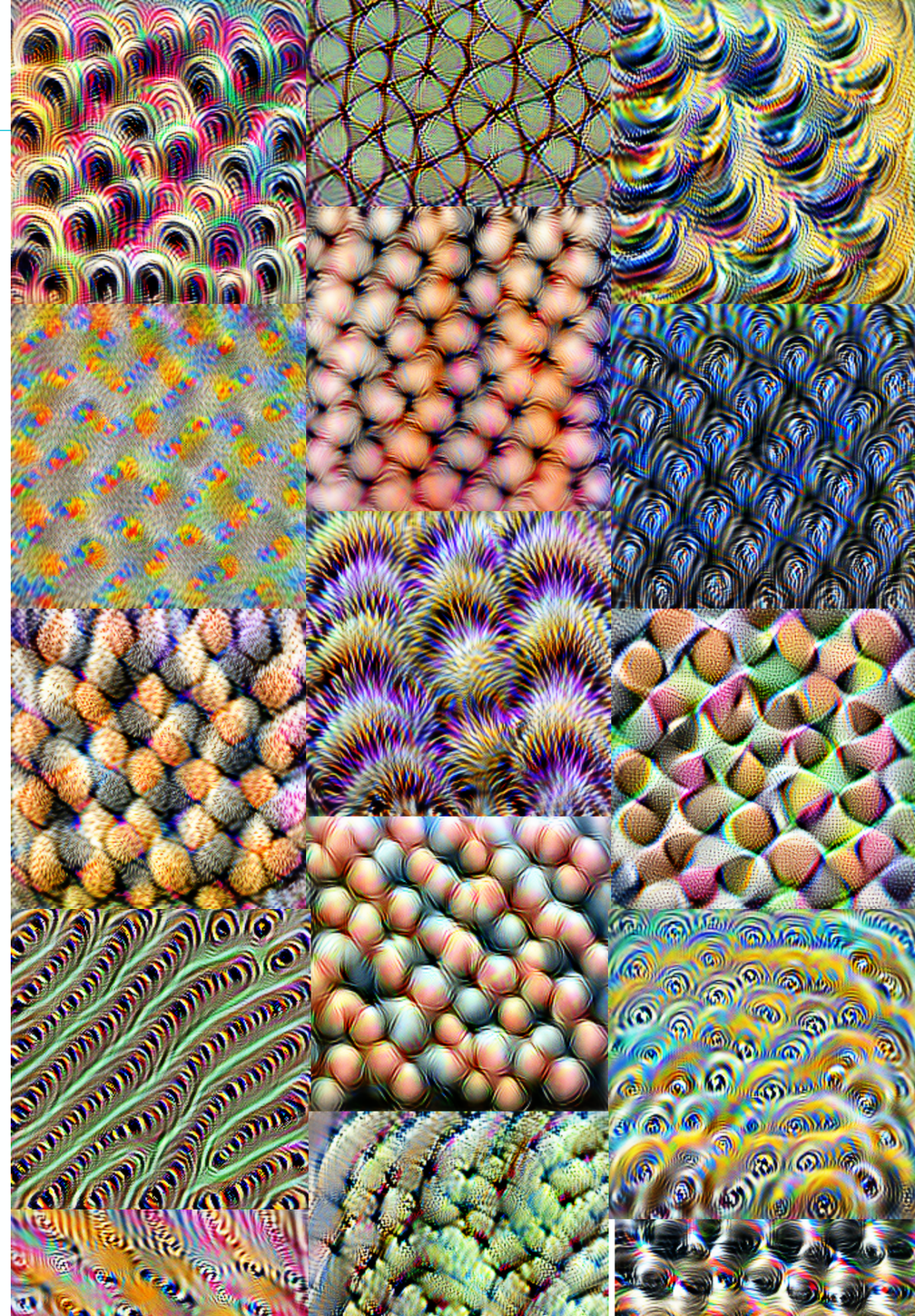
WITH THE SUPPORT OF DSC UPC

JEDI ❤ Machine Learning

Presenters: Eduard Bosch, Rita Geleta & Alberto López



About us

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Data Scientist

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MSc Artificial Intelligence

Outline

What is Machine Learning?

A gentle introduction to Machine Learning
Subfields of Machine Learning

What is Deep Learning?

Difference between Machine Learning and Deep Learning
Artificial Neural Networks

Real-life applications

Today's challenges solved with Machine Learning

What is Machine Learning?

From Wikipedia[en]: **Machine learning (ML)** is the study of computer algorithms that improve automatically through experience. It is seen as a subset of artificial intelligence.

From Wikipedia[es]: El **aprendizaje automático** o **aprendizaje automatizado** o **aprendizaje de máquinas** (del inglés, machine learning) es el subcampo de las ciencias de la computación y una rama de la inteligencia artificial, cuyo objetivo es desarrollar técnicas que permitan que las computadoras aprendan.

What is Machine Learning?

Using data to solve questions

Source: https://www.youtube.com/watch?v=HcqpanDadyQ

What do we need to solve a problem with ML?

LOTS OF DATA THAT THE MODEL CAN UNDERSTAND

To train our model, we will need to transform our data into something our model is able to digest, typically numbers.

A WAY TO EVALUATE THE RESULTS

To be able to solve questions, we first need to be able to differentiate a good answer from a bad answer. We will look more into that in a moment.

$$D_{correct} = \left\{ \text{  }, \quad 2, \quad 1 \right\}$$

$$D_{incorrect} = \left\{ \text{  }, \quad 5, \quad -1 \right\}$$

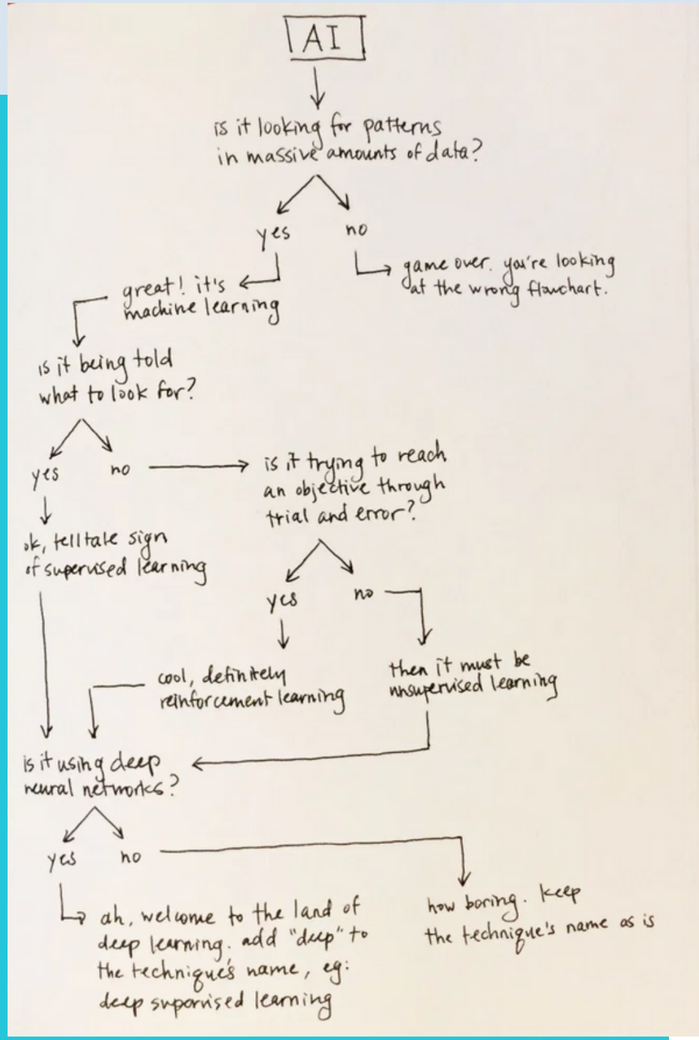
How can we approach it?

DO WE KNOW WHAT WE WANT TO GET?

There are models that are trained to behave following the patterns from the train data and some just try to identify those patterns by themselves. Those are called supervised and unsupervised learning models.

CAN WE NUMERICALLY EVALUATE EACH ACTION?

When we are able to receive feedback from each action taken, we can create a reinforcement learning model, that will try to maximise/minimise a score.



Source: https://www.technologyreview.com/2018/11/17/103781/what-is-machine-learning-we-drew-you-another-flowchart/

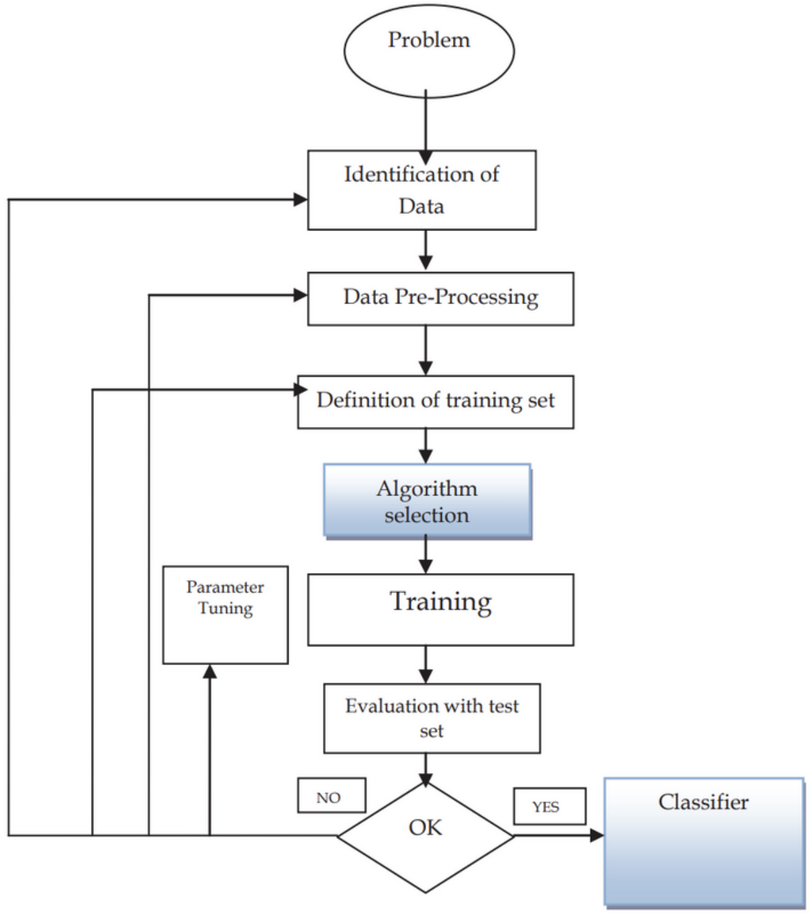
And, now what?

TRAINING → **Using data**

During this stage we use our data to create and fine-tune our model.

PREDICTING → **Solving questions**

During this stage, we present new unseen data to our model and answer our questions



But, that's just one case!

What is Deep Learning?

From Wikipedia[en]: **Deep learning** (also known as deep structured learning) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.

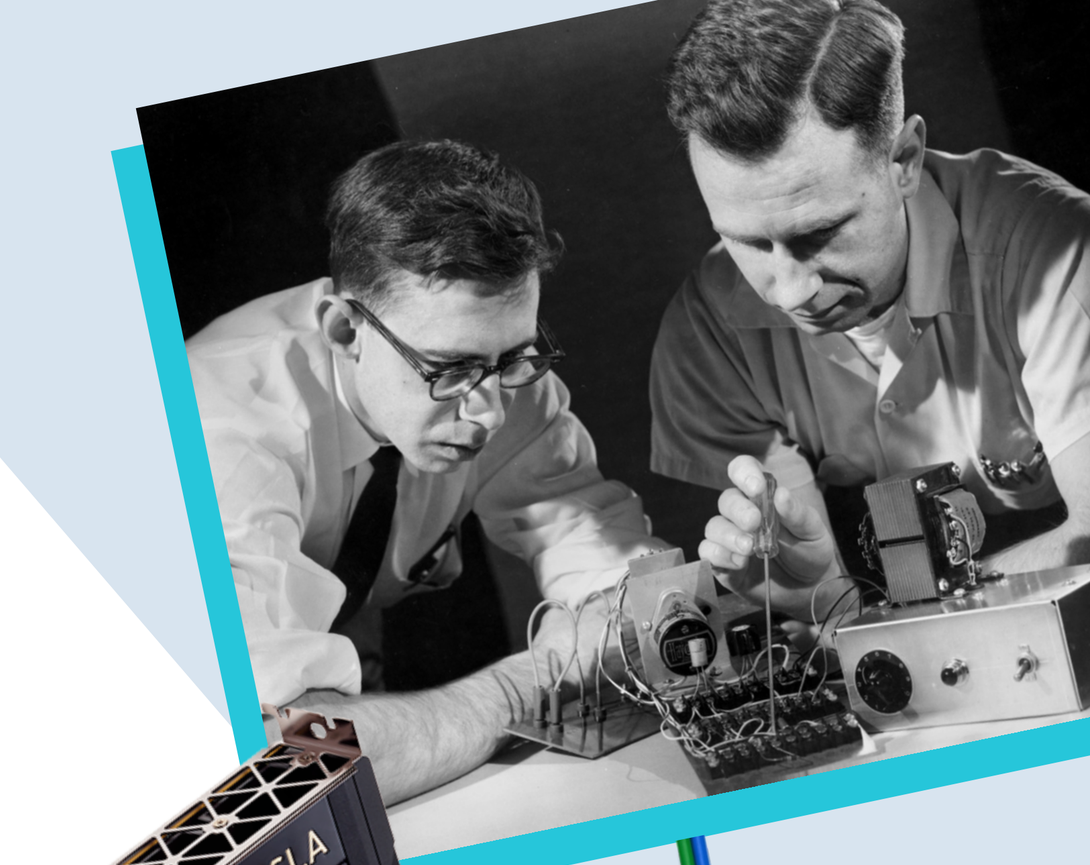
From Wikipedia[es]: **Aprendizaje profundo** (en inglés, deep learning) es un conjunto de algoritmos de aprendizaje automático (en inglés, machine learning) que intenta modelar abstracciones de alto nivel en datos usando arquitecturas computacionales que admiten transformaciones no lineales múltiples e iterativas de datos expresados en forma matricial o tensorial.

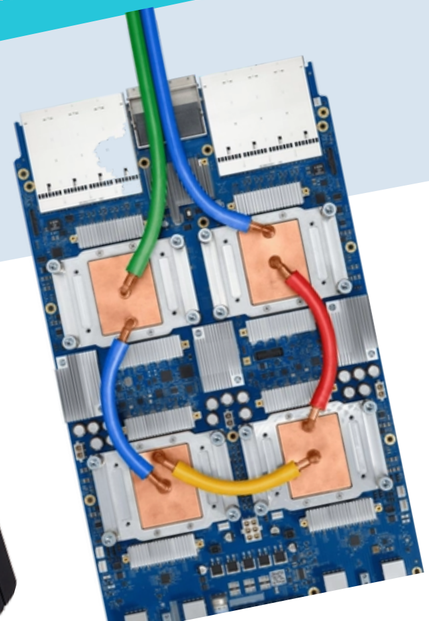
What is Deep Learning?

Deep Learning is the exploration, expansion and explotation of the Artificial Neural Network model at his maximum expression.

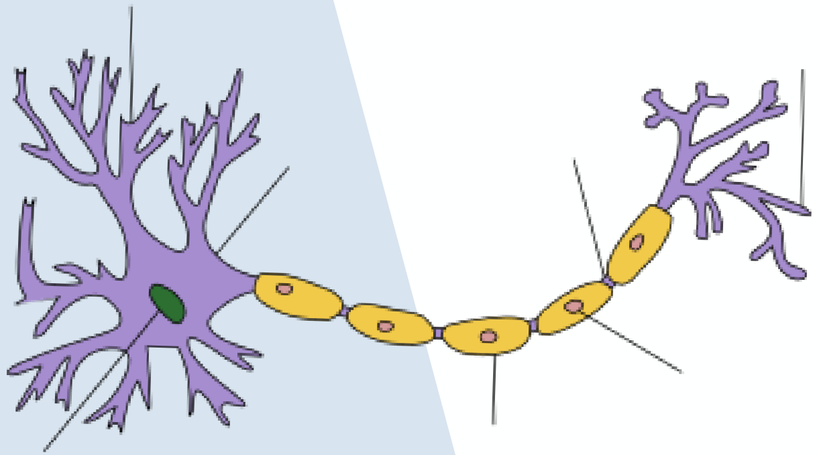
History

- Frank Rosenblatt creates the **Perceptron** in 1957
- **Back Propagation** in 1970
- in 2000 years the **graphics cards** start to become more powerful
- In 2007 NVIDIA release the first version of **CUDA**
- In May 2016 Google releases the first **TPU**
- In December 2020 Apple releases the **M1**, the first CPU with dedicated cores to machine learning algorithms.

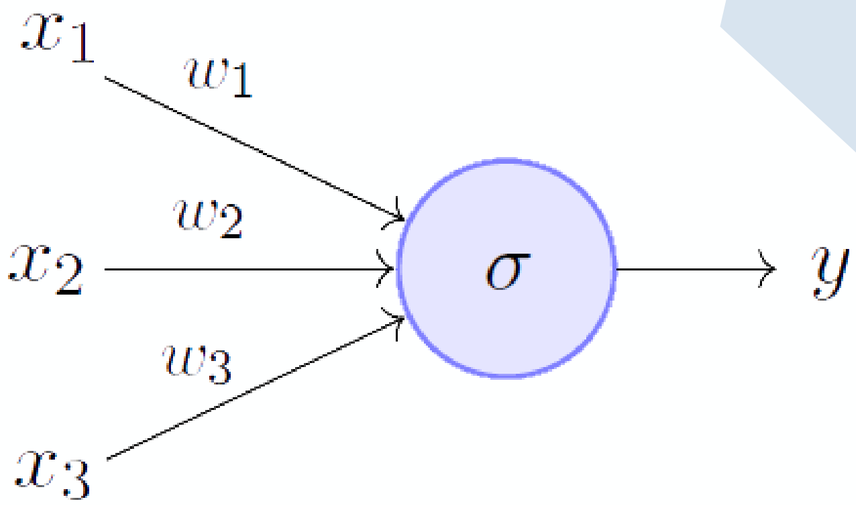




The basic unit: The neuron

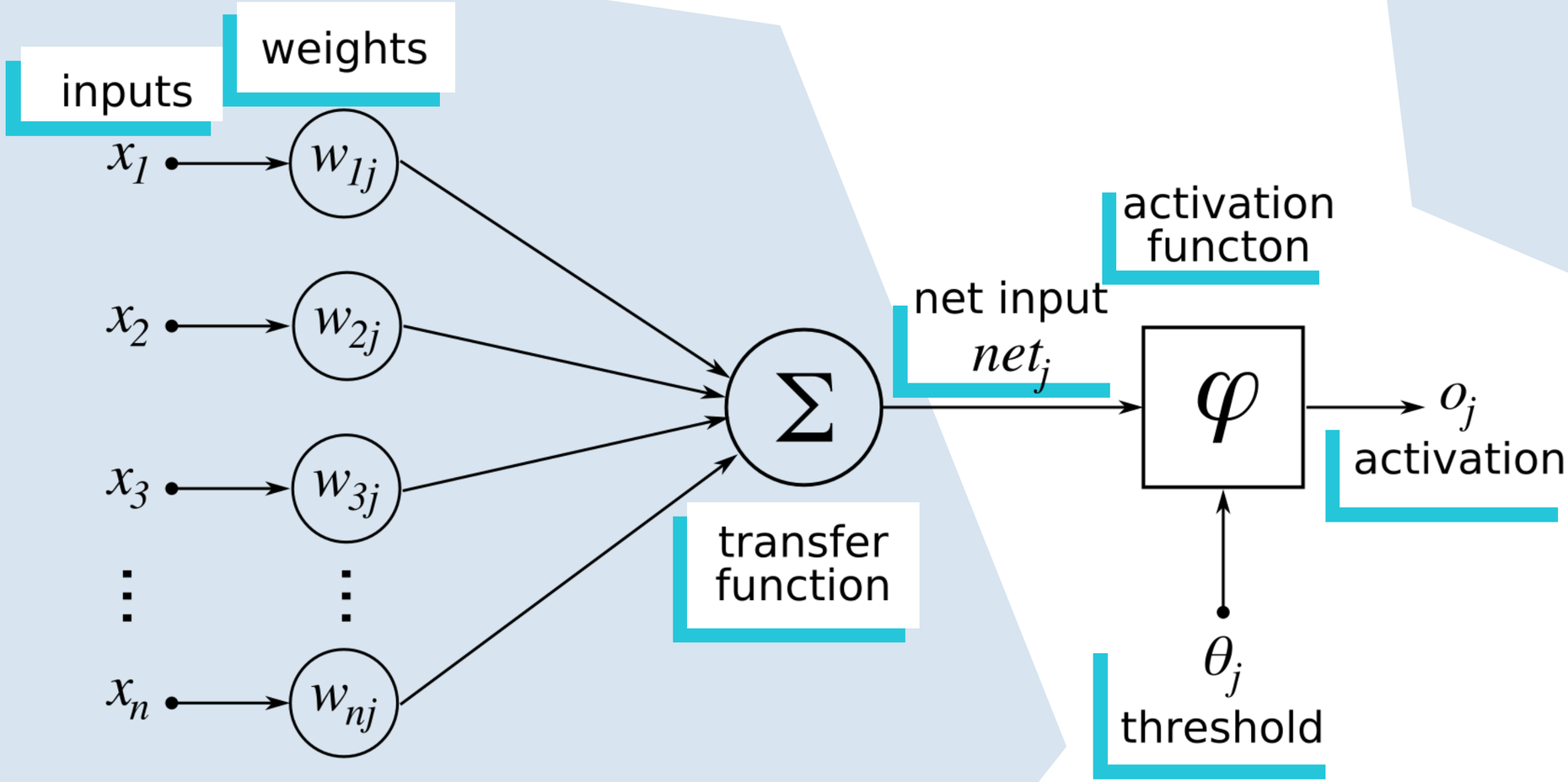


Natural neuron

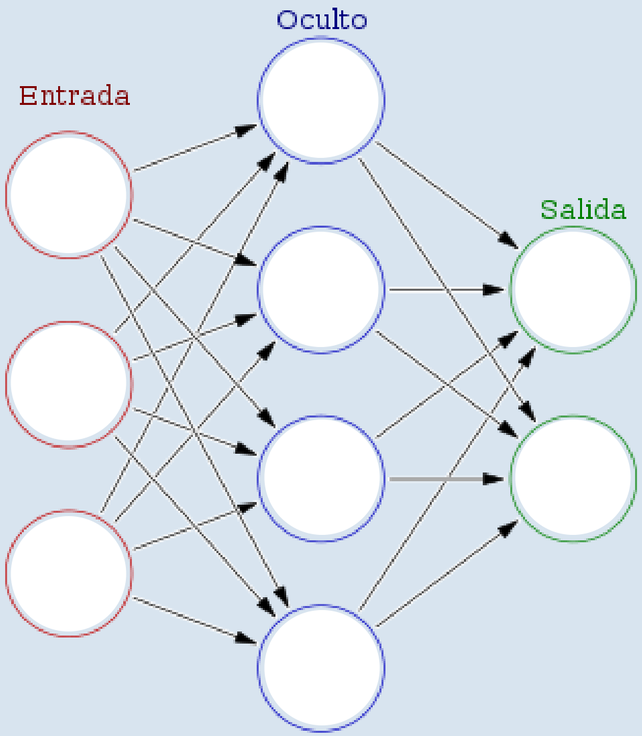


Artificial neuron

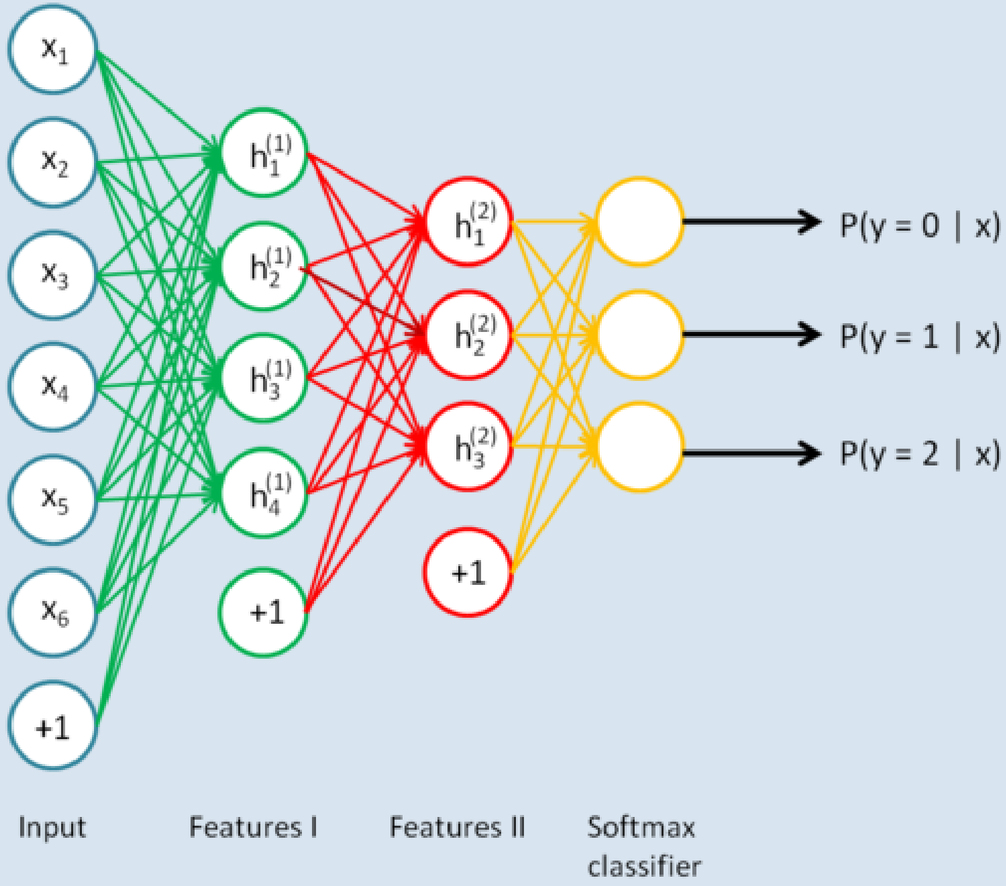
The neuron (in detail)



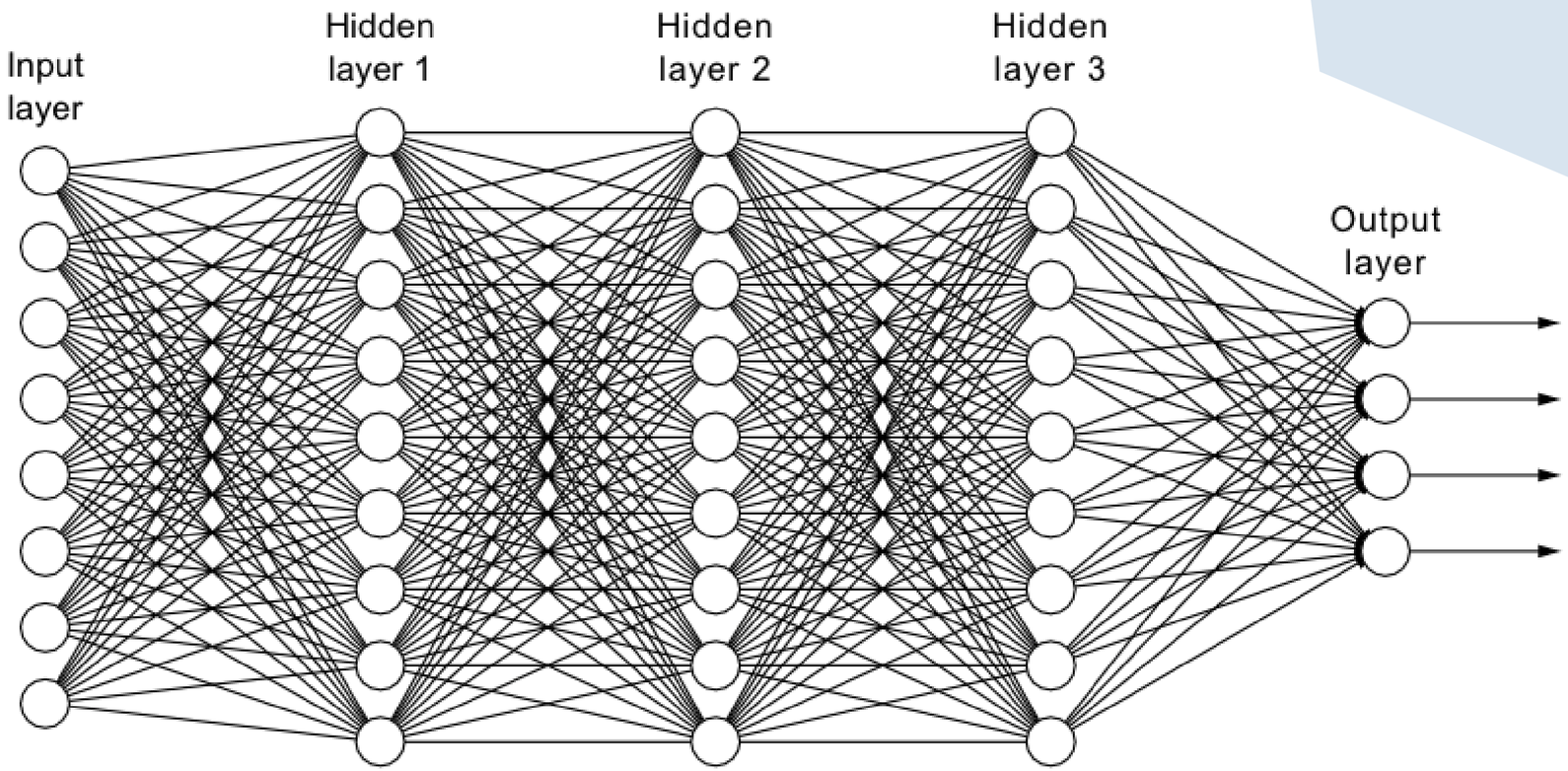
Machine Learning



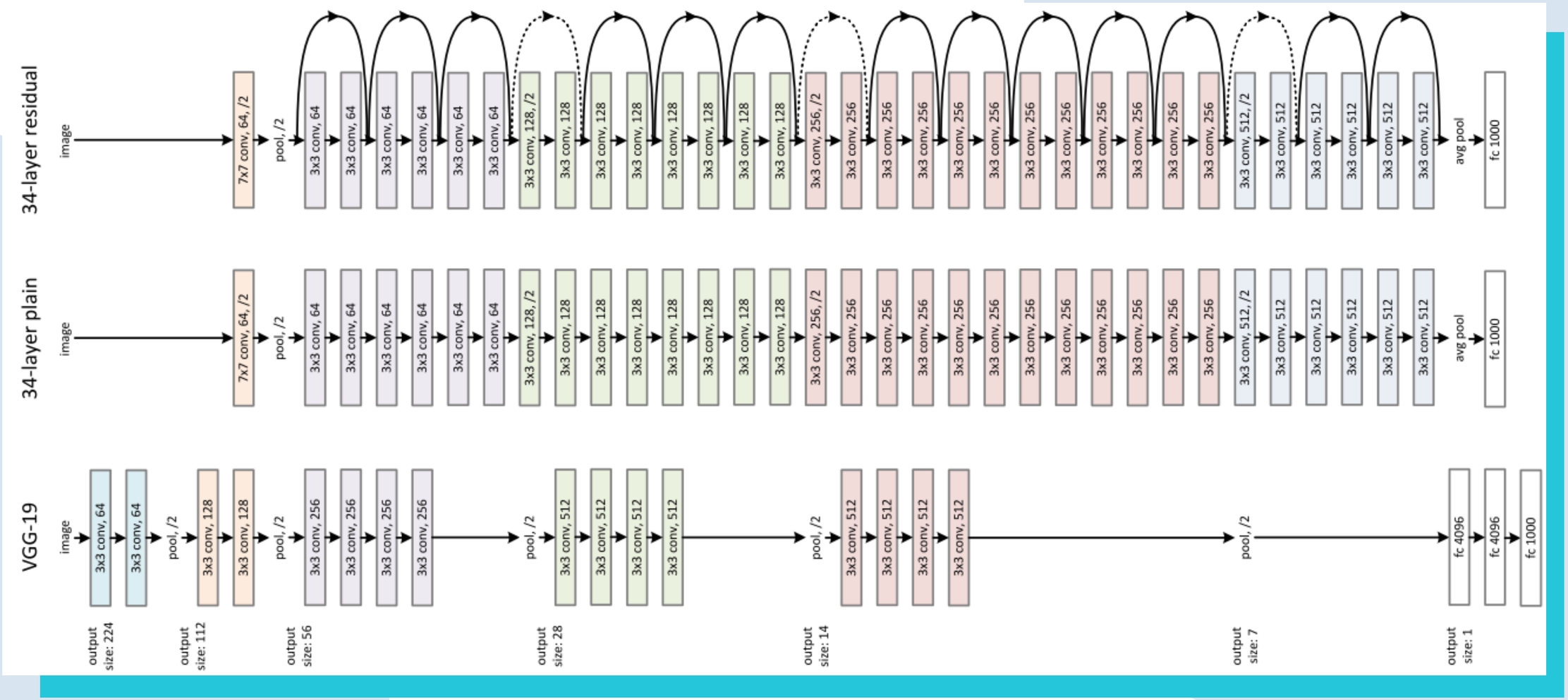
Deep Learning



How big can it be?

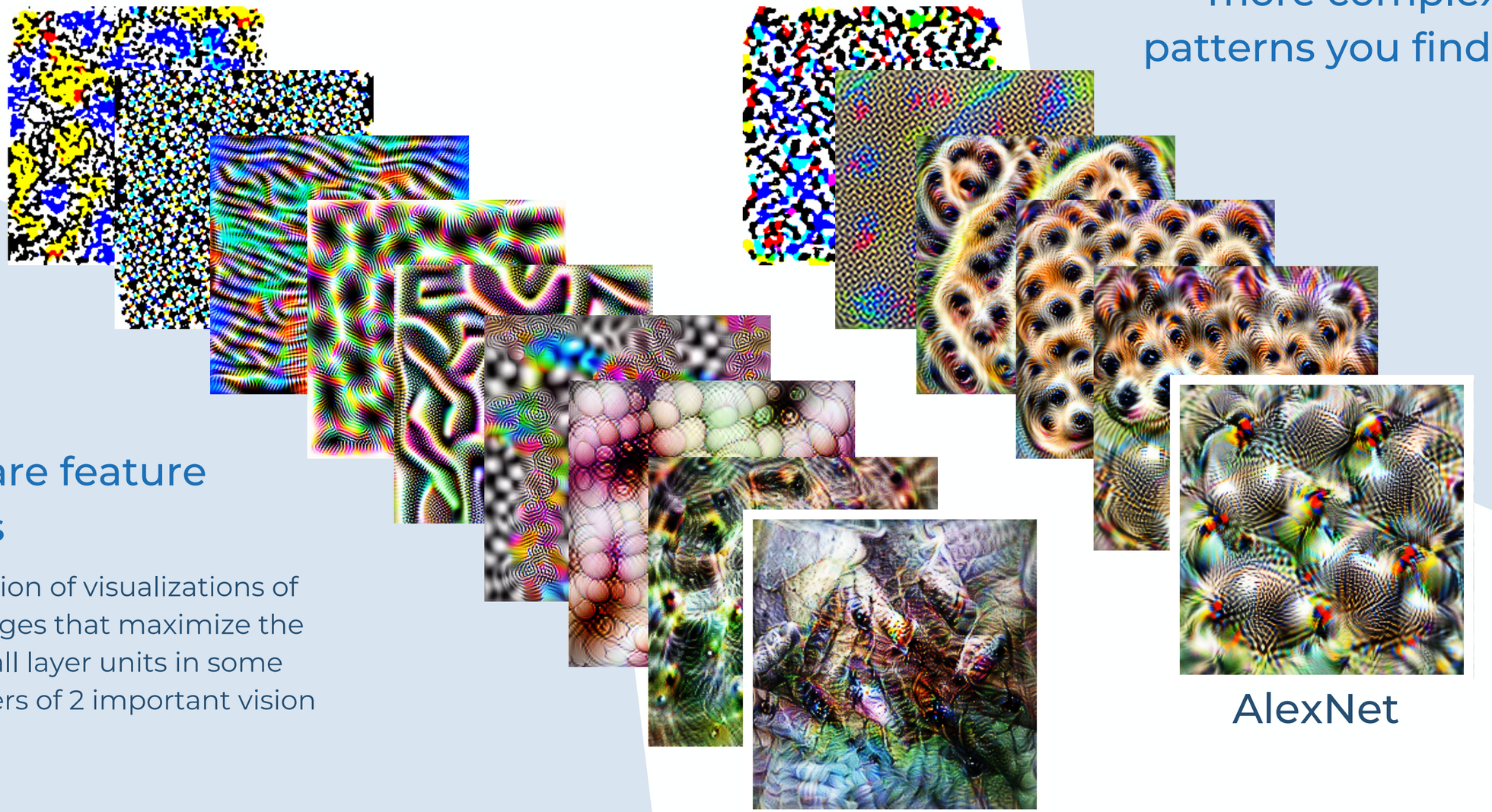


How big can it be?



What do neurons see?

The deeper you go, more complex patterns you find



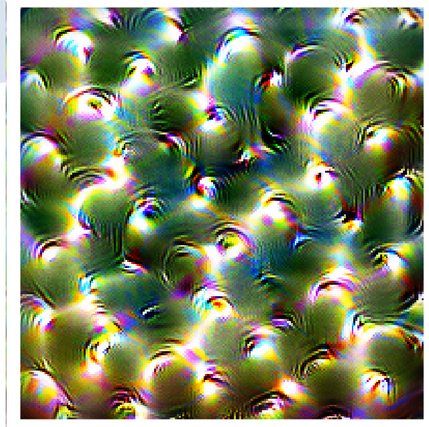
AlexNet

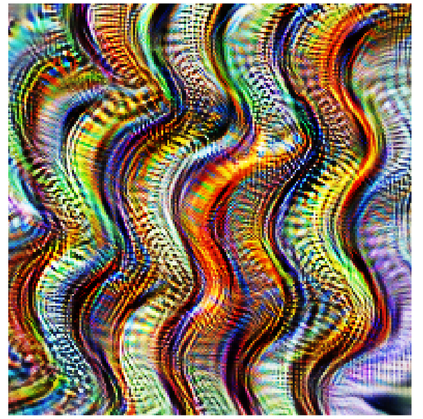
ResNet v2 50

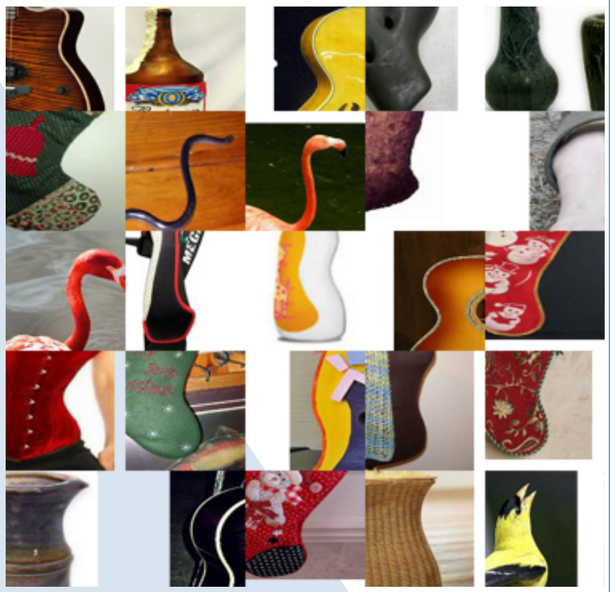
Neurons are feature extractors

See the collection of visualizations of optimized images that maximize the activations of all layer units in some significant layers of 2 important vision models.

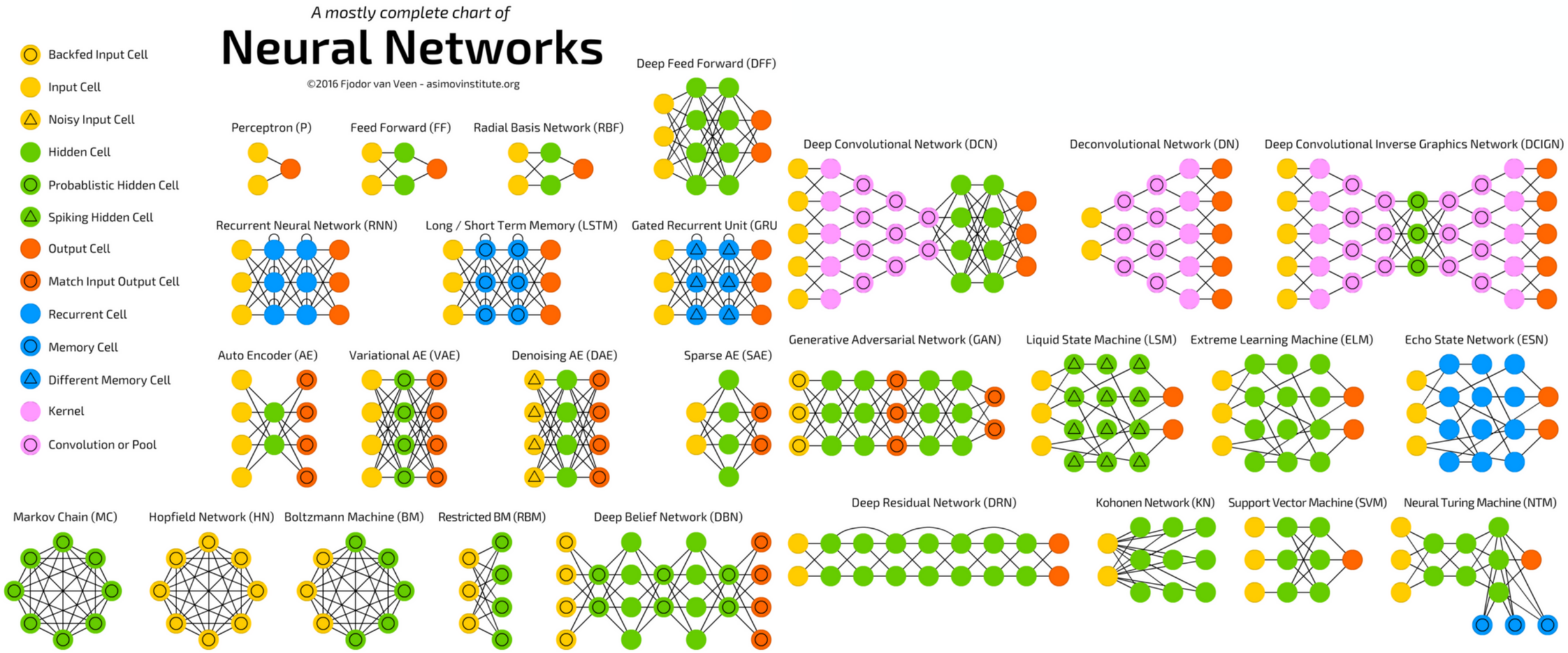
What do neurons see?







What kind of networks?



Some numbers

Accuracies

ImageNet 2017 - >97%

Sizes

GPT-3 Small 125M Parameters - 12 layers

GPT-3 (Real) 170B Parameters - 96 layers

Times

GPT-3 355 Years

Resnet-34 145 Hours

Money

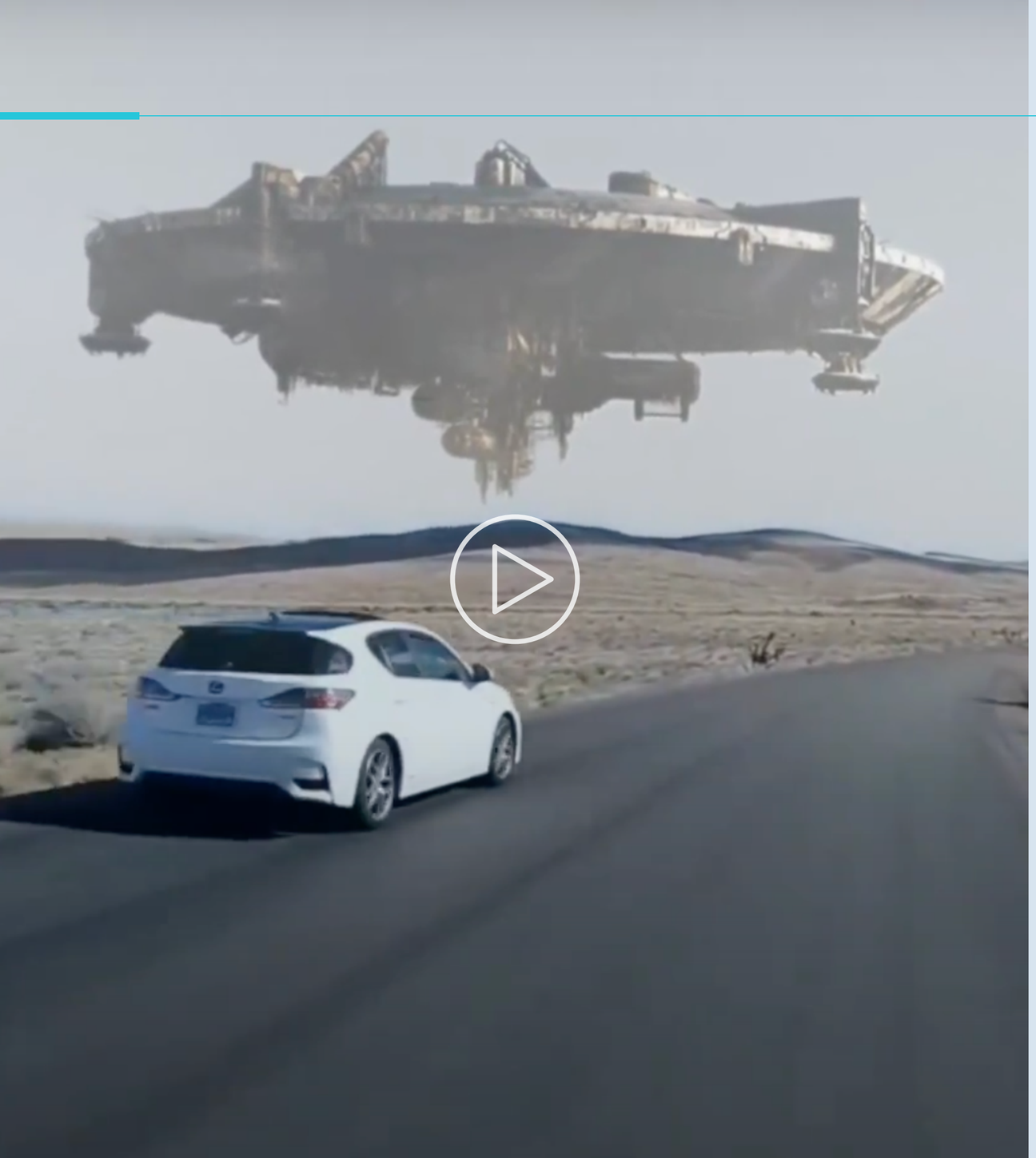
GPT-3 $4,600,000
to train

Where can we apply Machine Learning?

ANSWER: EVERYWHERE

The power of Machine Learning is used to solve problems where the decision rules are not clearly defined or where indeed there are unknown or highly complex rules.

In what follows we will readily review some of the most exciting real-life applications of Machine Learning.



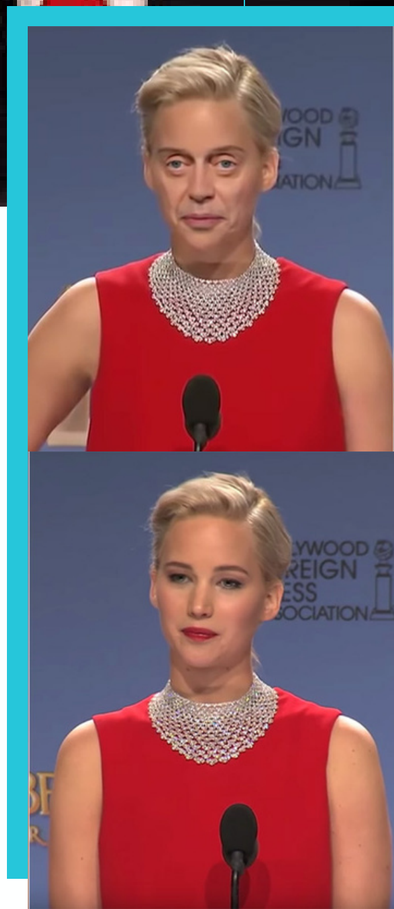
Dynamic Sky Replacement

Could you ever imagine that you can change dynamically the background in a video and adjust it so that it looks realistically harmonic with the foreground objects?

Lights. Camera. Machine Learning!

The next blockbusters will be filled with ML-based visual effects.

Zhengxia Zou



DEEP FAKES

Creating visual and audio content with great potential to deceive.

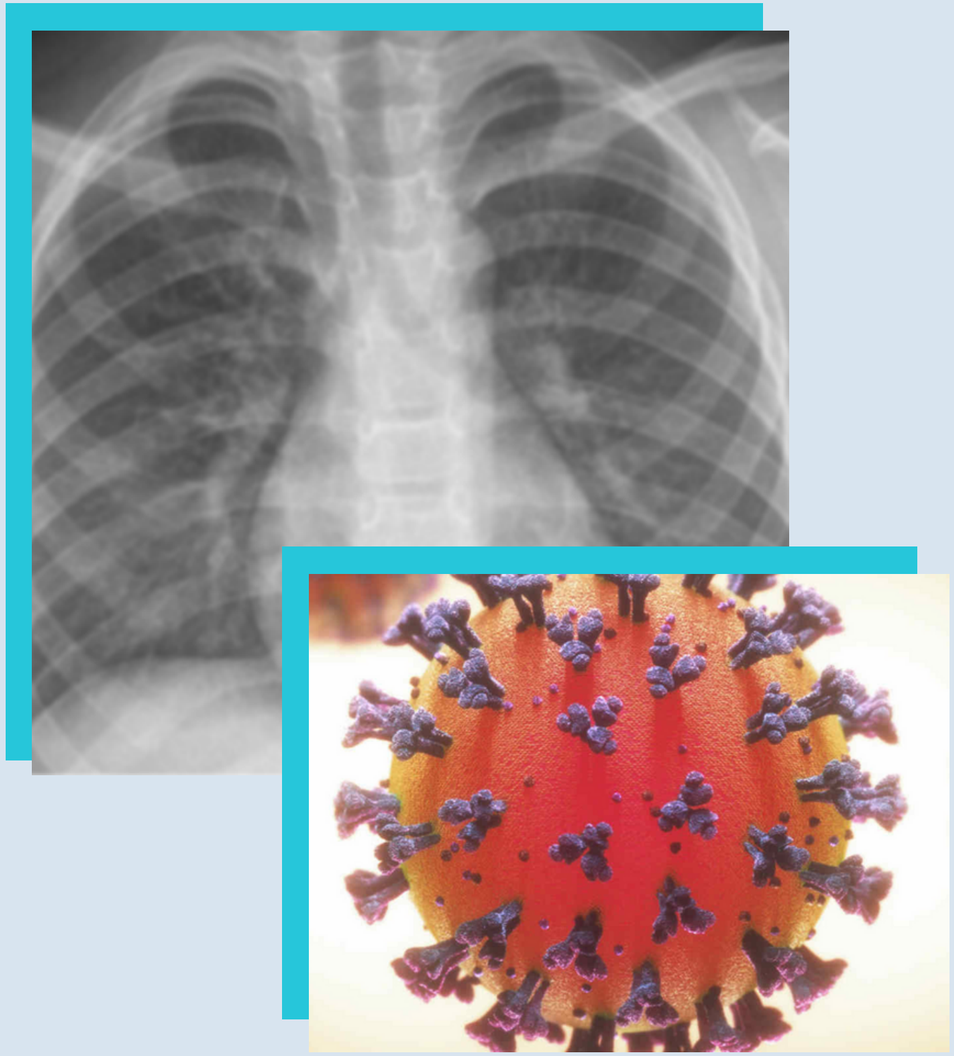
Deep fake technology is also huge for film studios in case an actor passes away. Instead of creating a 3D model, studios can just map the actor's face over the look-alike.

DEEP LEARNING IN THE **FASHION INDUSTRY**

- Show an outfit to the model and it will dress models of sizes and ethnicities that your shoppers will relate to the most.
- Choose backgrounds that work best with your brand and product personality.
- Give your image and put a garment on. See how it does look on you.

Would you like to see the photographs of your ancestors **in color**?

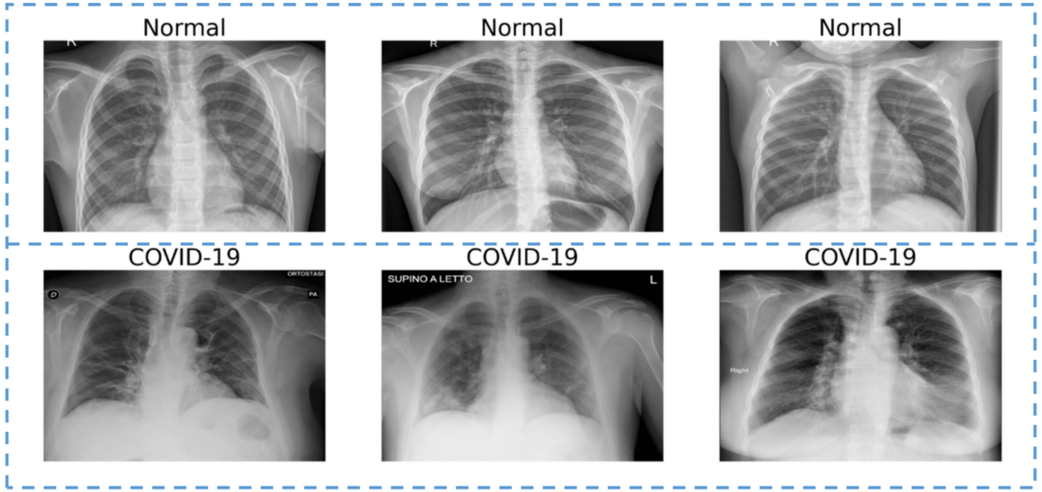
Colorize and restore old images and film footage with Deep Learning.



COVID-19 DIAGNOSIS (96.75% ACCURACY)

An efficient **mixture of deep** and **machine learning** models for **COVID-19 diagnosis** in chest X-ray images

Dingding Wang, Jiaqing Mo, Gang Zhou, Liang Xu, Yajun Liu



AlphaFold2

OVER 90% ACCURACY

What a protein does largely depends on its unique 3D structure.

Figuring out what shapes proteins fold into is known as the “**protein folding problem**”, and has stood as a great challenge in biology for the past 50 years.

GPT-3

OpenAI's **GPT-3** may be the biggest thing since Bitcoin (https://maraoz.com/2020/07/18/op
1079 points | maraoz | 19 days ago | 526 comments

Giving **GPT-3** a Turing Test (http://lacker.io/ai/2020/07/06/giving-**gpt-3**-a-turing-test.html)
453 points | DavidSJ | 18 days ago | 234 comments

GPT-3: Language Models Are Few-Shot Learners (https://arxiv.org/abs/2005.14165)
431 points | gwern | 2 months ago | 134 comments

How **GPT3** Works – Visualizations and Animations (https://jalammar.github.io/how-**gpt3**-wo
398 points | dsr12 | 10 days ago | 98 comments

Teaching **GPT-3** to Identify Nonsense (https://arr.am/2020/07/25/**gpt-3**-uncertainty-prompt
321 points | tosh | 8 days ago | 140 comments

GPT-3 (https://www.gwern.net/newsletter/2020/05#**gpt-3**)
291 points | cocoflunchy | 1 month ago | 200 comments

Philosophers on **GPT-3** (http://dailynous.com/2020/07/30/philosophers-**gpt-3**/)
284 points | freediver | 7 days ago | 324 comments

Tempering Expectations for **GPT-3** and OpenAI's API (https://minimaxir.com/2020/07/**gpt3**
267 points | vortex_ape | 18 days ago | 189 comments

GPT-3 Creative Fiction (https://www.gwern.net/**GPT-3**)
234 points | ashin | 1 month ago | 97 comments

Why **GPT-3** Matters (https://leogao.dev/2020/05/29/**GPT-3**-A-Brief-Summary/)
223 points | teruakohatu | 17 days ago | 163 comments

What is **GPT-3**? written in layman's terms (https://tinkeredthinking.com/index.php?id=841)
185 points | skylarker | 15 days ago | 67 comments

I asked **GPT-3** to make a presentation for me (http://www.bemmu.com/**gpt3**-presentation)
166 points | bemmu | 17 days ago | 101 comments

- OpenAI's new state of the art language model
- What's so special about GPT-3?

gpt3examples.com

- GPT-3 achieves strong performance on many NLP datasets, including translation, question-answering, and cloze tasks, as well as several tasks that require on-the-fly reasoning or domain adaptation.
- GPT-3 can generate samples of news articles which human evaluators have difficulty distinguishing from articles written by humans.

cursos.jediupc.com

Deep Learning

94 %

- **Precio:** 250 € / 150 € estudiantes
- **Horas totales:** 40 horas
- **Fecha:** 25/01/21 al 05/02/21
- **Horario:** 09:00 a 13:00
- **Créditos:** 2 ECTS

Introducción a Machine Learning

67 %

- **Precio:** 250 € / 150 € estudiantes
- **Horas totales:** 40 horas
- **Fecha:** 25/01/21 al 05/02/21
- **Horario:** 09:00 a 13:00
- **Créditos:** 3 ALE / 2 ECTS