

DEEP LEARNING

INTRODUÇÃO

AULA 1



# INSTRUÇÕES GERAIS

- ✓ Traga seu laptop



# INSTRUÇÕES GERAIS

- ✓ Traga seu laptop
- ✓ Use Software Livre



## INSTRUÇÕES GERAIS

- ✓ Traga seu laptop
- ✓ Use Software Livre
- ✓ Não converse por voz



## INSTRUÇÕES GERAIS

- ✓ Traga seu laptop
- ✓ Use Software Livre
- ✓ Não converse por voz
- ✓ Se não entender, pergunte!



## INSTRUÇÕES GERAIS

- ✓ Traga seu laptop
- ✓ Use Software Livre
- ✓ Não converse por voz
- ✓ Se não entender, pergunte!
- ✓ Se entender, explique!





## INSTRUÇÕES GERAIS

- ✓ Traga seu laptop
- ✓ Use Software Livre
- ✓ Não converse por voz
- ✓ Se não entender, pergunte!
- ✓ Se entender, explique!

✓ **NÃO ENTRE EM  
PÂNICO**



BOM DIA!

---

Eu sou Diego Dorgam

Estou interessado em saber quem é você,  
e quem você deseja ser?!

<http://bit.ly/dl-unb01>  
<https://t.me/DeepLearningUnB>  
@diegodorgam





# TÓPICOS EM DEEP LEARNING

Como essas aulas vão funcionar...



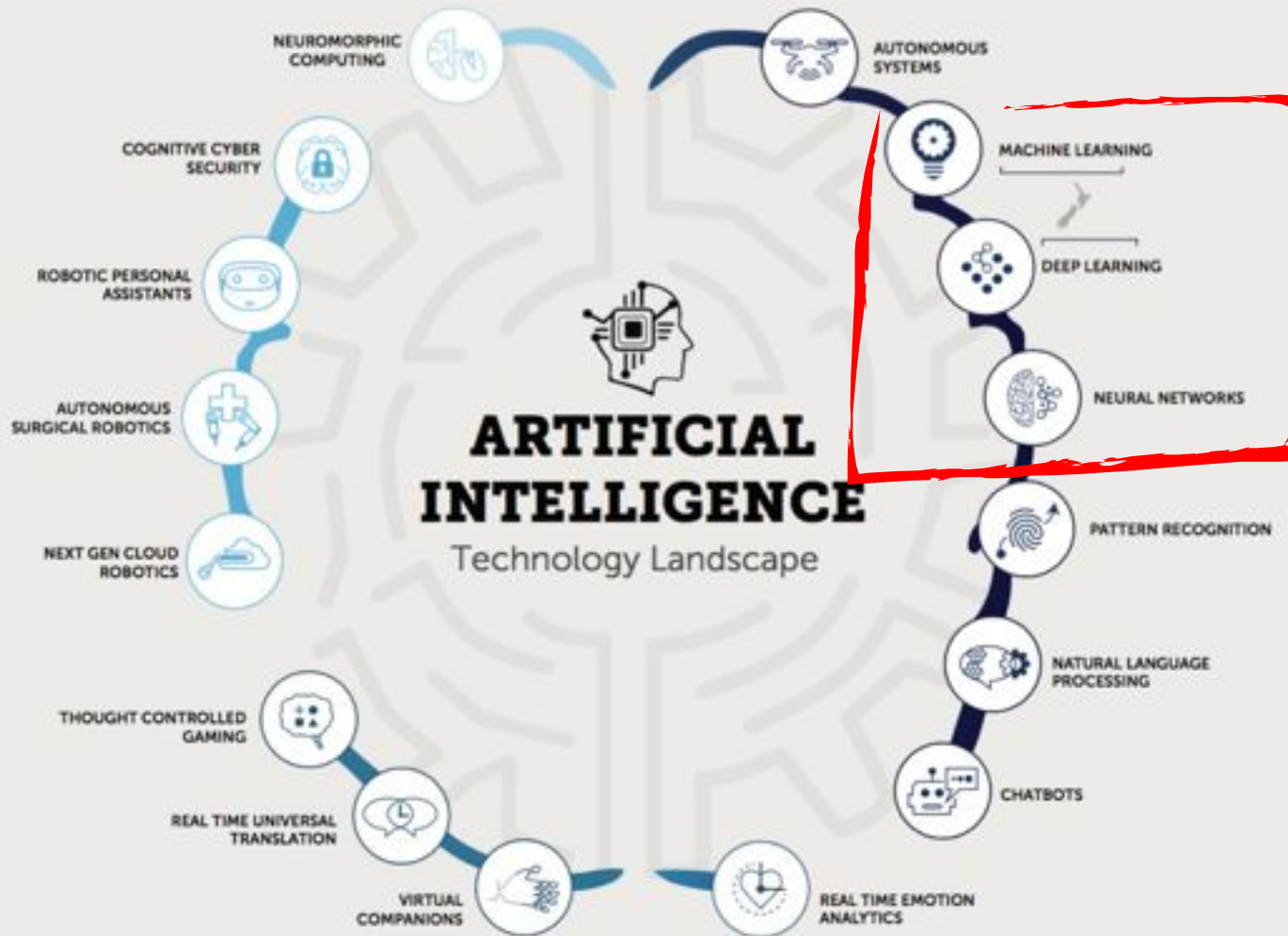
Success in creating effective AI, could be the biggest event in the history of our civilization. Or the worst. We just don't know. So we cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it

~ Stephen Hawking  
AI will 'transform or destroy' society



# INTELIGÊNCIA ARTIFICIAL?







## O QUE VAMOS APRENDER?

- ✓ Introdução à Deep Learning
- ✓ Machine Learning Basics
- ✓ ANN – Artificial Neural Networks
- ✓ CNN – Convolutional Neural Networks
- ✓ RNN – Recurrent Neural Networks
- ✓ SOM – Self Organizing Maps
- ✓ Boltzmann Machines
- ✓ AutoEncoders



# TECNOLOGIAS

- ✓ Python Anaconda
- ✓ Jupyter Notebooks
- ✓ NumPy
- ✓ Scikit-Learn
- ✓ TensorFlow
- ✓ Keras
- ✓ PyTorch





SE SOBRAR TEMPO...

- ✓ OpenCV
- ✓ OpenAI
- ✓ Machine Reasoning



# PROPOSTA PEDAGÓGICA

## Teoria / Intuição

Vamos explorar os conteúdos teóricos sobre a formação das redes neurais, e debater as diferentes abordagens

## Prática / Projeto

Iremos implementar um projeto fictício com a tecnologia que aprendemos



# AVALIAÇÕES

## Tarefas

Lições para serem feitas ao longo das aulas, entregues ou não, cada uma soma 1 ponto

## Projeto

Um projeto entregue e aprovado com avaliação positiva

$$\sum \text{TAREFAS} * (80/5) \quad + \quad \sum \text{ATRIBUTOS} * 10 \\ = F(\text{MENÇÃO})$$



Aproveite as aulas para se inspirar  
e acreditar que é possível desenvolver  
aquilo que você sempre sonhou

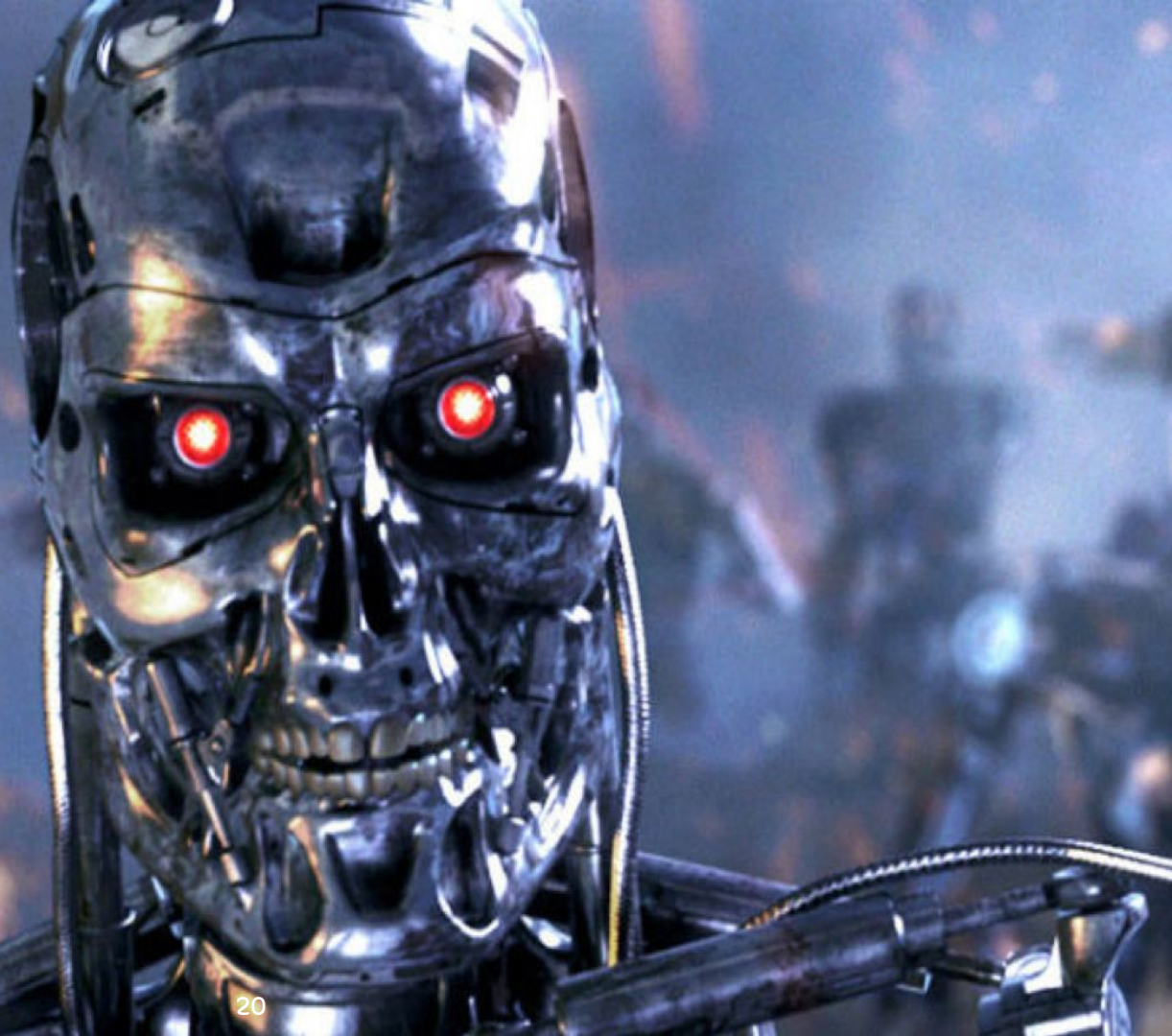


# CULTURA SciFi

Como vamos nos inspirar...



COMO VOCÊ  
IMAGINA QUE  
SERÁ O  
FUTURO?





COMO VOCÊ  
IMAGINA QUE  
SERÁ O  
FUTURO?



99.9% uptime



## STAR TREK NEXT GENERATION



Brent Spiner interpreta o Tenente Comandante Data, o primeiro andróide a ser reconhecido como ser senciente, e portanto, a ter direitos como uma forma de vida artificial



## O COLETIVO DOS BORG

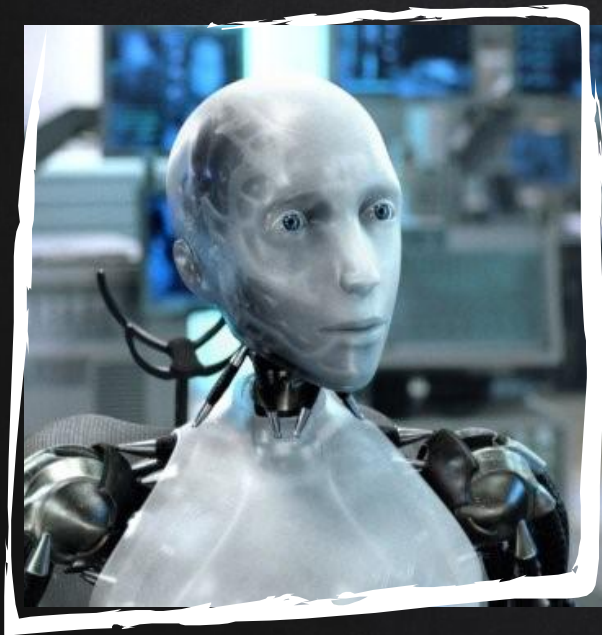


Alice Krige é a rainha Borg, uma espécie alienígena cibernética que evolui assimilando outras espécies.





## Eu, Robô



Alan Tudyk interpreta o robô Sony,  
o primeiro N5 a tomar consciência e  
desrespeitar as 3 leis de Asimov



J.A.R.V.I.S.



Edwin Jarvis é o personagem fictício da Marvel que atua em Homem de Ferro, Homem Aranha e os Vingadores.



## ULTRON

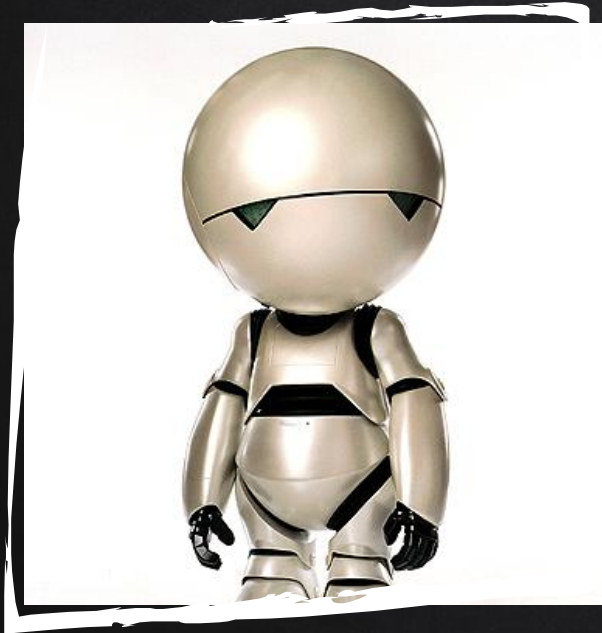


Fruto de uma experiência que sai do controle, Ultron é uma inteligência artificial, personagem do Universo Marvel, que tenta destruir a humanidade





MARVIN



Do guia do mochileiro das galáxias,  
Marvin é um robô super inteligente  
que se torna depressivo



## AUTOBOTS



Estreando nos filmes dos Autobots e ganhando o seu próprio longa, Bumblebee é uma forma de vida cibernética com capacidades metamórficas.



CYLON



Os cylons constituem uma civilização em guerra com as doze colônias da Humanidade no filme e na série de TV Battlestar Galactica



# STAR WARS



R2D2 é um droid navegador, tem a função de operar enquanto interface das naves X-Wing, enquanto C3PO é um andróide mordomo, para as tarefas do dia-a-dia.





## EXERCITE A IMAGINAÇÃO

Deep  
Learning

Soluções  
inovadoras

Ficção  
Científica



## EXERCITE A IMAGINAÇÃO

Deep  
Learning

Soluções  
inovadoras

Ficção  
Científica

VAMOS LÁ?





# O QUE É DEEP LEARNING

No início, havia apenas estatística...



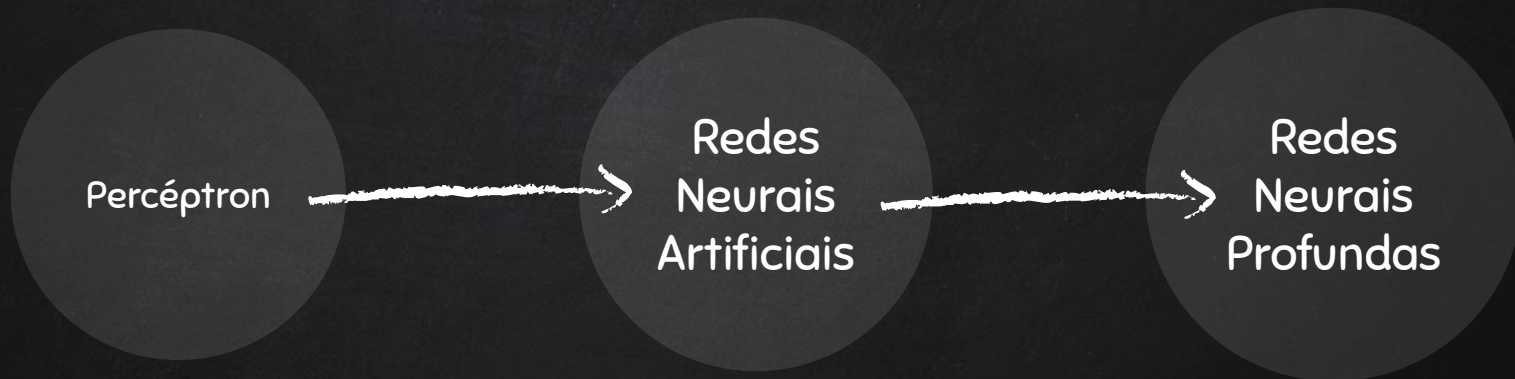
## GEOFFREY HINTON



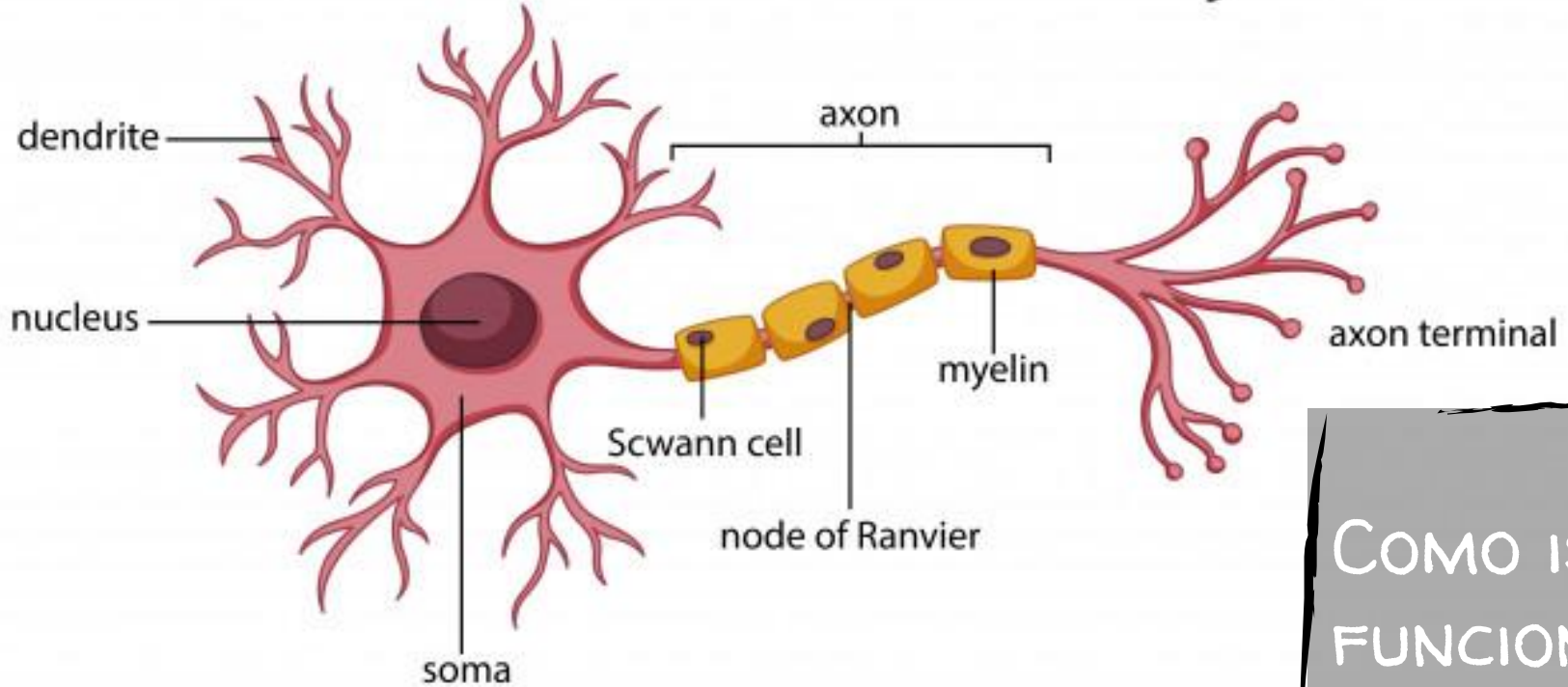
The GodFather of Deep Learning  
Passou décadas estudando redes neurais, hoje trabalha no Google, e leciona na Universidade de Toronto no Canadá.



## ENTENDENDO AS ORIGENS

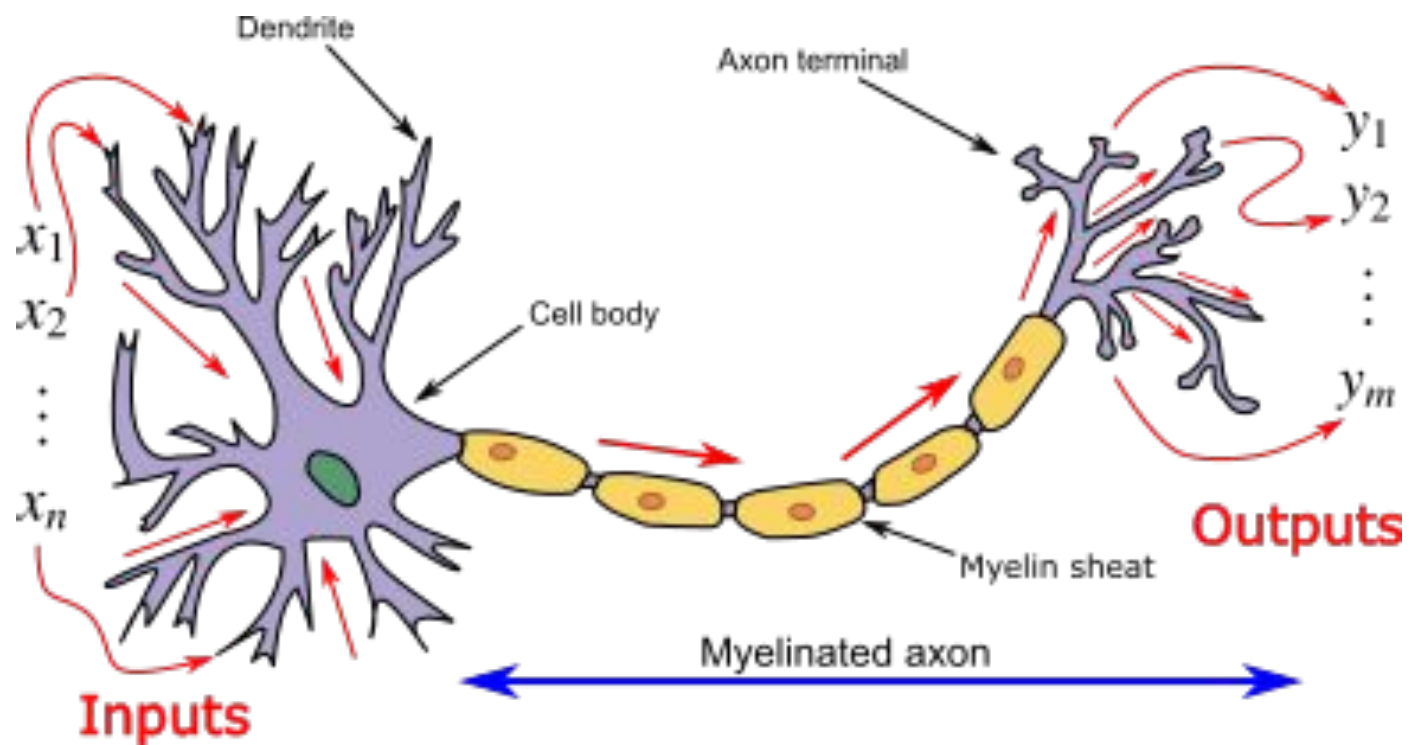


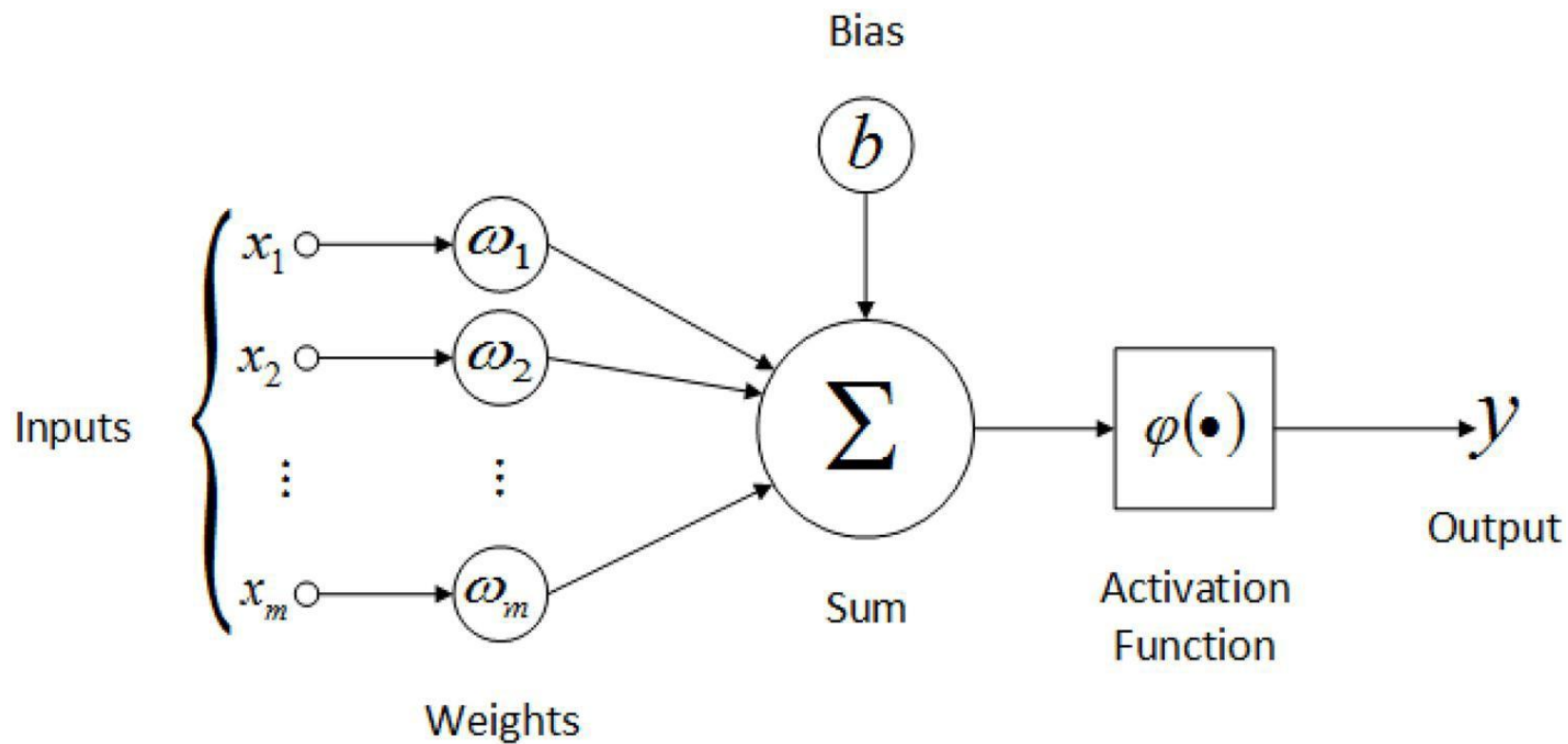
# Neuron Anatomy



COMO ISSO  
FUNCIONA?

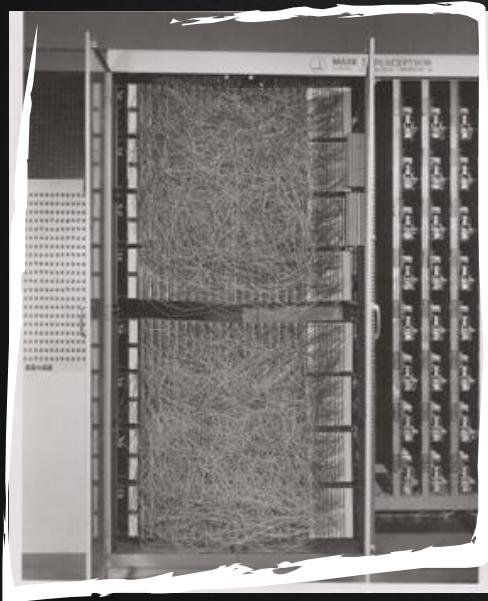








## BACK TO THE FUTURE

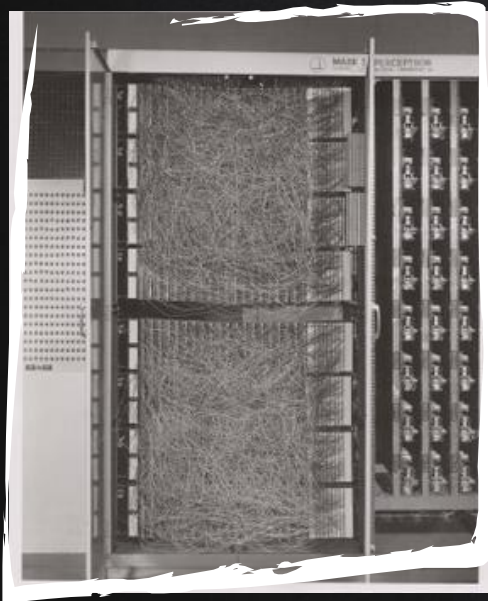


The perceptron algorithm was invented in 1957 at the Cornell Aeronautical Laboratory by Frank Rosenblatt,<sup>[3]</sup> funded by the United States Office of Naval Research.<sup>[4]</sup>

The perceptron was **intended to be a machine**, rather than a program, and while its first implementation was in software for the IBM 704, it was subsequently implemented in custom-built hardware as the "Mark 1 perceptron".



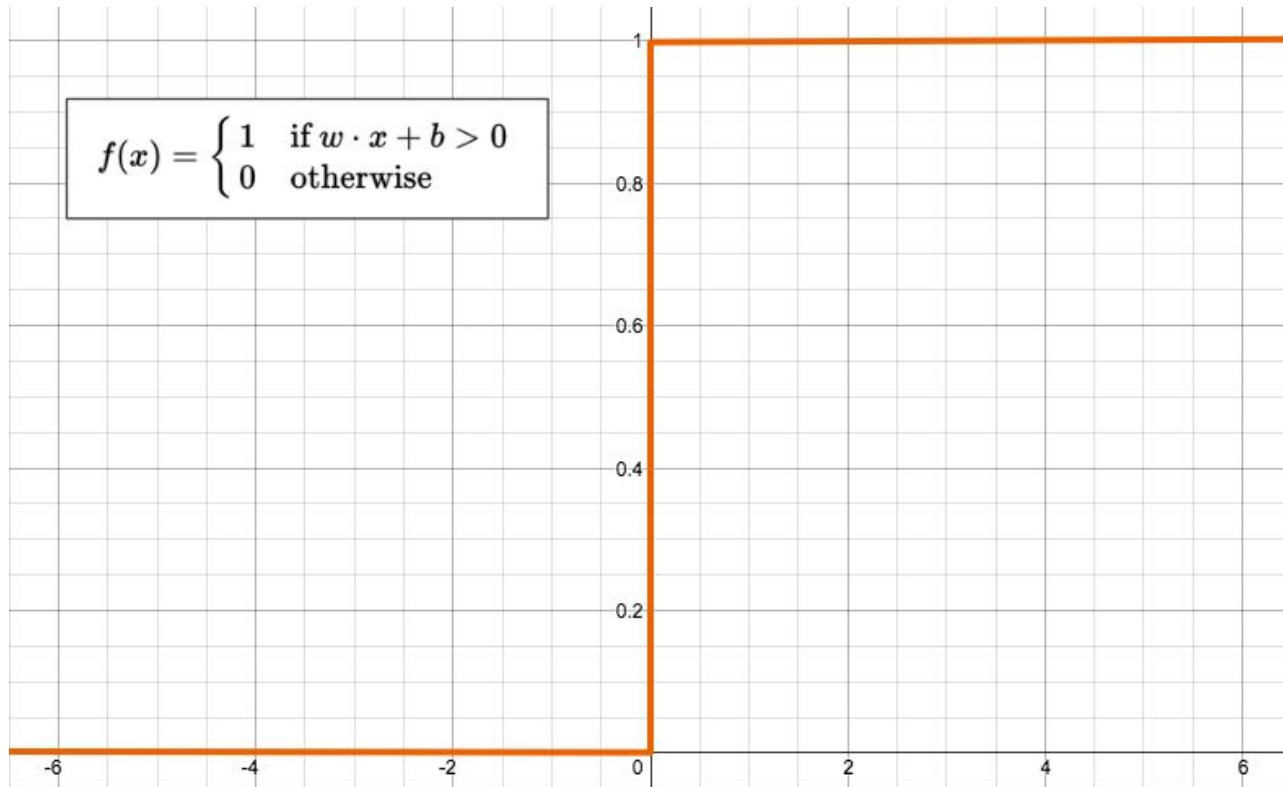
# GEOFFREY HINTON



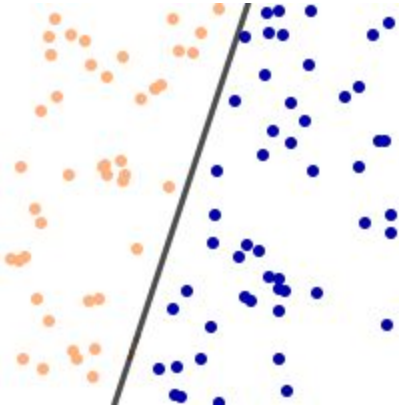
This machine was designed for image recognition: it had an array of 400 photocells, randomly connected to the "neurons". Weights were encoded in potentiometers, and weight updates during learning were performed by electric motors.<sup>[2]:193</sup>

In a 1958 press conference organized by the US Navy, Rosenblatt made statements about the perceptron that caused a heated controversy among the fledgling AI community; based on Rosenblatt's statements, The New York Times reported the perceptron to be "the embryo of an electronic computer that [the Navy] expects will be able to **walk, talk, see, write, reproduce itself and be conscious** of its existence."<sup>[4]</sup>





<https://appliedgo.net/perceptron/>



<https://appliedgo.net/perceptron/>



**MATH**

**MATH IS EVERYWHERE**

makeameme.org

<https://github.com/nikhilc3013/Perceptron-model/>







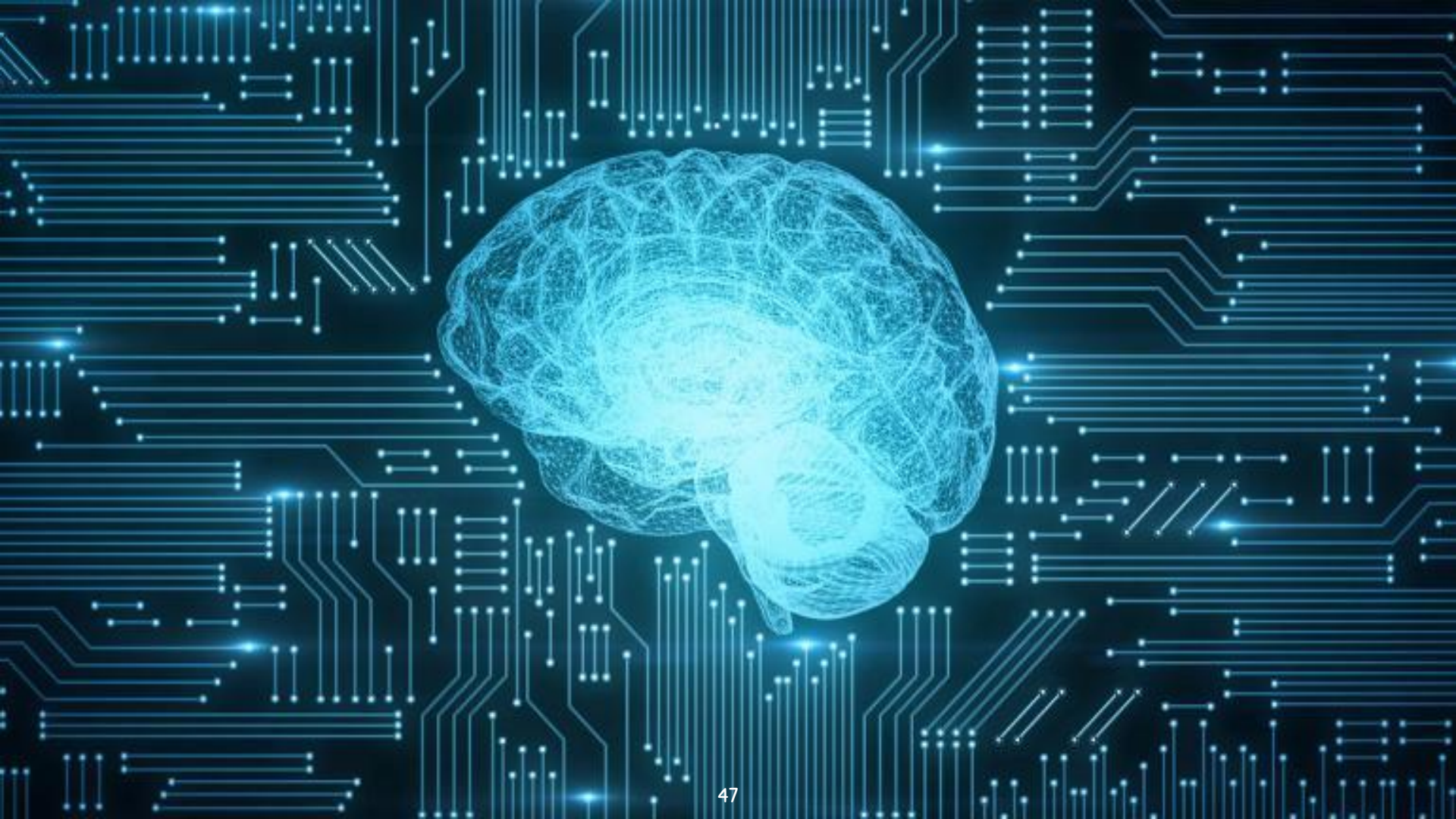
ONDE APLICAR

?

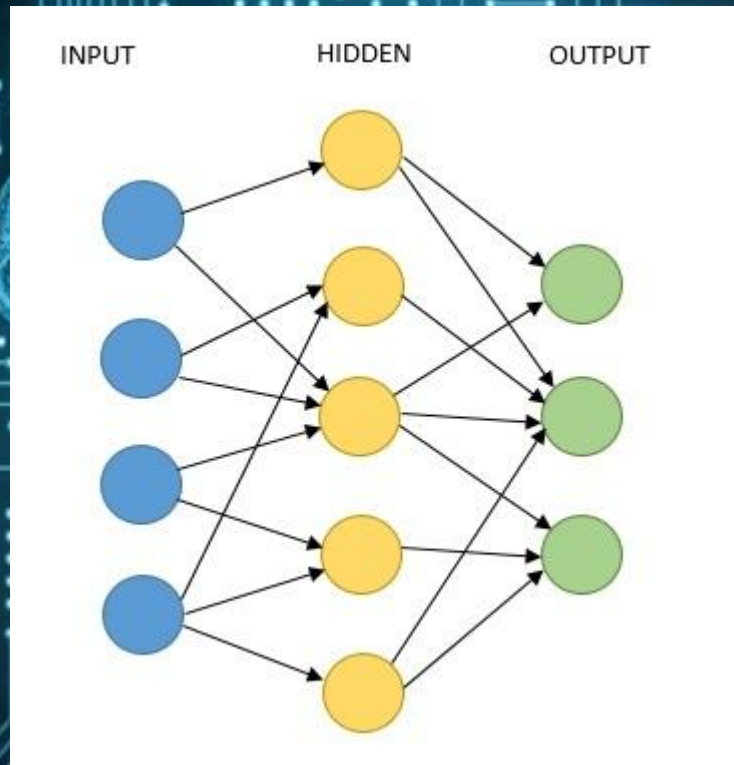


ONDE APLICAR

Muito bem,  
mas e daí?

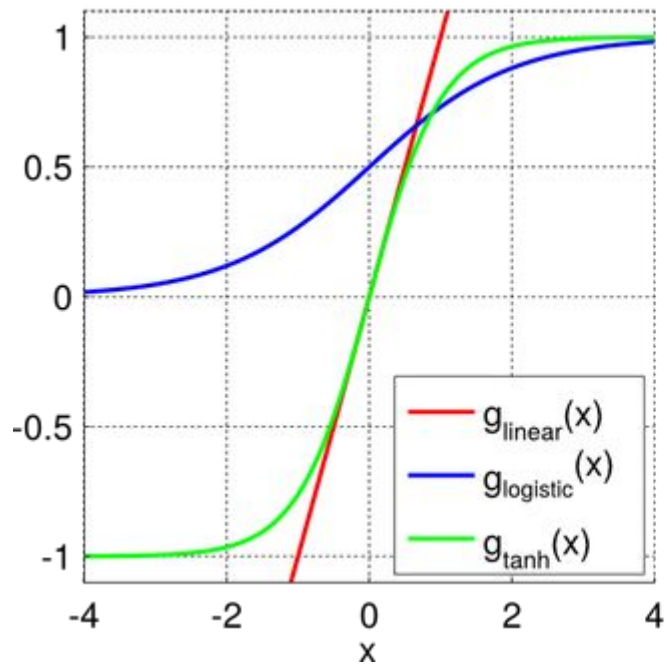




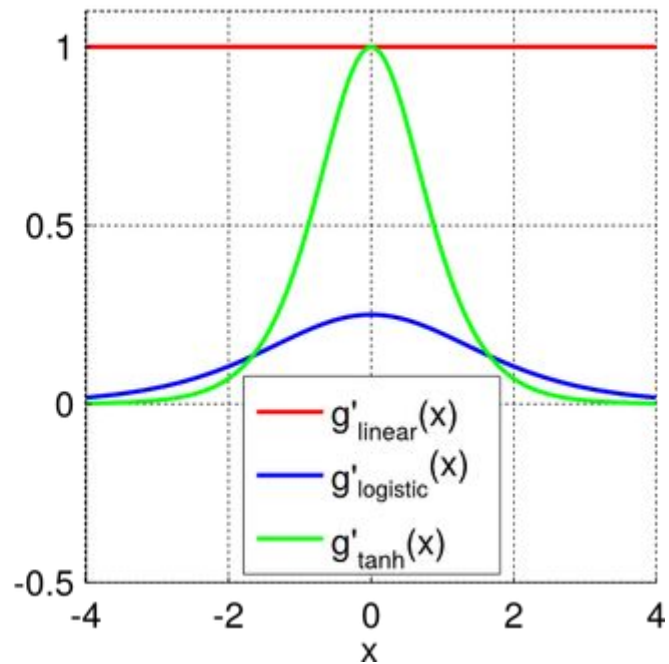




Some Common Activation Functions



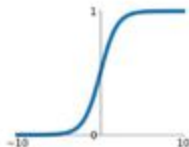
Activation Function Derivatives



# Activation Functions

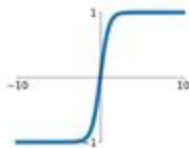
**Sigmoid**

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



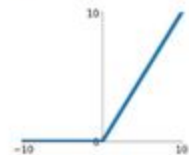
**tanh**

$$\tanh(x)$$



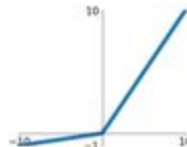
**ReLU**

$$\max(0, x)$$



**Leaky ReLU**

$$\max(0.1x, x)$$

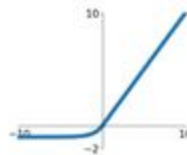


**Maxout**

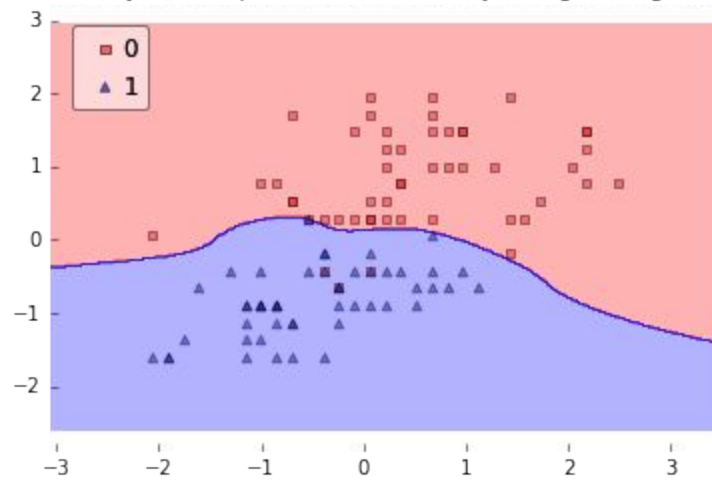
$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

**ELU**

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$

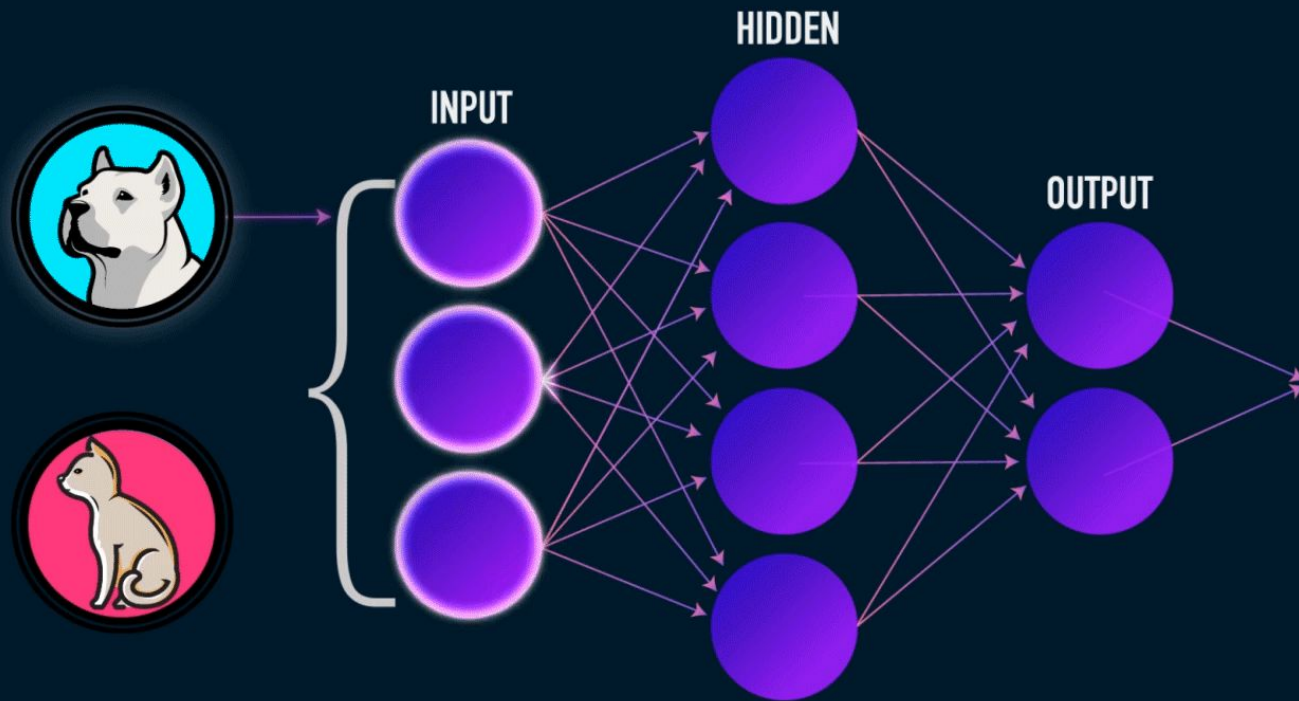


Multi-layer Perceptron w. 1 hidden layer (logistic sigmoid)







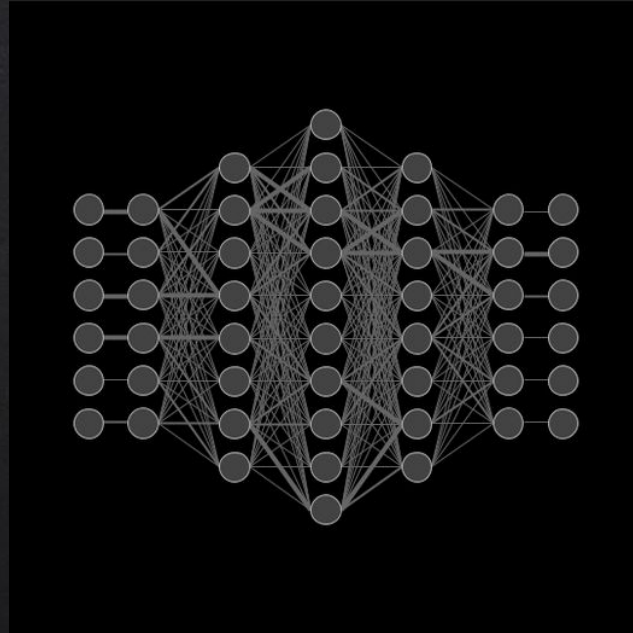




VAMOS PENSAR UM POUCO?



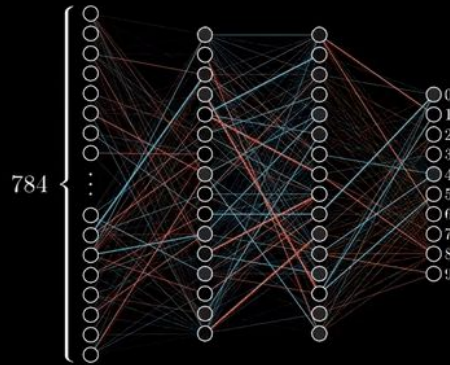
VAMOS PENSAR UM POUCO?





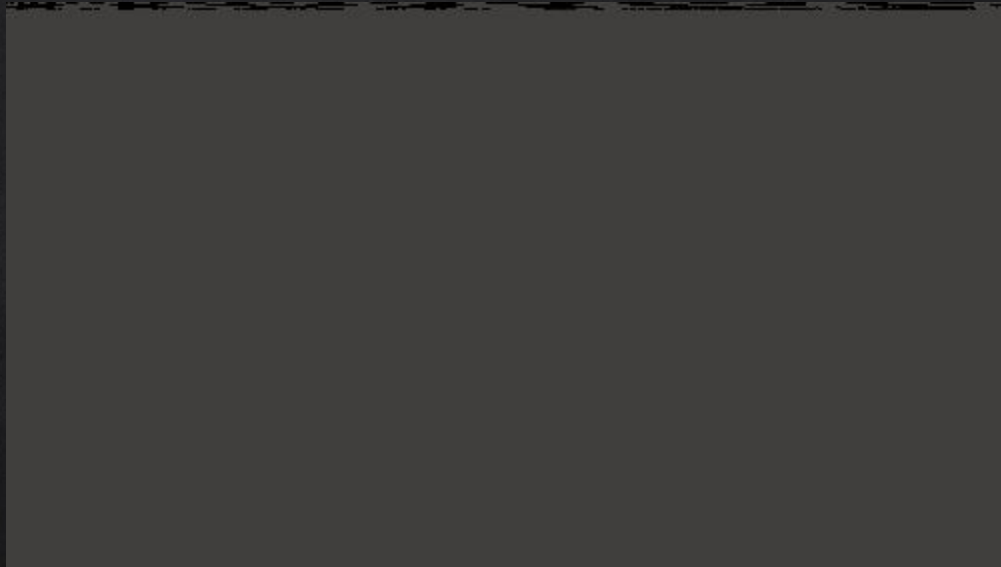
VAMOS PENSAR UM POUCO?

Training in  
progress...





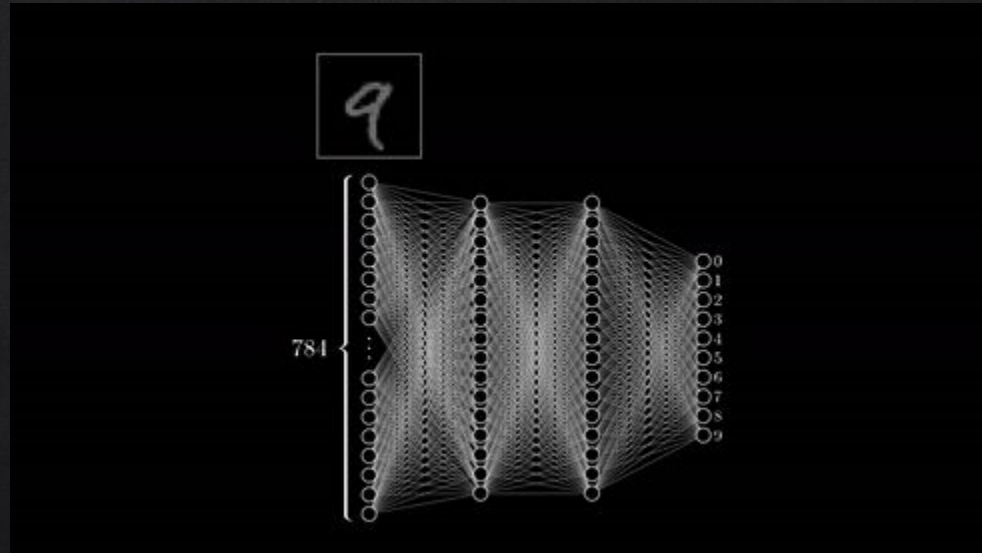
VAMOS PENSAR UM POUCO?







VAMOS PENSAR UM POUCO?



Input Volume (+pad 1) (7x7x3)

 $x[:, :, 0]$ 

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 2 | 0 |
| 0 | 1 | 0 | 2 | 0 | 1 | 0 |

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 2 | 2 | 0 | 0 |
| 0 | 2 | 0 | 0 | 2 | 0 | 0 |
| 0 | 2 | 1 | 2 | 2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

 $x[:, :, 1]$ 

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2 | 1 | 2 | 1 | 1 | 0 |
| 0 | 2 | 1 | 2 | 0 | 1 | 0 |

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 0 | 2 | 1 | 0 | 1 | 0 |
| 0 | 1 | 2 | 2 | 2 | 2 | 0 |
| 0 | 0 | 1 | 2 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

 $x[:, :, 2]$ 

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2 | 1 | 1 | 2 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 |

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 2 | 1 | 0 | 0 |
| 0 | 2 | 2 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Filter W0 (3x3x3)

 $w0[:, :, 0]$ 

|    |    |   |
|----|----|---|
| -1 | 0  | 1 |
| 0  | 0  | 1 |
| 1  | -1 | 1 |

 $w0[:, :, 1]$ 

|    |    |   |
|----|----|---|
| -1 | 0  | 1 |
| 1  | -1 | 1 |
| 0  | 1  | 0 |

 $w0[:, :, 2]$ 

|    |    |   |
|----|----|---|
| -1 | 1  | 1 |
| 1  | 1  | 0 |
| 0  | -1 | 0 |

Bias b0 (1x1x1)

 $b0[:, :, 0]$ 

|   |
|---|
| 1 |
|---|

Filter W1 (3x3x3)

 $w1[:, :, 0]$ 

|   |    |    |
|---|----|----|
| 0 | 1  | -1 |
| 0 | -1 | 0  |
| 0 | -1 | 1  |

 $w1[:, :, 1]$ 

|    |    |   |
|----|----|---|
| -1 | 0  | 0 |
| 1  | -1 | 0 |
| 1  | -1 | 0 |

 $w1[:, :, 2]$ 

|    |    |    |
|----|----|----|
| -1 | 1  | -1 |
| 0  | -1 | -1 |
| 1  | 0  | 0  |

Bias b1 (1x1x1)

 $b1[:, :, 0]$ 

|   |
|---|
| 0 |
|---|

Output Volume (3x3x2)

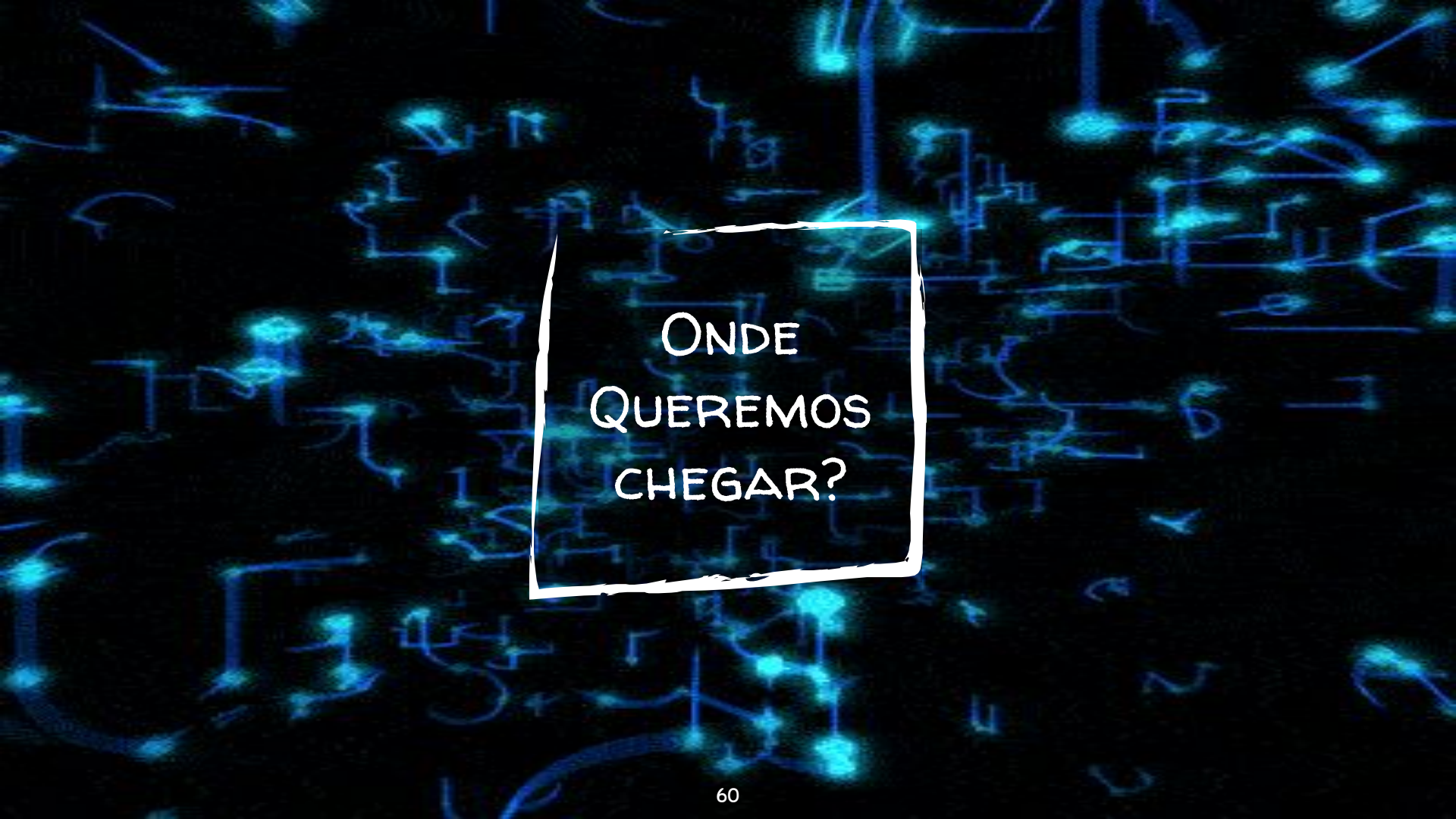
 $o[:, :, 0]$ 

|   |    |    |
|---|----|----|
| 2 | 3  | 3  |
| 3 | 7  | 3  |
| 8 | 10 | -3 |

 $o[:, :, 1]$ 

|    |    |    |
|----|----|----|
| -8 | -8 | -3 |
| -3 | 1  | 0  |
| -3 | -8 | -5 |

toggle movement



ONDE  
QUEREMOS  
CHEGAR?



# DOMINAÇÃO MUNDIAL







Iterations  
000,973

Learning rate  
0.01

Activation  
ReLU

Regularization  
None

Regularization rate  
0

Problem type  
Classification

## DATA

Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



Batch size: 5



REGENERATE

## INPUT

Which properties do you want to feed in?



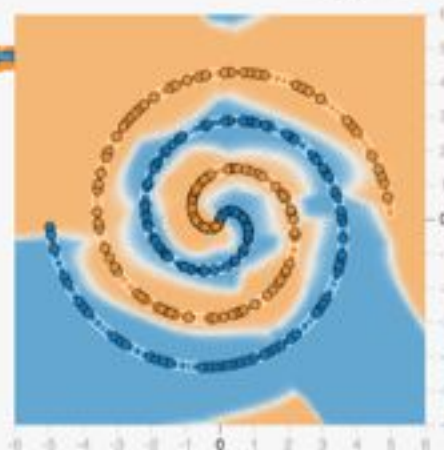
+ - 1 HIDDEN LAYER

+ -  
8 neurons



## OUTPUT

Test loss 0.018  
Training loss 0.007



Colors shows  
data, neuron and  
weight values.



☒ Show test data

☐ Discretize output



Vamos tocar juntos?



<https://experiments.withgoogle.com/ai/ai-duet/view/>

É o Nicolas Cage?



<https://youtu.be/BU9YAHigNx8>

DeepFake BABE!



<https://youtu.be/cQ54GDm1eL0>

Gostaram?





# Vamos Começar?

1. Preencha seus dados na lista de chamadas
  - <https://bit.ly/dl-unb-2019-02>
2. Aceite o convite para participar de
  - <https://github.com/deeplearningunb>
3. Entre no canal de telegram
  - <https://t.me/DeepLearningUnB>

Querem mais?





OBRIGADO!

Dúvidas?

<http://bit.ly/dl-unb01>  
<https://t.me/DeepLearningUnB>  
@diegodorgam

## CREDITS

Special thanks to all the people who made and released these awesome resources for free:

- ✕ Presentation template by SlidesCarnival
- ✕ Photographs by Unsplash