

10-11
OTTOBRE
2019
MILANO
PALAZZO
LOMBARDIA



Il progetto Europeo DeepHealth:
obiettivi e prospettive di ricerca

DEEPHEALTH

Prof. Marco Grangetto



di.unito.it

DIPARTIMENTO DI INFORMATICA
Università degli Studi di Torino



DeepHealth project

Deep-Learning and HPC to Boost Biomedical Applications for Health



21 partners from **9 countries**: Research centers, Health organizations, large industries and SMEs



Barcelona Supercomputing Center
Centro Nacional de Supercomputación



UNIVERSITÀ DEGLI STUDI DI TORINO



UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA



Karolinska Institutet



SPITALUL CLINIC PROF. DR. THEODOR BURGHELE BUCUREȘTI



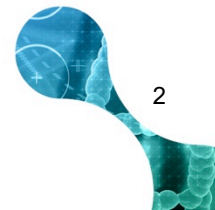
an NTT DATA Company

PHILIPS

THALES



Duration: 36 months
Starting date: Jan 2019



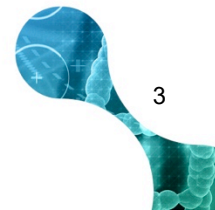


DeepHealth project



Objectives

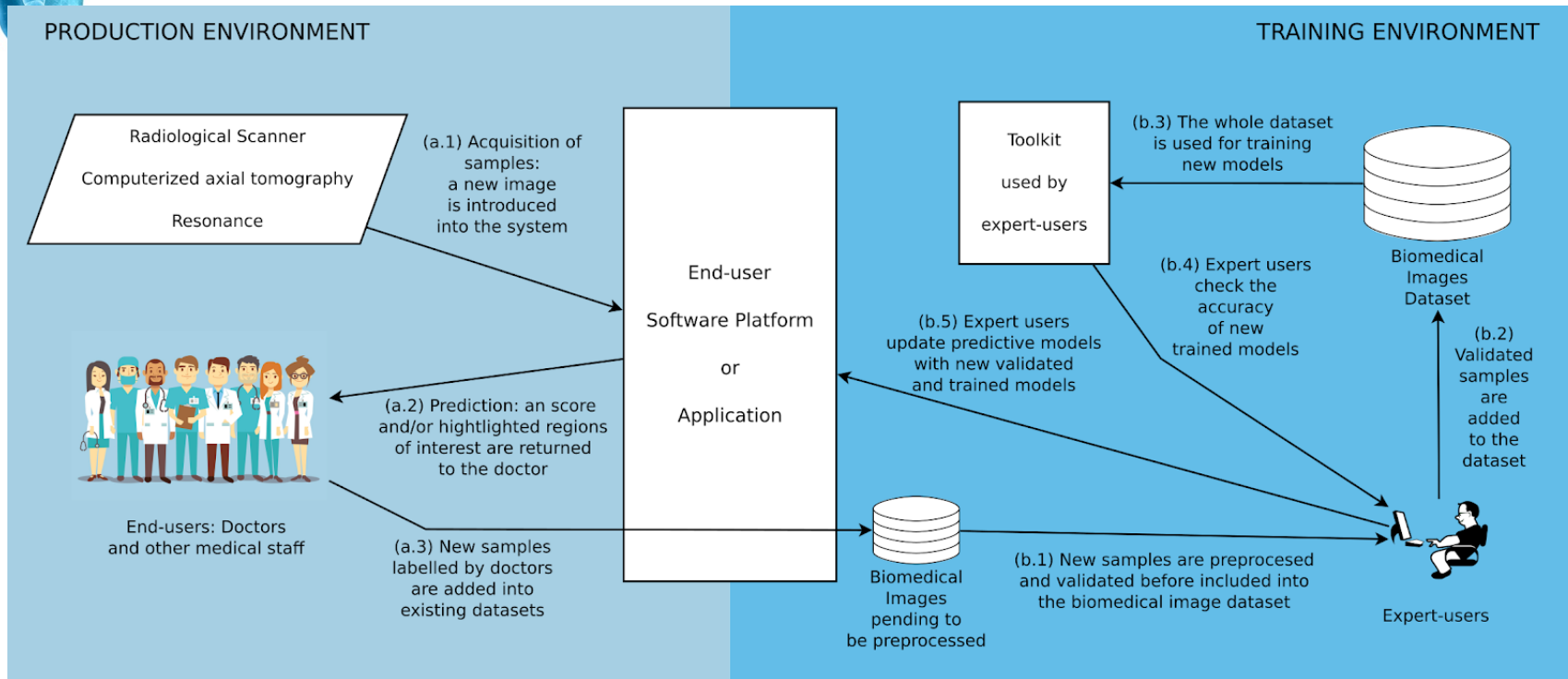
- **Facilitate the daily work** and increase the productivity of medical personnel and IT professionals **working on biomedical images**
- Facilitate the use and training of predictive models without the need of combining many different tools
- Offer a unified framework adapted to exploit underlying heterogeneous HPC and Big Data architectures supporting state-of-the-art and next-generation Deep Learning (AI) and Computer Vision algorithms to enhance European-based medical software platforms.
- Put HPC computing power at the service of biomedical applications with DL needs and, through an interdisciplinary approach, apply DL techniques on large and complex image biomedical datasets to support new and more efficient ways of diagnosis, monitoring and treatment of diseases.



The context



DEEPHEALTH



DeepHealth at a glance



DeepHealth project

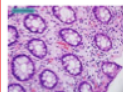
Use cases and data sets

UC1: migraine and seizure prediction



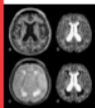
WINGS

UC2: Colon pathology



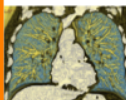
UNITO

UC3: Brain scans



UNITO

UC4: Chest scans



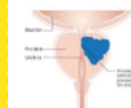
SALU

UC5: Deep Image annotation



UNITO

UC6: Prostate tumour diagnosis



KAROL
CRS4

UC7: Depression



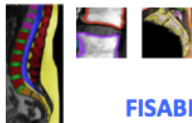
OVGU
MAGD

UC8: Dementia



OVGU
MAGD

UC9: Lumbar spine



FISABIO

UC10: Alzheimer



FISABIO

UC11: Urology



SIVECO
SCTH

UC12: Skin cancer
UNIMORE



UNIMORE

UC13: Epileptic seizures



CHUV
EPFL

UC14: Neurodegen.
disease



CHUV
EPFL

Platforms

PF1: Open Innovation Platform



PHILIPS

PF2: MigraineNet



WINGS

PF3: ExpressIF™



CEA

PF4: PIAF



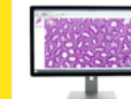
THALES

PF5: Open DeepHealth



UNITO

PF6: Digital pathology



CRS4



Torino team



UniTO: 3 departments, 4 research groups: **Image processing**, **Parallel Programming**, **Anatomical pathology**, **Neuroscience radiology**

Città della Salute e della Scienza: **Radiology 2 Molinette**

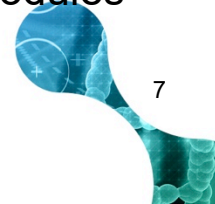


Deep Learning, High Performance Computing, Medical expertise



Use cases:

- colorectal polyps diagnosis
- estimation of brain perfusion maps
- detection of pulmonary nodules in CT chest scans





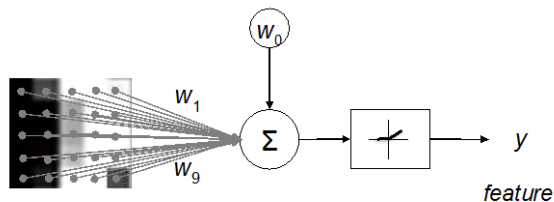
DeepLearning

A non expert fast bootstrap

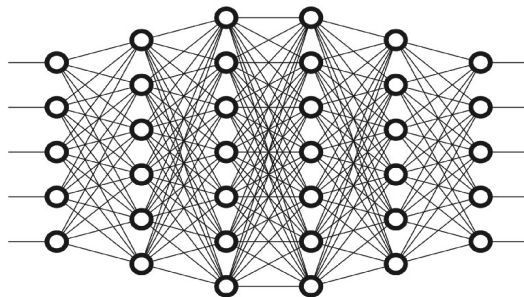
Data & labels



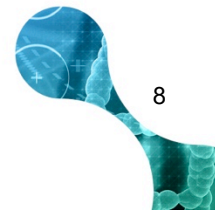
Try the model



Target output
&
Loss function



Fix the model

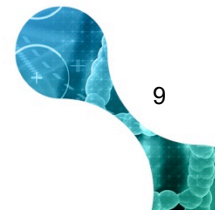
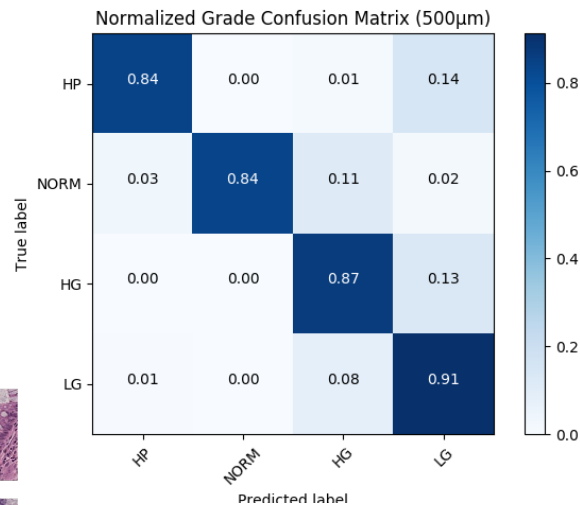
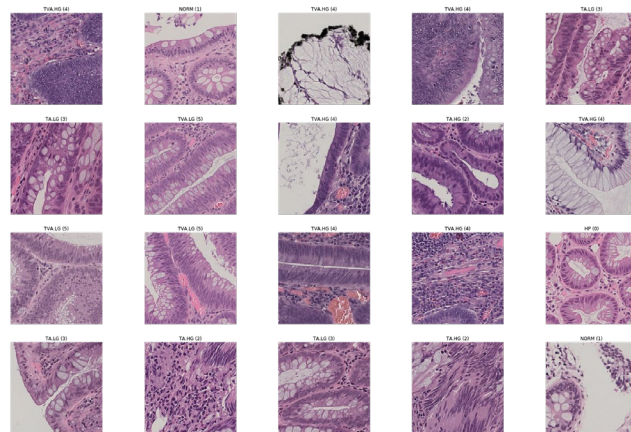




Use Case example (1)

Classification of polyps in colon biopsies:

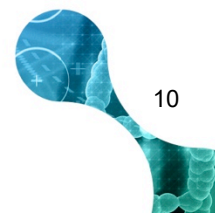
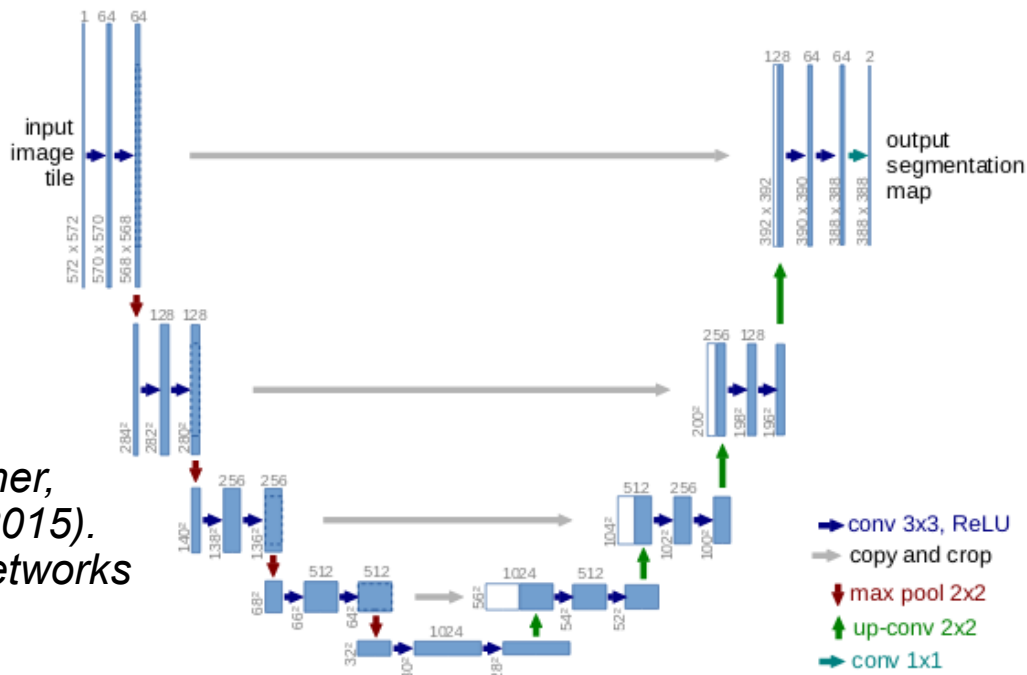
- 6 classes identified in the experiments
- Difficult multi-resolution problem
- Pathologists in the loop for label + ROI



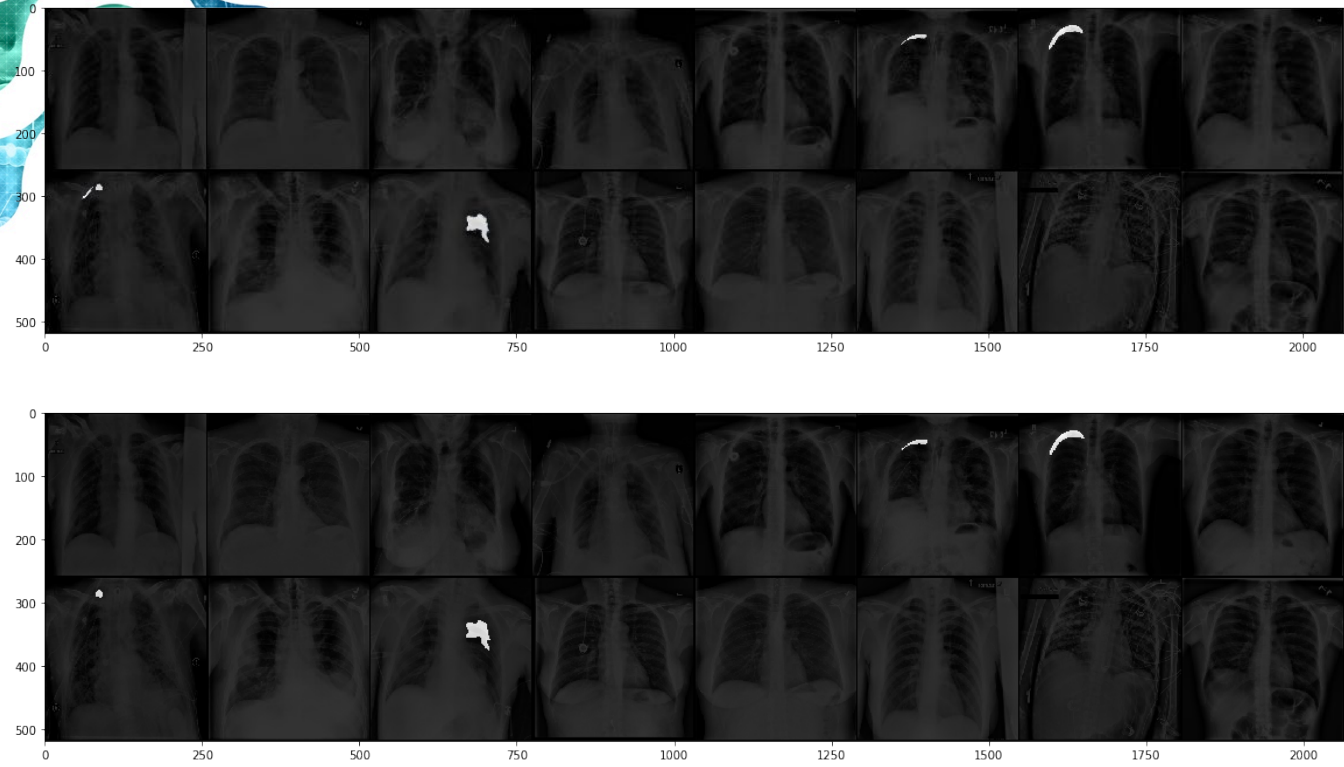
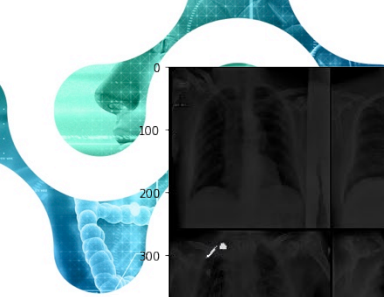


Use Case example (2)

Segmentation applied to CT scans

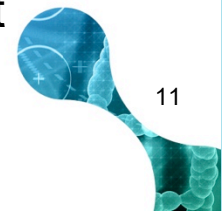


Ronneberger, Olaf; Fischer, Philipp; Brox, Thomas (2015). "U-Net: Convolutional Networks for Biomedical Image Segmentation"



Prediction

The dataset used consists in 13k images as training set and 3k as testset
([SIIM-ACR Pneumothorax Segmentation](#))





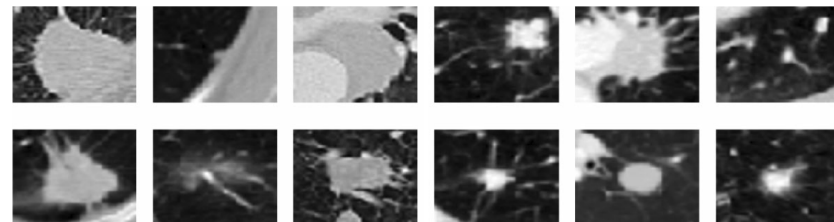
Use case example (2)

Results we achieved on the public dataset:

Overall accuracy: **0.803** (dice score: 0.6565, IoU: 0.5516)

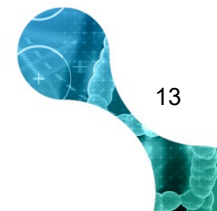
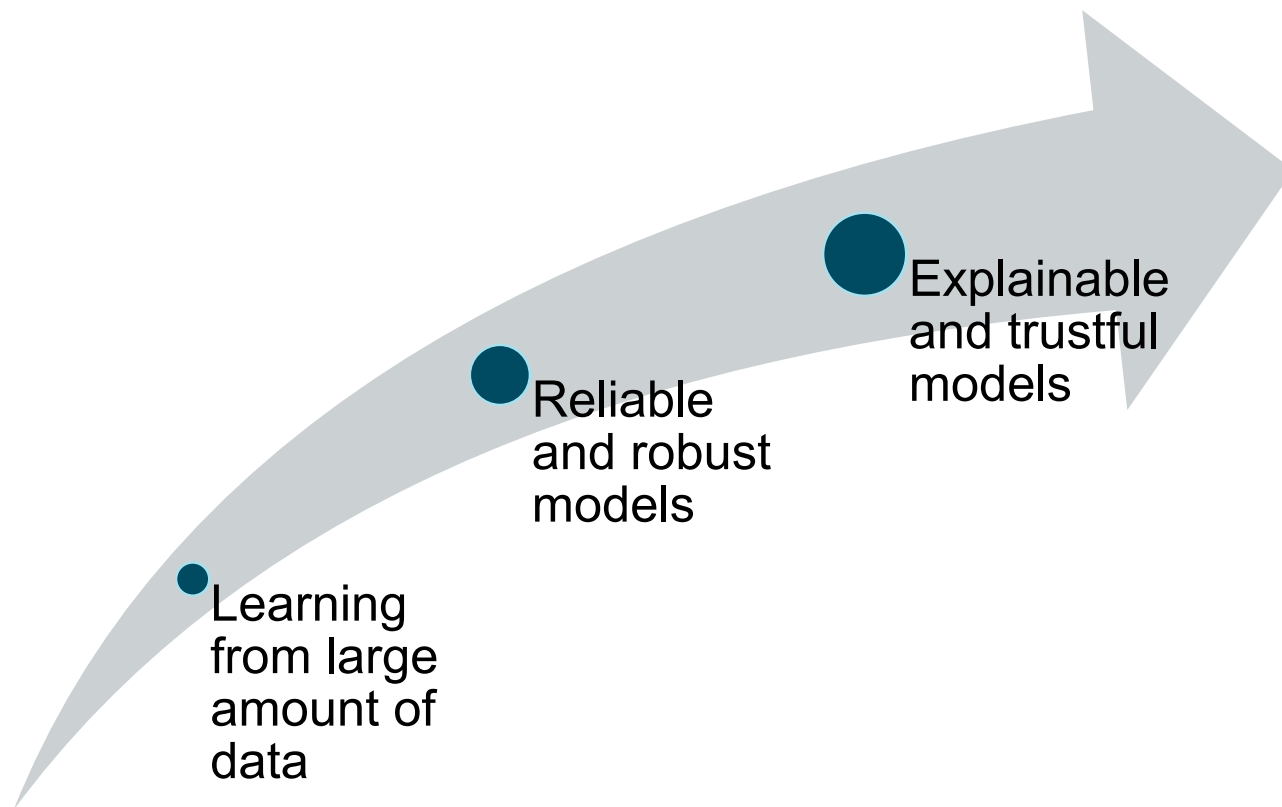
Typology	Precision	Recall	F1 score
normal	0.74	0.94	0.83
abnormal	0.92	0.66	0.77

Future plans: application to detection of Pulmonary nodule: small, focal, radiographic opacities that may be solitary or multiple, measuring ≤ 30 mm in diameter. Most of them are BENIGN
→ Difficult to find, hard to classify, high number of FP findings





Discussion





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Thank you!

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