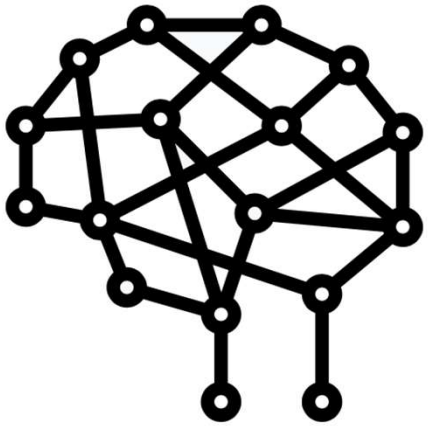
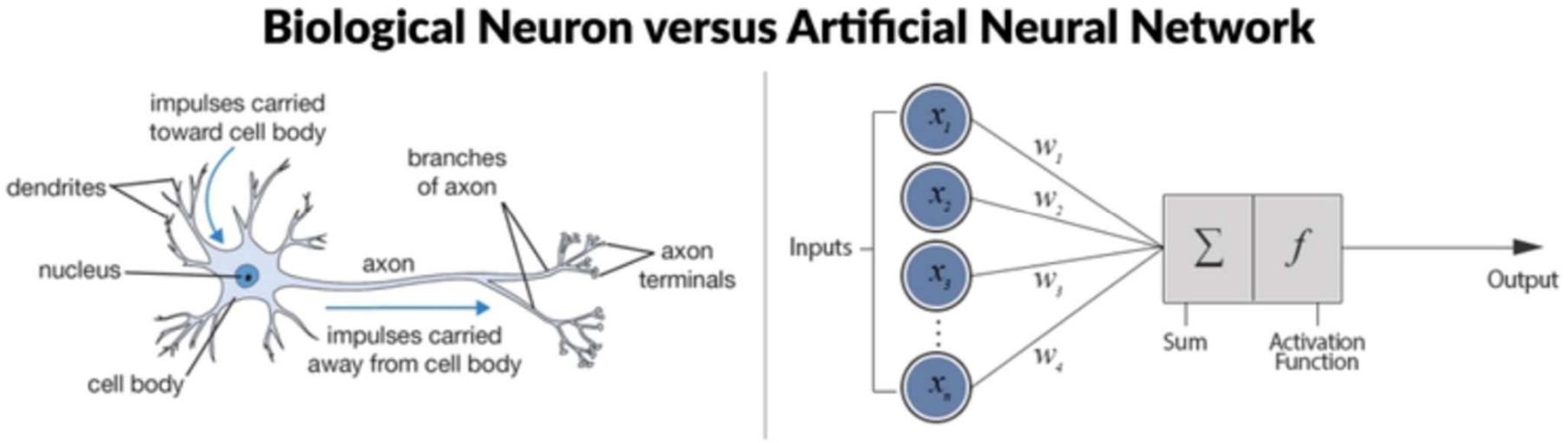
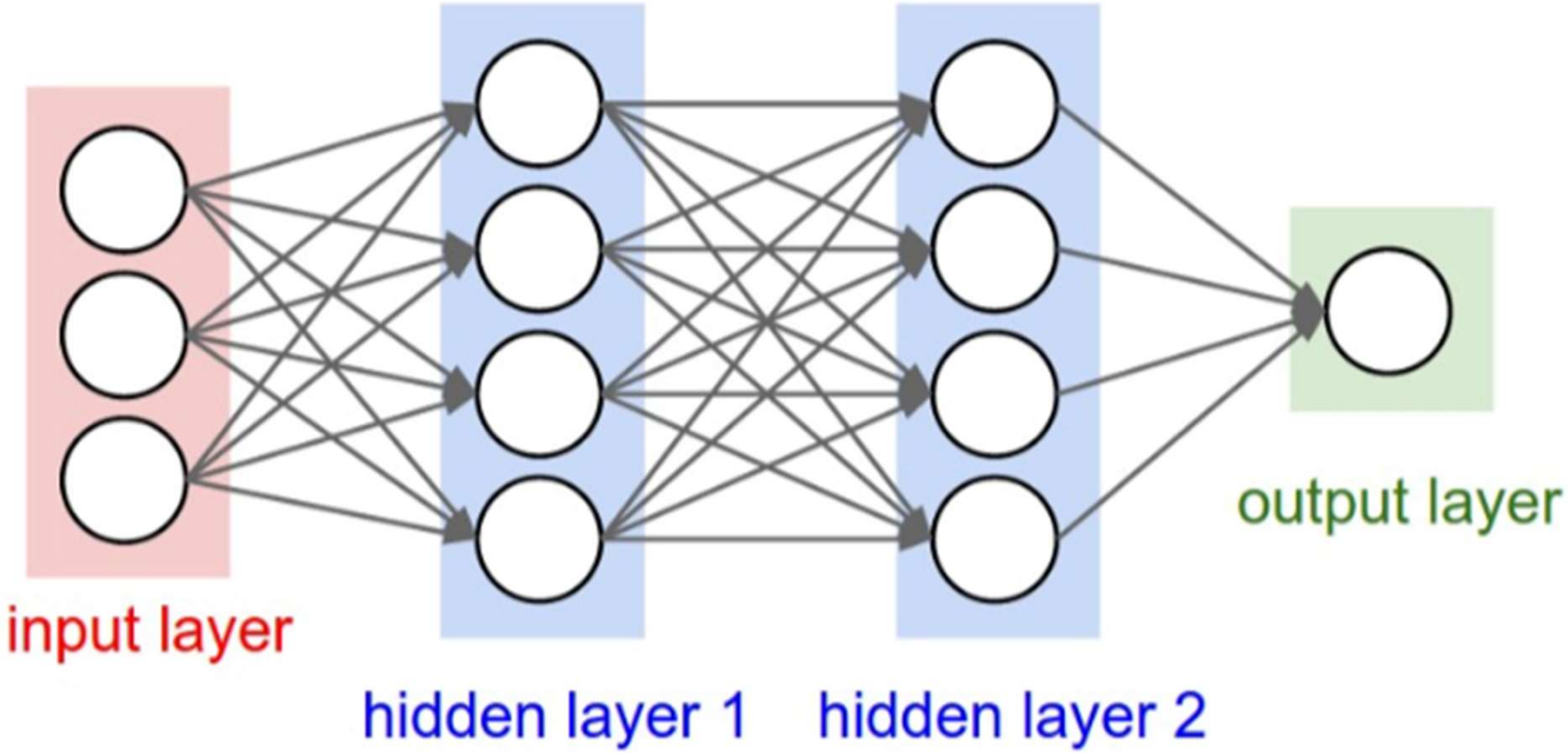


Neural Networks

Deep Learning

- A virtual neural network able to perform a single task as to extract patterns in images (medical or not)
- The potential goes from segmentation to extraction of complex radiomic features

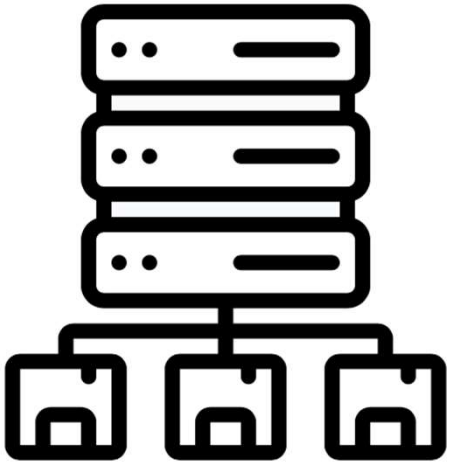



input layer
hidden layer 1
hidden layer 2
output layer

3 conditions to effectively train neural networks :

- Access to a large **Database** ; large enough to correctly train the network
- Access to a **Correct labelling** in digital form
- Access to **Computiong power** to accelerate the process of training(GPUs)

- After training, the network is usable to perform predictions on new data.



Local Project

1. Thyroid scintigraphy Segmentation

>2300 Scintigraphies

Drawing >2300 ROIs

Matrix 256 x 256

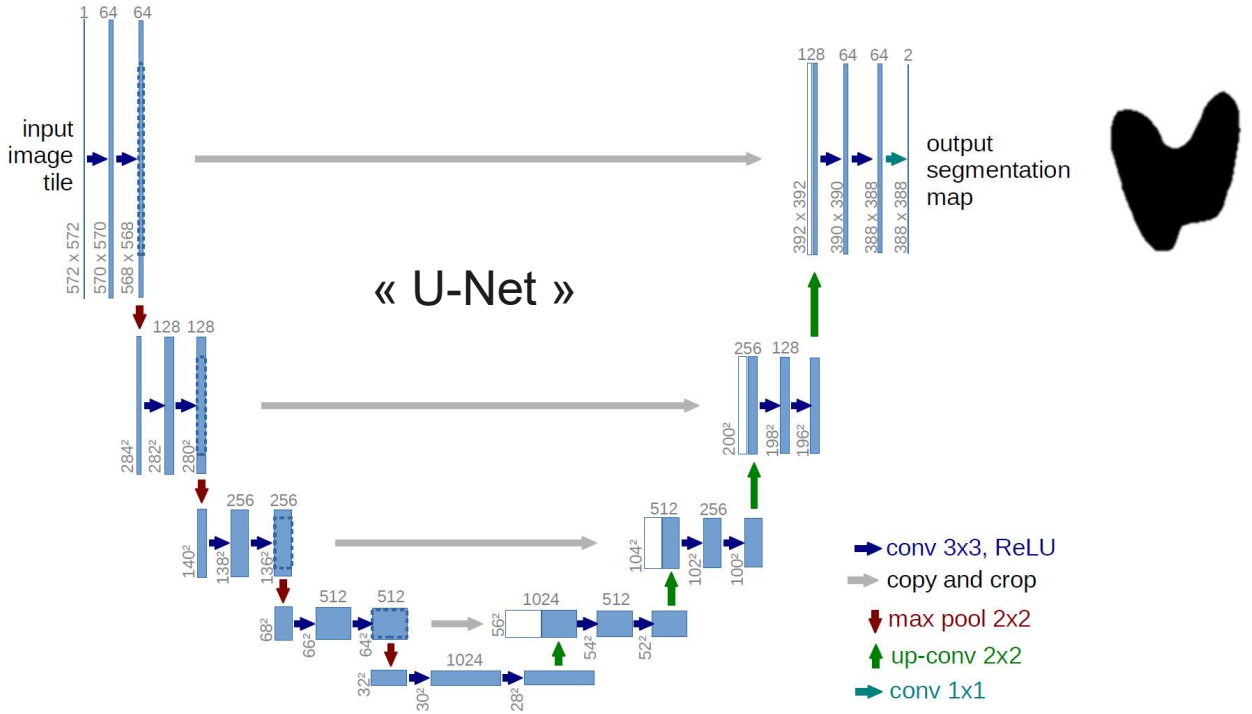
Conversion in « mask »

Automated using python script

>4600
couples scinti/masque

3800
pour training

800
For testing



python

Keras

TensorFlow

pydicom

2 GPUs NVIDIA GTX 1070 (2017)

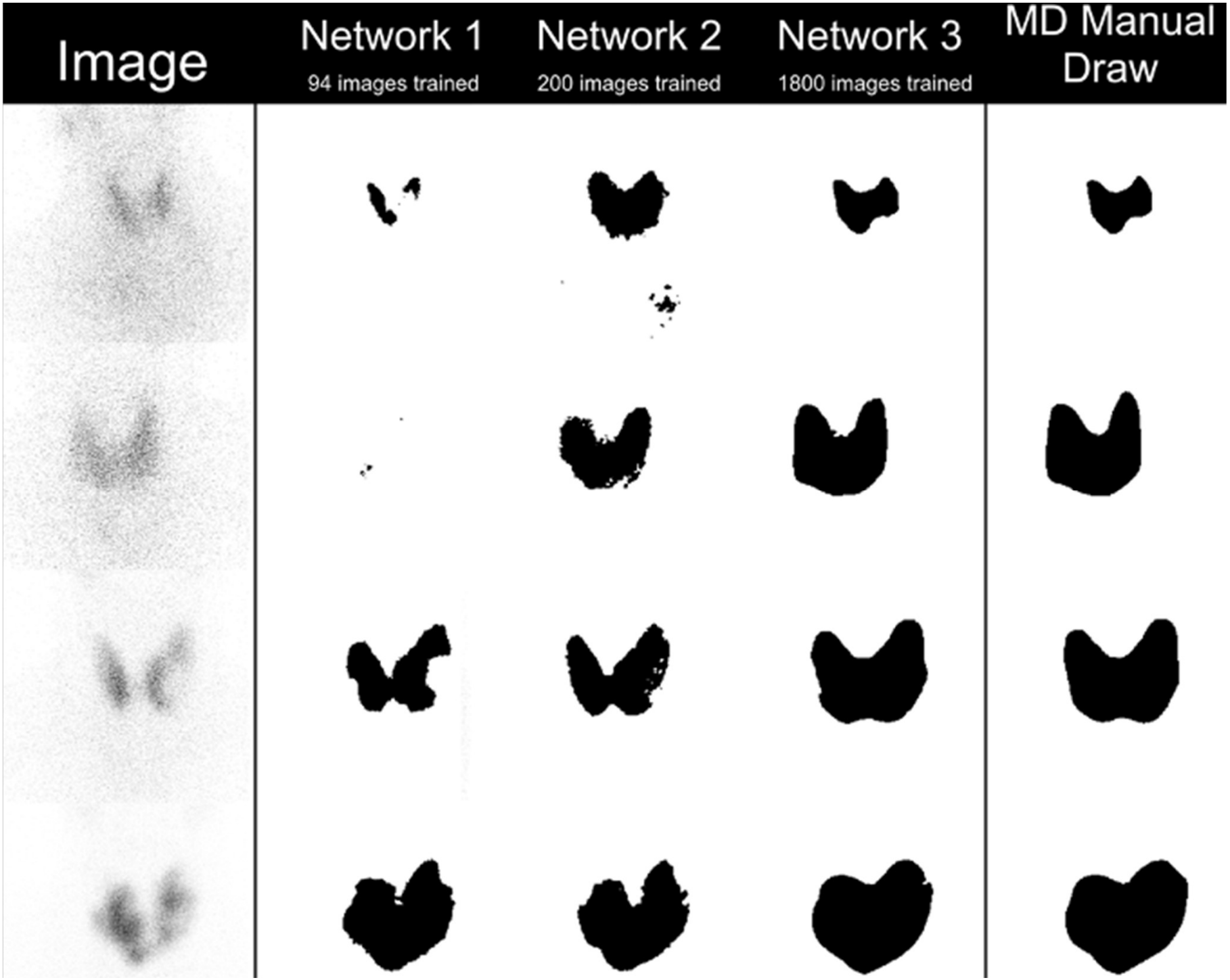
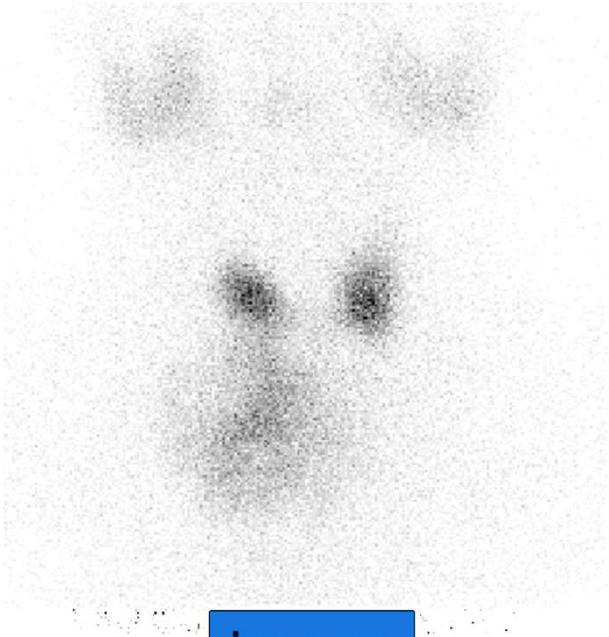


Image
Network 1
94 images trained
Network 2
200 images trained
Network 3
1800 images trained
MD Manual Draw

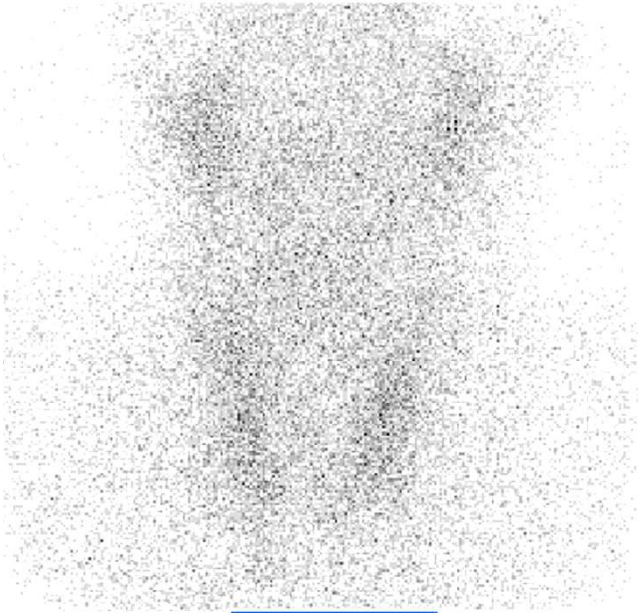


image

AI guess

dice 0.973

human drawn

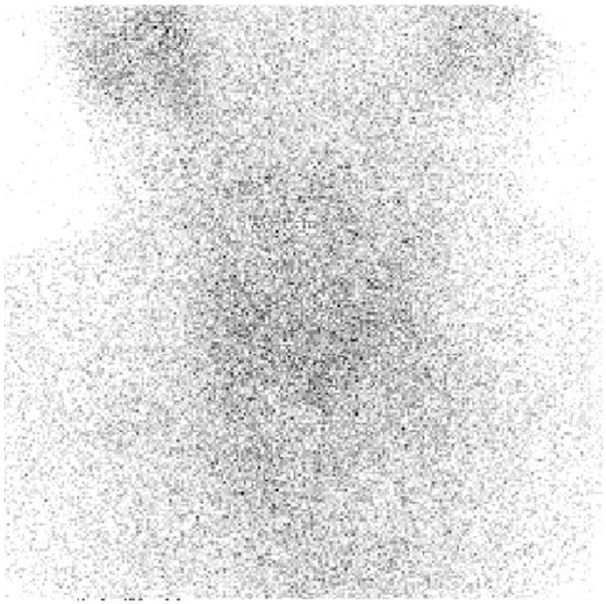


image

AI guess

dice w

human drawn



image

AI guess

dice w

human drawn

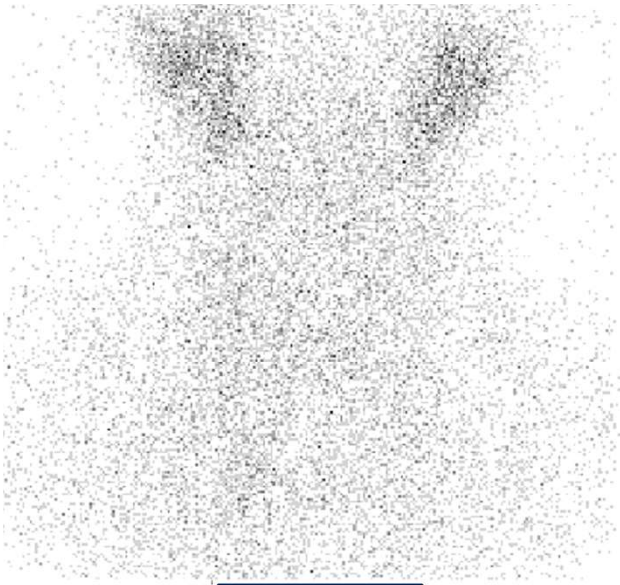


image | AI guess | dice - | human drawn

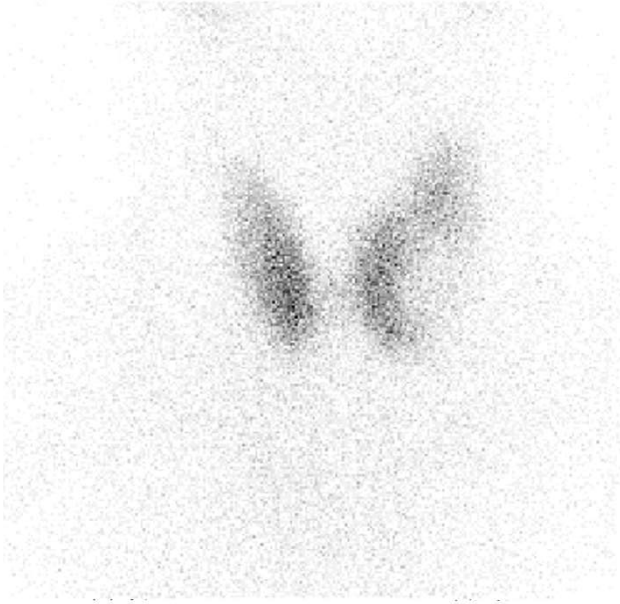
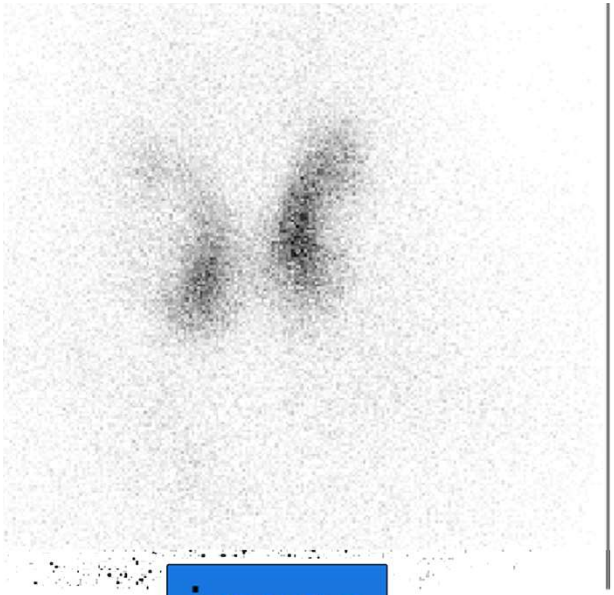


image | AI guess | dice 0.975 | human drawn



image

AI guess

0.9920

human drawn

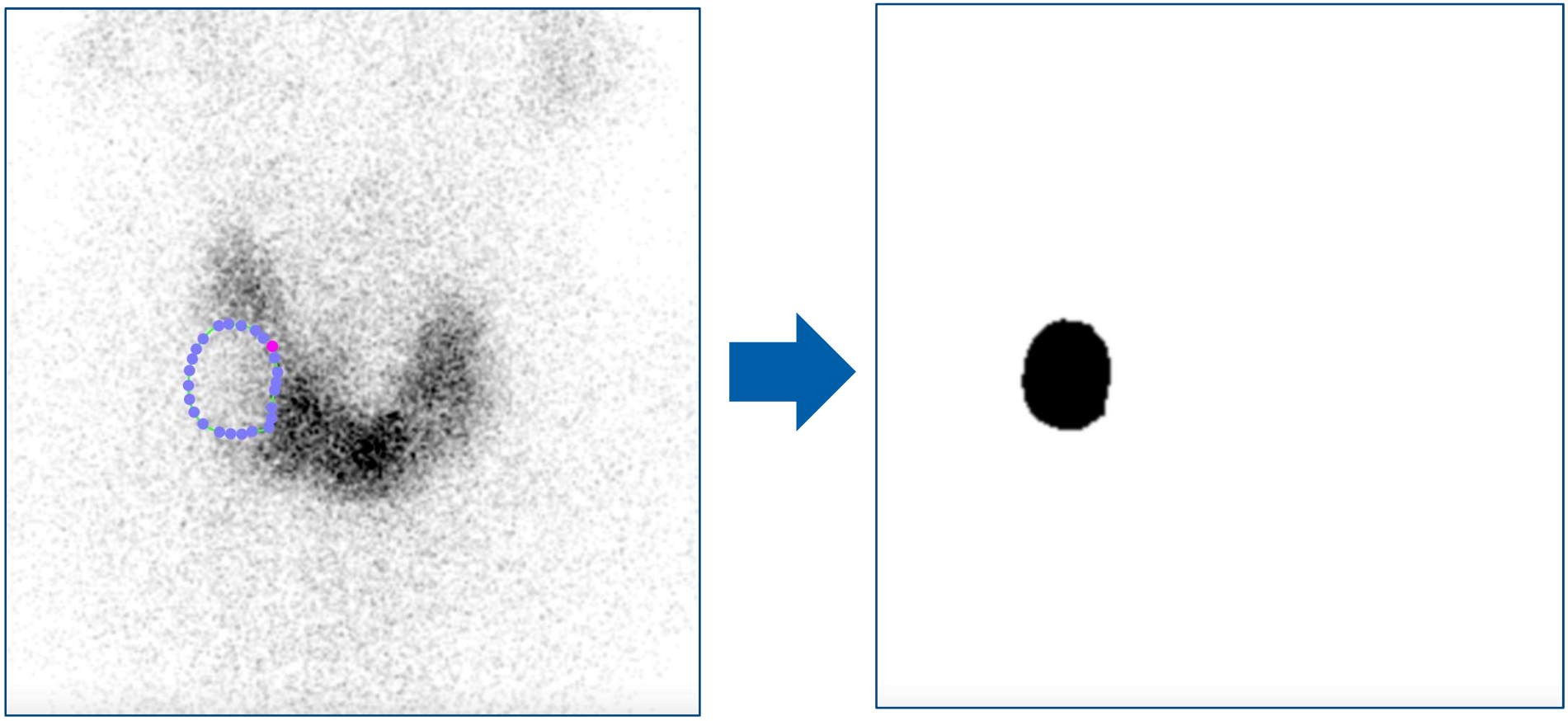
image

AI guess

0.9899

human drawn

2. Cold Nodules



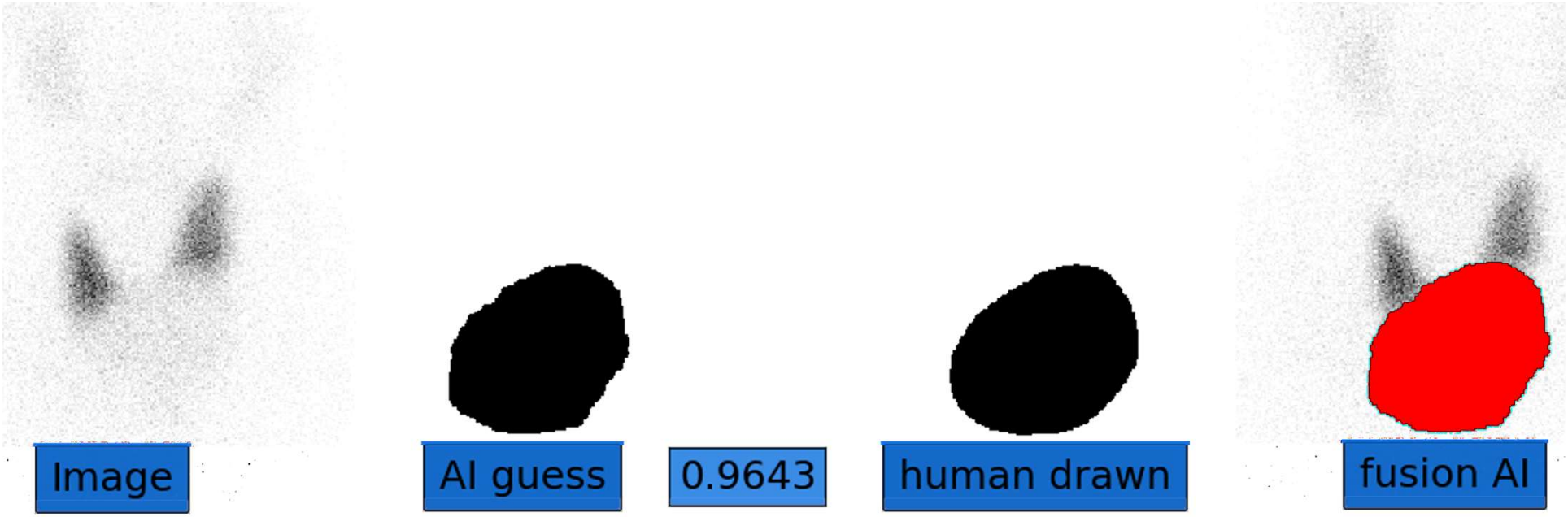


Image
AI guess
0.9643
human drawn
fusion AI

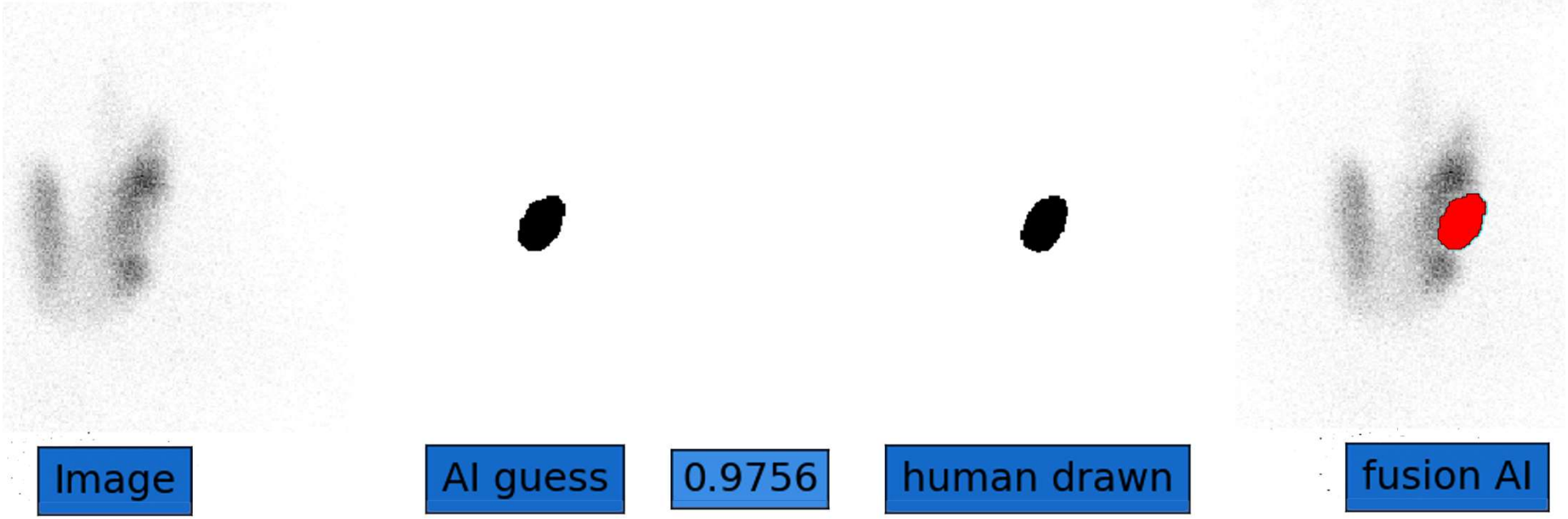
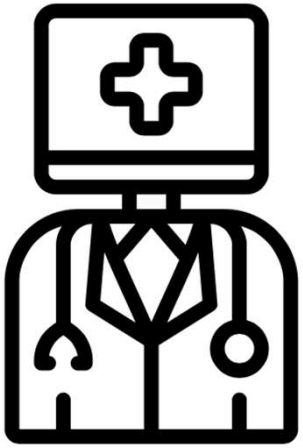


Image
AI guess
0.9756
human drawn
fusion AI



Clinical Use

2 sides of development

AI pure

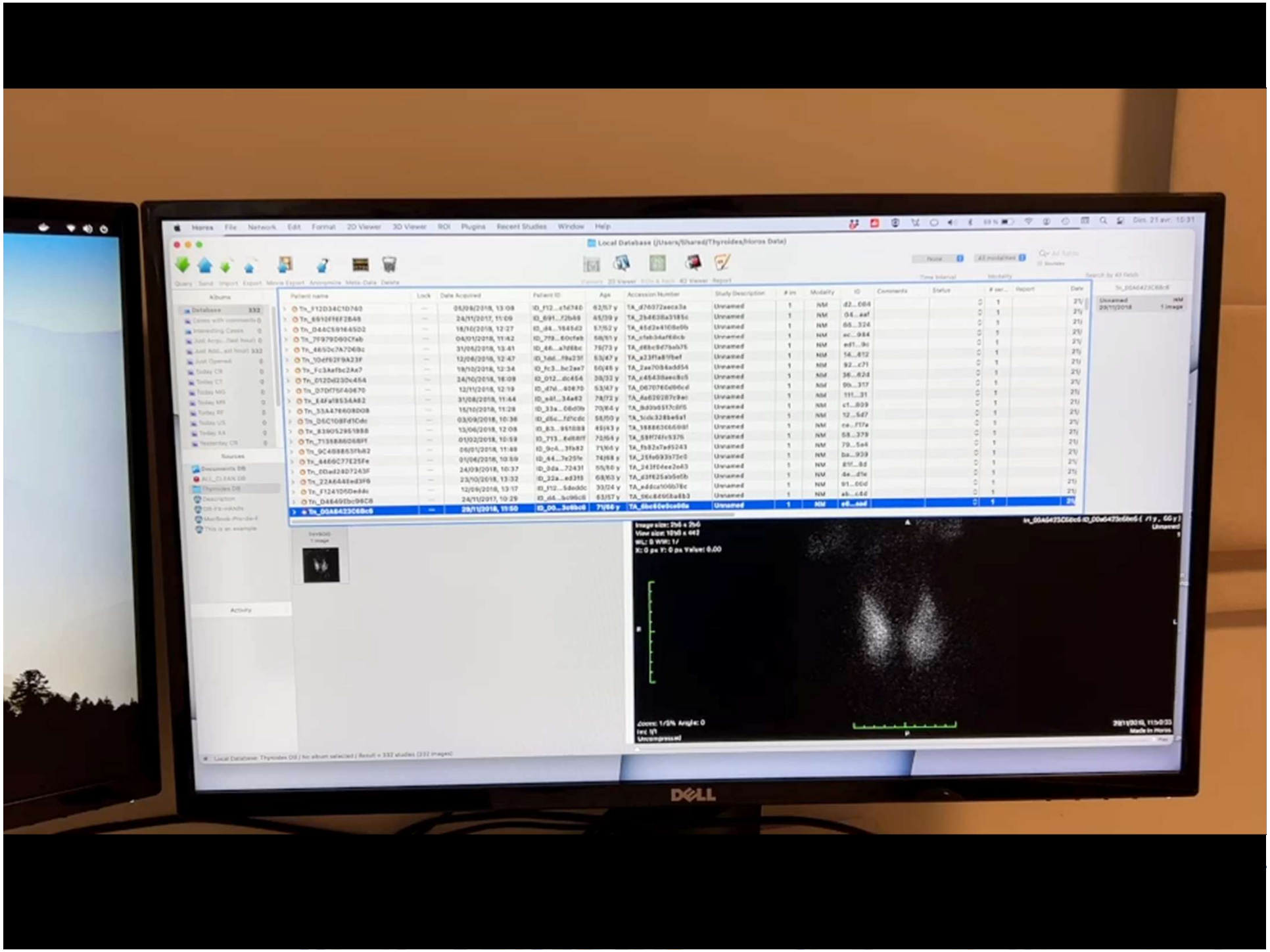
deep Learning

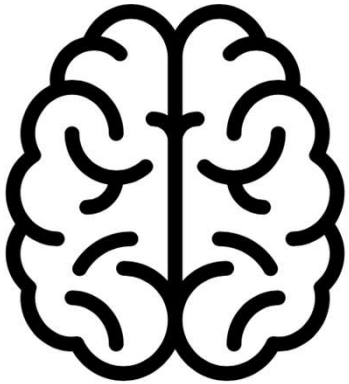
- Collect and preparation of data (data mining)
- Compilation of network architecture
- Training(s) to obtain a valid network
- Verification of performance with validation and test data

Solution for use

Clinical daily

- Incorporation of networks, libraries, and rules of functionning in a dicom server
- Pure backend server - no GUI
- Can handle multiple data interpretation based on rules related to dicom header
- Upgrade or versionning invisble to end user


Horos File Network Edit Format 2D Viewer 3D Viewer ROI Plugins Recent Studies Window Help
Local Database (/Users/Shared/Thyroides/Horos Data)
DELL



Conclusions

Conclusions - 1

This small project has no major clinical impact but reached mainly 2 objectives:

- Get hands in AI and finish an entire project from data mining, deep learning training, and clinical availability in a way to get ready for **larger projects**

- This project is a demonstration that deep learning can create added value to the interpretation of **Any** nuclear medicine image in a clinicaly acceptable time

Conclusions

- We – as a scientific community – have all the data and skills to establish **LARGE** databases in nuclear medicine that will lead the way to an increased data extraction of image features.
- The understanding of underlying processes is necessary to maintain a critical interpretation of results
- Detection of cold nodules is **very sensitive** but not specific **BY DESIGN** – as an adjuvant to interpretation, **NOT a substitute**

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