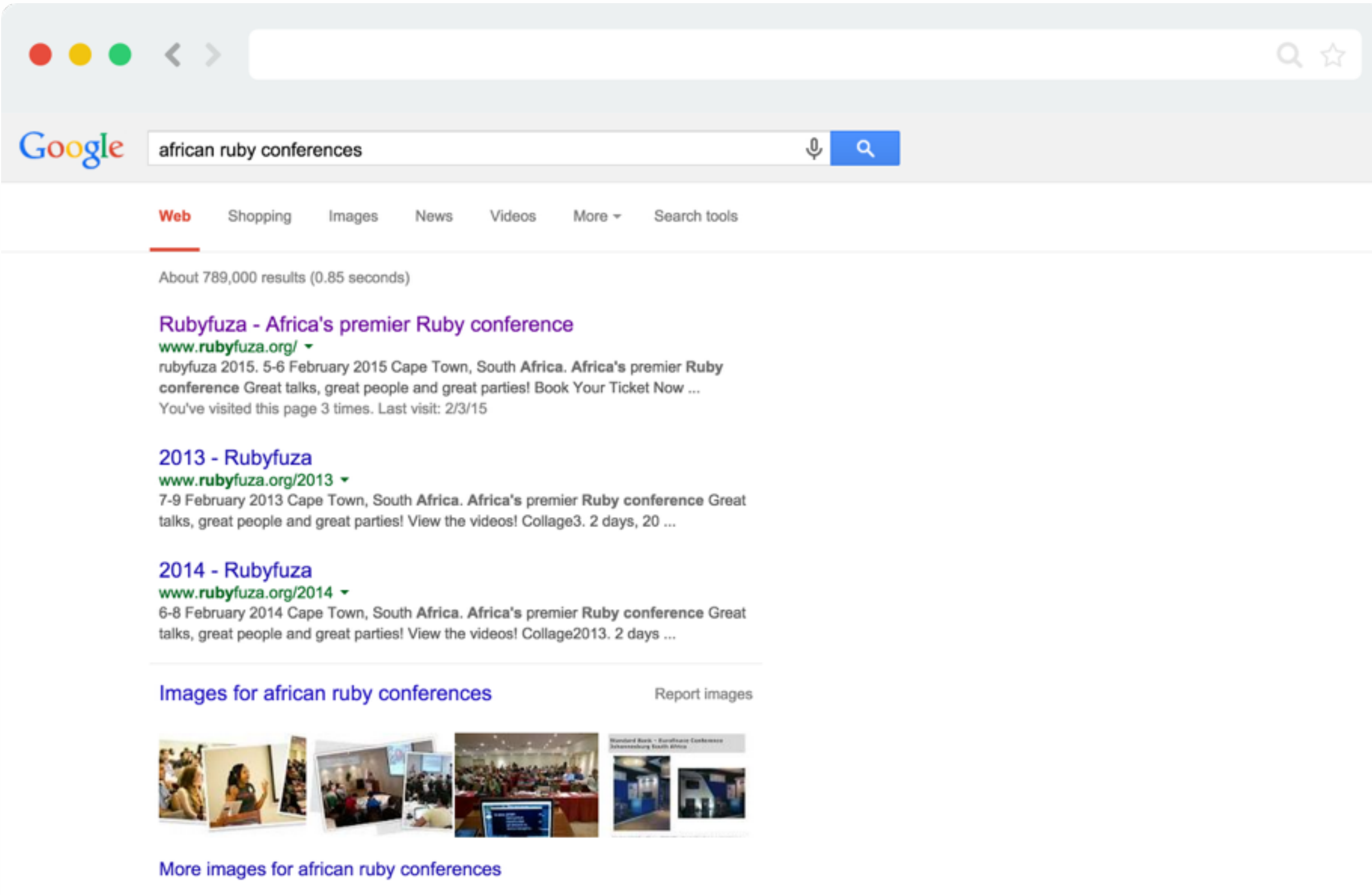
# HOW TO **DIAGNOSE CANCER** WITH **MACHINE LEARNING**

WITH @SIGHMIN

# HOW TO **DIAGNOSE CANCER** WITH **MACHINE LEARNING**

AND SHOW THAT MACHINE LEARNING IS FUN AND ACCESSIBLE TO ANYONE

# CONFERENCE!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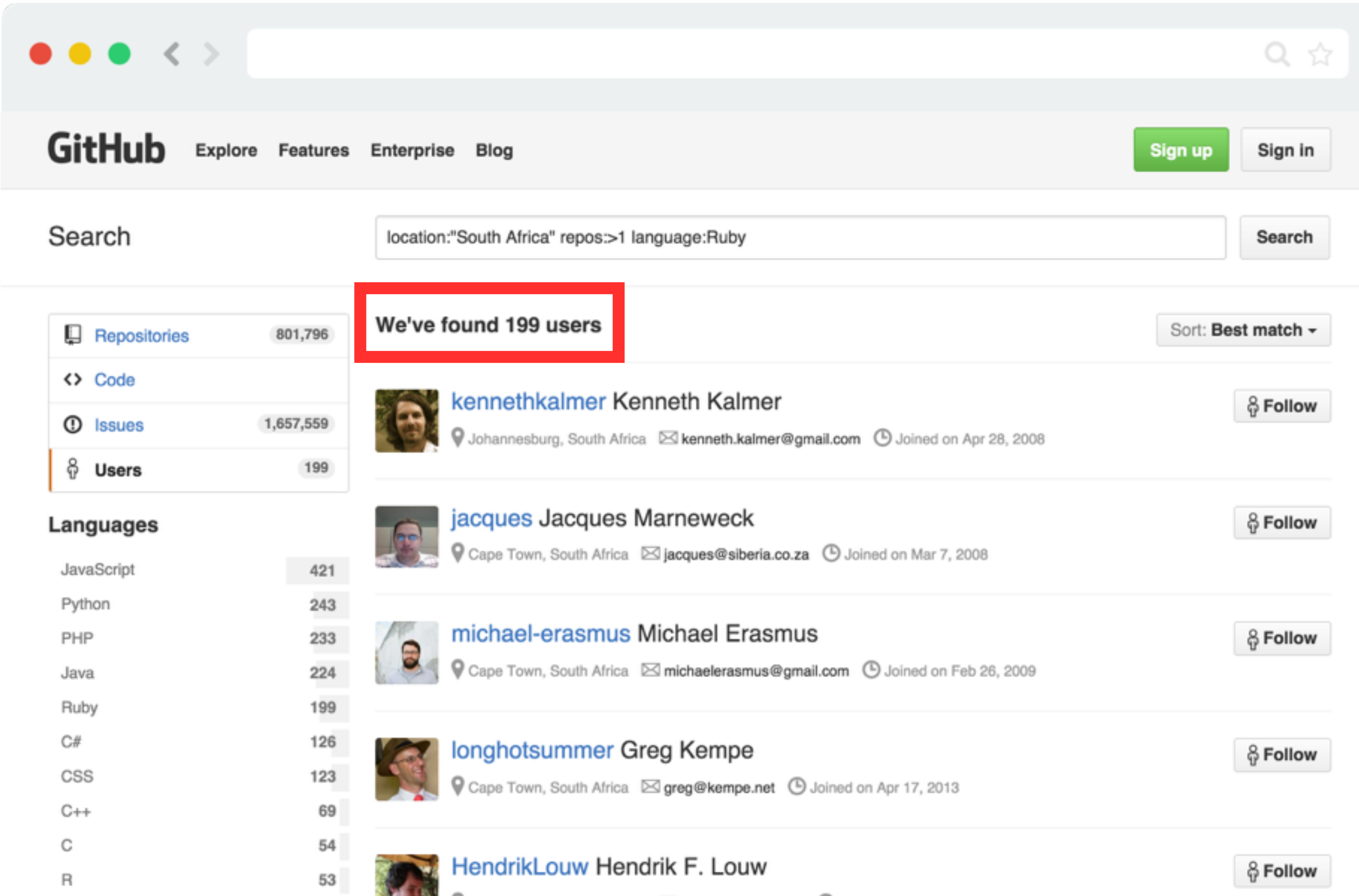
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We've found 199 users
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kennethkalmer Kenneth Kalmer
Johannesburg, South Africa kenneth.kalmer@gmail.com Joined on Apr 28, 2008
Follow
jacques Jacques Marneweck
Cape Town, South Africa jacques@siberia.co.za Joined on Mar 7, 2008
Follow
michael-erasmus Michael Erasmus
Cape Town, South Africa michaelerasmus@gmail.com Joined on Feb 26, 2009
Follow
longhotsummer Greg Kempe
Cape Town, South Africa greg@kempe.net Joined on Apr 17, 2013
Follow
HendrikLouw Hendrik F. Louw
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# FACT!

SOUTH AFRICA HAS THE LONGEST WINE ROUTE IN THE WORLD.

THE WORLD'S LARGEST DIAMOND WAS THE CULLINAN DIAMOND, FOUND IN SOUTH AFRICA IN 1905.

SOUTH AFRICA HAS THE HIGHEST COMMERCIAL BUNGI JUMP IN THE WORLD (710 FEET).

# FACT!

SOUTH AFRICA HAS THE CHEAPEST ELECTRICITY IN THE WORLD.

. . . WE ALSO DON'T HAVE ENOUGH

SOUTH AFRICA IS THE ONLY COUNTRY IN THE WORLD TO VOLUNTARILY ABANDON ITS NUCLEAR WEAPONS PROGRAM.

# FACT!

DR. CHRISTIAAN BARNARD, AT GROOTE SCHUUR HOSPITAL IN CAPE TOWN, PERFORMED THE FIRST HUMAN HEART TRANSPLANT IN THE WORLD IN 1967.

(WE HAVE BADASS DOCTORS)

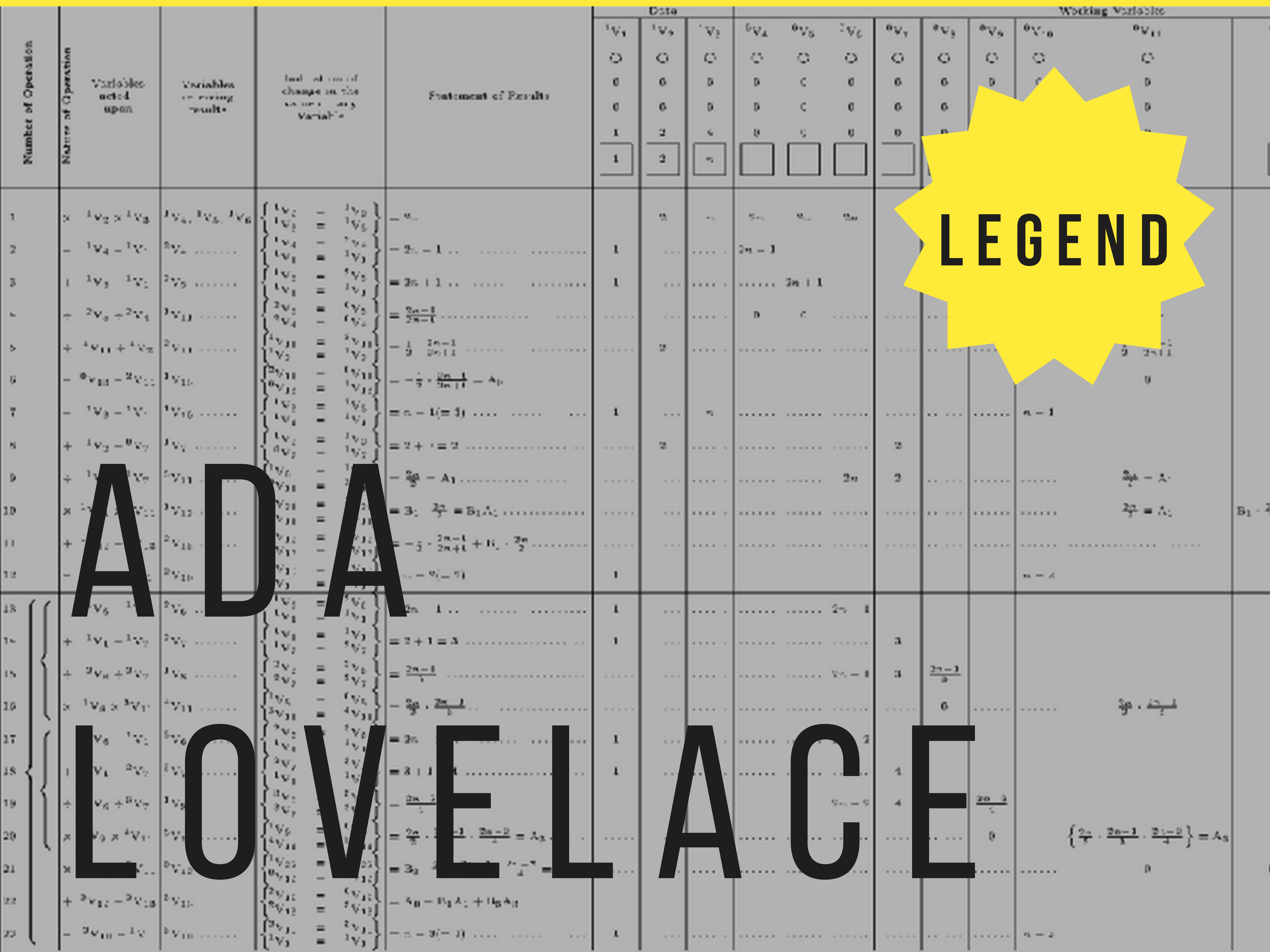
ELON MUSK IS SOUTH AFRICAN

(WE HAVE BADASS ENGINEERS)

# HOW TO DIAGNOSE CANCER WITH MACHINE LEARNING

WITH @SIGHMIN


LEGEND
CHARLES BABBAGE


LEGEND
ADA LOVELACE

# WHAT ARE MODELS?

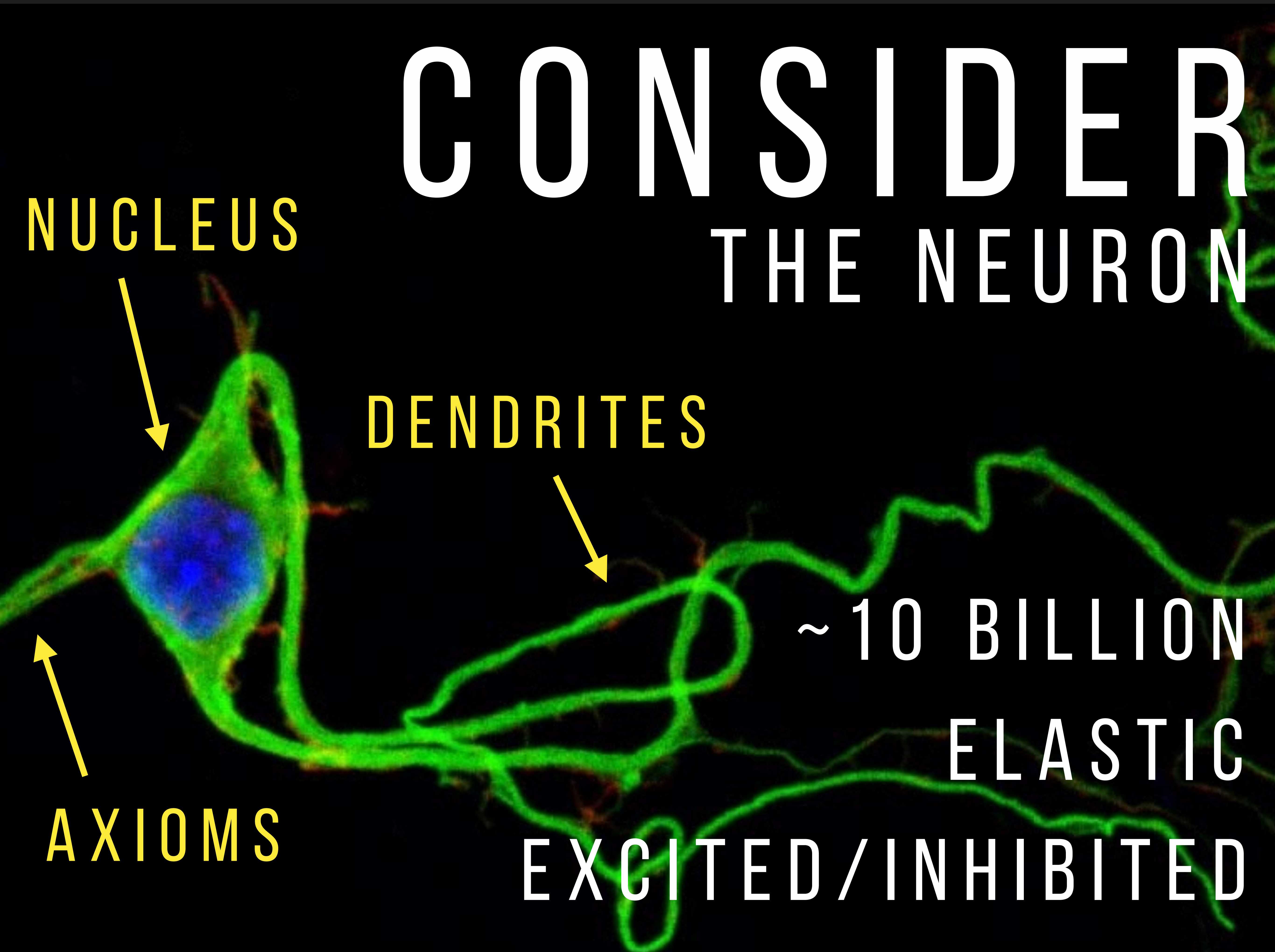
COMPUTER FOLDER

SERVER CLIPBOARD

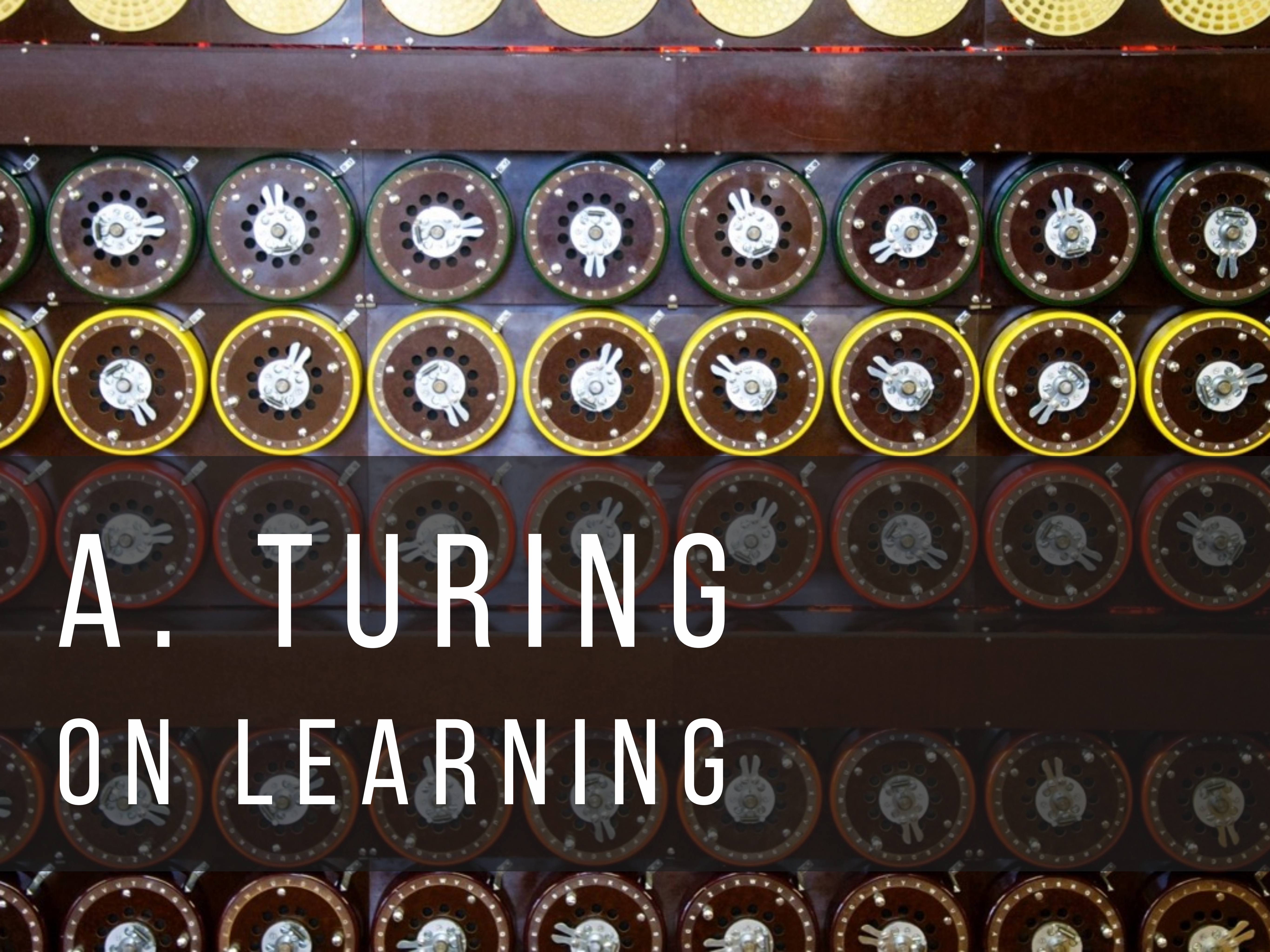
DESKTOP WINDOWS

THE

# ARTIFICIAL NEURAL NETWORK

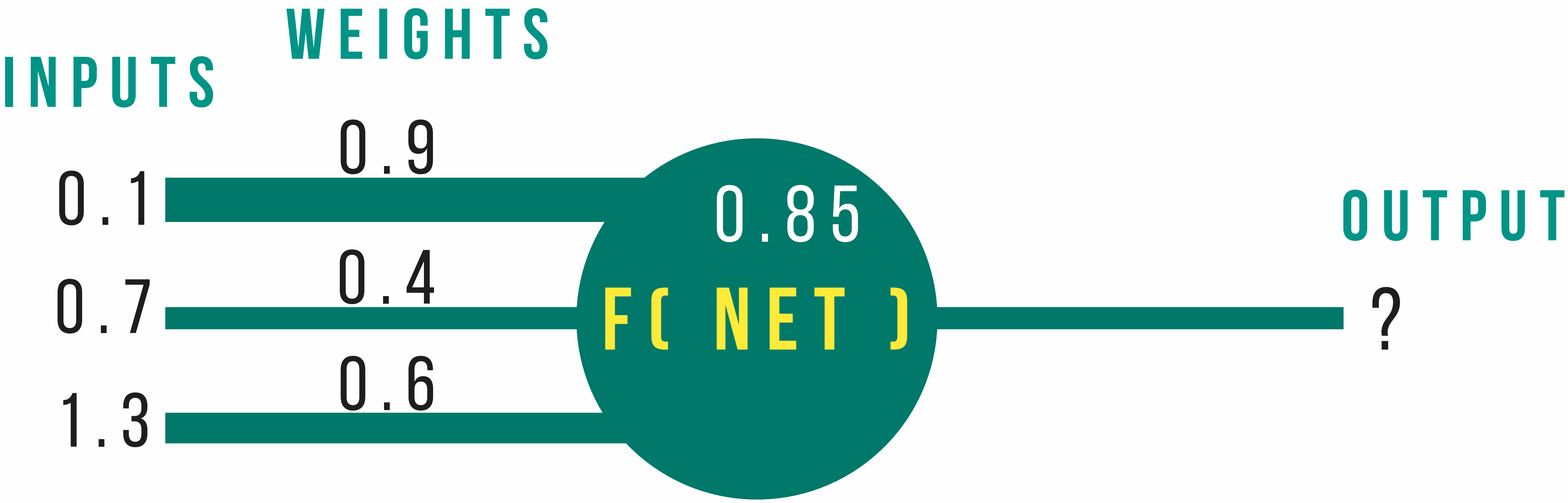

CONSIDER
THE NEURON
NUCLEUS
DENDRITES
AXIOMS
~10 BILLION
ELASTIC
EXCITED/INHIBITED

“APPROXIMATE THE GENERALISATION OF KNOWLEDGE & DISCOVERY — THEY LEARN”



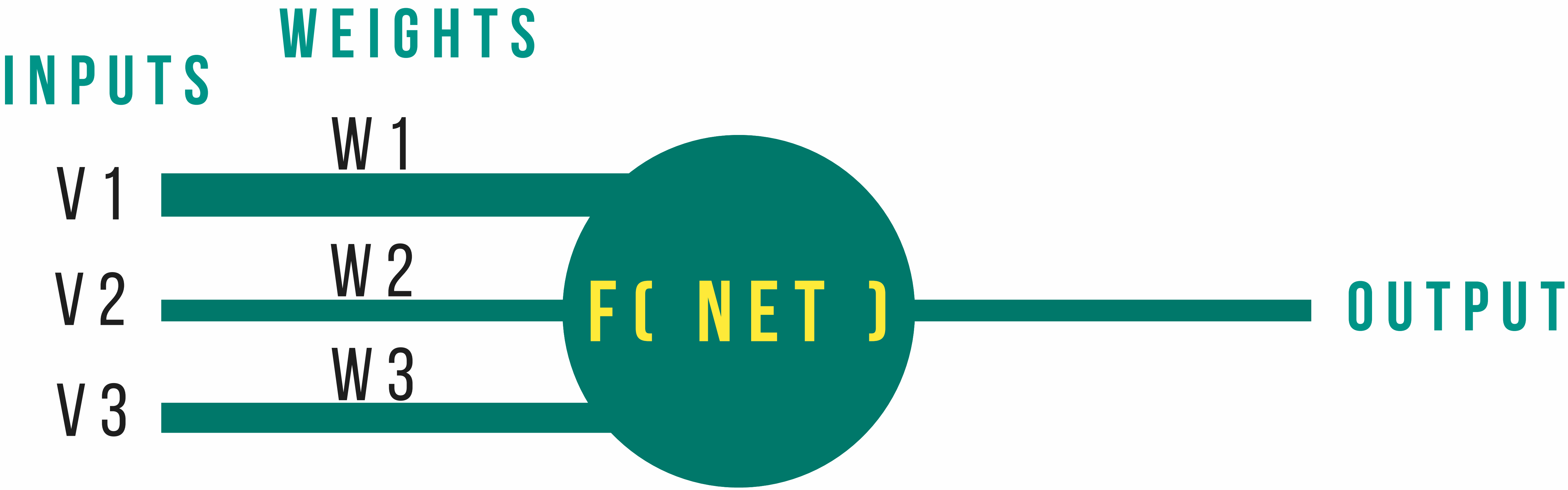
# A. TURING
# ON LEARNING

# PERCEPTRON




NET = 0.1*0.9 + 0.7*0.4 + 1.3*0.6

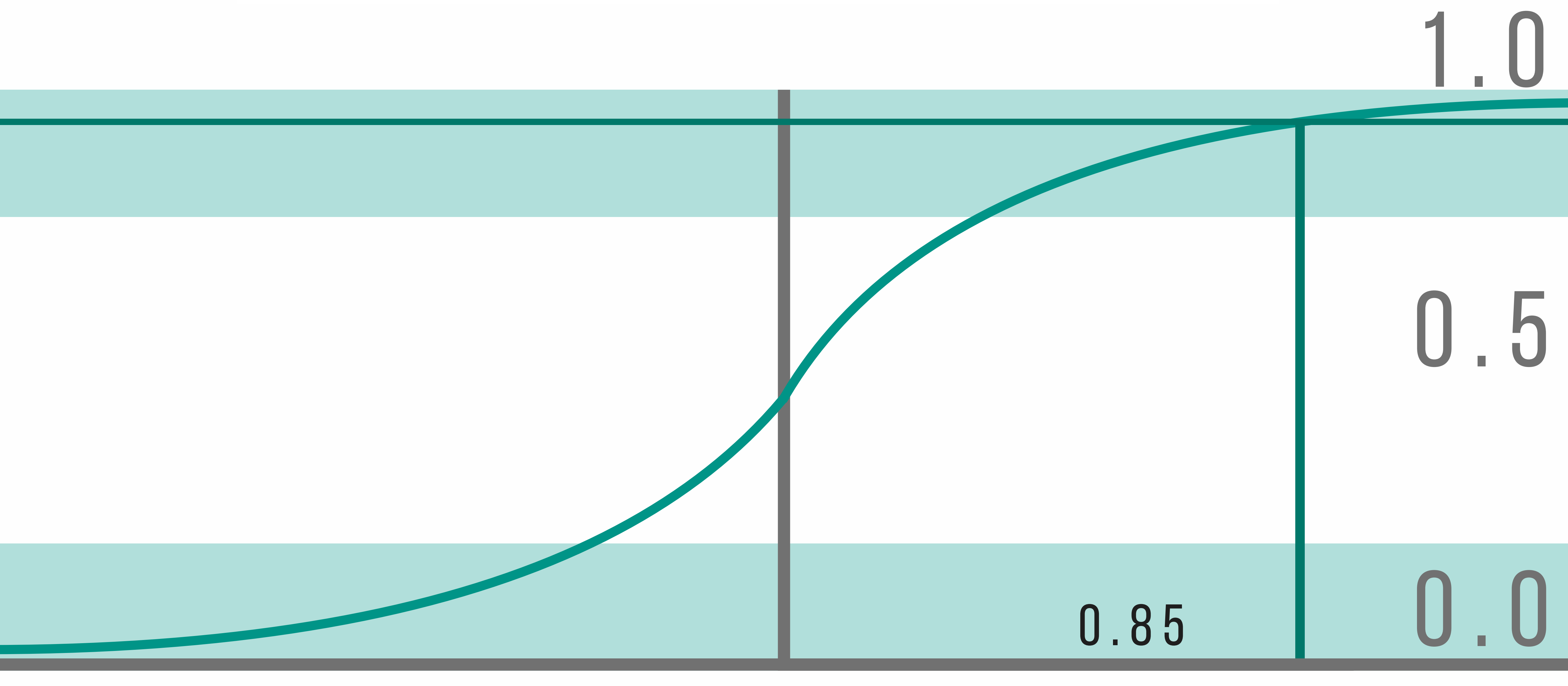
# PERCEPTRON




$$NET = V1*W1 + V2*W2 + V3*W3$$

# OUT = F(NET)

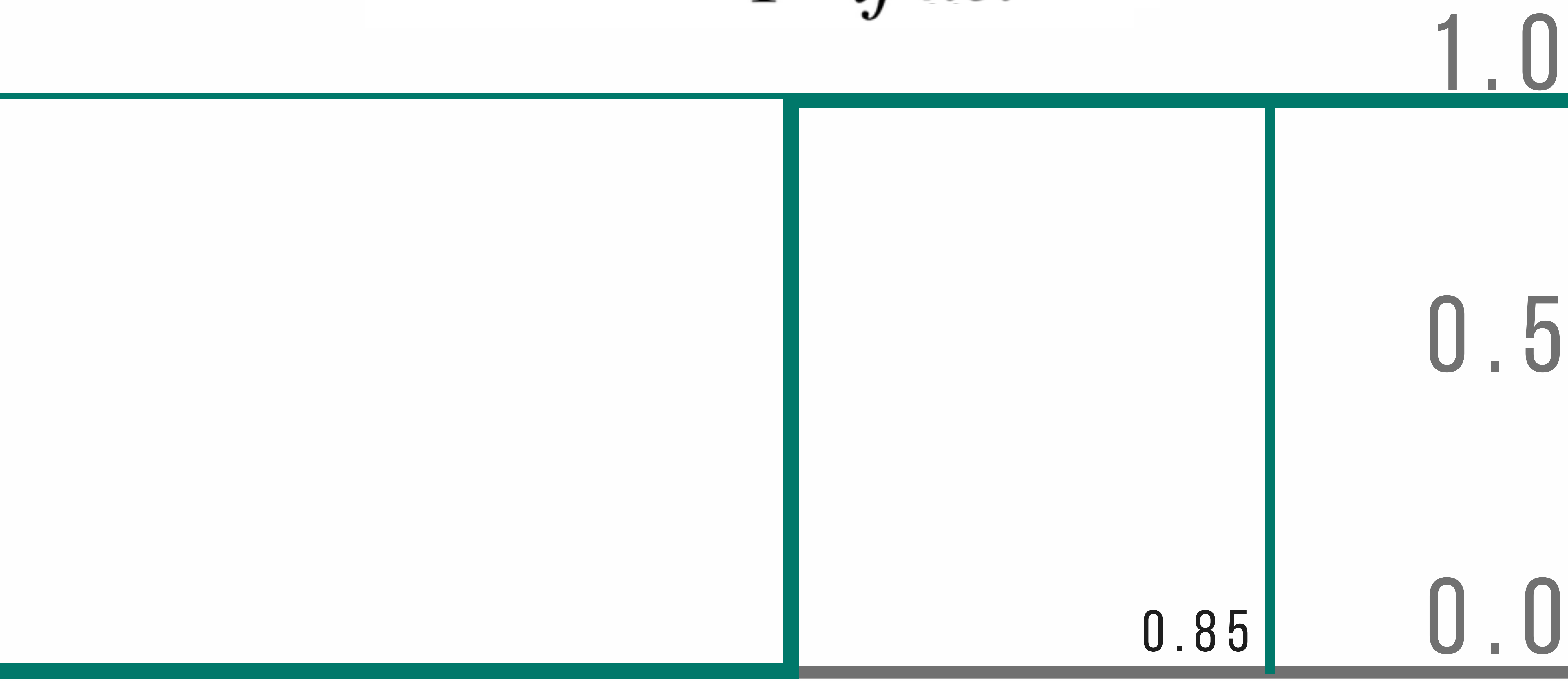
$$f(net) = \frac{1}{1+e^{-net}}$$



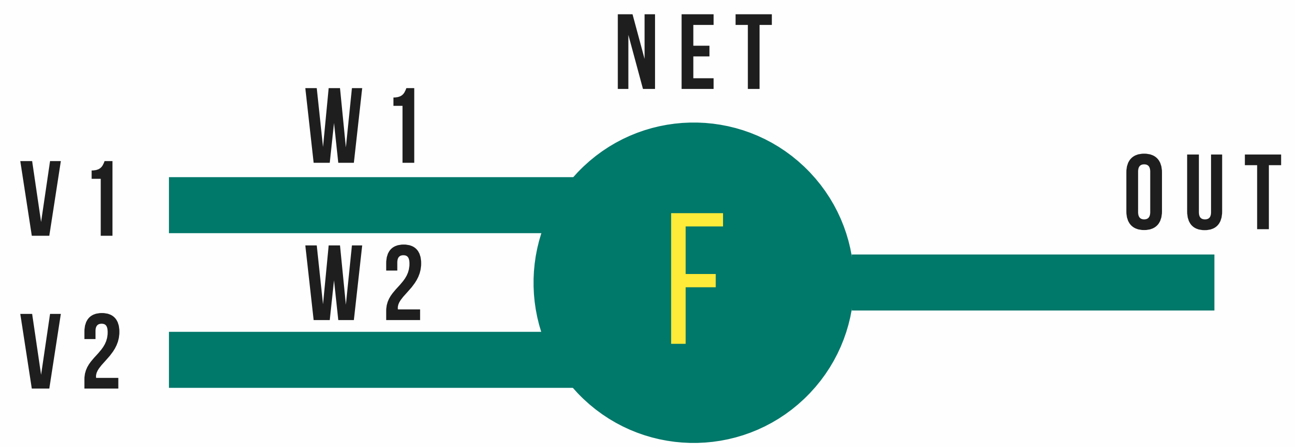
# OUT = F(NET)

STEP

$$f(net) = \begin{cases} 0 & \text{if } net \le 0 \\ 1 & \text{if } net > 0 \end{cases}$$

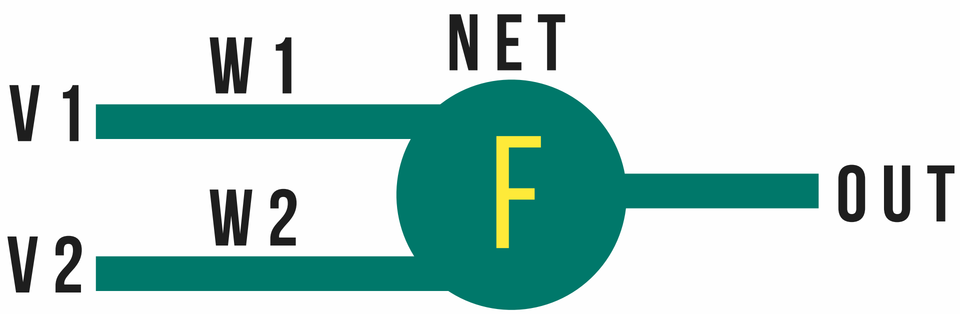


# EXAMPLE: OR




TEACH THE PERCEPTRON BY GUESSING THE "WEIGHTS"

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 1 | |
| 1 | 1 | 1 | |




$$f(net) = \begin{cases} 0 & \text{if } net \leq 0 \\ 1 & \text{if } net > 0 \end{cases}$$

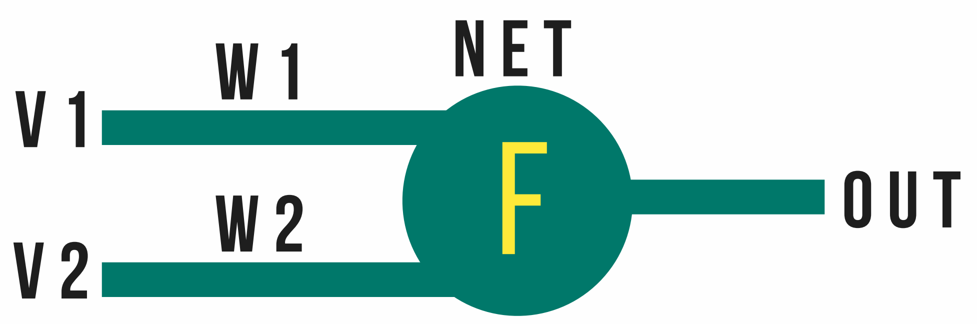
NET = V1*W1 + V2*W2

= …

OUT = F(NET)

= …

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | X |
| 0 | 1 | 1 | |
| 1 | 0 | 1 | |
| 1 | 1 | 1 | |

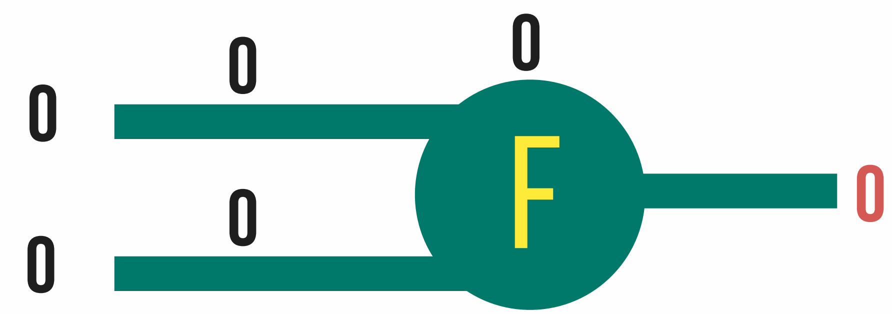



$$f(net) = \begin{cases} 0 & if\ net \leq 0 \\ 1 & if\ net > 0 \end{cases}$$

NET = V1*W1 + V2*W2 = ...

OUT = F(NET) = X

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | |
| 1 | 0 | 1 | |
| 1 | 1 | 1 | |

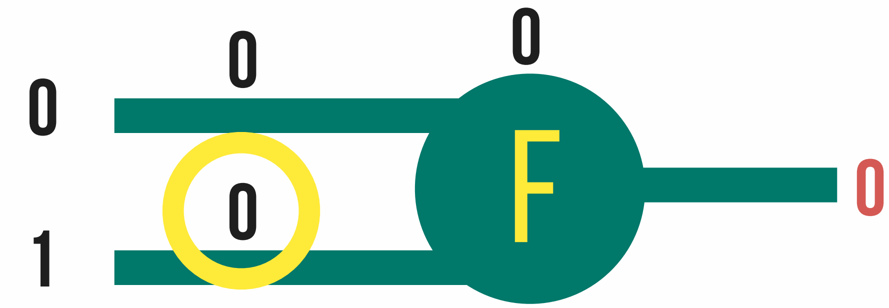



$$f(net) = \begin{cases} 0 & \text{if } net \le 0 \\ 1 & \text{if } net > 0 \end{cases}$$

NET = 0*0
+ 0*0
= 0

OUT = F(0)
= 0

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | |
| 1 | 1 | 1 | |




$$f(net) = \begin{cases} 0 & \text{if } net \leq 0 \\ 1 & \text{if } net > 0 \end{cases}$$

NET = 0*0

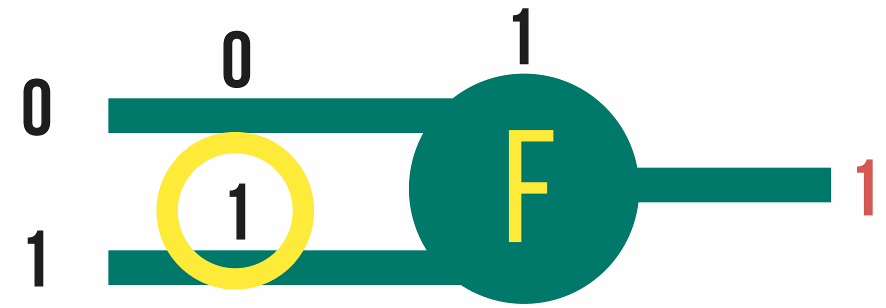
+ 1*0

= 0

OUT = F(0)

= 0

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | |
| 1 | 1 | 1 | |

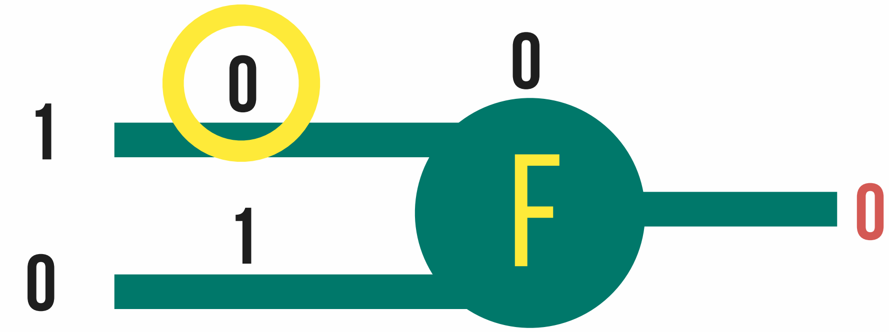



$$f(net) = \begin{cases} 0 & \text{if } net \leq 0 \\ 1 & \text{if } net > 0 \end{cases}$$

NET = 0*0
+ 1*1
= 1

OUT = F(1)
= 1

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | |

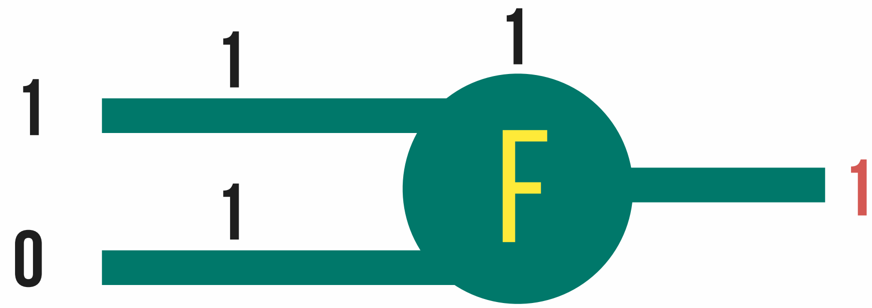



$$f(net) = \begin{cases} 0 & \text{if } net \leq 0 \\ 1 & \text{if } net > 0 \end{cases}$$

$$NET = 1*0 + 0*1 = 0$$

$$OUT = F(0) = 0$$

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | |

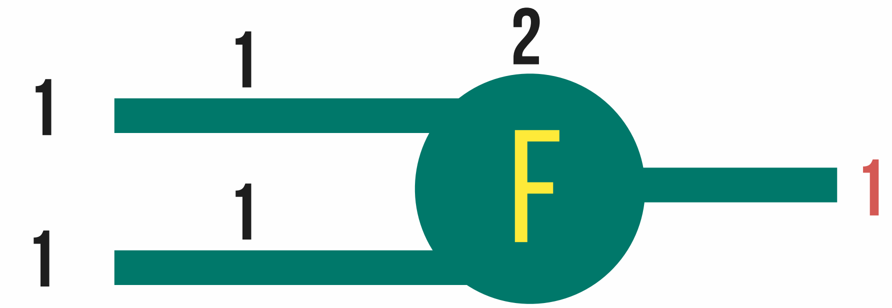



$$f(net) = \begin{cases} 0 & if\ net \leq 0 \\ 1 & if\ net > 0 \end{cases}$$

NET = 1*1
+ 0*1
= 1

OUT = F(1)
= 1

| V1 | V2 | TARGET | OUT |
| --- | --- | --- | --- |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 |




$$f(net) = \begin{cases} 0 & if\ net \le 0 \\ 1 & if\ net > 0 \end{cases}$$

NET = 1*1
+ 1*1
= 2

OUT = F(2)
= 1

# SUCCESS!

| V1 | V2 | TARGET | OUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 |

# CAN I APPROXIMATE ANY FUNCTION?

# NOPE

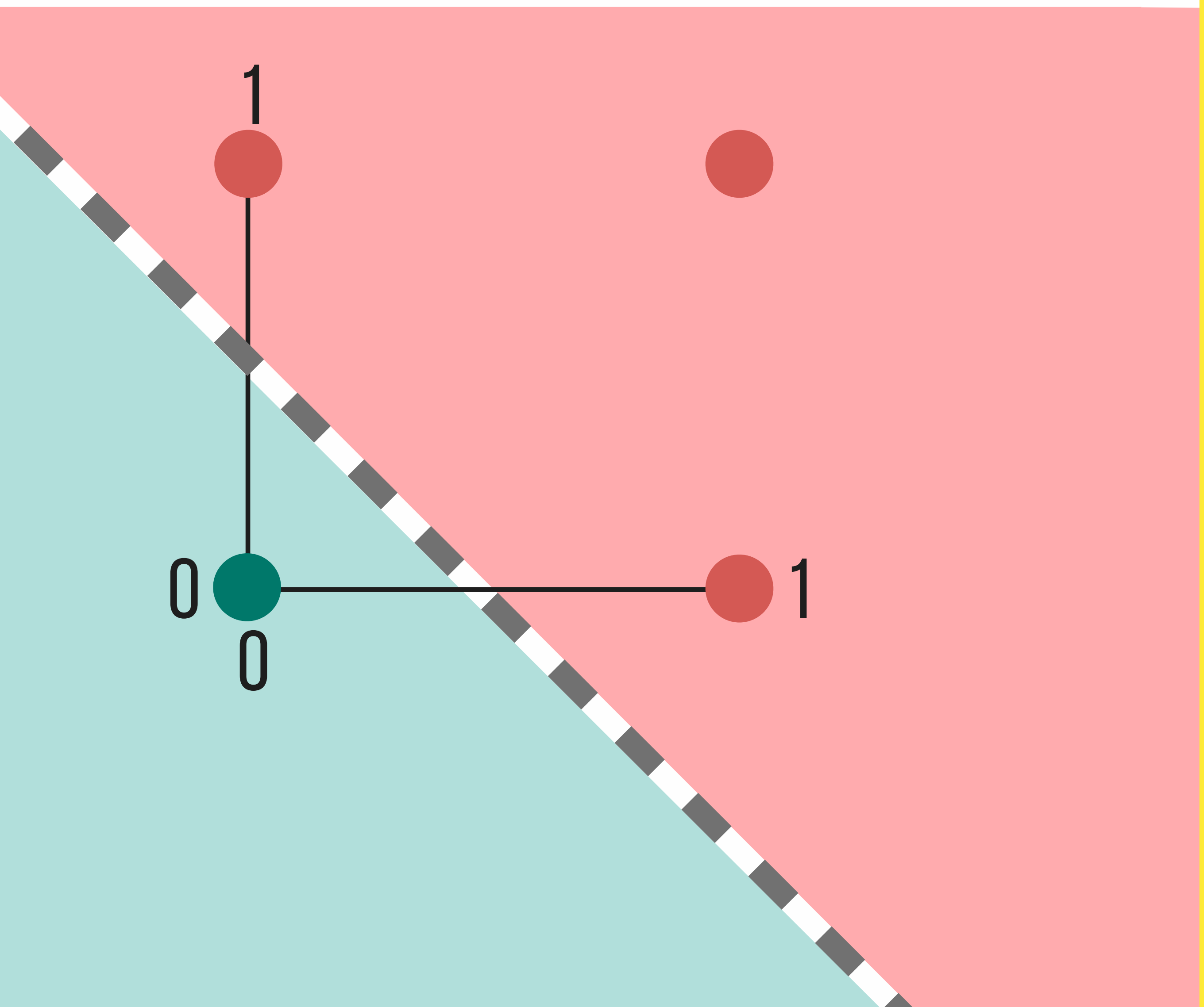
# WELL MAYBE

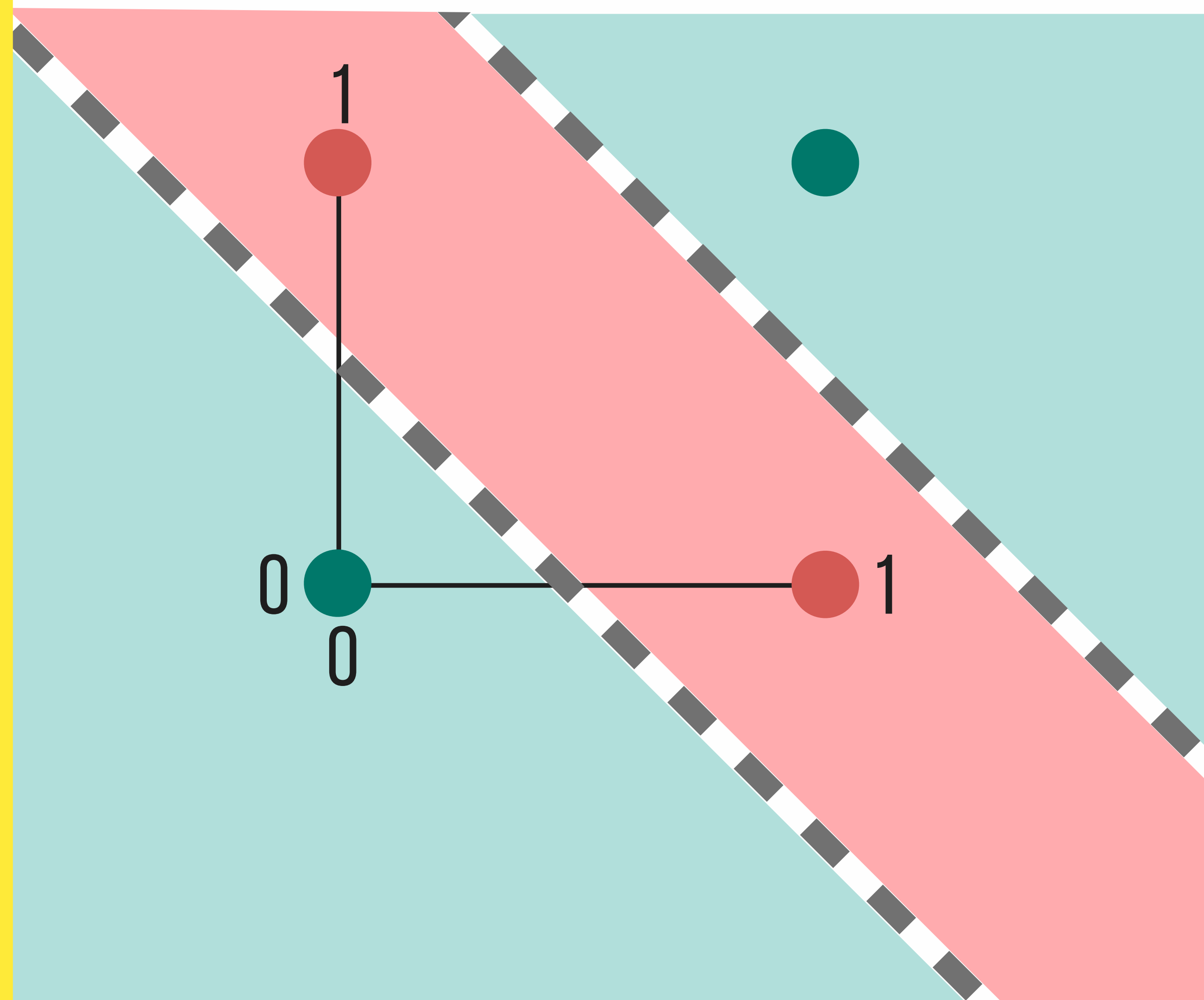
| V1 | V2 | TARGET |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

# O R

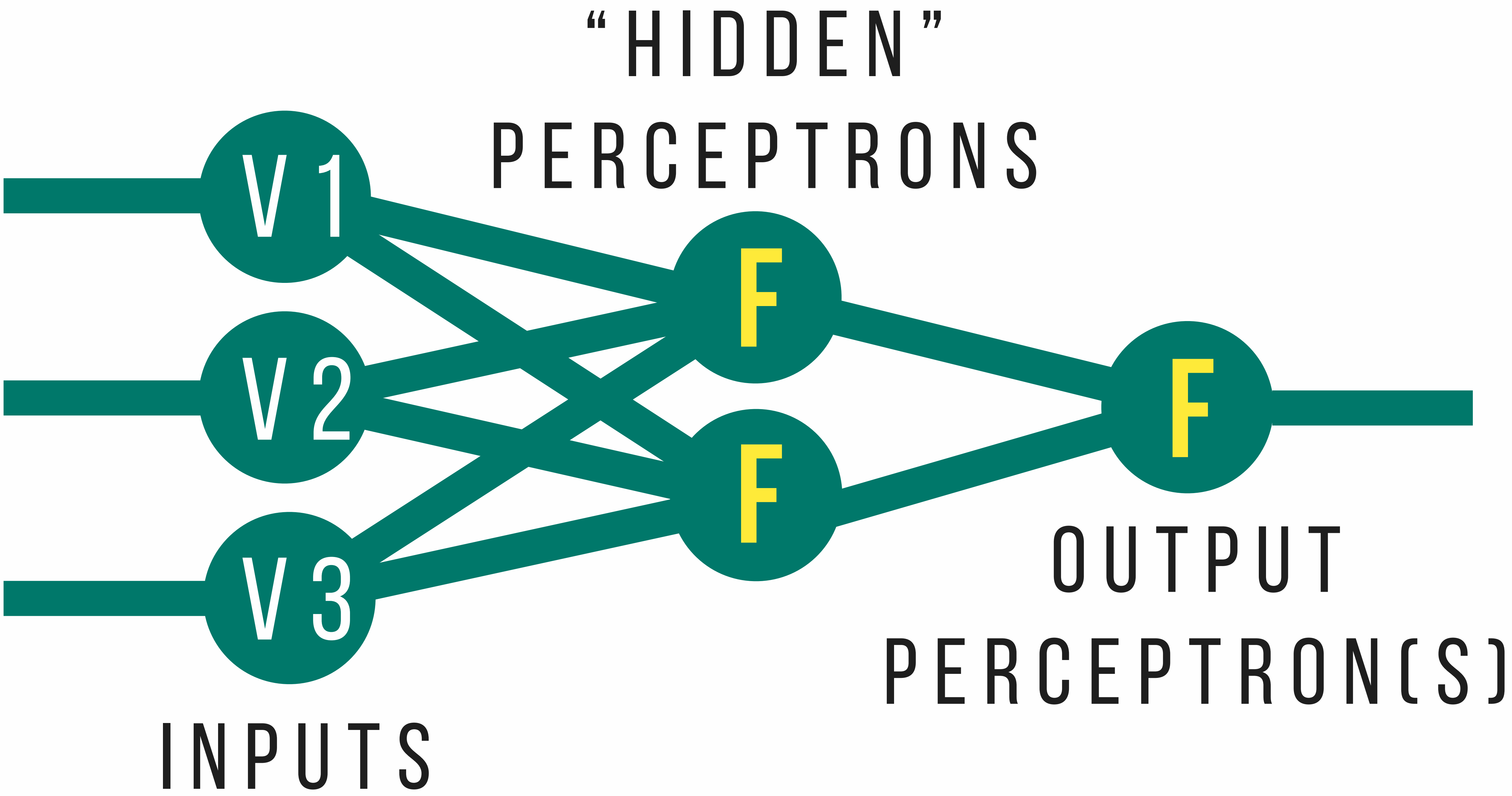
| V1 | V2 | TARGET |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

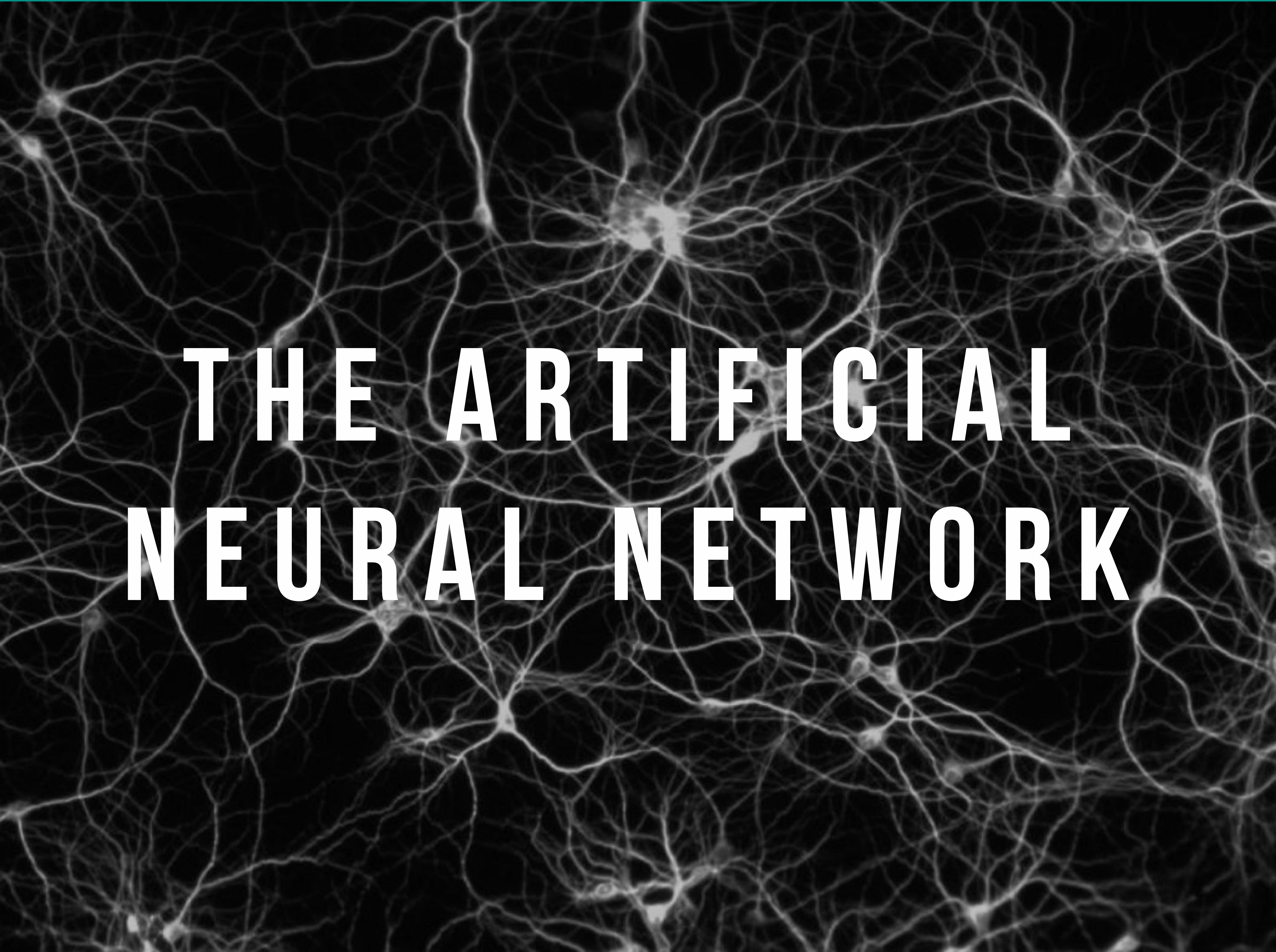
# X O R



# COMPOSE THEM




THE ARTIFICIAL
NEURAL NETWORK

# DIAGNOSING CANCER

FOR REALS

# CLASSIFICATION

(TARGET)

| | CELL | ... | TEXTURE | DIAGNOSIS |
|---|---|---|---|---|
| JAMES | 1.23 | ... | 4.56 | MALIGNANT |
| SARAH | ... | ... | ... | ... |
| JEFF | 0.41 | ... | 2.3 | BENIGN |

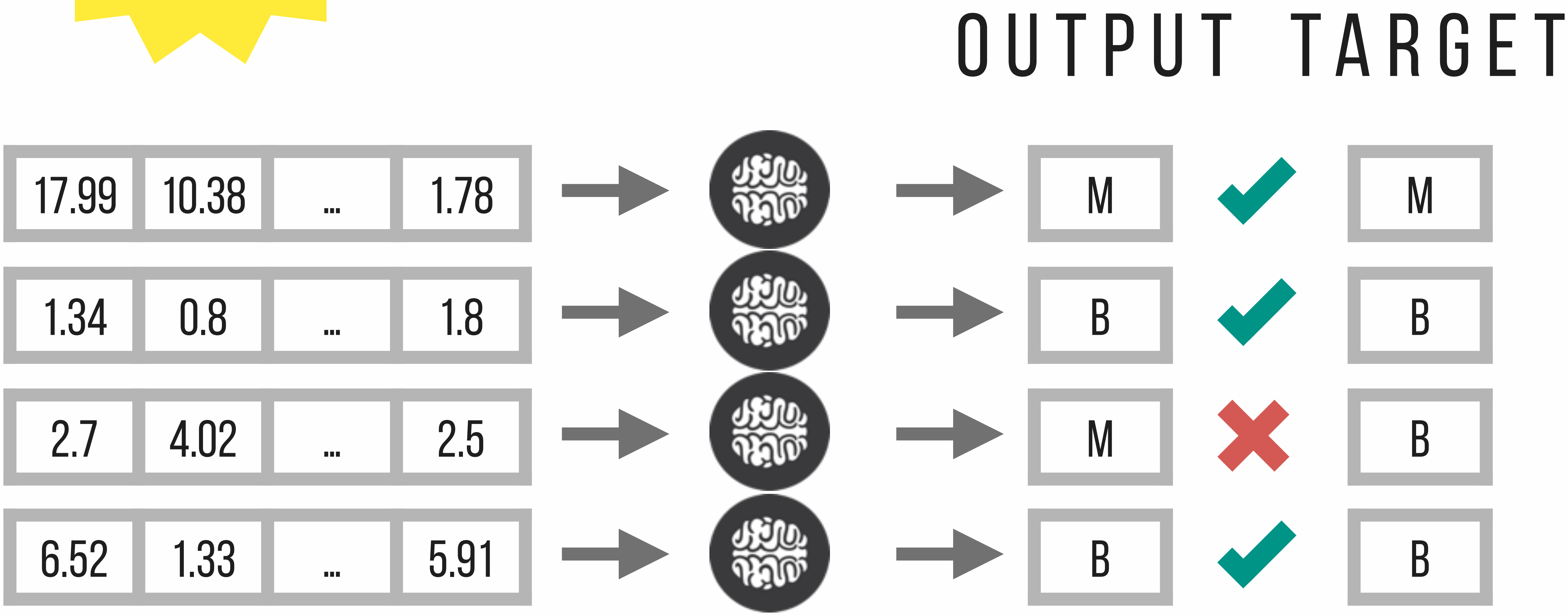
ATTRIBUTES

ATTRIBUTES ARE COMPUTED FROM A DIGITIZED IMAGE OF A FINE NEEDLE ASPIRATE (FNA) OF A BREAST MASS.

# EVALUATION

# TRAINING

**75%**



OUTPUT
TARGET
17.99
10.38
...
1.78
M
M
1.34
0.8
...
1.8
B
B
2.7
4.02
...
2.5
M
B
6.52
1.33
...
5.91
B
B

# SEARCH

GRADIENT DESCENT COEVOLUTION

RPROP PARTICLE SWARM OPTIMIZER

SIMULATED ANNEALING ANT SYSTEM

GENETIC ALGORITHM MONTE CARLO

DIFFERENTIAL EVOLUTION QPROP


BIRDS!

# $ DEMO

TINY.CC/MADISONRUBY2015

# CANCER IS DESTRUCTIVE

BUT

DIAGNOSISISSOLVABLE

# STOCHASTIC MACHINES

NEURAL TURING MACHINES:
[HTTP://ARXIV.ORG/ABS/1410.5401](http://arxiv.org/abs/1410.5401)

"IF A MACHINE IS EXPECTED TO BE INFALLIBLE, IT CANNOT ALSO BE INTELLIGENT"

— A. TURING

Platform45

@PLATFORM45

RUBY TECH

Pretoria.rb

NEURAL NETWORK

# QUESTIONS

@SIEFI

SIGHMIN/DIAGNOSING-CANCER-WITH-AI

SIMON@PLATFORM45.COM

*fin.*