

# JFM

Journées Francophones  
d'Imagerie Médicale



## ARTIFICIAL INTELLIGENCE AND RADIOLOGY

20 minutes to understand

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POITIERS, FRANCE

JFIM 18<sup>TH</sup> EDITION, MEXICO NOV 7-10 2019

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FANDANGO  
MOVIECLIPS ✂

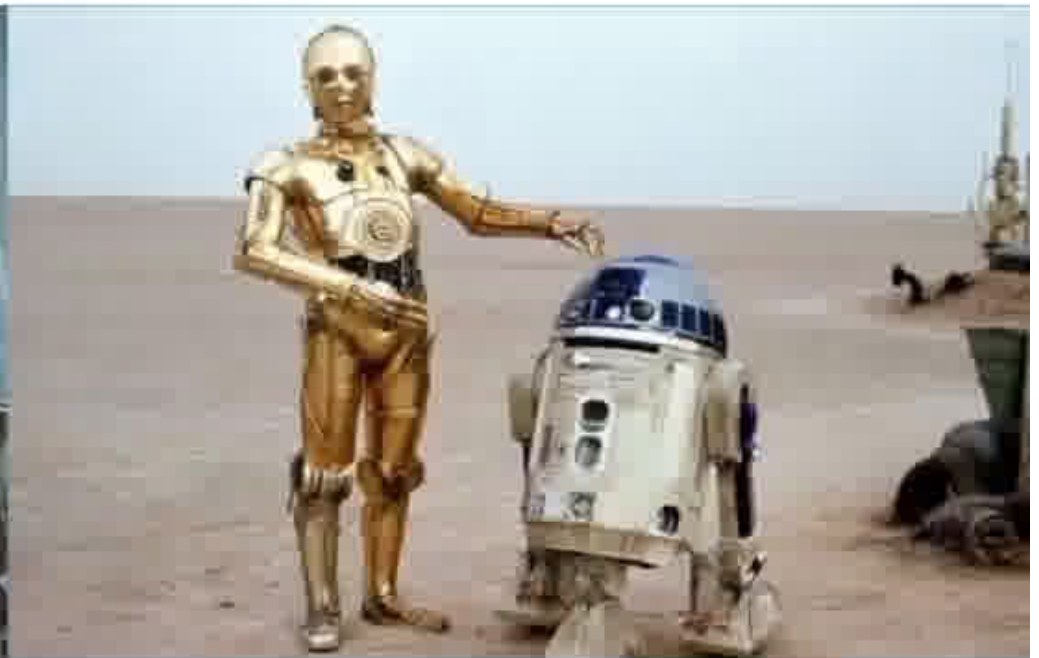
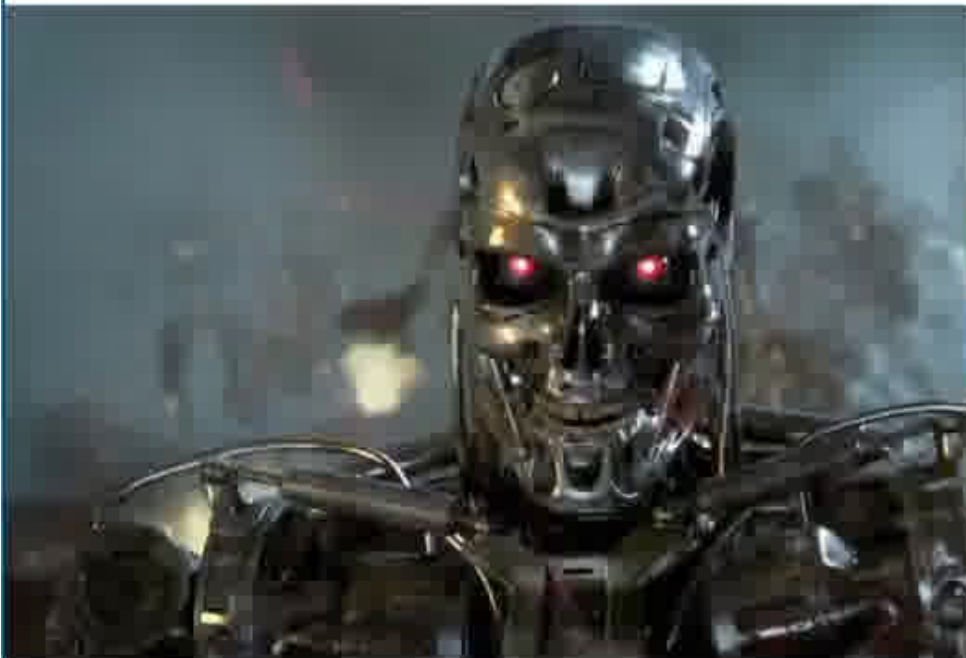
Artificial intelligence,  
Sure you know...



Artificial intelligence,  
Sure you know...

# AI AND PEOPLE MINDS

- **Be scared, IA which take over,**
  - Hal 9000, Terminator, Matrix
- **Be happy, l'IA collaborative**
  - Stars Wars



# Will the rise of the machines imperil radiologists?

By STEPHEN HANCOCK

How a computer learns your 3-D scan

174 SHARES    



The Resource for Healthcare IT Leaders

**HealthData** Management All Sections -

Now Reading **The Latest**

Are radiologists becoming obsolete?

CVS selects Epic for specialty care programs

Change Healthcare, McKesson unit complete merger

List of images

## Are radiologists becoming obsolete?

By Joseph Goedert

Published November 09 2016, 3:14pm EST

Main in: Artificial intelligence Medical imaging

 Print



 Email

 Reprints

 Share

With the evolution of IBM's Watson supercomputer and other advancements in artificial intelligence, could machines replace radiologists? That's a topic to be explored during a session at RSNA 2016, Nov. 27-Dec. 2 at McCormick Place in Chicago.

# Digital disruption in radiology – will it put doctors out of work?

Lydia Ramsey · 51   
Nov. 30, 2016, 4:48 PM  2,654

 FACEBOOK  LINKEDIN  TWITTER  EMAIL  PRINT

**MedCity** CHICAGO — Medical imaging has been one of the areas in healthcare most ripe for digital disruption.

"Phase 1 has already occurred," Day Woodlock, senior vice president of medical imaging at IBM Watson Health, says.



## WHAT WILL WE SEE TOGETHER?

- What is artificial intelligence?
- What is not-said on AI?
- Future in radiology

What is artificial intelligence?

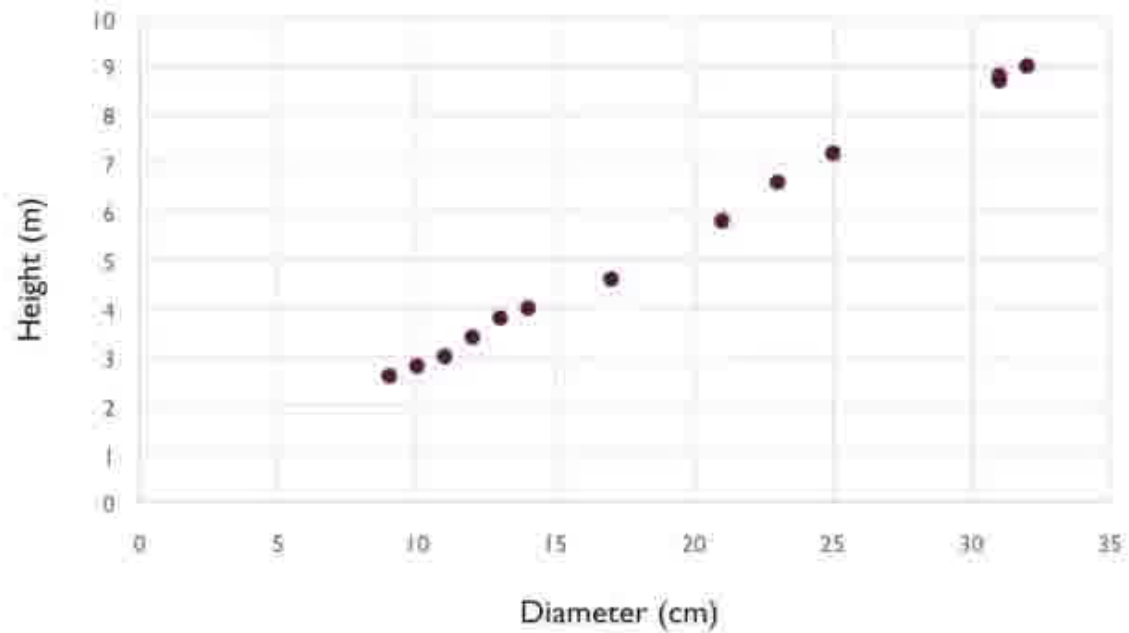


# UNDERSTAND MACHINE LEARNING

- Trunk size and tree height



Diameter (cm)	Height (m)
10	2.8
17	4.6
14	4
9	2.6
21	5.8
25	8.9
31	8.8
12	3.4
23	6.6
32	9
31	8.7
11	3
13	3.8

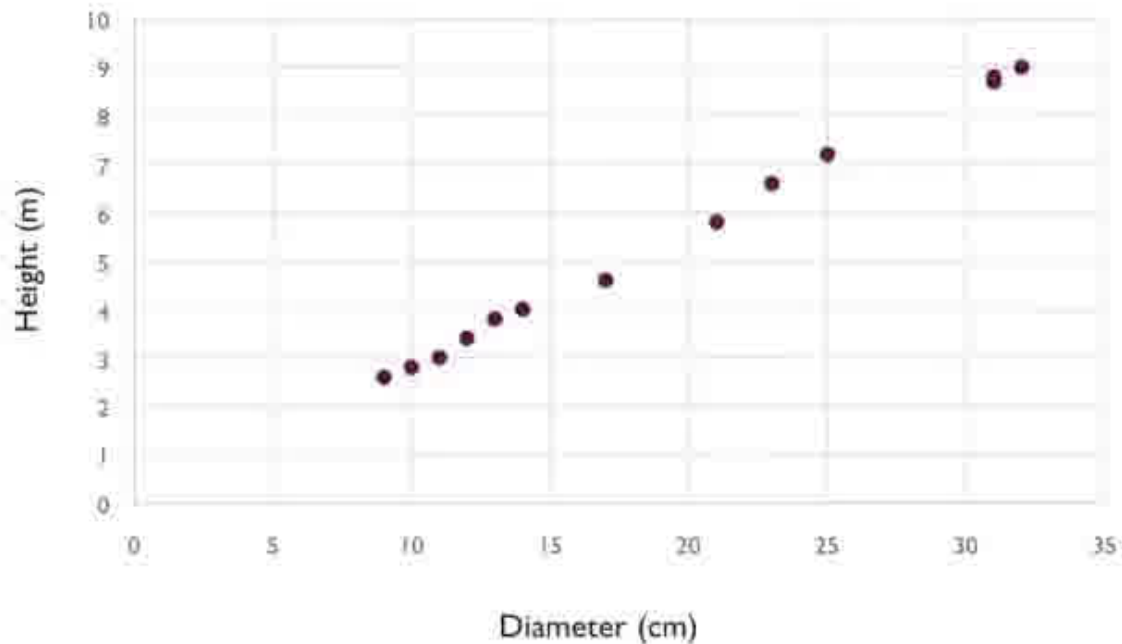


What is artificial intelligence?



# UNDERSTAND THE MACHINE LEARNING

- How does machine learning proceed?
  - The straight line has 2 parameters, a and b according to  $y=ax + b$



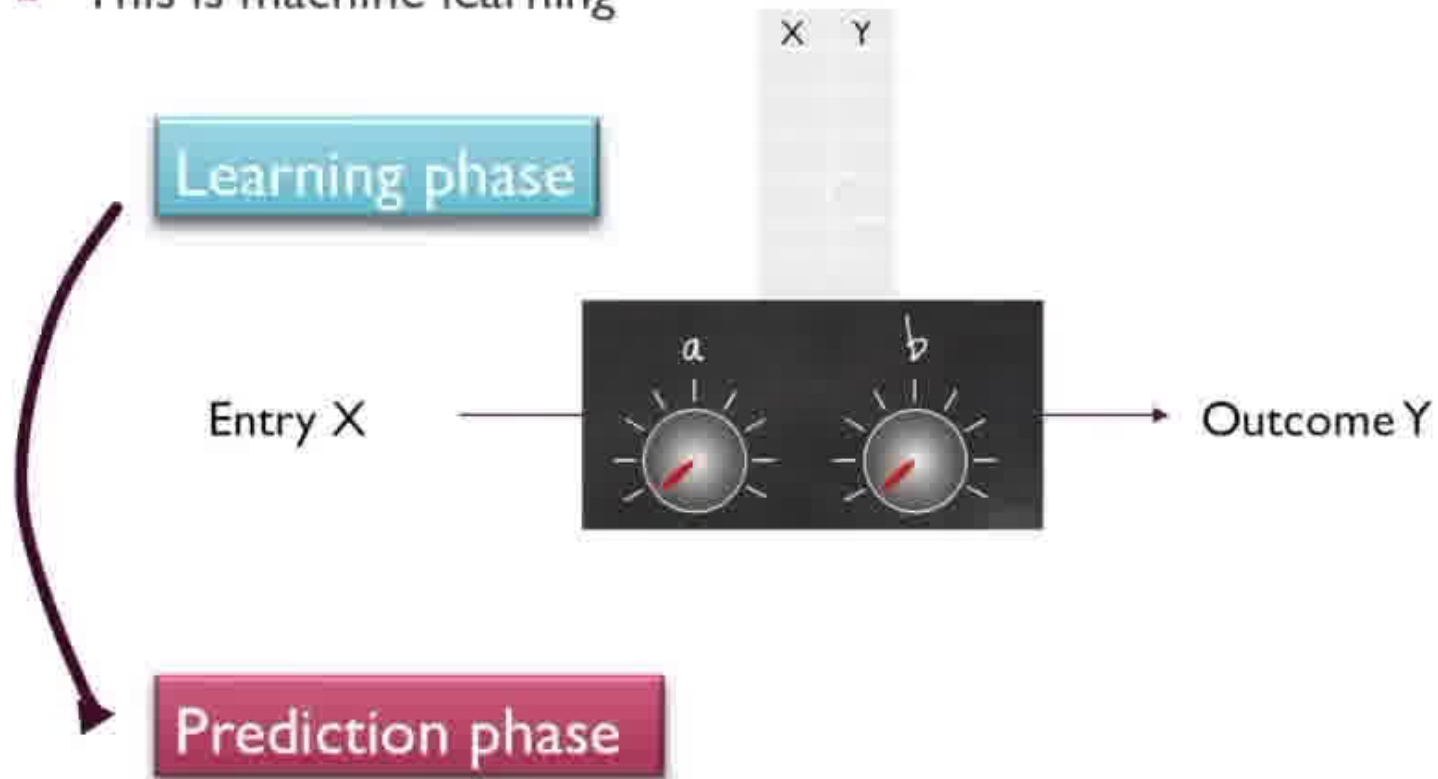


What is artificial intelligence?



# UNDERSTAND THE MACHINE LEARNING

- This is machine learning



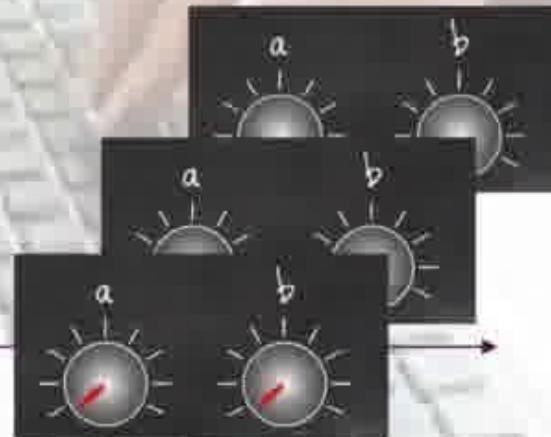
What is artificial intelligence?



## MACHINE LEARNING EXAMPLES

- Credit card on internet

Web Site  
Country  
Value  
Type of buying  
Habits  
.../...



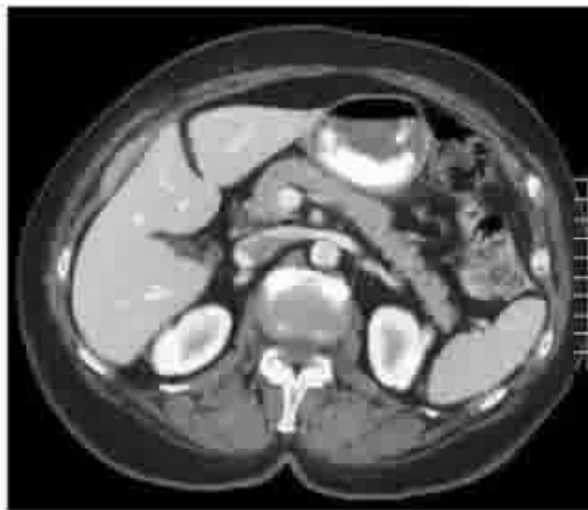
Fraud ?

What is artificial intelligence?

# MACHINE LEARNING AND IMAGE RECOGNITION



- The problem with image recognition is the number of data



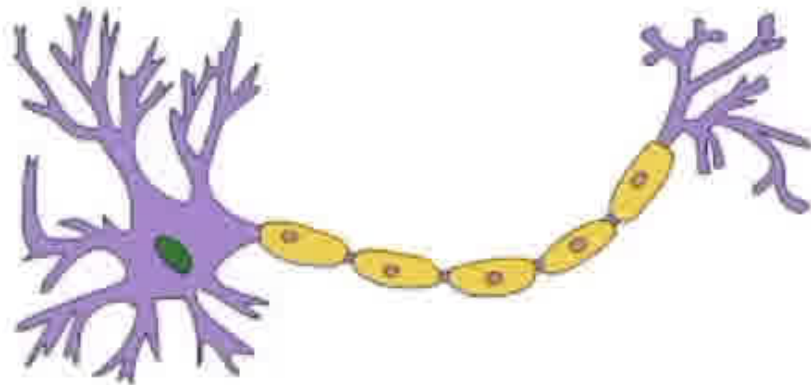
?

What is artificial intelligence?



# UNDERSTAND THE NEURONAL NETWORK

Natural neuron

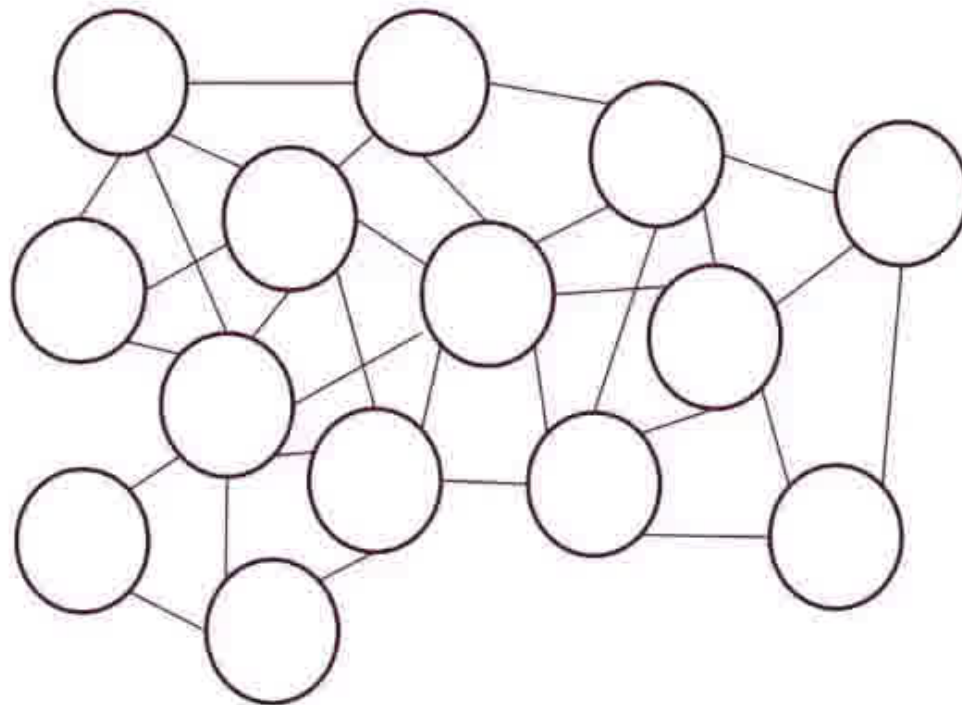


What is artificial intelligence?



# UNDERSTAND THE NEURONAL NETWORK

Artificial neuronal network

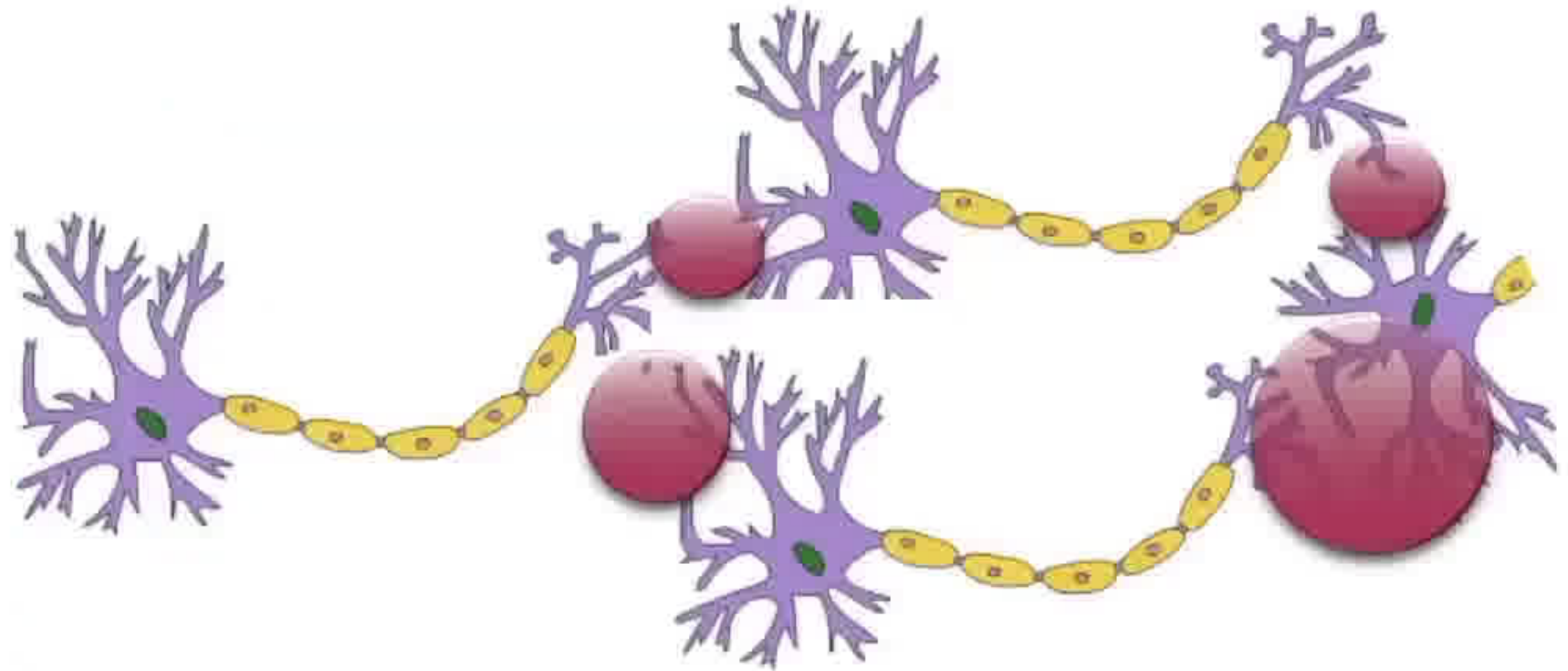


What is artificial intelligence?



# UNDERSTAND THE NEURONAL NETWORK

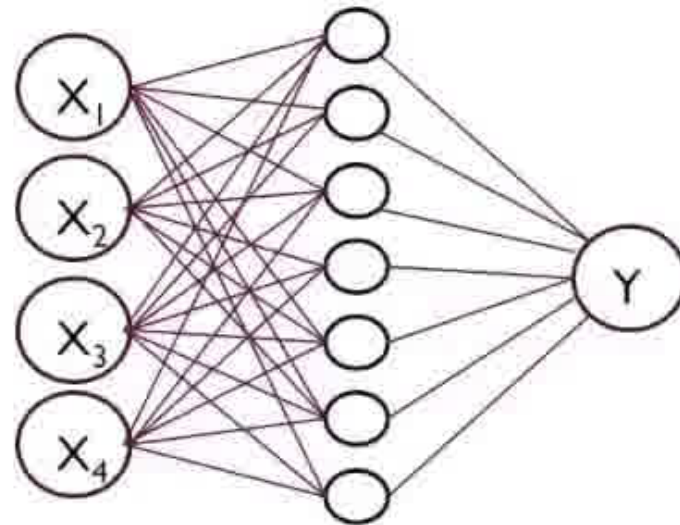
Natural neuron



Synapse efficiency

## UNDERSTAND THE NEURONAL NETWORK

- In the human brain, 100 billions of neurons and million billions of connexions (Each neuron connected to 1000 others, roughly)
- in cases of numerous artificial neurons, it rapidly becomes difficult to train the system (find the correct position of the button)
- In practice; 3 layers



What is artificial intelligence?



# UNDERSTAND THE NEURONAL NETWORK

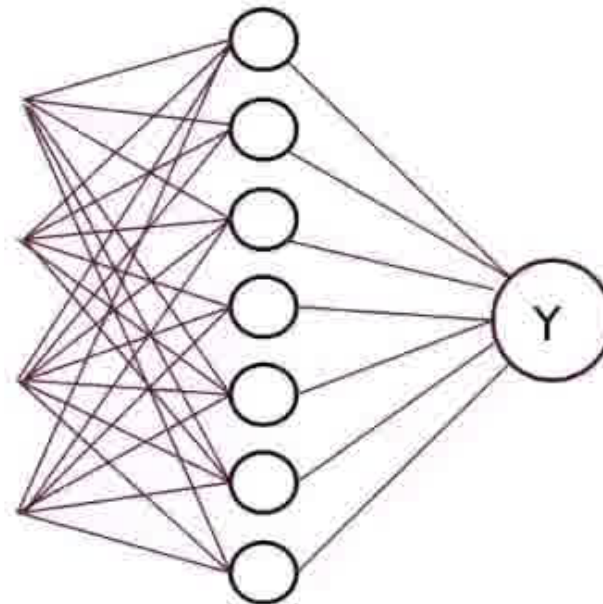
- For image recognition:

512 x 512 pixels



262,144 inputs  
(entries)

?

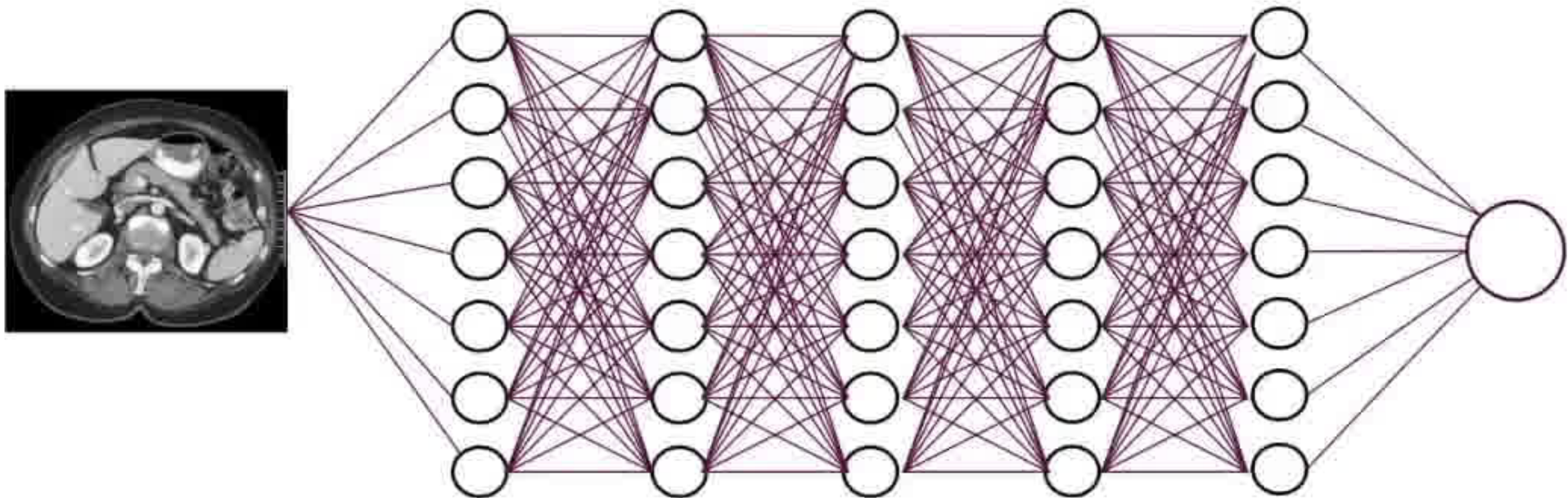






# UNDERSTAND THE DEEP LEARNING

- In deep learning, the system searches itself for the image characteristic features:





## UNDERSTAND THE DEEP LEARNING

- Yann le Cun was one of the first to believe in deep network in the 90s
- But during 12 years nothing...



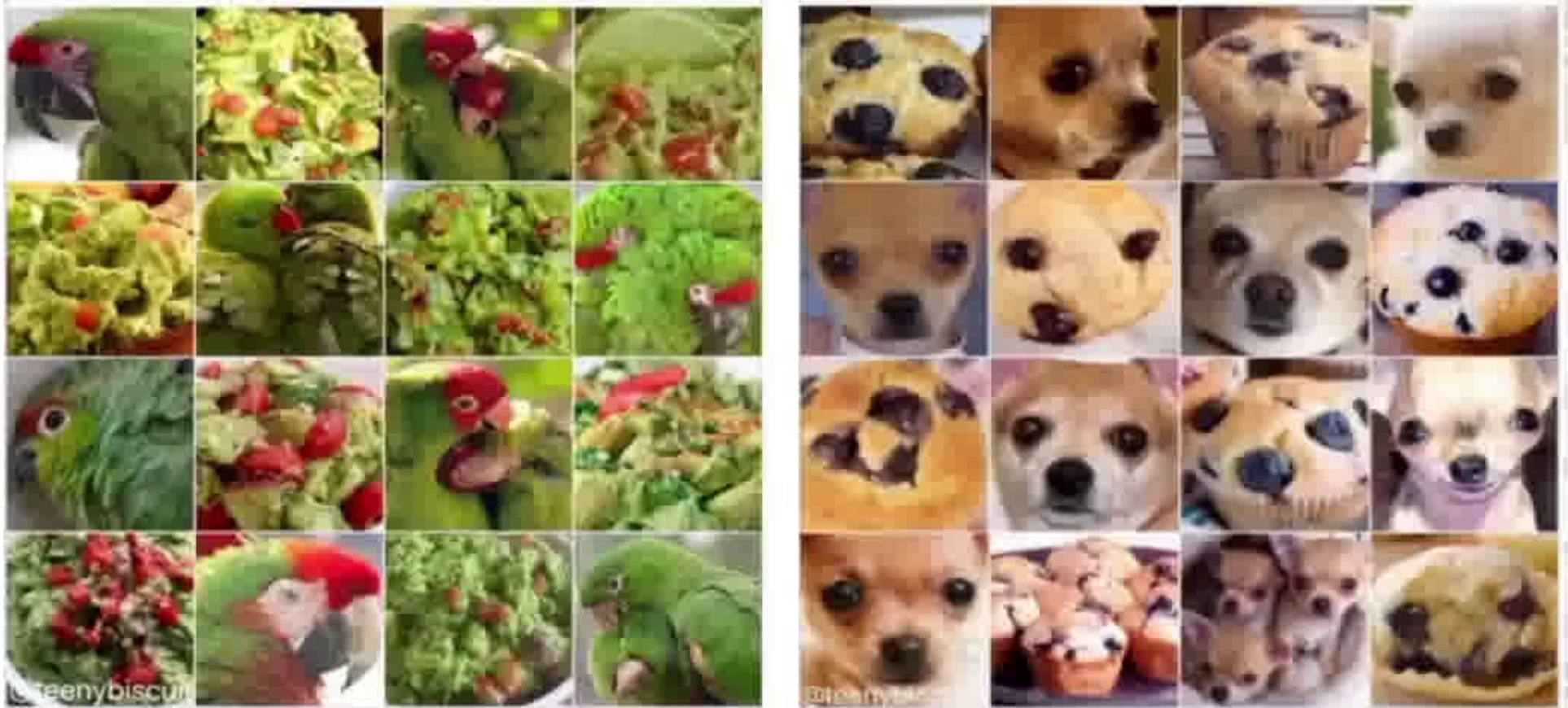
Yann le Cun,

What is artificial intelligence?



# UNDERSTAND THE DEEP LEARNING

- The Imagenet large scale visual recognition challenge (ILSVRC)



What is artificial intelligence?



# UNDERSTAND THE DEEP LEARNING

- The Imagenet large scale visual recognition challenge (ILSVRC)

A grid of images from the Imagenet challenge. The grid is divided into two main sections: the left section shows images of parrots and guacamole, and the right section shows images of dogs and cookies. The grid is organized into rows and columns, with each row representing a different category. The images are arranged in a 5x4 grid for parrots and guacamole, and a 5x4 grid for dogs and cookies. The background of the slide is a mosaic of small, colorful squares.

Software

NE

XR

ISIL

Poluk

Hminmax 54%



## UNDERSTAND THE DEEP LEARNING

- Why is it working now?
  1. Power of the graphic cards has increased
  2. The algorithm called “back-propagation of errors”
  3. Availability of big data base

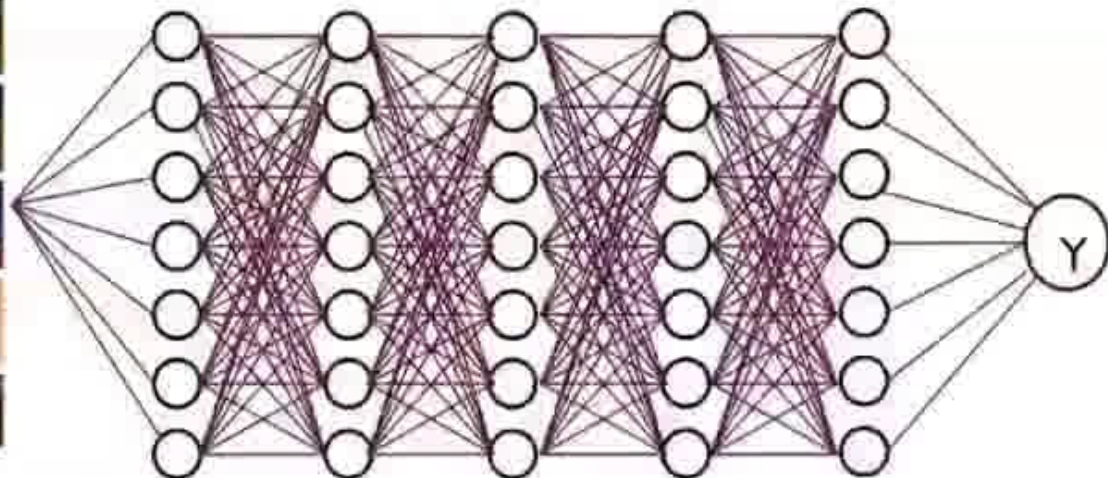


# UNDERSTAND THE DEEP LEARNING

- Because we have numerous buttons, we need numerous examples to feed the network
- Imagenet (<http://www.image-net.org/>)
  - 15 million images, all classified, published in 2009



Images from imagenet





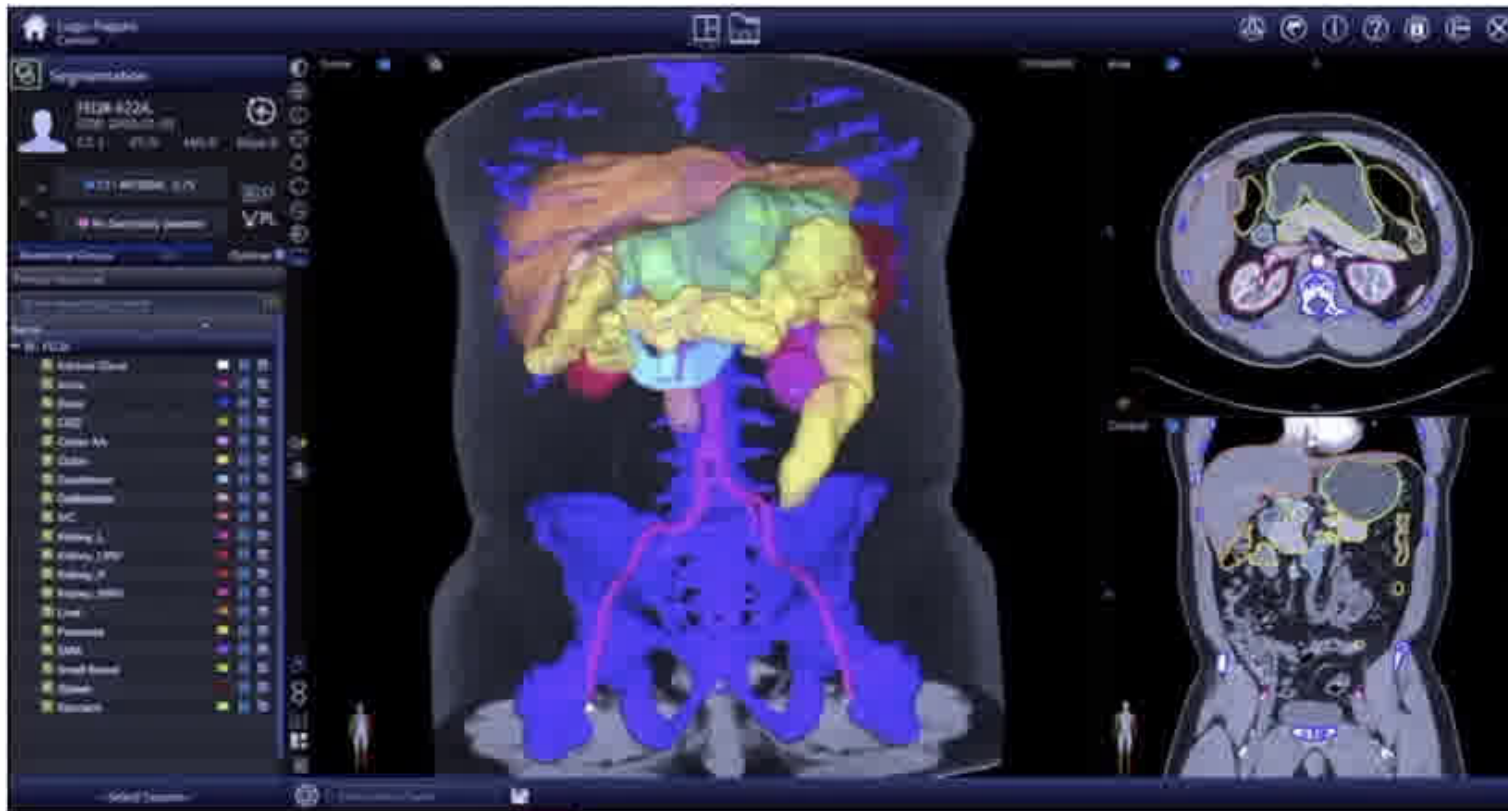
# APPLICATIONS OF DEEP LEARNING

IN IMAGING (EXAMPLES)



What is artificial intelligence?

# IMAGE RECOGNITION AND AUTOMATIC REPORT GENERATION



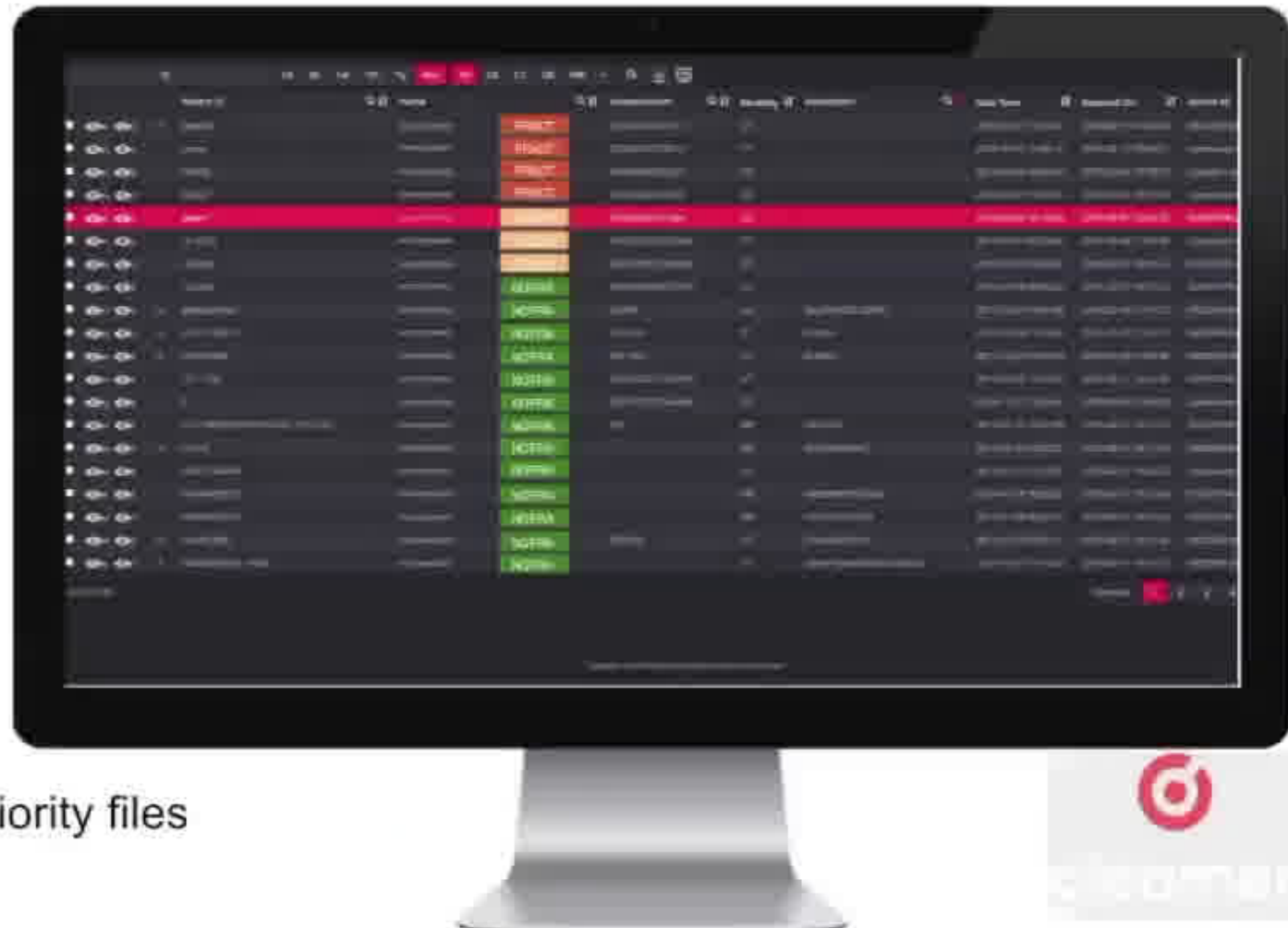
- Generation of a report;



What is artificial intelligence?



# AI AND CONVENTIONAL X-RAY READING



Worklist given priority files

2 - CR - FOOT



3 - CR - FOOT



4 - CR - FOOT



5 - CR - FOOT



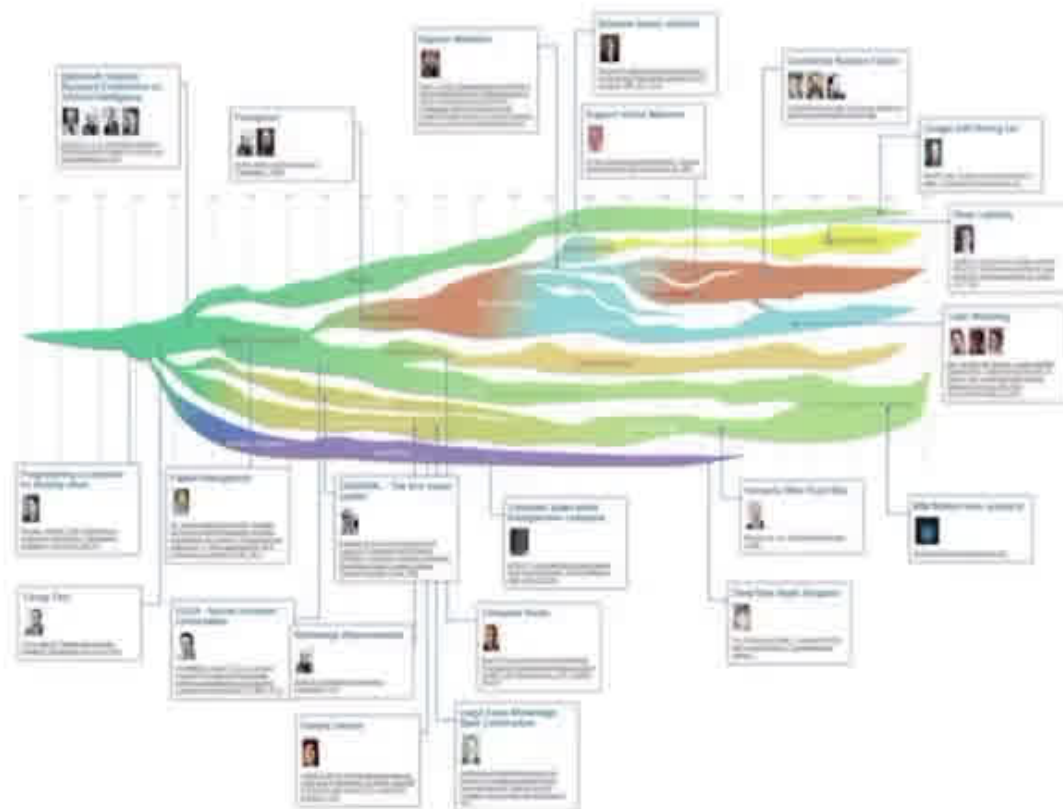
Left

## WHAT IS NOT-SAID ON AI?

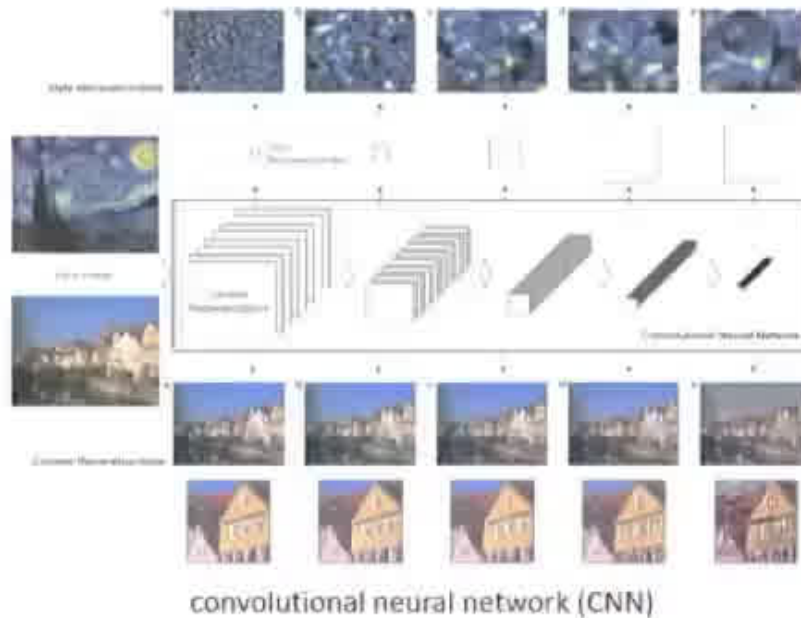
- 1- ARTIFICIAL INTELLIGENCE IS NOT ONLY MACHINE LEARNING
- 2- THE MACHINE LEARNING IS ONLY A CORRELATION-PREDICTION SYSTEM
- 3-PROBLEMS ON DATA
- 4- PROBLEMS ON REPRODUCIBILITY
- 5-LAW CONTEXT
- 6- SECURITY

# I-AI IS NOT ONLY THE MACHINE LEARNING

- Machine learning is only a small part of AI
- AI is also;
  - Knowledge
  - Knowledge transmission
  - Knowledge creation
  - Expertise
  - Learning process
  - Autonomy



# I-AI IS NOT ONLY THE MACHINE LEARNING



A Neural Algorithm of Artistic Style  
Leon A. Gatys et coll, arXiv:1508.06576v1  
The Bernstein Center for Computational Neuroscience, Germany



# 2- THE MACHINE LEARNING IS ONLY A CORRELATION-PREDICTION MODEL

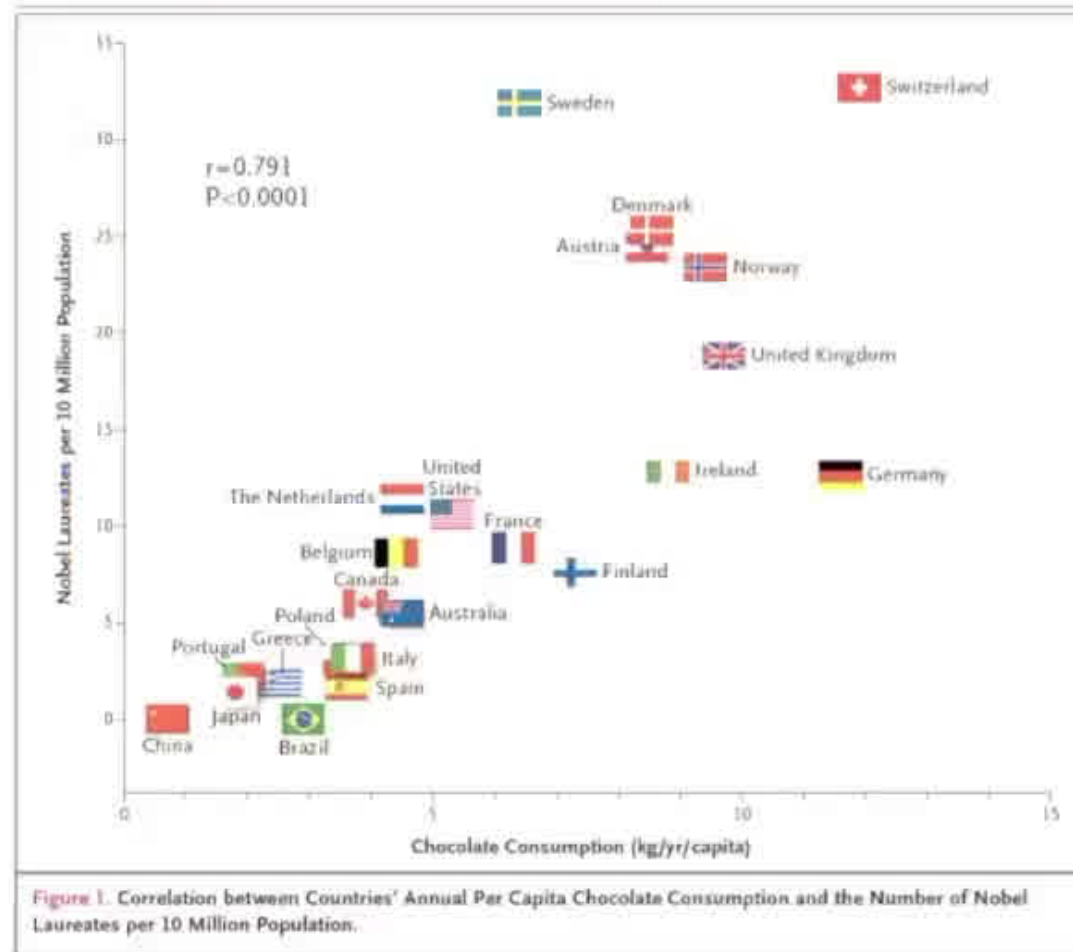
The NEW ENGLAND JOURNAL of MEDICINE

Messerli FH.

Chocolate consumption, cognitive function, and Nobel laureates.

N Engl J Med. 2012  
Oct 18;367(16):1562-4.

PubMed PMID: 23050509



What is artificial intelligence? What is not-said on AI?



# 3-PROBLEMS ON DATA

Google

women



Tous Images Vidéos Actualités Maps Plus Paramètres Outils

Collections SafeSearch

What is artificial intelligence? What is not-said on AI?



# 3-PROBLEMS ON DATA

Google

women



Tous Images Vidéos Actualités Maps Plus Paramètres Outils

Collections SafeSearch







# 3-PROBLEMS ON DATA

Google

women



Tous Images Vidéos Actualités Maps Plus Paramètres Outils

Collections SafeSearch





# 3-PROBLEMS ON DATA

Google

women



Tous Images Vidéos Actualités Maps Plus Paramètres Outils

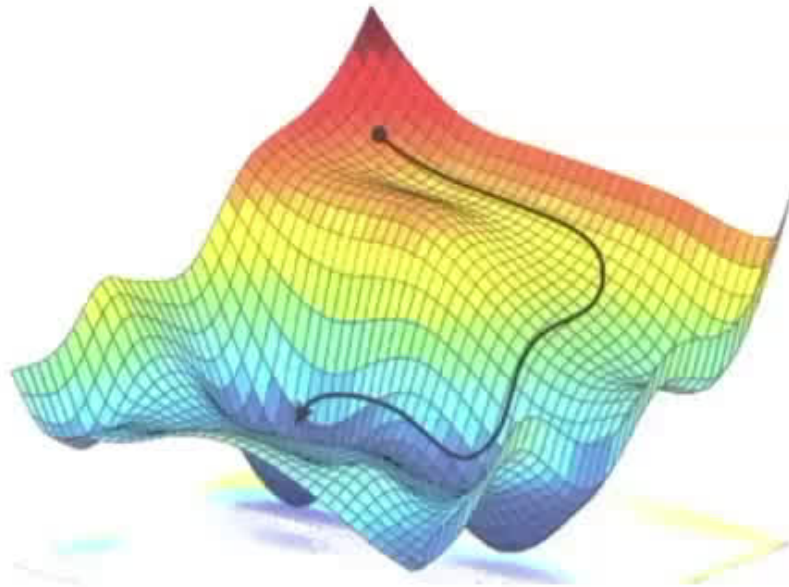
Collections SafeSearch



## 4- PROBLEMS ON REPRODUCIBILITY



SHARE



Gradient descent relies on trial and error to optimize an algorithm, aiming for minima in a 3D landscape.  
BY RANDI AMOR, HANIELA BIL, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ADAPTED BY M. ATARSI/SCIFY

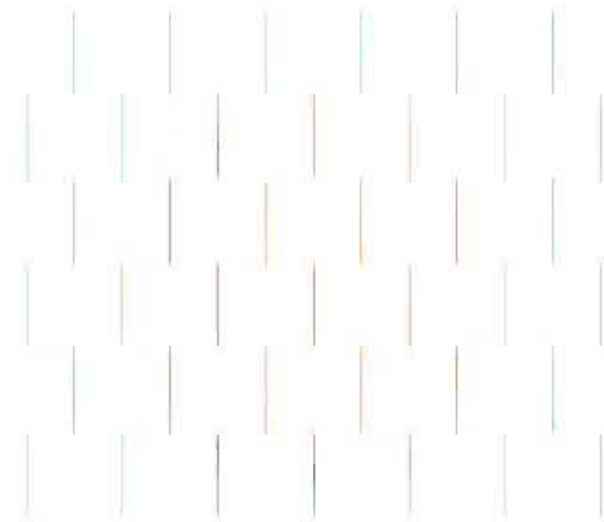
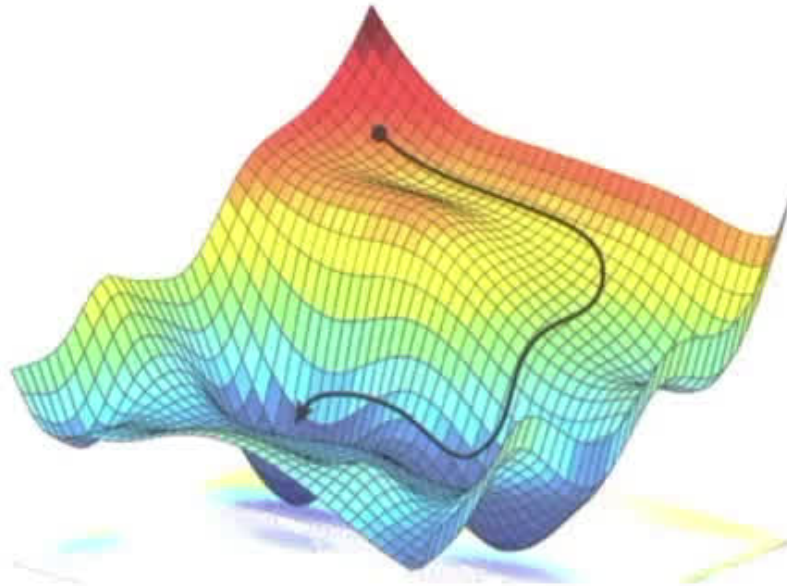
### AI researchers allege that machine learning is alchemy

By Matthew Hutson | May 3, 2018, 11:15 AM

# 4- PROBLEMS ON REPRODUCIBILITY



SHARE



Gradient descent relies on trial and error to optimize an algorithm, aiming for minima in a 3D landscape. ALEXANDER JAMNI, DANIELA RUS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ADAPTED BY M. ATAROD/SCIENCE

## AI researchers allege that machine learning is alchemy

By Matthew Hutson | May 3, 2018, 11:15 AM



# 4-PROBLEMS ON REPRODUCIBILITY


nature > nature biomedical engineering > articles > article

MENU ▾ nature biomedical engineering

2017

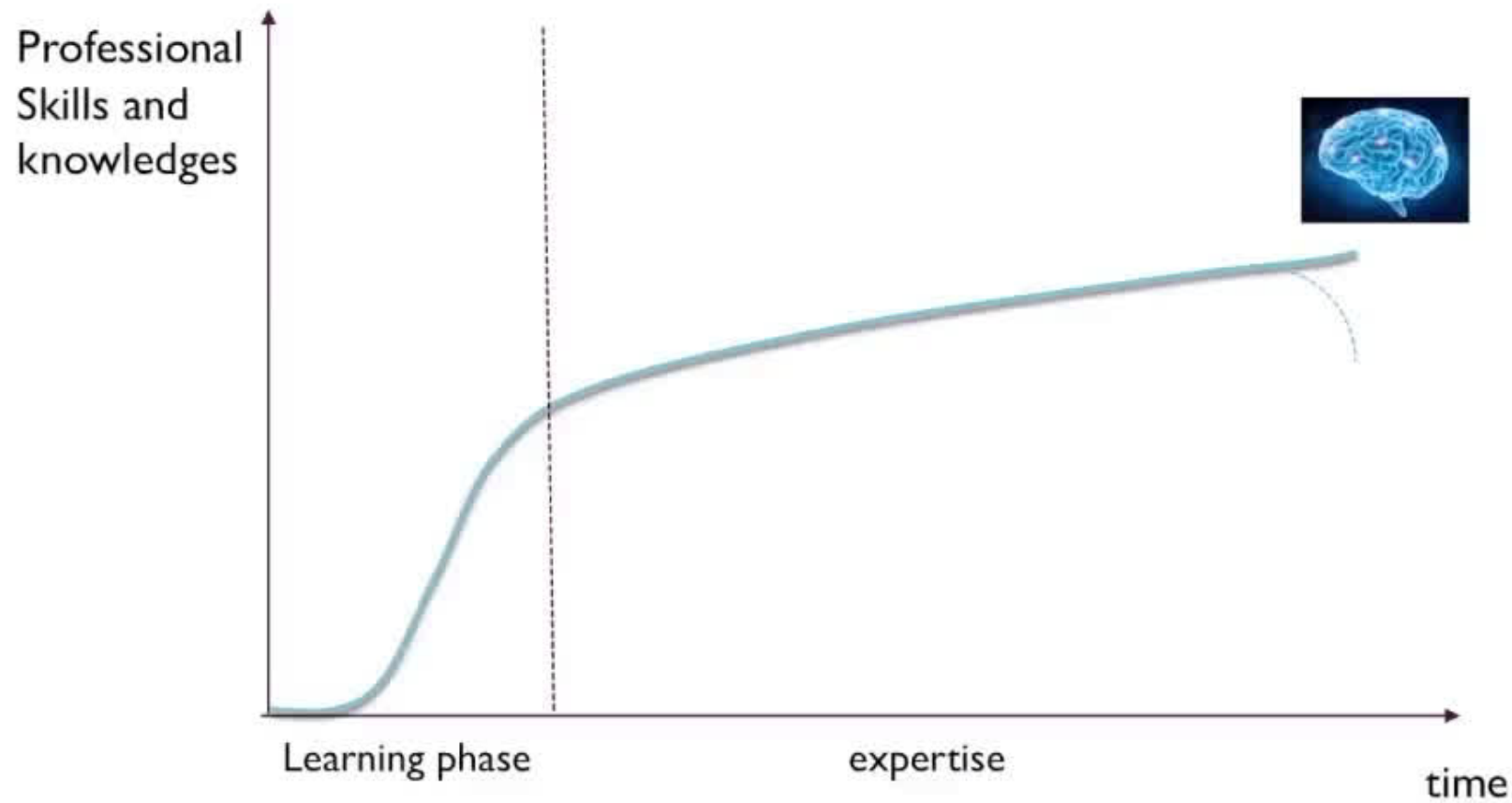
Article Published: 30 January 2017

## An artificial intelligence platform for the multihospital collaborative management of congenital cataracts

Erping Long, Haotian Lin , Zhenzhen Liu, Xiaohang Wu, Liming Wang, Jiewei Jiang, Yingying An, Zhuoling Lin, Xiaoyan Li, Jingjing Chen, Jing Li, Qianzhong Cao, Dongni Wang, Xiyang Liu, Weirong Chen & Yizhi Liu 

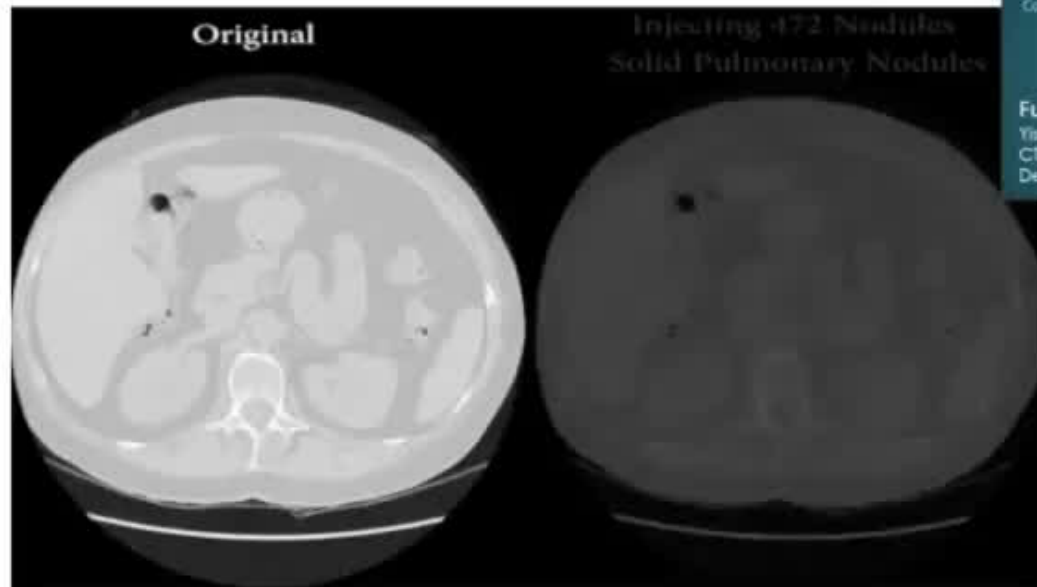
Nature Biomedical Engineering **1**, Article number: 0024 (2017) Download Citation 

# 5- LAW CONTEXT






# 6- SECURITY



**Demonstration:**  
Injecting and Removing Lung Cancer from CT Scans

Corresponding Author: Yisroel Minsky  
yminsky@post.tau.ac.il

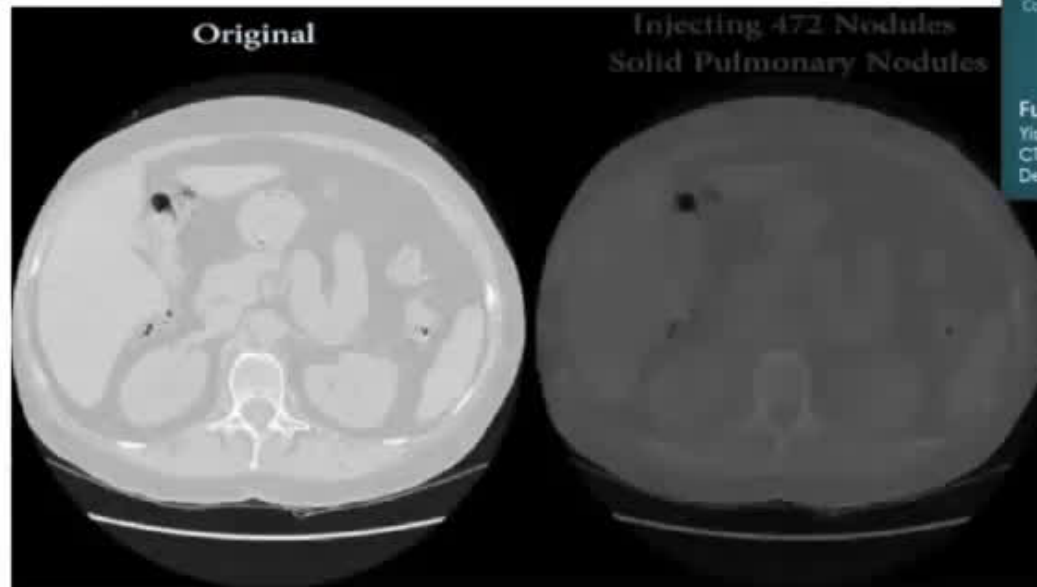
**Full paper:**  
Yisroel Minsky, Tom Mahler, Ilan Shelef, and Yuval Elovici  
CT-GAN: Malicious Tampering of 3D Medical Imagery using Deep Learning. <https://arxiv.org/abs/1901.03597>



Cyber security lab




# 6- SECURITY



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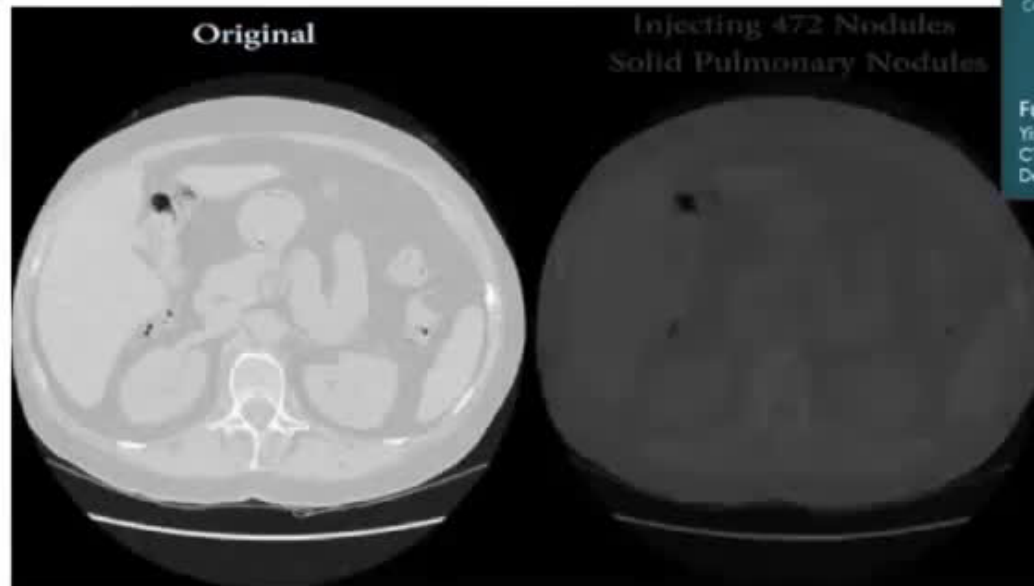
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Cyber security lab



## 6- SECURITY



**Demonstration:**  
Injecting and Removing Lung  
Cancer from CT Scans

Corresponding Author: Yisroel Mirsky  
ymirski@post.bgu.ac.il

**Full paper:**

Yisroel Mirsky, Tom Mahler, Ilan Shelef, and Yuval Elovici  
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Deep Learning. <https://arxiv.org/abs/1901.03597>



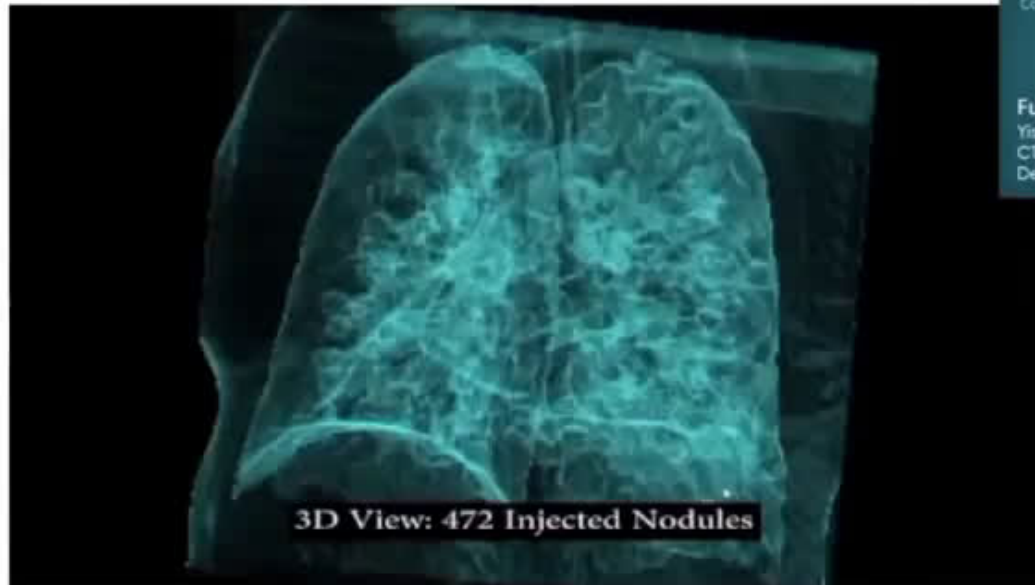
Cyber security lab

Imagine the consequences ;

- For your patient
- For your department (« ransomware »...)



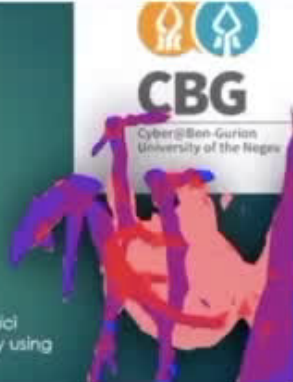
# 6- SECURITY



**Demonstration:**  
Injecting and Removing Lung Cancer from CT Scans

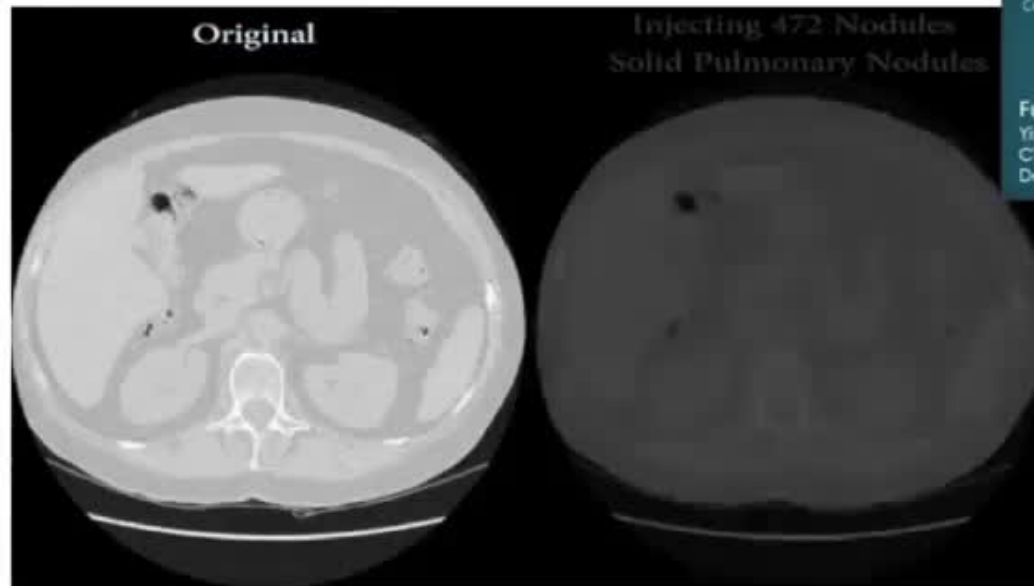
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CT-GAN: Malicious Tampering of 3D Medical Imagery using Deep Learning. <https://arxiv.org/abs/1901.03597>



Cyber security lab

## 6- SECURITY



### Demonstration: Injecting and Removing Lung Cancer from CT Scans

Corresponding Author: Yisroel Mirsky  
yisroel@post.bgu.ac.il

#### Full paper:

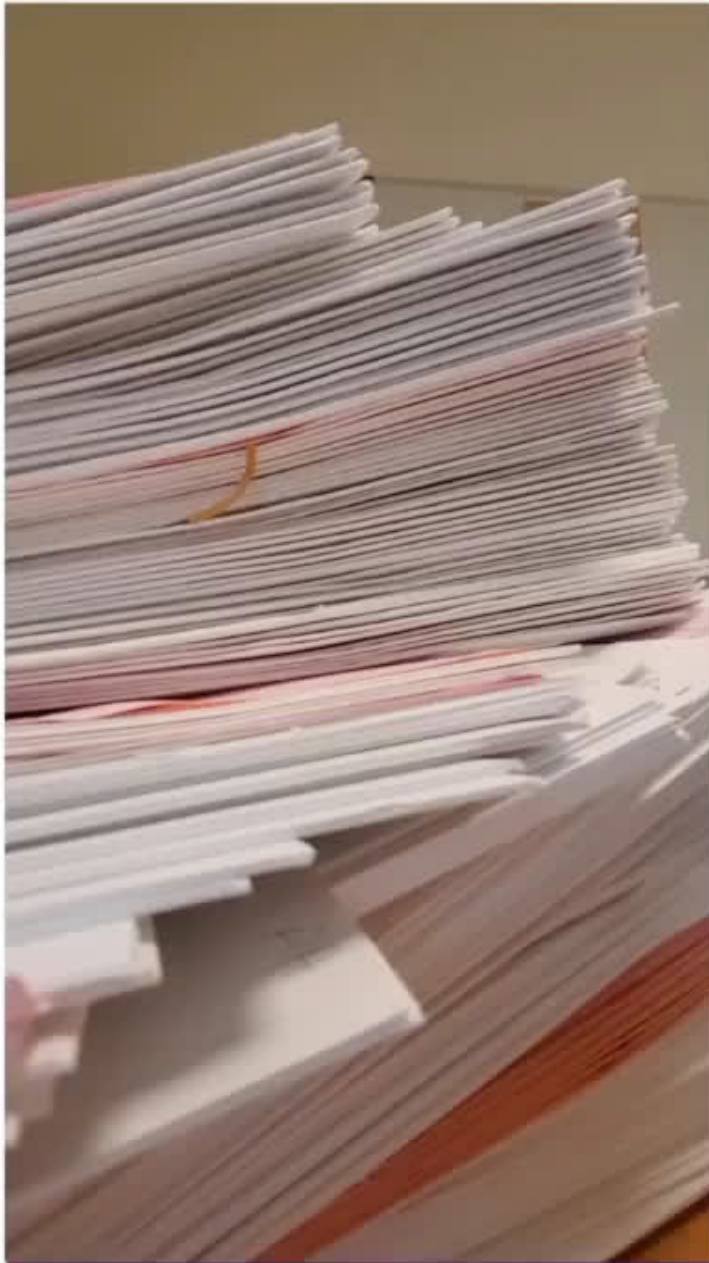
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Deep Learning. <https://arxiv.org/abs/1901.03597>



Cyber security lab

Imagine the consequences ;

- For your patient
- For your department (« ransomware »...)



## MY CURRENT WORK-LIFE...



# MY FUTURE WORK-LIFE...

## Step 1: Get an appointment



Automatic  
call center

Gave appointment and all information

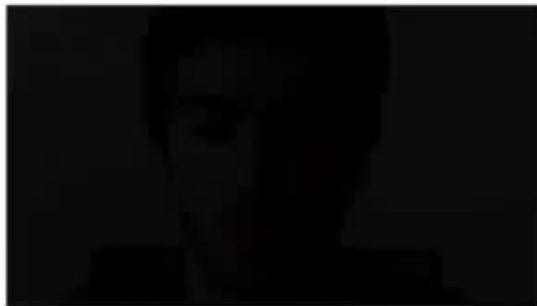
Entries;  
-date  
-type of exam  
-contra indication(s)  
-etc...

Outcome; appointment



# MY FUTURE WORK-LIFE...

Step 2: patient examination



Patient automatic recognition, self-registration, patient accompanying, exam performed





# MY FUTURE WORK-LIFE...

## Step 2: patient examination



Facial recognition

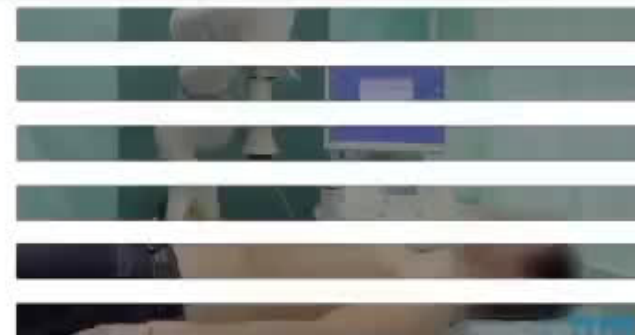


Patient accompanying

Patient automatic recognition, self-registration, patient accompanying, exam performed



Self registration



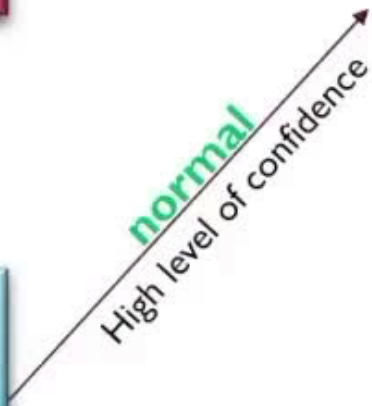
Exam performing



# MY FUTURE WORK-LIFE...

Step 3: report

Automatic report generation



Examination given to the patient with his/her QR code and available on line





# MY FUTURE WORK-LIFE...

## Step 3: report

Automatic report generation



Examination given to the patient with his/her QR code and available on line



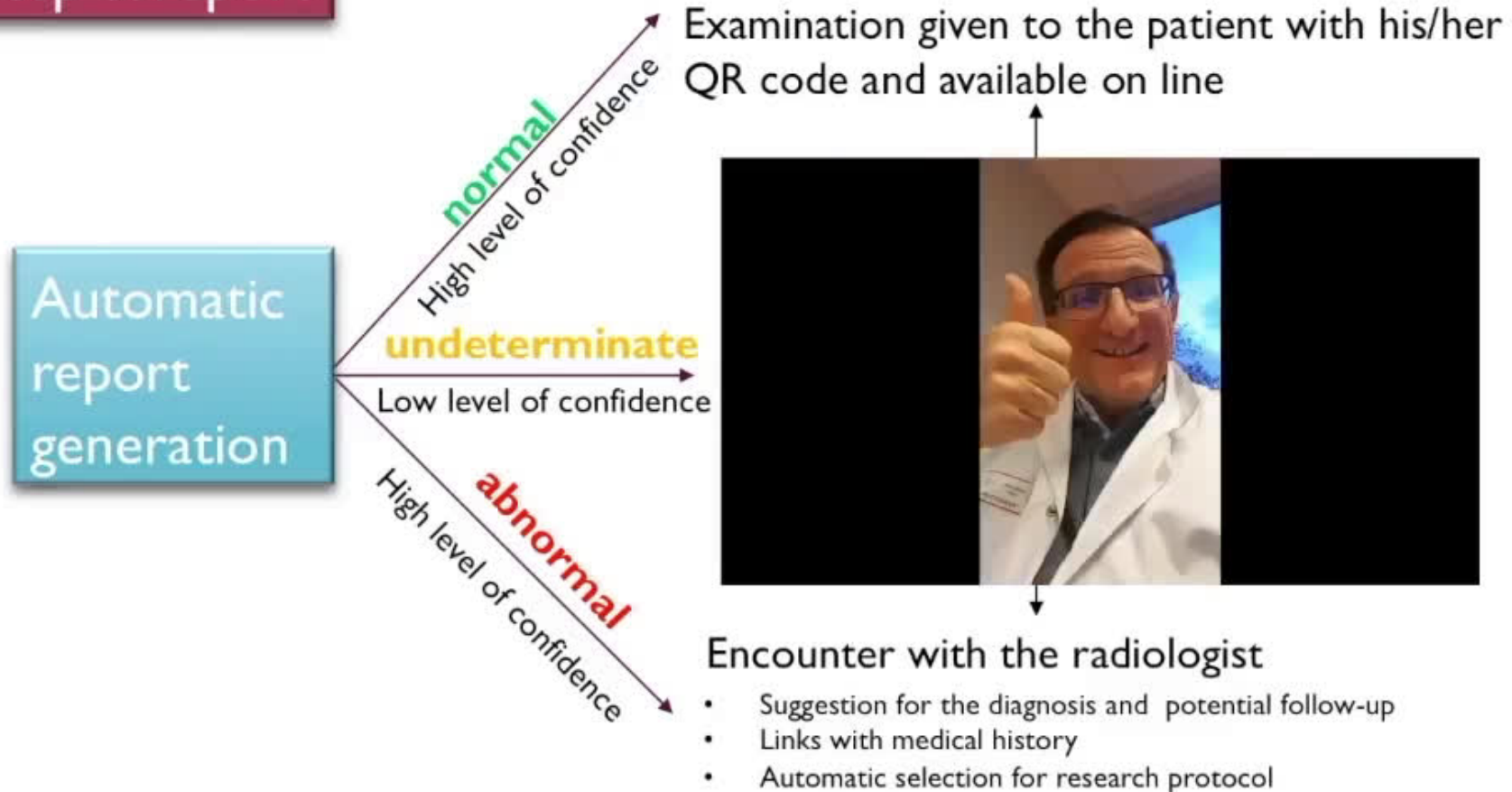
Encounter with the radiologist

- Suggestion for the diagnosis and potential follow-up
- Links with medical history
- Automatic selection for research protocol



# MY FUTURE WORK-LIFE...

## Step 3: report



## TO CONCLUDE

- IA is going to change our way of working;
  - By helping us in repetitive and low-level skill tasks
  - By increasing our medical « added value »
  - By giving time to the patient
- But not tomorrow morning



Thanks a lot for your attention  
Muchas gracias por su atencion  
Merci de votre attention



University hospital



Medical School



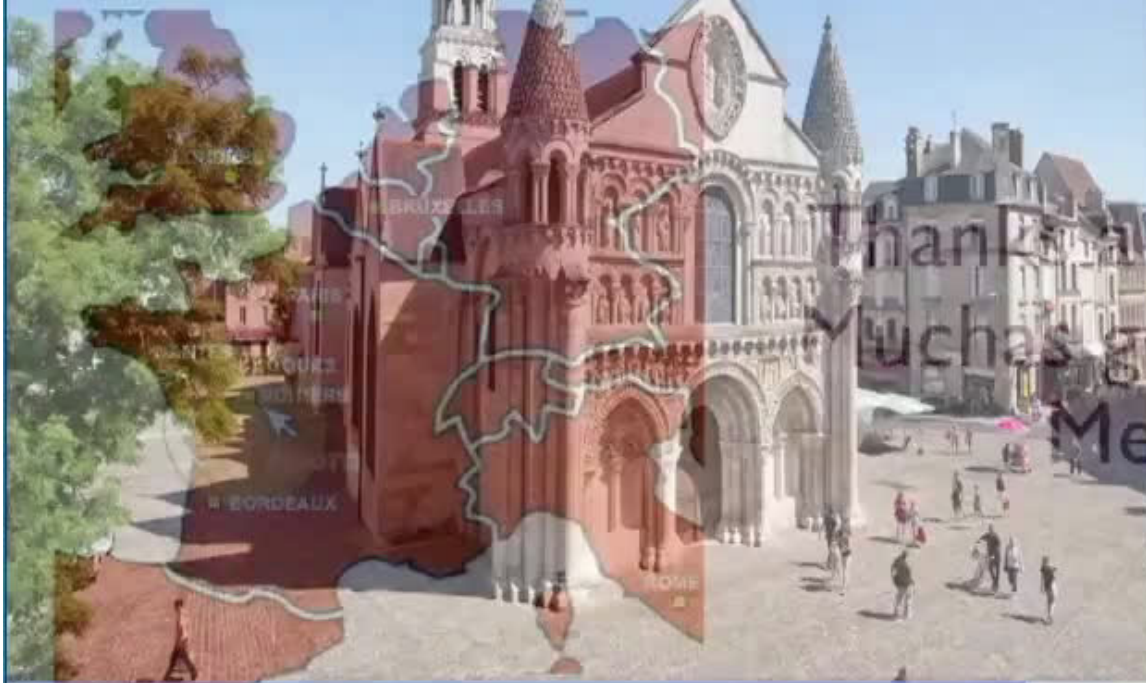
faculté de  
*Médecine* et  
de Pharmacie



Université  
de Poitiers

One of the two oldest Universities in France (1432)

# Centre ville (Downtown Poitiers)



Thank you a lot for your attention  
Muchas gracias por su atencion  
Merci de votre attention



Futuroscope  
(entertainment park)

CHU  
de Poitiers

University hospital



Medical School

Faculté de  
Médecine et  
de Pharmacie

One of the two oldest Universities in France (1432)