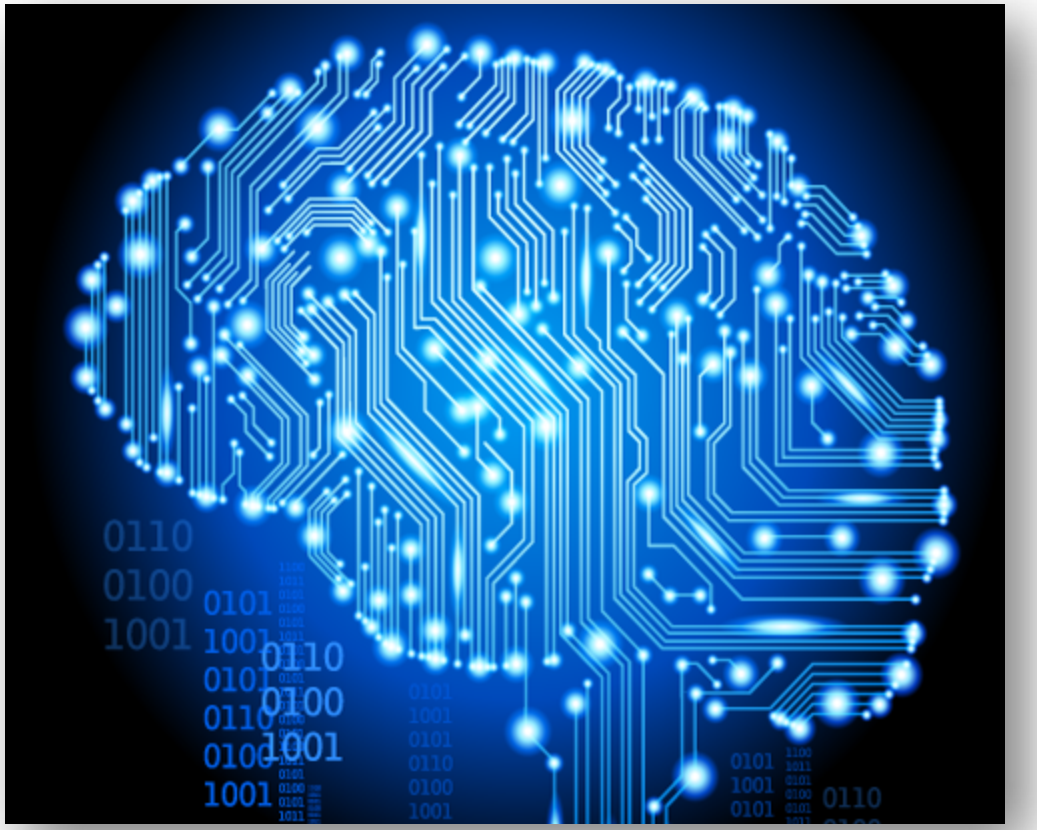
Session IV: Deep Learning/CNN Methods



ARTIFICIAL INTELLIGENCE

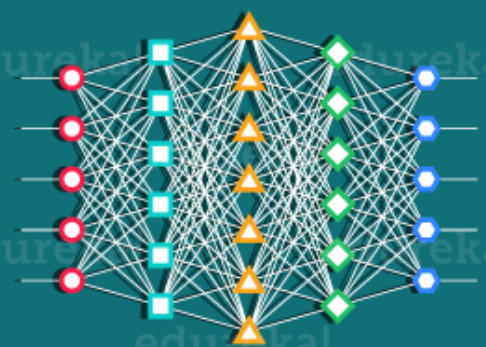
Engineering of making Intelligent Machines and Programs

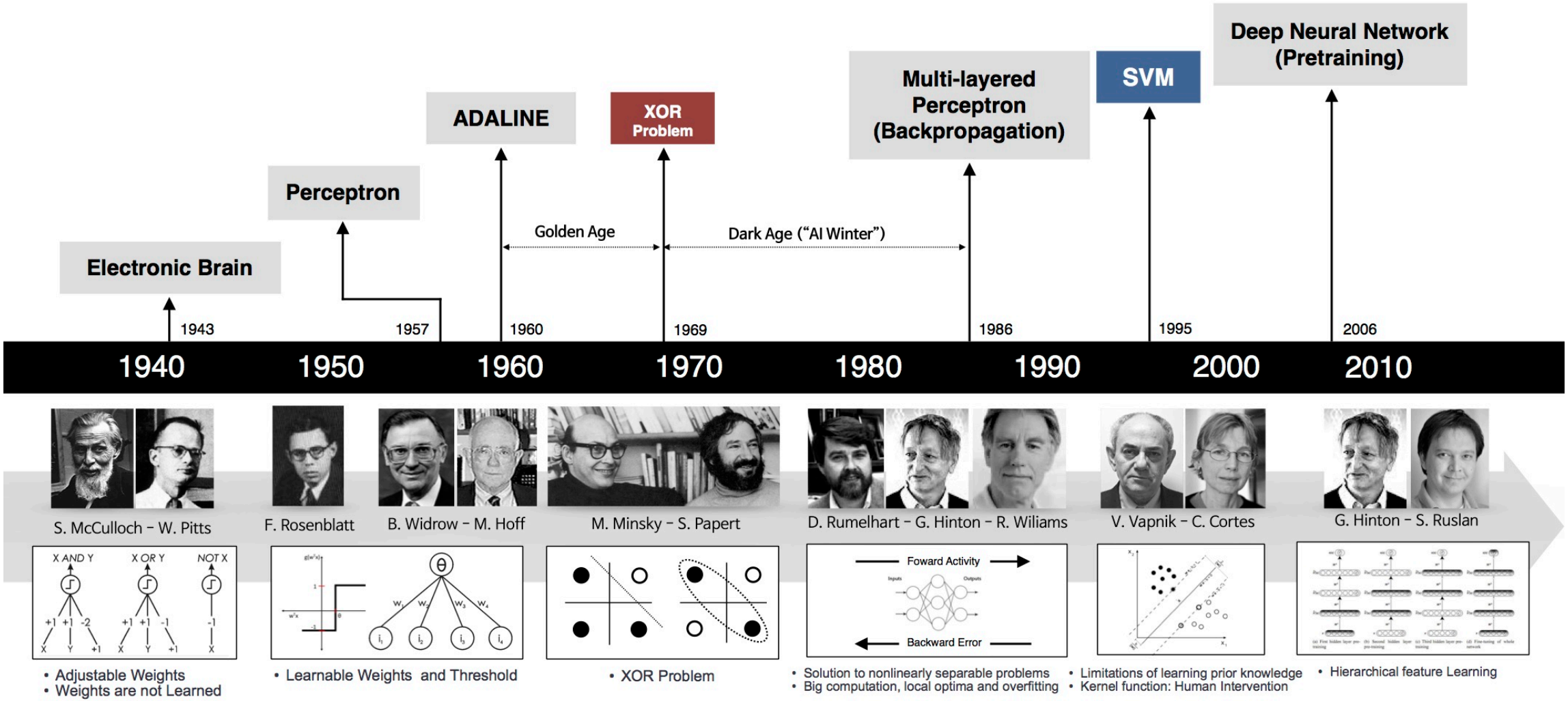
MACHINE LEARNING

Ability to learn without being explicitly programmed

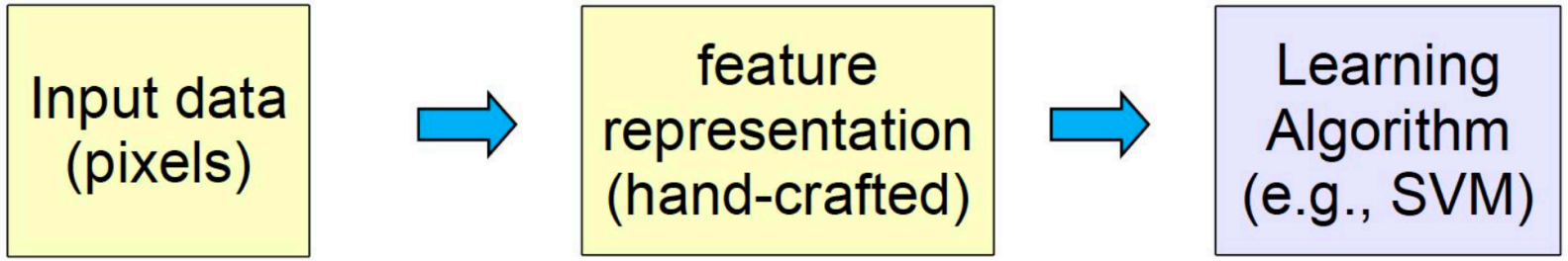
DEEP LEARNING

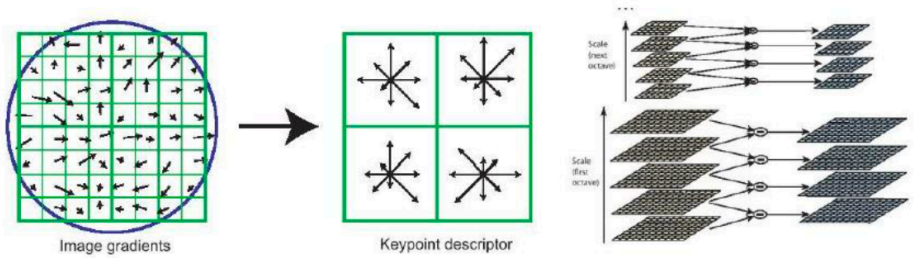
Learning based on Deep Neural Network



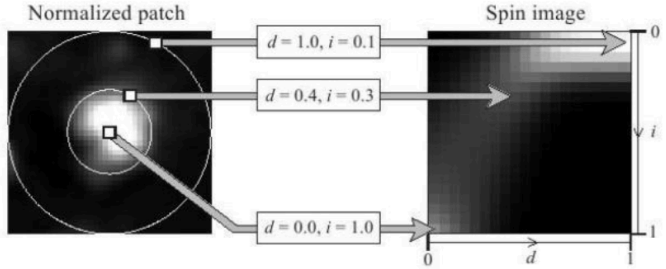

Electronic Brain
1943
Perceptron
1957
ADALINE
1960
XOR Problem
1969
Golden Age
Dark Age ("AI Winter")
Multi-layered Perceptron (Backpropagation)
1986
SVM
1995
Deep Neural Network (Pretraining)
2006
1940
1950
1960
1970
1980
1990
2000
2010
S. McCulloch - W. Pitts
F. Rosenblatt
B. Widrow - M. Hoff
M. Minsky - S. Papert
D. Rumelhart - G. Hinton - R. Wiliams
V. Vapnik - C. Cortes
G. Hinton - S. Ruslan
X AND Y
X OR Y
NOT X
Foward Activity
Backward Error
• Adjustable Weights
• Weights are not Learned
• Learnable Weights and Threshold
• XOR Problem
• Solution to nonlinearly separable problems
• Big computation, local optima and overfitting
• Limitations of learning prior knowledge
• Kernel function: Human Intervention
• Hierarchical feature Learning

Traditional Machine Learning Approach

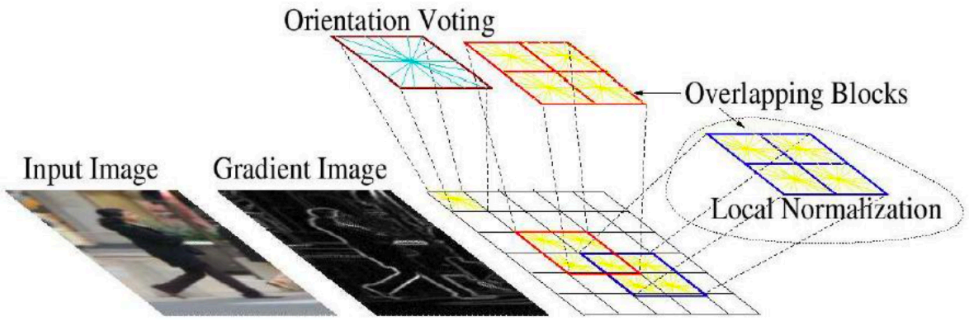




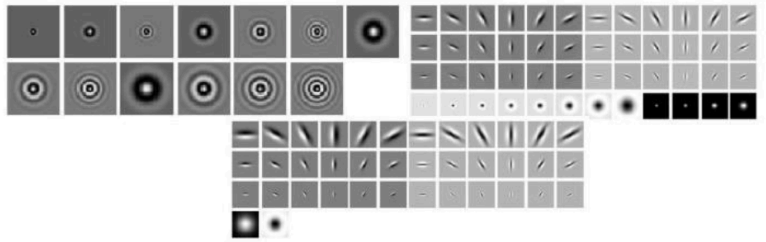
SIFT



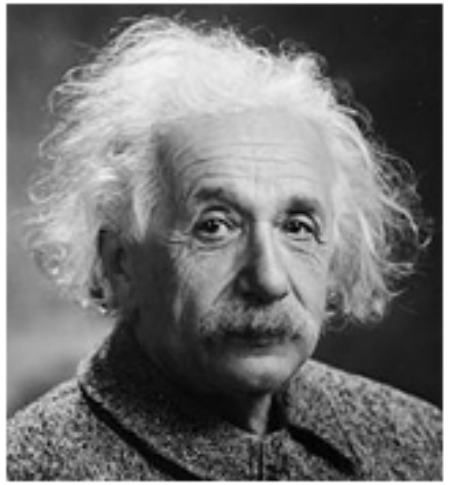
Spin image

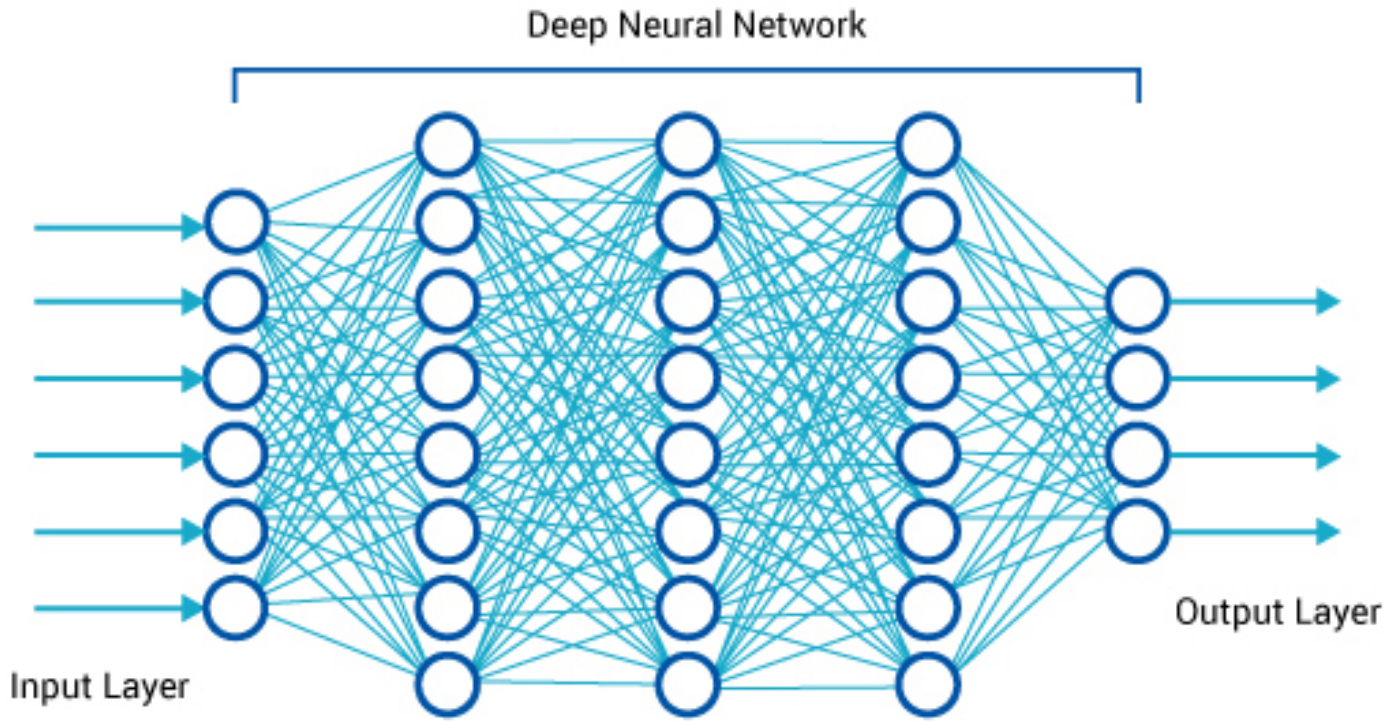


HoG



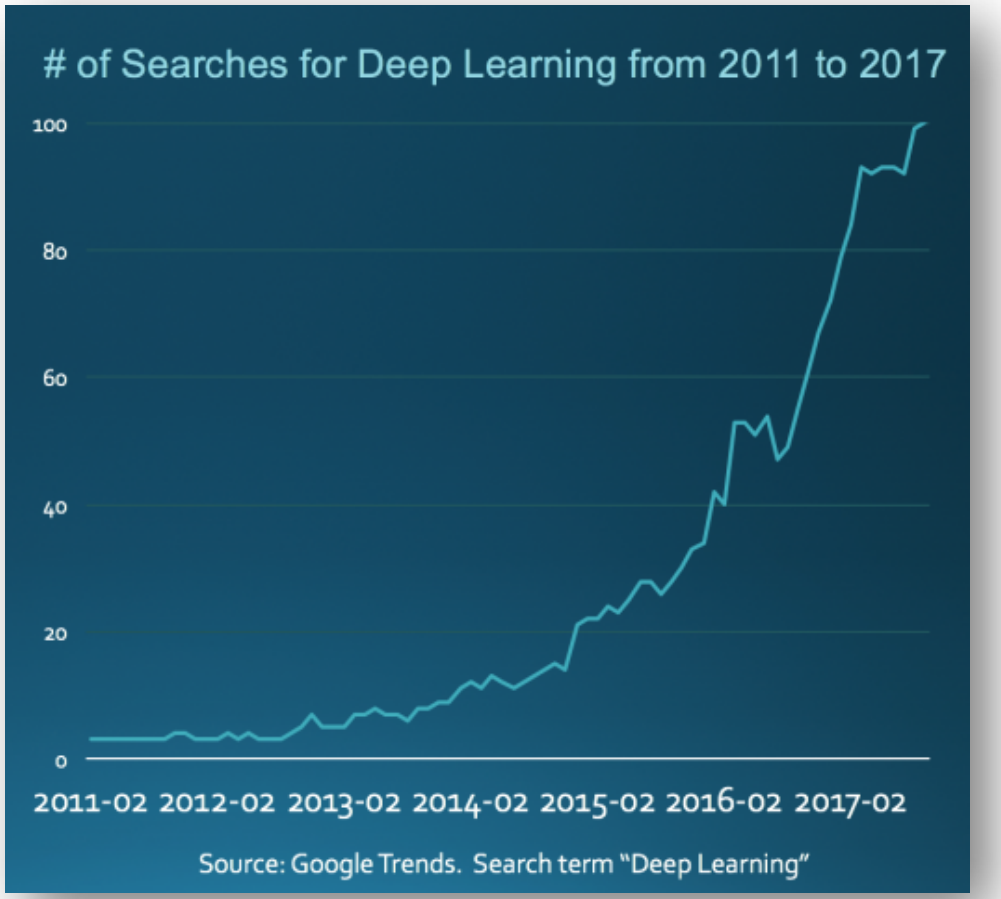
Textons

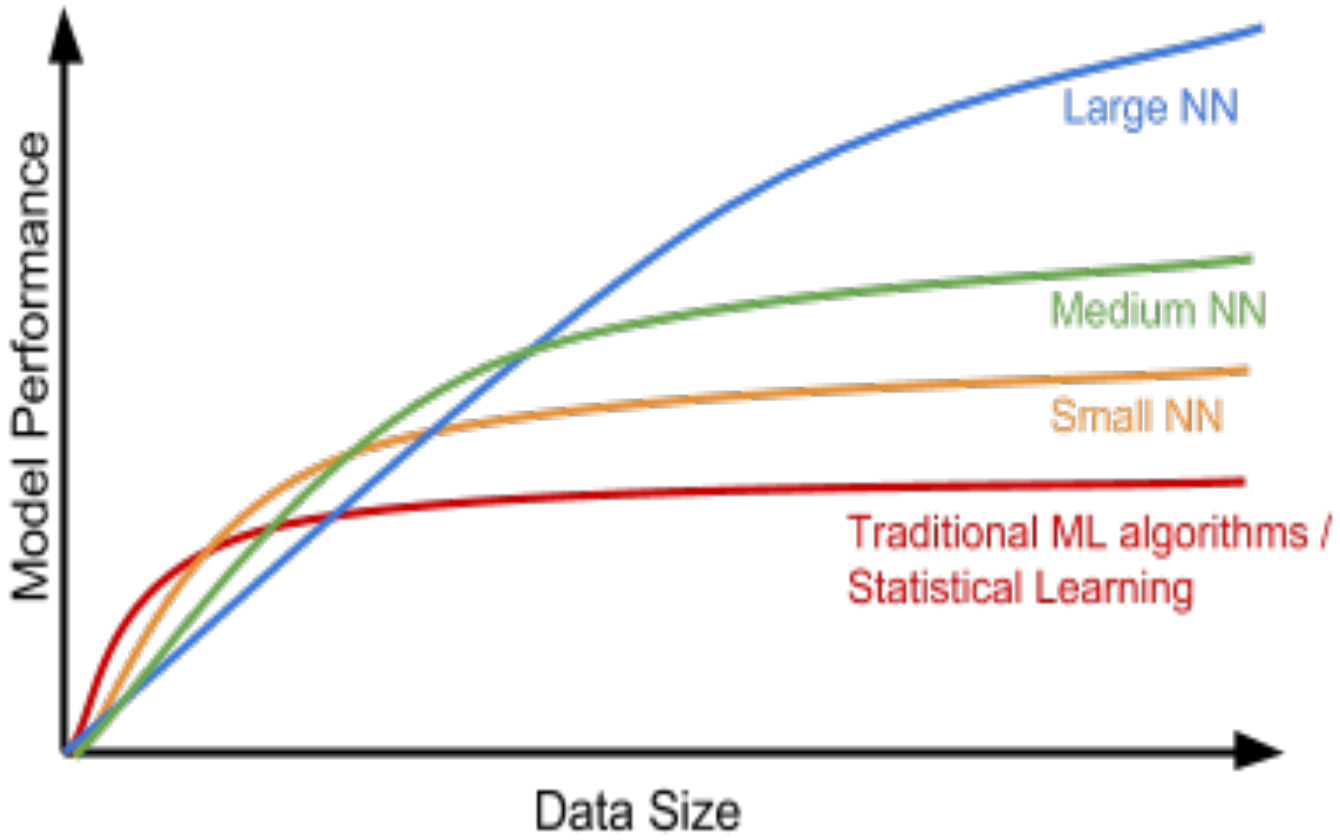


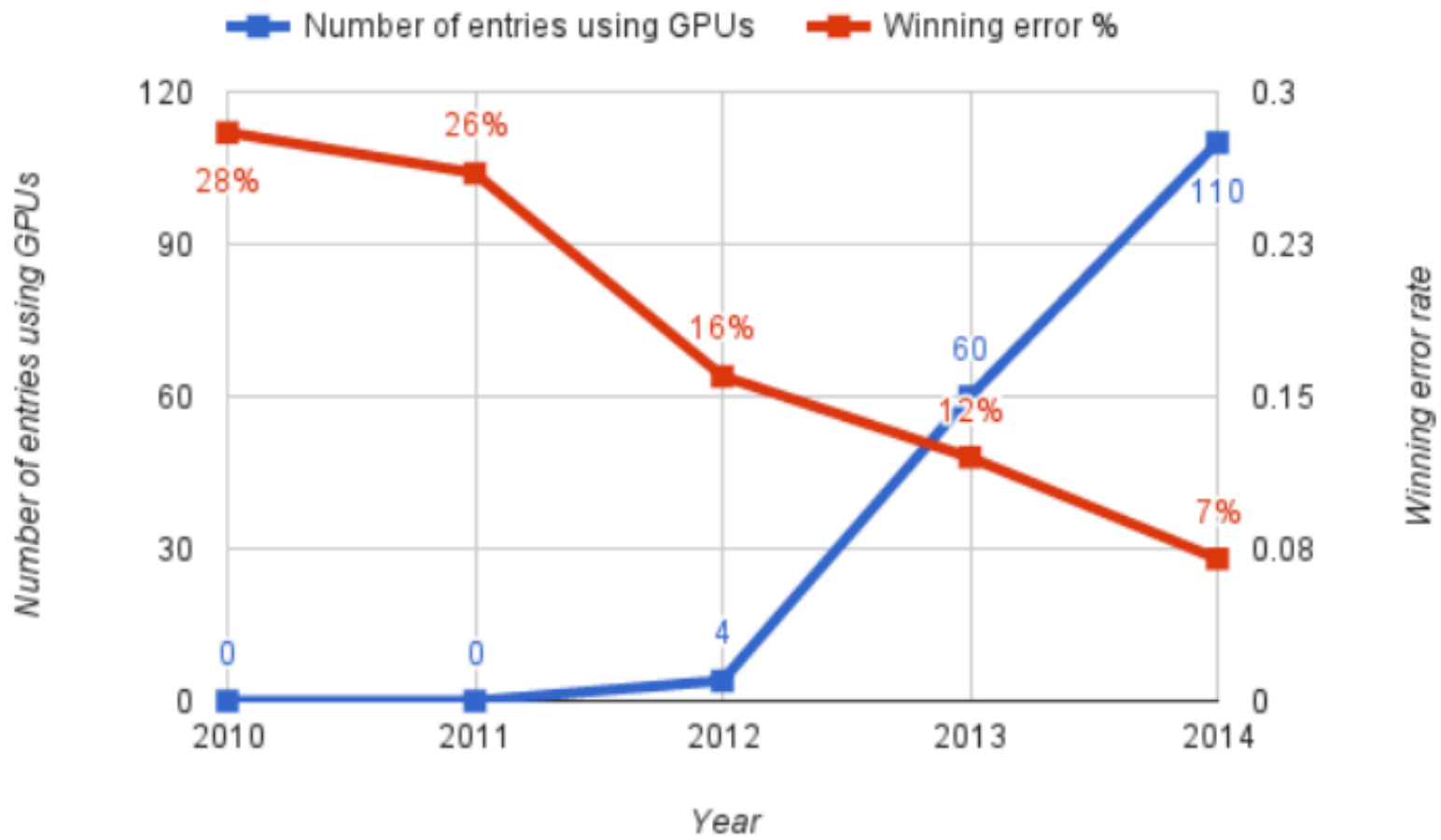


IT'S EINSTEIN!

edges | combinations of edges | object models


# of Searches for Deep Learning from 2011 to 2017
100
80
60
40
20
0
2011-02 2012-02 2013-02 2014-02 2015-02 2016-02 2017-02
Source: Google Trends. Search term "Deep Learning"

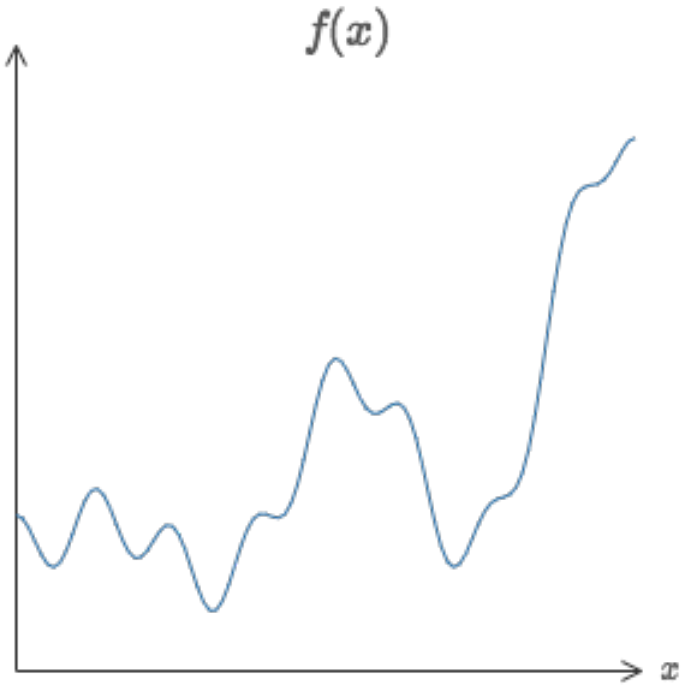

Model Performance
Large NN
Medium NN
Small NN
Traditional ML algorithms /
Statistical Learning
Data Size

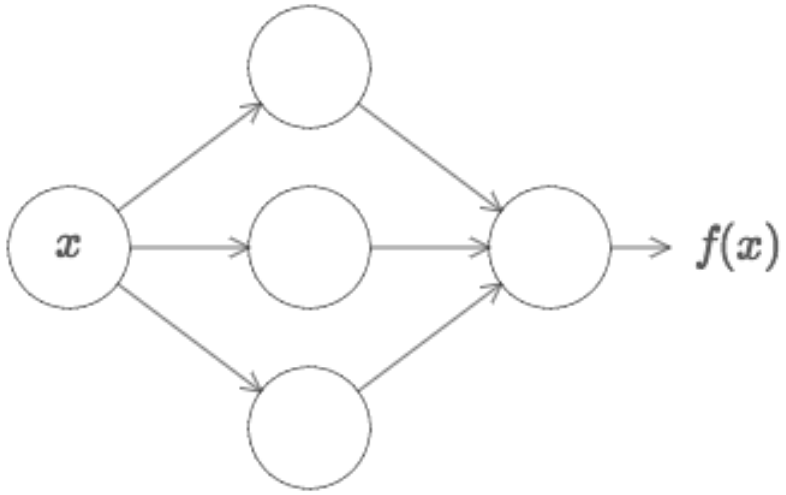


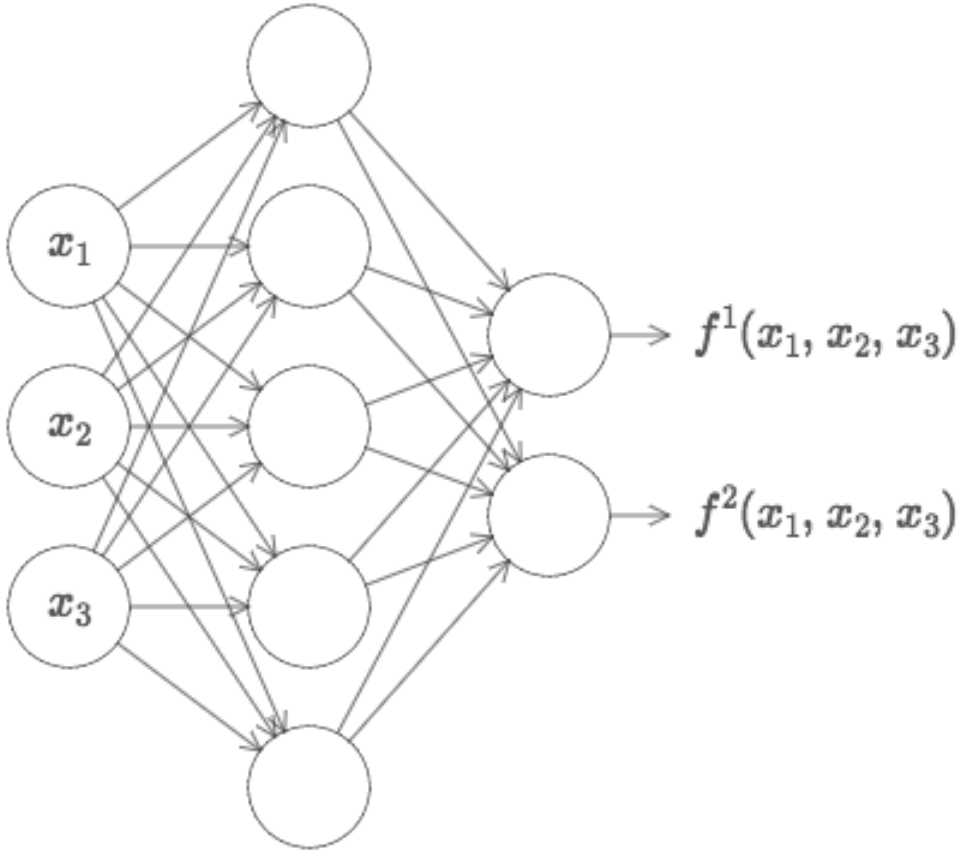
IMAGENET

Krizhevsky, Sutskever, & Hinton, 2012

Universal Approximation Theorem







Kurt Hornik (1991) *Neural Networks*, 4, 251–257.


@teenybiscuit

Panda

Gibbon