Deep Learning applied to automated Chest X-Ray screening

Fos-Guarinos B., *Alberich-Bayarri A.*[1,2], *Bosch-Roig I., Ten-Esteve A.* [2], *Martí-Bonmatí L.* [3]

HOSPITAL LA FE DE VALENCIA
UNIVERSITARI I POLITÈCNIC

1 PhD. GIBI Director and QUIBIM CEO
2 M. Sc GIBI230
3 MD, PhD. GIBI PI and QUIBIM Founder

Outline

- Introduction
- Purpose
- Materials and methods
- Results
- Conclusion

Introduction

75% of the explorations carried out in the **Imaging Diagnosis** area are radiographs, being **chest X-rays** the majority of them because they contain **potential information** of the main structures of the human body (heart, lungs…).

Reporting chest x-rays is a demanding task and very important **medical-legally**, sometimes forgettable. So, we wanted to set up a **screening tool** in order to **aid radiologist** by setting a prefilter for **giving priority** to the **abnormal ones** and facilitate the chest x-ray reporting task.

Valdés P., Morales Á. (2015) Posición SERAM sobre la necesidad de informar la radiología simple. SERAM.

Purpose

- Designing, developing and evaluating the effectivity of a **Computer-Aided Diagnosis (CAD) system** based on artificial intelligence techniques (**deep learning**) able to perform automatically a **first screening task** of **healthy and pathological chest radiographs**.

Materials and Methods

MACHINE LEARNING

A type of **artificial intelligence** that provides **computers** the ability to **learn** and perform certain **tasks without being programmed** explicitly to do so.

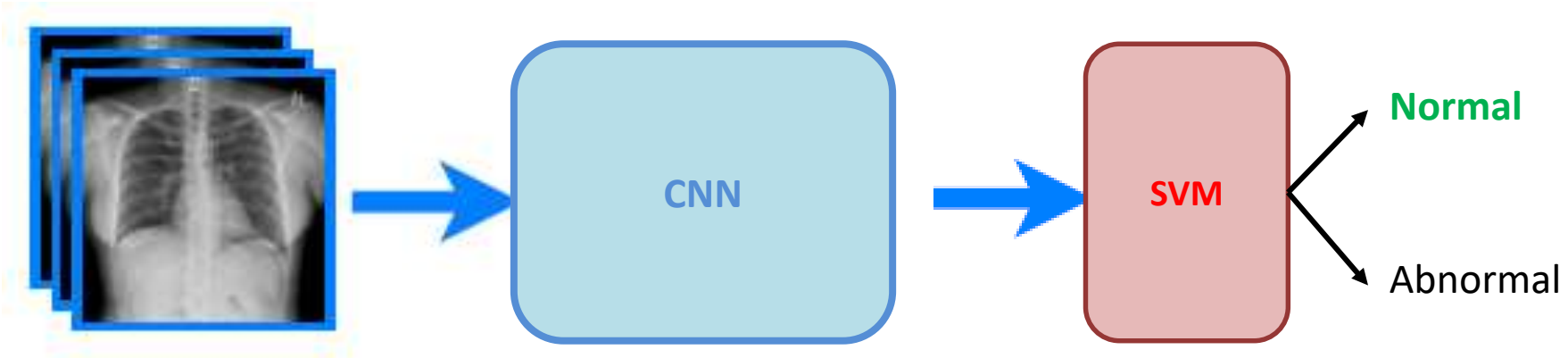
DEEP LEARNING

A **machine learning technique** that can learn useful representations or **features directly from** data such as **images, text or sound**.

Nehemia A., Prasanna S. (2015). Deep Learning for Computer Vision with Matlab. MATHWORKS. Conference

Materials and Methods

WORKFLOW



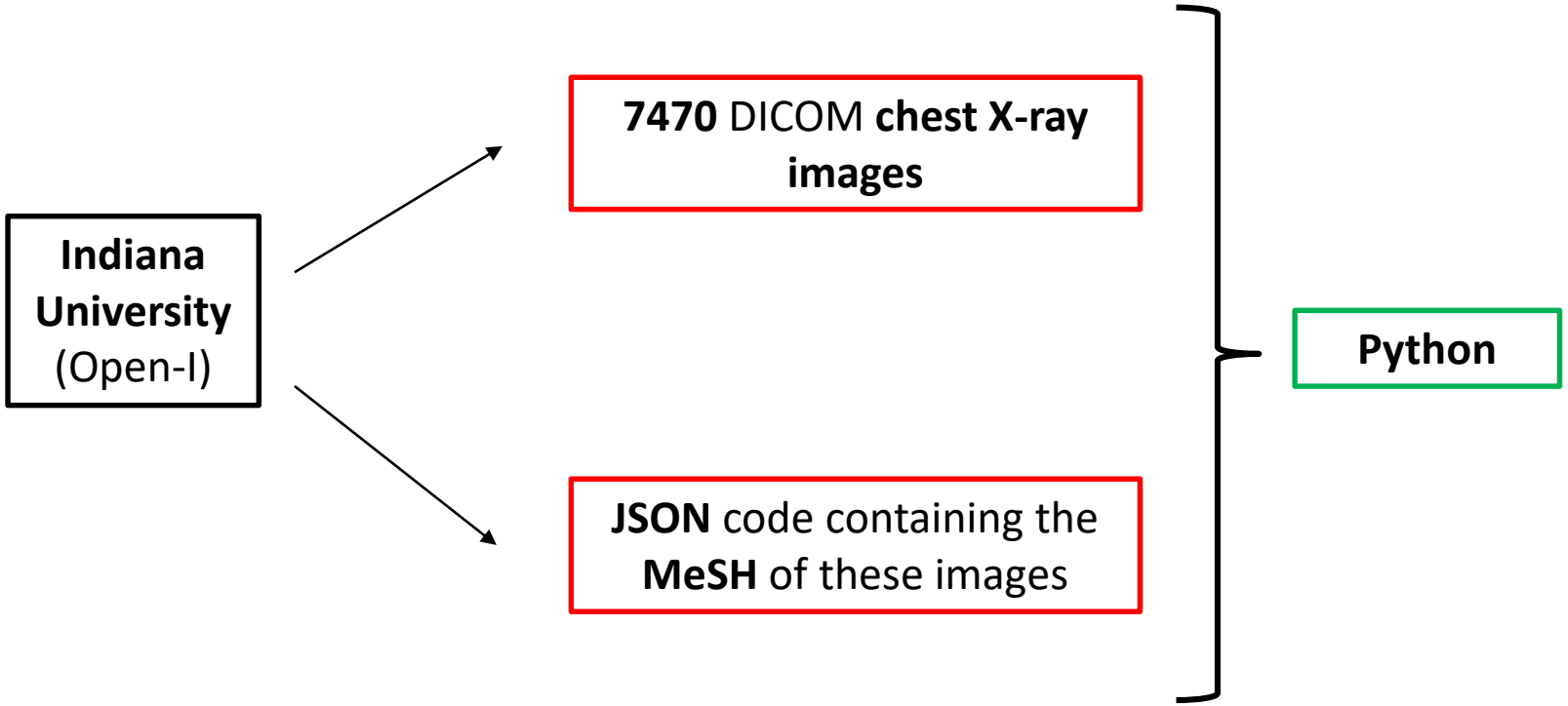
Preparing the radiological database

Automatic feature extraction

Training a classifier

Materials and Methods

- Preparing the radiological database



Materials and Methods

- Preparing the radiological database

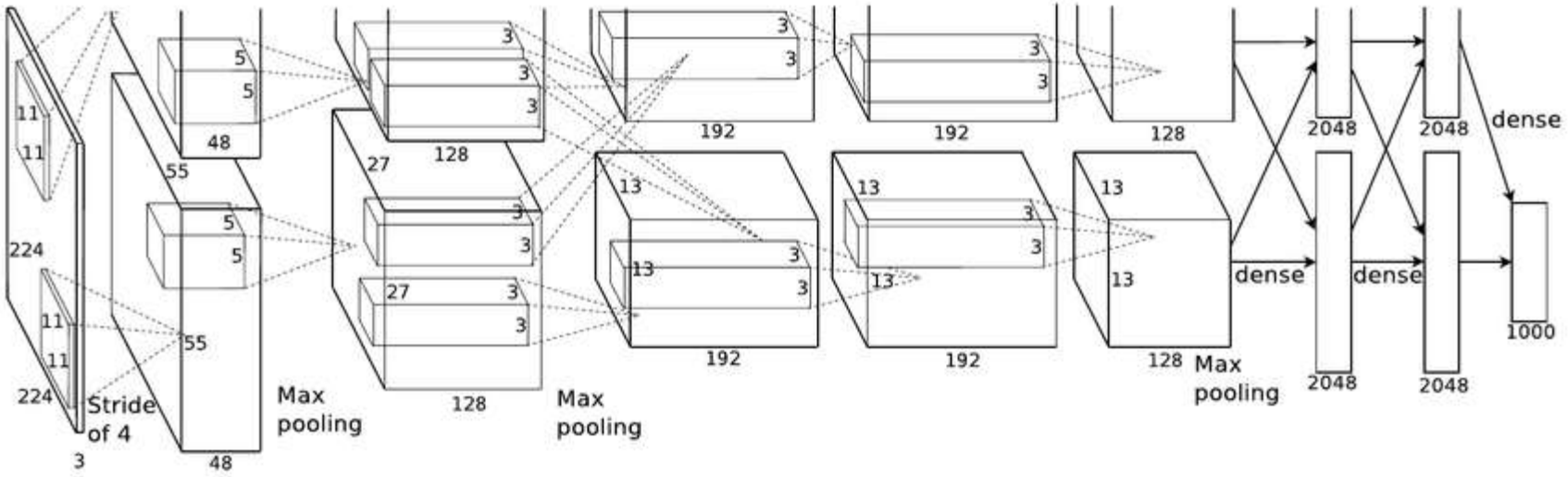
Category	Total
Atelectasis	293
Cardiomegaly	331
Nodule	253
Opacity	412
Pleural effusion	144

Category	Total
Abnormal	868
Normal	137

Materials and Methods

- Automatic feature extraction

AlexNet → Pretrained on ImageNet

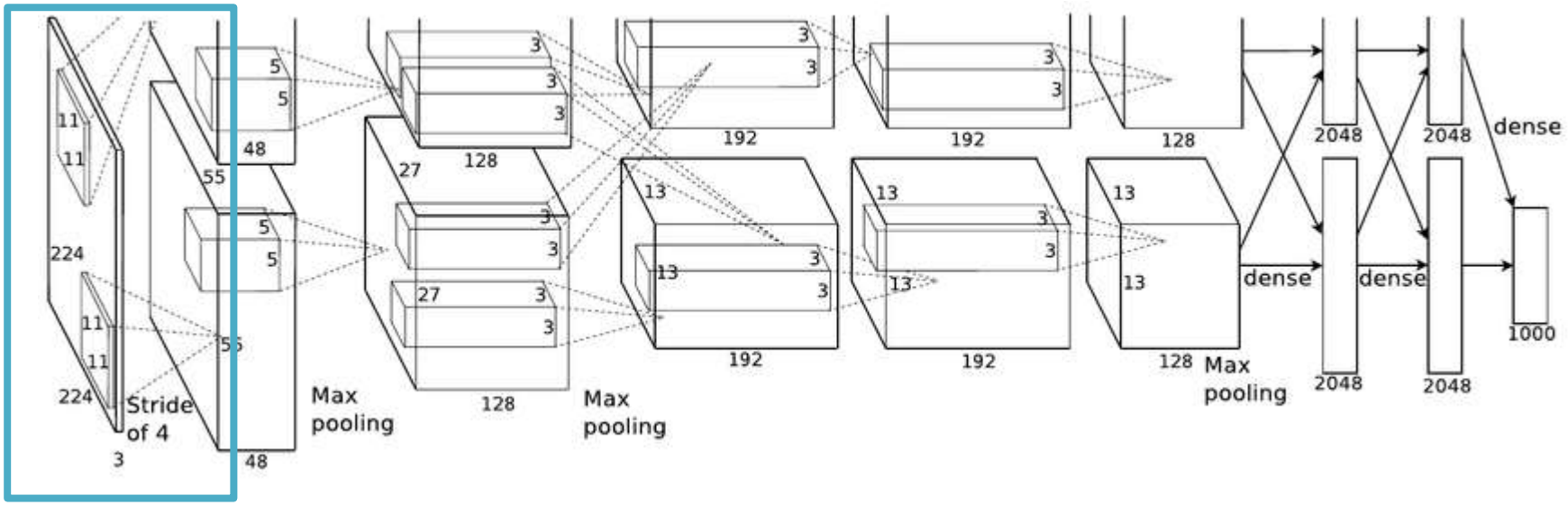


Krizhevsky et al. (2012). ImageNet Classification With Deep Convolutional Neural Networks

Materials and Methods

- Automatic feature extraction

AlexNet → Pretrained on ImageNet



Input layer

Krizhevsky et al. (2012). ImageNet Classification With Deep Convolutional Neural Networks

Materials and Methods

- Automatic feature extraction

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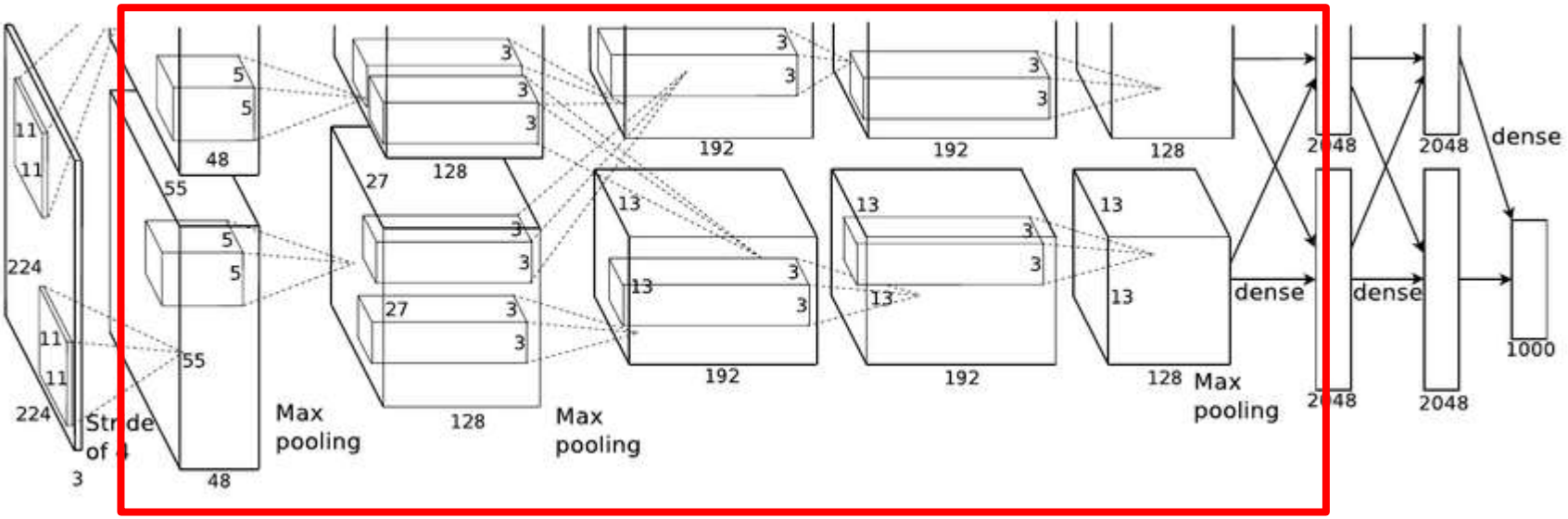


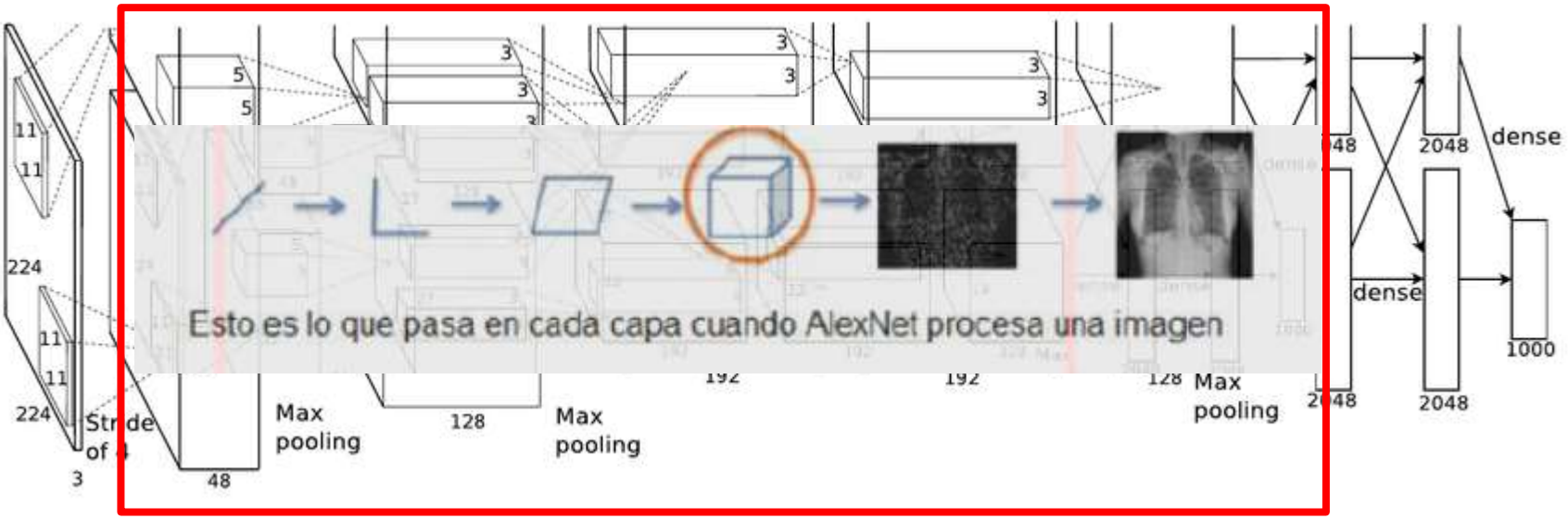
Convolutional layers

Krizhevsky et al. (2012). ImageNet Classification With Deep Convolutional Neural Networks

Materials and Methods

- Automatic feature extraction

AlexNet → Pretrained on ImageNet



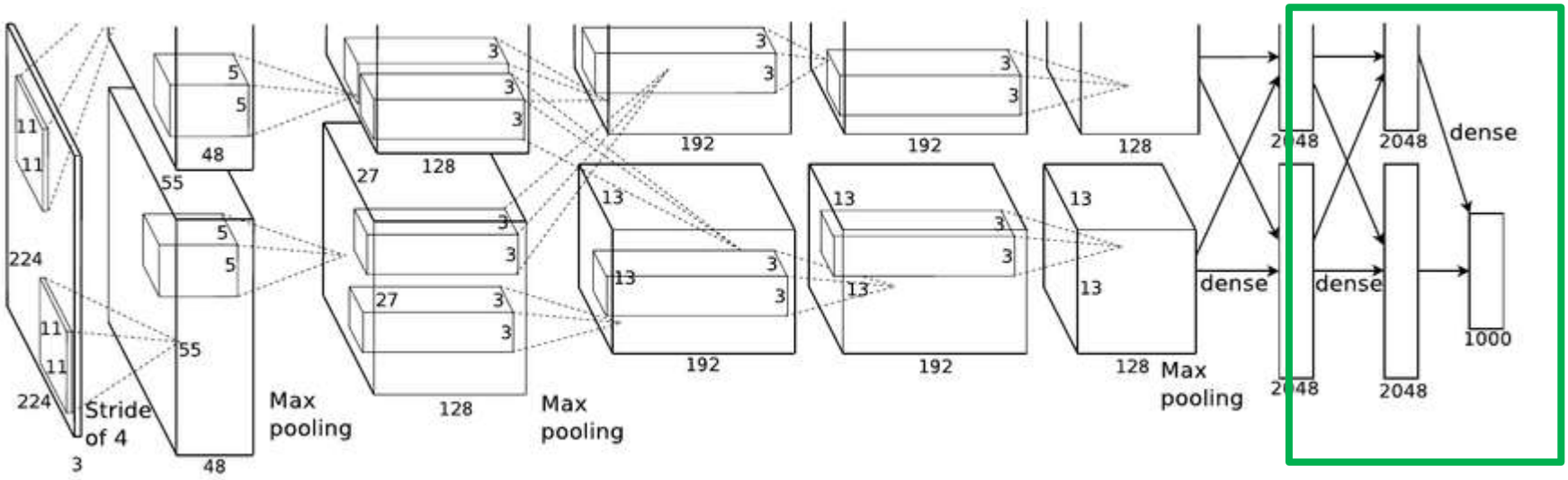
Convolutional layers

Krizhevsky et al. (2012). ImageNet Classification With Deep Convolutional Neural Networks

Materials and Methods

- Automatic feature extraction

AlexNet → Pretrained on ImageNet



Fully-connected layers

Krizhevsky et al. (2012). ImageNet Classification With Deep Convolutional Neural Networks

Materials and Methods

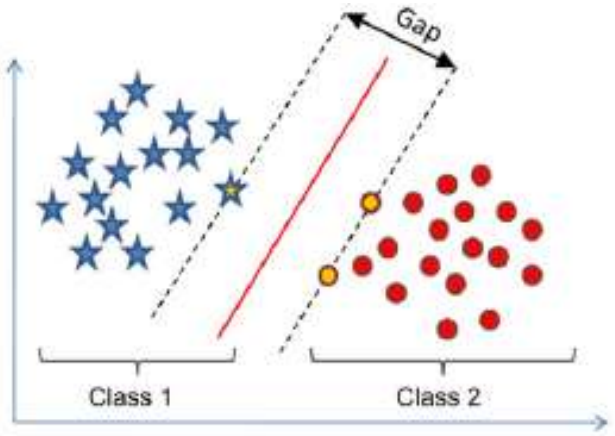
- Training a classifier

Radiological database

80% for training the classifier

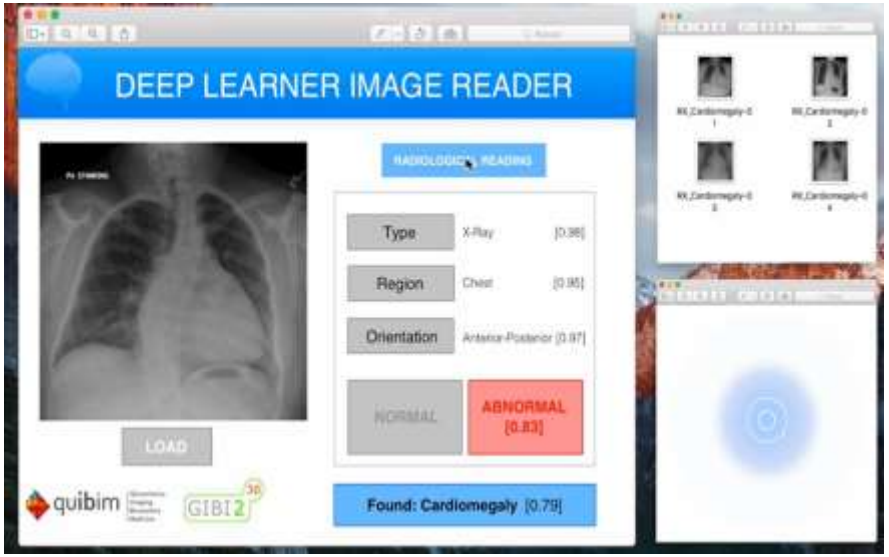
20% for test and evaluation

Automatically extracted features → **Support Vector Machines**



Results

Development of a **graphical user interface** → GUIDE of MATLAB

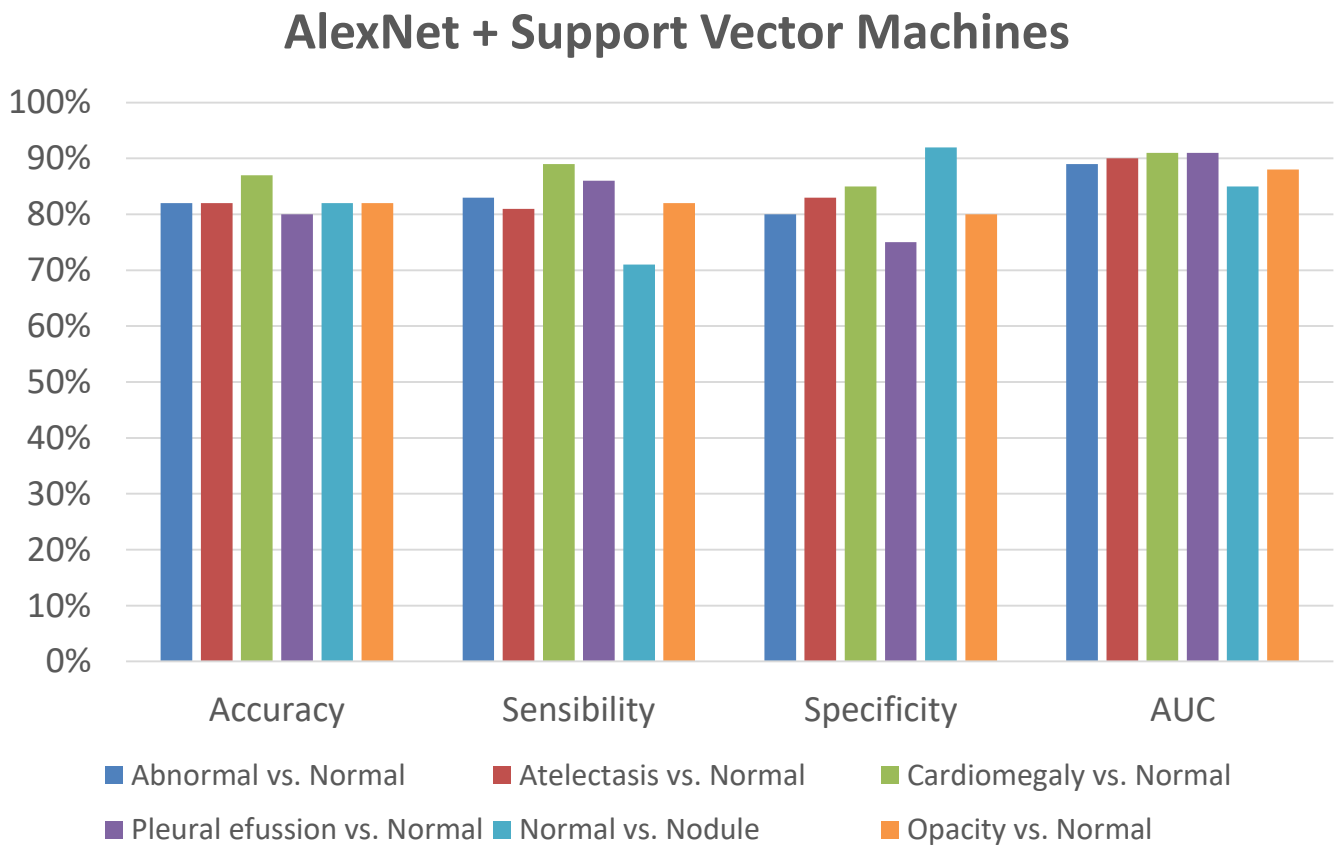


Results

20% of the data for test and **evaluation system** (confusion matrix)

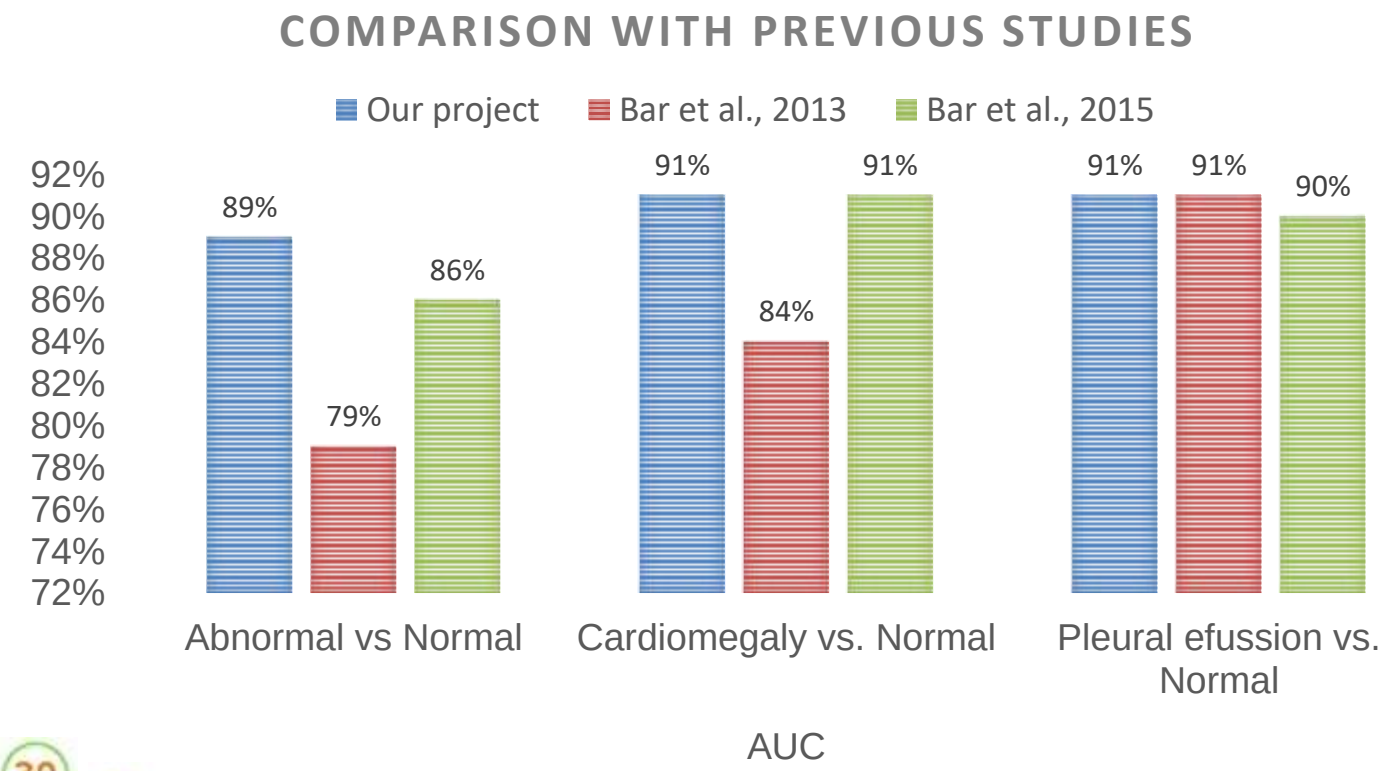
	Abnormal vs. Normal	Atelectasis vs. Normal	Cardiomegaly vs. Normal	Pleural efussion vs. Normal	Normal vs. Nodule	Opacity vs. Normal
Accuracy	82%	82%	87%	80&	82%	82%
Sensibility	83%	81%	89%	86%	71%	82%
Specificity	80%	83%	85%	75%	92%	80%
AUC	89%	90%	91%	91%	85%	88%

Results


AlexNet + Support Vector Machines
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Accuracy
Sensibility
Specificity
AUC
Abnormal vs. Normal
Atelectasis vs. Normal
Cardiomegaly vs. Normal
Pleural efussion vs. Normal
Normal vs. Nodule
Opacity vs. Normal

Results

Our study **improves or equals** the results achieved by classifiers trained similarly in previous studies.



Conclusions

- A **Computer-Aided Diagnosis system** has been designed and developed (**DEEPLIR**) based on **convolutional neural networks**, able to perform automatically a **first screening task** in **healthy and pathological chest X-rays** aimed at solving the problems that have motivated this project.

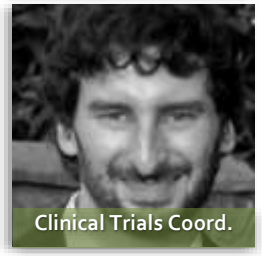
- **AlexNet** has a great **potential of knowledge transfering to the chest x-ray images**. From now on, deep learning by CNNs has to be considered as the first candidate in any essential task of visual recognition.

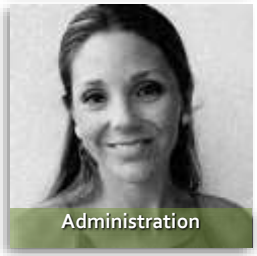
Team

Luis Martí Bonmatí – MD, PhD. GIBI PI and QUIBIM Founder
Ángel Alberich-Bayarri – PhD. GIBI Director and QUIBIM CEO


QUIBIM Staff
Fabio García Castro - M.Sc
Rafa Hernández Navarro - B.Sc
David García - M.Sc
Encarna Sánchez - M.Sc
Katherine Wilisch R. - M.Sc

GIBI2³⁰ Staff
Enrique Ruiz Martínez – M.Sc
Amadeo Ten Esteve – M.Sc
Ana Penadés - Adm.





Internship Students
Belén Fos Guarinos
Alfredo Torregrosa Lloret
Carlos Moya Claramunt
Ana Jiménez Pastor
Irene Mayorga Ruiz