

image analysis
machine learning
artificial intelligence



contextflow

spinoff of the Medical University of Vienna

exploration of large-scale medical imaging data

Problem

Vast amounts of imaging data

Radiologists have no (clever) way of using it

A lot of time spent on difficult cases



Solution

Image search based on image content

Semantic analysis

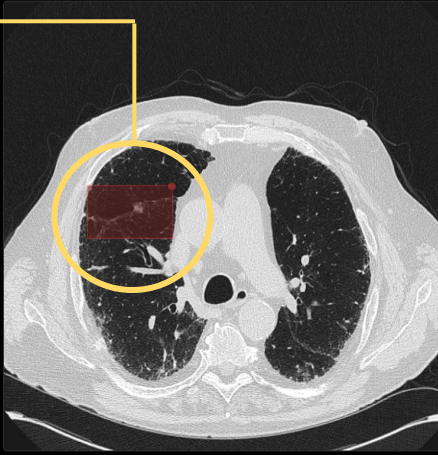
Automatically link images, reference cases, articles, ...



Deep learning based 3D image search

1. Mark region of interest

Query



Filters

All Male Female All <18 18-25 >45 Not Grouped Grouped

Results statistics

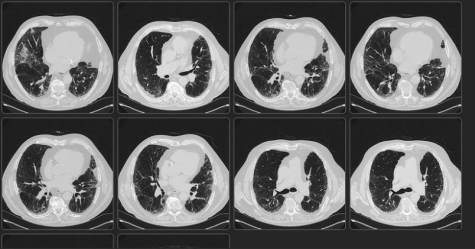
lung emphysema

lung nodules

healthy lung

Results RadiologyExplorer

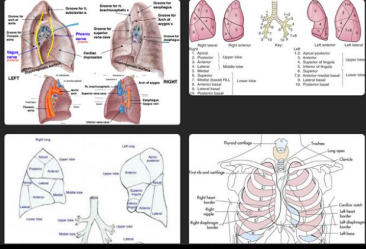
Volumes



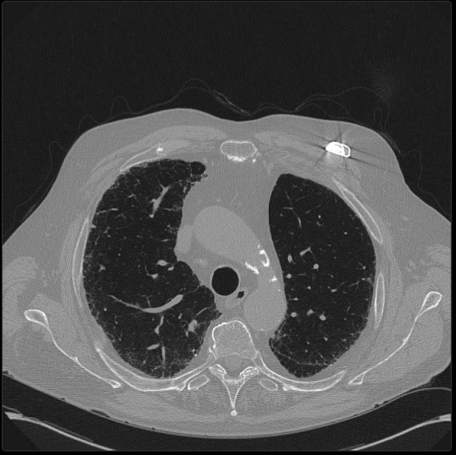
PubMed

- [Pulmonary Imaging Biomarkers of Gas Trapping and Emphysema in COPD: \(3\)He MR Imaging and CT Parametric Response Maps.](#)
Capaldi DP, Zha N, Guo F, Pike D, McCormack DG, Kirby M, Parraga G. Radiology. 2016 May;279(2):597-608. doi: 10.1148/radiol.2015151484. Epub 2016 Jan 8.
- [Chronic obstructive pulmonary disease: CT quantification of airways disease.](#)
Hackx M, Bankier AA, Gevenois PA. Radiology. 2012 Oct;265(1):34-48. Review.
- [Monitoring of smoking-induced emphysema with CT in a lung cancer screening setting: detection of real increase in extent of emphysema.](#)
Gietema HA, Schilham AM, van Ginneken B, van Klaveren RJ, Lammers JW, Prokop M. Radiology. 2007 Sep;244(3):890-7.
- [Fracture Incidence in Chronic Obstructive Pulmonary Disease \(COPD\).](#)

Anatomy



Details



No report.

PatientID	
Modality	CT
PixelSpacing	0.7363281250.736328125
StudyDescription	CT HR-CT
PatientName	
id	
PatientAge	0
SliceThickness	1.0
PatientBirthDate	
AcquisitionDate	

Deep learning based 3D image search

1. Mark region of interest
2. Instantly get:
Distribution of findings in visually similar cases
3. Visually similar cases + relevant findings

Case relevant information from reference sites, publications and guidelines

The interface is divided into four main sections: Query, Results, RadiologyExplorer, and Details.

Query: Displays a CT scan of a chest. A yellow circle highlights a region of interest in the right lung. Below the scan are filters: All, Male, Female, All, <18, 18-25, >45, Not Grouped, Grouped. Below the filters is a 'Results statistics' section with a bar chart showing the distribution of findings: lung emphysema (highest), lung nodules, and healthy lung.

Results: Displays a grid of 8 CT scan slices. Below the grid is a 'PubMed' section with a list of search results. The first result is 'Pulmonary Imaging Biomarkers of Gas Trapping and Emphysema in COPD: (3)He MR Imaging and CT Parametric Response Maps. Capaldi DR, Zha N, Guo F, Pike D, McCormack DG, Kirby M, Parraga G. Radiology. 2016 May;279(2):597-608. doi: 10.1148/radiol.2015151484. Epub 2016 Jan 8.' The second result is 'Chronic obstructive pulmonary disease: CT quantification of airways disease. Hackx M, Bankier AA, Gevenois PA. Radiology. 2012 Oct;265(1):34-48. Review.' The third result is 'Monitoring of smoking-induced emphysema with CT in a lung cancer screening setting: detection of real increase in extent of emphysema. Gietema HA, Schilham AM, van Ginneken B, van Klaveren RJ, Lammers JW, Prokop M. Radiology. 2007 Sep;244(3):890-7.' The fourth result is 'Craniolite Fracture Incidence in Chronic Obstructive Pulmonary Disease (COPD)'.

RadiologyExplorer: Displays anatomical diagrams of the lungs and chest. The diagrams show the lungs, trachea, and bronchi. The diagrams are labeled with anatomical terms such as 'Right Lung', 'Left Lung', 'Trachea', 'Bronchi', 'Lobes', 'Segments', 'Subsegments', 'Lobules', 'Fissures', 'Hilum', 'Root', 'Mediastinum', 'Diaphragm', 'Ribs', 'Sternum', 'Vertebrae', 'Intercostal spaces', 'Costal cartilages', 'Xiphoid cartilage', 'Xiphoid process', 'Manubrium', 'Body', 'Fundus', 'Cardiac notch', 'Aortic arch', 'Subcarinal space', 'Hilar space', 'Apical space', 'Posterior space', 'Anterior space', 'Inferior space', 'Superior space', 'Medial space', 'Lateral space', 'Anterior mediastinum', 'Posterior mediastinum', 'Inferior vena cava', 'Superior vena cava', 'Aortic arch', 'Subcarinal space', 'Hilar space', 'Apical space', 'Posterior space', 'Anterior space', 'Inferior space', 'Superior space', 'Medial space', 'Lateral space', 'Anterior mediastinum', 'Posterior mediastinum', 'Inferior vena cava', 'Superior vena cava'.

Details: Displays patient information. The information includes: PatientID, Modality (CT), PixelSpacing (0.7363281250.736328125), StudyDescription (CT HR-CT), PatientName, id, PatientAge (0), SliceThickness (1.0), PatientBirthDate, and AcquisitionDate.

Deep learning based 3D image search

1. Mark region of interest
2. Instantly get:
Distribution of findings in visually similar cases
3. Visually similar cases + relevant findings

Case relevant information from reference sites, publications and guidelines
4. Detailed information on selection

Query

Filters: All Male Female All <18 18-25 >45 Not Grouped Grouped

Results statistics

lung emphysema

lung nodules

healthy lung

Results

PubMed

Pulmonary Imaging Biomarkers of Gas Trapping and Emphysema in COPD: (3)He MR Imaging and CT Parametric Response Maps.
Capaldi DP, Zha N, Guo F, Pike D, McCormack DG, Kirby M, Parraga G. Radiology. 2016 May;279(2):597-608. doi: 10.1148/radiol.2015151484. Epub 2016 Jan 8.

Chronic obstructive pulmonary disease: CT quantification of airways disease.
Hackx M, Bankier AA, Gevenois PA. Radiology. 2012 Oct;265(1):34-48. Review.

Monitoring of smoking-induced emphysema with CT in a lung cancer screening setting: detection of real increase in extent of emphysema.
Gietema HA, Schilham AM, van Ginneken B, van Klaveren RJ, Lammers JW, Prokop M. Radiology. 2007 Sep;244(3):890-7.

Emphysema Incidence in Chronic Obstructive Pulmonary Disease (COPD)

Radiology Explorer

Details

No report.

PatientID: [icon]

Modality: CT

PixelSpacing: 0.7363281250.736328125

StudyDescription: CT HR-CT

PatientName: [icon]

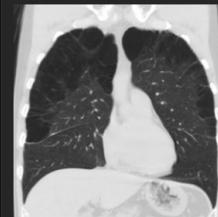
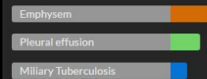
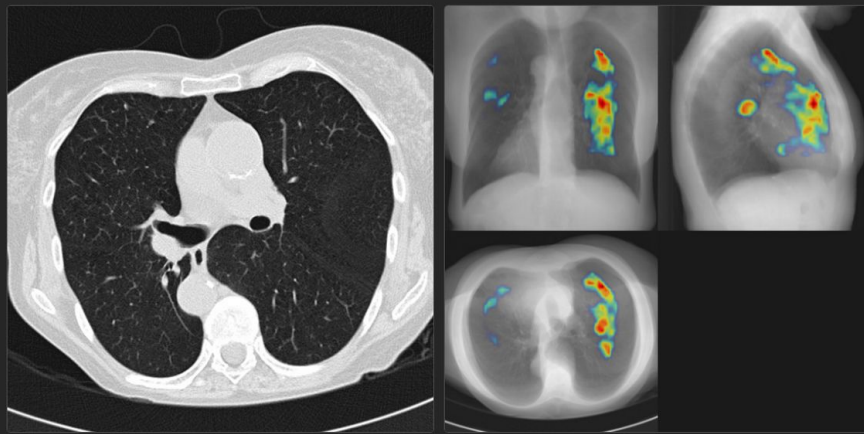
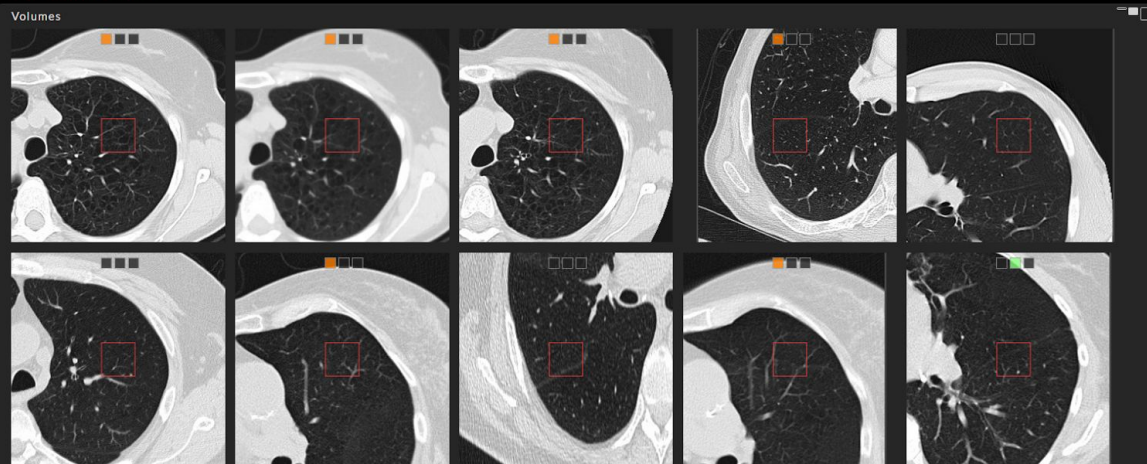
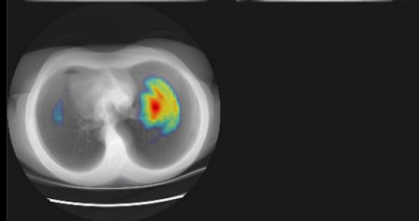
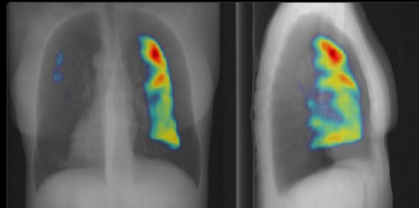
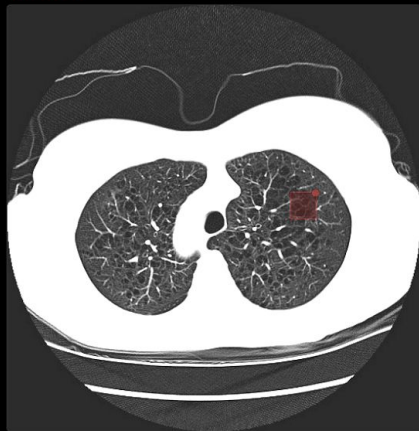
id: [icon]

PatientAge: 0

SliceThickness: 1.0

PatientBirthDate: [icon]

AcquisitionDate: [icon]



Pleural effusion tends to be used as a catch-all term denoting a collection of fluid within the pleural space. This can be further divided into exudates and transudates depending on the biochemical analysis of aspirated pleural fluid (see below). Essentially it represents any pathological process which overwhelms the pleura's ability to reabsorb fluid.

Moon Jun Na
2014, Tuberculosis & Respiratory Diseases

Miliary tuberculosis is an uncommon pulmonary manifestation of tuberculosis. It represents haematogenous dissemination of uncontrolled tuberculous infection and carries a relatively poor prognosis.



Challenges

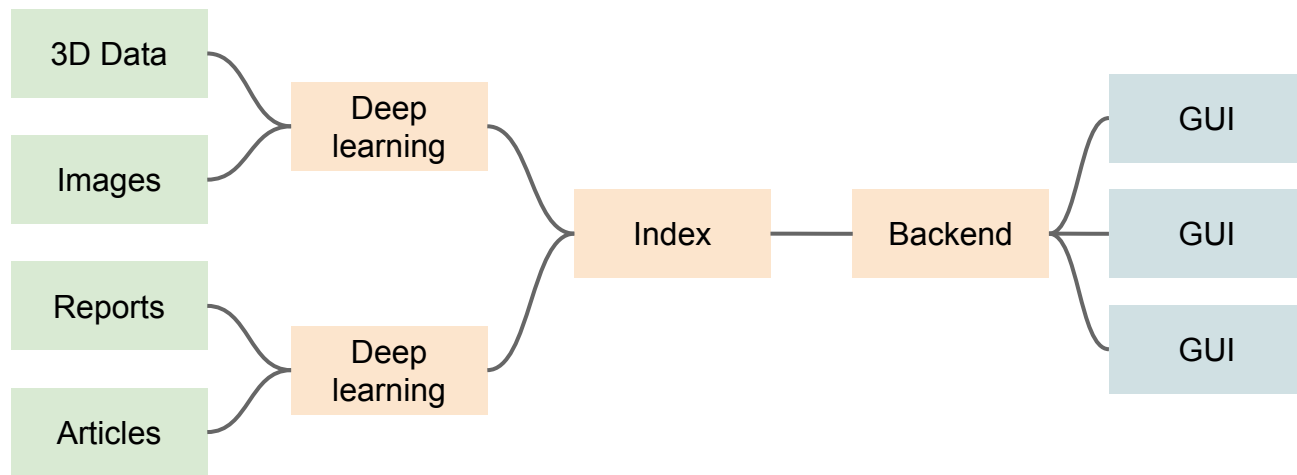
Many TBs of images, quick indexing, instant retrieval

“Know” what it is the image

“Know” what an article / report talks about



Overview



Data Flow Framework

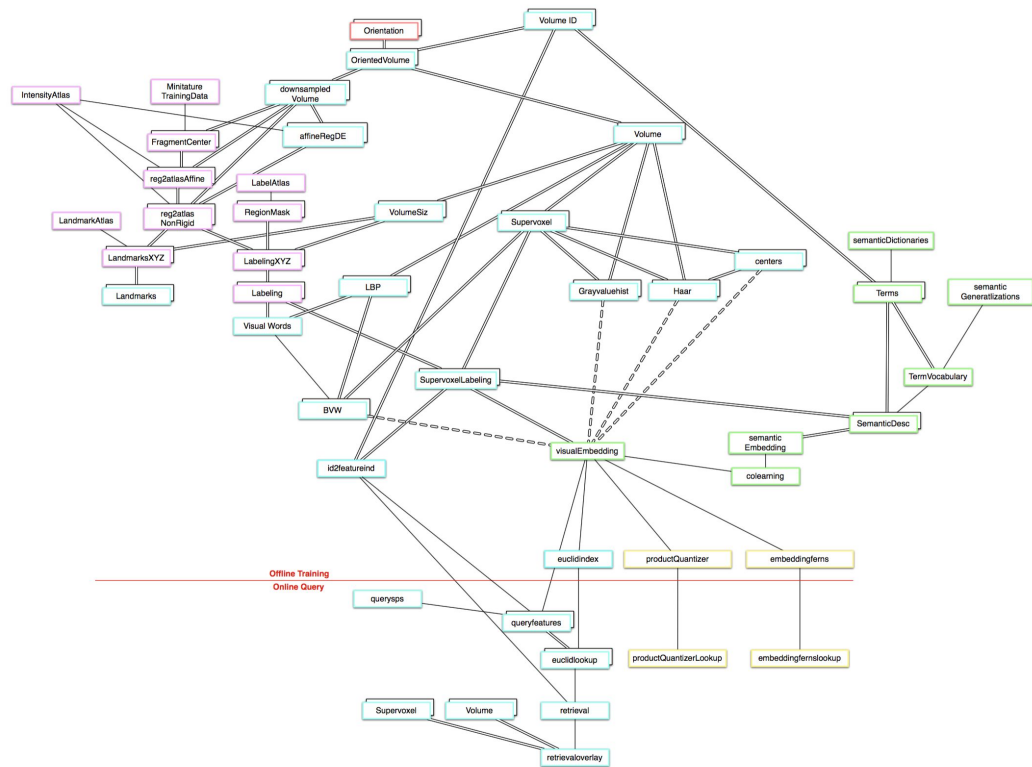
Scheduling

dependencies drive computation

Storage

no explicit state

Focus on algorithms



Julia Programming Language

Easy to code

Like Python / Matlab

Focus on numerical computing and HPC

Fast

Like C. JIT compiled.

Easy parallelization, control over memory layout

Deep learning

Tensorflow, MXNet, Knet

CUDA, CuDNN



Julia



image analysis
machine learning
artificial intelligence



contextflow

spinoff of the Medical University of Vienna

exploration of large-scale medical imaging data