

机器会学习吗?



机器会判断,会下棋



机器会目标跟踪, 会打球



机器会避障, 会抓取东西



机器会人类语言, 会交流

机器学习



阿瑟·萨缪尔 (Arthur Samuel, 1901-1990)

"机器学习之父",研制的西洋跳棋程序是最早在计算机上执行 非数值计算任务的程序之一,也是世界上第一个具有自学习功 能的游戏程序并战胜了人类棋手,这一成果论证了"计算机可 以完成事先没有显示编程好的任务"

https://en.wikipedia.org/wiki/Arthur_Samuel/

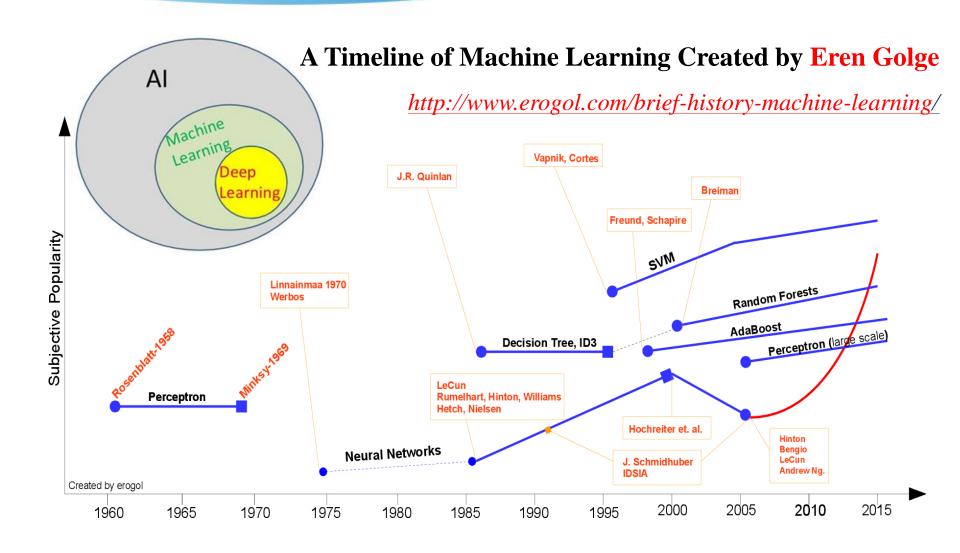


人工智能

- 20世纪50~70年代 推理期 赋予机器逻辑推理能力
- 20世纪70年代中期 知识期 专家系统,知识工程
- 学习期 从样例中学习 符号主义 ■ 20世纪80年代
- 20世纪90年代
- 21世纪初

- 学习期 从样例中学习 连接主义 神经网络
- 20世纪90年代中期 学习期 从样例中学习 统计学习 核方法
 - 学习期 从样例中学习 连接主义 深度学习

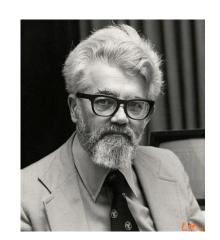
人工智能、机器学习、深度学习



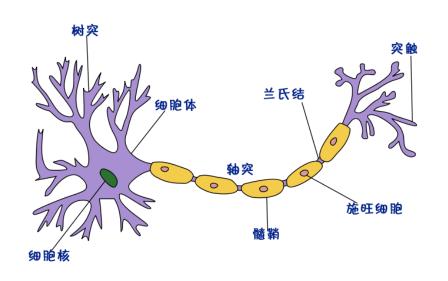
生物神经元

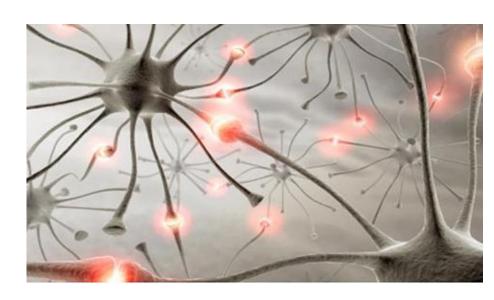
我们可以考虑通过两种途径来实现人工智能。一 是生物学方法,二是计算机科学方法。

-------约翰·麦卡锡(John McCarthy, 1927-2011)



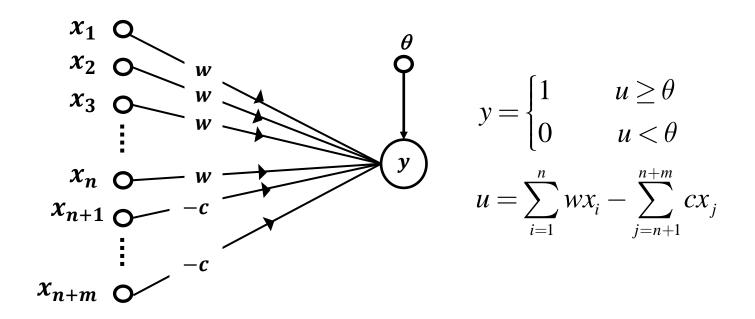
Hoffman R. G. John McCarthy: Approach to Artificial Intelligence. Computing Futures, June 1990





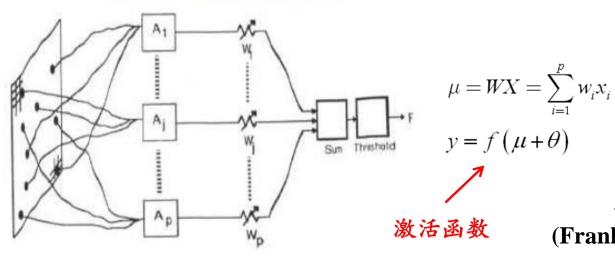
McCulloch-Pitts神经元模型

阈值为 θ 的McCulloch-Pitts神经元y的体系结构



McCulloch W. and Pitts W. A logical calculus of the ideas immanent in nervous activity. Bulletin of Mathematical Biophysics, Vol.5, pp. 115-133, 1943

感知器模型(Perceptron)





弗兰克·罗森布拉特 (Frank Rosenblatt, 1928-1971)

Rosenblatt F. The Perceptron: A probabilistic Model for information storage and organization in the brain. Psychological Review, Vol.65, pp. 386-408, 1958.



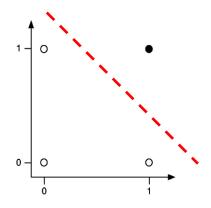
只要是单层感知器(网络),无论使用什么样的非 线性激活函数,其分类能力都一样,即只能解决线 性可分问题

-----马文·明斯基 (Marvin Minsky, 1927-2016)

异或门 (XOR Circuit)

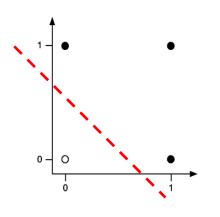
只要是单层感知器(网络),无论使用什么样的非线性激活函数,其分类能力都一样,即只能解决线性可分问题

● 类1 ○ 类2



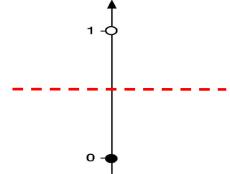
(a) 逻辑与(AND)

当且仅当两个属性值都为1时,类值为1



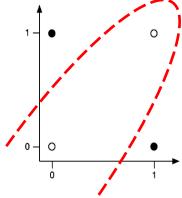
(b) 逻辑或(OR)

当且仅当两个属性值都为0时,类值为2



(c) 逻辑非(NOT)

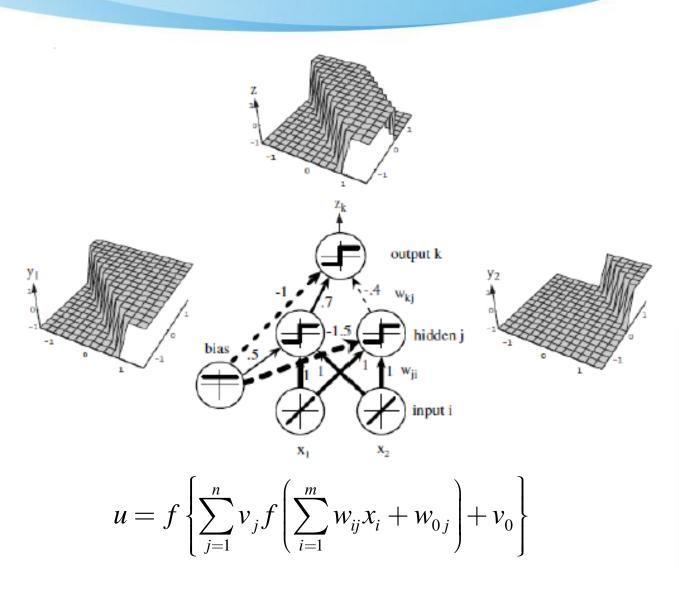
当且仅当属性值为1时,类值为2

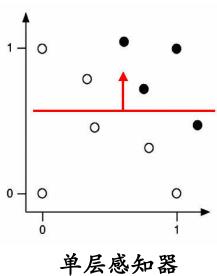


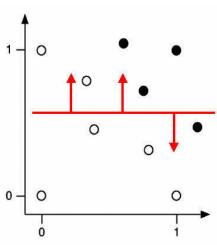
(d) 逻辑异或(XOR)

当且仅当只有一个属性值为1时,类值为1

多层感知器模型 (MLP)

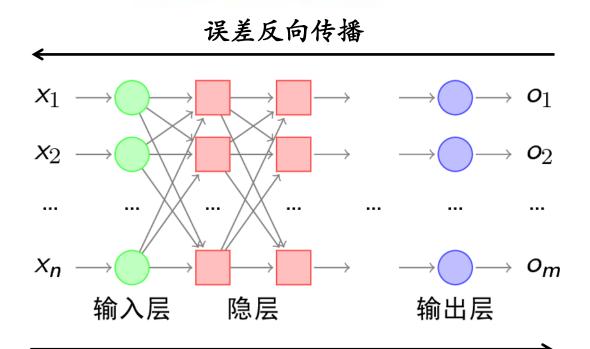






多层感知器

BP神经元网络模型





杰弗里 希尔顿 (Geoffrey Hinton, 1947-)

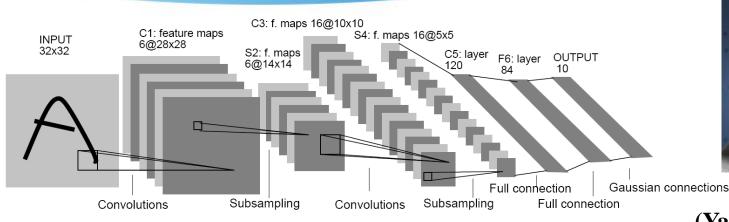
信息前向传播

Rumelhart D. E., Hinton G. E. and Williams R. J. Learning representations by back-propagating errors. Nature, Vol.323, pp. 533-536, 1986.

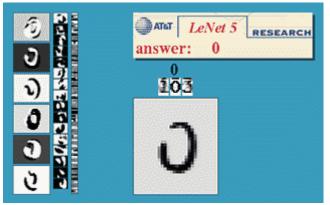
具有一个隐含层的前馈神经元网络可以逼近任何连续函数

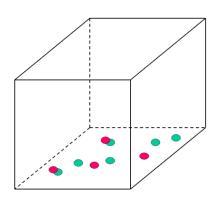
Hornik K. M., Stinchcombe M. and White H. Multilayer Feedforward Networks are Universal Approximators. Neural Networks, Vol.2 (2), pp. 359-366, 1989.

卷积神经网络模型 (CNN) 和支持向量机模型 (SVM)



^{ections} 严乐春 (**Yann Lecun, 1960**-)





弗拉基米尔·瓦普尼克 (Vladmir Vapnik, 1936-)

Y. LeCun, et al. Backpropagation Applied to Handwritten Zip Code Recognition, Neural Computation, 1(4):541-551, Winter 1989.

Y. LeCun, et al. Gradient-Based Learning Applied to Document Recognition, Proceedings of the IEEE, 86(11):2278-2324, 1998

瓦普尼克著, 许建华,张学工译. 统计学习理论, 电子工业出版社, 2009

NVIDIA (英伟达)

When in doubt, use brute force.

如果遇到困惑(的问题), 就使用蛮力.

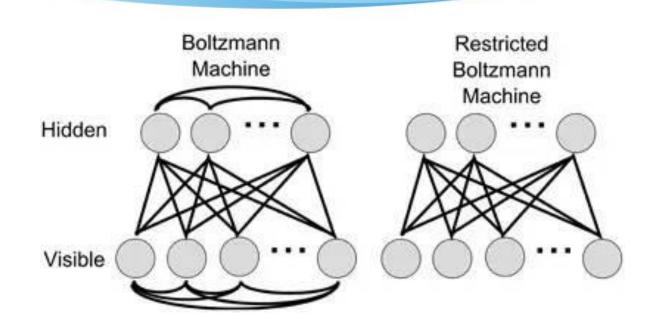






黄仁勋 (Jen-Hsun Huang, 1963-)

深度学习概念的诞生





杰弗里·希尔顿 (Geoffrey Hinton, 1947-)

Hinton, G. E., Osindero, S. and Teh, Y. A fast learning algorithm for deep belief nets. Neural Computation, Vol.18, pp:1527-1554, 2006

RBM 可以从输入数据中进行预先训练,自己寻找发现重要的特征,对神经网络连接的权重进行有效的初始化,初始化后的神经网络,再用反向传播算法微调

深度学习初露锋芒









Rajat Raina

Anand Madhavan (Andrew Ng, 1976-)

Rajat Raina, Anand Madhavan, Andrew Y. Ng. Large-scale Deep Unsupervised Learning using Graphics Processors, ICML 2009.



Dan Ciresan

D. Ciresan, U. Meier, L. M. Gambardella, J. Schmidhuber. Deep, Big, Simple Neural Nets for Handwritten Digit Recognition. Neural Computation, 2010

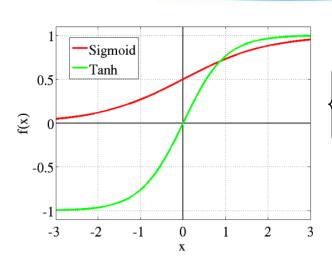
Quoc Viet Le, et al. Building high-level features using large scale unsupervised learning. ICML, 2012

http://www.image-net.org/



黎越国(Quoc Viet Le)

深度学习算法的改进—ReLU激励函数



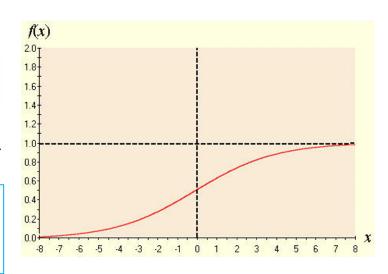
Sigmoid函数

$$f(x) = \frac{1}{1 + e^{(-\alpha x)}}, \quad \alpha > 0$$

$$f(x) = \tanh\left(\frac{x}{2}\right) = \frac{1 - e^{(-x)}}{1 + e^{(-x)}}$$

ReLU函数

$$f(x) = \max(0,x)$$





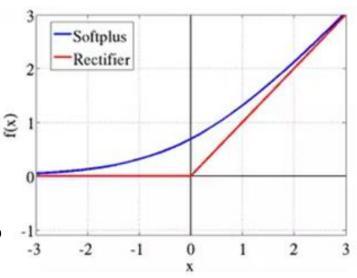
Xavier Glorot



Antoine Bordes

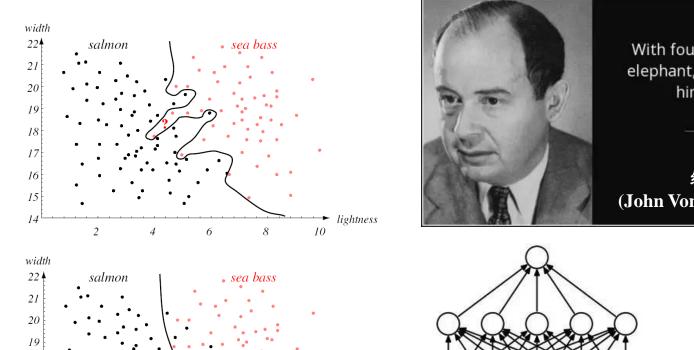


Yoshua Bengio



X. Glorot, A. Bordes, and Y. Bengio. Deep Sparse Rectifier Neural Networks, vol.15 of JMLR 2011.

深度学习算法的改进—"丢弃" (Dropout) 算法



lightness

10

R. O. Duda, et al. Pattern Classification. 2001

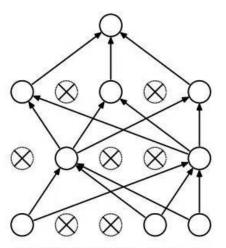
8

(a) Standard Neural Net

With four parameters I can fit an elephant, and with five I can make him wiggle his trunk.

— John von Neumann —

约翰·冯·诺依曼 (John Von Neumann, 1903-1957)



(b) After applying dropout.

Hinton, G. E., et al. Improving neural networks by preventing co-adaptation of feature detectors, 2012.

深度学习获得成功



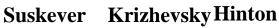


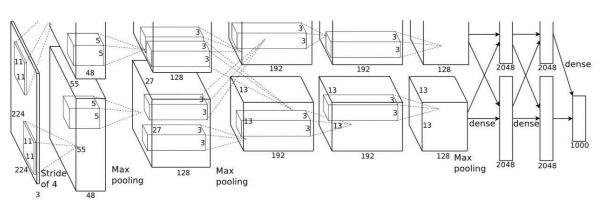
Image classification
Easiest classes
red fox (100) hen-of-the-woods (100) lbex (100) goldfinch (100) flat-coated retriever (100)
hamster (100) porcupine (100) stingray (100) Blenheim spaniel (100)

Hardest classes
muzzle (71) hatchet (68) water bottle (68) velvet (68) loupe (66)
hook (66) spotlight (66) ladle (65) restaurant (64) letter opener (59)

李飞飞 (Fei-Fei Li) J. Deng, et al. ImageNet: A Large-Scale Hierarchical Image Database, CVPR, 2009

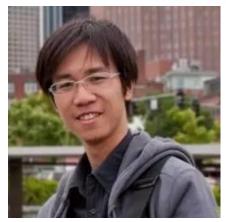


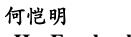


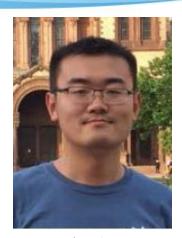


Krizhevsky, A., Sutskever, I. and Hinton, G. E. ImageNet Classification with Deep Convolutional Neural Networks, Advances in Neural Information Processing 25, 2012

深度学习算法的不断探索







张祥雨

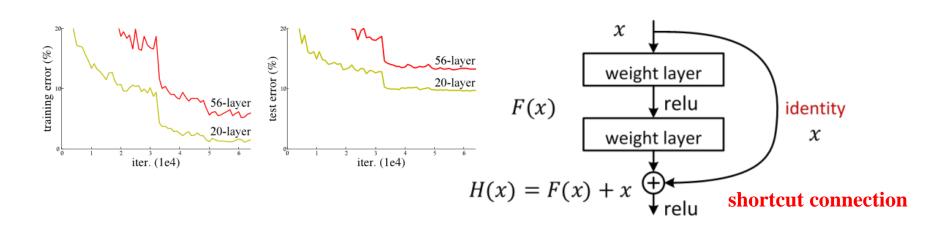


任少庆 (Kaiming He, Facebook) (Xiangyu Zhang, MSRA) (Shaoqing Ren, MSRA)



孙健 (Jian Sun, Face++)

Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. Deep Residual Learning for Image Recognition, IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016



对深度学习的质疑

Does Deep Learning Come from the Devil?

Deep learning has revolutionized computer vision and natural language processing. Yet the mathematics explaining its success remains elusive. Vladimir Vapnik offered a critical perspective. Big data and deep learning both have the flavor of brute force

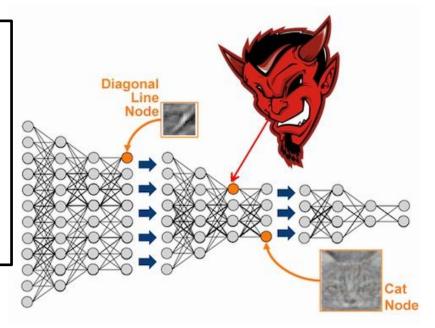


弗拉基米尔·瓦普尼克 (Vladmir Vapnik, 1936-)

http://www.kdnuggets.com/2015/10/deep-learning-vapnik-einstein-devil-yandex-conference.html

机器学习的现实情况:

- 除非对每个可能的数据进行训练,否则 总会存在多个假设使得真实错误率不为0 ,即学习器无法保证和目标函数完全一 致
- 2. 训练样本是随机选取的,训练样本总有 一定的误导性





Is "Artificial Intelligence" Dead? Long Live Deep Learning ?!?

http://www.kdnuggets.com/2016/08/artificial-intelligence-dead-long-live-deep-learning.html



When you look at something like AlphaGo, it's often portrayed as a big success for deep learning, but it's actually a combination of ideas from several different areas of AI and machine learning: deep learning, reinforcement learning, selfplay, Monte Carlo tree search, etc.

-----Pedro Domingos: professor at the University of Washington



There's a potential danger that referring to AI as just deep learning could put us in a mindset where we would be less receptive to the possibility that other scientific ideas can contribute to AI.

----- Hugo Larochelle: Twitter Cortex researcher and professor at Universit éde Sherbrooke

■ 记忆是如何存储的 (三联生活周刊,2012年第七期142页)

Amitabha Majumdar et. al. "Critical Role of Amyloid-like Oligomers of Drosophila Orb2 in the Persistence of Memory". Cell, Volume 148, Issue 3, 515-529, 26 January 2012



我们必须决定知识的相对价值

— Francis Bacon

英国近代唯物主义哲学家、思想家和科学家(1561-1626)

