

Clinical validation of the M5L lung Computer-Assisted Detection system

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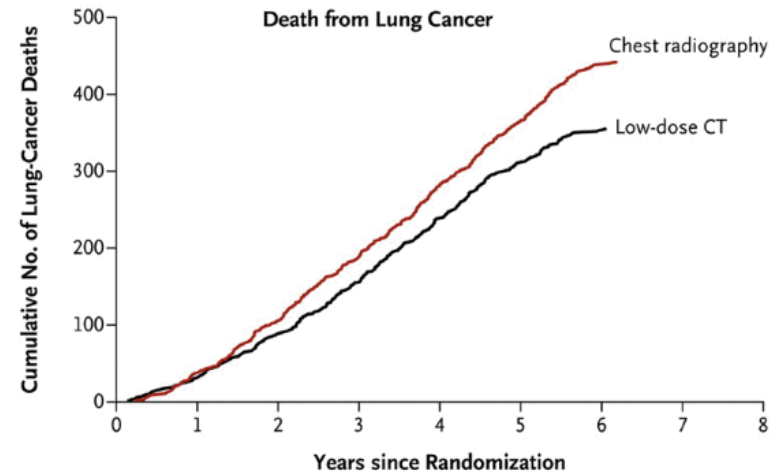
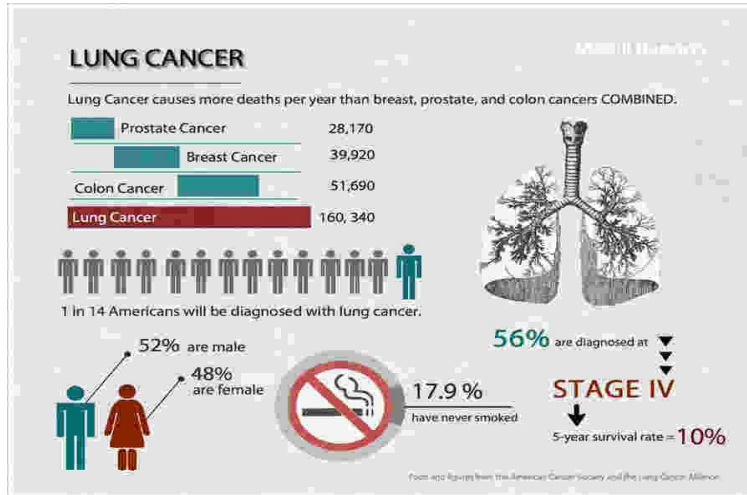
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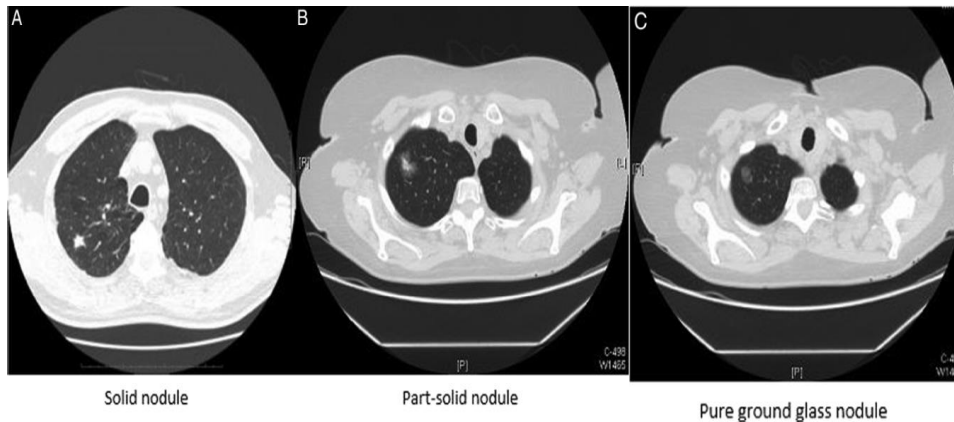
Geneva, 15-19 February 2016

Lung Cancer



- ▶ Many lung cancers are **detected in late-stage**, when the probability of survival is low
- ▶ **Low-dose chest CT** screening trials **reduce mortality**
- ▶ Screening high risk individuals for lung cancer with low-dose CT scans is now being implemented in the United States and other countries will likely follow

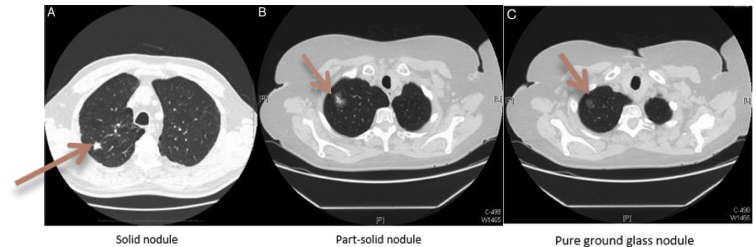
Automated Detection of Lung Cancer



- ▶ The **detection of pulmonary nodules** is a very time-consuming / **difficult task** for radiologists:

- ▶ Poor contrast / noisy images
- ▶ Large number of 'slices' to be analysed

- ▶ **Computer Aided Detection (CAD)** algorithms for the automated detection of pulmonary nodules



- ▶ **CAD increases the performance of radiologists**
- ▶ **combining different CAD algorithms increases the sensitivity**

CAD: status and challenges



Despite proven benefits, the usage of CAD in clinical practice has not spread (yet)

CAD: status



Stand-alone workstations with high SW license cost



Dedicated HW + **Static** Computing resources



Difficulty to share medical results between radiologists of different medical facilities

CAD: prospects



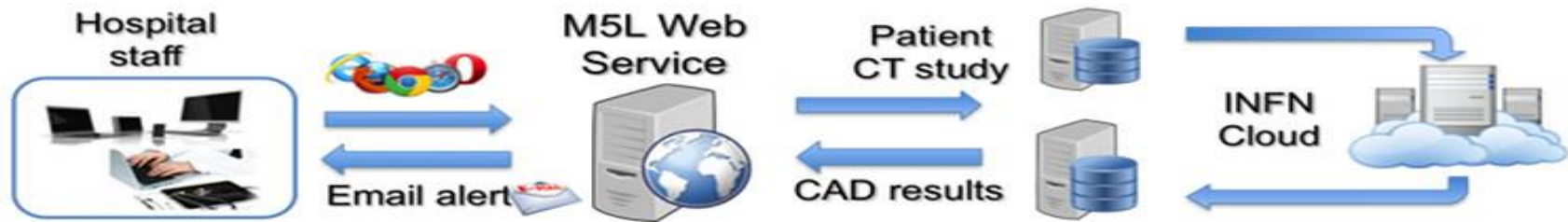
CAD results available **without** requiring **any HW/SW** installation



Sharing medical annotations between several medical facilities + **Combining several CADs**



M5L on-demand lung CAD service



three functional blocks



Web front-end for CT submission, access to CAD results, review, on-line medical annotations

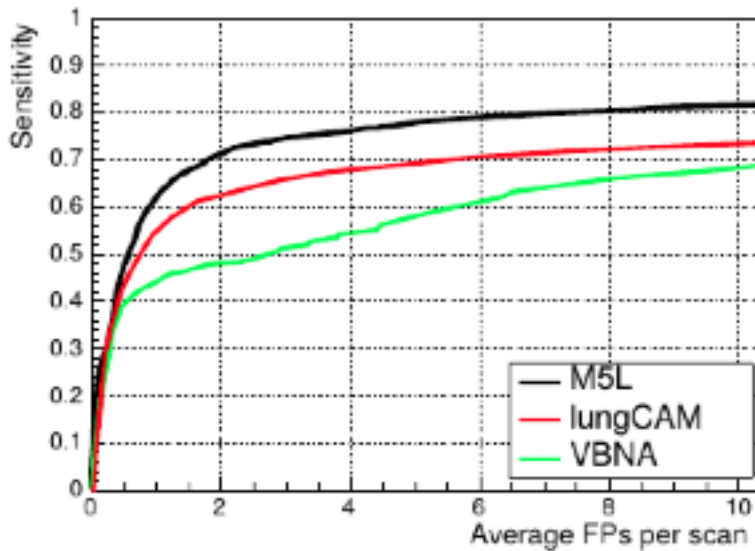
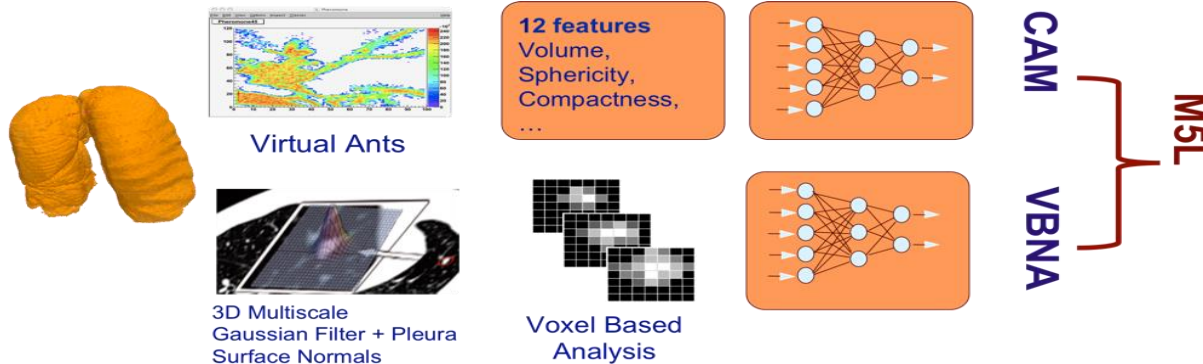


Cloud back-end for image analysis



Combination of independent CAD systems for the automated detection of pulmonary nodules

M5L: large scale validation



- Validation on **1043** CT scans from **3** independent datasets, including the full LIDC/IDRI
- Results consistent across data-sets
- sensitivity of about **80%** in the 4-8 FP findings per scan range

Web front-end: m5l.to.infn.it

Home **Submit** My CASES My Review CASES ALL CASES **Centers** Users

Contact us

Home » Submit a new case

Submit a new case

View Edit Manage display Grant Devel

CASE ID *

Enter an identify name for your case. Only alphanumeric character without space are allow.

Type of study *

- Select -

Select type of study you want to submit

Choose a zipped DICOM case *

Choose File No file chosen **Upload**

The uploaded file must be a zip file containing the DICOM files. Only one CT serie is accepted.

Add Reviewers

Run CAD

Check this option if you want to run the CAD.

Reader Role: First Reader

Status: *

In progress

Complete

Description/Notes:

▼ ROIs

ROI List:

▼ ROI

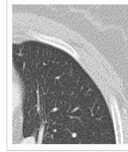

ROI: 160114-090640

Diameter: 4.00 mm

X: 65 mm

Y: -167 mm

Z: 637.90 mm



ROI-CAD: 3

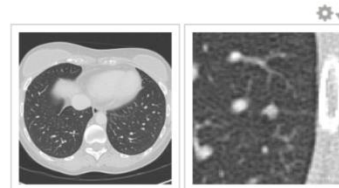
X: 113 mm

Y: -134 mm

Z: 4.50 mm

Radiologist Review: True Positive

Malignancy: Moderately Unlikely for Cancer



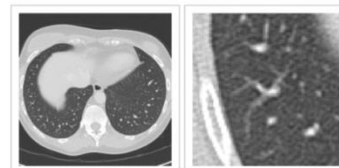
ROI-CAD: 4

X: -101 mm

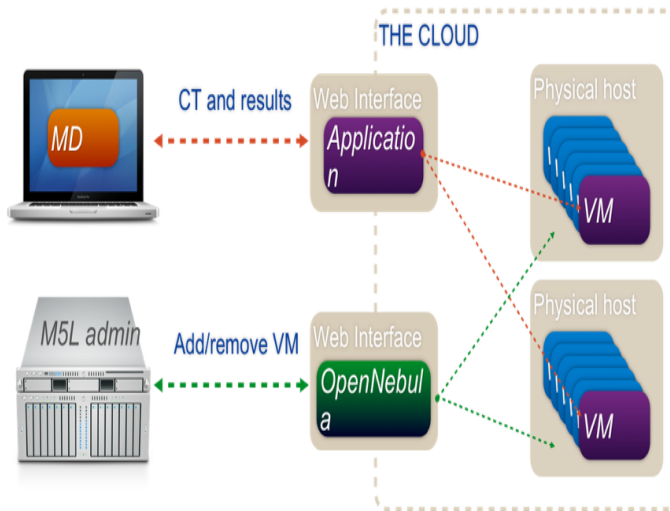
Y: -118 mm

Z: -4.00 mm

Radiologist Review: False Positive



Cloud back-end @ INFN Computing Centre



- **Infrastructure As A Service**: resources allocated according to user requests
- **SW as a Service**: CAD algorithms computed by virtual machines
- **Virtual Machines (VM)** nodes are instantiated in real-time according to the required computing power

- no **HW/SW** requirements to users
- combine multiple **CADs**, leading to an increase of the **performance**



Clinical Validation / **preliminary**



Collaboration with the Radiology Department of IRCCS Candiolo (Italy)

- every day CT scans of oncological patients under-going staging or re-staging are submitted to M5L
- three radiologists independently annotate the CTs (**first-reader mode**)
- CAD results are made available to radiologists for review (**second-reader mode**) only after the first-reading annotation was completed
- Goal: dataset of about 1000 scans

	RAD0	RAD1	RAD2	RAD0&RAD1&RAD2	RAD0&CAD	RAD1&CAD	RAD2&CAD	RAD0&RAD1&RAD2&CAD
Nodules	35	38	19	17	38	41	30	36
FP/SCAN	3.25	4.02	3.4	3.6				
Sensitivity	90%	86%	90%	89%	91%	87%	94%	95%
TP added by CAD (relative %)	3 (9%)	3 (8%)	11 (58%)	9	-	-	-	-
FN	4	6	2	2	4	6	2	2

▶ **We would be pleased to increase our network of users:**

m5l.to.infn.it