

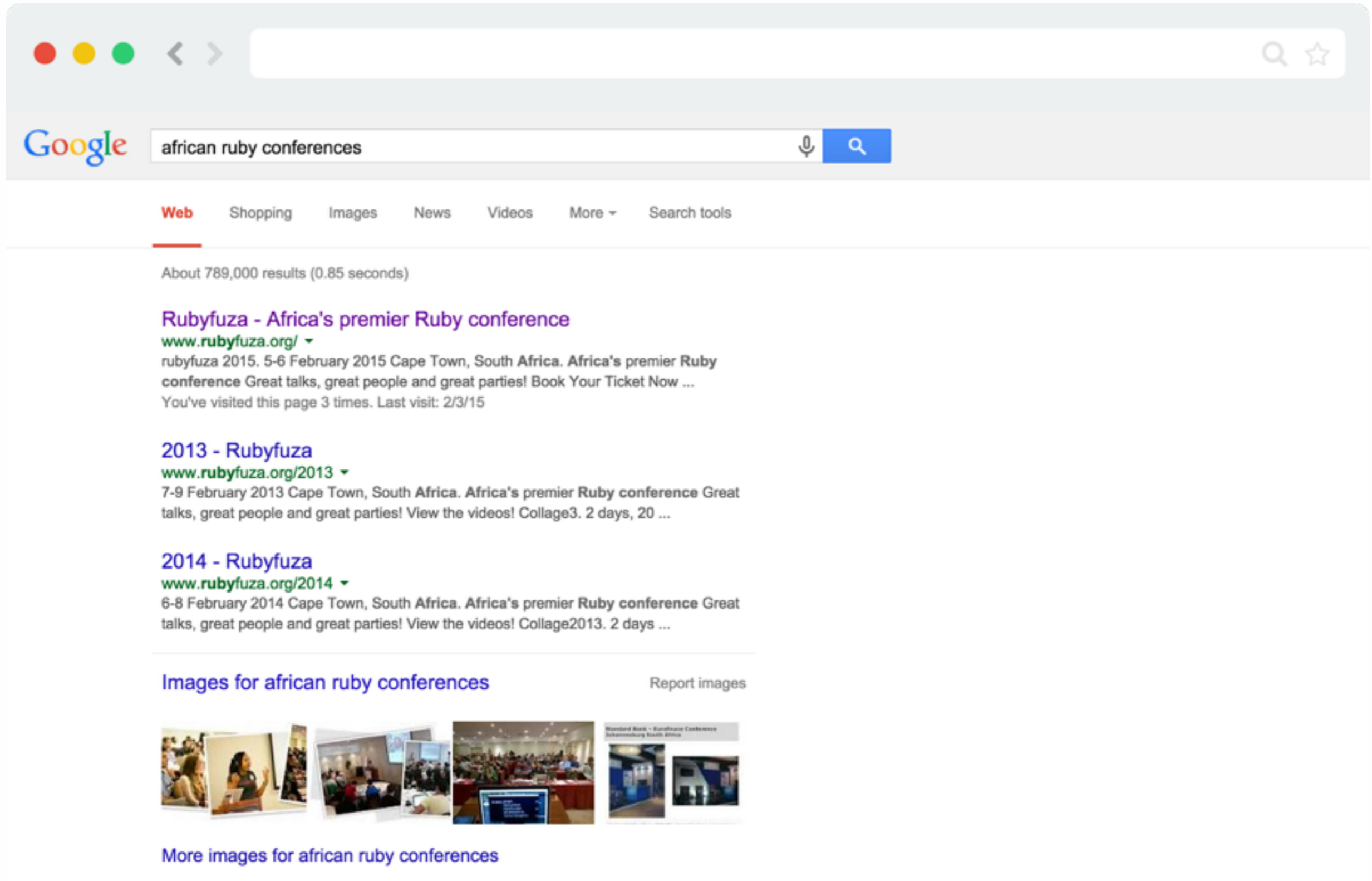
# HOW TO DIAGNOSE CANCER WITH MACHINE LEARNING

WITH @SIGHMIN

# HOW TO DIAGNOSE CANCER WITH MACHINE LEARNING

AND SHOW THAT MACHINE LEARNING IS  
FUN AND ACCESSIBLE TO ANYONE

# CONFERENCE!



The image is a screenshot of a Google search results page. At the top, the word "CONFERENCE!" is written in large, bold, black capital letters. Below this is a browser window showing a Google search for "african ruby conferences". The search bar contains the text "african ruby conferences" and a blue search button with a magnifying glass icon. Below the search bar, there are navigation links for "Web", "Shopping", "Images", "News", "Videos", "More", and "Search tools". The "Web" link is highlighted with a red underline. Below the navigation links, the search results are displayed. The first result is "Rubyfuza - Africa's premier Ruby conference" with a link to "www.rubyfuza.org/". The second result is "2013 - Rubyfuza" with a link to "www.rubyfuza.org/2013". The third result is "2014 - Rubyfuza" with a link to "www.rubyfuza.org/2014". Below the search results, there is a section for "Images for african ruby conferences" with a "Report images" link. This section shows a grid of six small images related to the conference, including people speaking at a podium, a large audience in a hall, and a stage with a screen.


About 789,000 results (0.85 seconds)

**Rubyfuza - Africa's premier Ruby conference**  
[www.rubyfuza.org/](http://www.rubyfuza.org/) ▾  
rubyfuza 2015. 5-6 February 2015 Cape Town, South Africa. Africa's premier Ruby conference Great talks, great people and great parties! Book Your Ticket Now ...  
You've visited this page 3 times. Last visit: 2/3/15

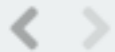
**2013 - Rubyfuza**  
[www.rubyfuza.org/2013](http://www.rubyfuza.org/2013) ▾  
7-9 February 2013 Cape Town, South Africa. Africa's premier Ruby conference Great talks, great people and great parties! View the videos! Collage3. 2 days, 20 ...

**2014 - Rubyfuza**  
[www.rubyfuza.org/2014](http://www.rubyfuza.org/2014) ▾  
6-8 February 2014 Cape Town, South Africa. Africa's premier Ruby conference Great talks, great people and great parties! View the videos! Collage2013. 2 days ...

**Images for african ruby conferences** [Report images](#)



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[2013](#)

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# rubyfuza 2015

5-6 February 2015  
Cape Town, South Africa



## AFRICA'S PREMIER RUBY CONFERENCE

Great talks, great people and great parties!



**BOOK YOUR TICKET NOW!**



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# RUBYCONF KENYA 2015

On the 8th to 9th May 2015, leading Ruby developers from around the world will come together to share, inspire and learn.

[View schedule.](#)

Nairobi, Kenya

8<sup>th</sup>-9<sup>th</sup> May 2015

[REGISTER NOW!](#)



# RUBYISTS!

The screenshot shows a web browser window displaying the GitHub search interface. The search query is "location:'South Africa' repos:>1 language:Ruby". The search results are sorted by "Best match". A red box highlights the text "We've found 199 users". The left sidebar shows navigation options: Repositories (801,796), Code, Issues (1,657,559), and Users (199). Below the sidebar is a "Languages" section with a list of programming languages and their respective user counts. The main content area displays a list of user profiles, each with a profile picture, username, real name, location, email address, and join date. Each profile has a "Follow" button.

**GitHub** Explore Features Enterprise Blog [Sign up](#) [Sign in](#)

Search  [Search](#)

**We've found 199 users** [Sort: Best match ▾](#)

Language	Count
JavaScript	421
Python	243
PHP	233
Java	224
Ruby	199
C#	126
CSS	123
C++	69
C	54
R	53

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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**

Number of Operation	Nature of Operation	Variables acted upon	Variables in resulting result*	Ind. of no. of change in the value of any Variable	Statement of Results	Data						Working Variables					
						${}^1V_1$	${}^1V_2$	${}^1V_3$	${}^0V_4$	${}^0V_5$	${}^2V_6$	${}^0V_7$	${}^0V_8$	${}^0V_9$	${}^0V_{10}$	${}^0V_{11}$	
1	x	${}^1V_2 \times {}^1V_3$	${}^1V_4, {}^1V_5, {}^1V_6$	$\left. \begin{matrix} {}^1V_2 \\ {}^1V_3 \end{matrix} \right\} = \left. \begin{matrix} {}^1V_4 \\ {}^1V_5 \end{matrix} \right\}$	$= 2 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
2	-	${}^1V_4 - {}^1V_5$	${}^2V_2 \dots$	$\left. \begin{matrix} {}^1V_4 \\ {}^1V_5 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_2 \\ {}^2V_3 \end{matrix} \right\}$	$= 2n - 1 \dots$	1	0	0	0	0	0	0	0	0	0	0	0
3		${}^1V_3 - {}^1V_1$	${}^2V_5 \dots$	$\left. \begin{matrix} {}^1V_3 \\ {}^1V_1 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_5 \\ {}^2V_1 \end{matrix} \right\}$	$= 2n + 1 \dots$	1	0	0	0	0	0	0	0	0	0	0	0
4	+	${}^2V_6 + {}^2V_4$	${}^3V_{11} \dots$	$\left. \begin{matrix} {}^2V_6 \\ {}^2V_4 \end{matrix} \right\} = \left. \begin{matrix} {}^3V_{11} \\ {}^3V_4 \end{matrix} \right\}$	$= \frac{2n-1}{2n-1} \dots$	0	0	0	0	0	0	0	0	0	0	0	0
5	+	${}^1V_{11} + {}^1V_2$	${}^2V_{11} \dots$	$\left. \begin{matrix} {}^1V_{11} \\ {}^1V_2 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{11} \\ {}^2V_2 \end{matrix} \right\}$	$= \frac{1}{2} \cdot \frac{2n-1}{2n+1} \dots$	0	2	0	0	0	0	0	0	0	0	0	0
6	-	${}^0V_{11} - {}^2V_{11}$	${}^1V_{11} \dots$	$\left. \begin{matrix} {}^0V_{11} \\ {}^2V_{11} \end{matrix} \right\} = \left. \begin{matrix} {}^1V_{11} \\ {}^1V_{12} \end{matrix} \right\}$	$= -\frac{1}{2} \cdot \frac{2n-1}{2n+1} - A_1 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
7	-	${}^1V_3 - {}^1V_1$	${}^1V_{16} \dots$	$\left. \begin{matrix} {}^1V_3 \\ {}^1V_1 \end{matrix} \right\} = \left. \begin{matrix} {}^1V_6 \\ {}^1V_1 \end{matrix} \right\}$	$= n - 1 (= 3) \dots$	1	0	0	0	0	0	0	0	0	0	0	0
8	+	${}^1V_2 + {}^0V_7$	${}^1V_7 \dots$	$\left. \begin{matrix} {}^1V_2 \\ {}^0V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^1V_7 \\ {}^1V_7 \end{matrix} \right\}$	$= 2 + 1 = 3 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
9	+	${}^1V_6 + {}^1V_7$	${}^2V_{11} \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^1V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{11} \\ {}^2V_{11} \end{matrix} \right\}$	$= \frac{2n}{2} - A_1 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
10	x	${}^1V_6 \times {}^2V_{11}$	${}^3V_{12} \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^2V_{11} \end{matrix} \right\} = \left. \begin{matrix} {}^3V_{12} \\ {}^3V_{11} \end{matrix} \right\}$	$= 3; \frac{2n}{2} = B_1 A_1 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
11	+	${}^2V_{12} - {}^2V_{11}$	${}^2V_{12} \dots$	$\left. \begin{matrix} {}^2V_{12} \\ {}^2V_{11} \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{12} \\ {}^2V_{11} \end{matrix} \right\}$	$= -\frac{1}{2} \cdot \frac{2n-1}{2n+1} + B_1 \cdot \frac{2n}{2} \dots$	0	0	0	0	0	0	0	0	0	0	0	0
12	-	${}^2V_{11}$	${}^2V_{11} \dots$	$\left. \begin{matrix} {}^2V_{11} \\ {}^2V_{11} \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{11} \\ {}^2V_{11} \end{matrix} \right\}$	$= -n(-n) \dots$	1	0	0	0	0	0	0	0	0	0	0	0
13	-	${}^1V_6 - {}^1V_1$	${}^2V_6 \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^1V_1 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_6 \\ {}^2V_1 \end{matrix} \right\}$	$= 2n - 1 \dots$	1	0	0	0	0	0	0	0	0	0	0	0
14	+	${}^1V_1 - {}^1V_7$	${}^2V_7 \dots$	$\left. \begin{matrix} {}^1V_1 \\ {}^1V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_7 \\ {}^2V_7 \end{matrix} \right\}$	$= 2 + 1 = 3 \dots$	1	0	0	0	0	0	0	0	0	0	0	0
15	+	${}^2V_6 + {}^2V_7$	${}^3V_8 \dots$	$\left. \begin{matrix} {}^2V_6 \\ {}^2V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^3V_8 \\ {}^3V_7 \end{matrix} \right\}$	$= \frac{2n-1}{2} \dots$	0	0	0	0	0	0	0	0	0	0	0	0
16	x	${}^1V_6 \times {}^3V_7$	${}^4V_{11} \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^3V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^4V_{11} \\ {}^4V_{11} \end{matrix} \right\}$	$= \frac{2n}{2} \cdot \frac{2n-1}{2} \dots$	0	0	0	0	0	0	0	0	0	0	0	0
17	-	${}^1V_6 - {}^1V_1$	${}^5V_6 \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^1V_1 \end{matrix} \right\} = \left. \begin{matrix} {}^5V_6 \\ {}^5V_1 \end{matrix} \right\}$	$= 2n \dots$	1	0	0	0	0	0	0	0	0	0	0	0
18		${}^1V_1 - {}^2V_7$	${}^6V_7 \dots$	$\left. \begin{matrix} {}^1V_1 \\ {}^2V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^6V_7 \\ {}^6V_7 \end{matrix} \right\}$	$= 2 + 1 = 3 \dots$	1	0	0	0	0	0	0	0	0	0	0	0
19	+	${}^1V_6 + {}^0V_7$	${}^1V_9 \dots$	$\left. \begin{matrix} {}^1V_6 \\ {}^0V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^1V_9 \\ {}^2V_7 \end{matrix} \right\}$	$= \frac{2n-1}{2} \dots$	0	0	0	0	0	0	0	0	0	0	0	0
20	x	${}^1V_3 \times {}^4V_7$	${}^5V_7 \dots$	$\left. \begin{matrix} {}^1V_3 \\ {}^4V_7 \end{matrix} \right\} = \left. \begin{matrix} {}^5V_7 \\ {}^5V_7 \end{matrix} \right\}$	$= \frac{2n}{2} \cdot \frac{2n-1}{2} \cdot \frac{2n-2}{2} = A_3 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
21	x	${}^0V_{12}$	${}^0V_{12} \dots$	$\left. \begin{matrix} {}^0V_{12} \\ {}^0V_{12} \end{matrix} \right\} = \left. \begin{matrix} {}^0V_{12} \\ {}^0V_{12} \end{matrix} \right\}$	$= 3_2 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
22	+	${}^2V_{12} - {}^2V_{13}$	${}^2V_{11} \dots$	$\left. \begin{matrix} {}^2V_{12} \\ {}^2V_{13} \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{12} \\ {}^2V_{12} \end{matrix} \right\}$	$= A_0 - B_1 A_1 + B_2 A_2 \dots$	0	0	0	0	0	0	0	0	0	0	0	0
23	-	${}^2V_{11} - {}^1V_1$	${}^2V_{11} \dots$	$\left. \begin{matrix} {}^2V_{11} \\ {}^1V_1 \end{matrix} \right\} = \left. \begin{matrix} {}^2V_{11} \\ {}^1V_1 \end{matrix} \right\}$	$= n - n(-n) \dots$	1	0	0	0	0	0	0	0	0	0	0	0



ADDA

LOVELLACE

B<sub>1</sub> - 2

$$\left\{ \frac{2n}{2} \cdot \frac{2n-1}{2} \cdot \frac{2n-2}{2} \right\} = A_3$$

WHAT  
ARE MODELS ?

COMPUTER FOLDER

SERVER CLIPBOARD

DESKTOP WINDOWS

THE  
**ARTIFICIAL  
NEURAL  
NETWORK**



# CONSIDER

## THE NEURON

NUCLEUS



DENDRITES



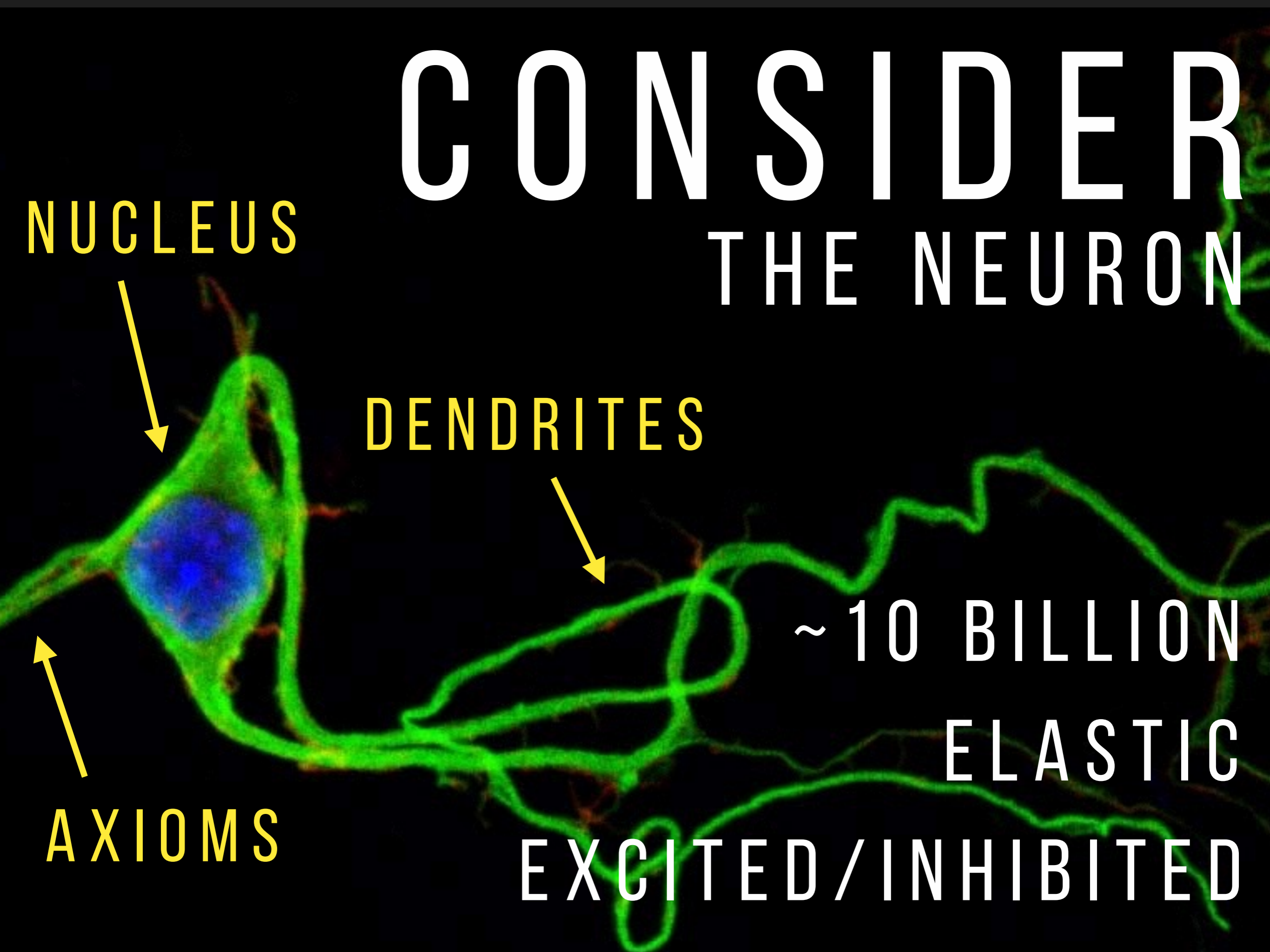
~ 10 BILLION

ELASTIC



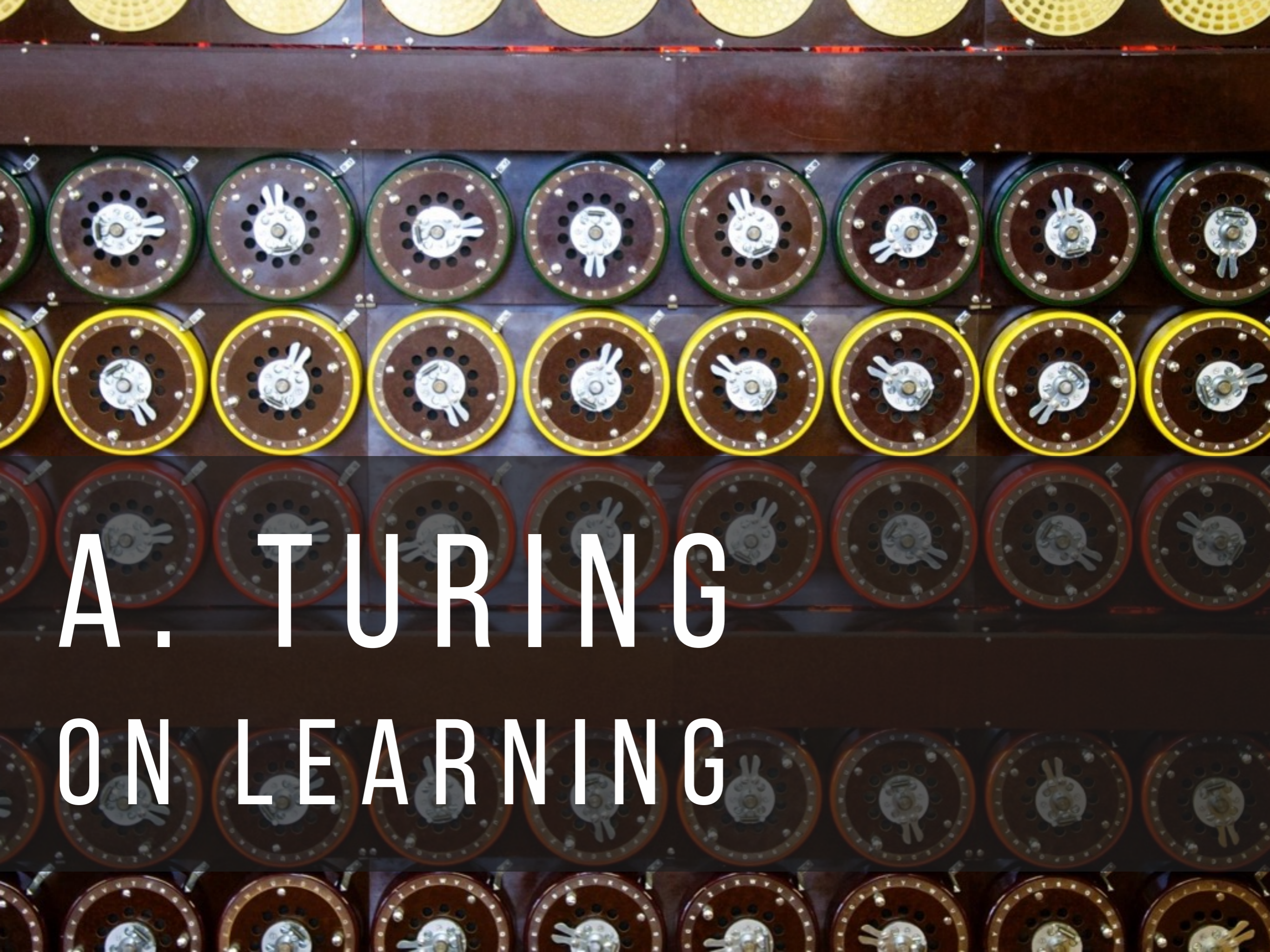
AXIOMS

EXCITED/INHIBITED



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



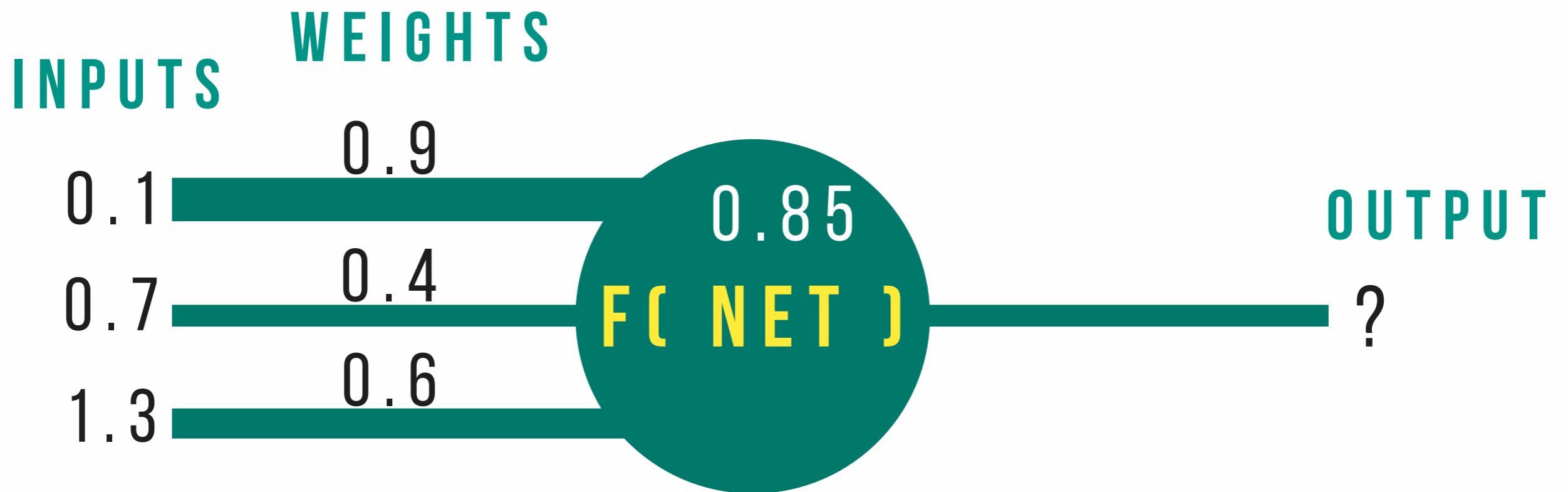


A. TURING

ON LEARNING

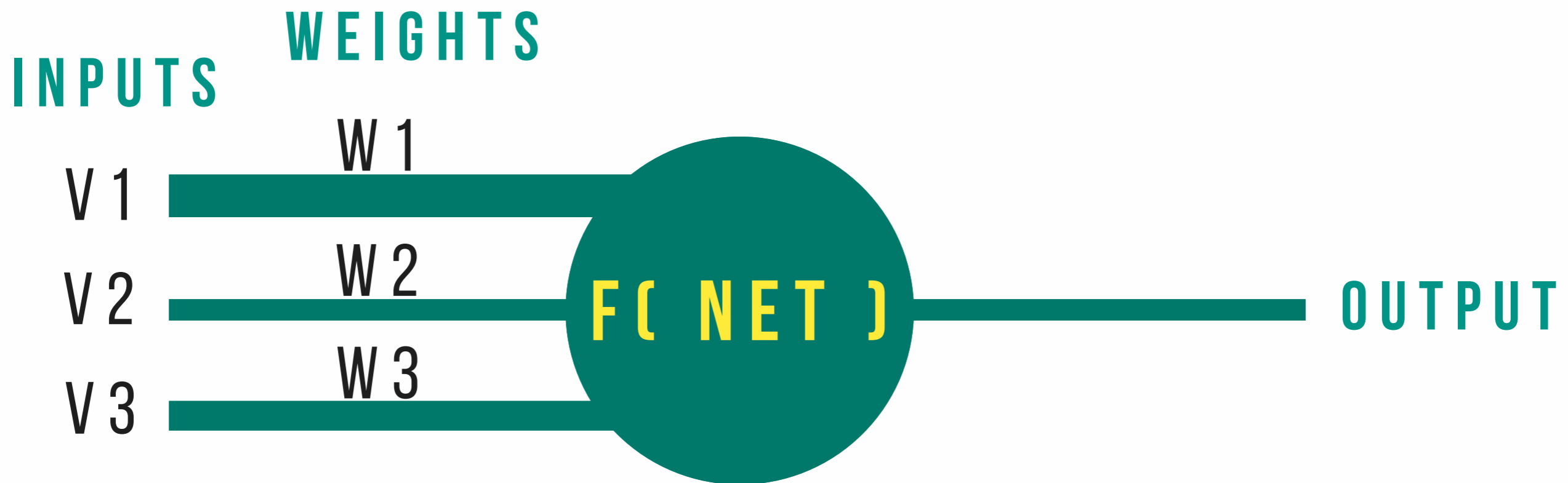


# PERCEPTRON



$$\text{NET} = 0.1 * 0.9 + 0.7 * 0.4 + 1.3 * 0.6$$

# PERCEPTRON

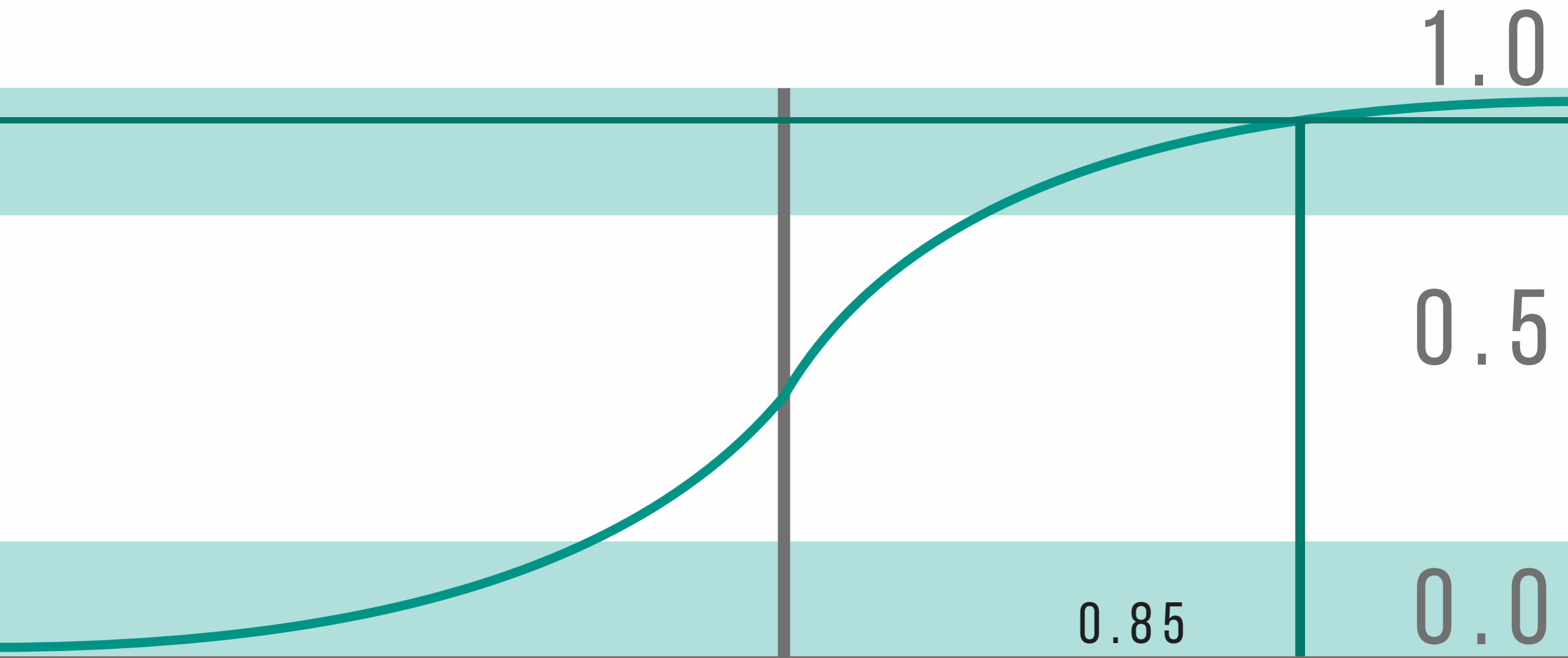


$$\text{NET} = V_1 * W_1 + V_2 * W_2 + V_3 * W_3$$

$$\text{OUT} = F(\text{NET})$$

SIGMOID

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





# OUT = F(NET)

STEP

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

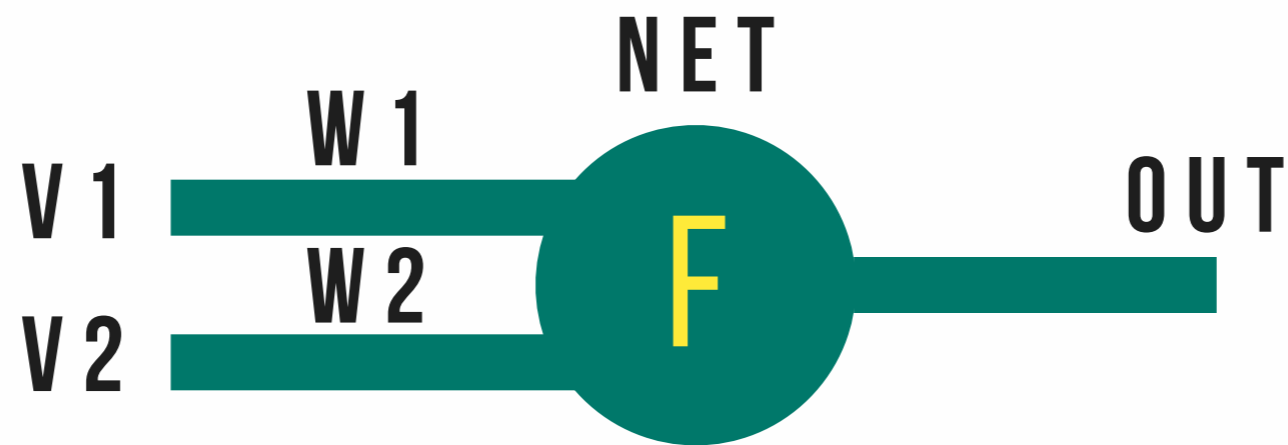
1.0

0.5

0.85

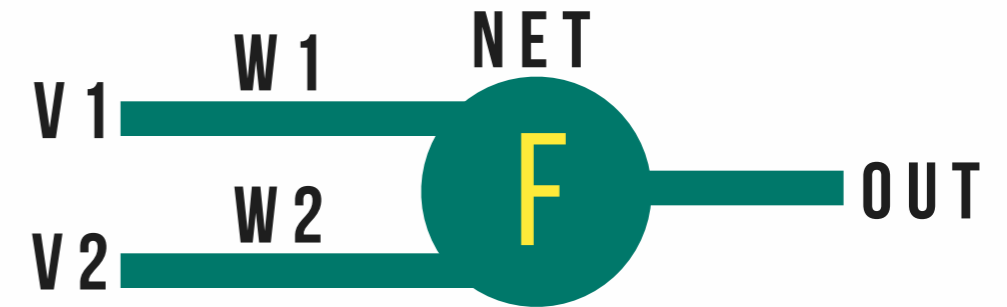
0.0

# 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	

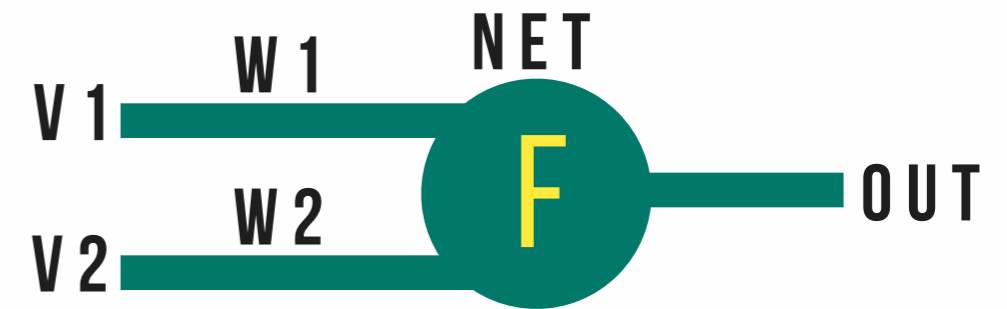


$$f(\text{net}) = \begin{cases} 0 & \text{if } \text{net} \leq 0 \\ 1 & \text{if } \text{net} > 0 \end{cases}$$

$$\begin{aligned} \text{NET} &= V1 * W1 \\ &+ V2 * W2 \\ &= \dots \end{aligned}$$

$$\begin{aligned} \text{OUT} &= F(\text{NET}) \\ &= \dots \end{aligned}$$

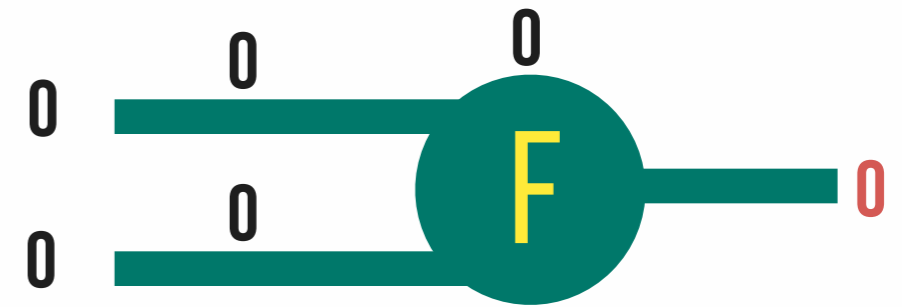
V1	V2	TARGET	OUT
0	0	0	X
0	1	1	
1	0	1	
1	1	1	



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

$$\begin{aligned} \text{NET} &= V1 * W1 + V2 * W2 \\ &= \dots \end{aligned} \quad \begin{aligned} \text{OUT} &= F(\text{NET}) \\ &= X \end{aligned}$$

V1	V2	TARGET	OUT
0	0	0	0
0	1	1	
1	0	1	
1	1	1	

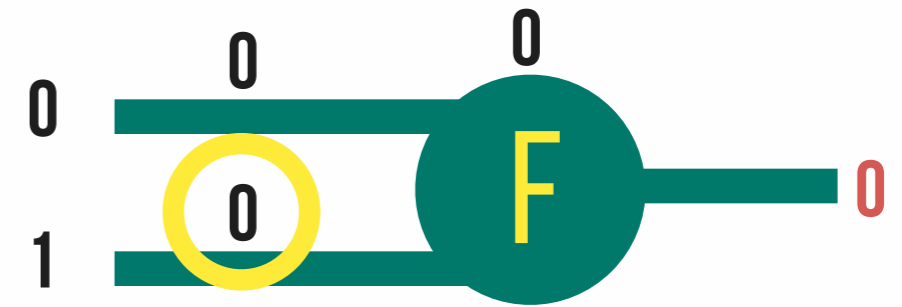


$$f(\text{net}) = \begin{cases} 0 & \text{if } \text{net} \leq 0 \\ 1 & \text{if } \text{net} > 0 \end{cases}$$

$$\begin{aligned} \text{NET} &= 0 * 0 \\ &+ 0 * 0 \\ &= 0 \end{aligned}$$

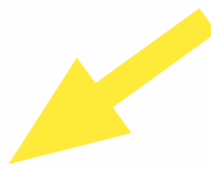
$$\begin{aligned} \text{OUT} &= F(0) \\ &= 0 \end{aligned}$$

V1	V2	TARGET	OUT
0	0	0	0
0	1	1	0
1	0	1	
1	1	1	



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

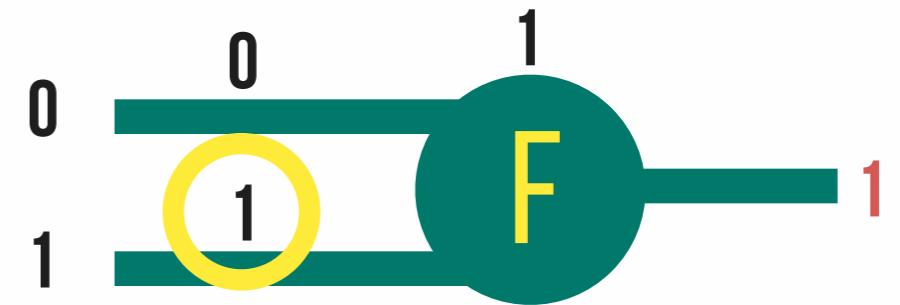
$$\begin{aligned} NET &= 0 * 0 \\ &+ 1 * 0 \\ &= 0 \end{aligned}$$



$$\begin{aligned} OUT &= F(0) \\ &= 0 \end{aligned}$$

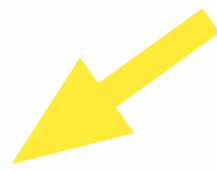


V1	V2	TARGET	OUT
0	0	0	0
0	1	1	1
1	0	1	
1	1	1	



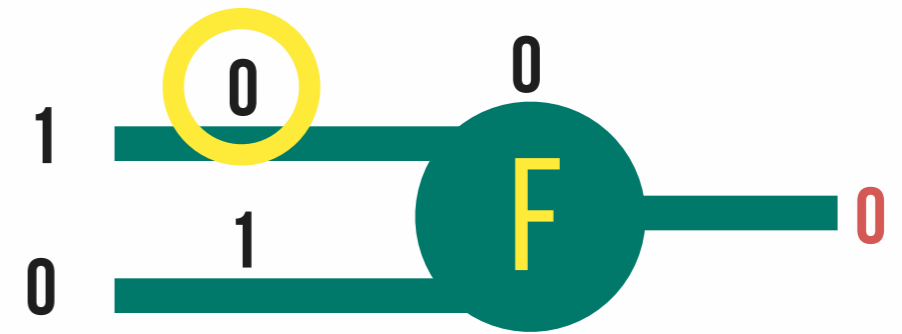
$$f(\text{net}) = \begin{cases} 0 & \text{if } \text{net} \leq 0 \\ 1 & \text{if } \text{net} > 0 \end{cases}$$

$$\begin{aligned} \text{NET} &= 0 * 0 \\ &+ 1 * 1 \\ &= 1 \end{aligned}$$



$$\begin{aligned} \text{OUT} &= F(1) \\ &= 1 \end{aligned}$$

V1	V2	TARGET	OUT
0	0	0	0
0	1	1	1
1	0	1	0
1	1	1	

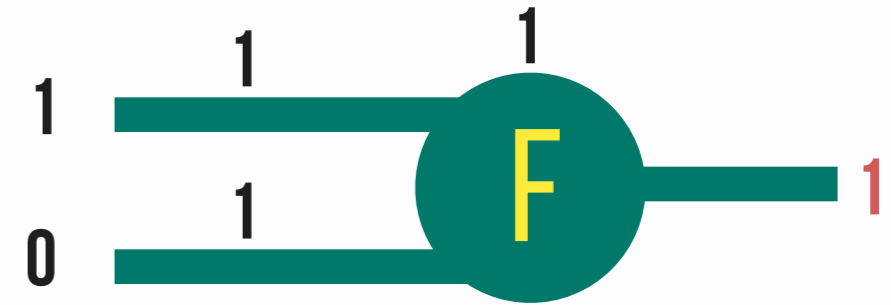


$$f(\text{net}) = \begin{cases} 0 & \text{if } \text{net} \leq 0 \\ 1 & \text{if } \text{net} > 0 \end{cases}$$

$$\begin{aligned} \text{NET} &= 1 * 0 \\ &+ 0 * 1 \\ &= 0 \end{aligned}$$

$$\begin{aligned} \text{OUT} &= F(0) \\ &= 0 \end{aligned}$$

V1	V2	TARGET	OUT
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	

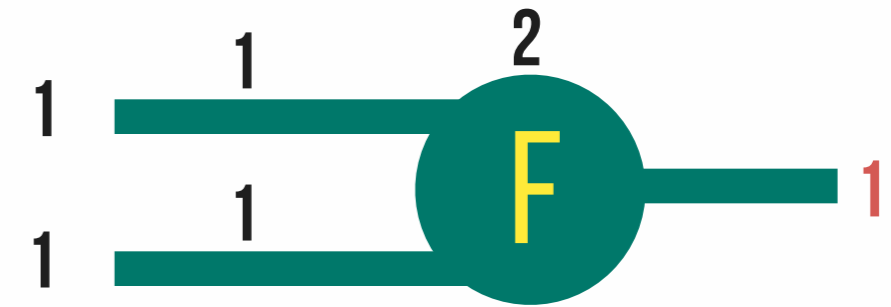


$$f(\text{net}) = \begin{cases} 0 & \text{if } \text{net} \leq 0 \\ 1 & \text{if } \text{net} > 0 \end{cases}$$

$$\begin{aligned} \text{NET} &= 1 * 1 \\ &+ 0 * 1 \\ &= 1 \end{aligned}$$

$$\begin{aligned} \text{OUT} &= F(1) \\ &= 1 \end{aligned}$$

V1	V2	TARGET	OUT
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	1



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

$$\begin{aligned} NET &= 1 * 1 \\ &+ 1 * 1 \\ &= 2 \end{aligned}$$

$$\begin{aligned} OUT &= F(2) \\ &= 1 \end{aligned}$$

# 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**

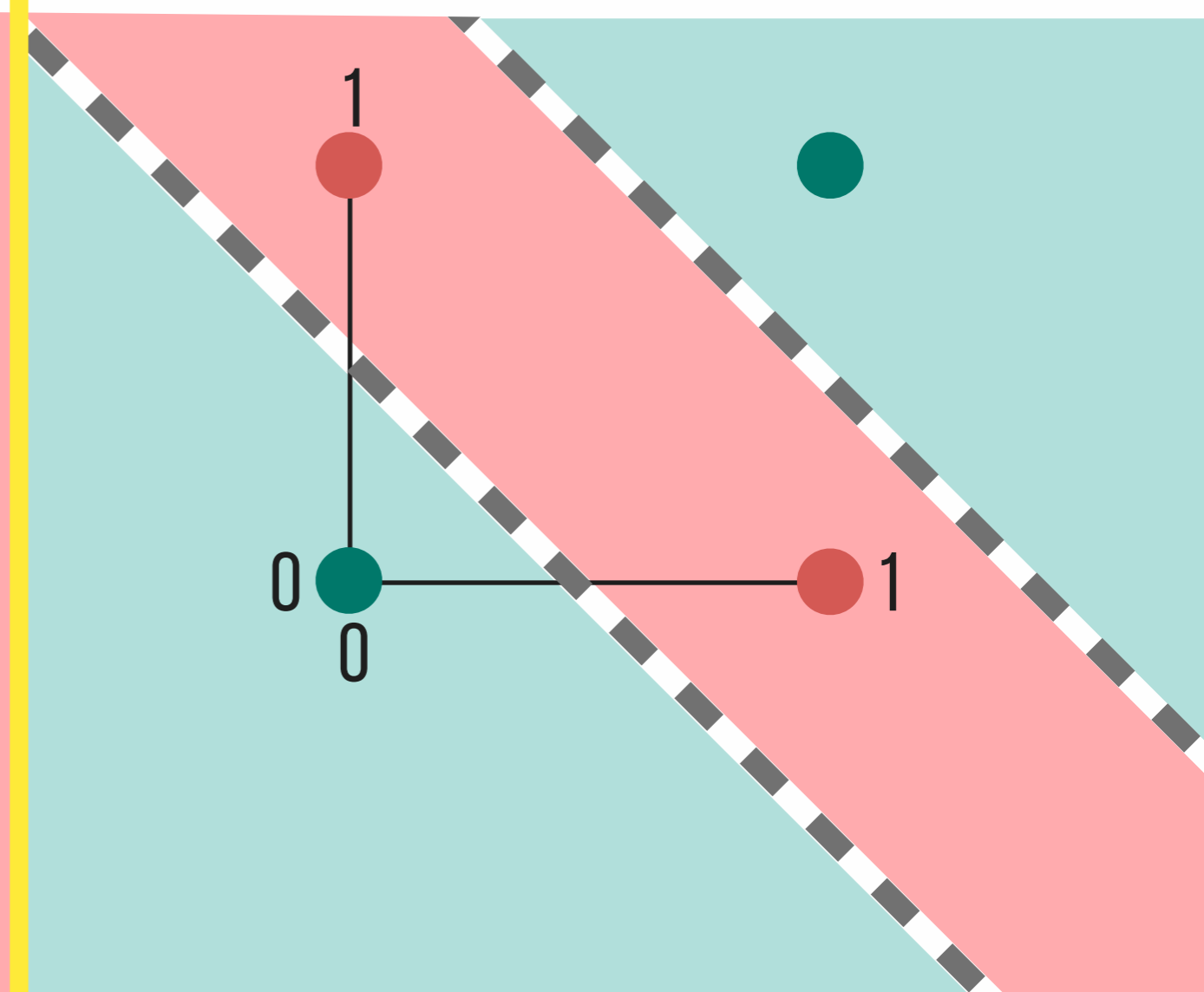
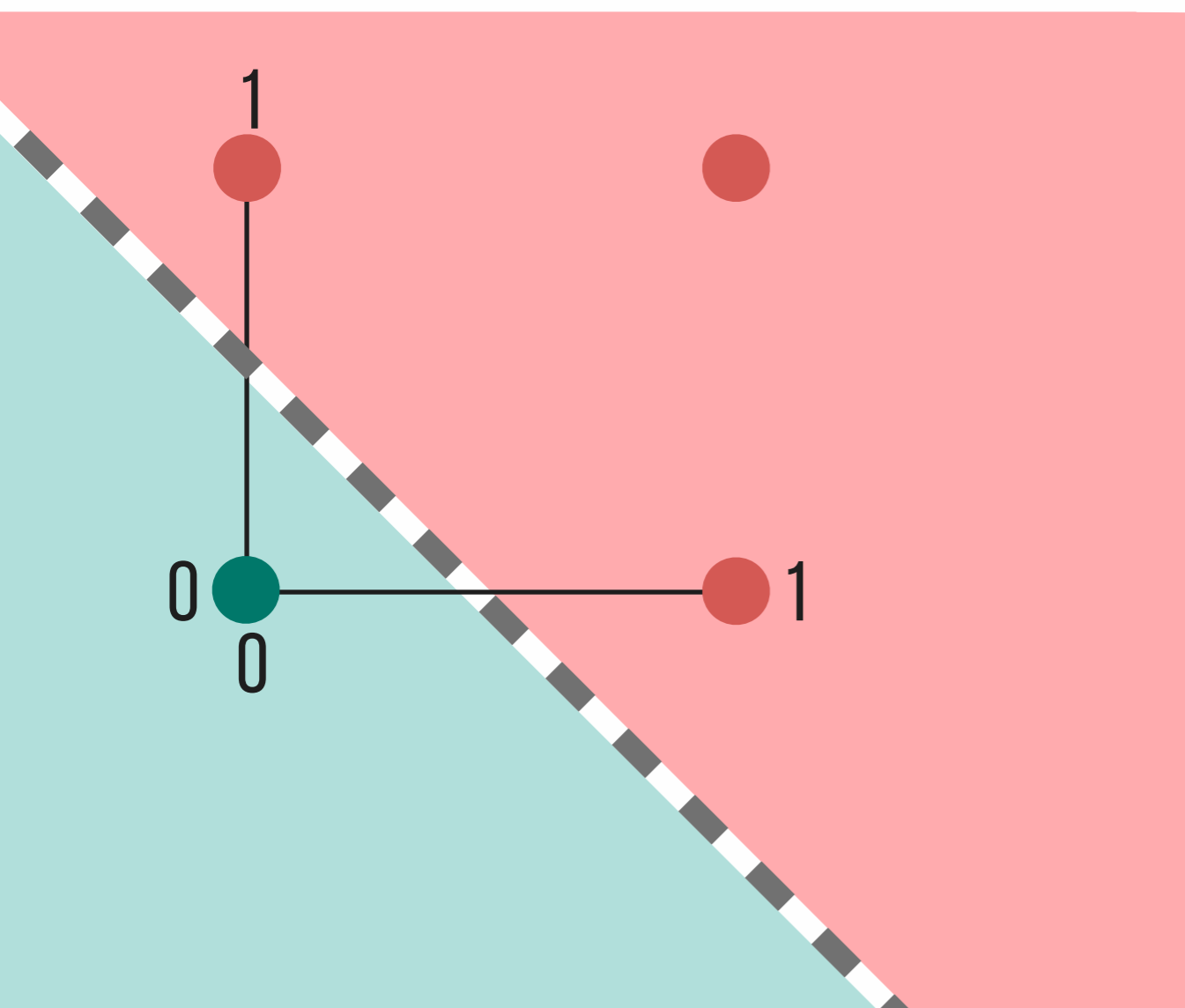
**WELL MAYBE**

V1	V2	TARGET
0	0	0
0	1	1
1	0	1
1	1	1

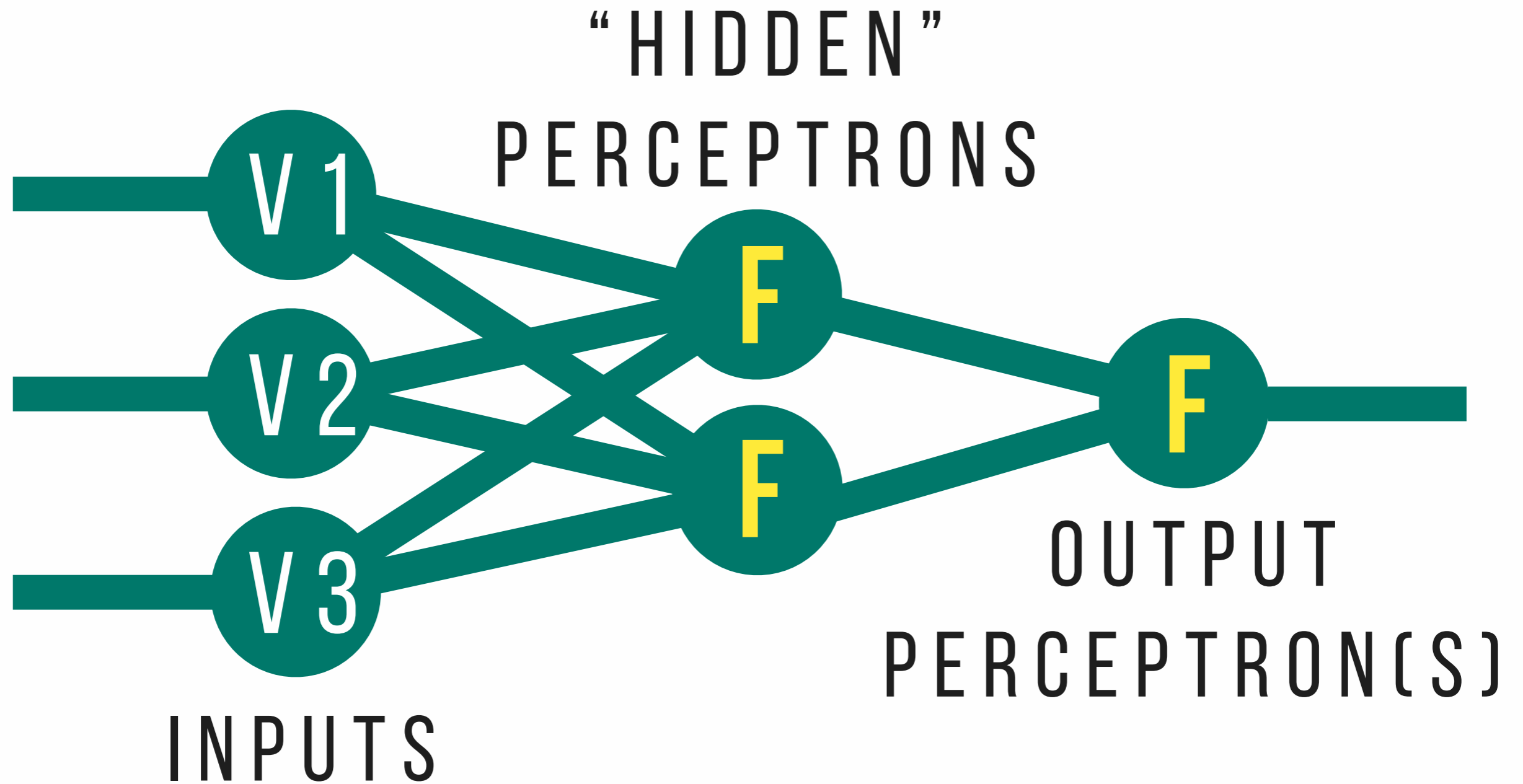
**OR**

V1	V2	TARGET
0	0	0
0	1	1
1	0	1
1	1	0

**XOR**



# 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

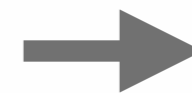
ATTRIBUTES



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

# EVALUATION

UNSEEN DATA



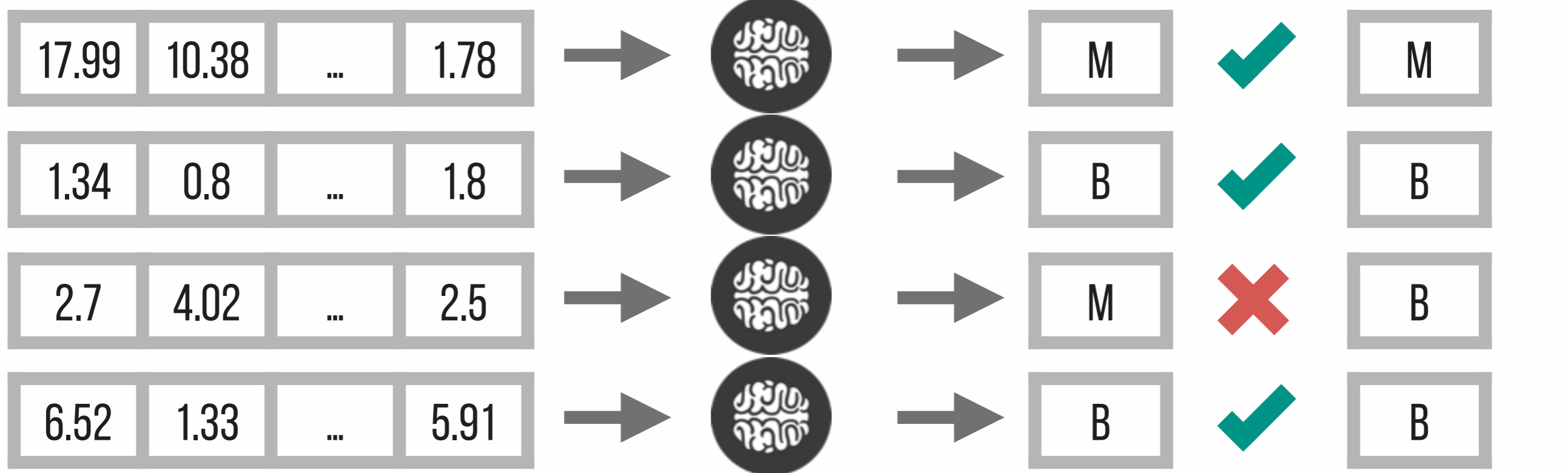
OUTPUT



‘TRAINED’  
NETWORK

# TRAINING

75%



# SEARCH

GRADIENT DESCENT      COEVOLUTION

RPROP    PARTICLE SWARM OPTIMIZER

SIMULATED ANNEALING    ANT SYSTEM

GENETIC ALGORITHM      MONTE CARLO

DIFFERENTIAL EVOLUTION      QPROP



BIRDS!





# \$ DEMO

[TINY.CC/MADISONRUBY2015](http://TINY.CC/MADISONRUBY2015)



CANCER IS DESTRUCTIVE

**BUT**

DIAGNOSIS IS SOLVABLE

# STOCHASTIC MACHINES

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

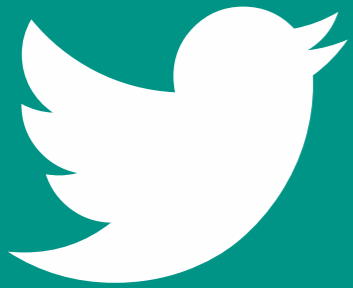
“IF A MACHINE IS  
EXPECTED TO BE  
INFALLIBLE, IT CANNOT  
ALSO BE INTELLIGENT”  
— A. TURING

# Platform 45

@PLATFORM45



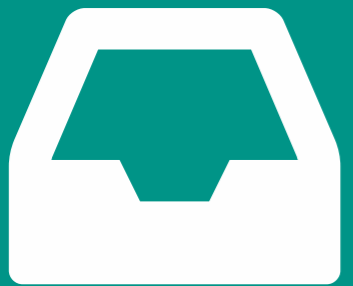
# QUESTIONS



@SIEFI



SIGHMIN/DIAGNOSING-  
CANCER-WITH-AI



SIMON@PLATFORM45.COM



*Fin.*