# AI applied to Healthcare



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# Introduction

### How can AI (special attention on Deep Learning) help Healthcare

Concerning healthcare, artificial intelligence will redesign it completely – and for the better. AI could help medical professionals in designing treatment plans and finding the best suited methods for every patient. It might assist repetitive, monotonous jobs, so physicians and nurses can concentrate on their actual jobs instead of e.g. fighting with the tread-wheel of bureaucracy.
Without a doubt one of the most exciting potential uses for AI (Artificial Intelligence) and in particular deep learning is in healthcare. Traditionally, diagnosis of killer illnesses such as cancer and heart disease have relied on examinations of x-rays and scans to spot early warning signs of developing problems.

### Short introduction to image recognition (visual genome, Google's Vision)

Image recognition  is the ability of software to identify objects, places, people, writing and actions in images. Computers can use machine vision technologies in combination with a camera and artificial intelligence software to achieve image recognition.

- Visual genome
- Google's vision

# Job Description

Currently, there are multiple companies researching about this topic. Three of the most important companies in this topic have been chosen.

Name: Infervision
Researchers:  Chen Kuan and his team
Used in: following a pilot project working with the Szechwan People's Hospital in China. Infervision has now begun working with a number of the country's top hospitals
How does it work: supervised learning, because data sets where the outcome is known were used to "teach" the model how to spot images which indicate danger. In this case this data would be previous CT scans which led to diagnosis of lung cancer.

Name: -
Researchers:  Researchers from the National Institutes of Health in Bethesda, Maryland
Used in: -

How does it work: Their system then creates detailed captions for the X-rays, making it easier for doctors to screen patients and detect critical diseases early. The NIH researchers used a public dataset of chest X-ray images to train a convolutional neural network to recognize diseases. Then, in what may be a first for radiology images, they trained a recurrent neural network to describe the context of the disease.

Name: Enlitic
Researchers: Jeremy Howard's company, Enlitic
Used in: Capitol Health Limited, a radiology clinic with locations across Australia
How does it work: the software is designed to help radiologists do their jobs more quickly and make fewer mistakes. First, it checks each file submitted to make sure the image matches what the technicians say it's supposed to be—for example, it makes sure that if an image is tagged as a left knee that it's not actually a right knee. Then, it looks for anomalies in the image. Depending on what it finds, it assigns a priority to the X-ray and routes it to a radiologist.
They have developed a lung nodule detector that they claim is able to achieve positive predictive values that are 50% higher than those of a radiologist. As the detection model analyzes images, it learns from those images. It not only finds lung nodules, it also provides a probability score for malignancy.

## Description of results

The team's system needs further training and higher prediction rates before hospitals and clinics deploy it. But once auto-annotation systems like this are up and running, doctors will be able to search electronic records for all X-rays with a particular disease.
This system is not only used for cancer diagnosis, also bone health, cardiovascular analysis and lung conditions.

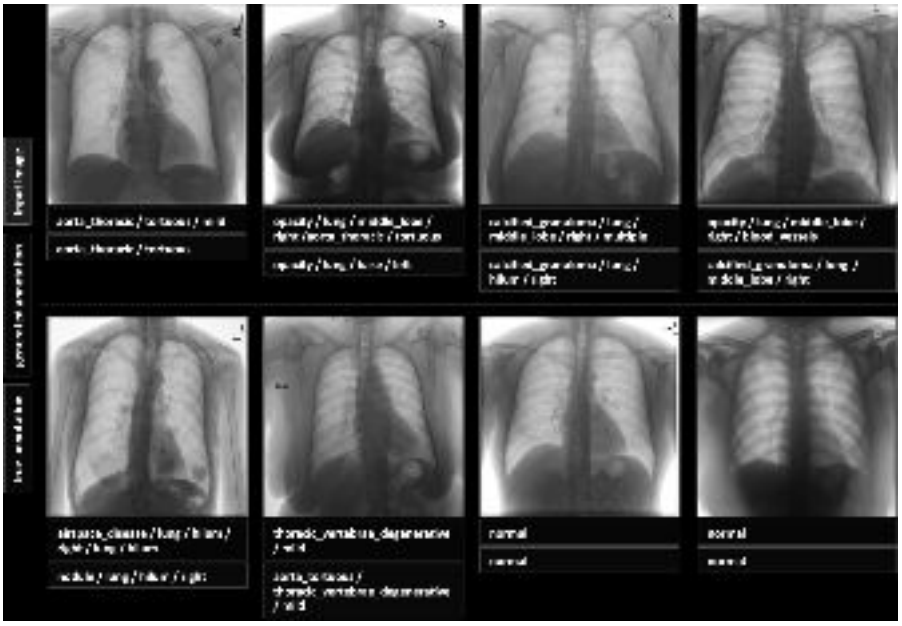


Image 1: Lung x-ray with the results obtained by the system

## Infervision

- Augmented CT Screening Solution (AI—CT)
  AI—CT is applied in early lung cancer screening. With its high paralleling computing power, AI—CT can precisely grasp the core characteristics of lung cancer and efficiently detect suspicious lung cancer lesions in CT scans. AI—CT is a technology that facilitates early detection and early treatment of lung cancer. AI—CT is especially sensitive to hard-to-detect nodules such as semi-solid and ground glass nodules and hence enhances radiologists' diagnosis accuracy.

- Augmented X-ray Screening Solution (AI—DR)
  AI—DR can detect more than 20 different kinds of cardiothoracic lesions. It helps screening diseases during both regular physical examinations as well as inpatient and outpatient radiology studies. AI—DR is especially sensitive to lung nodules on X-ray scans. During several months of use at a collaborating hospital, AI—DR helped screen out a few lung cancer patients who were initially misdiagnosed by radiologists.

- AI—Scholar
  Deep Learning Research Platform AI—Scholar surveys deep learning models to provide robust and powerful GPU computation for medical data modeling. The platform can process over 100 high-resolution medical DICOM images in one second.

## Enlitic

Enlitic's deep learning technology can incorporate a wide range of unstructured medical data, including radiology and pathology images, laboratory results such as blood tests and EKGs, genomics, patient histories, and electronic health records (EHRs). This richness allows higher accuracy and deeper insights for every patient.

It integrates seamlessly into the existing health system infrastructure. For example, radiology solutions communicate with third party image viewers and archiving systems.

Patient triaging solutions scan incoming cases for multiple clinical findings, determine their priority, and route them to the most appropriate doctor. Enlitic's technology can interpret a medical image in milliseconds —up to 10,000 times faster than the average radiologist.

## Comparison with other systems

Radiologists work from CT scan images to hopefully diagnose sufferers at the earliest opportunity. But in a country where there is a serious shortage of qualified doctors, particularly radiologists, this often means they find themselves examining hundreds of images every day. It is incredibly tedious and due to fatigue, mistakes and misdiagnoses are not uncommon.

Enlitic is now conducting a trial on a model that detects wrist fractures. Igor Barani, MD, Enlitic's CMO, says as many as 30% to 40% of such fractures can be missed; this can result in improper healing and chronic pain. The model is being trained to find the fractures on X-ray images and overlay a heat map to highlight their location within a conventional PACS viewer. To test the technology's effectiveness, the trial presents multiple radiologists with images that are either annotated with heat maps or not. The radiologists evaluate each image twice, in random order, to check accuracy.

## Discussion or reflections regarding the work presented

### Is this technology appropriate?

Indeed, this technology is appropriate as there has been meaningful improvements in this area of research. Furthermore, multiple companies are working on this topic and all of them are basing their work on the same technology, image recognition and artificial intelligence, using these technologies with supervised learning.

### Where is it actually used?

Nowadays it is specifically used for the diagnosis of lung cancer in China and Australia by Infervision and Enlitic, respectively. Although, Enlitic is expanding the research to detect wrist fractures, and both companies are on its way of expanding the testing in other hospitals.

## Final conclusions

These systems could even help countries with limited clinical resources screen large numbers of patients for diseases. As they could help improve medicine, detection of lung cancer in particular,  in limited areas of the world.

As it is already said, these systems could truly help radiologists to focus on meaningful tasks, more than monotonous and automatic ones, which are the ones done by the system.

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