Deep Learning - un pas important vers l'apprentissage autonome des machines

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Institute of Complex Systems

Ecole d'ingénieurs et d'architectes de Fribourg
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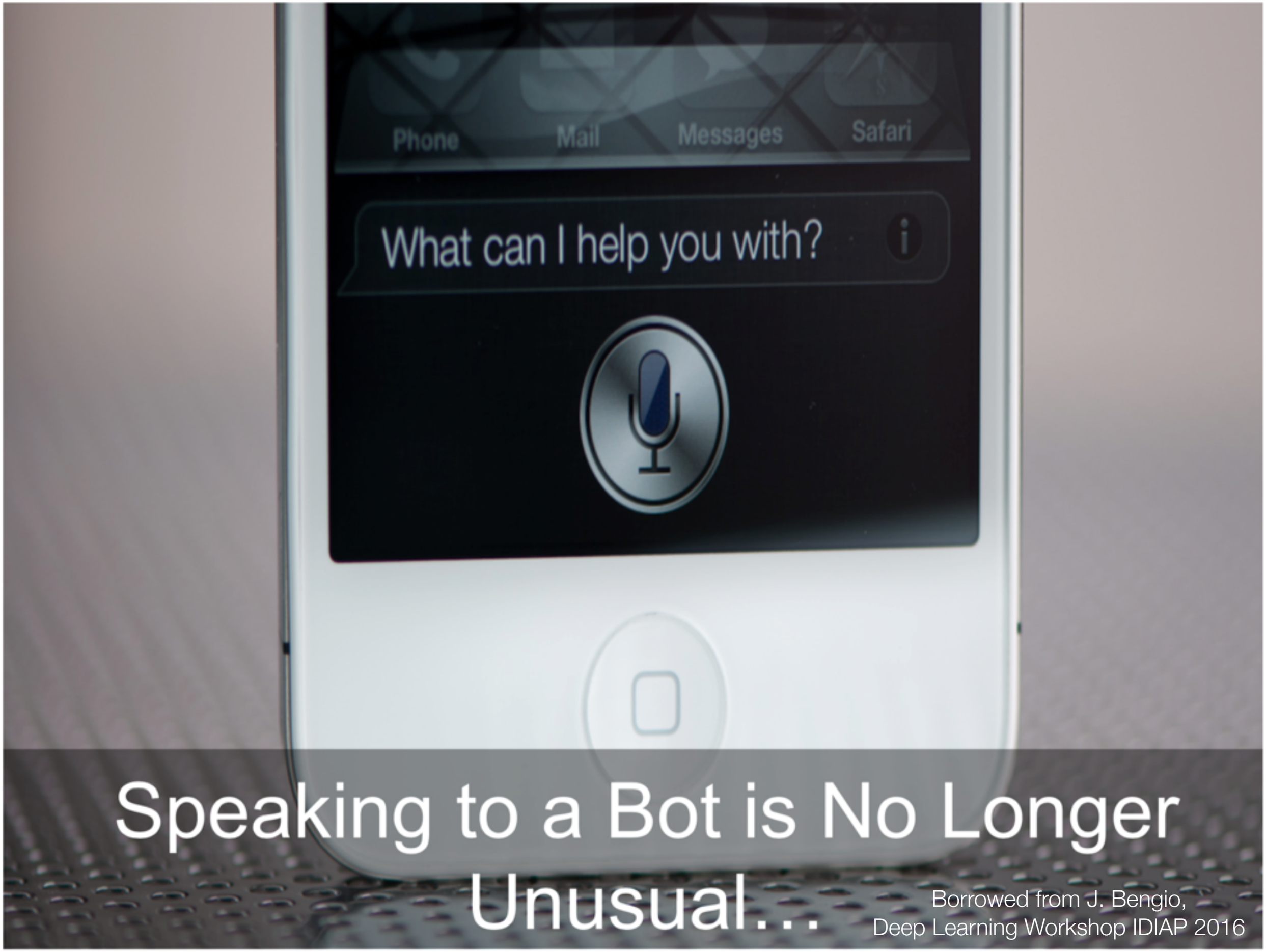
itvalley

DAPLAB
Data Analysis and Processing Lab

Cars are now driving themselves…

Borrowed from J. Bengio, Deep Learning Workshop IDIAP 2016



Speaking to a Bot is No Longer Unusual…

Borrowed from J. Bengio,
Deep Learning Workshop IDIAP 2016

March 2016: World Go Champion Beaten by Machine

A new revolution seems to be in the work after the industrial revolution.

Devices are becoming intelligent.

And Deep Learning is at the epicenter of this revolution.

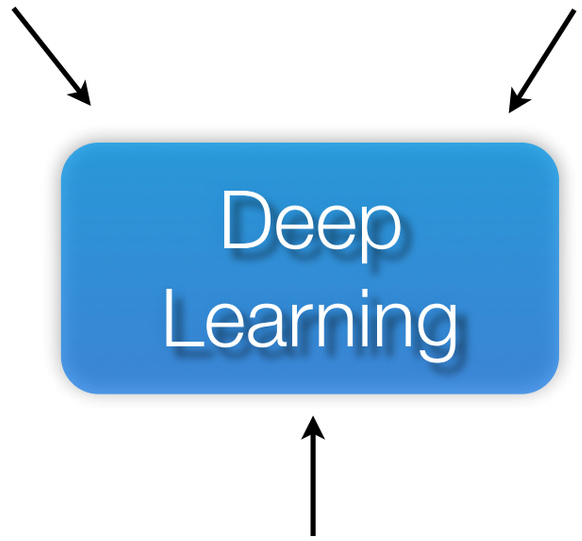
Borrowed from J. Bengio, Deep Learning Workshop IDIAP 2016

What is deep learning?

- New trend in the field of machine learning
- At the convergence of

Larger quantities of data
text, audio, images, videos, ...

New algorithms
DBN, RBM, CNN ...

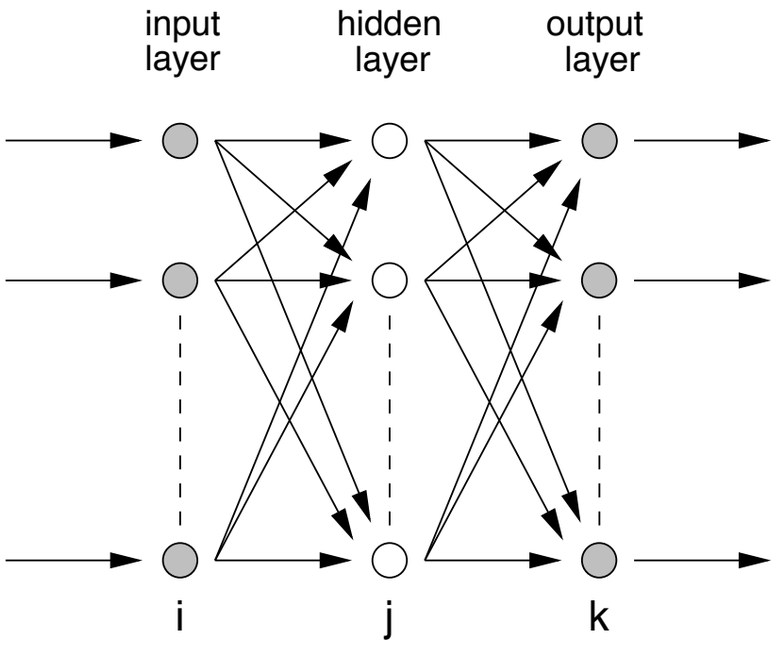


Better computer performance
GPU, distributed computing ...

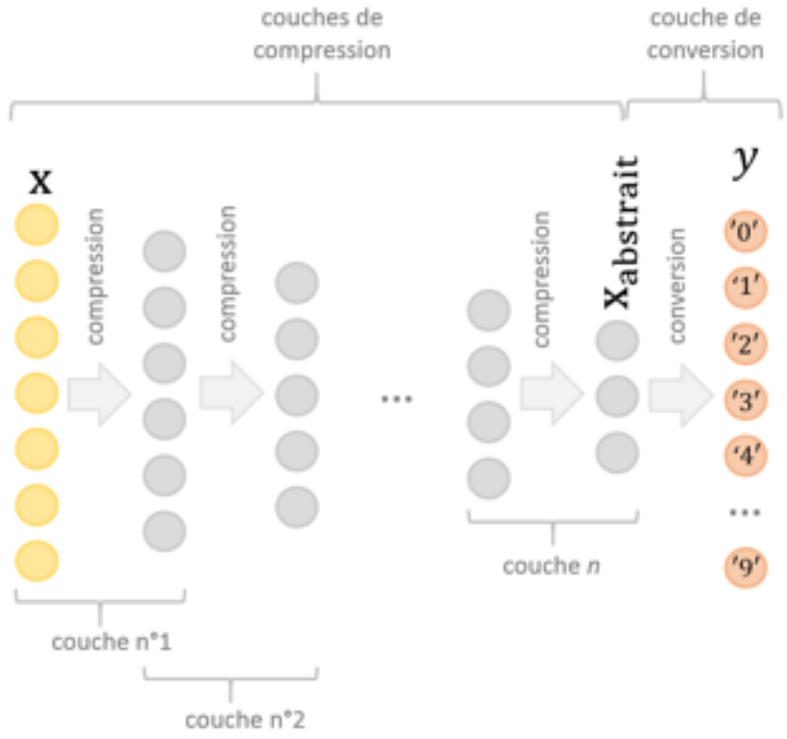
Breaking news: 4x Tesla K80 coming soon @ www.daplab.ch

What is deep learning?

- Neuronal architecture with many layers and neurons



1990’s
500 neurons
50K params
months of training on cpu



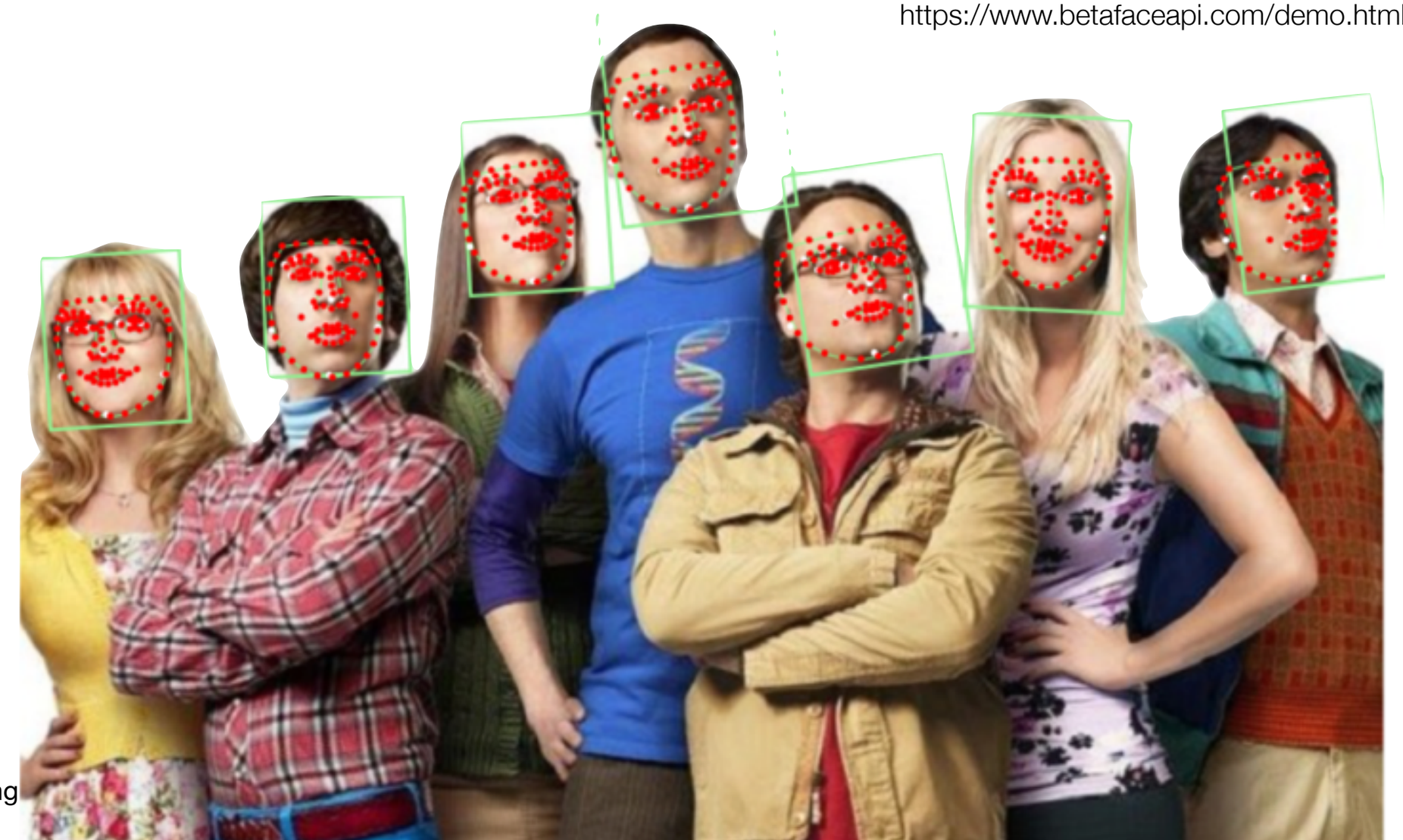
2010’s
500’000 neurons
60M params
days/weeks of training on gpu

Face recognition task

The problem has actually three parts

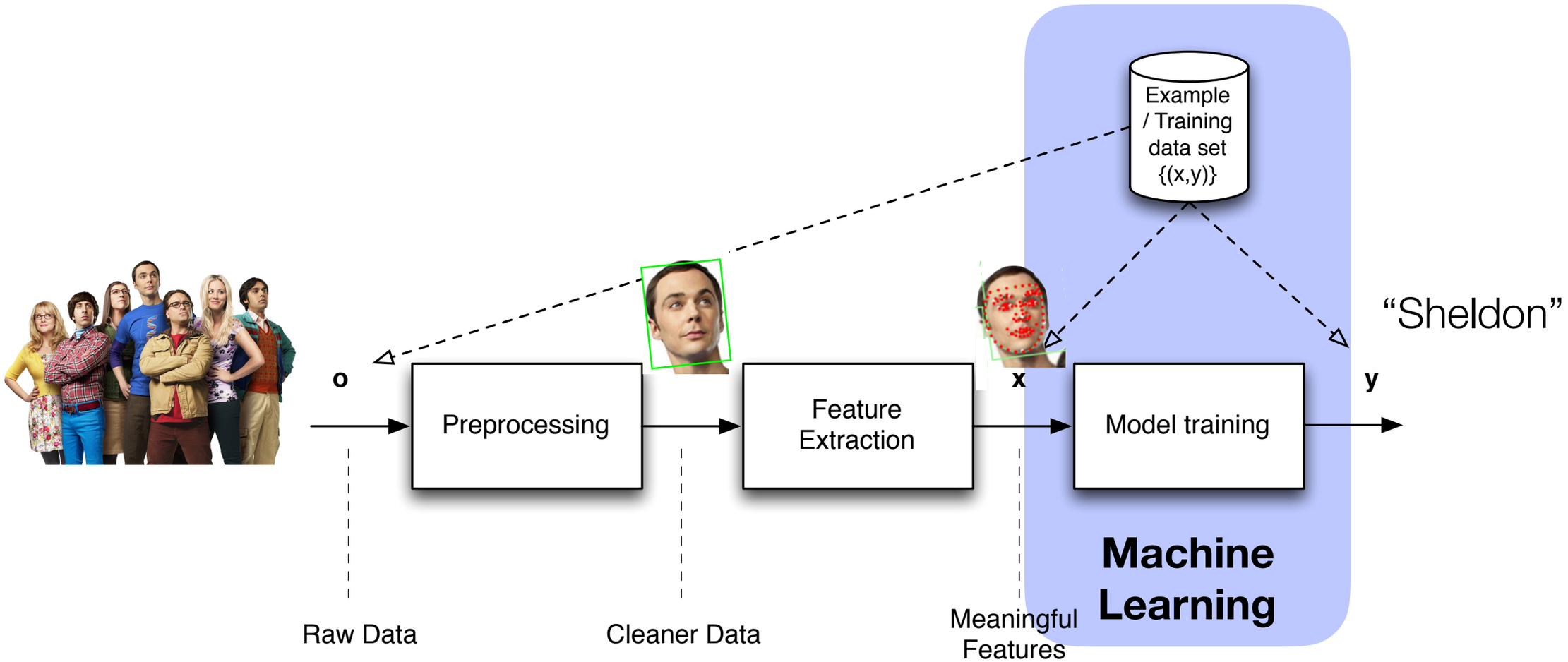
- Face detection — where is the face?
- Feature extraction — what defines a face?
- Face matching — who is associated to this face?

https://www.betafaceapi.com/demo.html



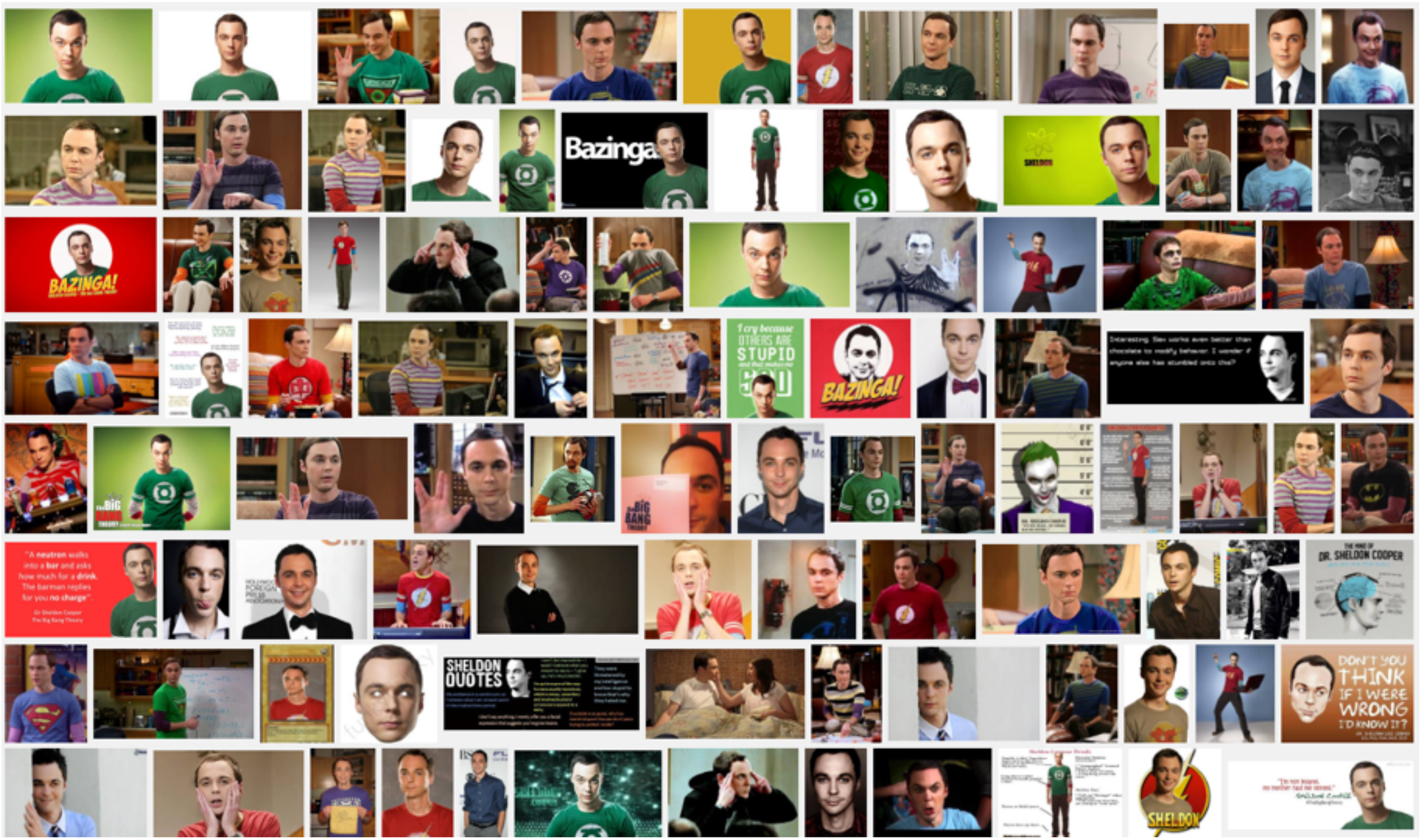
Supervised machine learning

With **supervised learning**, the goal is to extract some relevant features **x** from raw observation data **o** and to learn a mapping from inputs **x** to outputs **y** given a set of example data called the training set.



...

Training with many examples of Sheldon, Raj, Penny,…

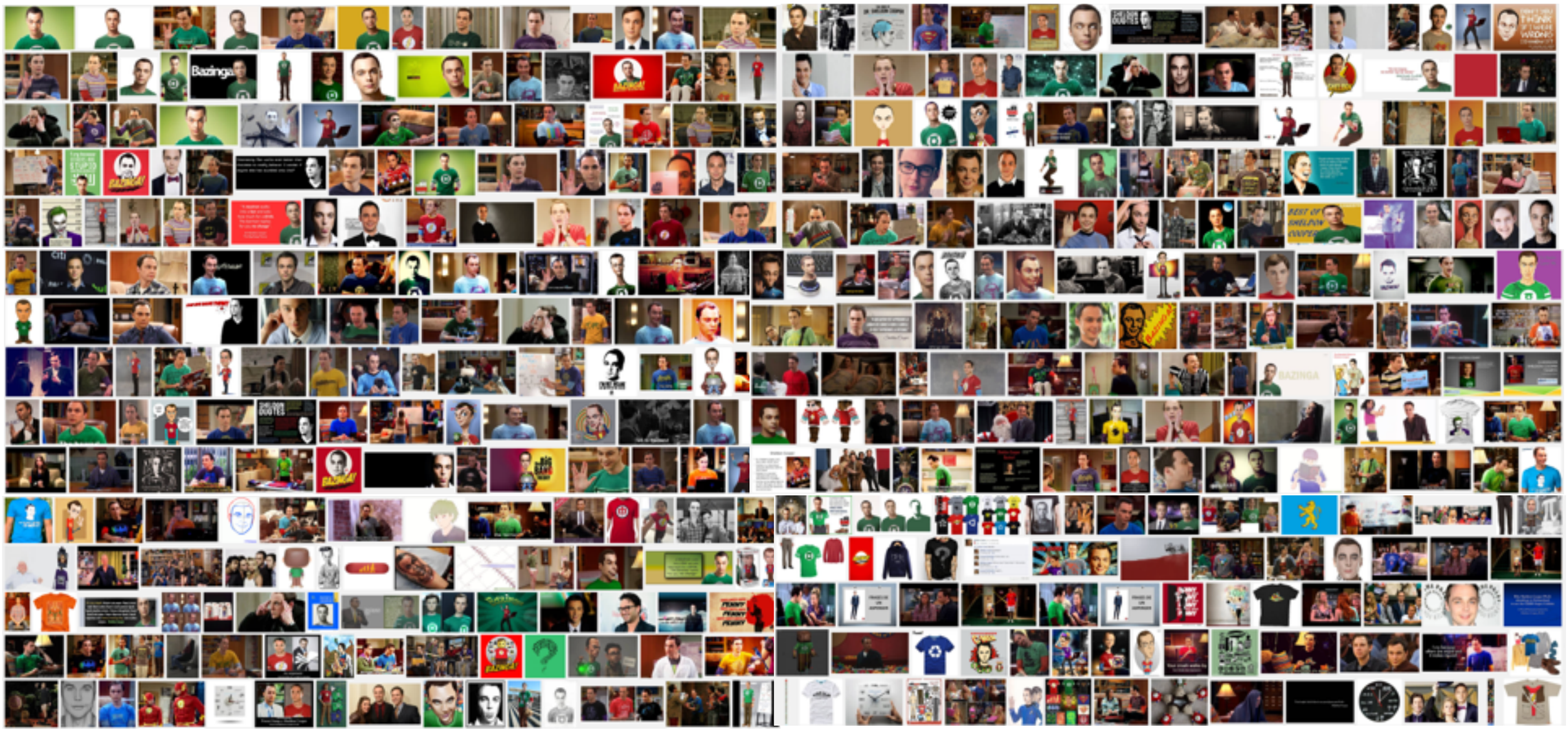


PROBLEM 1: We need **large quantities of human validated examples!** …and this is costly to build

...

- Are we able to **generalise**?
- We have here more complex **variabilities** such as growing a barb, changing hair style, …
- This means we need more examples or to find ways to look for *invariant features …*

We will need more examples of Sheldon, Raj, Penny,…

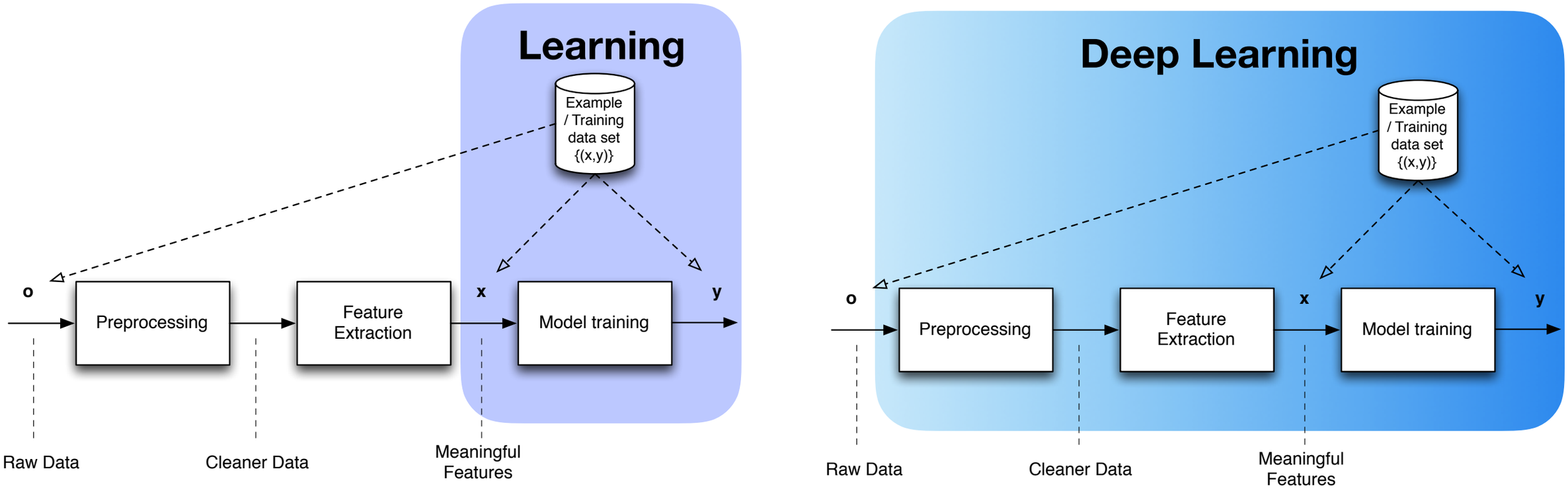


PROBLEM 2: Because of the variabilities, we will need even **more data** and **complex mapping functions**.

PROBLEM 3: We usually spend a lot of time to hand-craft interesting compact features, this is called **feature engineering**

Deep Learning answers these problems:

Learn the feature extraction using unsupervised learning algorithms



Supervised learning problems

1. We need **large quantities of human validated examples!** …and this is costly to build
2. We need **even more data and complex mapping functions to learn variabilities** of the input
3. We usually need a lot of hand-crafted **feature engineering** to compute interesting/compact inputs **x**

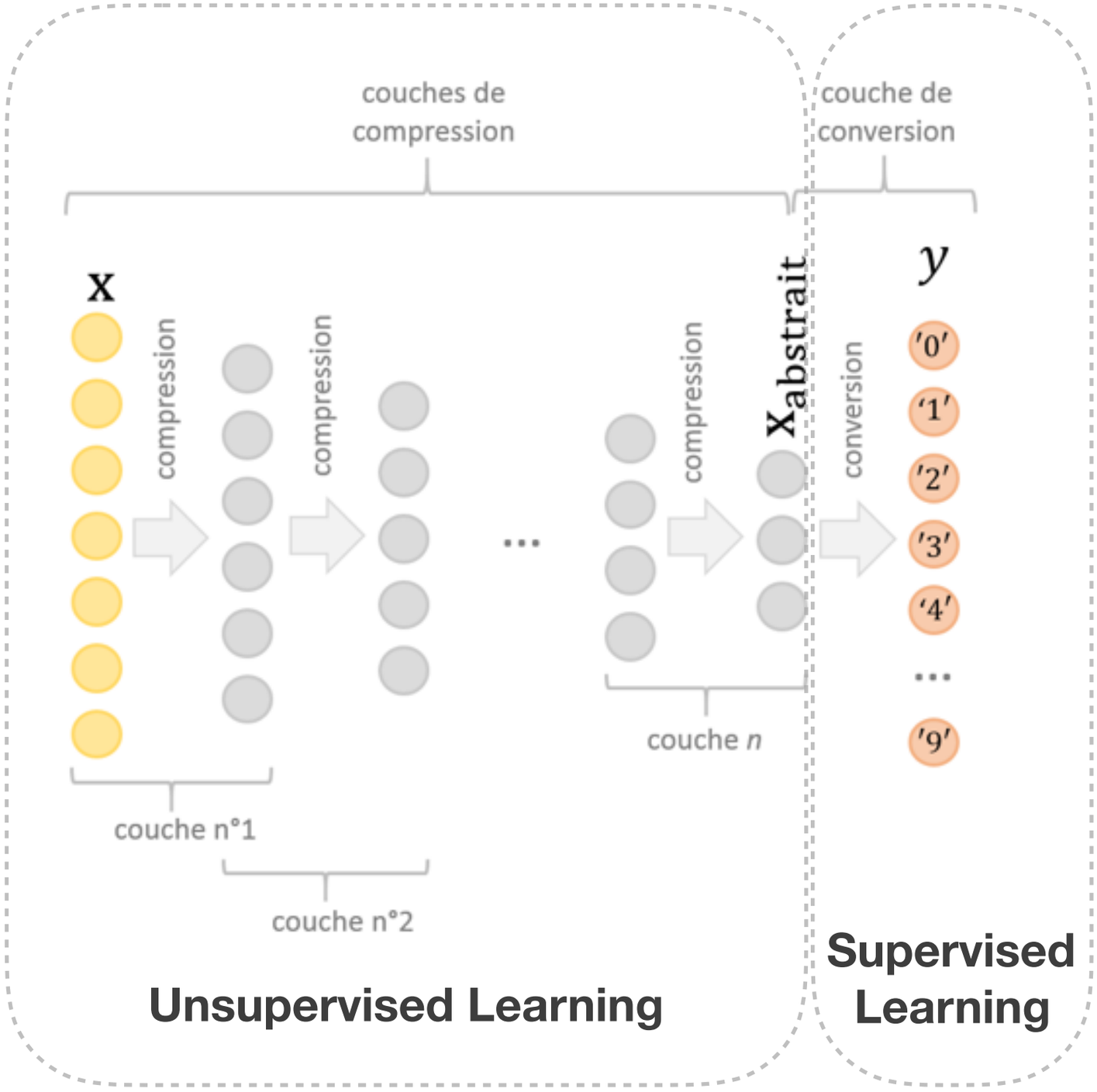
Deep learning answers

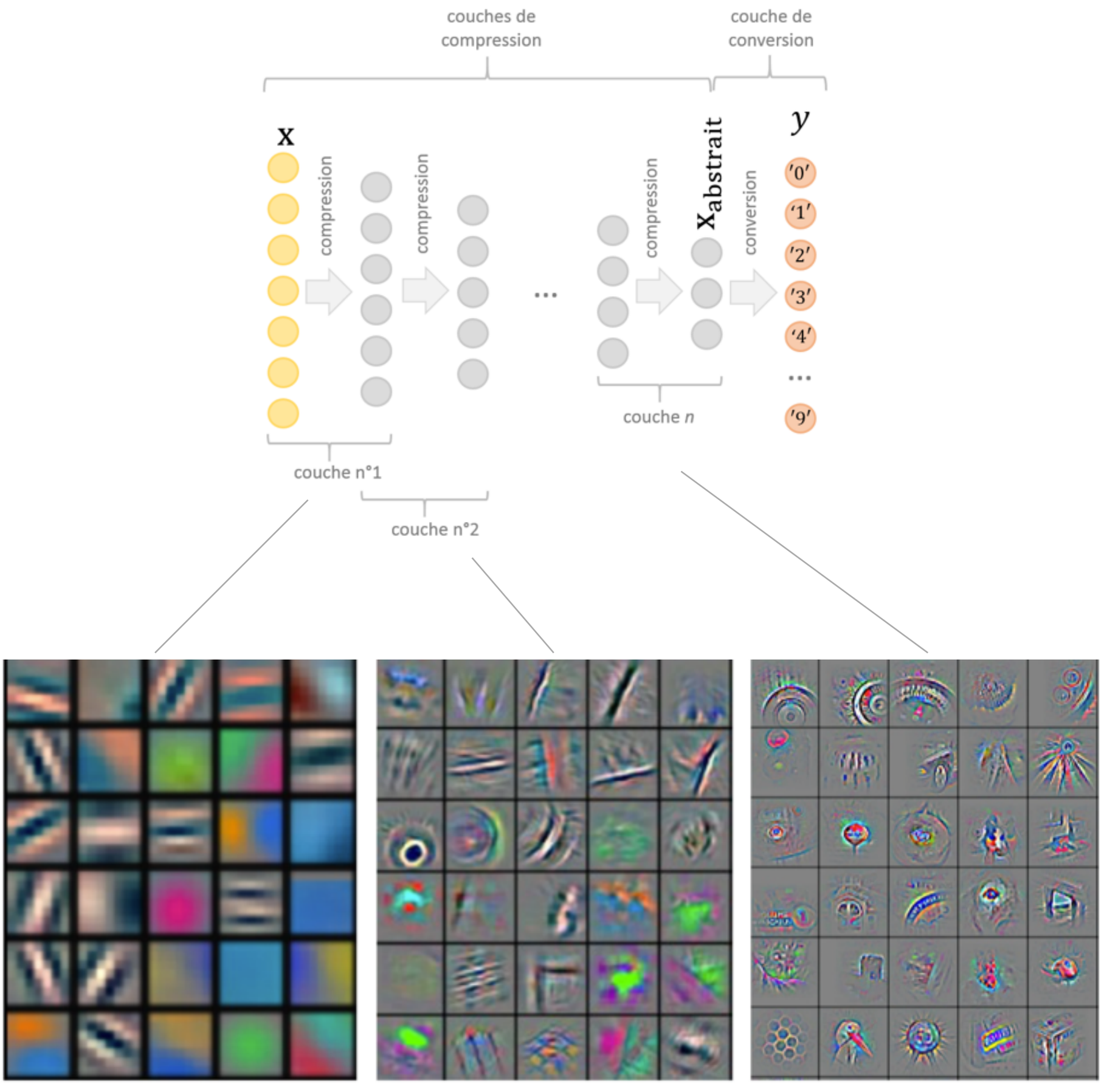
1. Let's use all the labelled data and unlabelled data
2. Let's use deep neural networks
3. Let's **learn the feature extraction in unsupervised learning mode**

Deep learning system

With **unsupervised learning**, the goal is to discover interesting structures from inputs

The **supervised learning** phase is as before, learning a mapping from features to useful outputs.





Feature visualization of convolutional net trained on ImageNet from [Zeiler & Fergus 2013]

Conclusions

Scalability of learning on very large data sets

Ability to learn the feature extraction in unsupervised mode and classification in supervised mode

Larger quantities of data

text, audio, images, videos, ...

New algorithms

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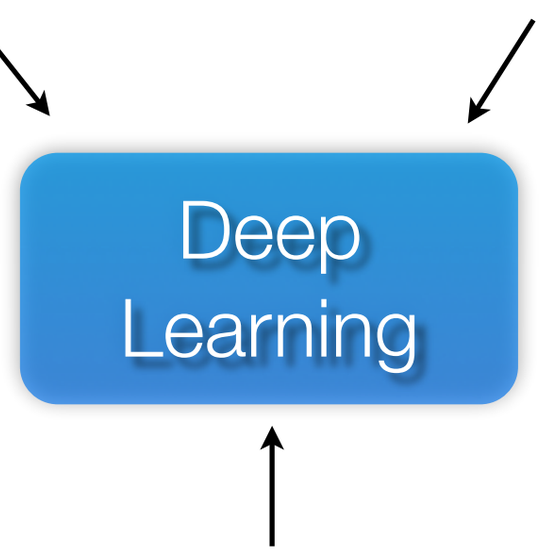


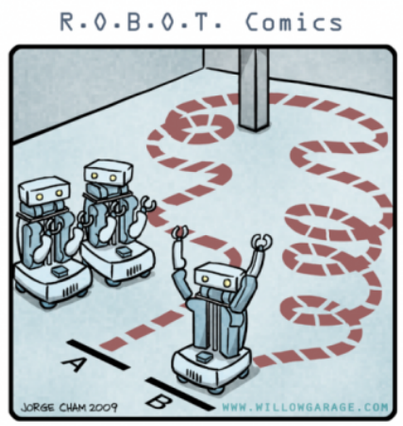
Better computer performance

GPU, distributed computing ...

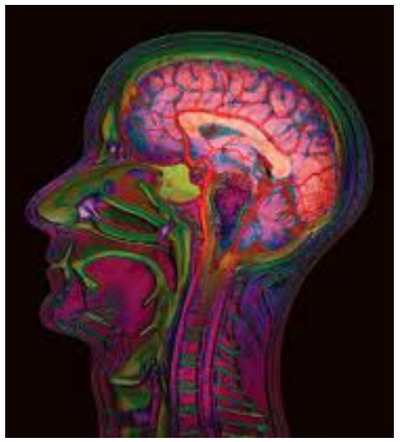
Ability to train complex mapping functions

Deep learning - many applications

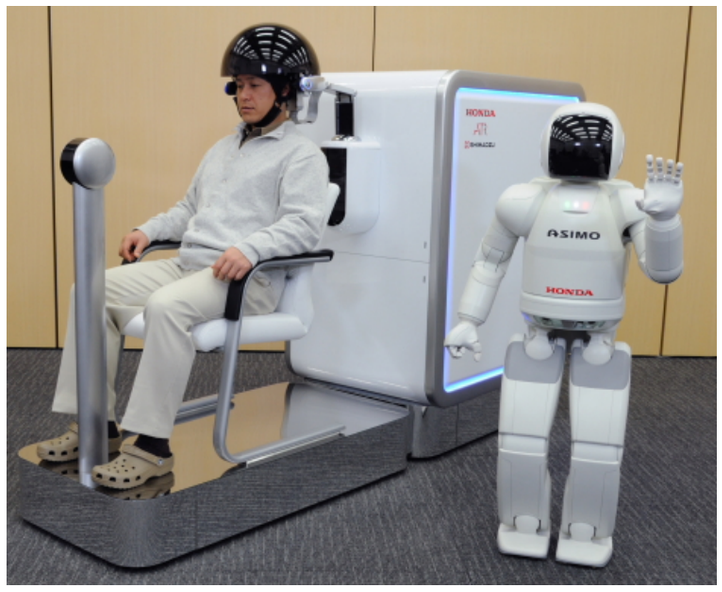
Recognition



Planning



Diagnosis



Robot Control

Prediction

Haute école d'ingénierie et d'architecture Fribourg
Hochschule für Technik und Architektur Freiburg

Institute of
Complex Systems

iCoSys

- Institute of Complex Systems
  - Created end 2012
  - For now: clear focus on computer science arm of Complex Systems
  - 5 profs - 10 scientific collaborators - 5 PhD students

> *All things being in a chain of influence and in a chain of causes, i deem it impossible to know the whole without knowing the parts or to know the parts without knowing the whole.*
>
> *Blaise Pascal, Thinkings.*

Distributed Computing

> Large-scale parallel and distributed architectures
> Middelware for parallel and distributing programming
> Parallel and distributed high performance applications
> Large mobile and sensor networks

Intelligent Data Analysis

> Machine learning
> Big data analysis
> Signal processing
> Algorithms

Sustainable ICT for Smart Living

> Data management and processing for sensor networks
> Web of Things
> Energy efficient IT
> IT for energy efficiency