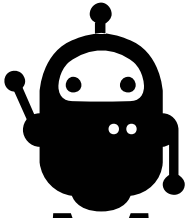
AI Machine Learning & deep learning



T8 : « Programmer et déployer votre IA »

Jean-Luc PAROUTY – CNRS/SIMaP

7 juillet 2020

cnrs SIMaP JDEV

Previously in SEASON 1 :

Artificial Intelligence, Machine Learning, Deep Learning... what are we talking about ?

Deep Learning uses artificial neurons, okay…
...but what's an artificial neuron?

AI Machine Learning & deep learning

SEASON 2

« Un autre paradigme pour les sciences numériques »

« La revanche des neurones : L'invention des machines inductives et la controverse de l'intelligence artificielle[1] »

Dominique Cardon, Jean-Philippe Cointet, Antoine Mazieres

https://hal.archives-ouvertes.fr/hal-01925644

FIDLE

Formation Introduction au Deep Learning[2]

Soraya ARIAS – INRIA
Eric MALDONADO – INRAE
Jean-Luc PAROUTY – SIMaP

[1] Dominique Cardon, Jean-Philippe Cointet, Antoine 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.211.0173ff. ffhal-01925644

[2] Contact : Fidle.Contact@grenoble.cnrs.fr

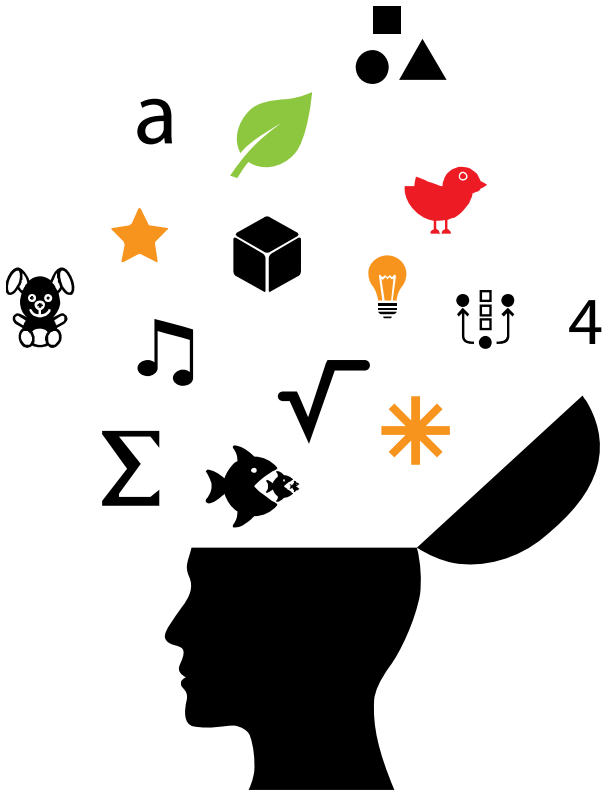
[intelligence]

[intelligence]

« Capacité de percevoir ou d'inférer l'information, et de la conserver comme une connaissance à appliquer à des comportements adaptatifs dans un environnement ou un contexte donné »

« Ability to perceive or infer information, and to retain it as knowledge to be appli towards adaptive behaviors within an environment or context »[*]

[*] Wikipedia - Illustration : [POTATO]



[intelligence]

« Ensemble des fonctions mentales ayant pour objet la connaissance conceptuelle et rationnelle »*

« Set of mental functions aimed at conceptual and rational knowledge »

* https://www.larousse.fr

The big Controversy

Modelling the brain :

« Penser s'apparente
à un calcul massivement parallèle de
fonctions élémentaires.

L'information est un **signal** avant
d'être un code »[1]

Making a mind :

« Penser, c'est calculer des **symboles** qui
ont à la fois une réalité matérielle et une
valeur sémantique de représentation »[1]

L'information est une donnée
symbolique de **haut niveau**.

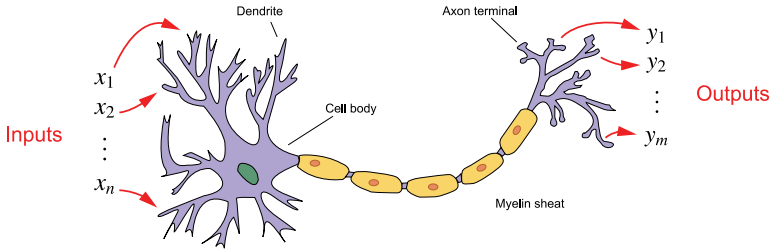
Connectionnism

Modelling the brain
Modéliser le cerveau

vs

Symbolic

Making a mind
Forger une opinion



Tout [homme] est [mortel]
[Socrate] est un [homme]

Donc [Socrate] est [mortel]

[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

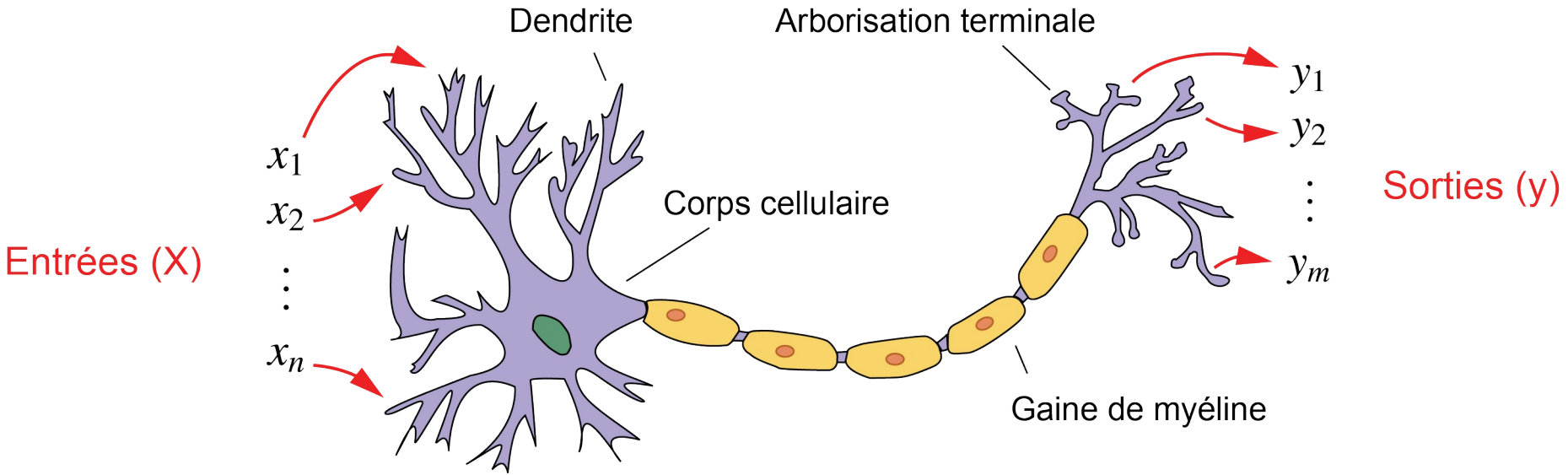
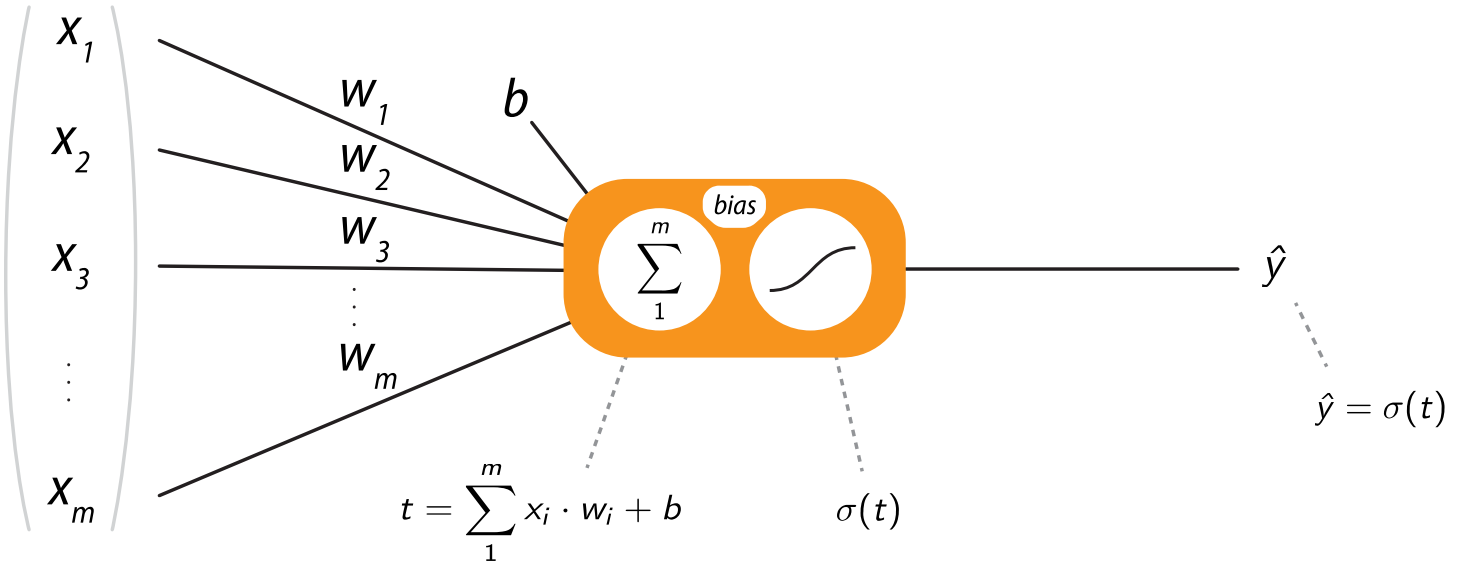


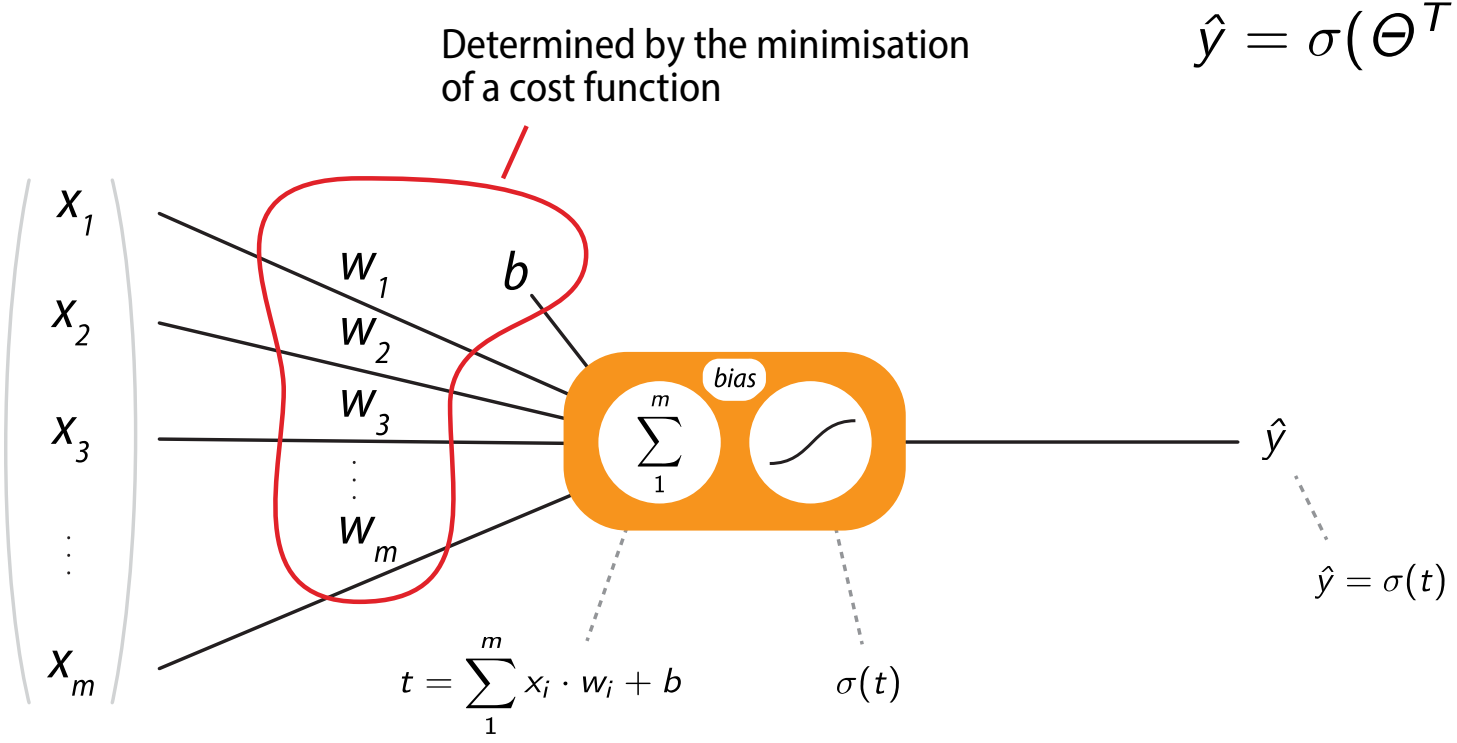
Illustration : [NEURON]

$$\hat{y} = \sigma(\Theta^T \cdot X + b)$$



Input	Bias / Weight	Activation function	Output
X	Θ, b	$\sigma(t)$	$\hat{y}$

$$\hat{y} = \sigma(\Theta^T \cdot X + b)$$



Input	Bias / Weight	Activation function	Output
X	Θ, b	$\sigma(t)$	$\hat{y}$

The big Controversy

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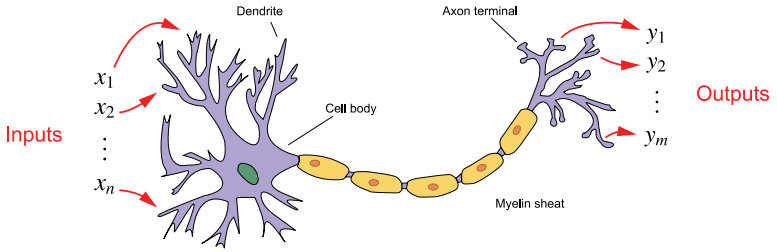
Connectionnism

Modelling the brain
Modéliser le cerveau

vs

Symbolic

Making a mind
Forger une opinion



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[Socrate] est un [homme]

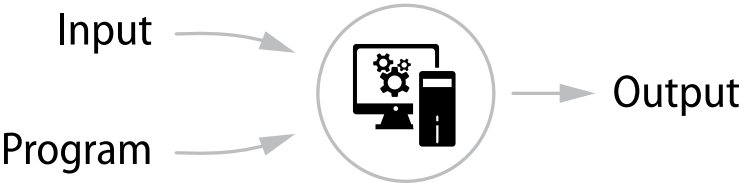
Donc [Socrate] est [mortel]

[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

The big Controversy

Inductive approach

Deductive approach



Connectionnism vs **Symbolic**

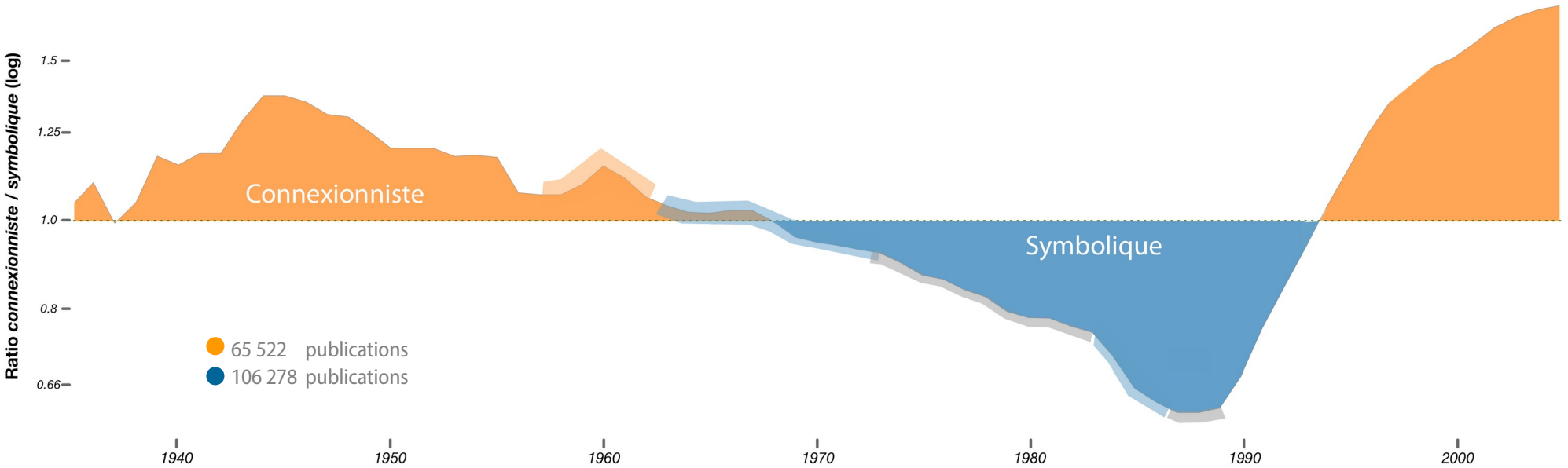
Facts ▶ Rules and laws

Rules and laws ▶ Special case

The big Controversy

Evolution of the academic influence of connexionist and symbolic approaches[1]

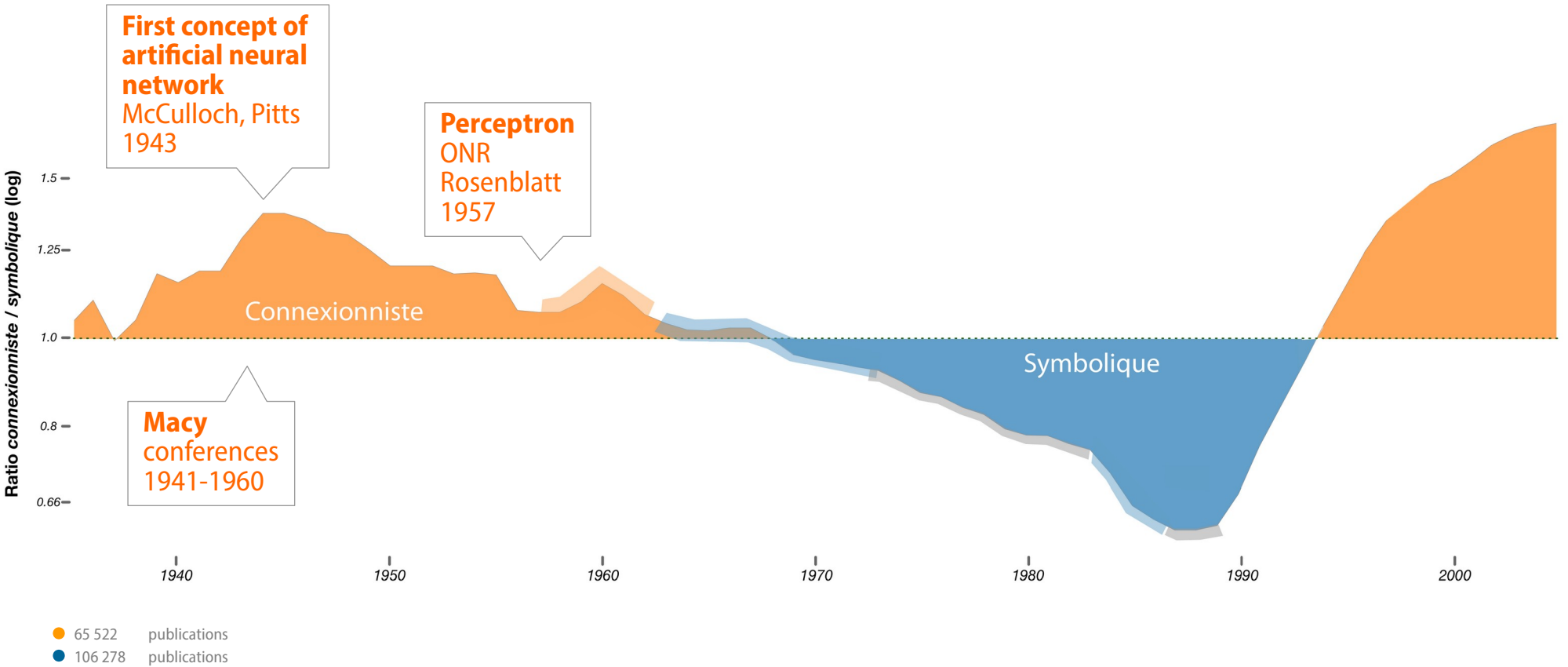
Ration of publications between connexionists and symbolists



[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

The big Controversy

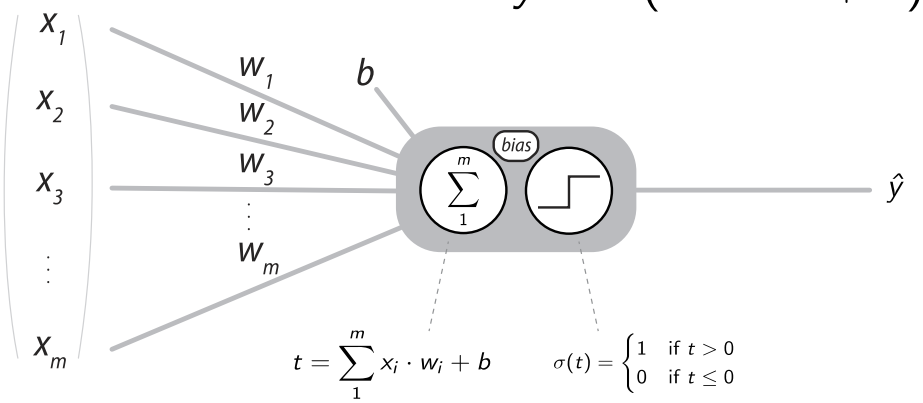
Evolution of the academic influence of connexionist and symbolic approaches[1]

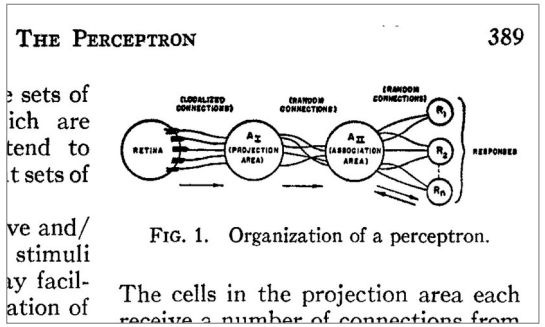


[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

Perceptron

$$\hat{y} = \sigma(\Theta^T \cdot X + b)$$





THE PERCEPTRON 389

sets of
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t sets of

ve and/
stimuli
y facil-
ation of

RETINA
(PROJECTION AREA)
(ASSOCIATION AREA)
RESPONSES

FIG. 1. Organization of a perceptron.

The cells in the projection area each

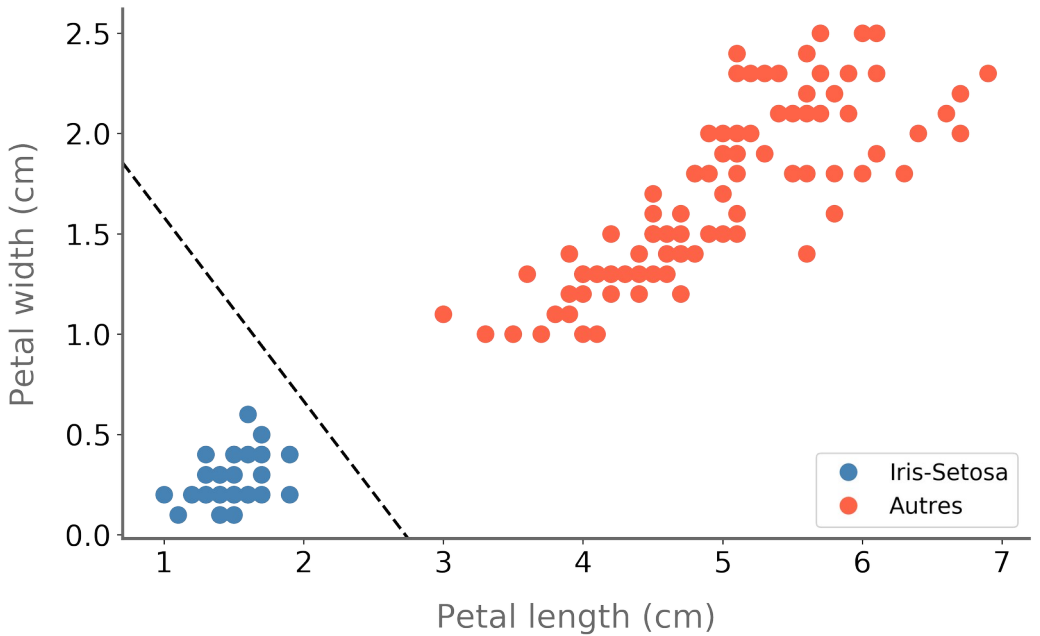
Perceptron
Frank Rosenblatt
1958

Linear and binary classifier

F. Rosenblatt, 1958 [FROS]

Iris plants dataset

Dataset from : Fisher, R.A. "The use of multiple measurements in taxonomic problems" Annual Eugenics, 7, Part II, 179-188 (1936)

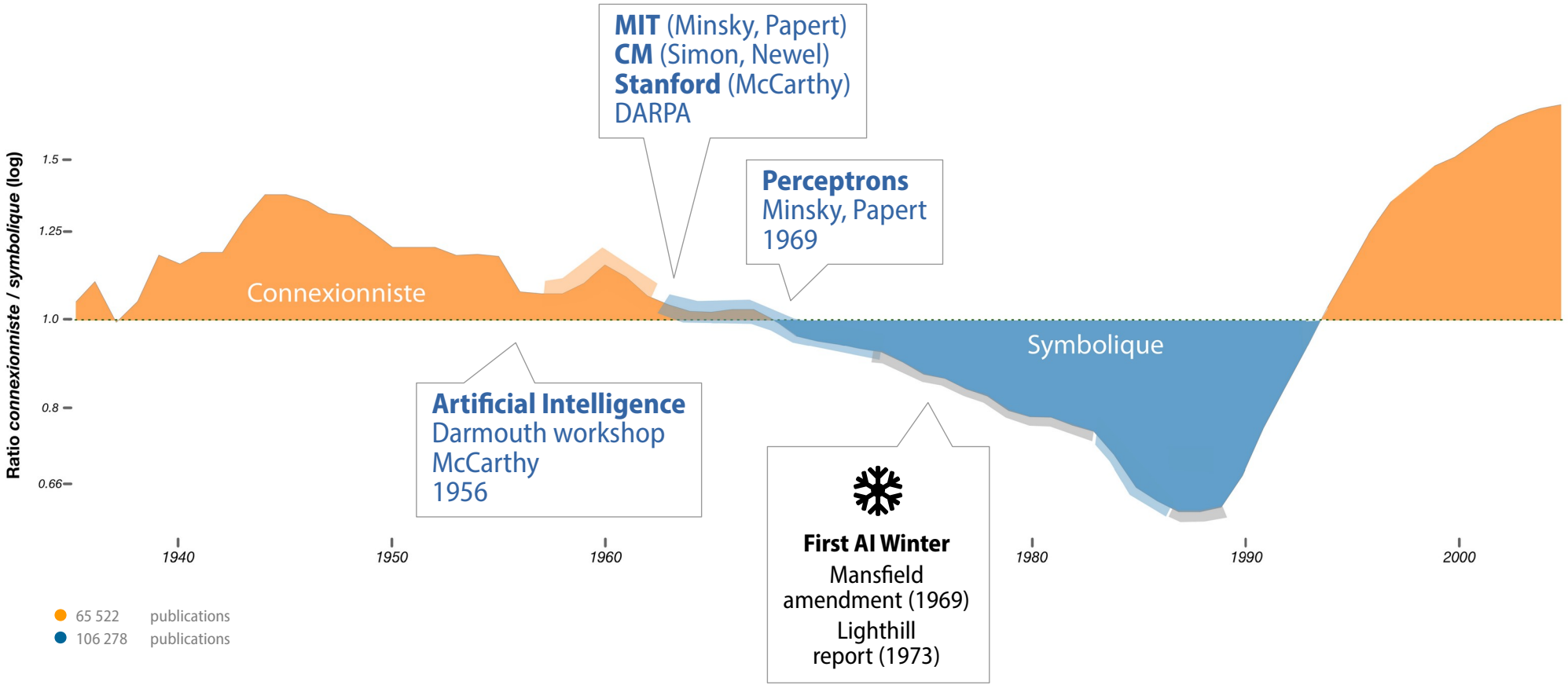


Length x_1	Width x_2	Iris Setosa (0/1) y
1.4	1.4	1
1.6	1.6	1
1.4	1.4	1
1.5	1.5	1
1.4	1.4	1
4.7	4.7	0
4.5	4.5	0
4.9	4.9	0
4.0	4.0	0
4.6	4.6	0
(...)		

Notebook [PER57]

The big Controversy

Evolution of the academic influence of connexionist and symbolic approaches[1]



[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

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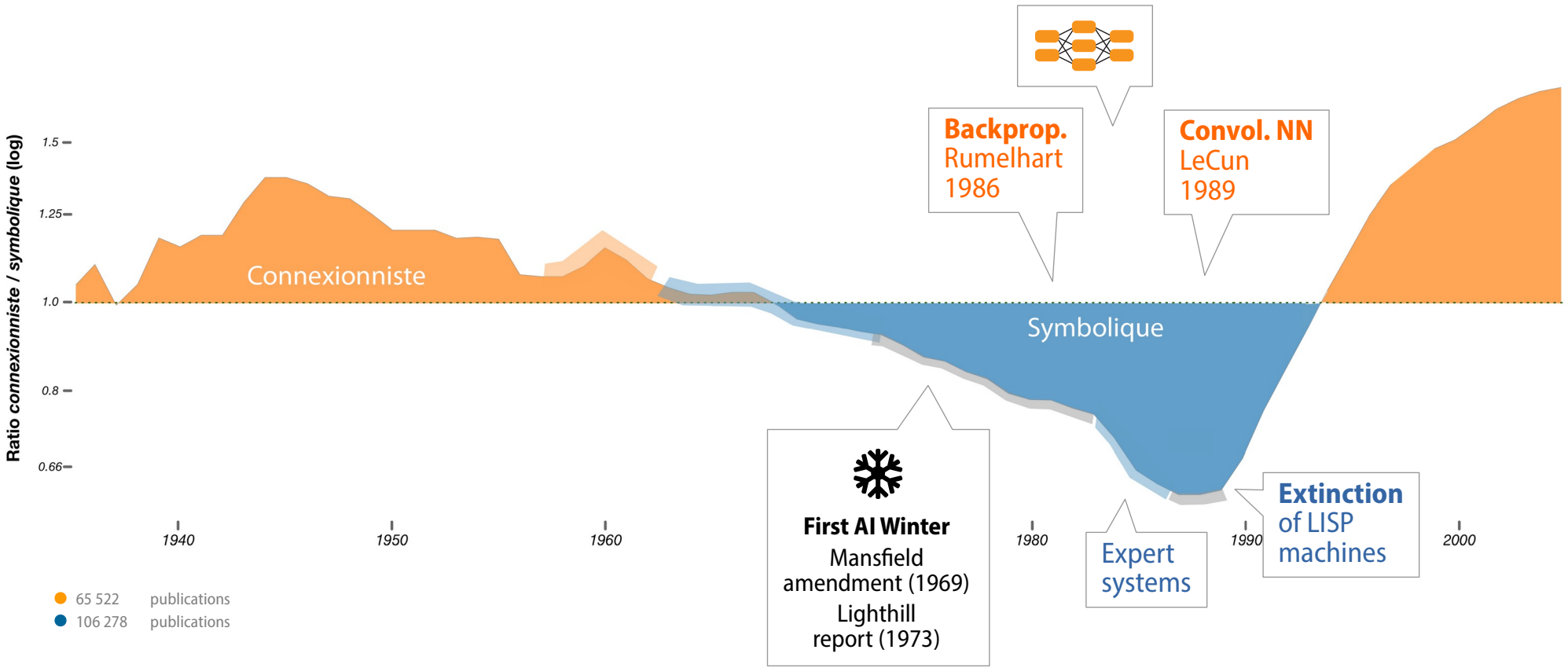
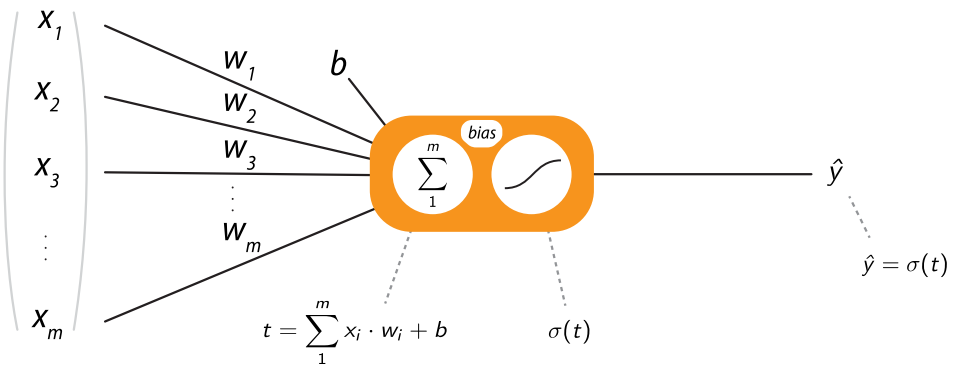
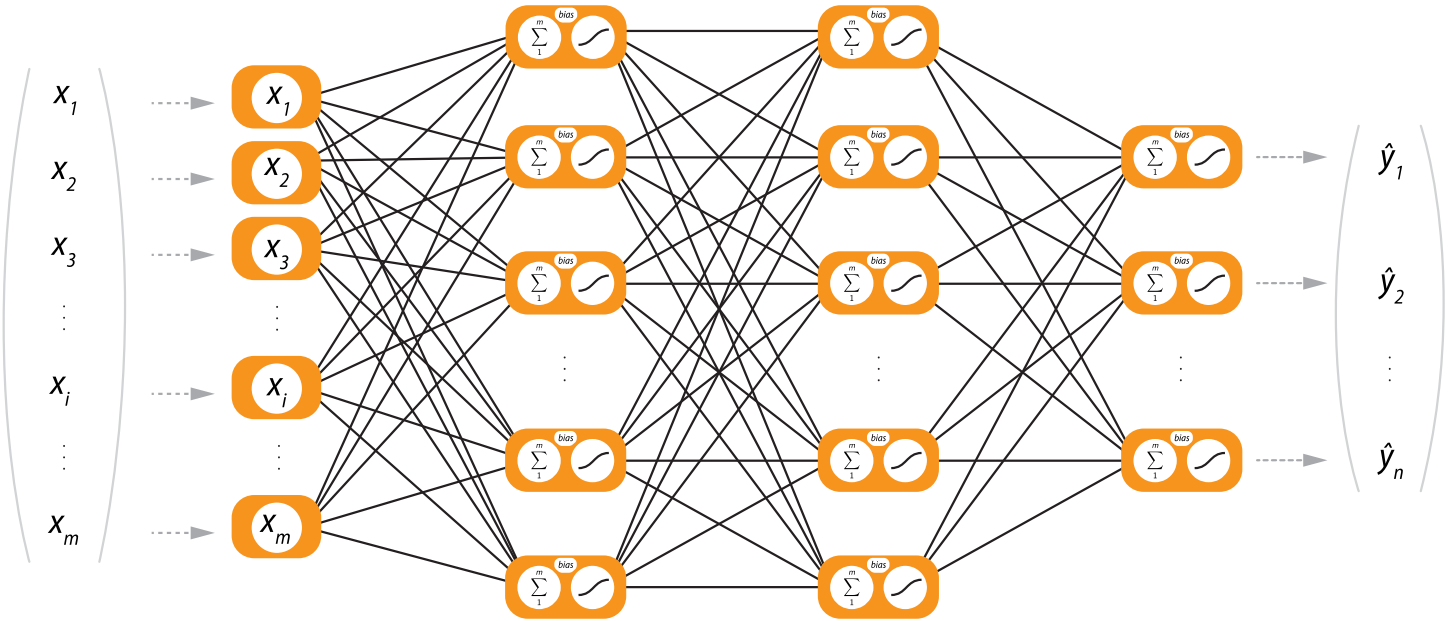


[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

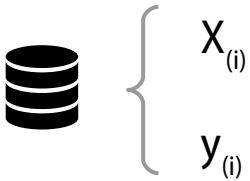
Deep Neural Networks



Deep Neural Networks



Deep Neural Networks



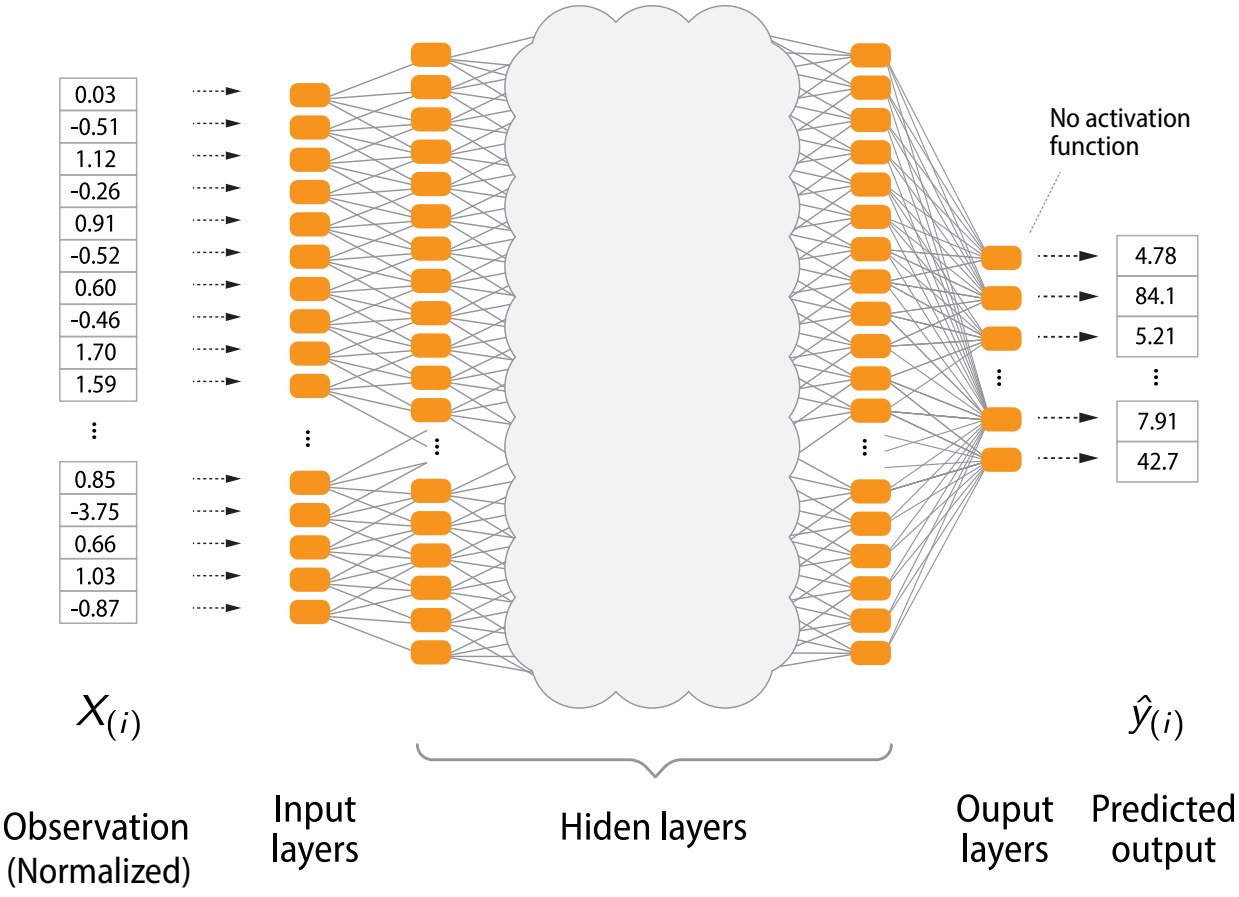
$X_{(i)}$

$y_{(i)}$

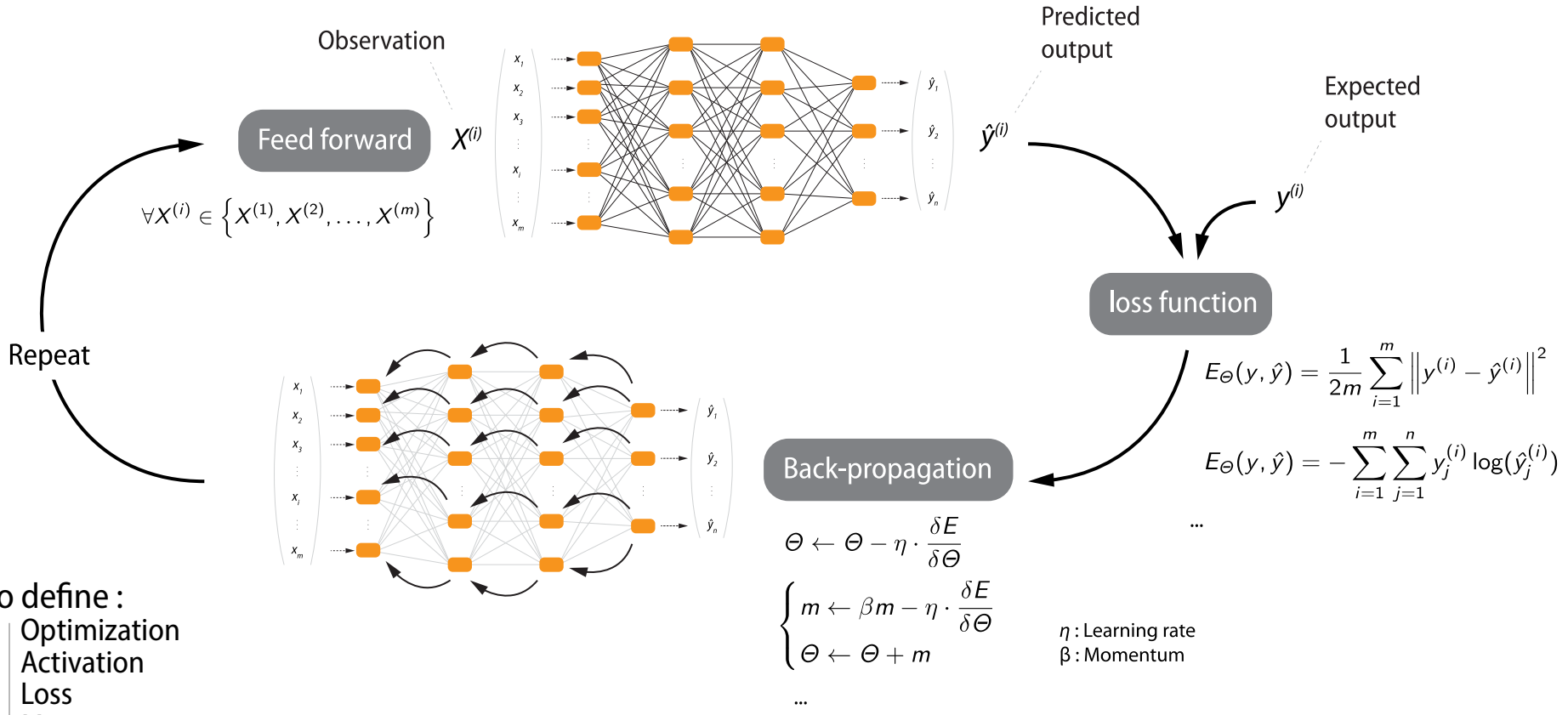
Train set

$X_{(i)}$: Observations

$y_{(i)}$: Expected output

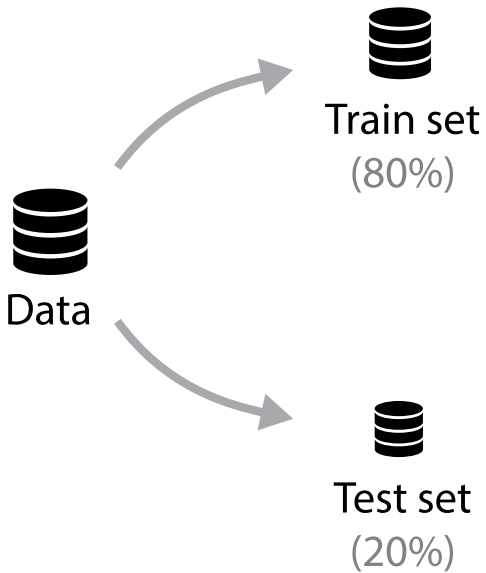


Back-propagation

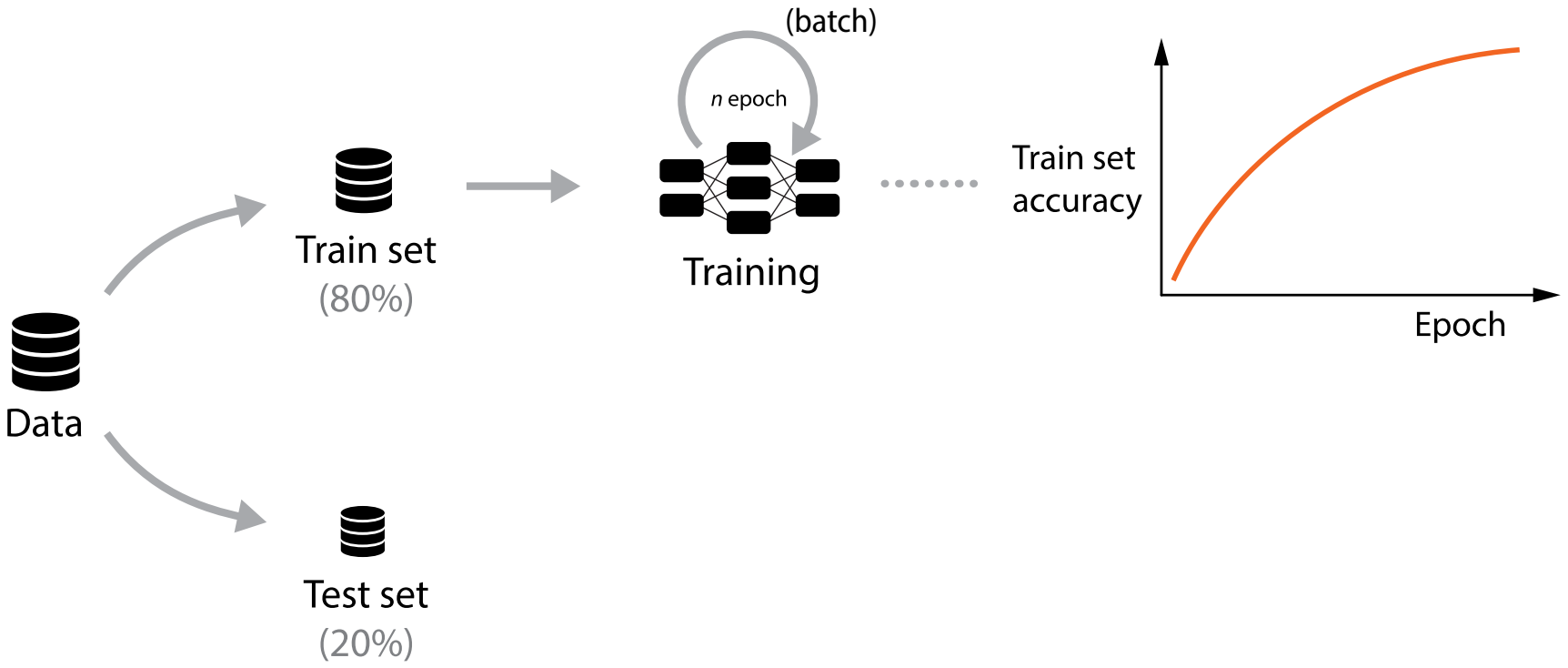


To define :
- Optimization
- Activation
- Loss
- Metrics
- ...

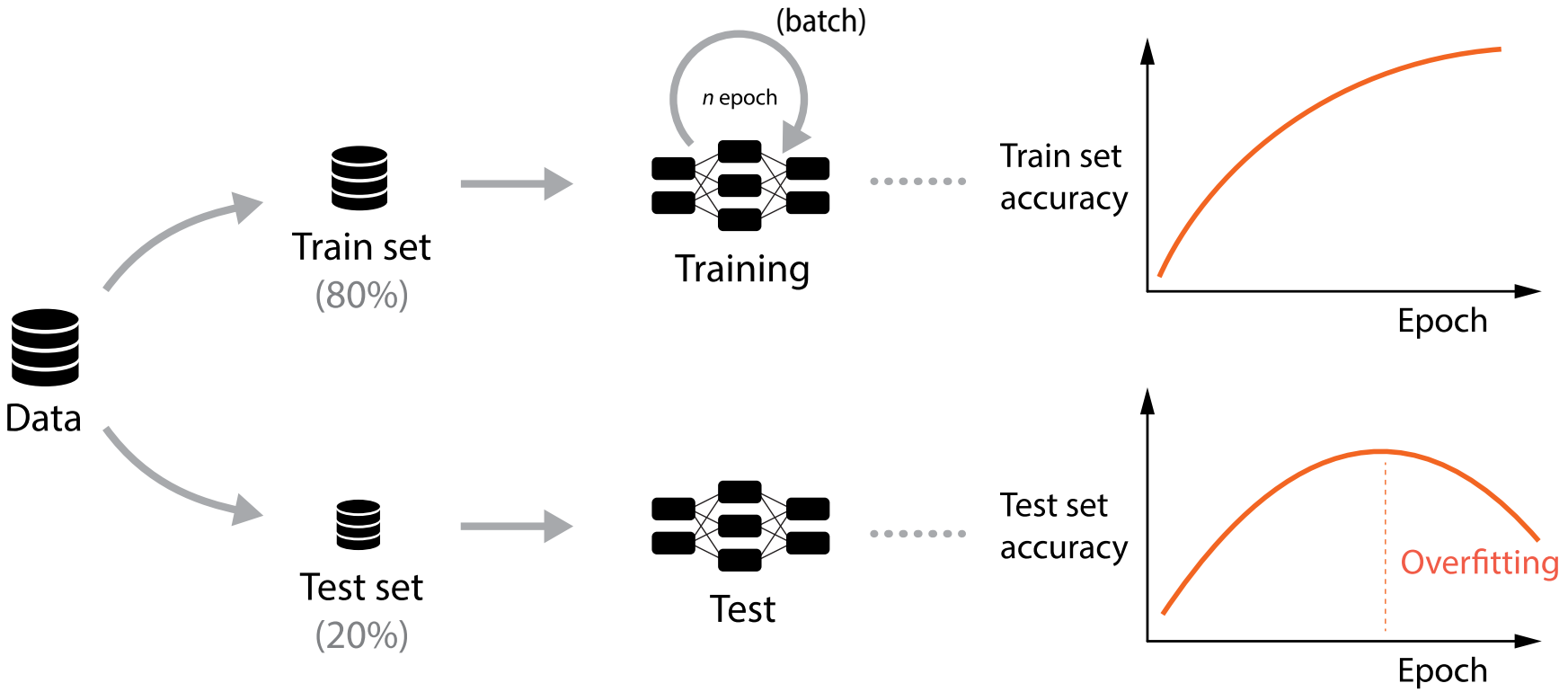
Training process - general



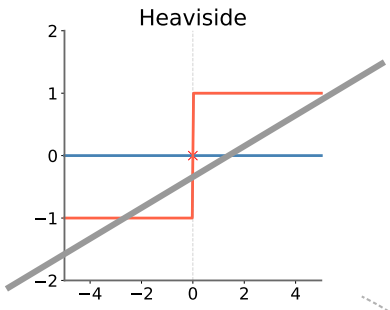
Training process - general



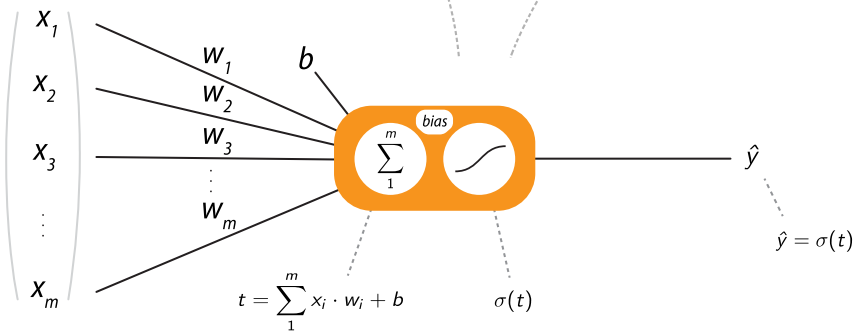
Training process - general



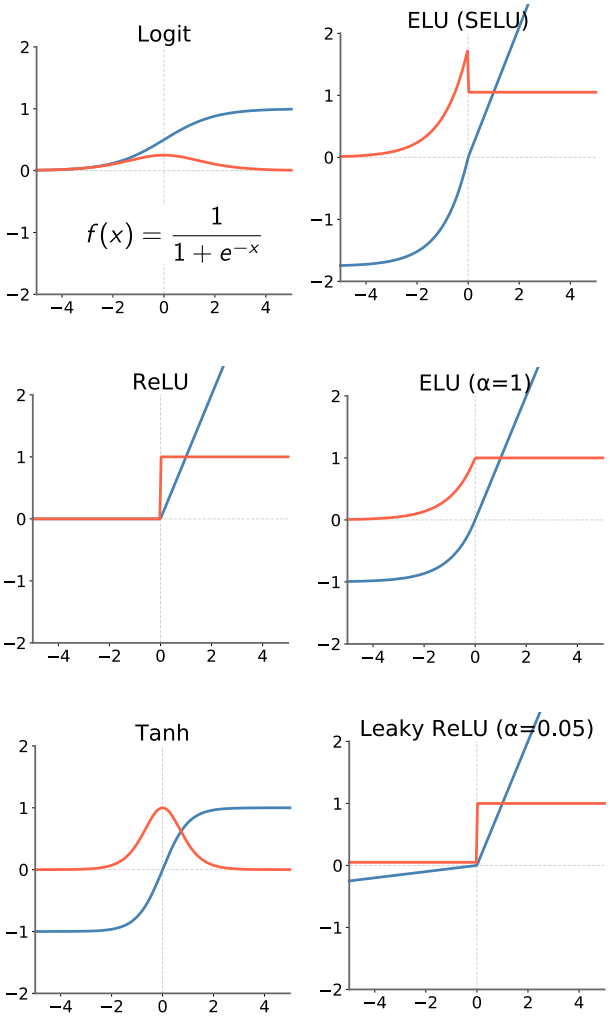
Deep Neural Networks



1958



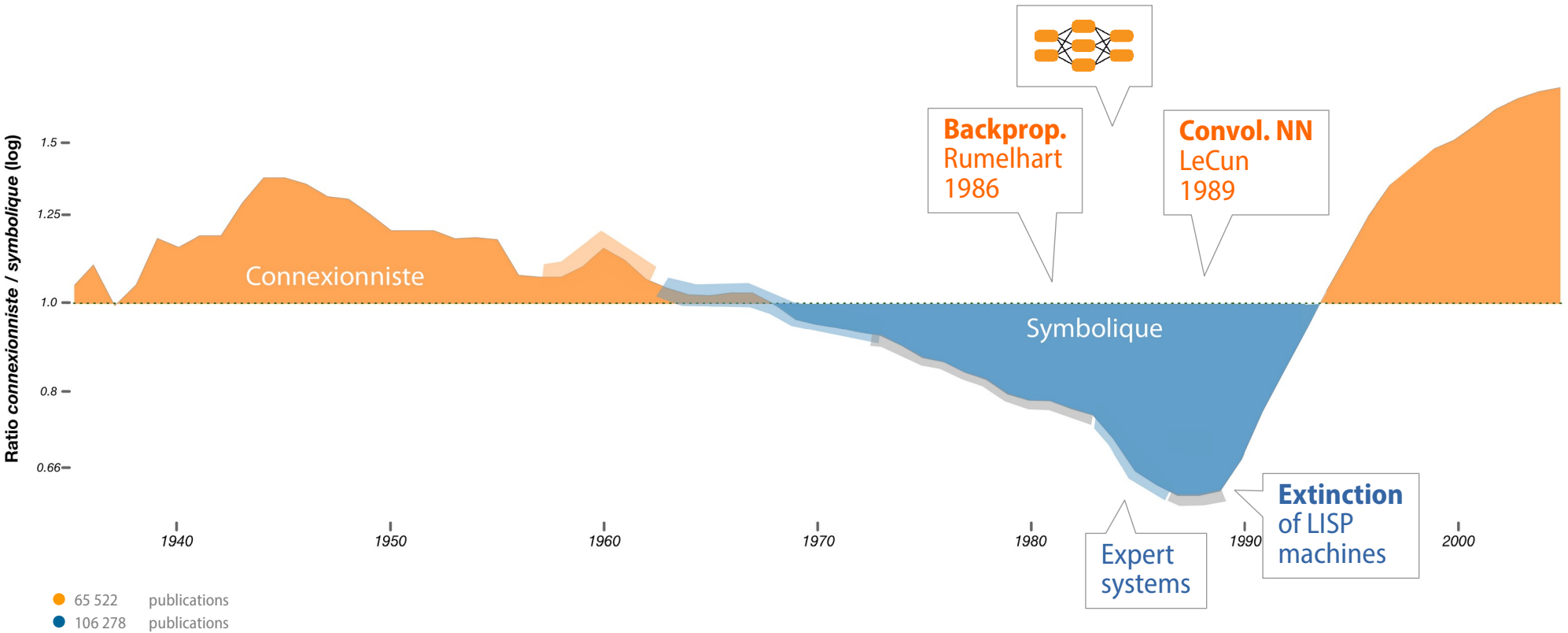
Input X | **Bias / Weight** Θ | **Activation function** $\sigma(t)$ | **Output** $\hat{y}$



Notebook : FIDLE

The big Controversy

Evolution of the academic influence of connexionist and symbolic approaches[1]



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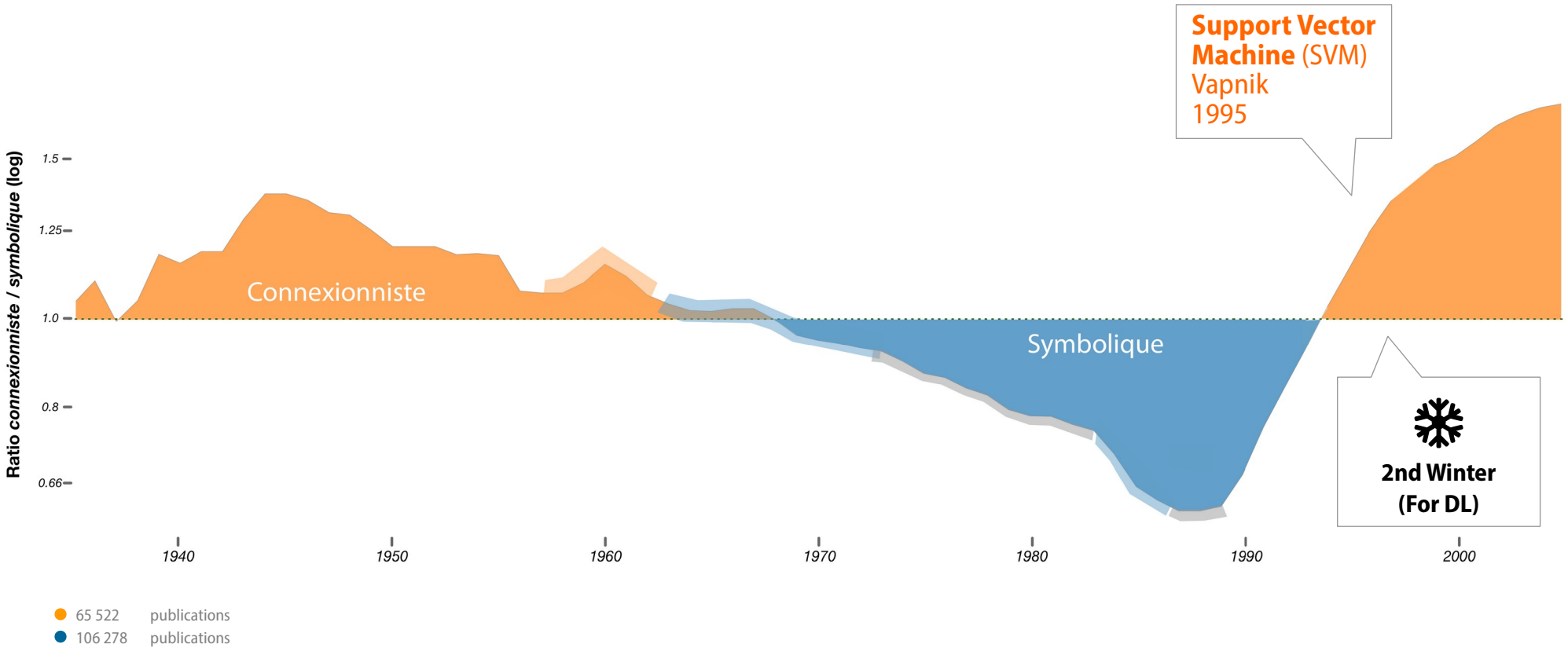
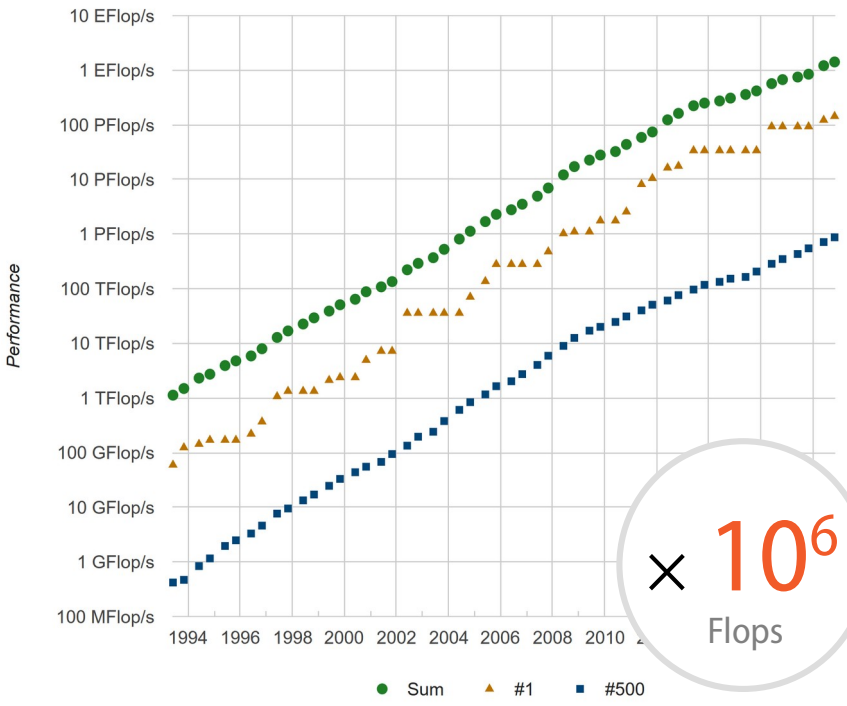


[1] D Cardon, JP Cointet, A Mazieres, 2018 [LRDN]

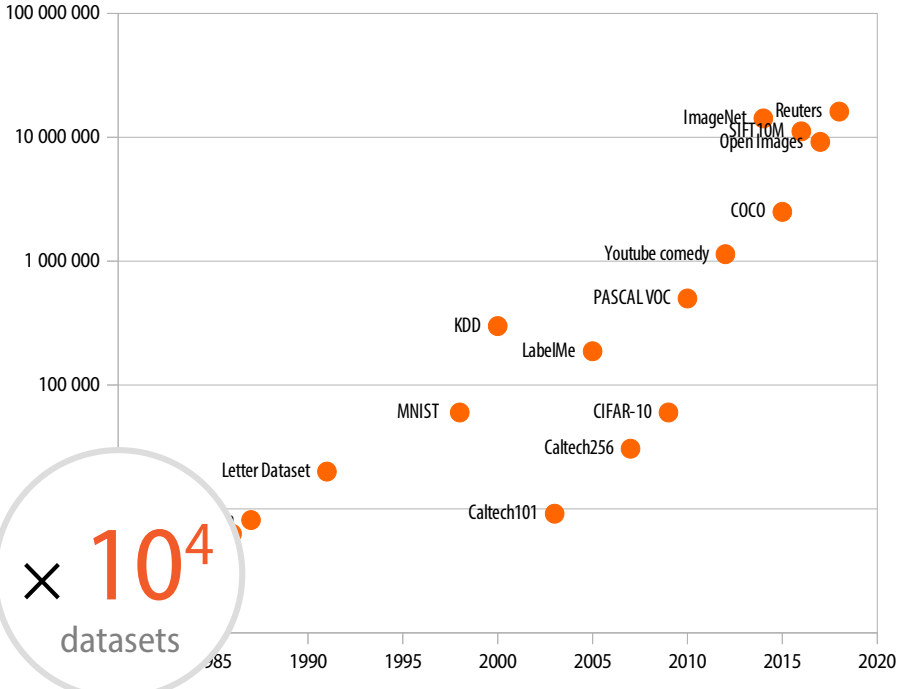
The big Controversy

Performance Development[1]



× 10^6 Flops

Datasets for machine-learning[2]



× 10^4 datasets

25 ans

Laboratoire
Cas particulier

→

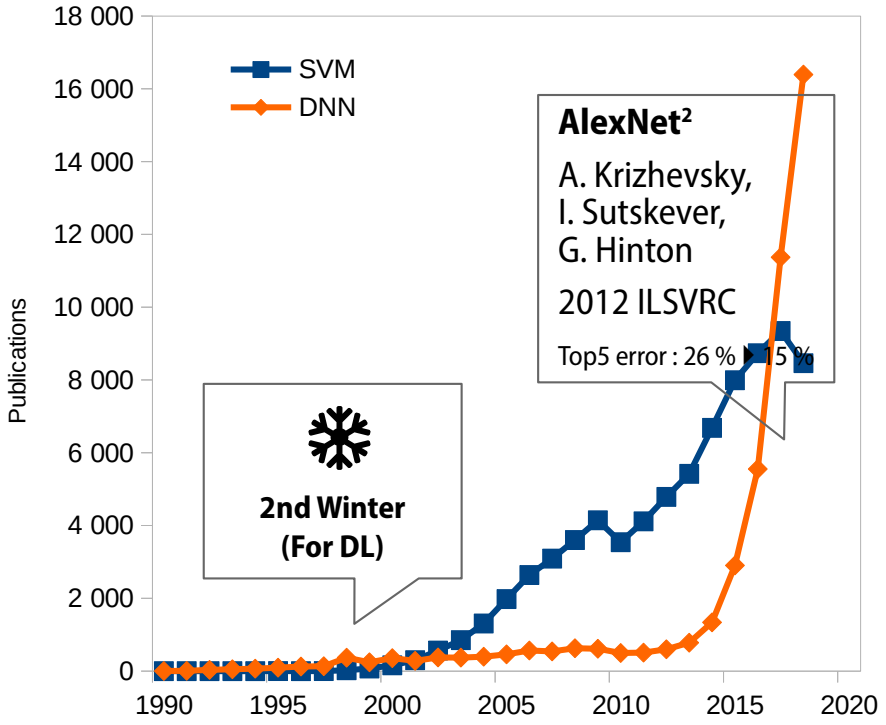
Monde réel

[1] TOP500 List [TOP500]

[2] Wikipedia [WKP1]

The big Controversy

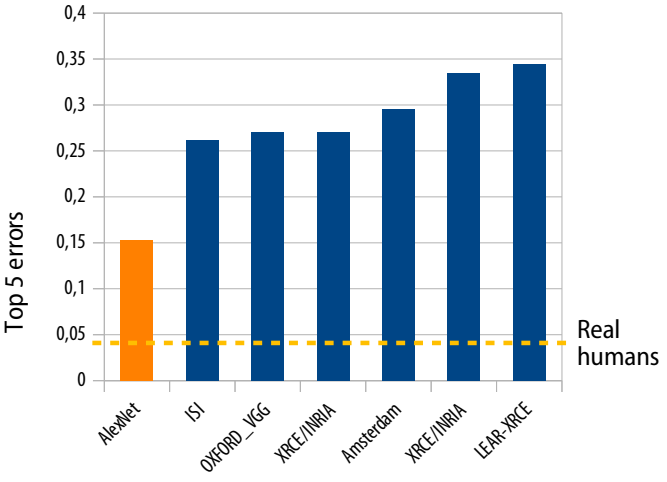
Publications SVM vs DNN[1]



Images classification
Top 5 error at ILSVRC 2012[3,4]

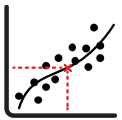
DNN

Real human



Without mathematical guarantee, DNN have proven to be more effective in the face of the complexity of the real world !

[1] Web of Science [WOS1][WOS2]
[2] AlexNet [ALEX]
[3] ImageNet Large Scale Visual Recognition [ILSVRC]
[4] Similar evolution in Natural language processing, translation, board games, etc. See : DeepL.com, AlphaGo, AlphaZero, ...

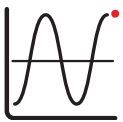


Basic Regression
DNN

Basic Classification
DNN

Hight Dimensionnal Data
(images, …)
CNN

Sparse data
(text, …)
Embedding



Sequences data
(Time data, ...)
RNN

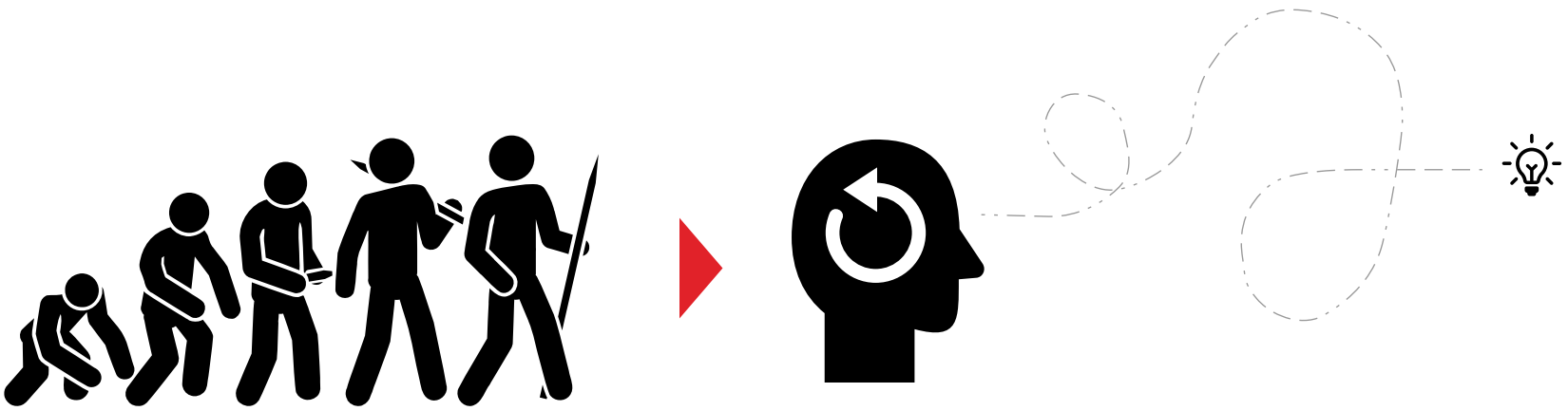
Reinforcement
learning

Variational Antoencoder
VAE

Generative Adversarial Network
GAN

• • •

Change



Change in the apprehension of problems, tools and techniques

Generational fracture
Infrastructure adaptation
Competences development
...and major societal impacts
...

Find out more :

T8

Ateliers à venir

Formation Introduction au Deep Learning

Formation Permanente CNRS – GRICAD – IDRIS, Fidle.Contact@grenoble.cnrs.fr
Soraya ARIAS – INRIA
Eric MALDONADO – INRAE
Jean-Luc PAROUTY – SIMaP


Thanks !
FIDLE

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[AMAZ] Antoine Mazieres (2016) Thèse : « Cartographie de l'apprentissage artificiel et de ses algorithmes » Université Paris 7 Denis Diderot, <hal-01771655>

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[WKP1] Wikipedia/en. (2018) « List of datasets for machine-learning research ». https://en.wikipedia.org

[WOS1] Core database : TS=("support vector machine*" OR ("SVM" AND "classification") OR ("SVM" AND "regression") OR ("SVM" AND "classifier") OR "support vector network*" OR ("SVM" AND "kernel trick*"))

[WOS2] Core database : TS=("deep learning" OR "deep neural network*" OR ("DNN" AND "neural network*") OR "convolutional neural network*" OR ("CNN" AND "neural network*") OR "recurrent neural network*" OR ("LSTM" AND "neural network*") OR ("RNN*" AND "neural network*"))

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[AIDEX] AI Index. « A starting point for informed conversations about progress in artificial intelligence. The report aggregates a diverse set of metrics, and makes the underlying data easily accessible to the general public ». https://aiindex.org

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[CNIL2] Reconnaissance faciale : pour un débat à la hauteur des enjeux 15 novembre 2019 https://www.cnil.fr/fr/reconnaissance-faciale-pour-un-debat-la-hauteur-des-enjeux

Illustrations

[POTATO]	From *Die Giftpflanzen Deutschlands,* Peter Esser, 1910, via iconspng.com
[CONVO]	An Introduction to different Types of Convolutions in Deep Learning https://towardsdatascience.com/types-of-convolutions-in-deep-learning-717013397f4d
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