Deep Learning in Neuroscience

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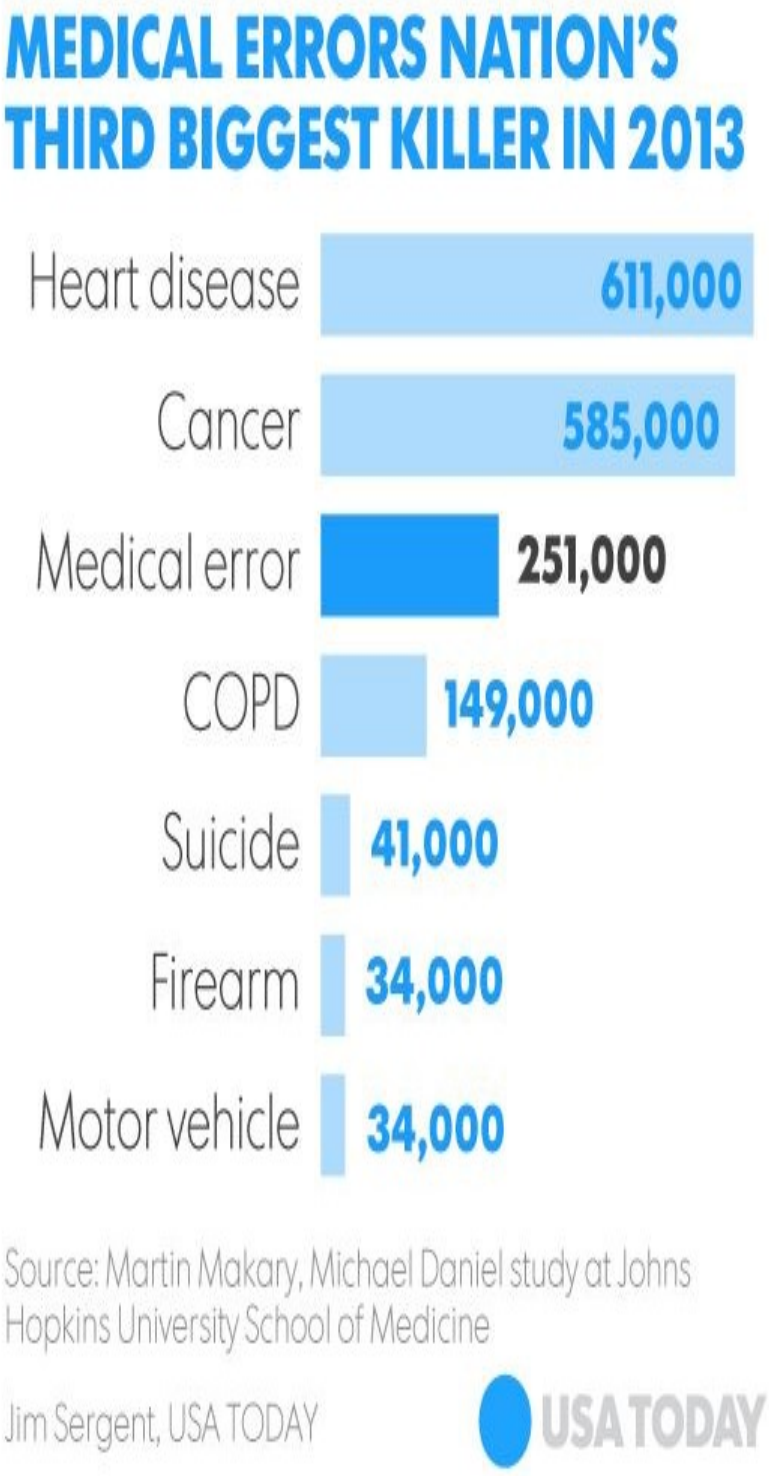
Abstract. *This is the slideshow presentation of talk by Prof. Cristian R. Munteanu presented as part of the NEURODAT'21 training program funded by IBRO-PERC Soft Skills Training call of the International Brain Research Organization (IBRO) and the Pan-Europe Regional Committee (PERC). NEURODAT'21 is devoted to promote soft skills on entry level medicine and also STEMS area students interested on neurosciences. The talk includes two parts, part 1 focuses on Deep Learning models introduction and part 2 focuses on applications to medical diagnosis in Neurosciences. In this first part the talk introduces concepts as Deep Learning, Predictive Models, Artificial Intelligence, Neural Networks and Deep Neural Networks. Language note:* ***English-Spanish bi-lingual talk and English text****.*

Outlines

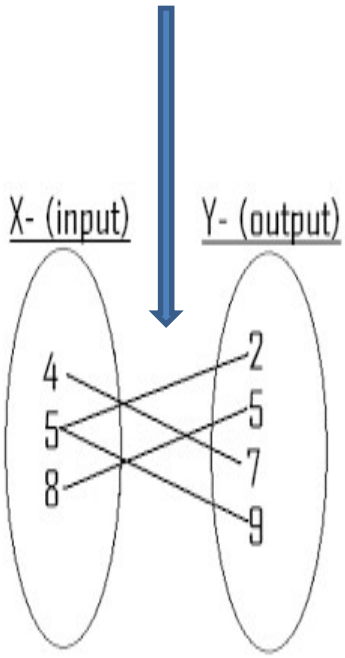
- Prediction model
- Artificial neuron
- Machine Learning
- Deep learning (DL)
- DL application in Alzheimer

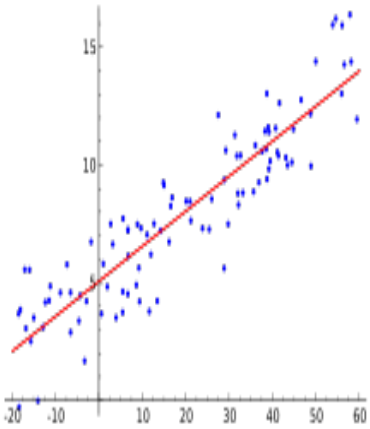

MEDICAL ERRORS NATION'S THIRD BIGGEST KILLER IN 2013
Heart disease
611,000
Cancer
585,000
Medical error
251,000
COPD
149,000
Suicide
41,000
Firearm
34,000
Motor vehicle
34,000
Source: Martin Makary, Michael Daniel study at Johns Hopkins University School of Medicine
Jim Sergent, USA TODAY
USA TODAY

Prediction model

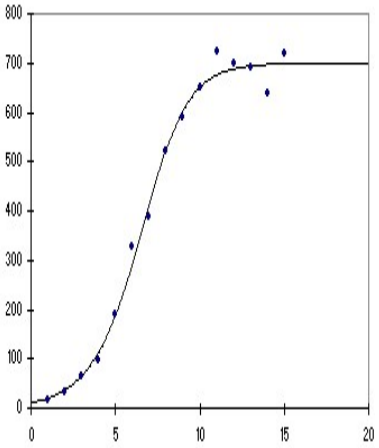
Err or

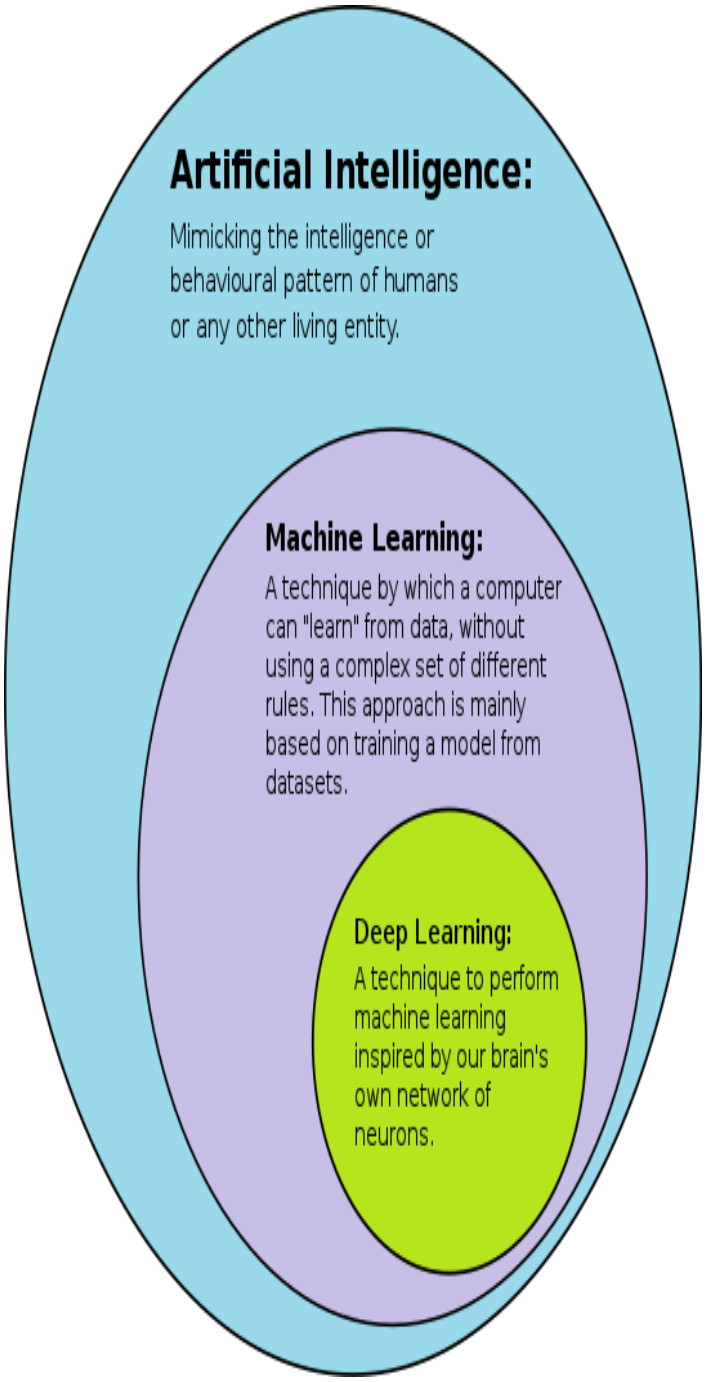
Prediction model ≡ Mathematical formula ≡ Complex function





Linear vs non-linear





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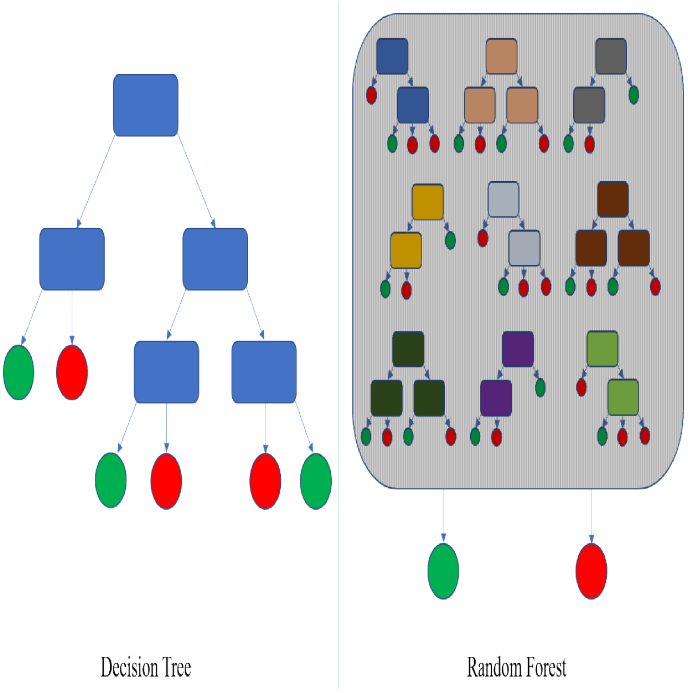
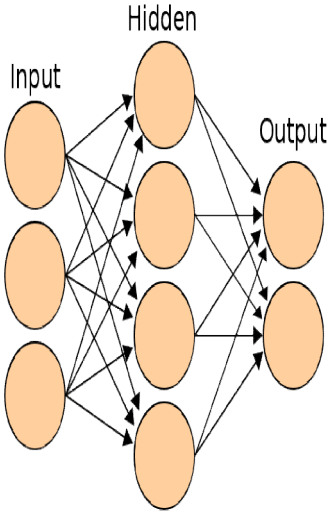
ML methods

- Bayes networks
- Support vector machines
- Decision trees
- Random trees
- Neural netwoks
- ……



Decision Tree Random Forest



Neural netwok/

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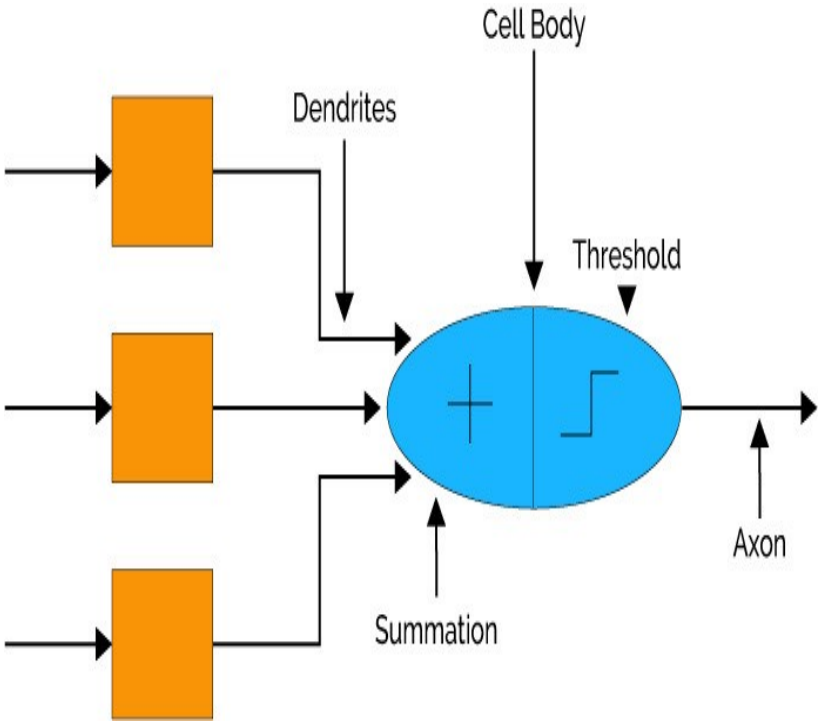
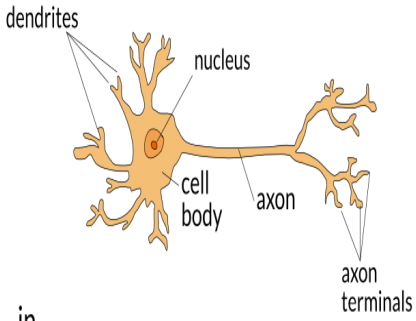
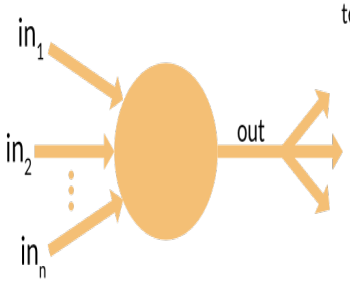
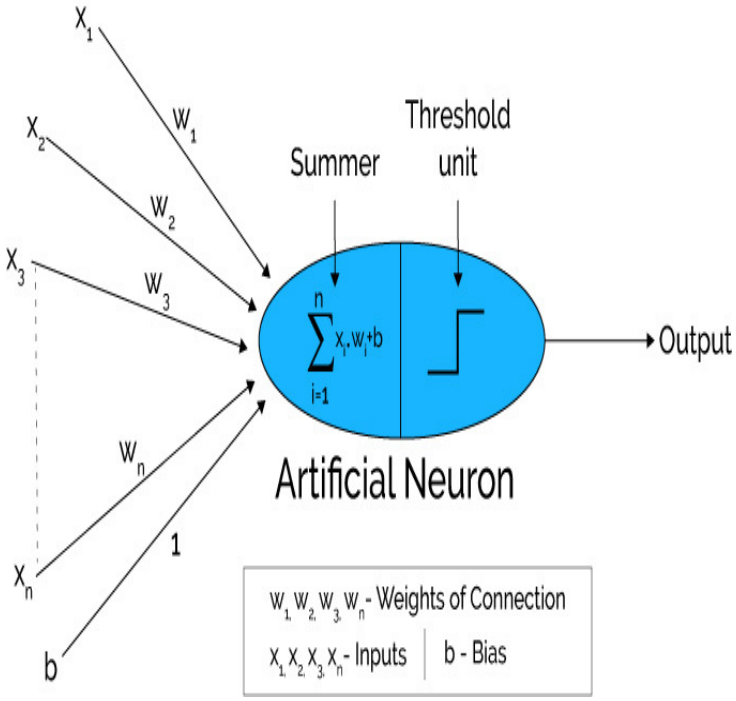

Cell Body
Dendrites
Threshold
Axon
Summation
Inputs
Data transformation (linear and non-linear functions)
Output

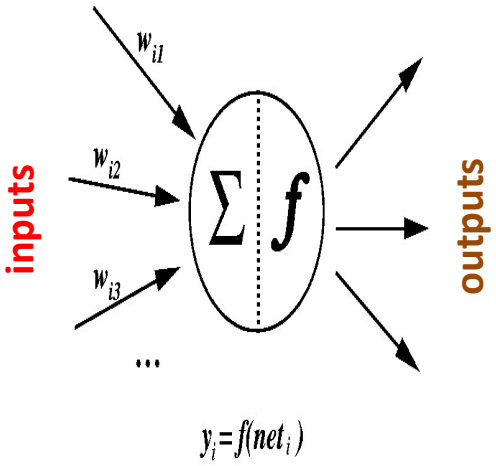

dendrites
nucleus
cell body
axon
axon terminals

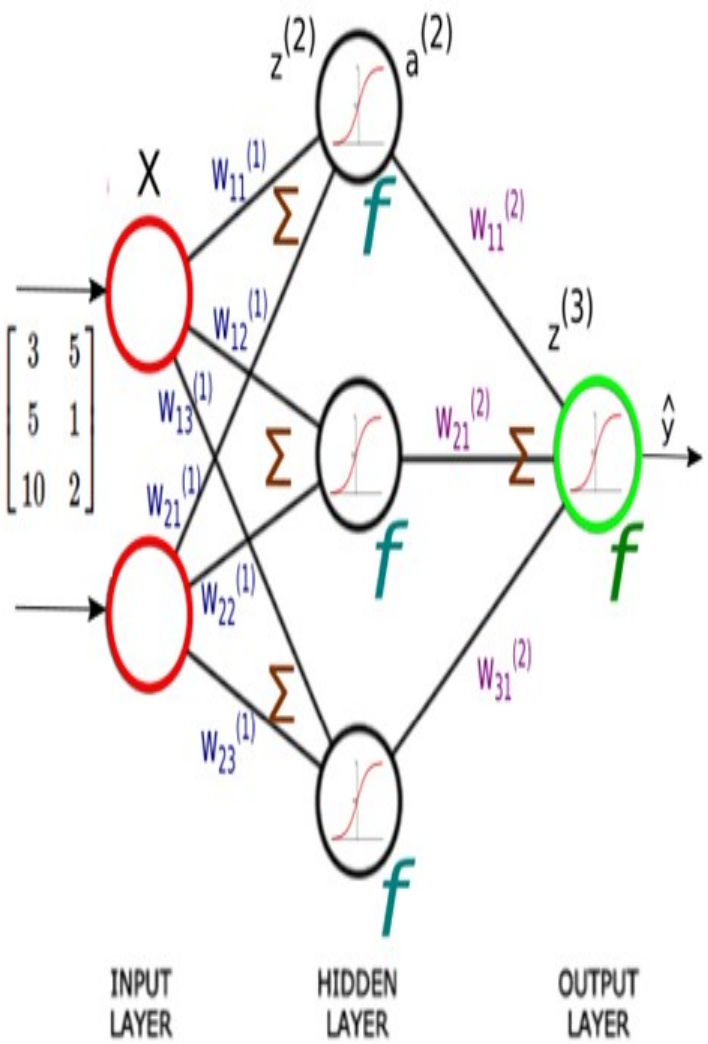

in1
in2
inn
out


X1
X2
X3
Xn
W1
W2
W3
Wn
b
1
Summer
Threshold unit
Output
Artificial Neuron
W1, W2, W3, Wn - Weights of Connection
X1, X2, X3, Xn - Inputs
b - Bias

Artificial Neural Network (ANN)

Fully Connected Neur





Artificial Neuron

Mathematical Formula

Outputs = $f_{nonlinear}(f_{linear}$(inputs, weights))

Artificial Neural Network

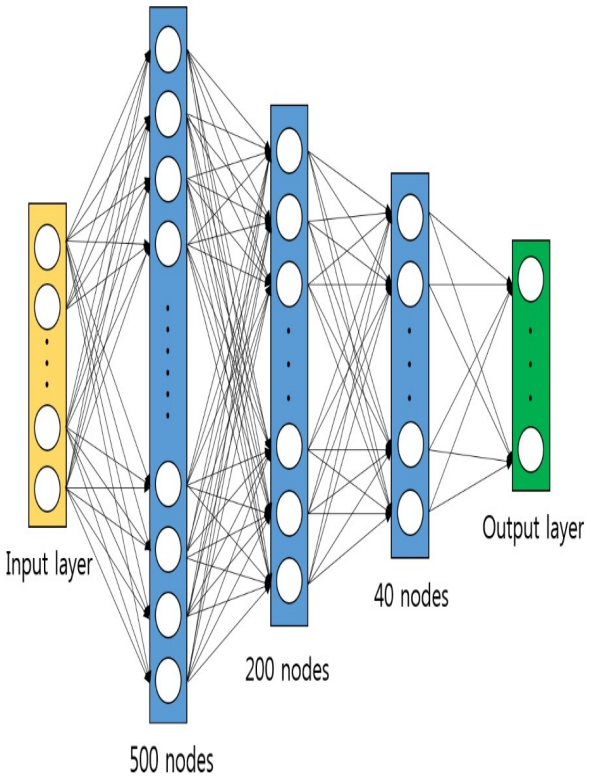
Complex Mathematical Formula

Nested Parametrized Function

Outputs = f1(f2(f3(……)))

Distortion of spatial dimensions!

Deep Neural Nets = Approximation Function



Fully-connected net

GPU
TPU
NPU
Big data
Cloud computing

Question: Is it possible to create a prediction model for this specific task?

Answer: Yes, always! But it depends on dataset, time, computational power … Remember, it is a supervised method! We need a dataset and to train a model.