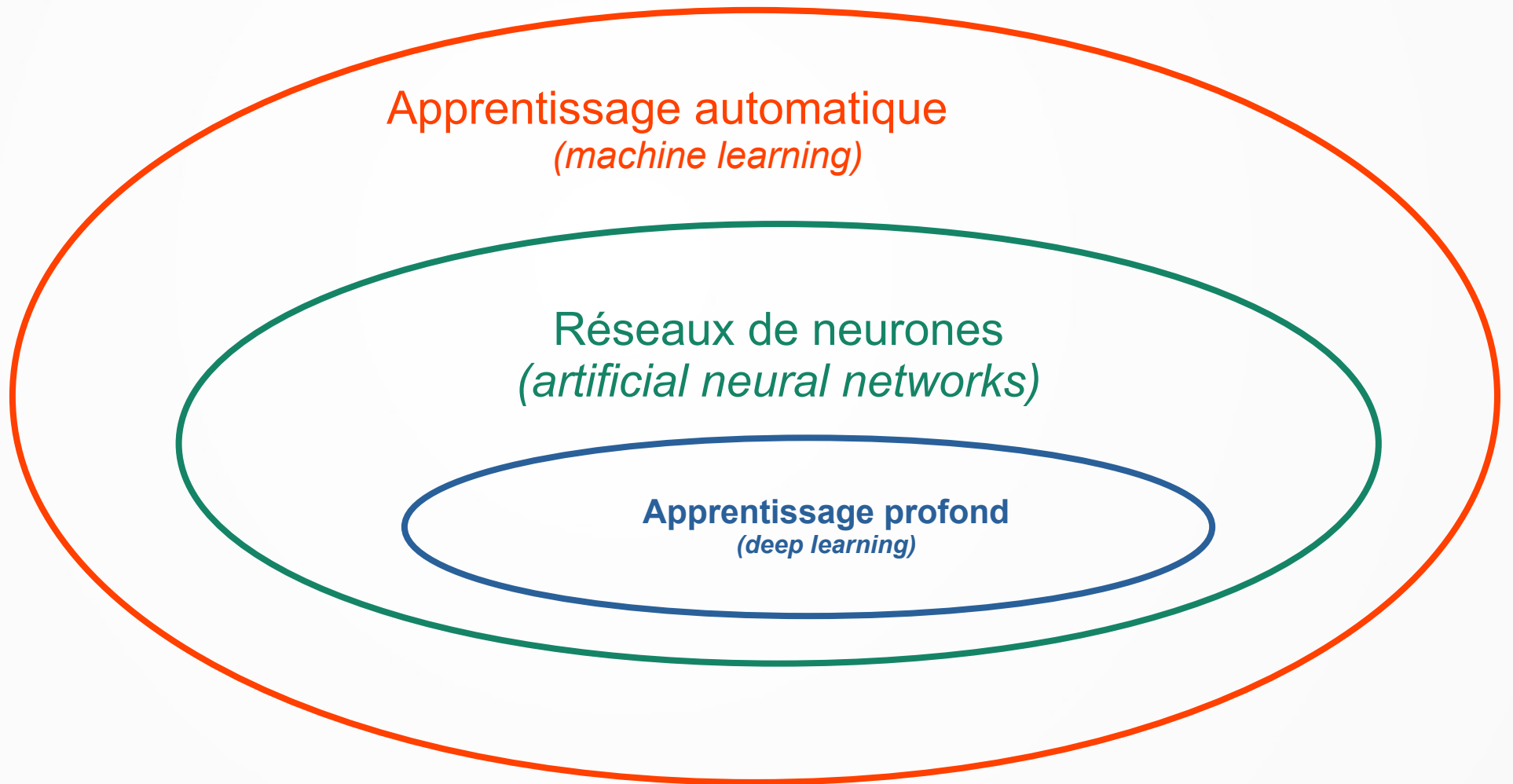
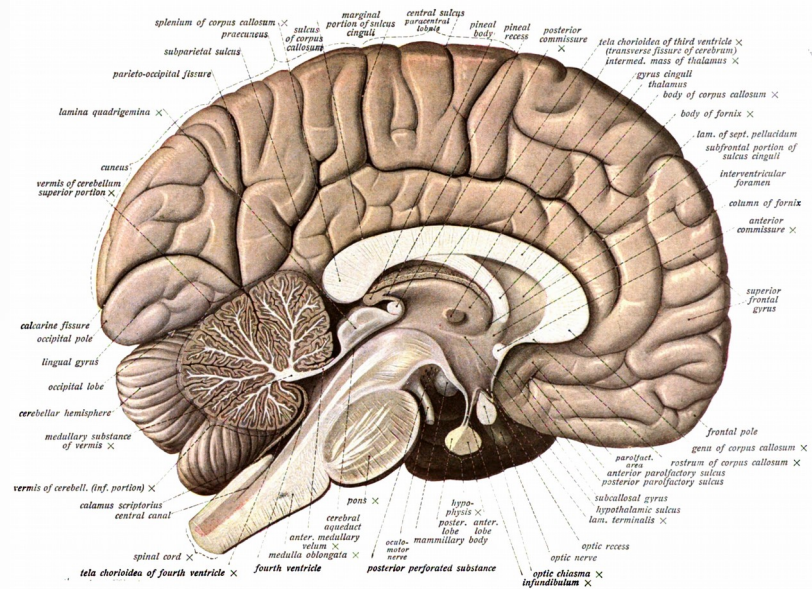


Réseau de neurones artificiels et apprentissage profond

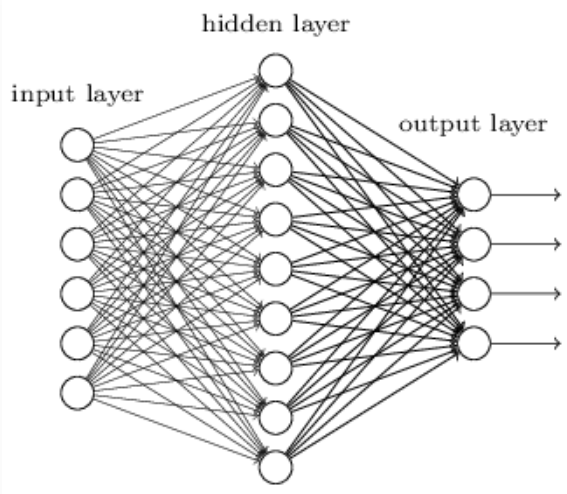
Pascal Germain
Inria Lille - Nord Europe
Équipe-projet Modal

IA : Intelligence artificielle
(AI : Artificial intelligence)

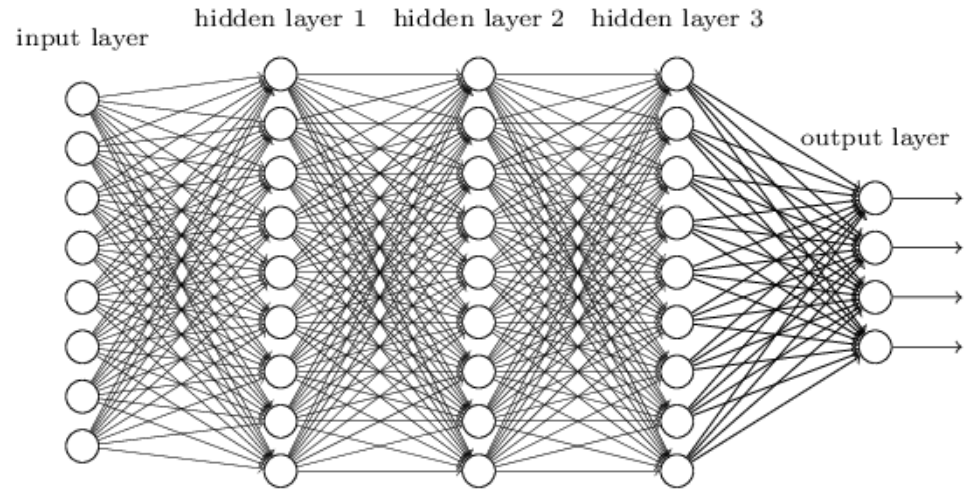




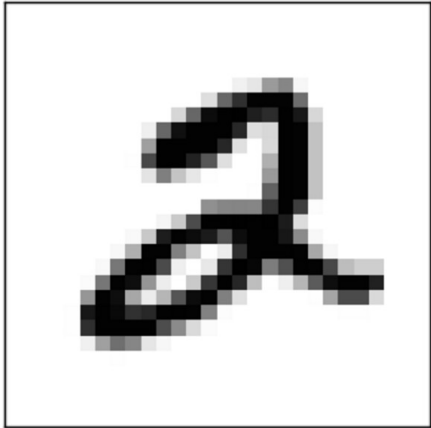
"Non-deep" feedforward neural network



Deep neural network



Source:
<https://stats.stackexchange.com>

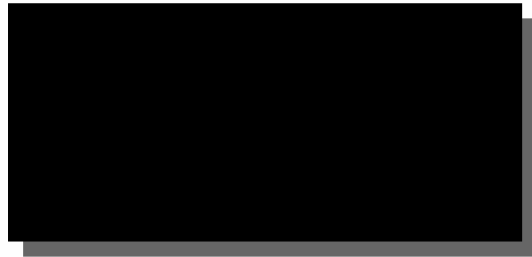


« 2 »

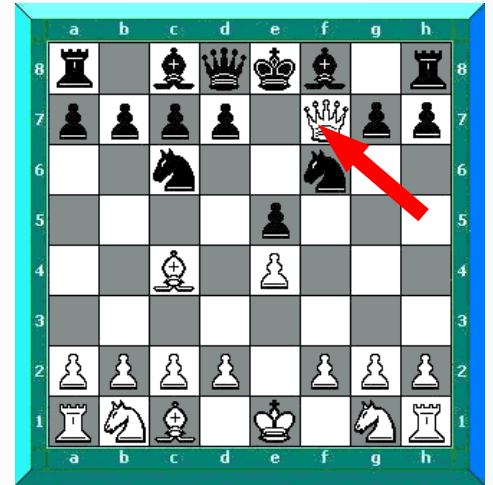
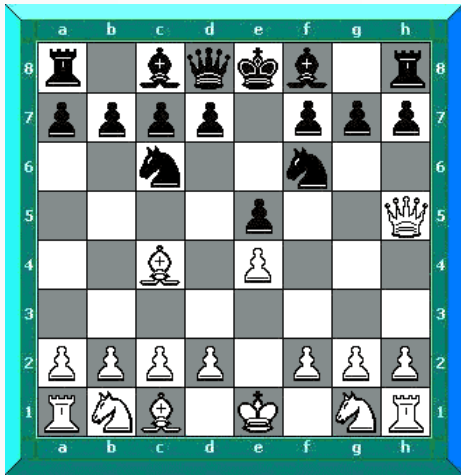


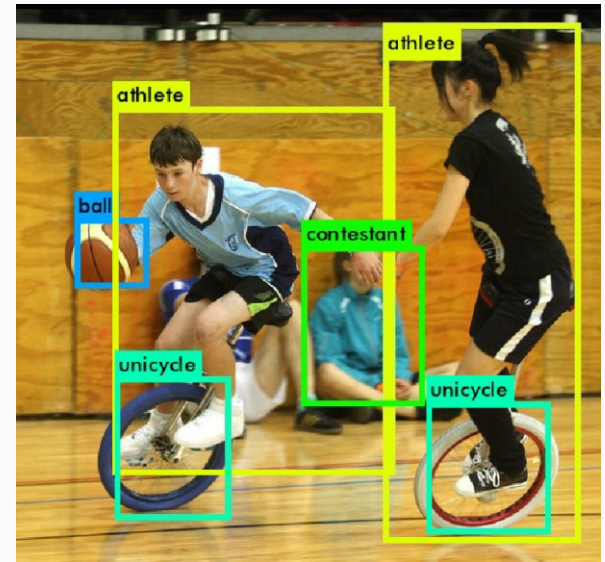
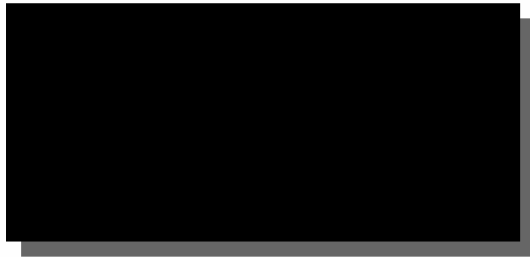
« banane »

« It is a banana. »



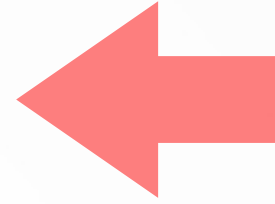
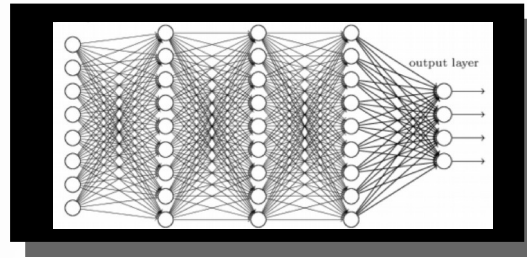
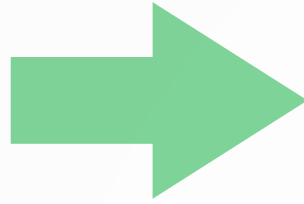
« C'est une banane. »





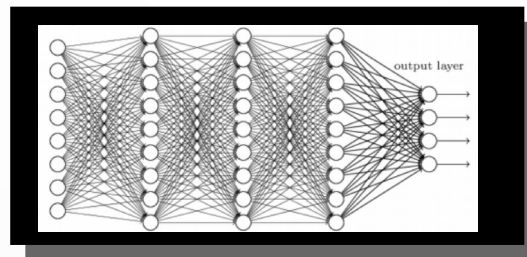
Phase d'apprentissage

0000000000000000
1111111111111111
2222222222222222
3333333333333333
4444444444444444
5555555555555555
6666666666666666
7777777777777777
8888888888888888
9999999999999999



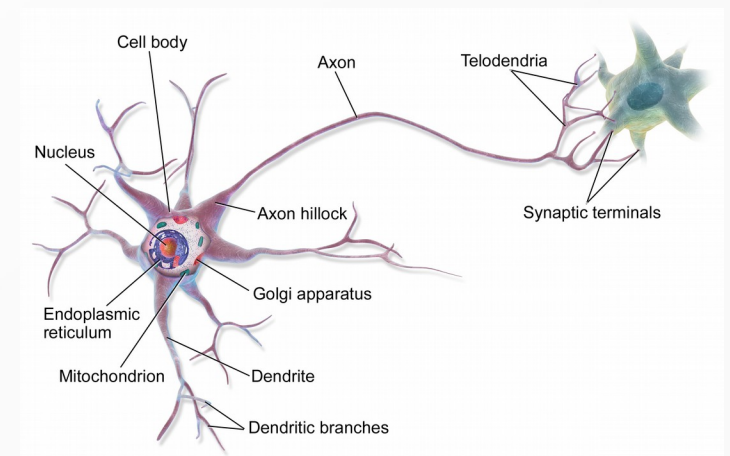
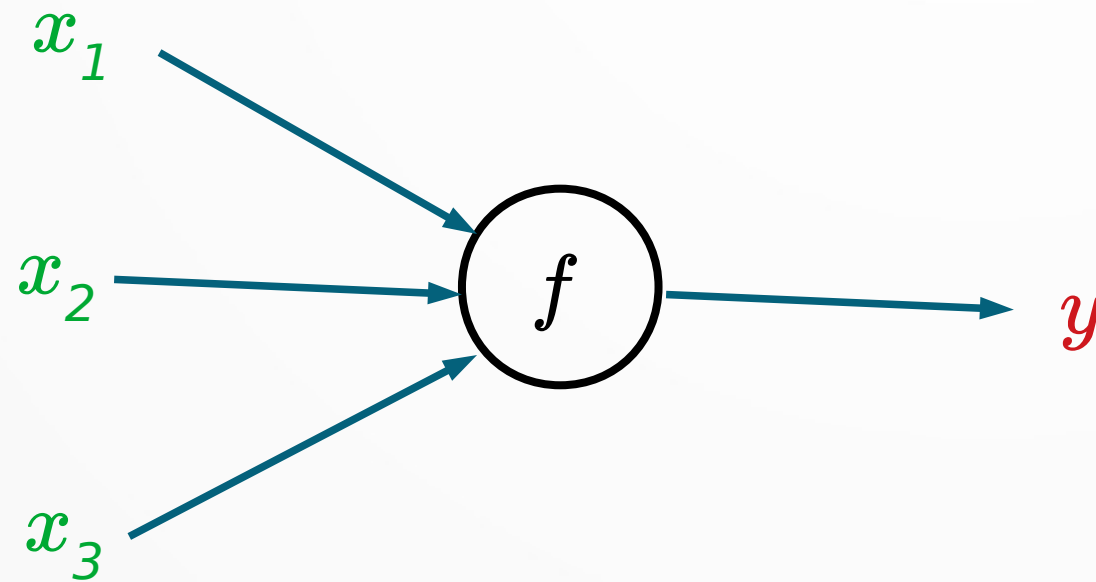
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Phase de prédiction

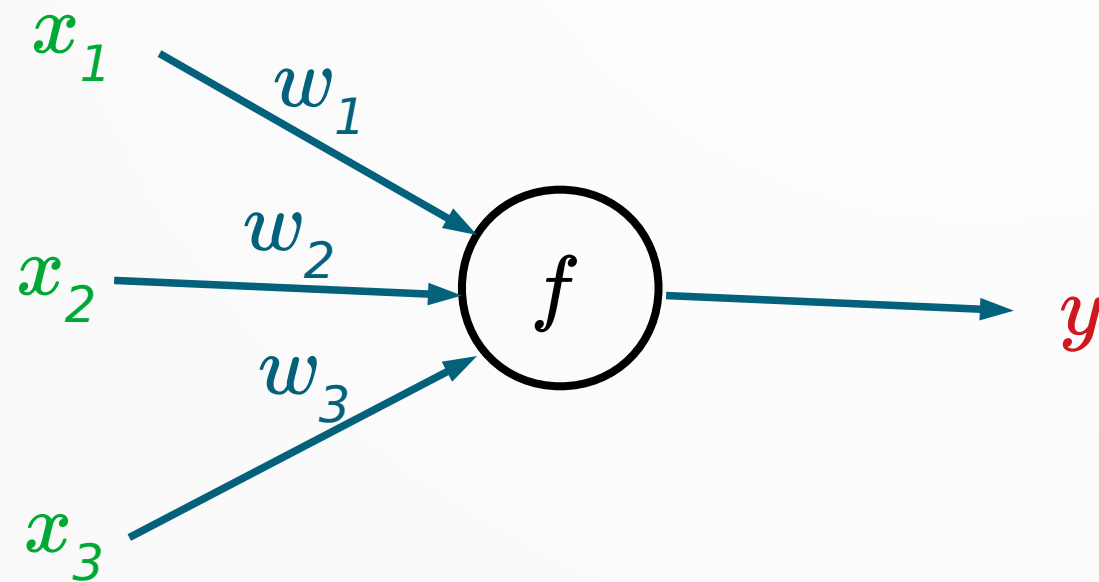
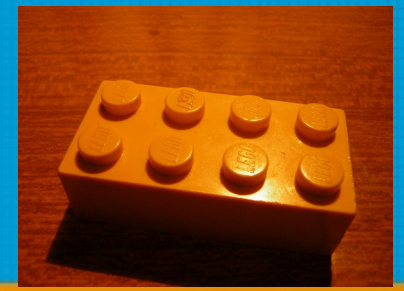


« 2 »

La neurone artificielle

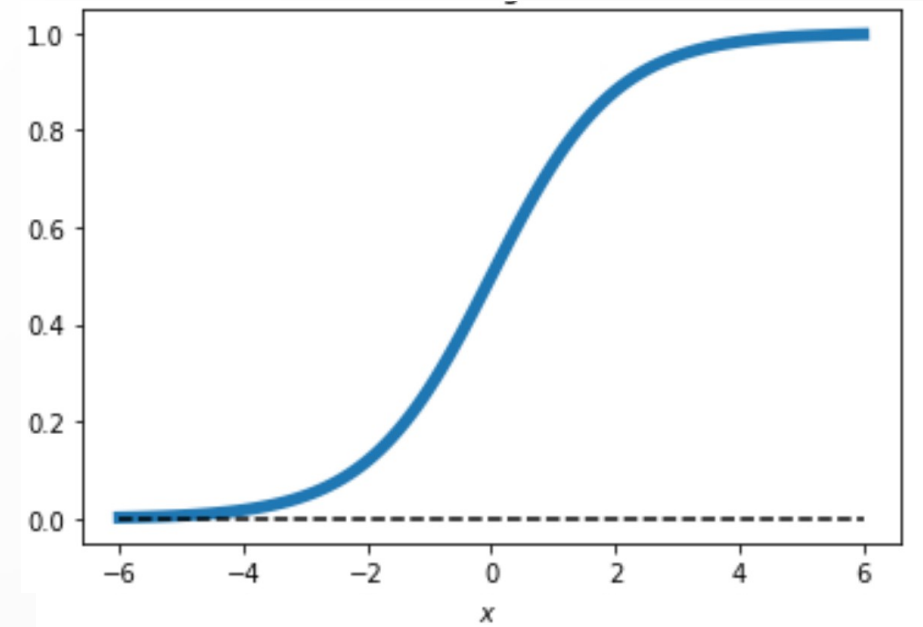
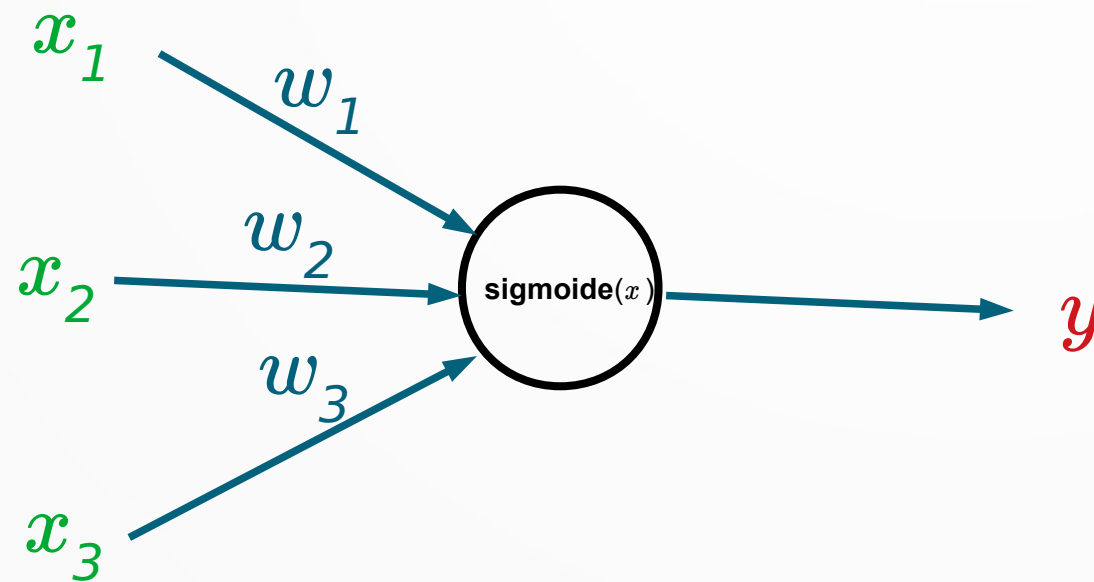


La neurone artificielle



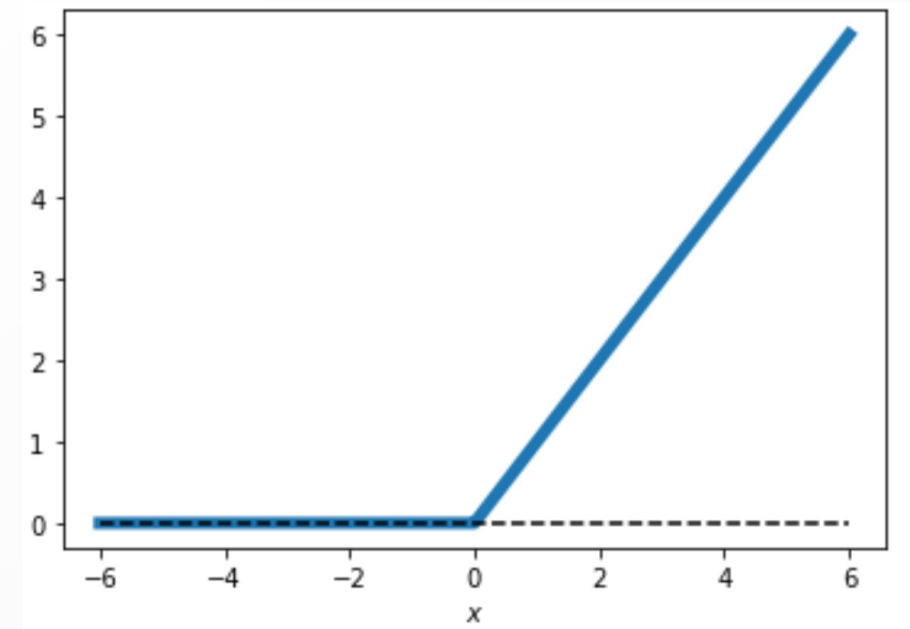
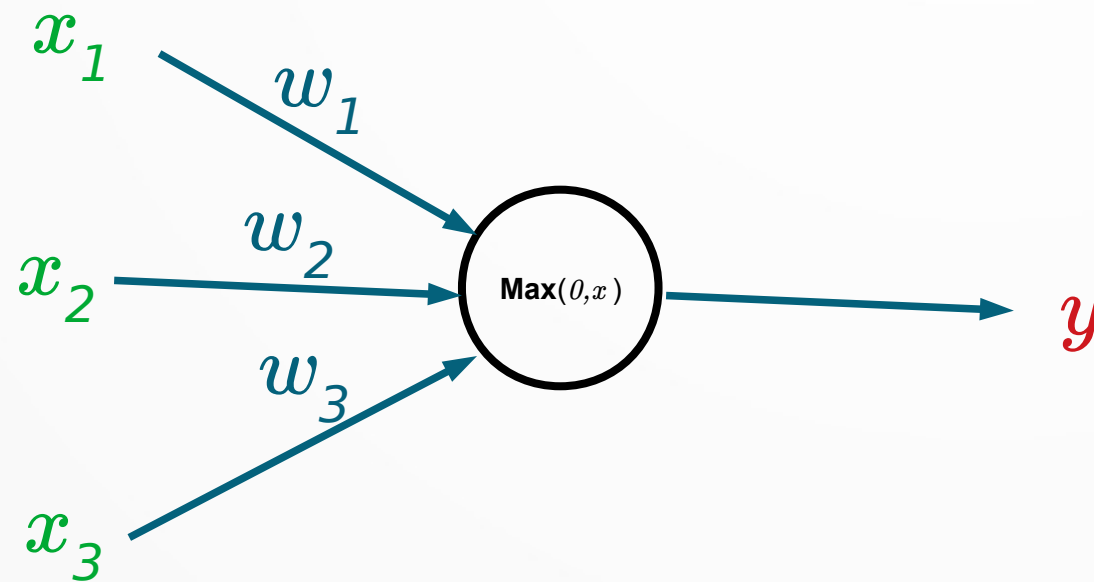
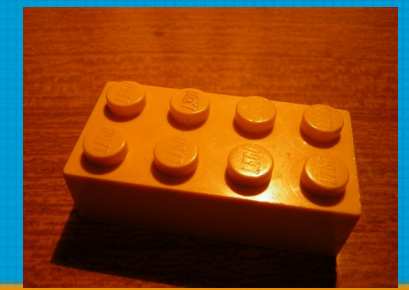
$$f(w_1x_1 + w_2x_2 + w_3x_3 + \dots) = y$$

La neurone artificielle



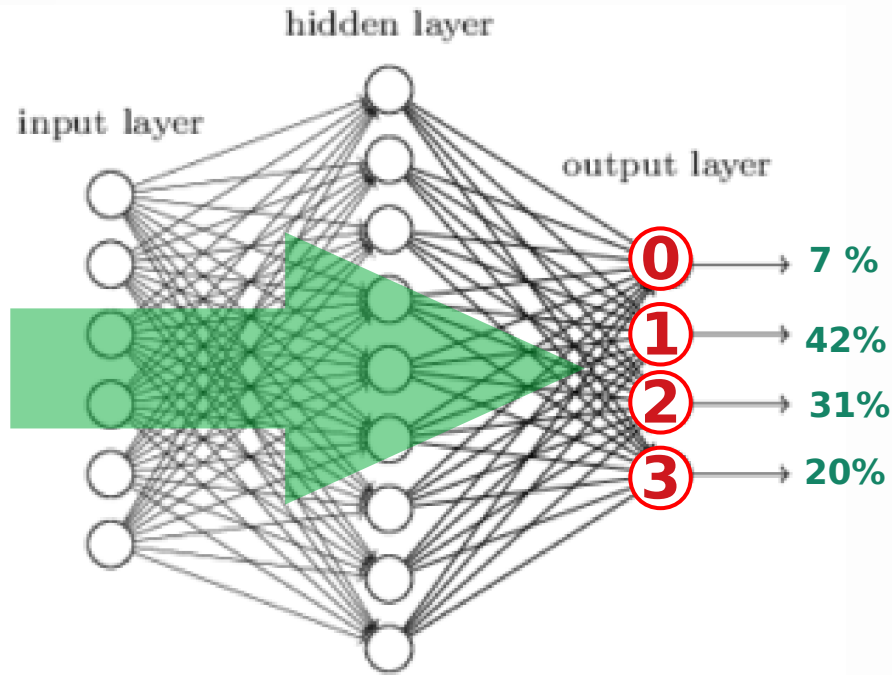
$$\text{sigmoide}(w_1x_1 + w_2x_2 + w_3x_3 + \dots) = y$$

La neurone artificielle



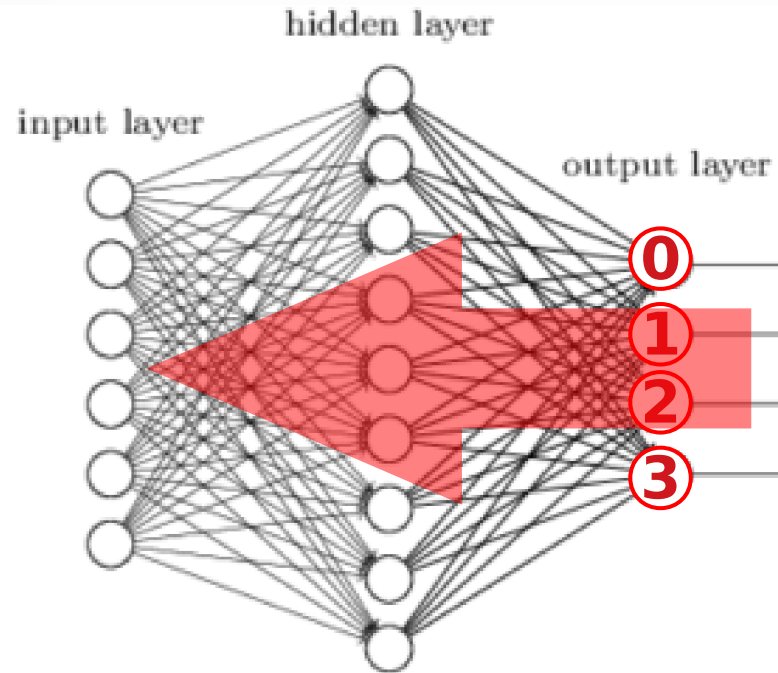
$$\text{Maximum}(0, w_1x_1 + w_2x_2 + w_3x_3 + \dots) = y$$

0 0 0 0 0 0 0 0 0 0 0 0
 1 1 1 1 1 1 1 1 1 1 1 1
 2 2 2 2 2 2 2 2 2 2 2 2
 3 3 3 3 3 3 3 3 3 3 3 3
 4 4 4 4 4 4 4 4 4 4 4 4
 5 5 5 5 5 5 5 5 5 5 5 5
 6 6 6 6 6 6 6 6 6 6 6 6
 7 7 7 7 7 7 7 7 7 7 7 7
 8 8 8 8 8 8 8 8 8 8 8 8
 9 9 9 9 9 9 9 9 9 9 9 9



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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
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7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
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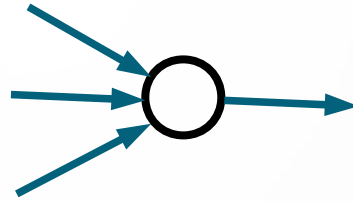


0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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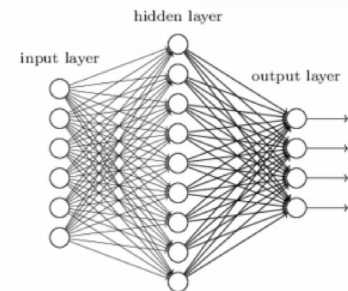
0	→	55 %	100 %
1	→	3 %	0 %
2	→	3 %	0 %
3	→	39 %	0 %

Intermède historique

- 1950-1960: Perceptron (le neurone)

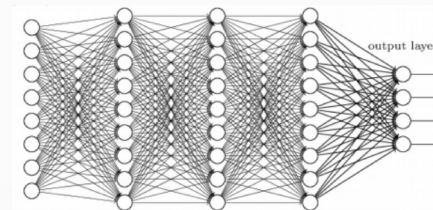


- 1980-1990: Réseau de neurones à deux couches



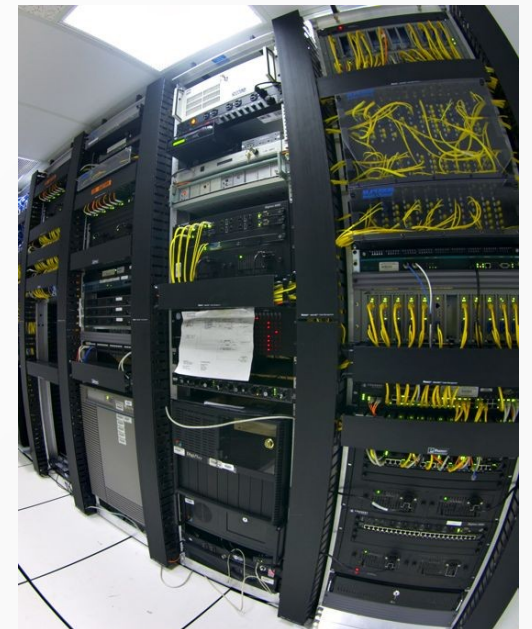
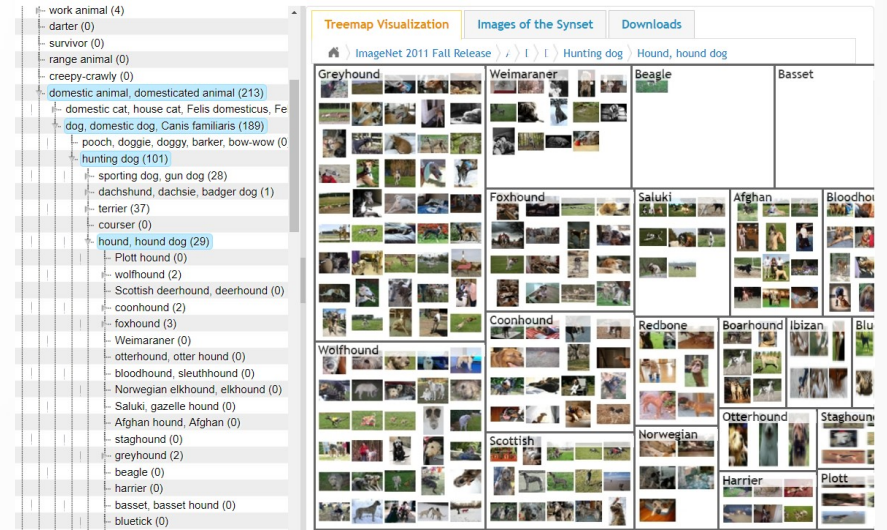
- 1995-2005: *L'hiver des réseaux de neurones*

- 2006 - : Réseaux de neurones profonds

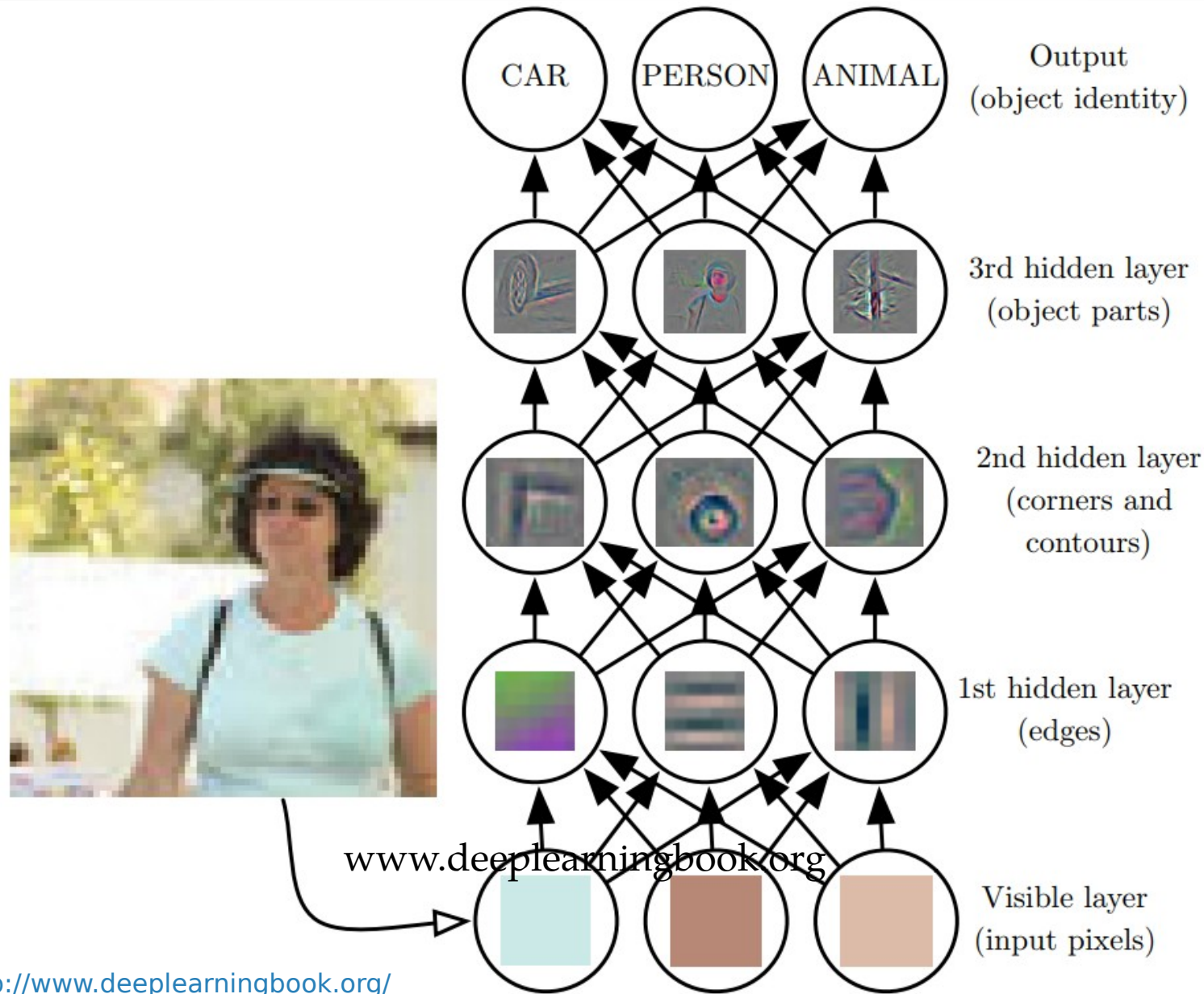


La renaissance

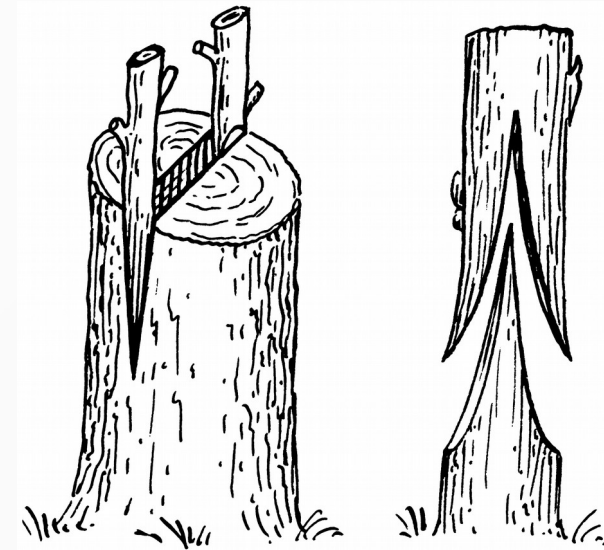
- Recherche scientifique
- Grand jeux de données
- Puissance de calcul
- Intérêt des grandes industries
(Google, Facebook, Amazon, Microsoft, ...)



Apprentissage de représentations



Bouturage



La nouvelle technologie ? permet les crypto-monnaies

← T = 3 →

← T = 3 →

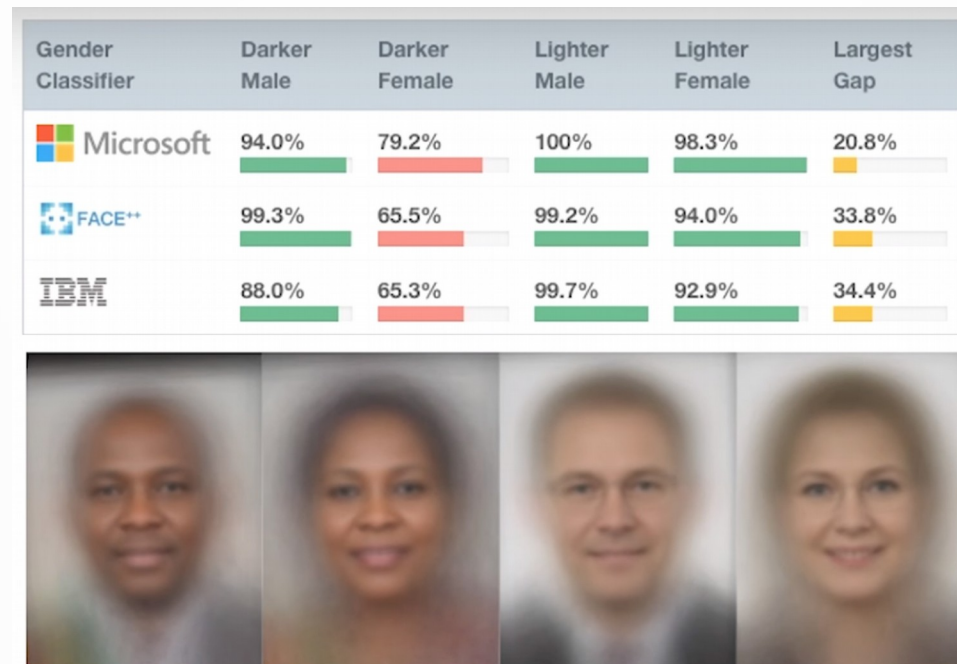
France - Paris + Italie = Rome

Relationship	Example 1	Example 2	Example 3
France - Paris	Italy: Rome	Japan: Tokyo	Florida: Tallahassee
big - bigger	small: larger	cold: colder	quick: quicker
Miami - Florida	Baltimore: Maryland	Dallas: Texas	Kona: Hawaii
Einstein - scientist	Messi: midfielder	Mozart: violinist	Picasso: painter
Sarkozy - France	Berlusconi: Italy	Merkel: Germany	Koizumi: Japan
copper - Cu	zinc: Zn	gold: Au	uranium: plutonium
Berlusconi - Silvio	Sarkozy: Nicolas	Putin: Medvedev	Obama: Barack
Microsoft - Windows	Google: Android	IBM: Linux	Apple: iPhone
Microsoft - Ballmer	Google: Yahoo	IBM: McNealy	Apple: Jobs
Japan - sushi	Germany: bratwurst	France: tapas	USA: pizza

Source : Mikolov et al., Efficient Estimation of Word Representations in Vector Space, 2013

Attention aux biais

Homme – Programmeur + Femme = Ménagère



En terminant...

- Le domaine progresse très rapidement !
- Actuelles forces des réseaux de neurones :
 - Succès empiriques impressionnants
(images, vidéos, reconnaissance de la parole, traduction, ...)
 - Flexibilité
 - Permet le transfert d'une tâche à une autre («bouturage»)
- Actuelles faiblesses des réseaux de neurones :
 - Demande beaucoup de « bidouillage »
 - Requièrent de grandes bases d'apprentissage
 - Difficilement interprétables

Démo

The screenshot shows the TensorFlow Playground interface. At the top, there are controls for Epoch (000,060), Learning rate (0.03), Activation (ReLU), Regularization (None), Regularization rate (0), and Problem type (Classification). Below this, the interface is divided into several sections:

- DATA:** Includes a selection of datasets, a slider for the ratio of training to test data (set to 50%), a slider for noise (set to 0), and a slider for batch size (set to 10). A "REGENERATE" button is also present.
- FEATURES:** Lists input features: X^1 , X^2 , X^{12} , X^{22} , X^1X^2 , $\sin(X^1)$, and $\sin(X^2)$.
- 3 HIDDEN LAYERS:** A diagram showing three layers of neurons. The first hidden layer has 3 neurons, the second has 2 neurons, and the third has 2 neurons. Lines of varying thickness connect neurons between layers, representing weights. A tooltip indicates: "The outputs are mixed with varying weights, shown by the thickness of the lines." Another tooltip points to a single neuron: "This is the output from one neuron. Hover to see it larger."
- OUTPUT:** Displays a scatter plot of data points on a 2D plane (x and y axes from -6 to 6). The plot shows a clear separation between two classes (blue and orange). A legend indicates: "Colors shows data, neuron and weight values." There are also checkboxes for "Show test data" and "Discretize output".

Loss values are shown: Test loss 0.009 and Training loss 0.007. A small line graph above the scatter plot shows the training loss decreasing over time.

<https://playground.tensorflow.org/>