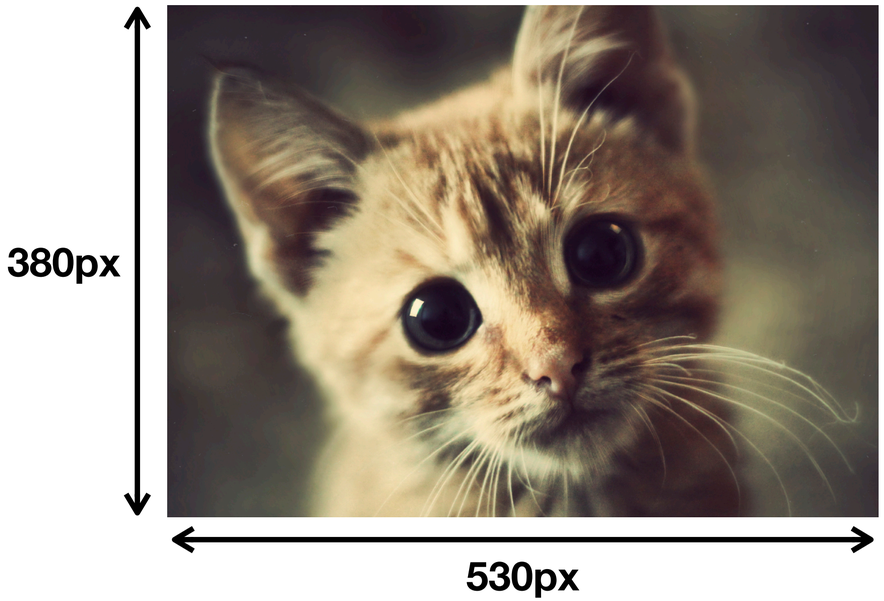
Deep Learning

Introduction for HCI students

Input dimensions



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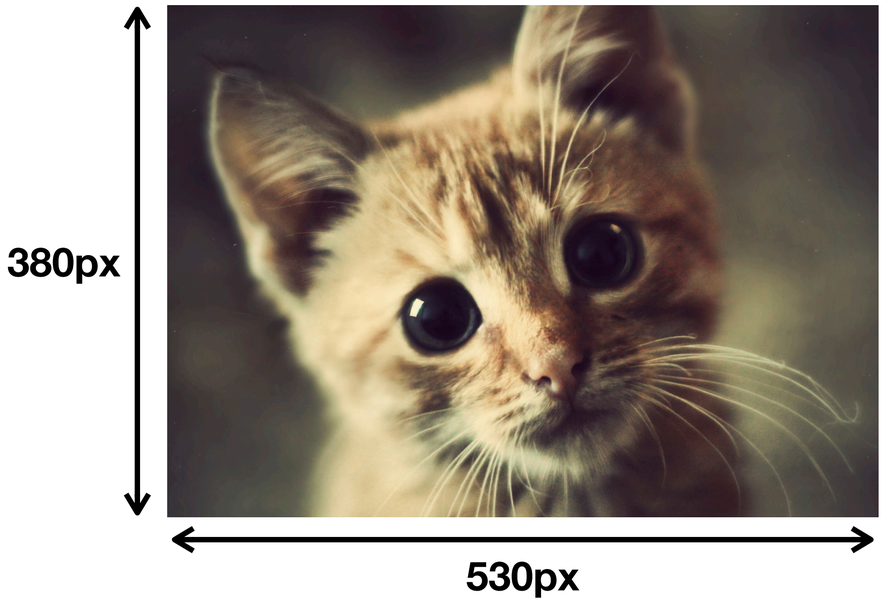

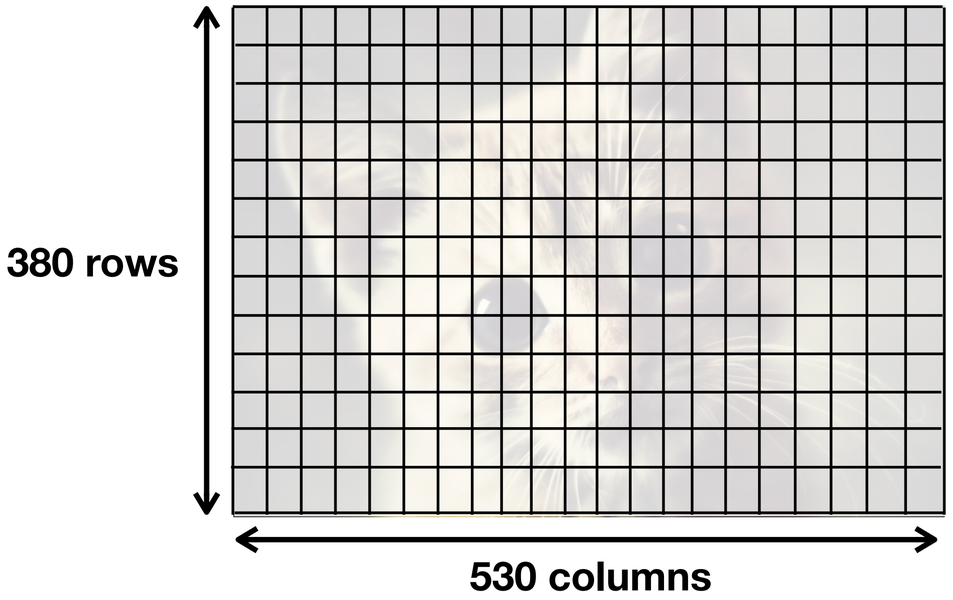

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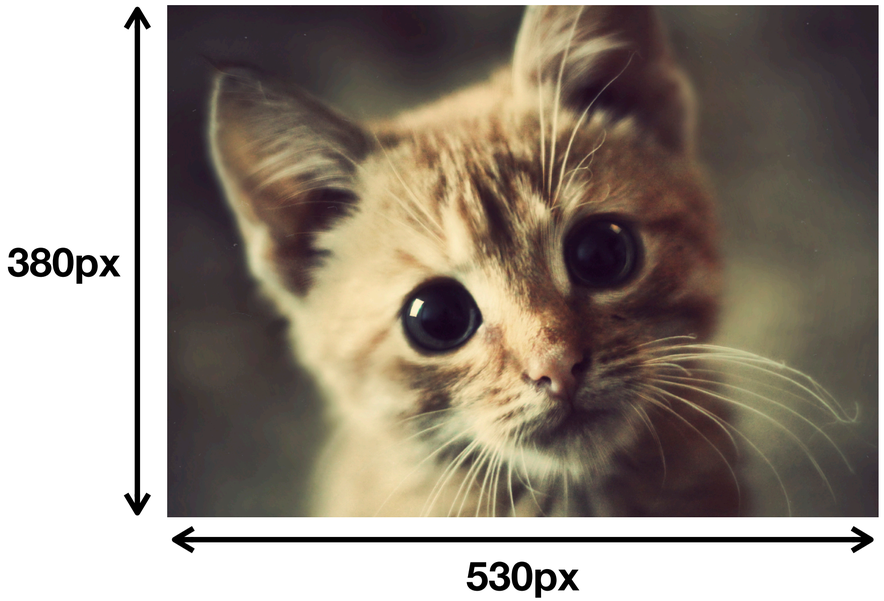

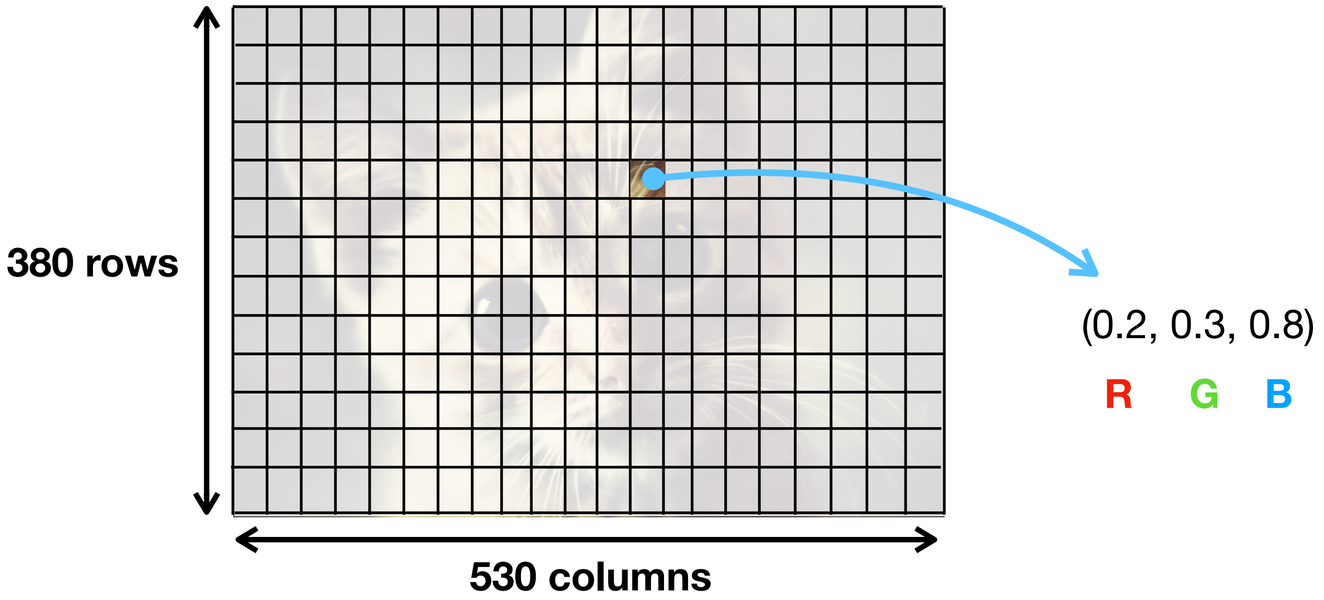

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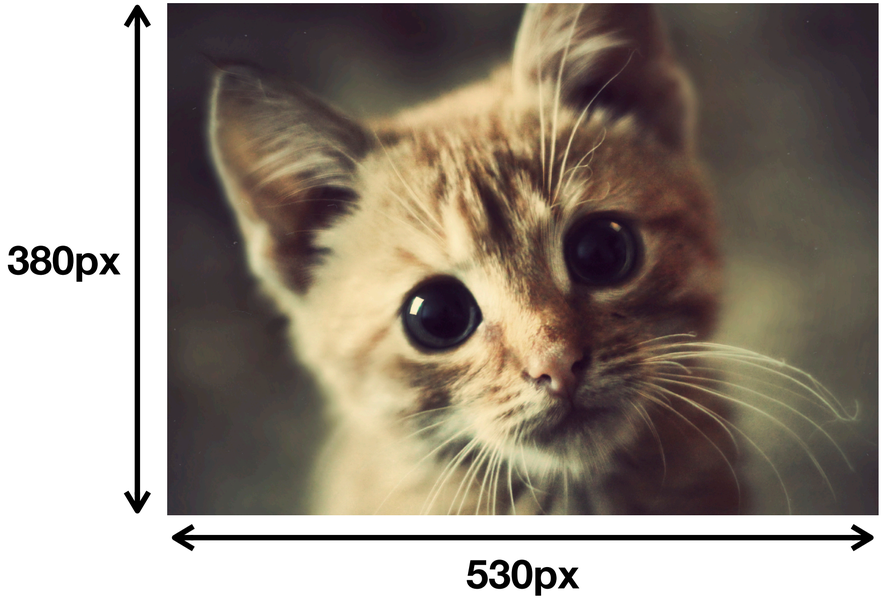

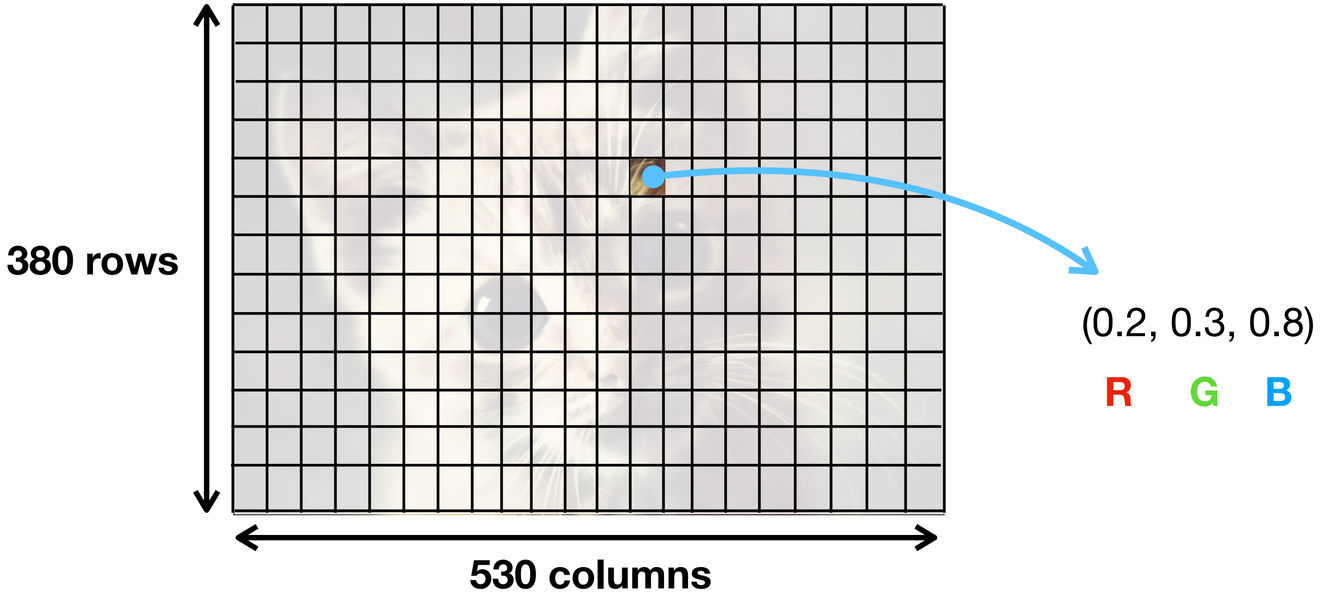

Matrix dimensions: (380, 530, 3)

Total dimensions: 380 x 530 x 3 = **604,200** !!!!

Why deep learning?

In a nutshell: **common methods** used in machine learning, such as SVM, **scale poorly** when having high dimensional input data.

However, deep learning is well suited for handling high-dimensional input and extracting good representations in a lower-dimensional space that can then be used for classification or other predictive tasks.

What is deep learning?

Deep learning is a set of statistical methods that can extract **rich representations** from (very) **high-dimensional input data** (such as a 600k-dimensional cat) thanks to an architecture that allows for distributed and hierarchical feature extraction.

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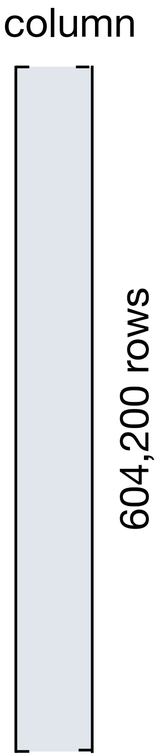

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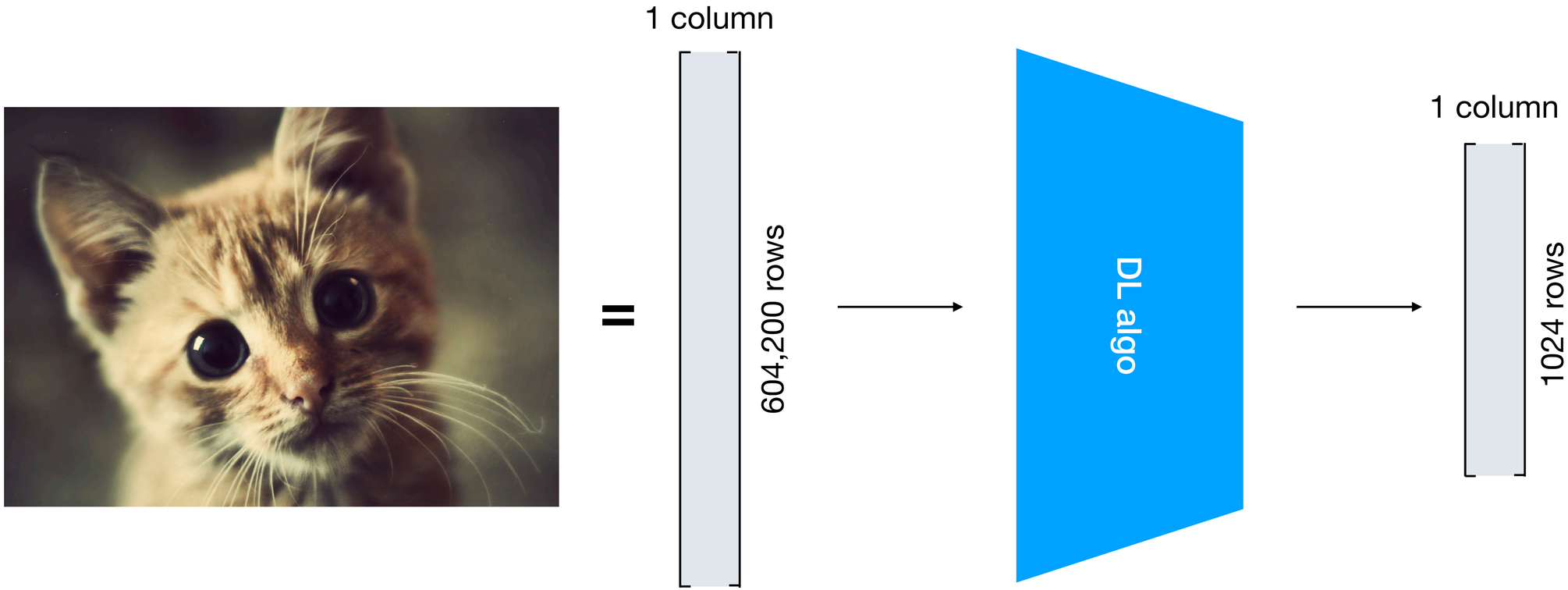

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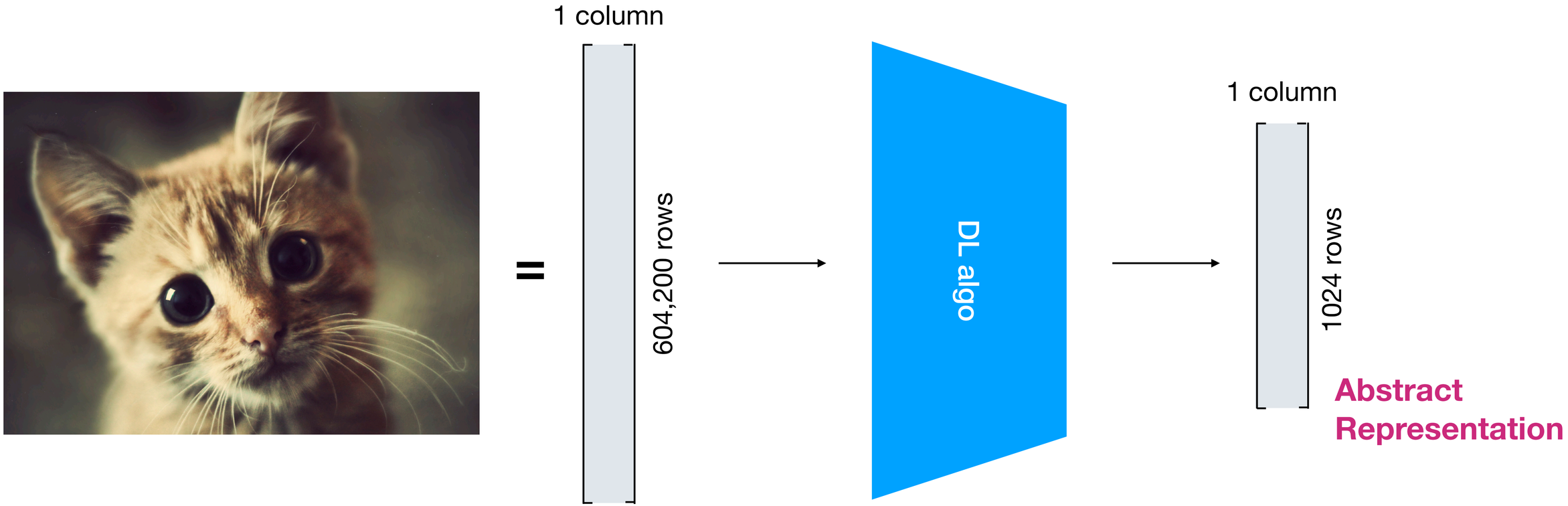
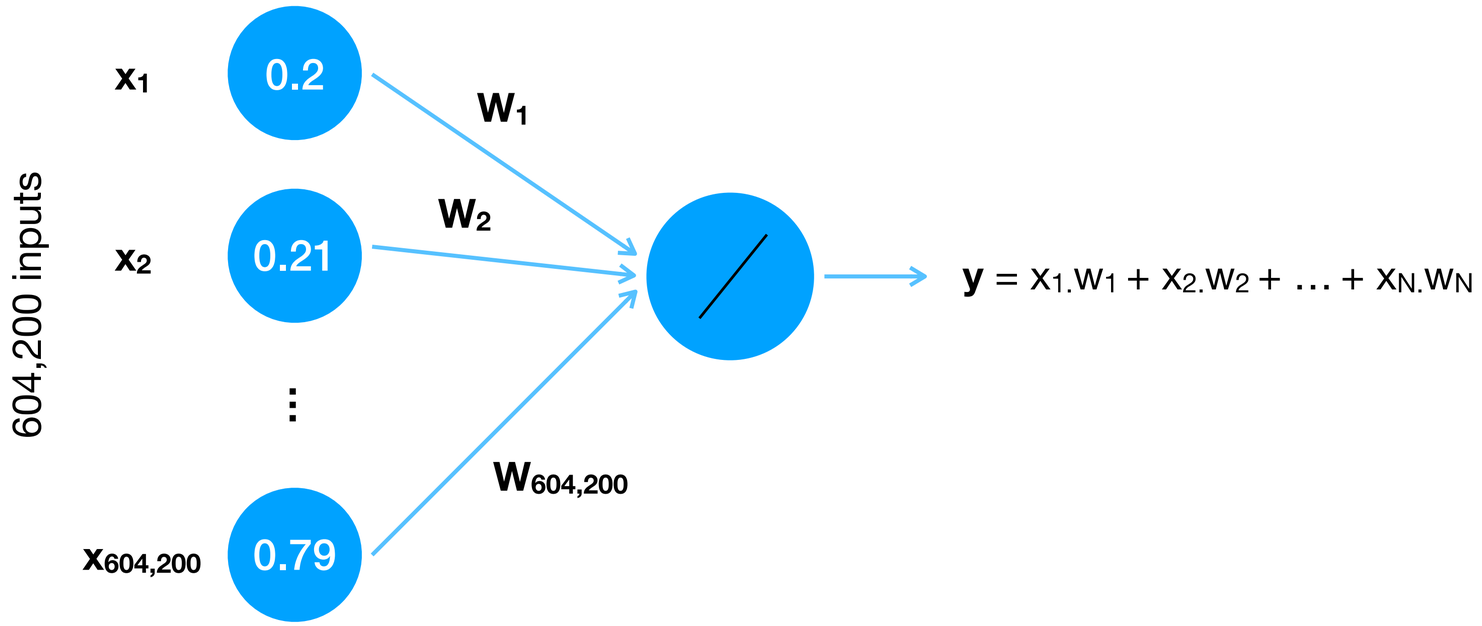


Neural Networks

At the core of the deep learning algorithms lies **Artificial Neural Networks**, which are a set of operations, combined, whose structure is “inspired” by cortical neurons.

Artificial Neuron

Artificial neutron is a set of operations “inspired” by the operations performed by cortical neurons.



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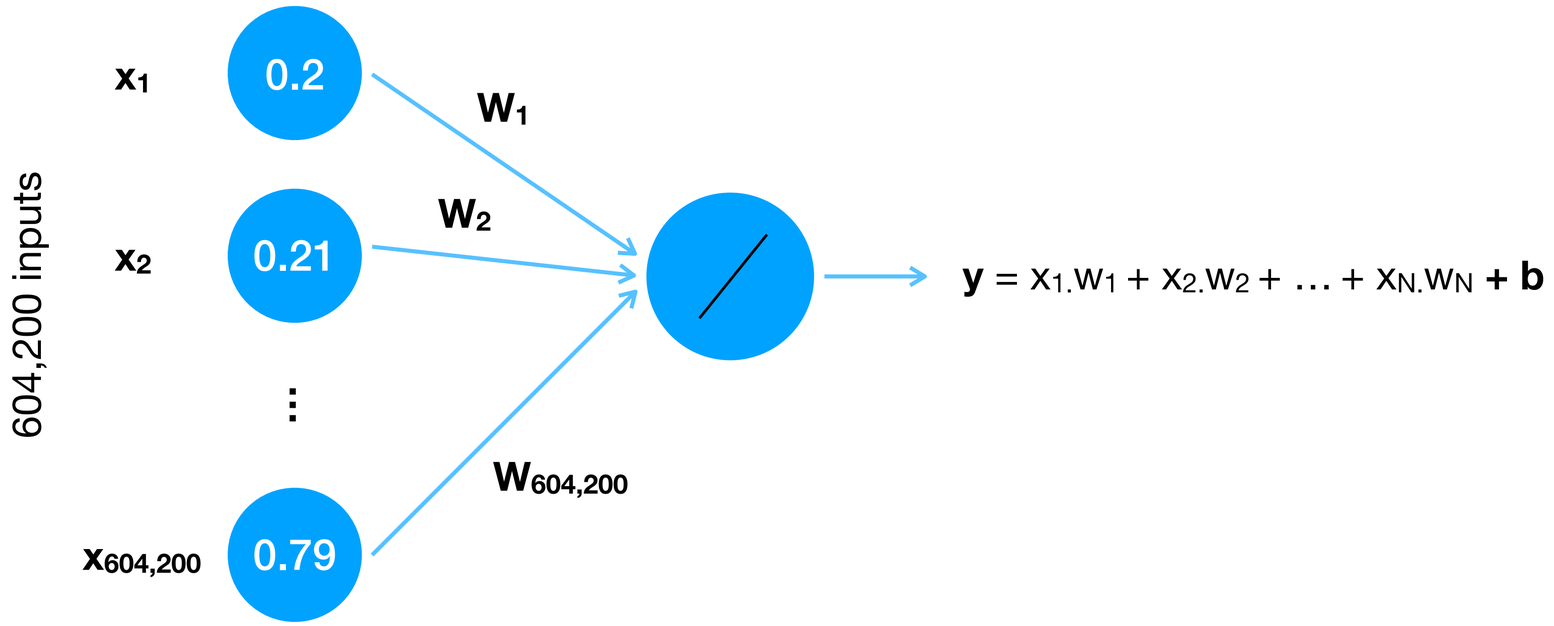

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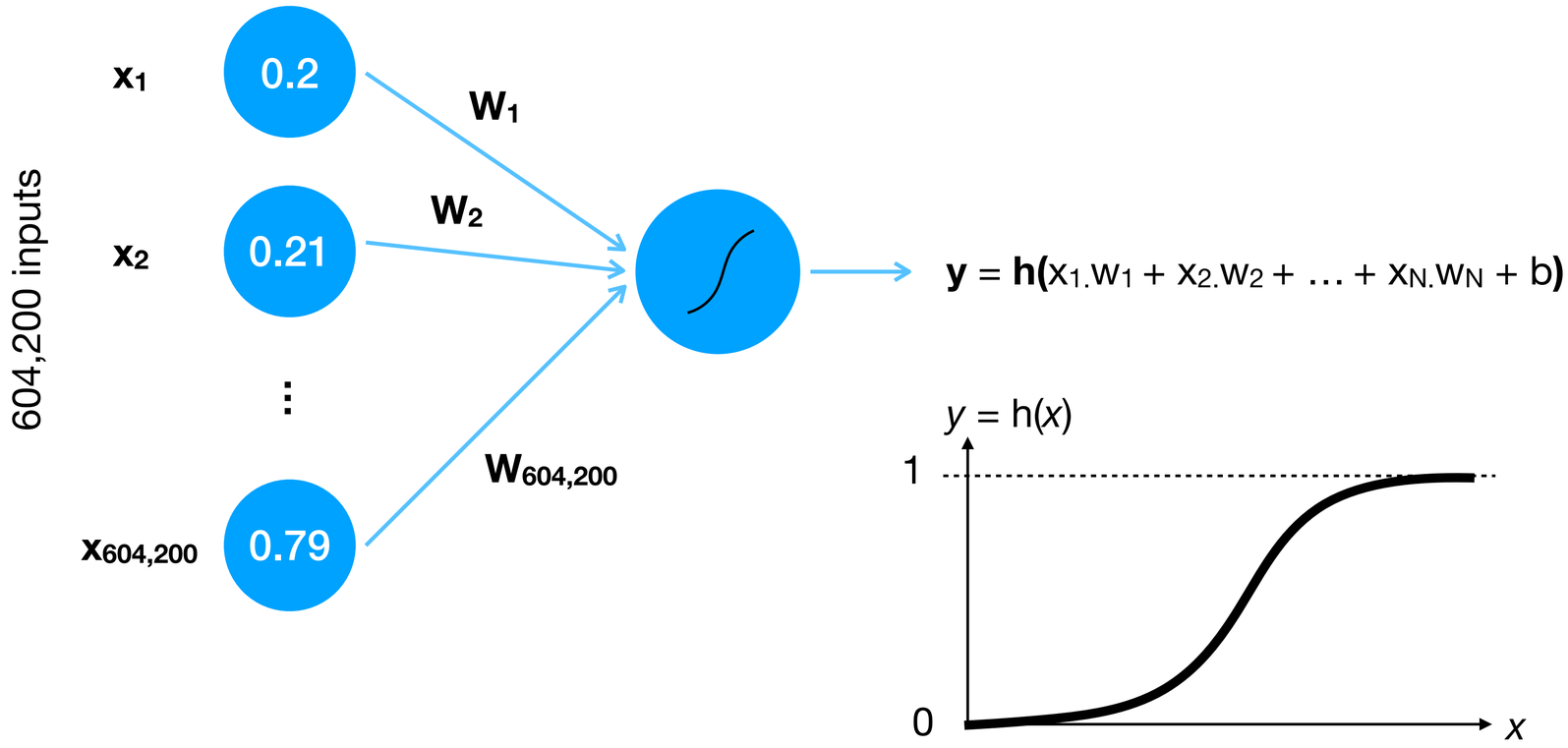

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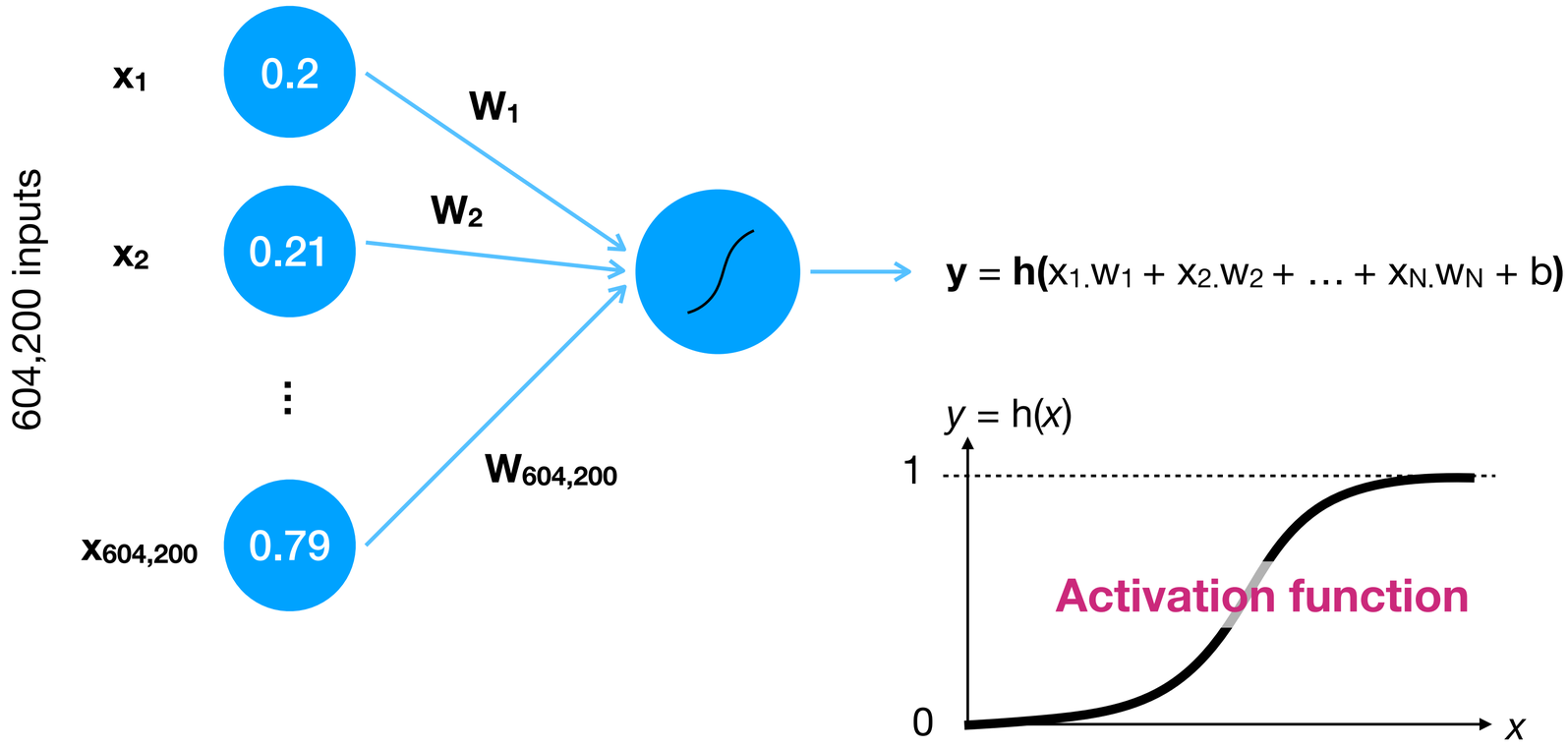
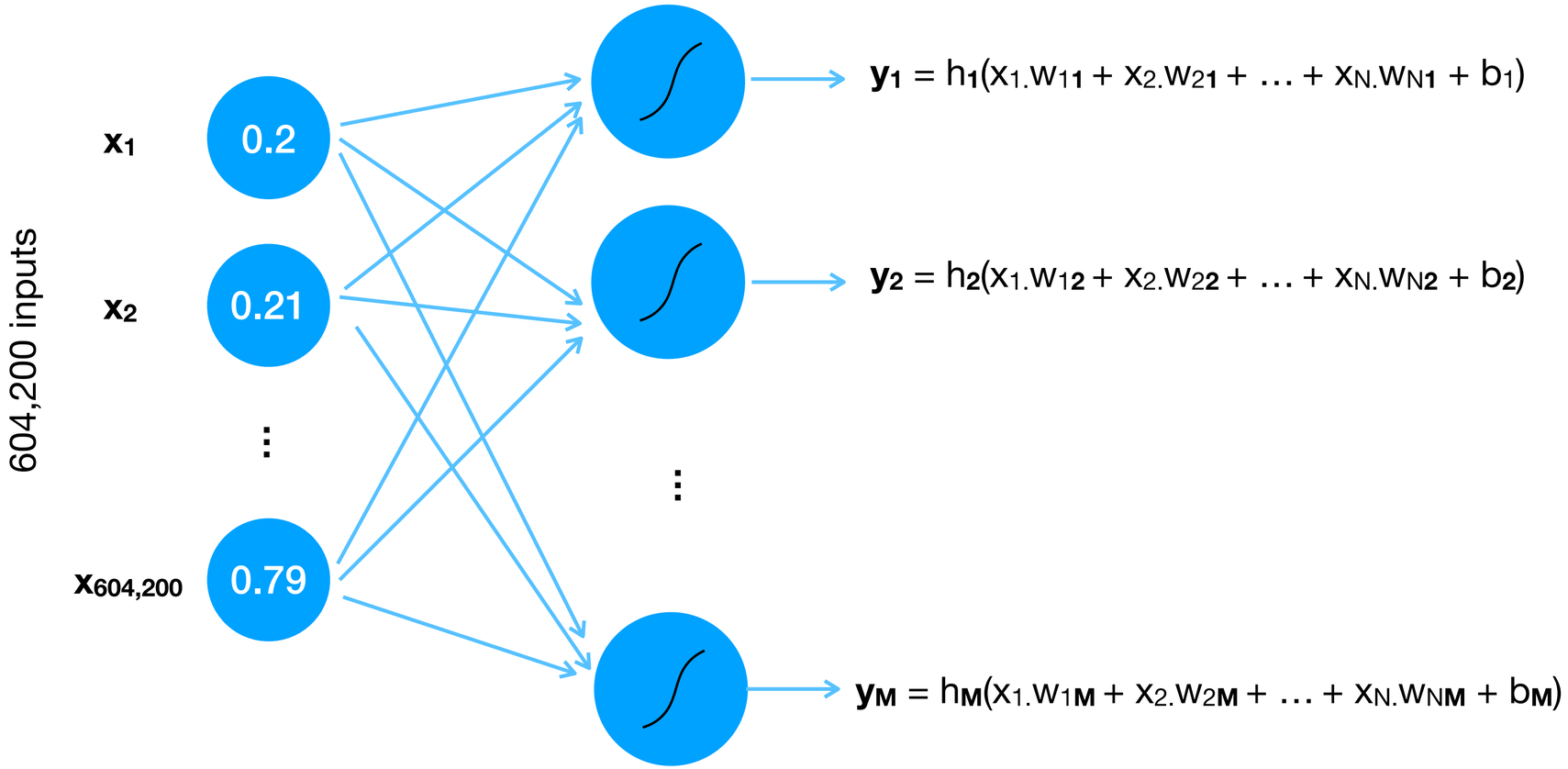


Simple Neural Network

Neural Network is a set of **combined** artificial neurons.



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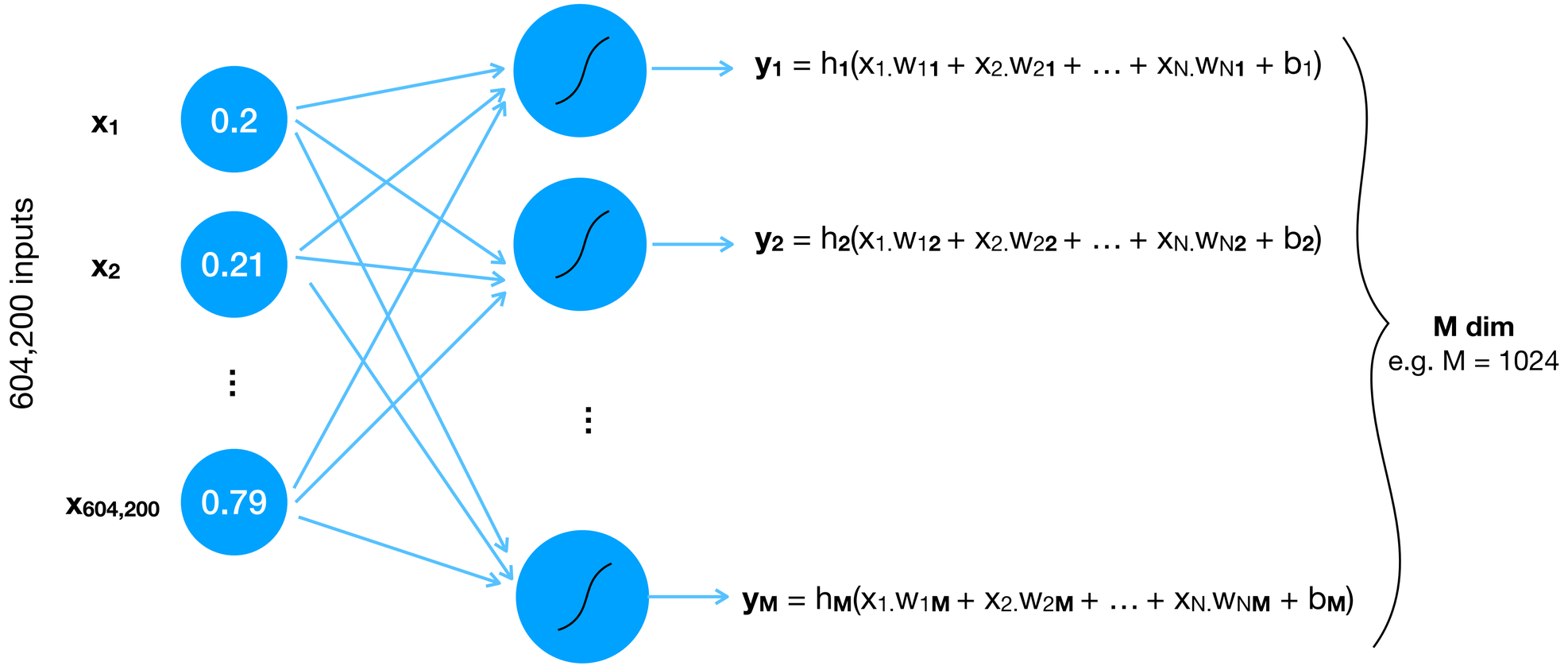

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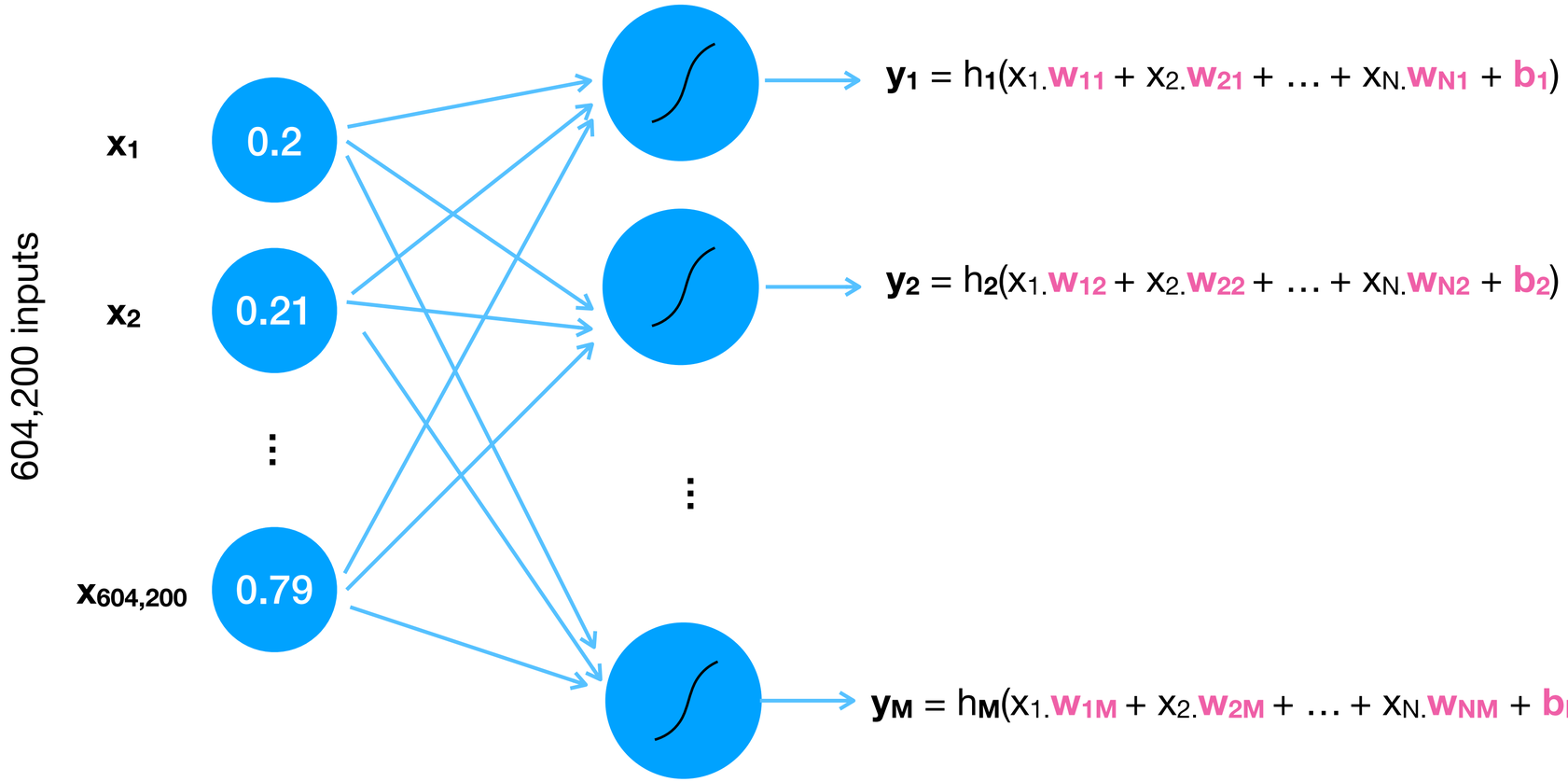
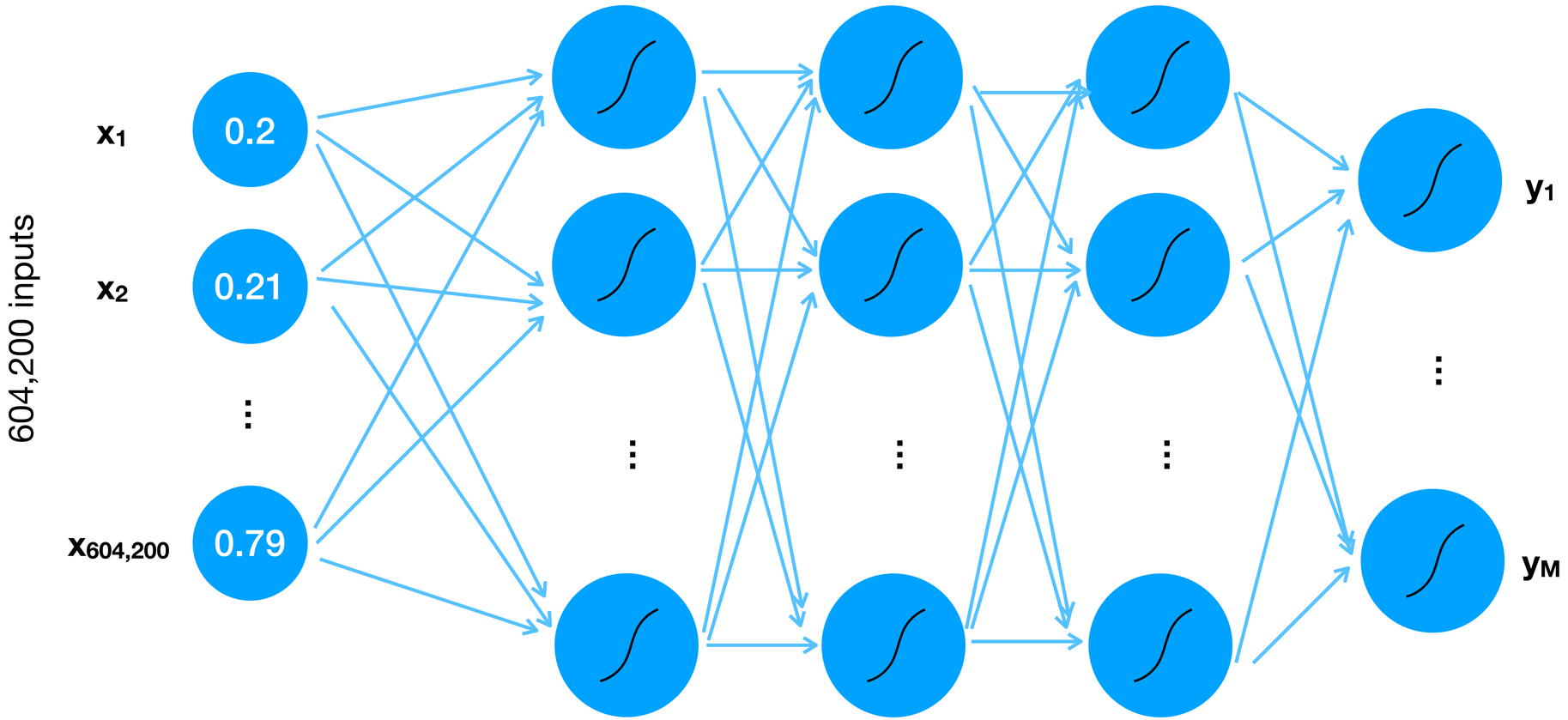


Learning means to find the set of parameters $\mathbf{w_{ij}}$ and $\mathbf{b_i}$.

Deep Neural Network

Deep Neural Networks are **stacked** neural networks



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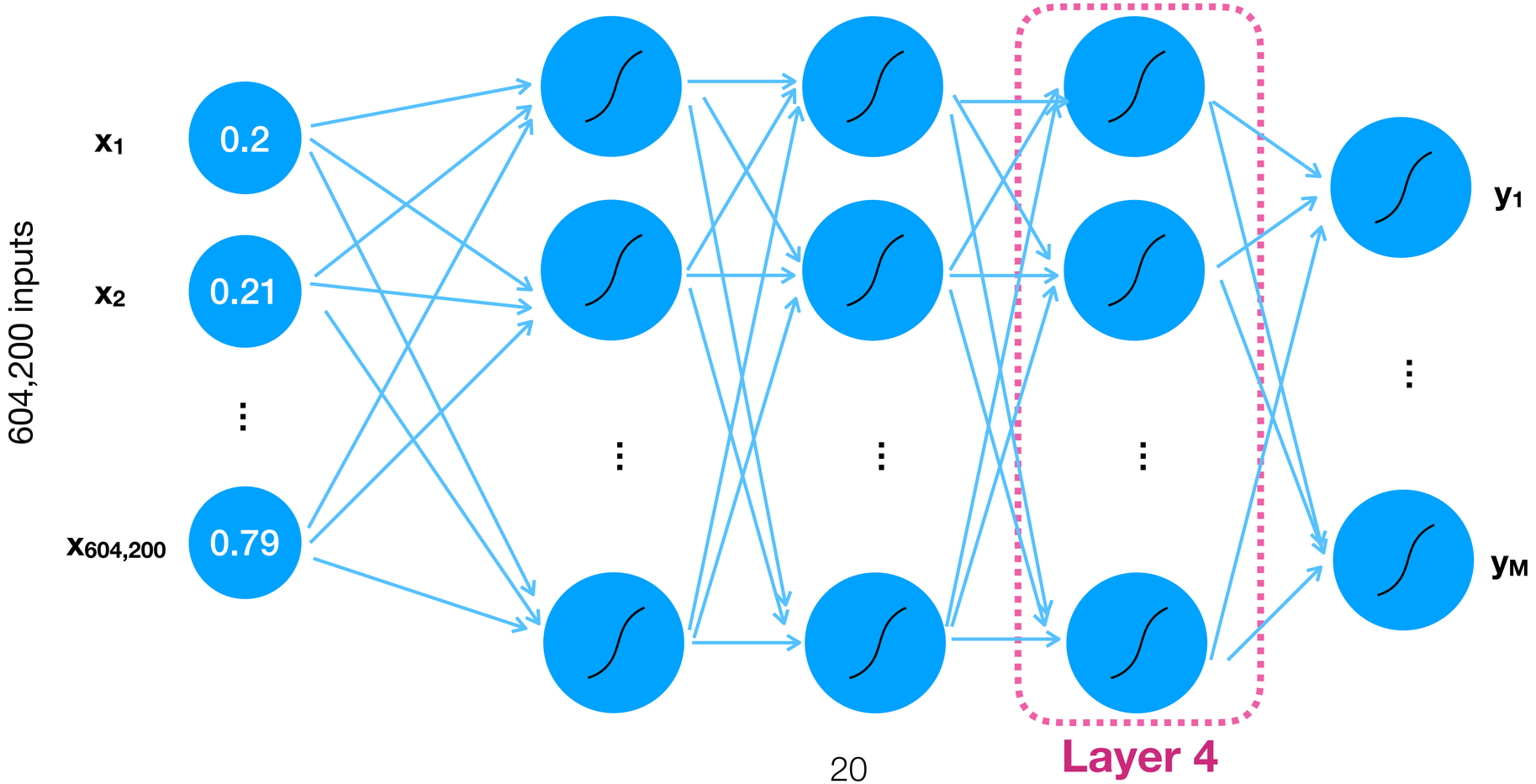
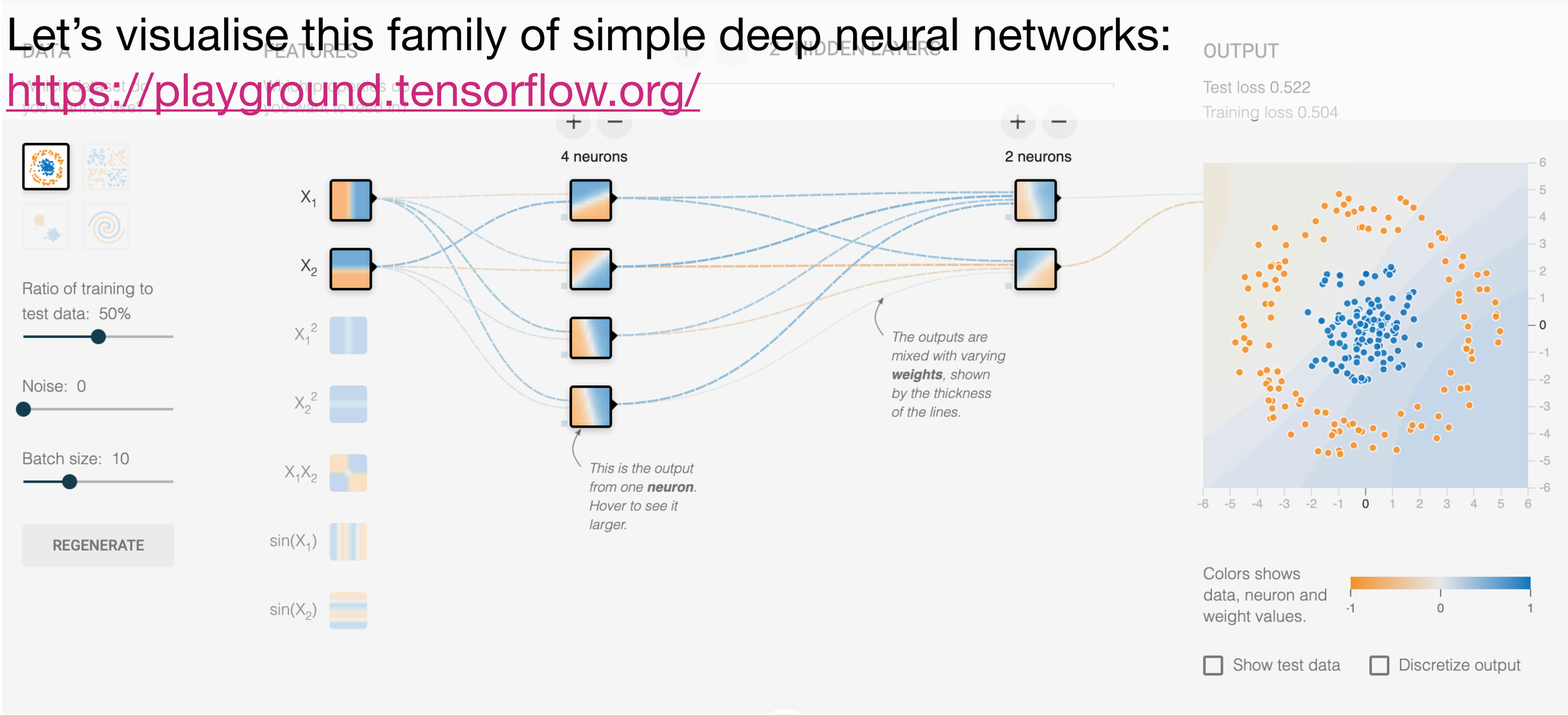


Visualisation

Let’s visualise this family of simple deep neural networks:
https://playground.tensorflow.org/



Types of DNN

DNN introduced so far are **dense** neural networks or **multi-layer perceptron** (MLP).

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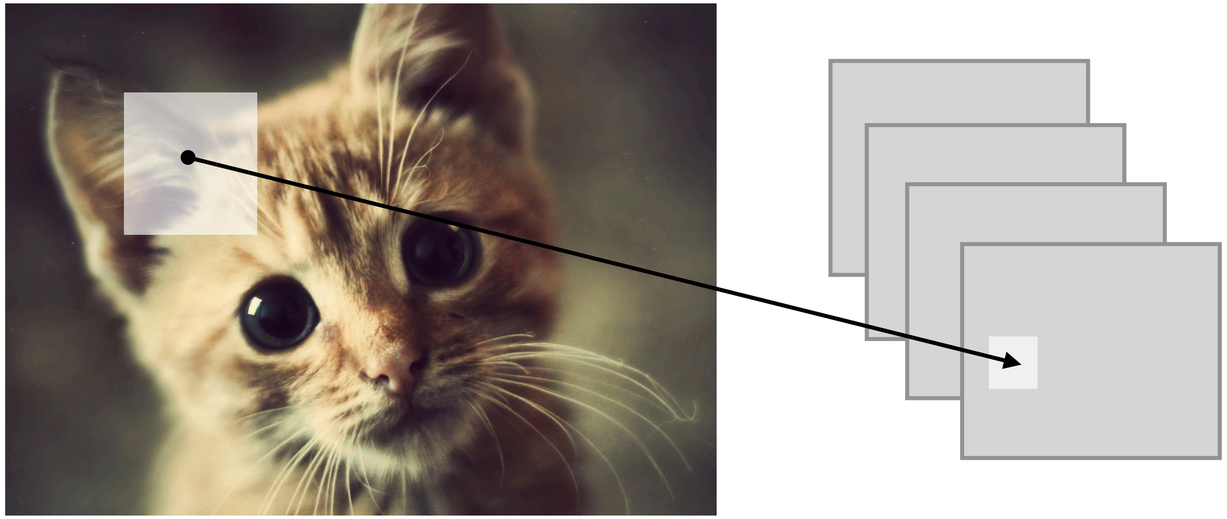
Convolutional Neural Networks



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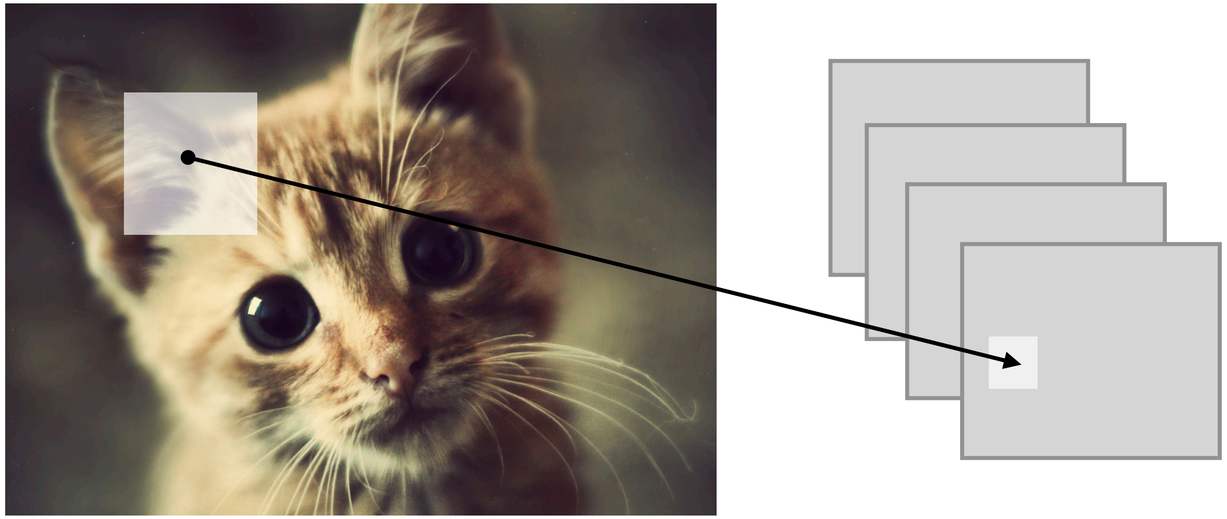
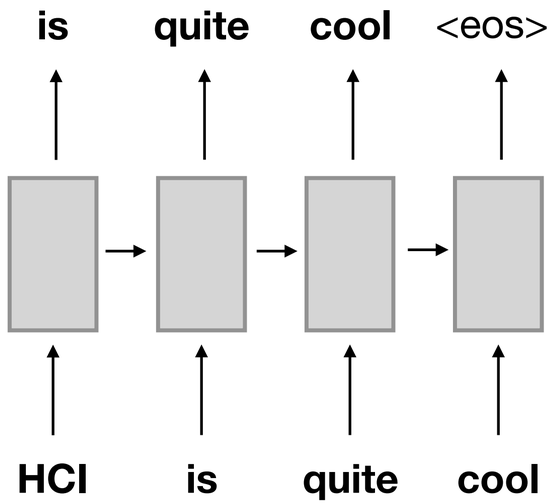
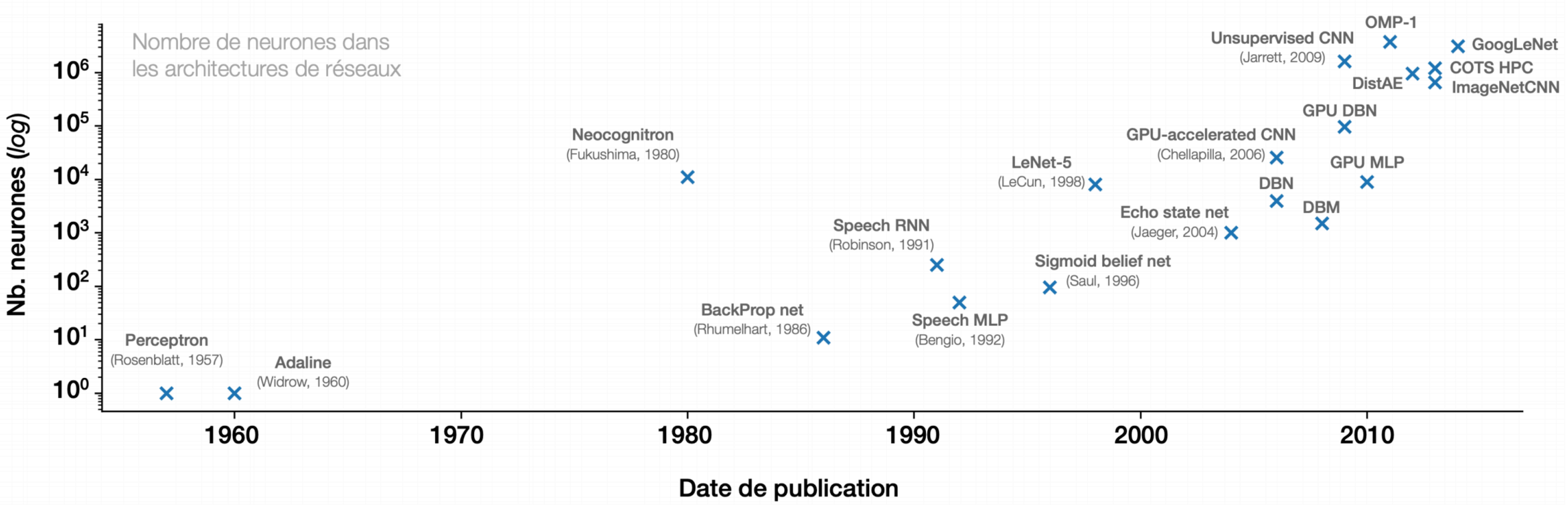


Recurrent Neural Networks



How deep is deep learning?



Credits: Cardon, Cointet, Mazieres. La revanche des neurones : L'invention des machines inductives et la controverse de l'intelligence artificielle. Réseaux, La Découverte, 2018, 5 (211), ff10.3917/res.211.0173f

Tasks

Classification

DNN

“cat”

Regression

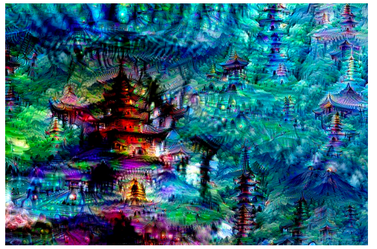
DNN

12,340,000€

Generation

Input signal

DNN

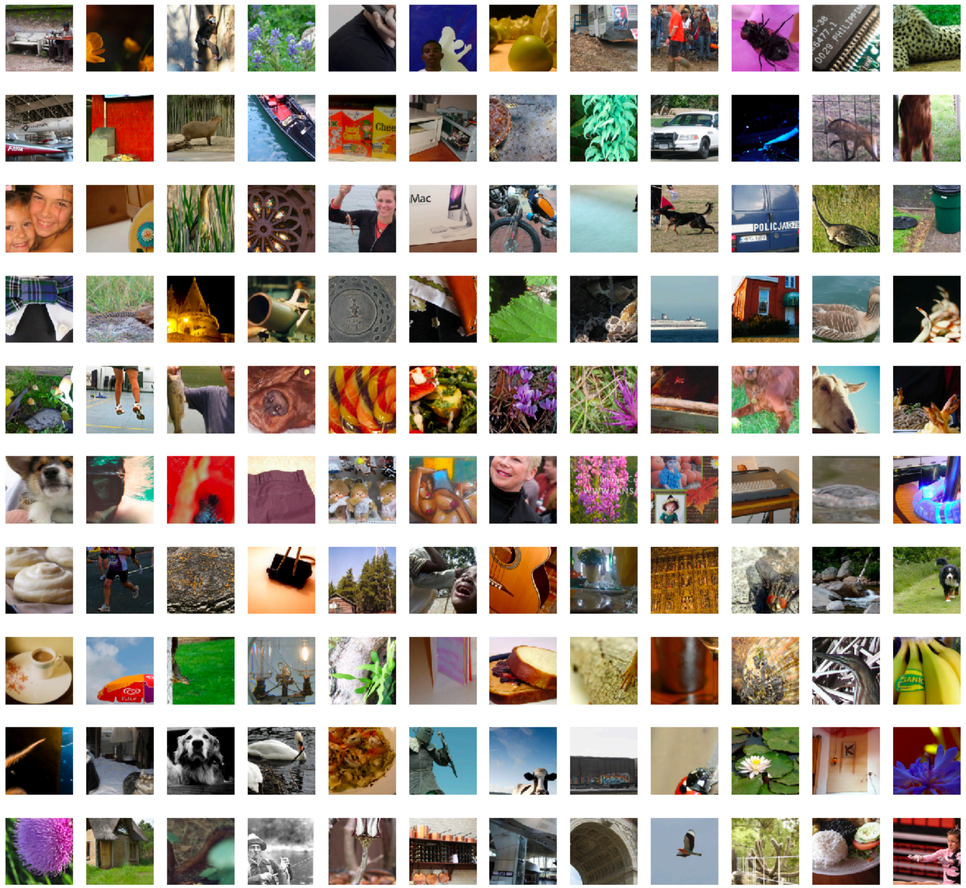


Generation

Deep dream
https://deepdreamgenerator.com/#tools

This person does not exist
https://thispersondoesnotexist.com/

Why is everybody so excited?



ImageNet
1.2 M training examples
100k testing examples
1000 categories

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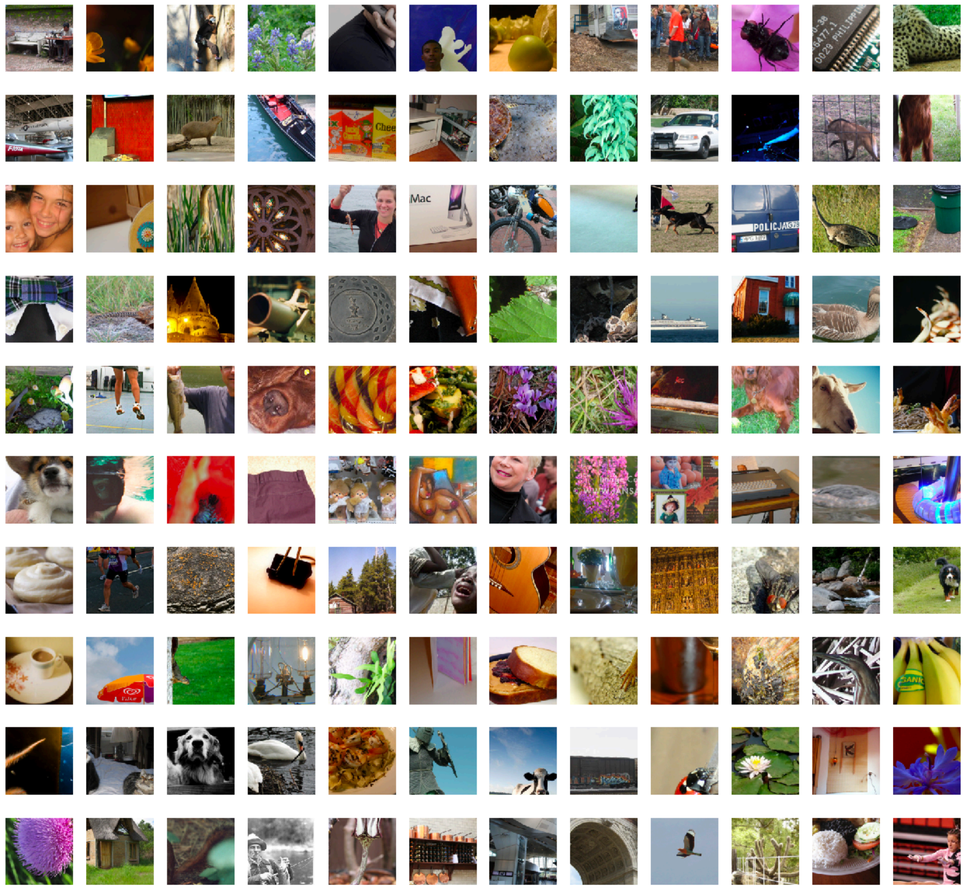

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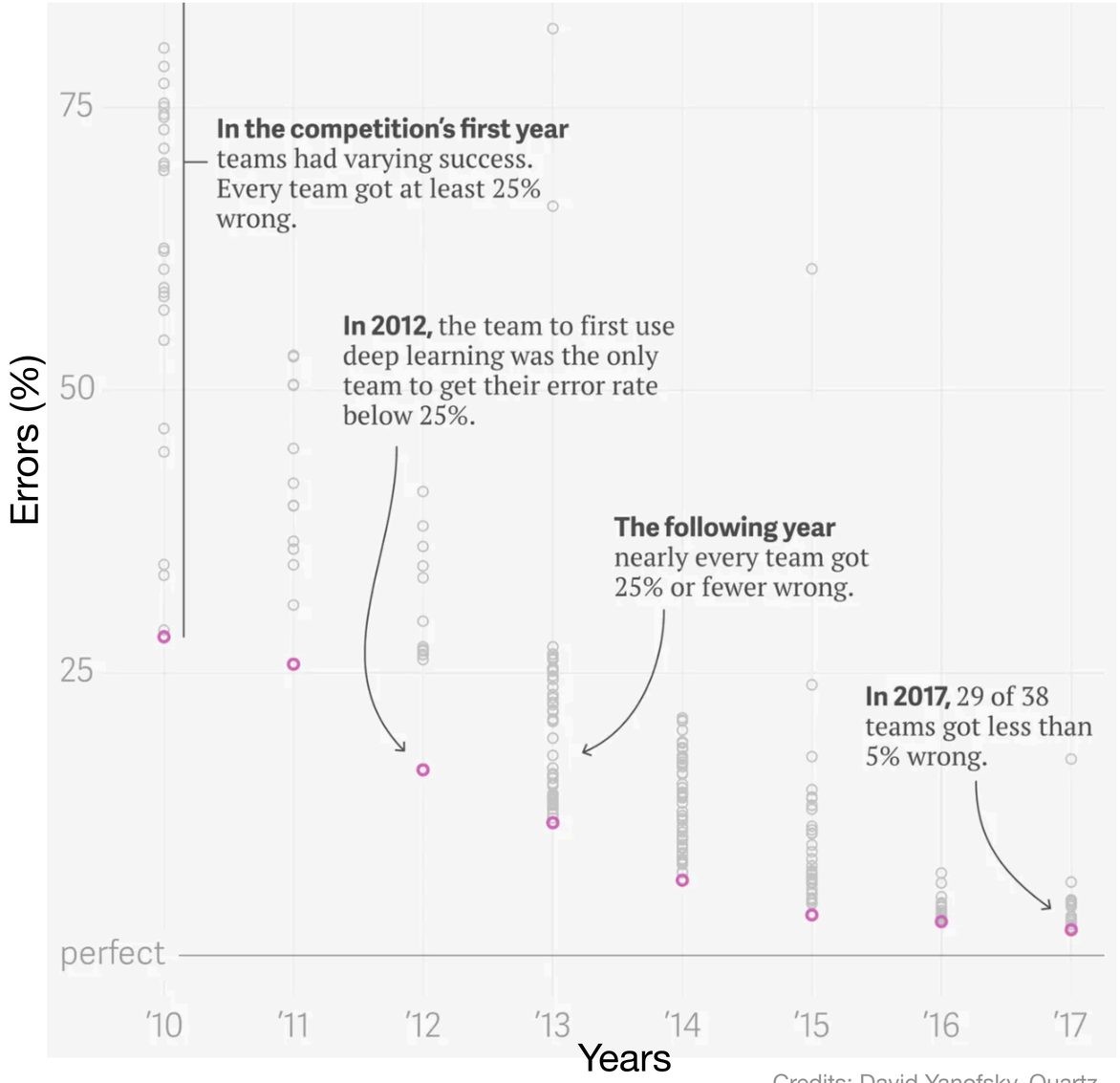

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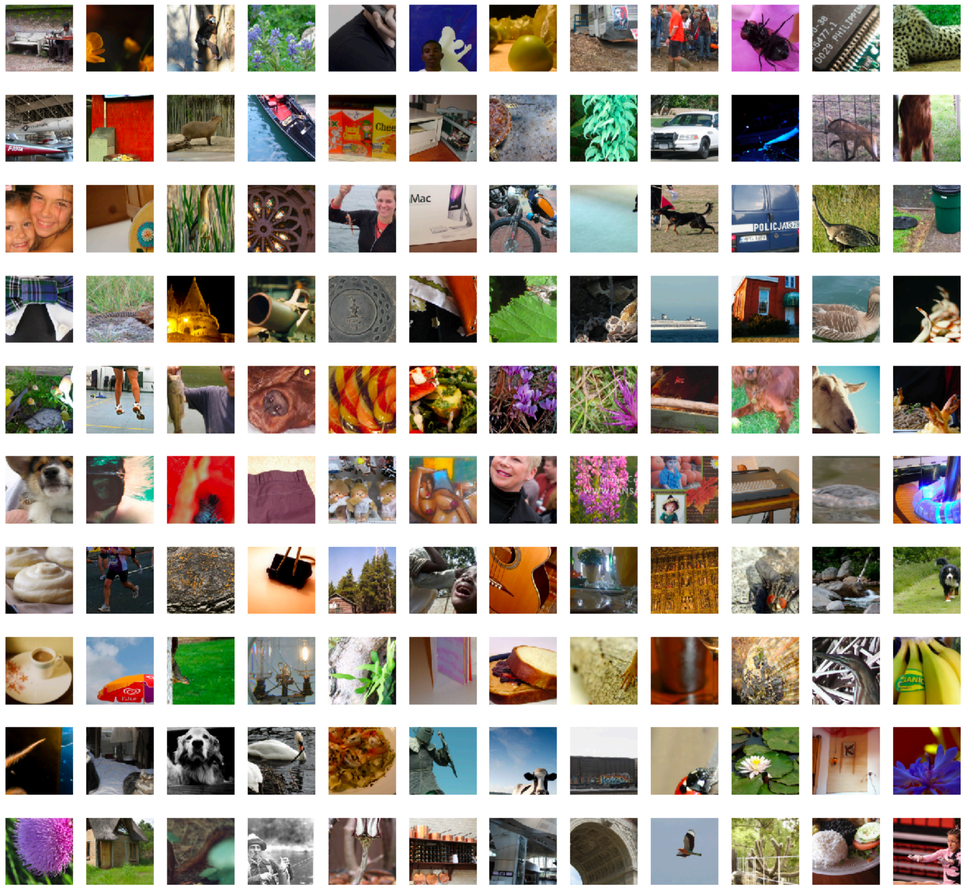

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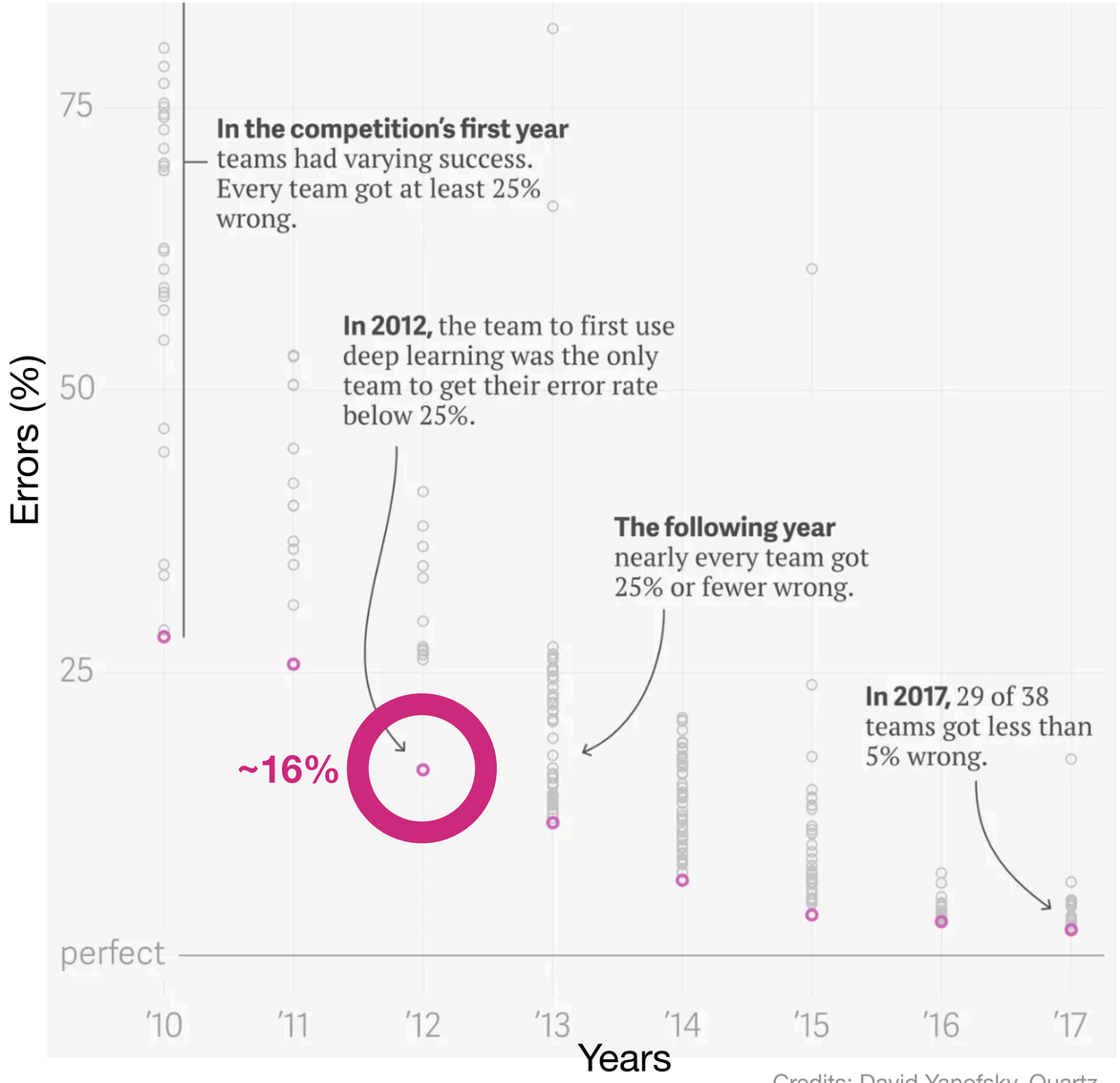

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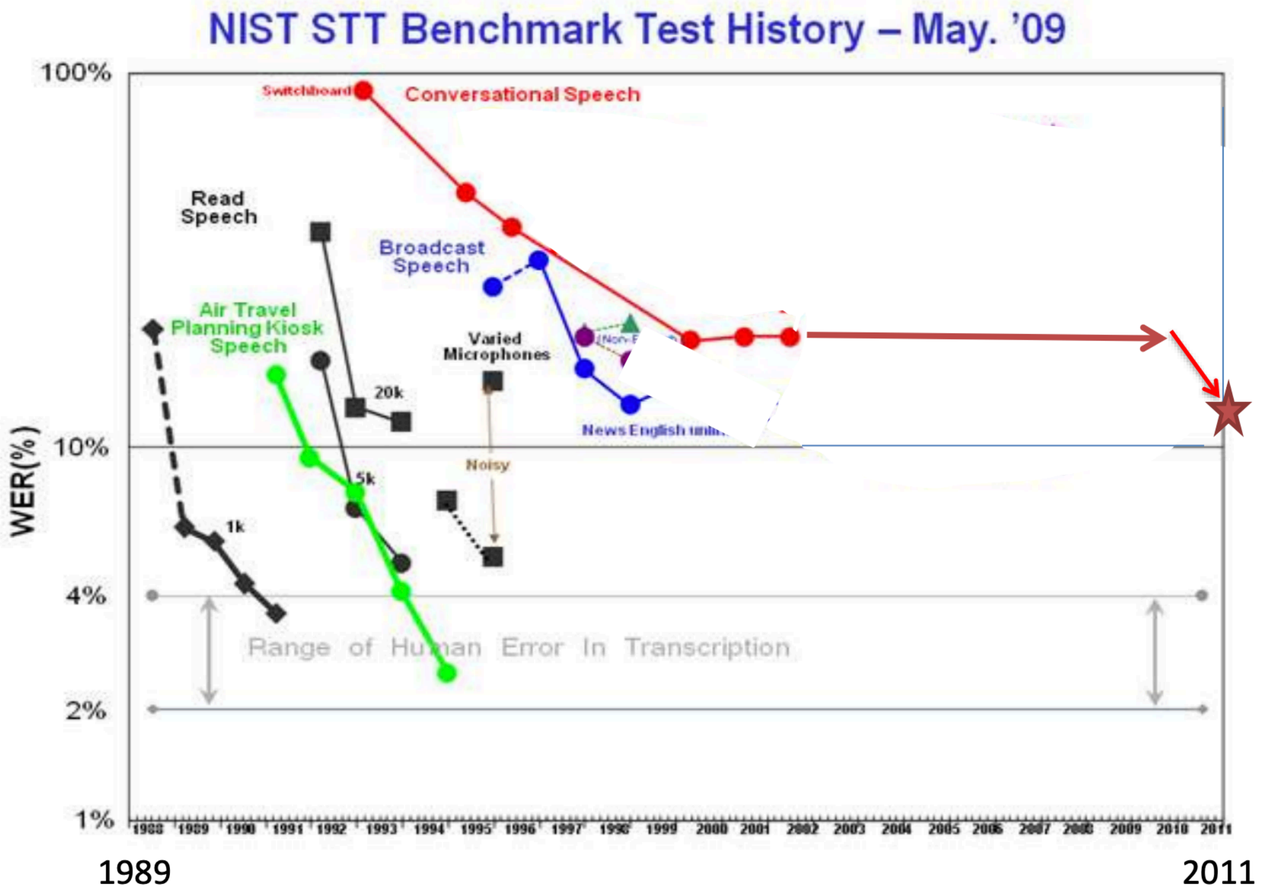
DL spread to other domains



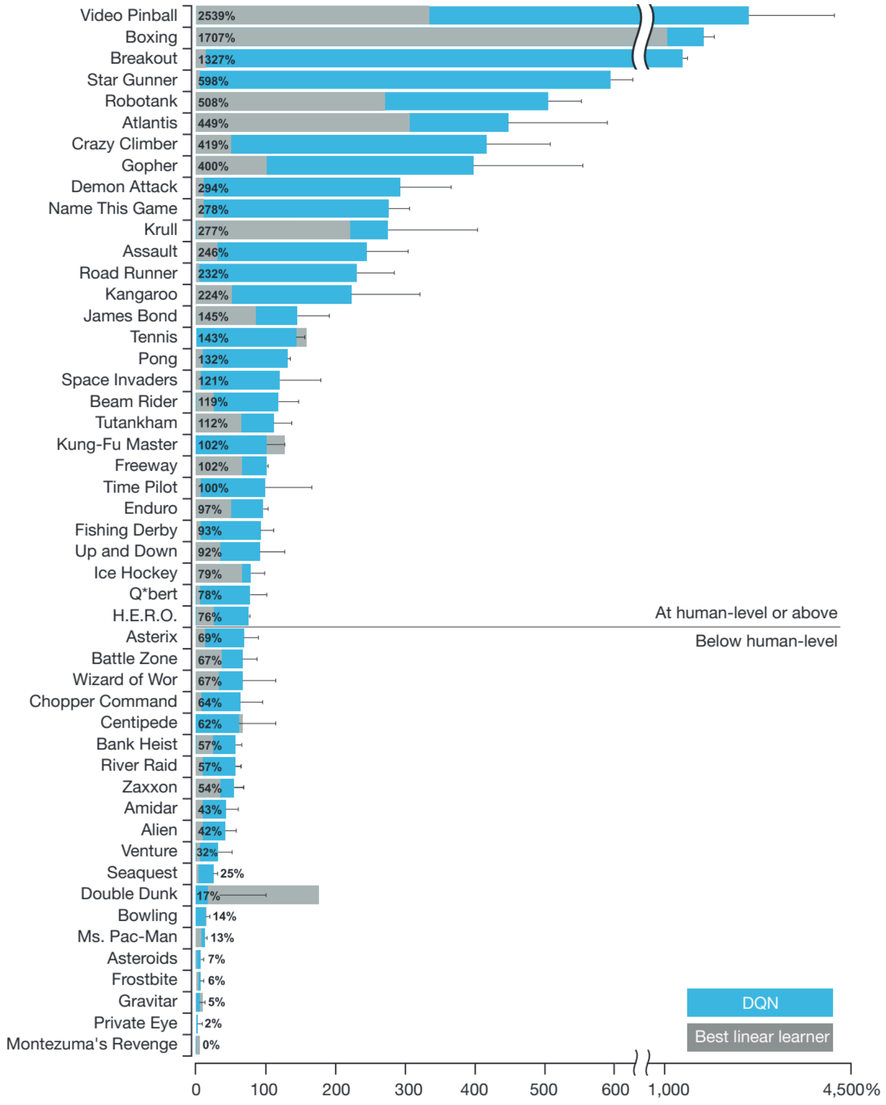
Automatic Speech Recognition

From https://www.microsoft.com/en-us/research/wp-content/uploads/2017/02/deepsr-chinasip-july6.pdf

DL spread to other domains

“Artificial Intelligence”

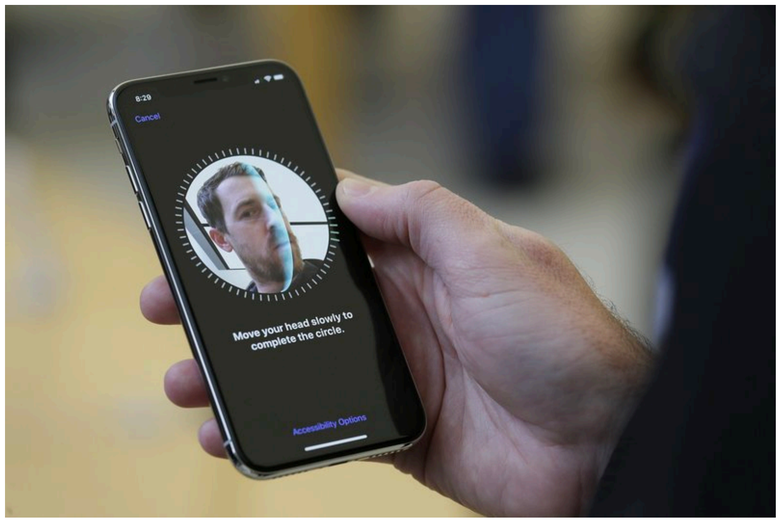
DL spread to other domains



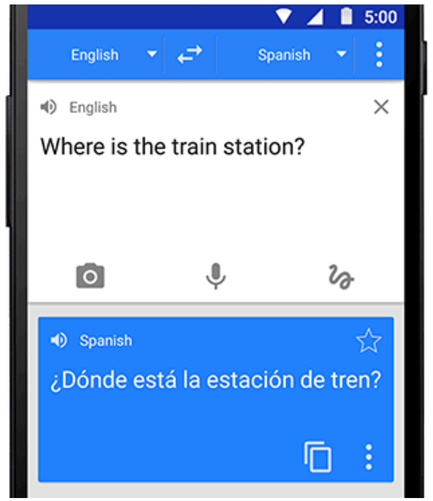
"Artificial Intelligence"

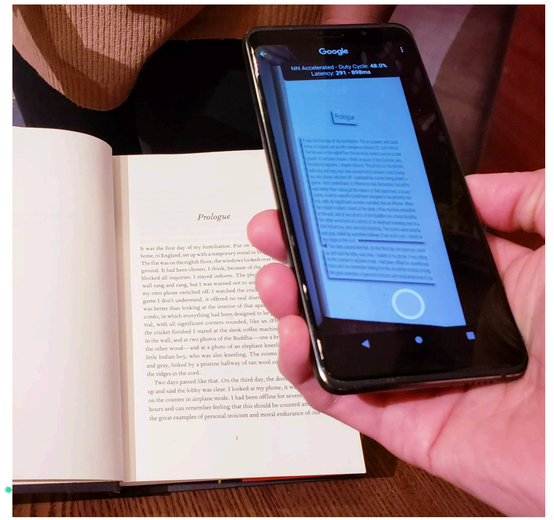
From: Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A. A., Veness, J., Bellemare, M. G., ... & Petersen, S. (2015). Human-level control through deep reinforcement learning. Nature, 518(7540), 529.

Industrial applications



iPhone face recognition





Google Translate

Amazon Echo

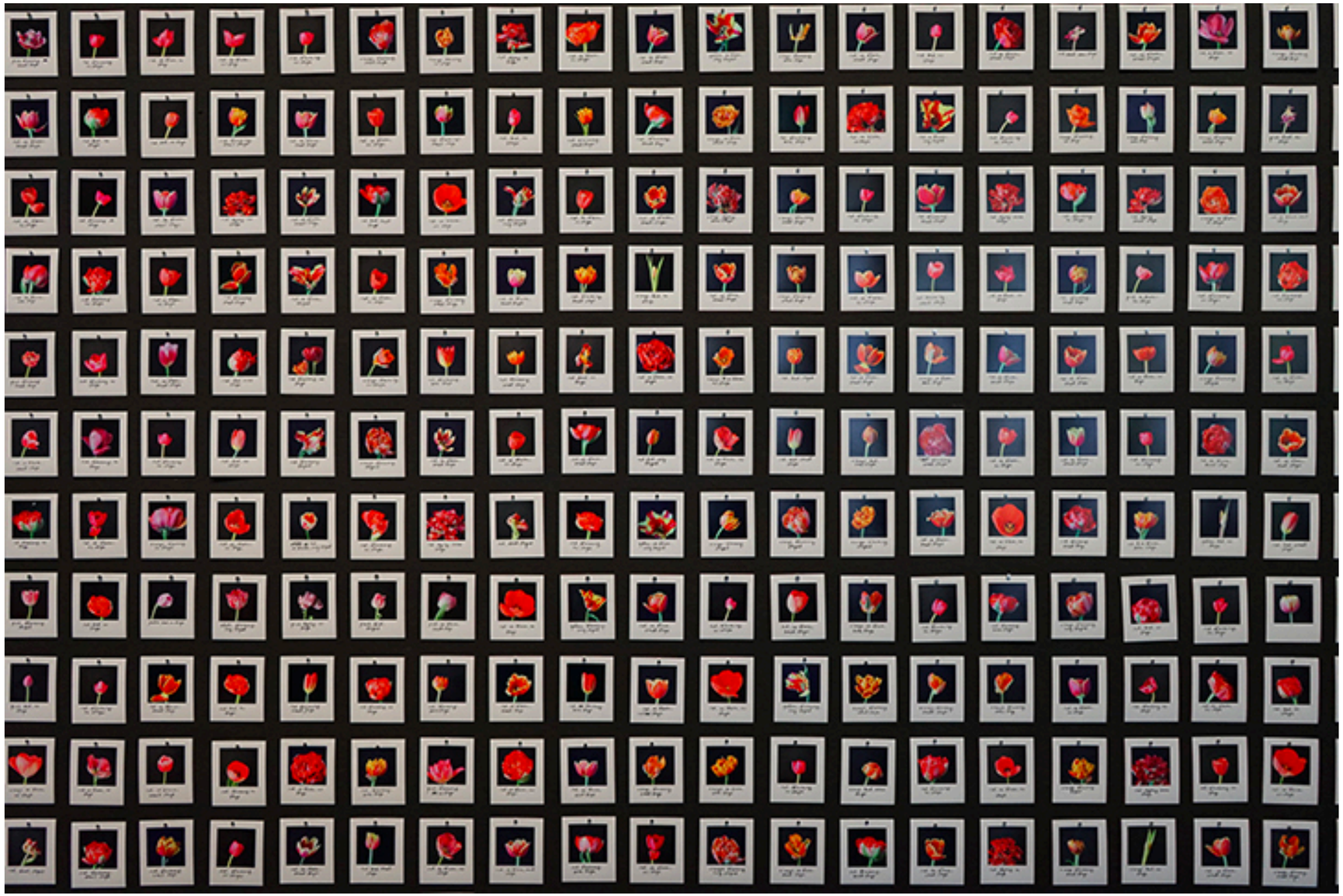
Artistic appropriation

Many artists have explored the use of deep learning in their art work, as a tool or medium to explore new aesthetics or critical spaces.

Art

Anna Ridler

http://annaridler.com/

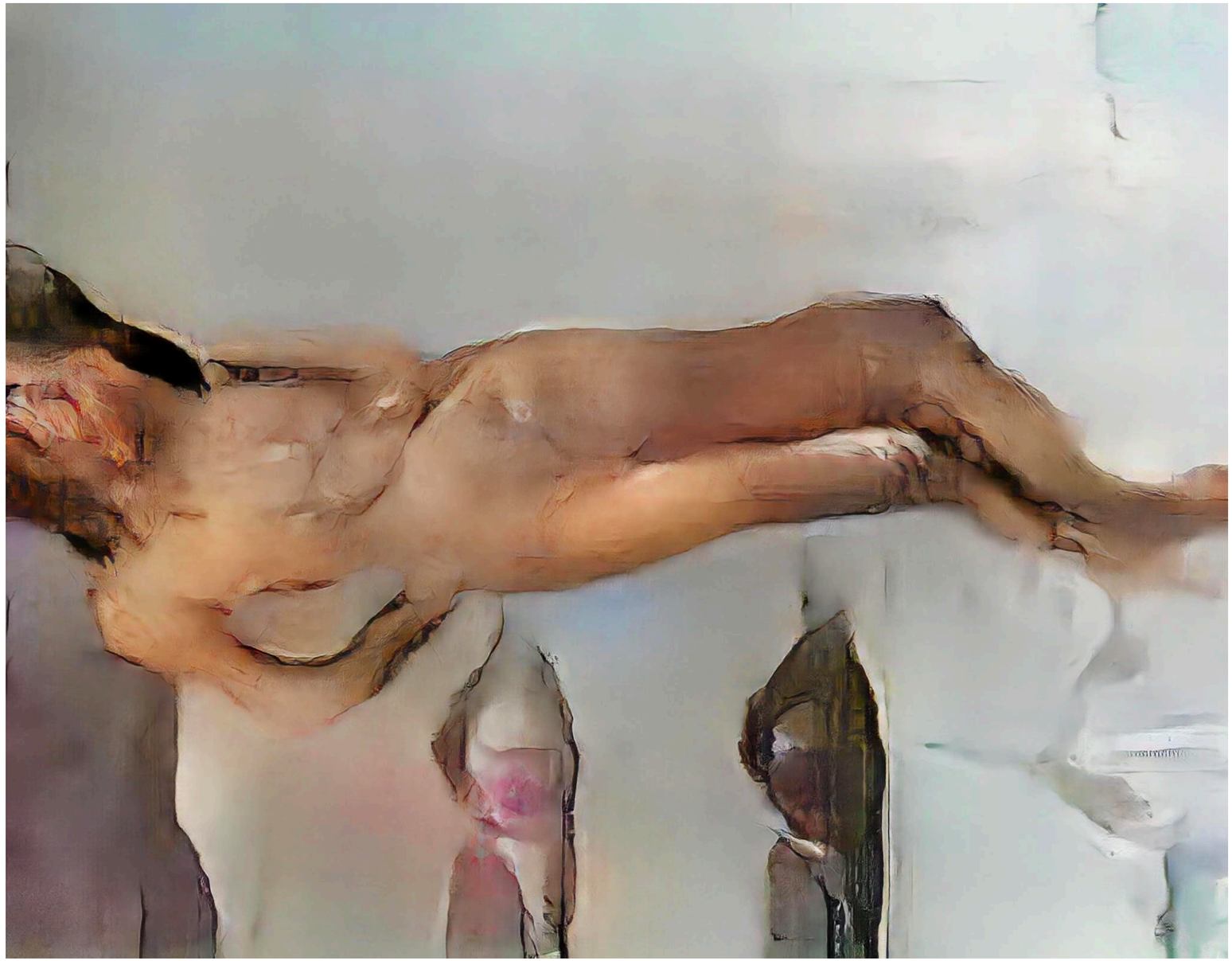


Anna Ridler: Myriad (Tulips)

Art

Mario Klingemann

http://quasimondo.com/



Mario Klingemann: My Artificial Muse

Art

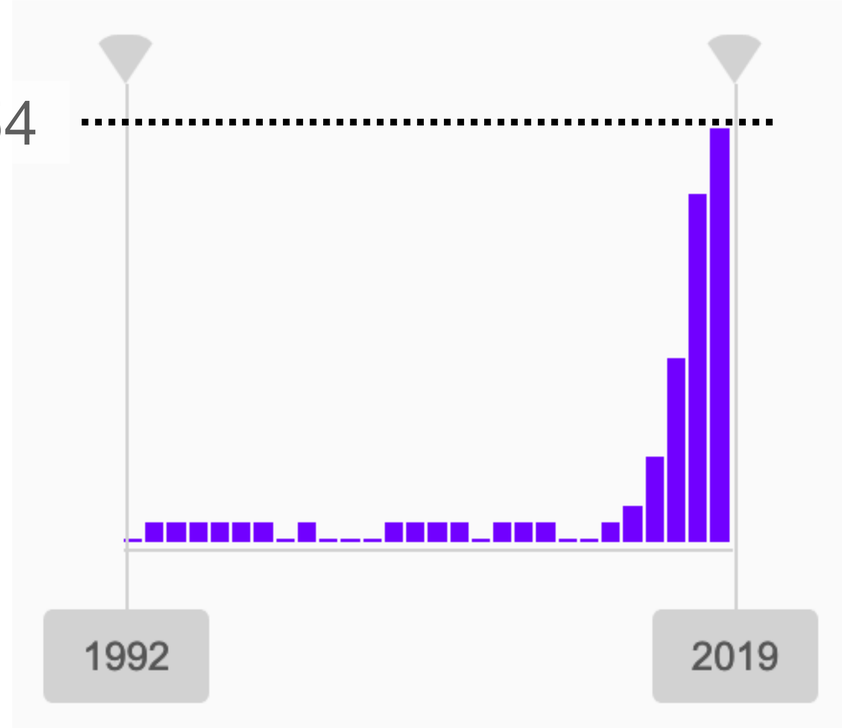
Memo Akten

http://www.memo.tv/works/

Memo Akten: Gloomy Sunday - 2

HCI take

Interactive machine learning using deep learning is receiving increasing attention, although it is slow…



Number of papers that has “deep learning” in their content at CHI.

From: dl.acm.org

Notebook: Basics_DL.ipynb

https://marcelle-example-01.glitch.me

https://marcelle-example-02.glitch.me