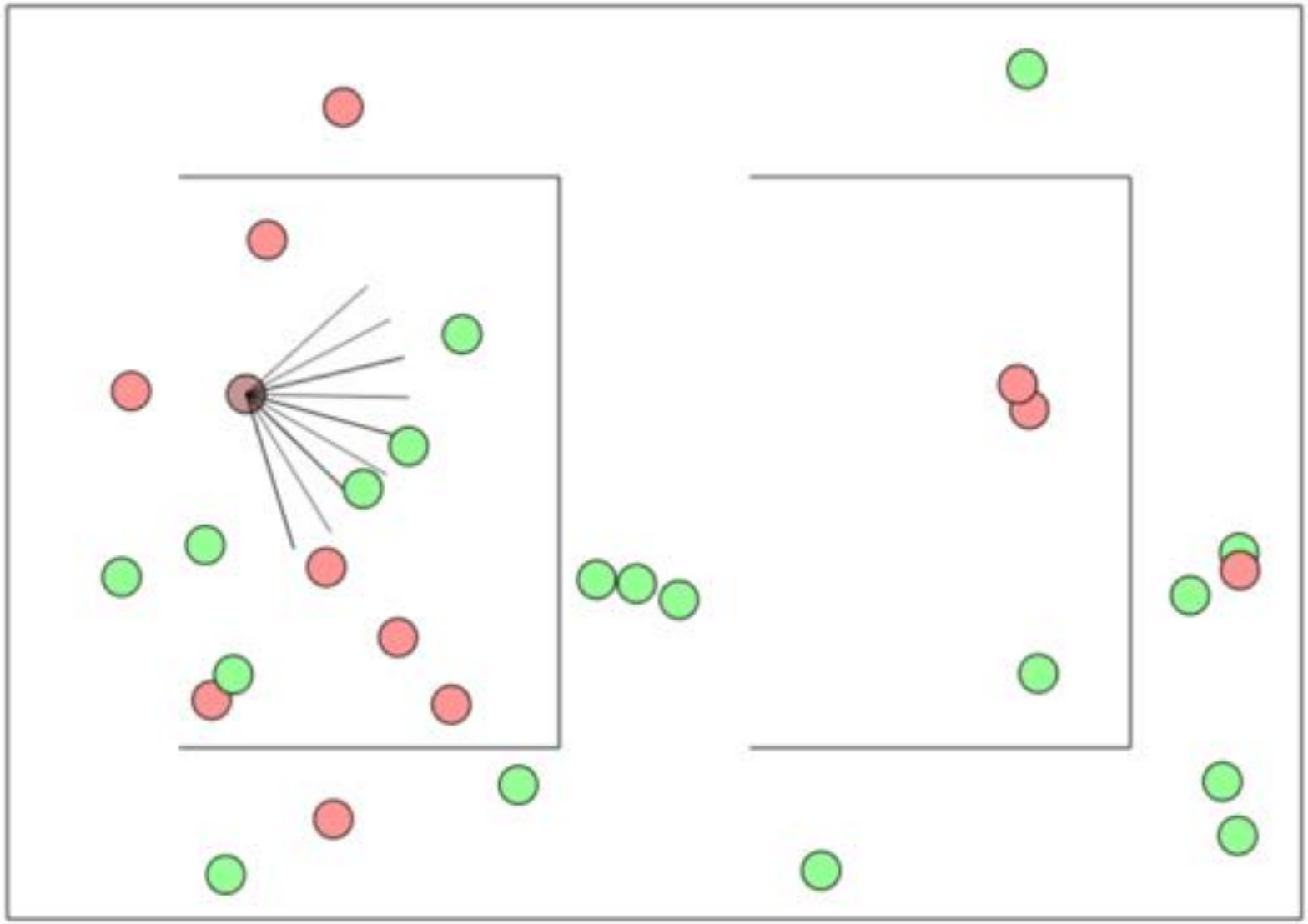
Artificial Intelligence

Chris Piech

CSBridge 2019

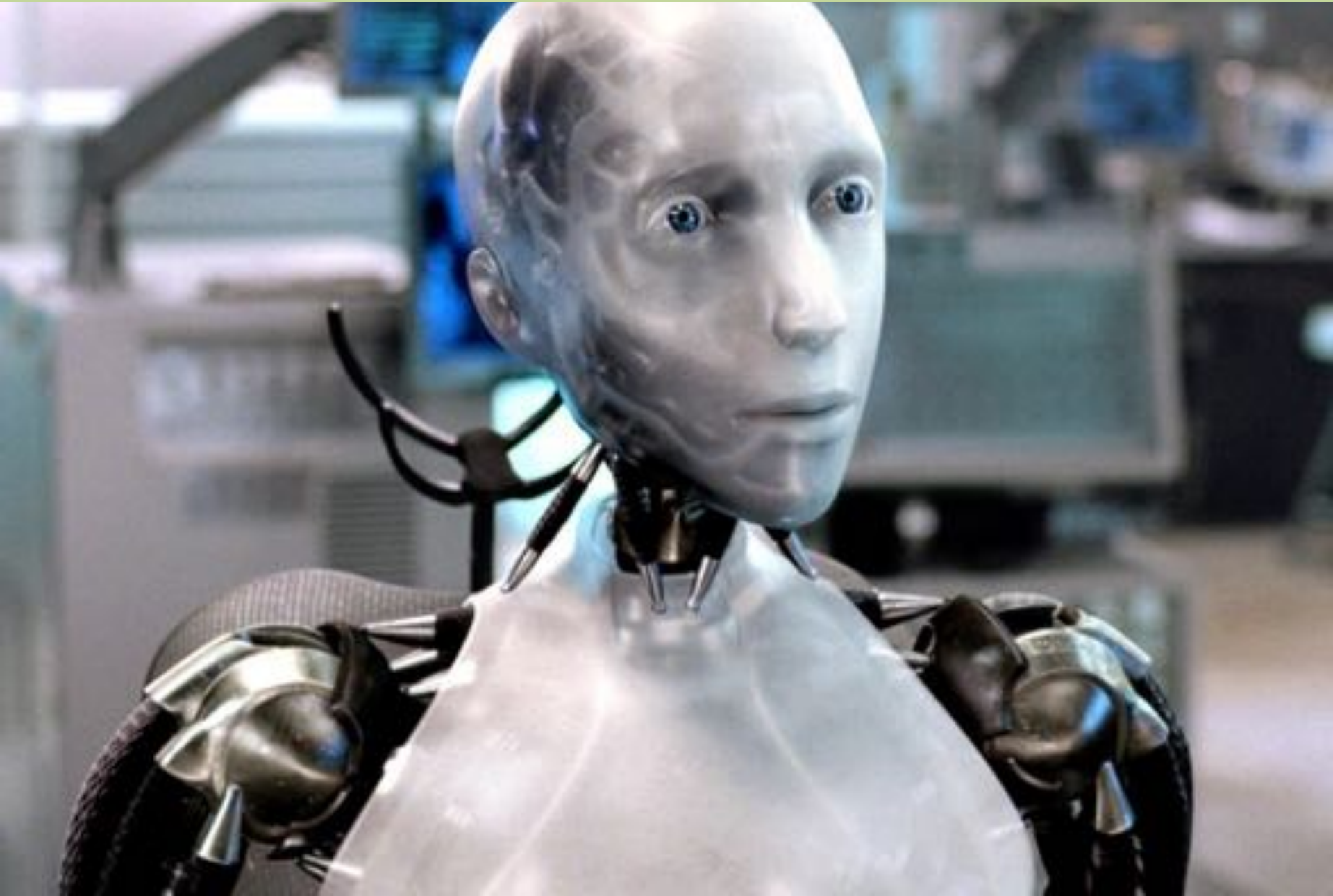
A Little AI



Something big is happening
in the world of AI…

Where is my robot?

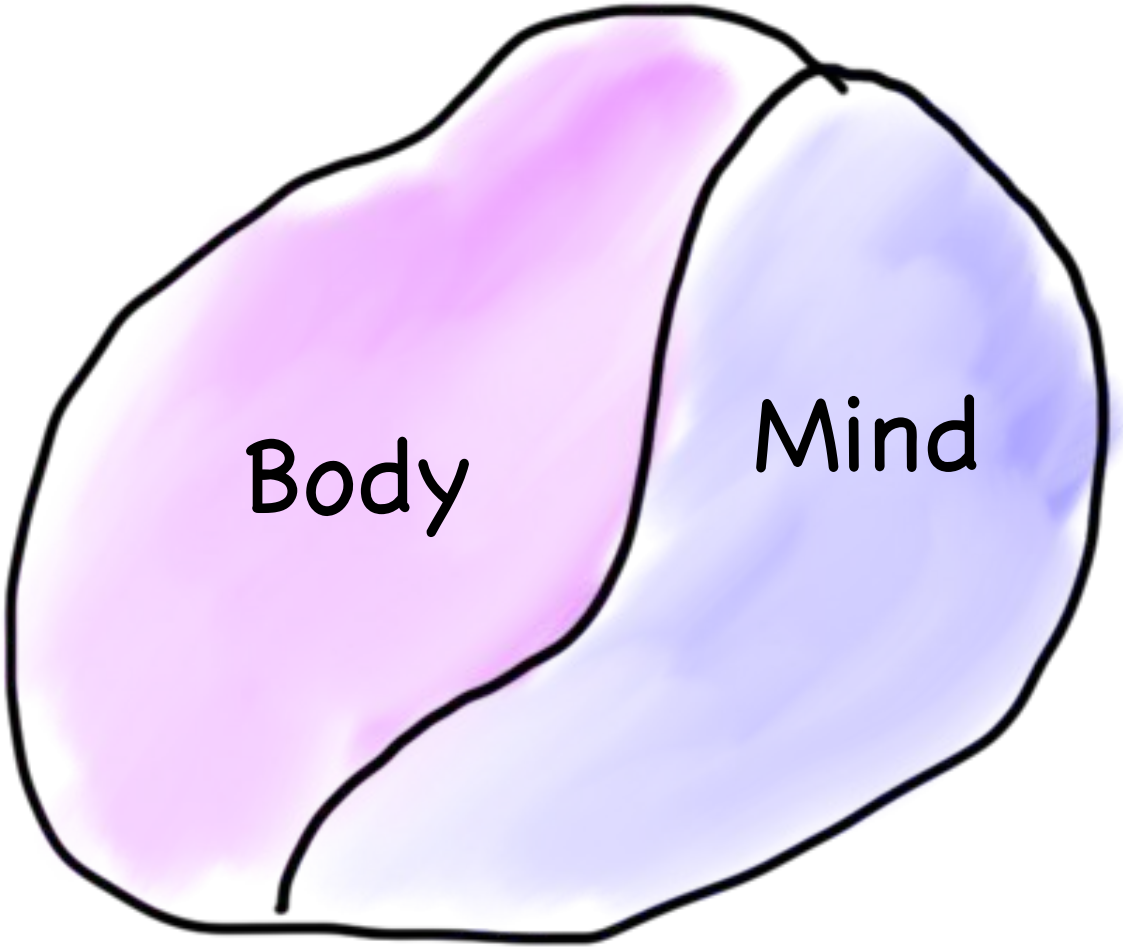
Sci-Fi Has Promised Me Robots



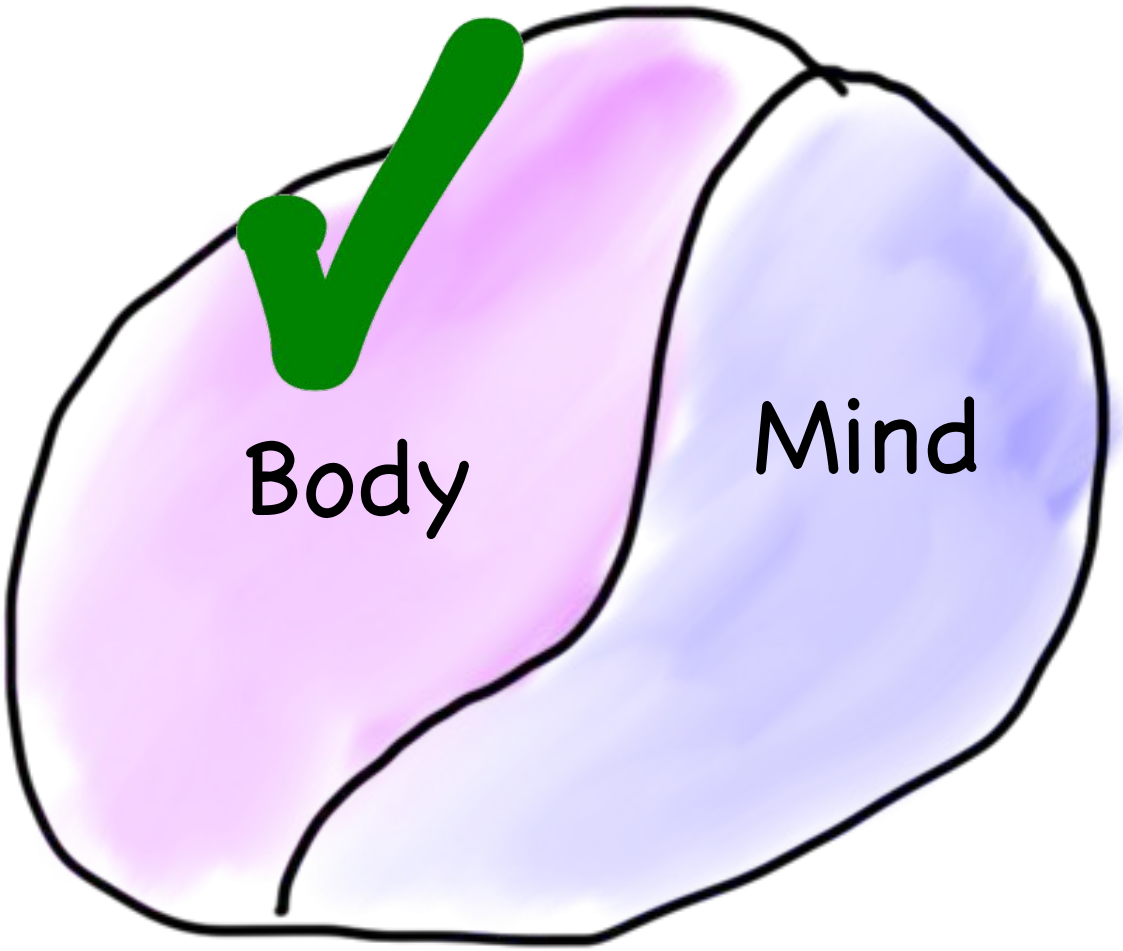
House Cleaning Robot

House Cleaning Robot

Robots?



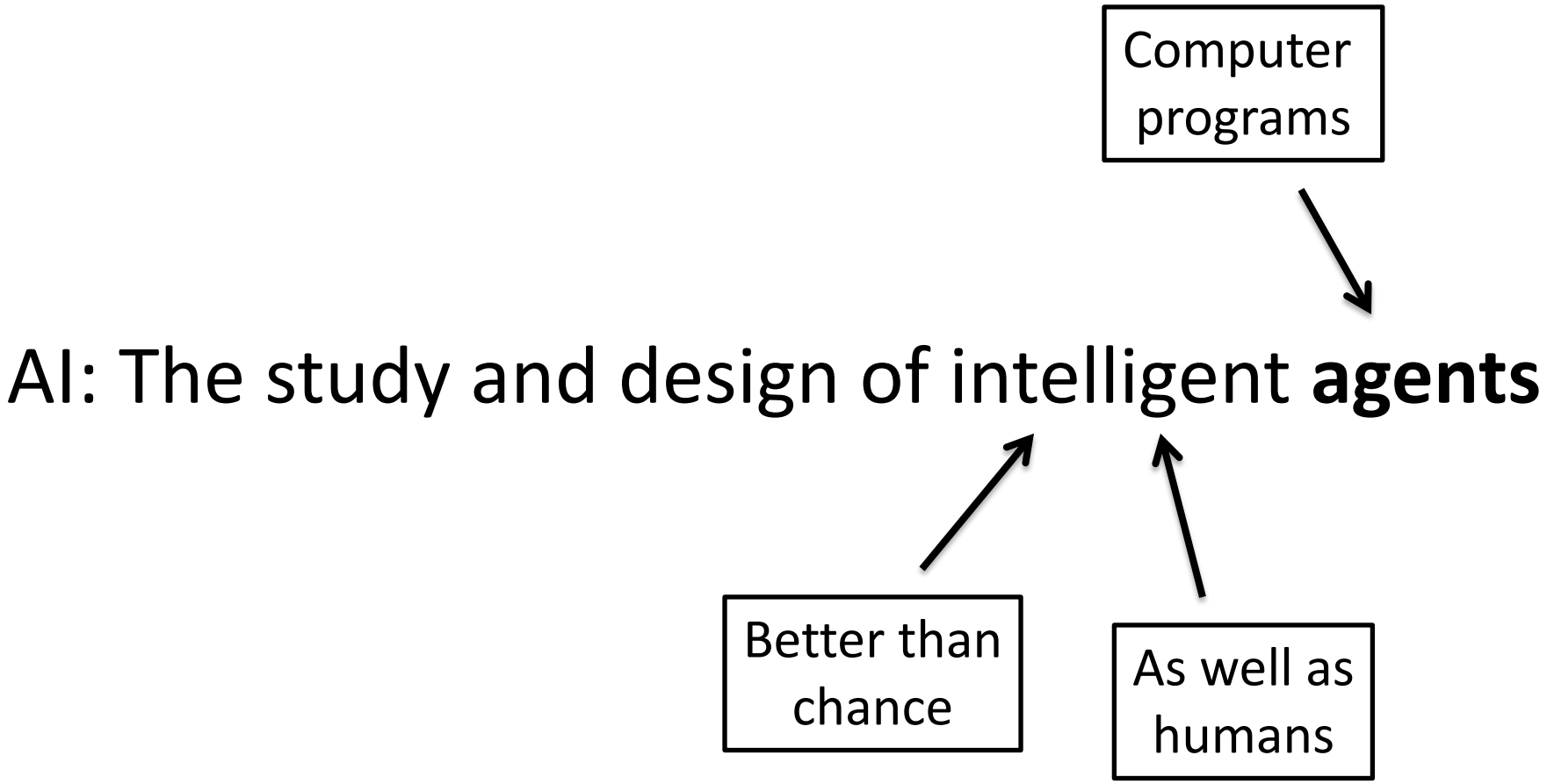
Robots?



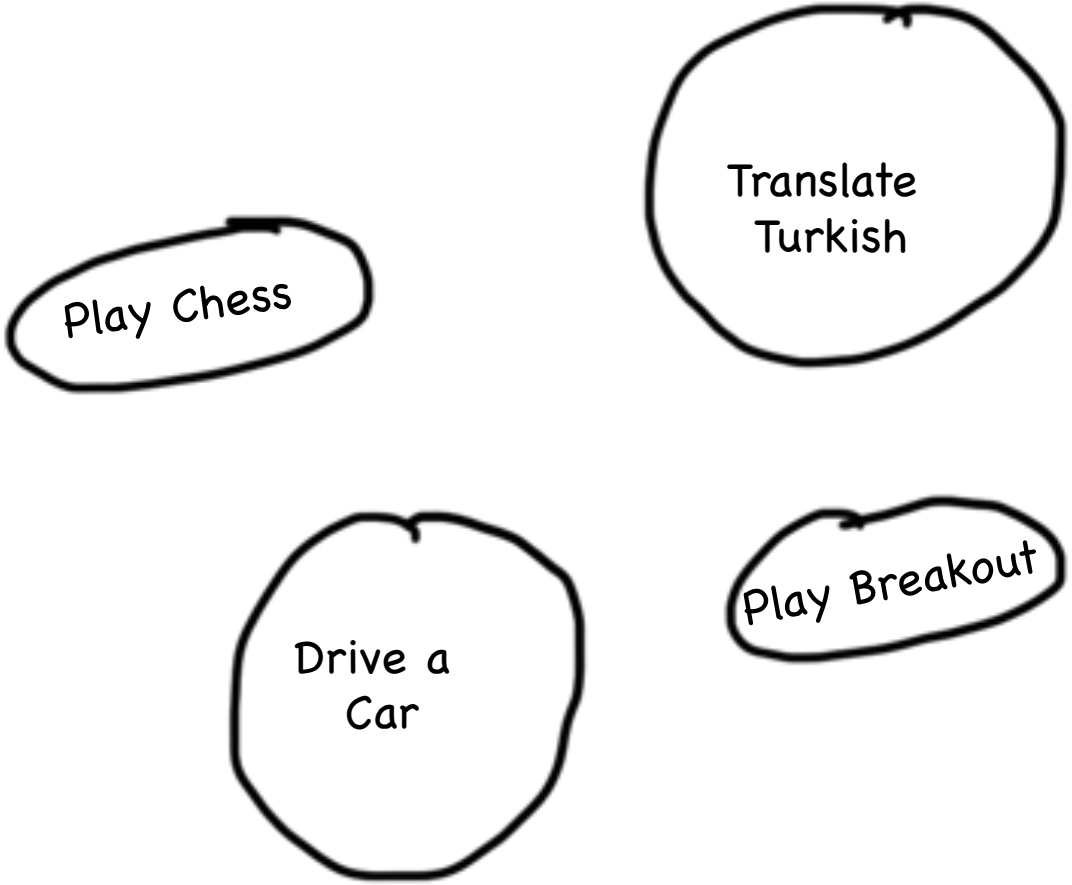
What is AI?

[suspense]

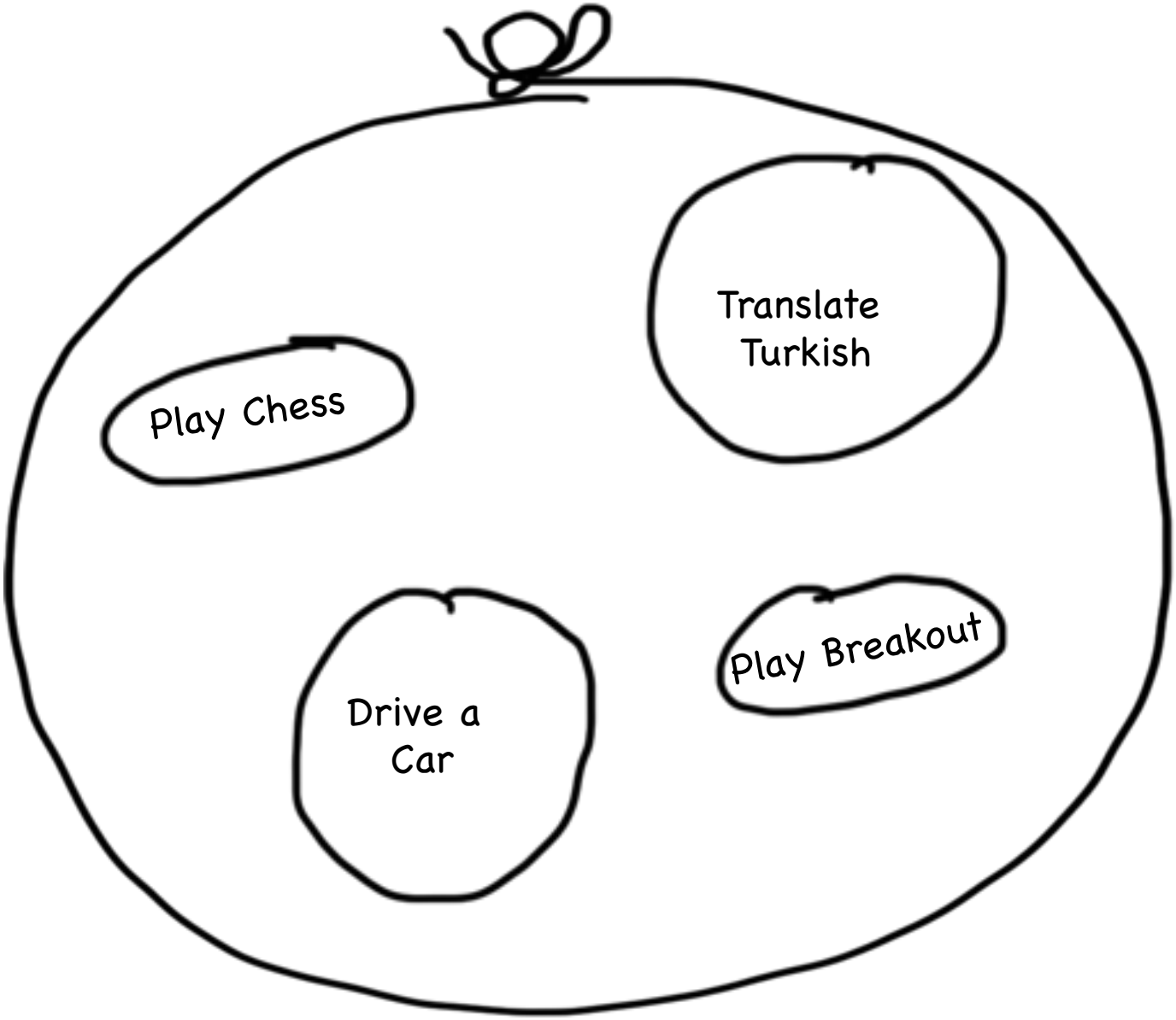
AI: The study and design of intelligent **agents**


Computer programs
AI: The study and design of intelligent **agents**
Better than chance
As well as humans

Narrow Intelligence



General Intelligence



Brief History

Early Optimism 1950s

1952

Early Optimism 1950s

"Machines will be capable, within twenty years, of doing any work a man can do."
–Herbert Simon, 1952

Underwhelming Results 1950s to 1980s

The spirit is willing but the flesh is weak.

↓

(Russian)

↓

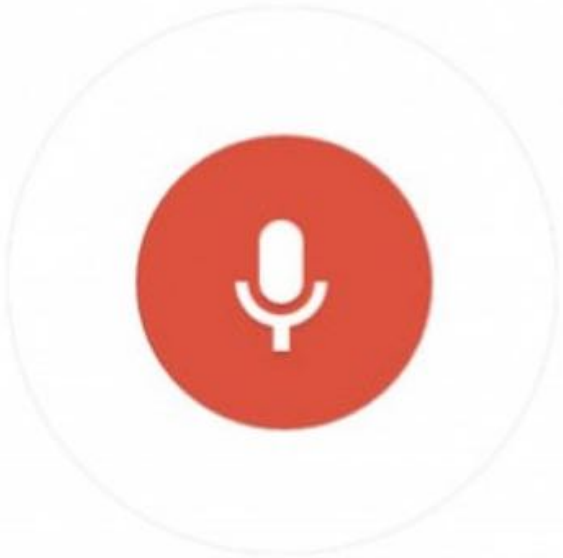
The vodka is good but the meat is rotten.

The world is too complex


BRACE YOURSELVES
WINTER IS COMING

Big Milestones

Told Speech Was 30 Years Out



Almost perfect…

The Last Remaining Board Game

Computers Making Art

Self Driving Cars

What is going on?

[more suspense]

Story of Modern AI

Focus on one problem

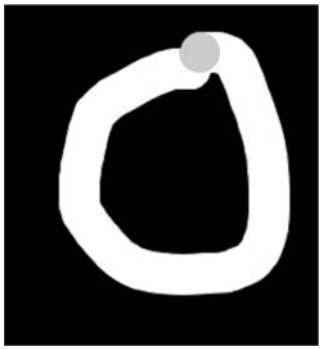
Make a Harry Potter Sorting Hat

Classification

That is a picture of a **one**

Classification

That is a picture of a **zero**



Classification

That is a picture of an **zero**

* It doesn't have to be correct all of the time

Can you do it?

How about now?

What a computer sees

0	0	1	0	1	0	1	0	0	0	1	1	1	0	1
1	0	0	1	0	1	1	1	0	1	0	0	0	0	0
1	1	1	0	1	0	0	1	1	0	0	1	0	1	0
1	1	1	1	1	0	0	0	0	0	1	1	0	1	1
0	0	0	1	1	0	0	1	0	0					
1	0	0	1	1	0	0	0	1	0					
1	1	0	1	1	0	0	1	1	0					
1	0	1	0	0	1	0	0	1	0					
0	0	0	0	1	0	1	0	1	1					
0	1	1	0	0	0	0	0	1	1					
0	0	1	0	1	1	1	0	0	0					
0	1	1	1	0	1	0	0	1	0					
1	1	0	0	0	0	0	0	0	0					
0	0	0	0	0	0	0	0	1	1					
0	0	1	1	1	0	1	0	1	1					

What a human sees

Why is it easy for Humans?

About 30% of your cortex is used from vision
3% is used to process hearing

Very hard to Program


```
public class HarryHat extends ConsoleProgram {

   public void run() {
      println("Todo: Write program");
   }

}
```

Perhaps there is an insight?

Two Great Ideas

1. Artificial Neurons

2. Learn by Example

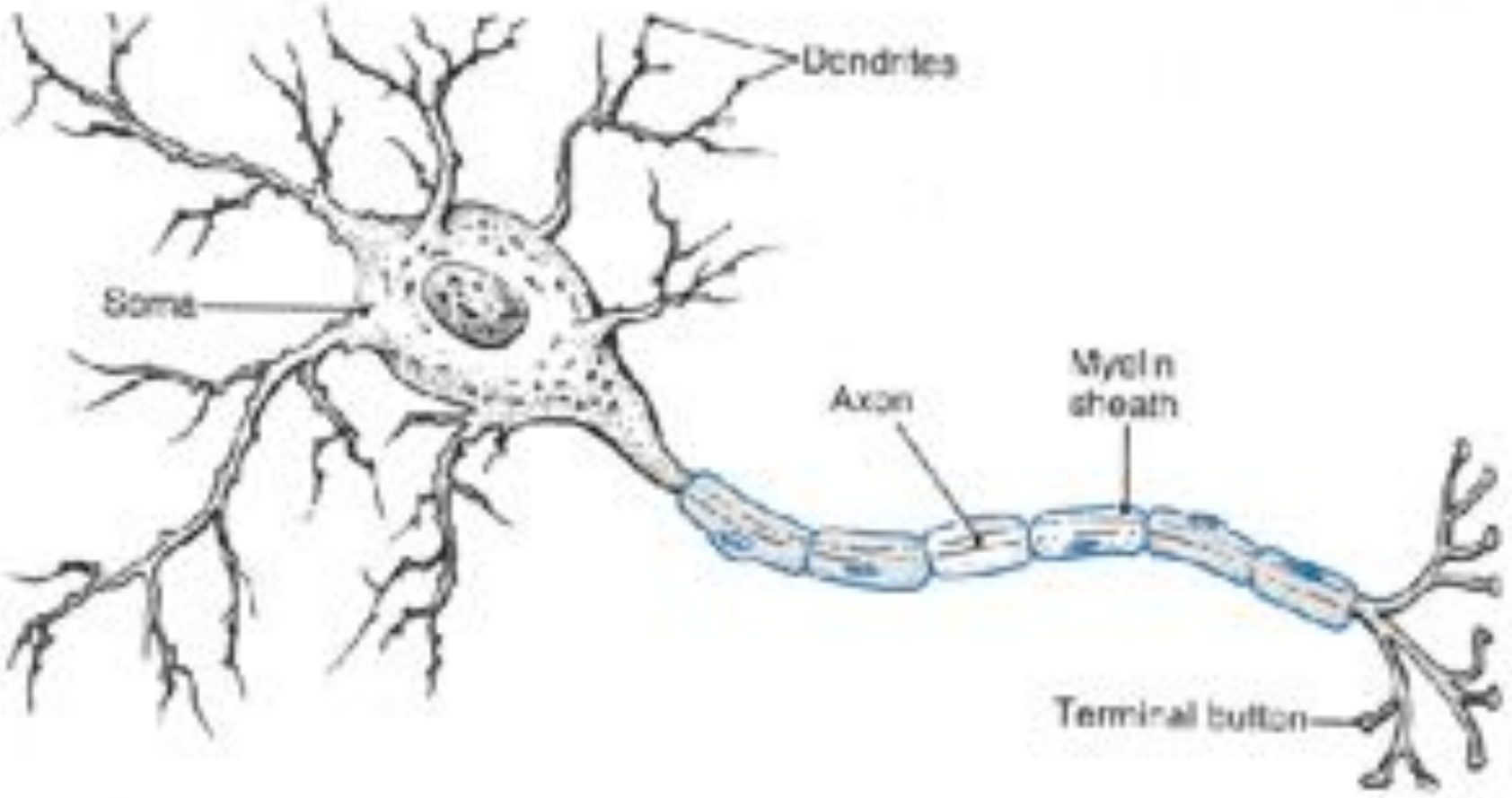
Two Great Ideas

1. Artificial Neurons

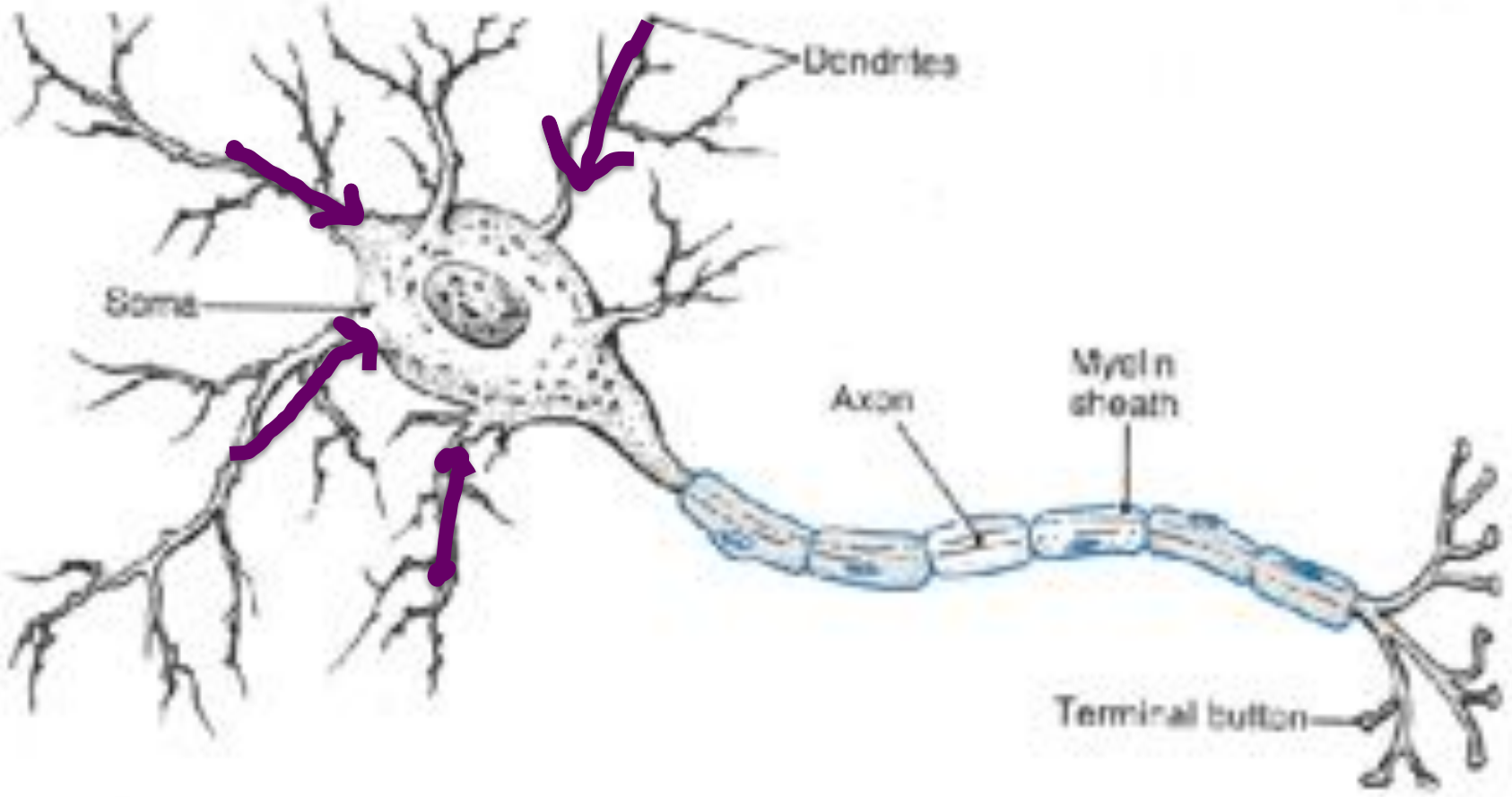
2. Learn by Example

1. Artificial Neurons

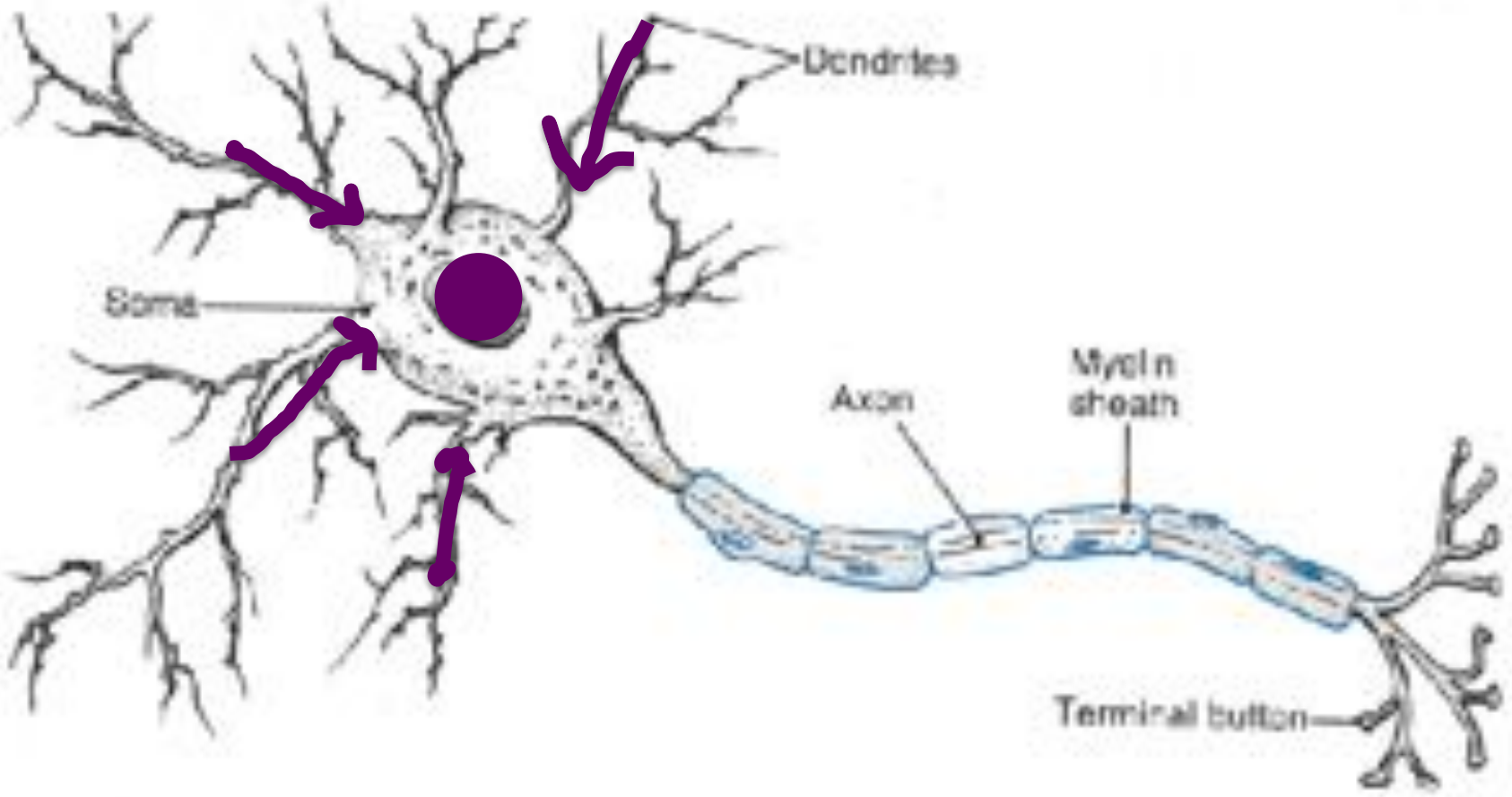
Neuron



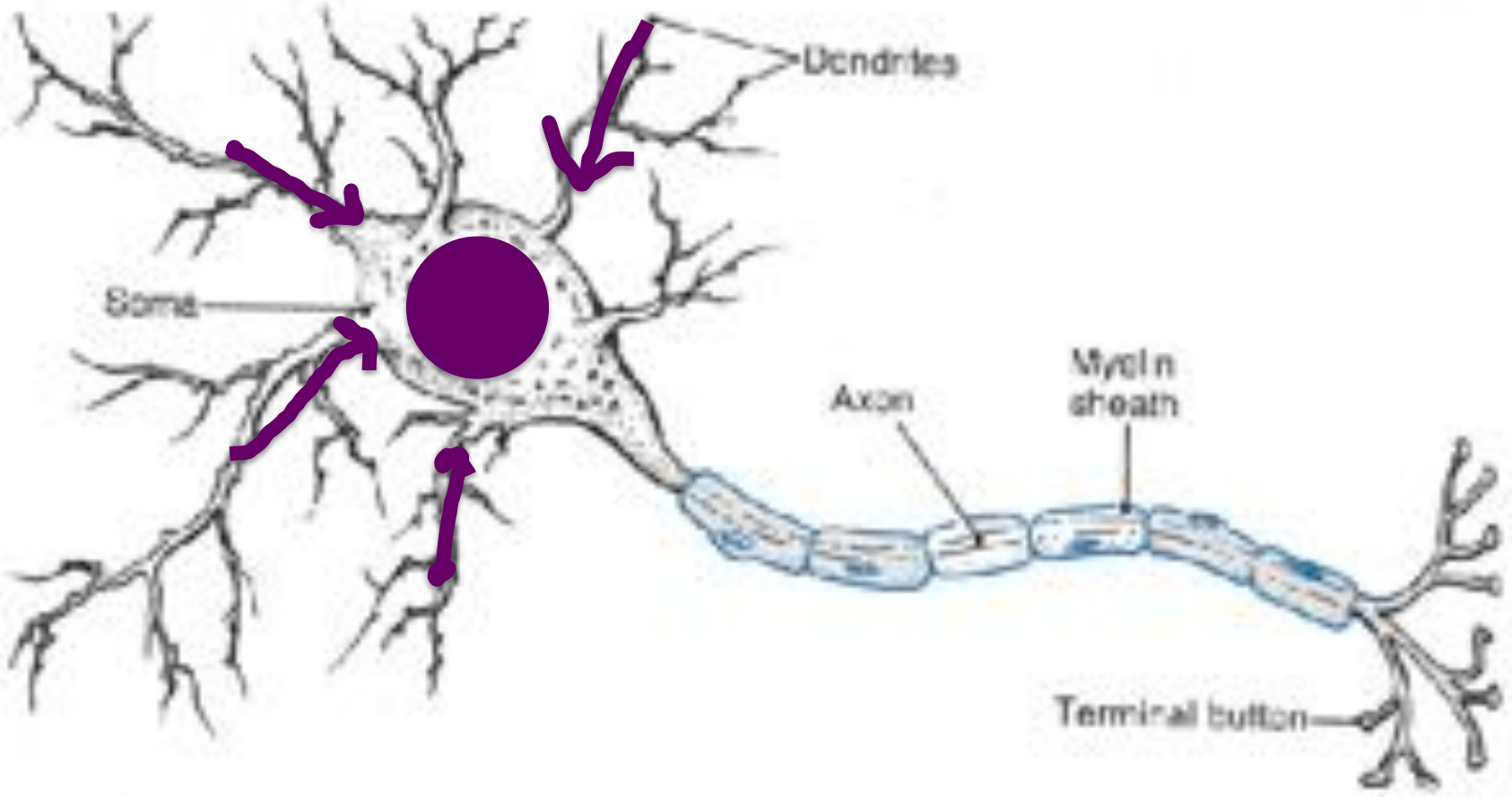
Neuron



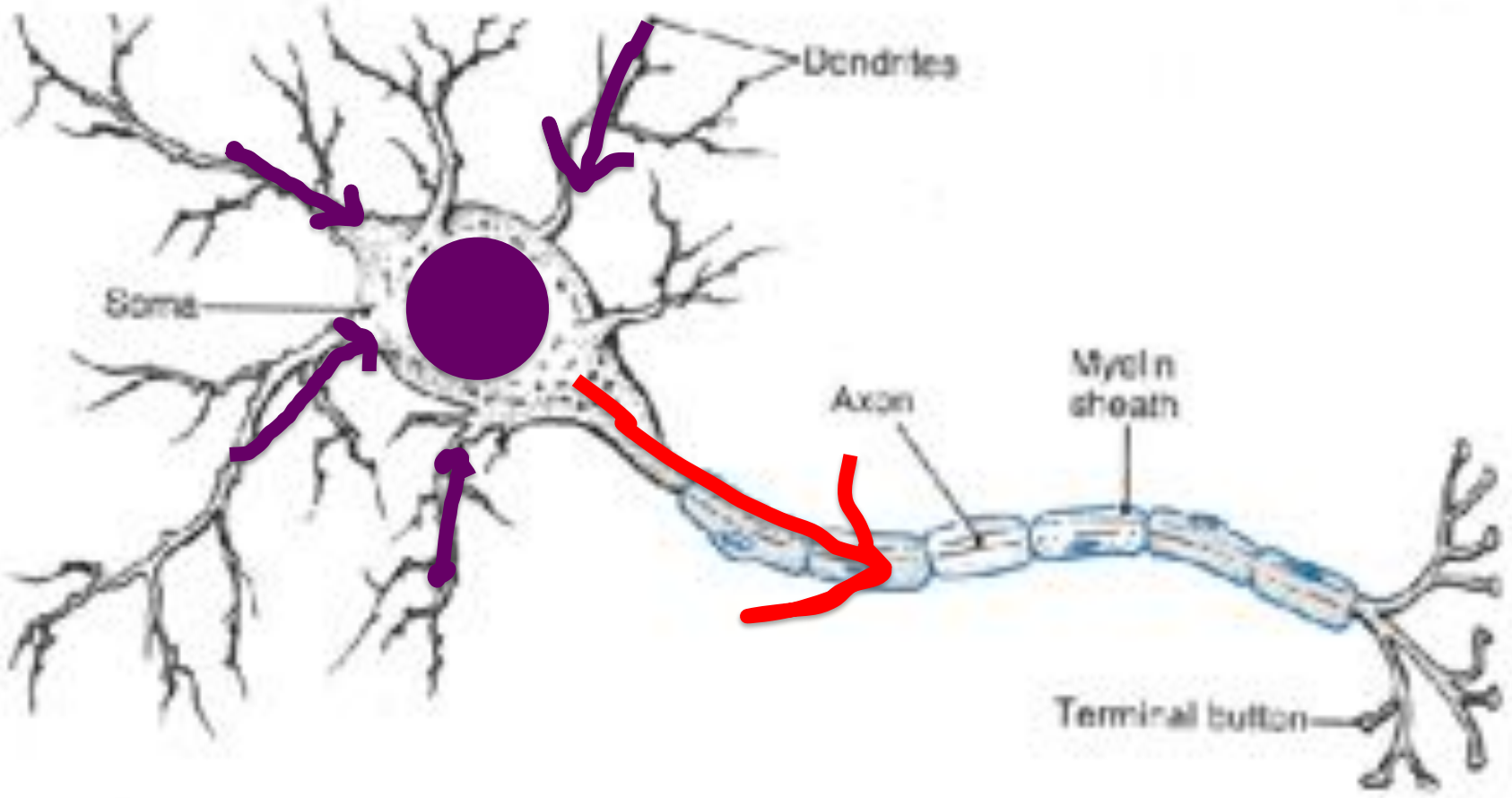
Neuron



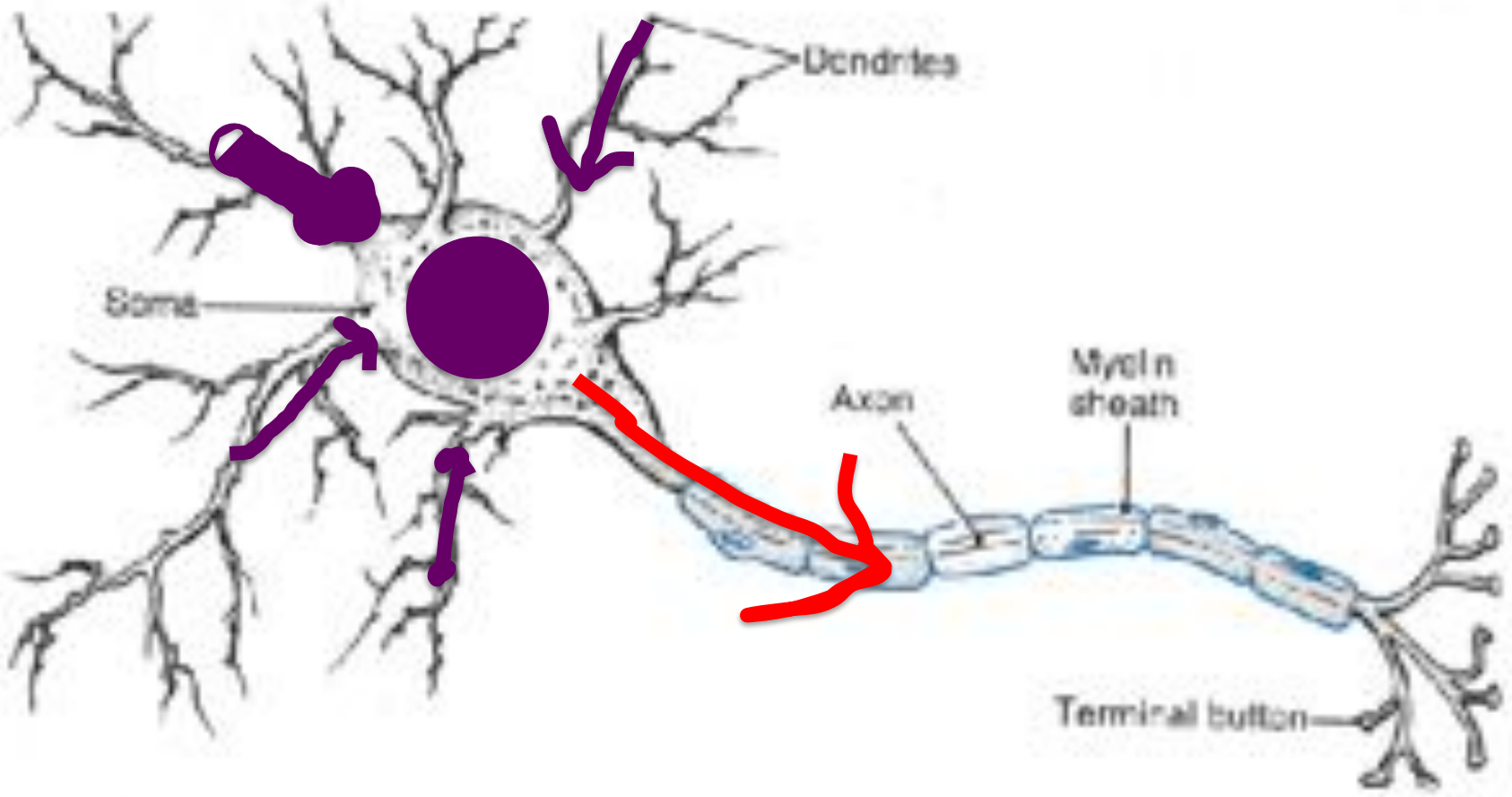
Neuron



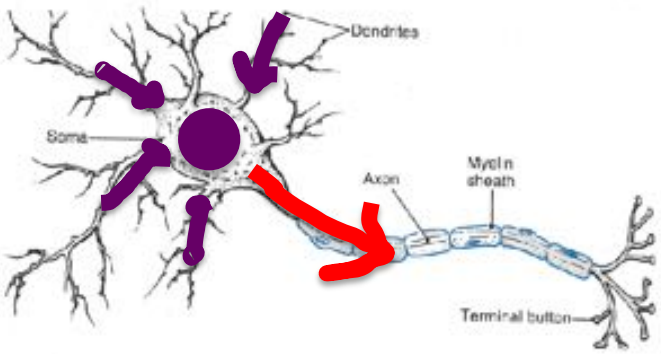
Neuron

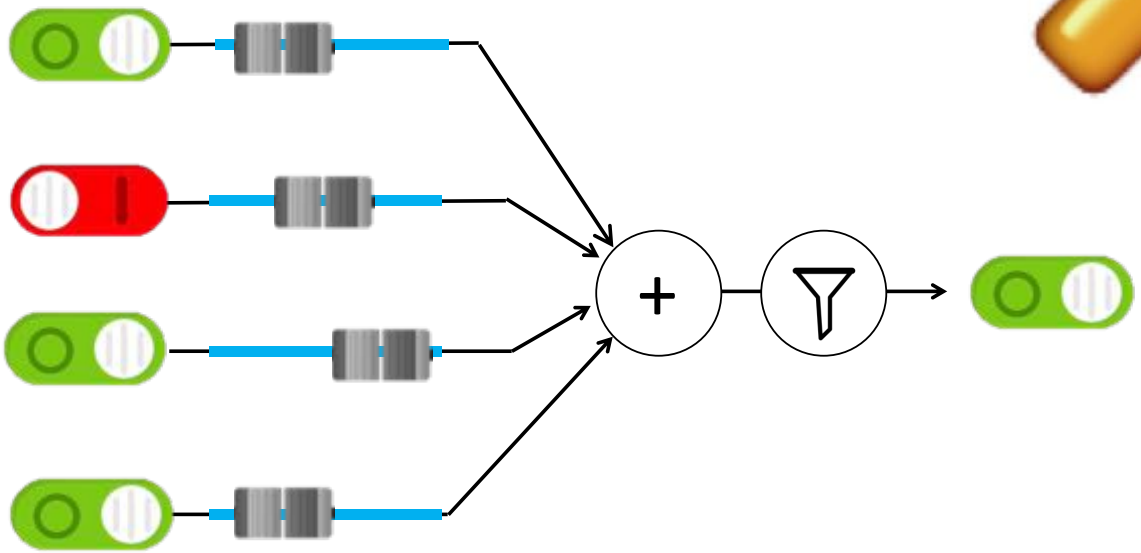


Some Inputs are More Important

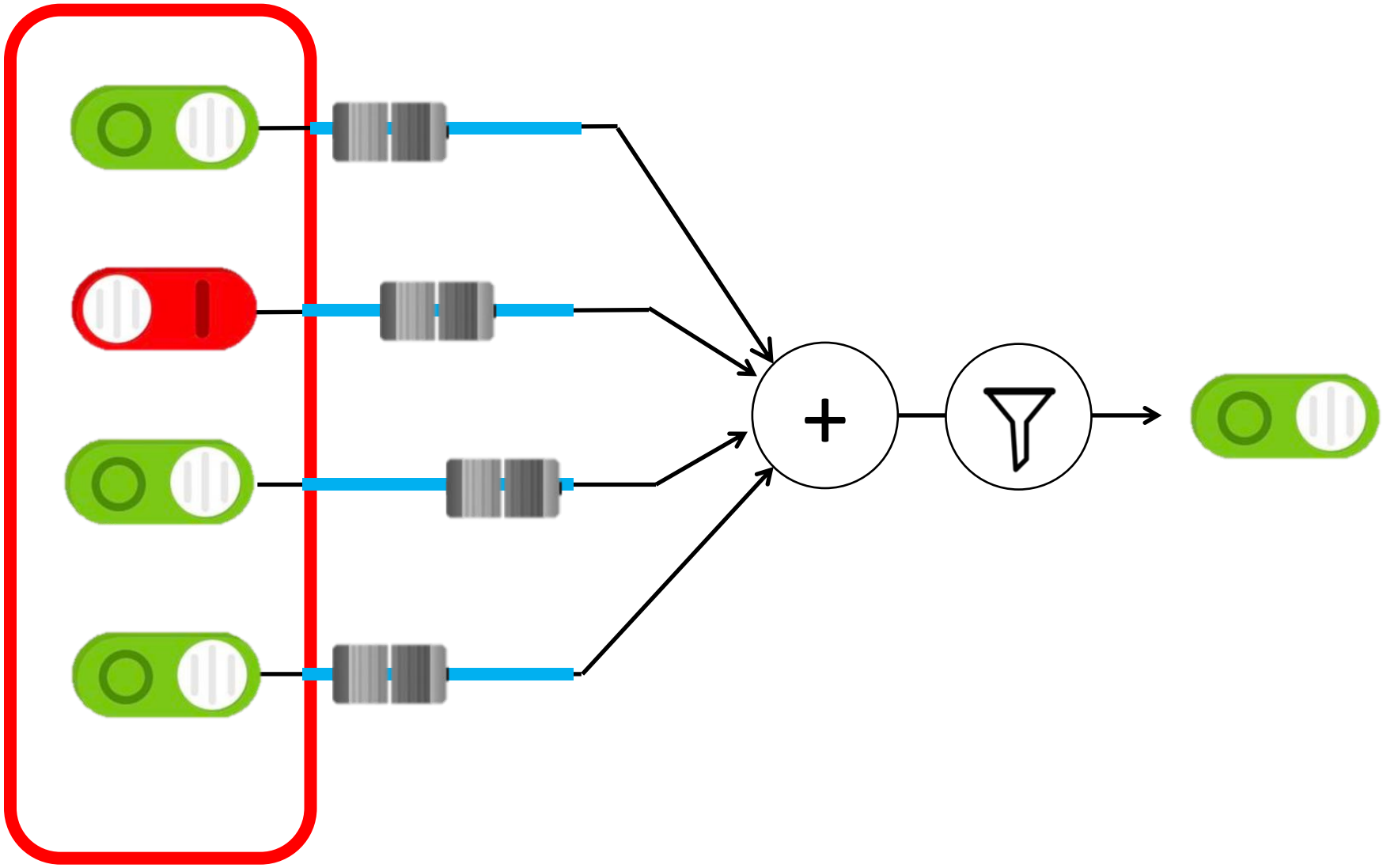


Artificial Neuron



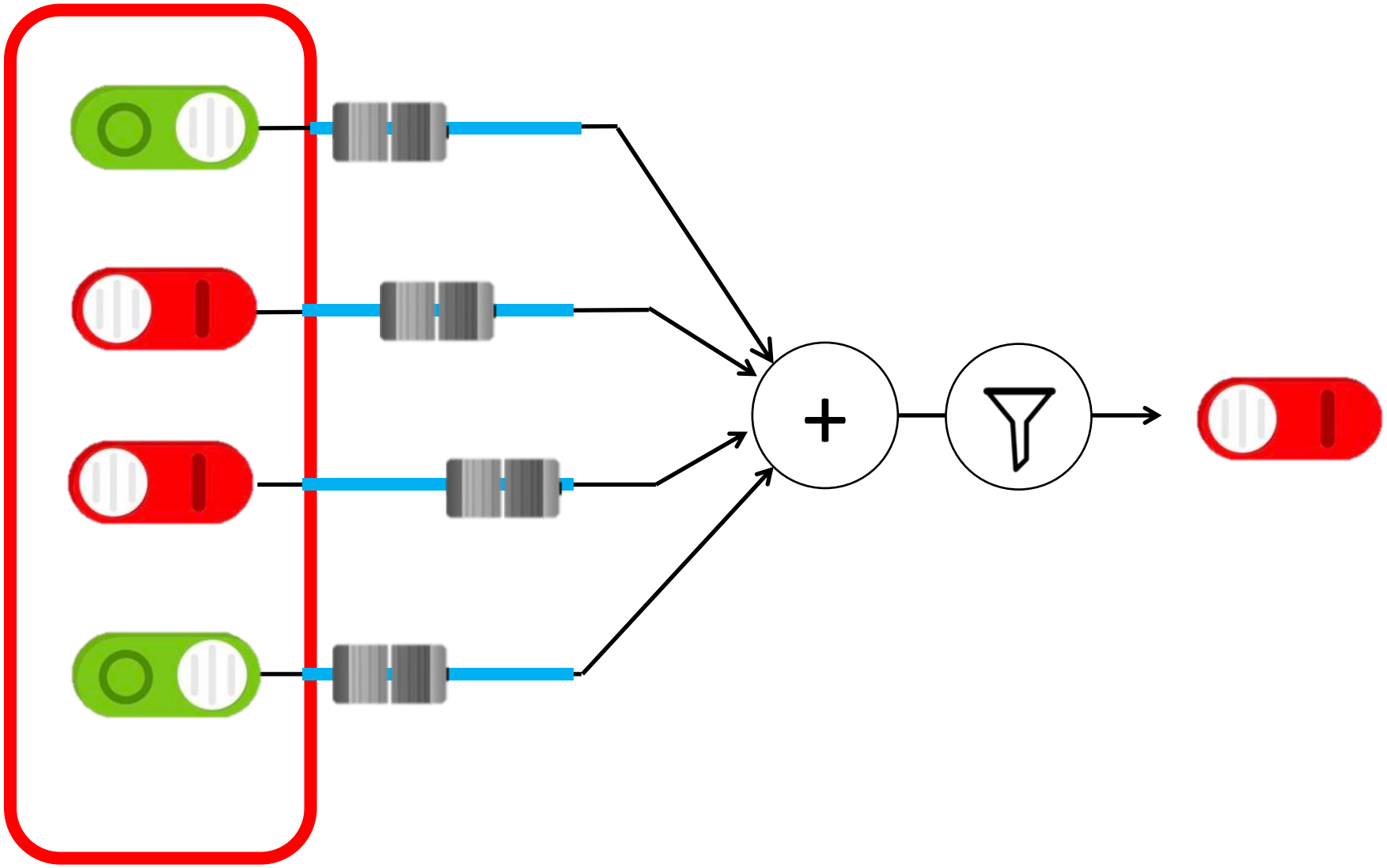


Inputs



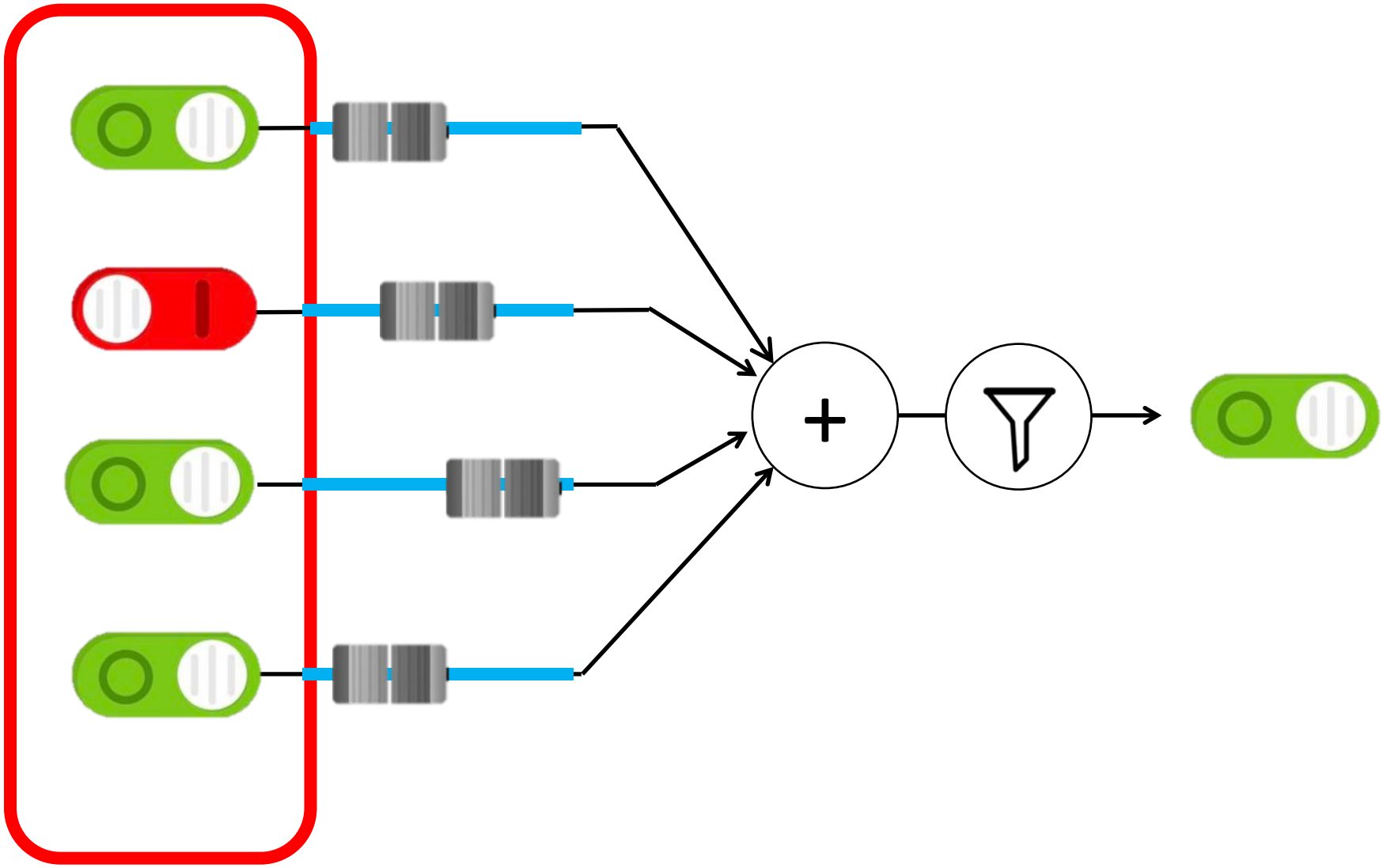
Numbers between 0 and 1

Inputs



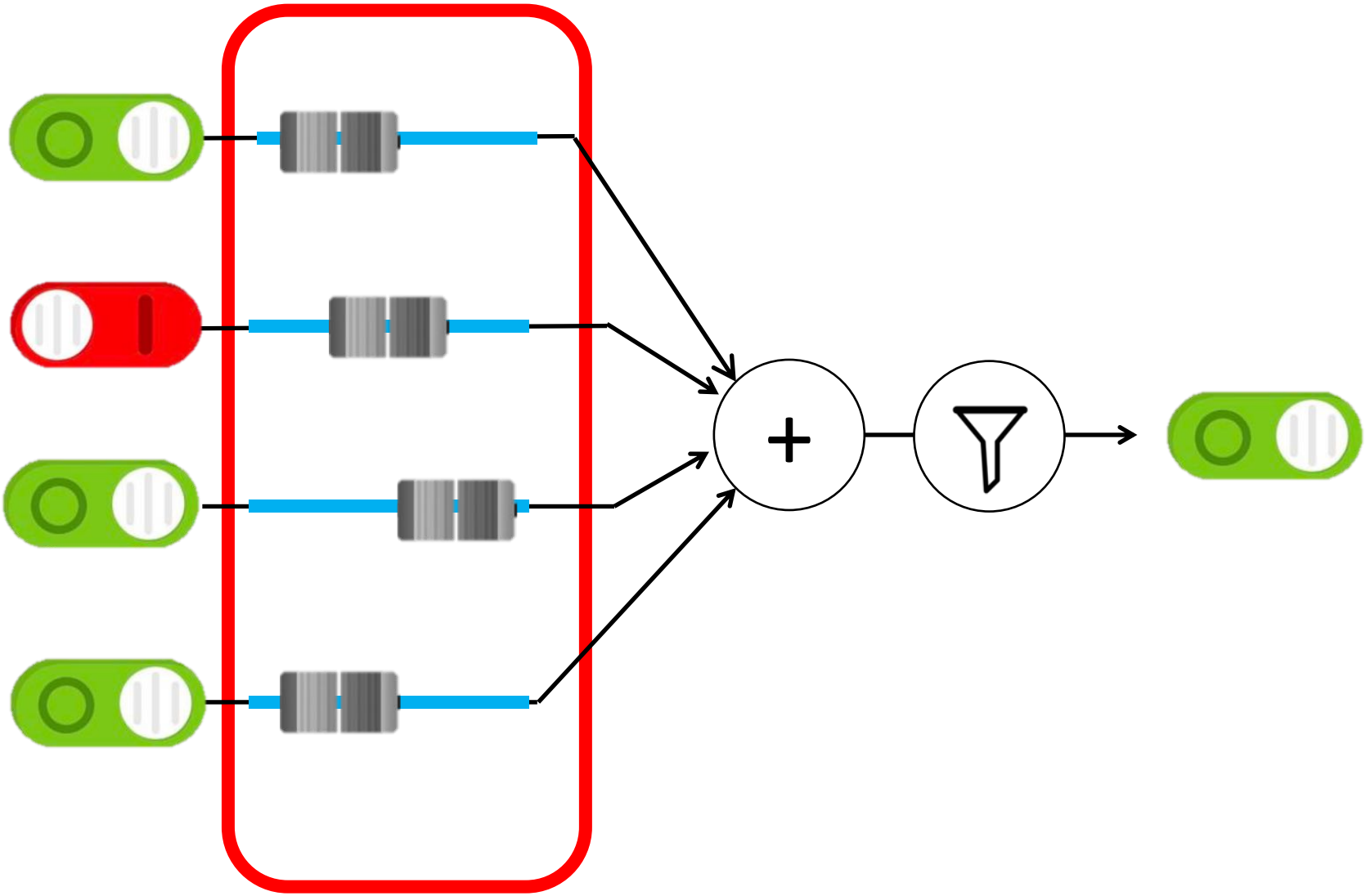
Numbers between 0 and 1

Inputs



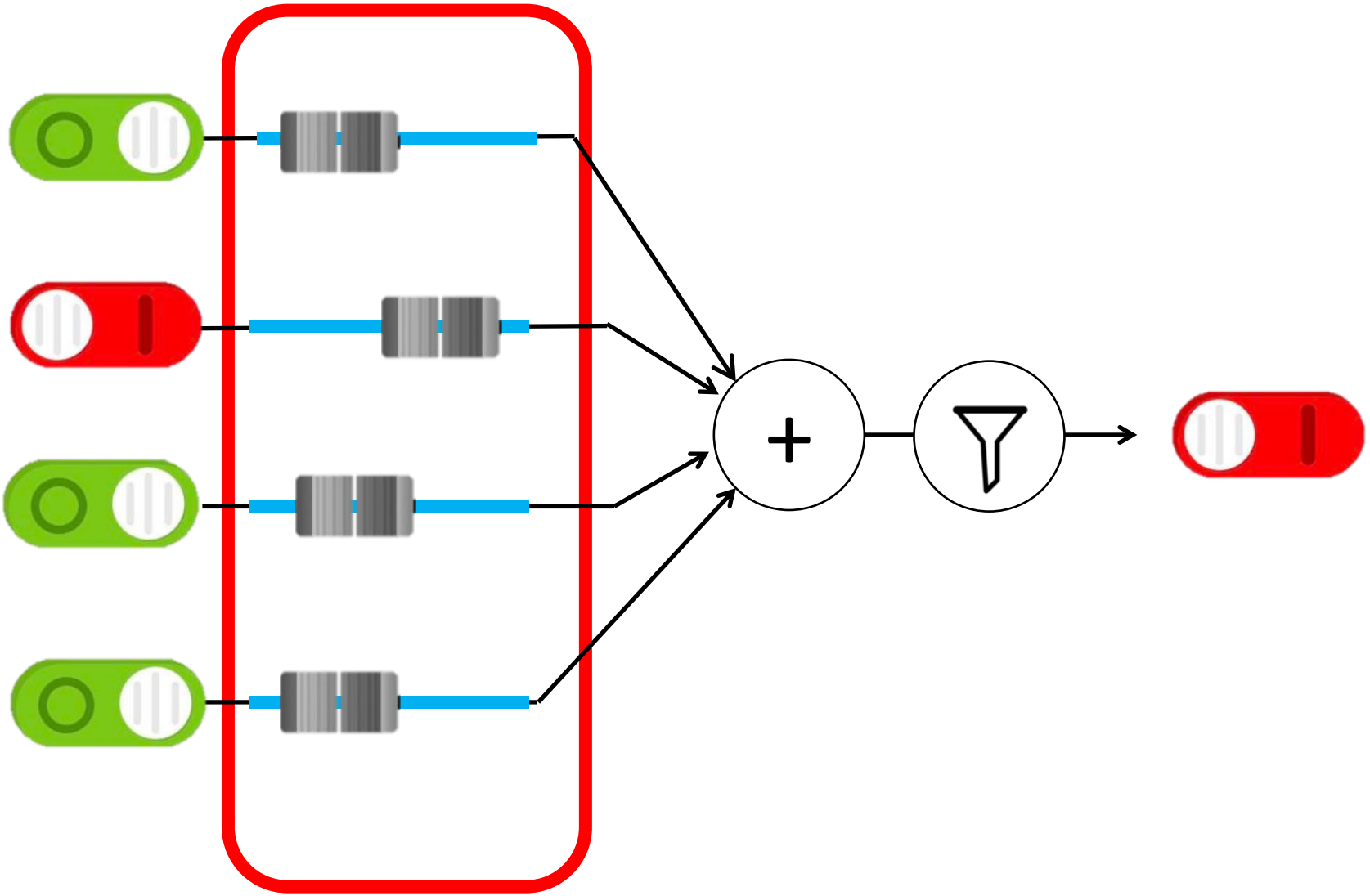
Numbers between 0 and 1

Weights

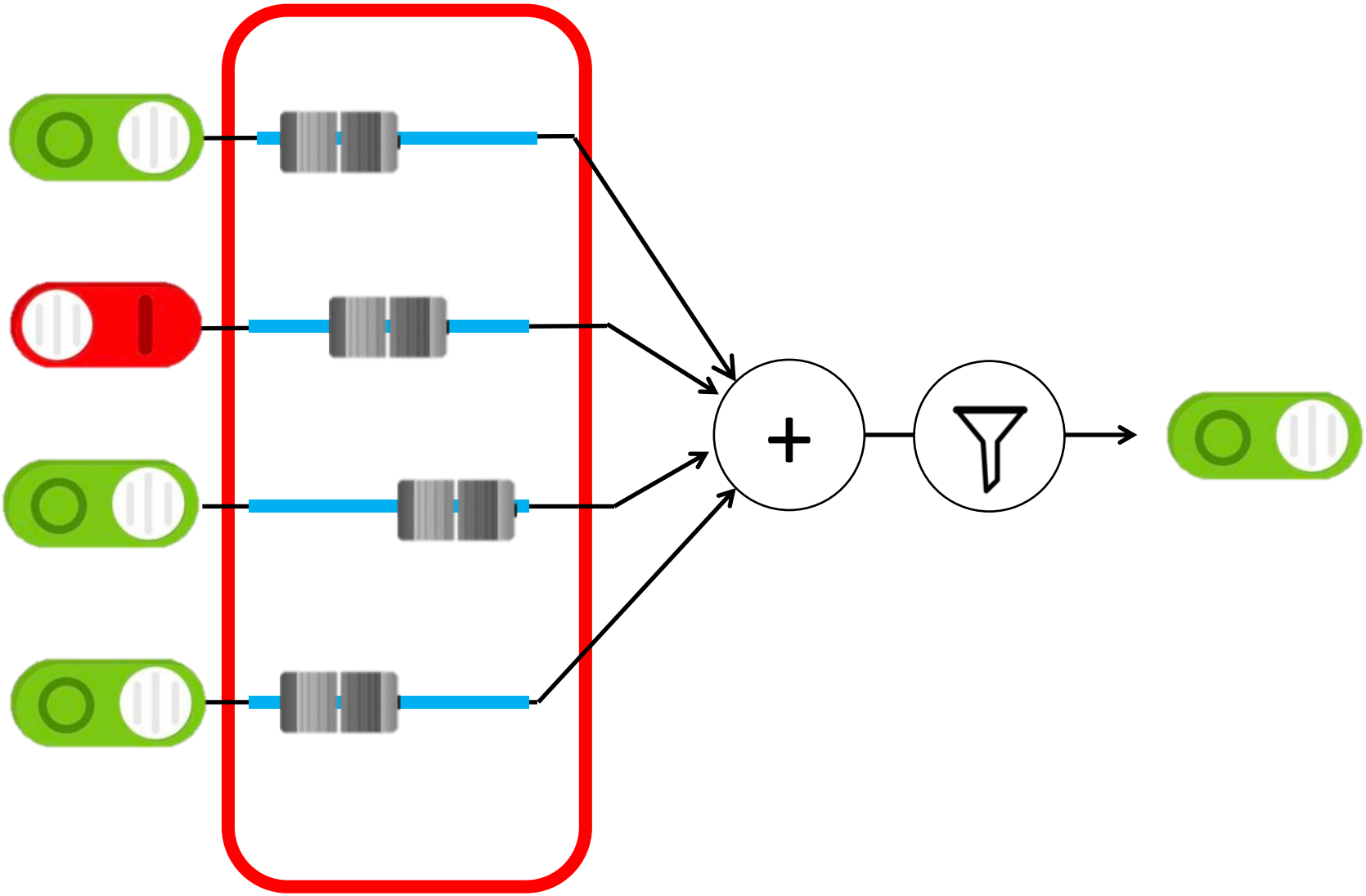


Negative or positive numbers

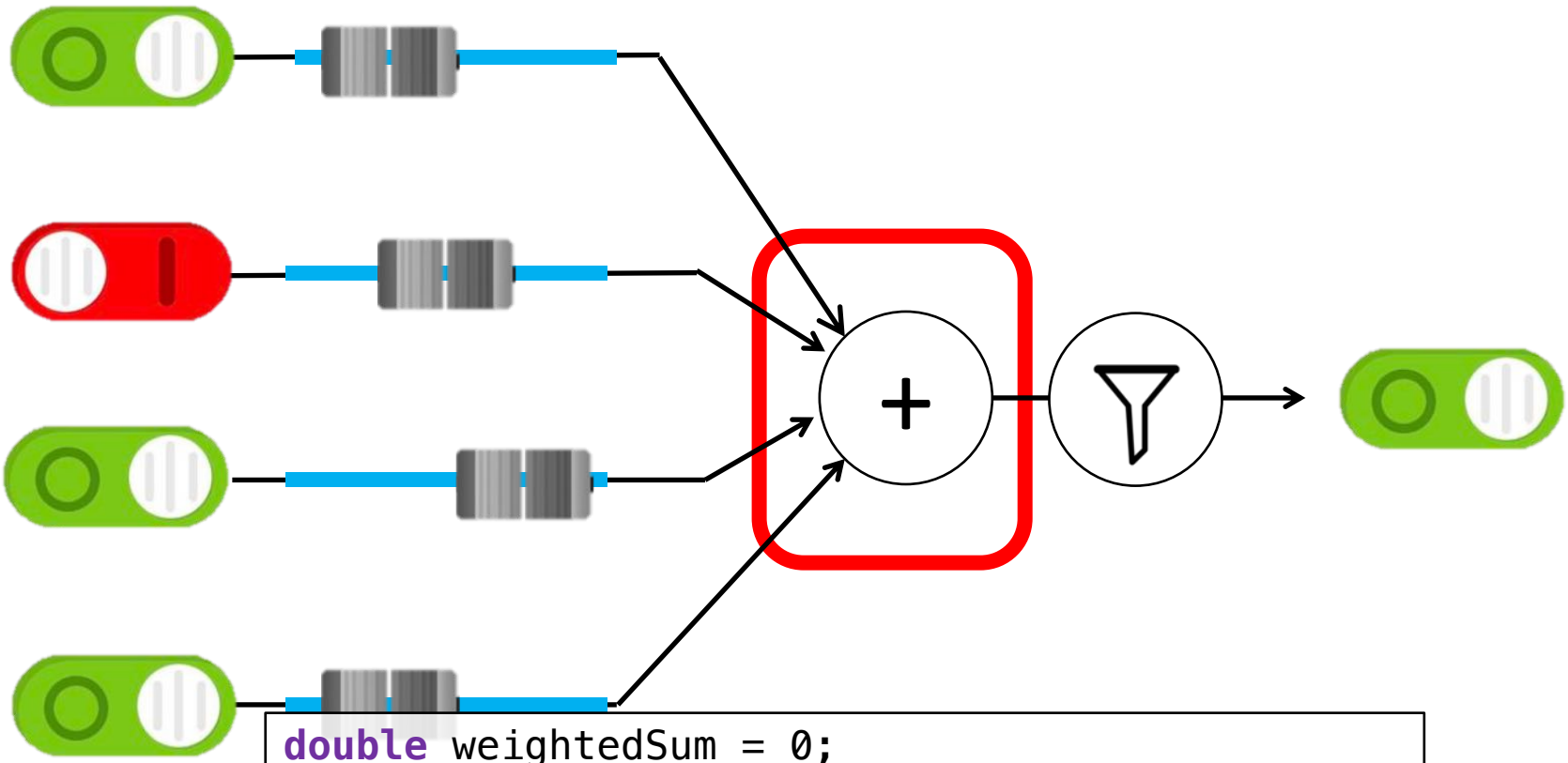
Weights



Weights

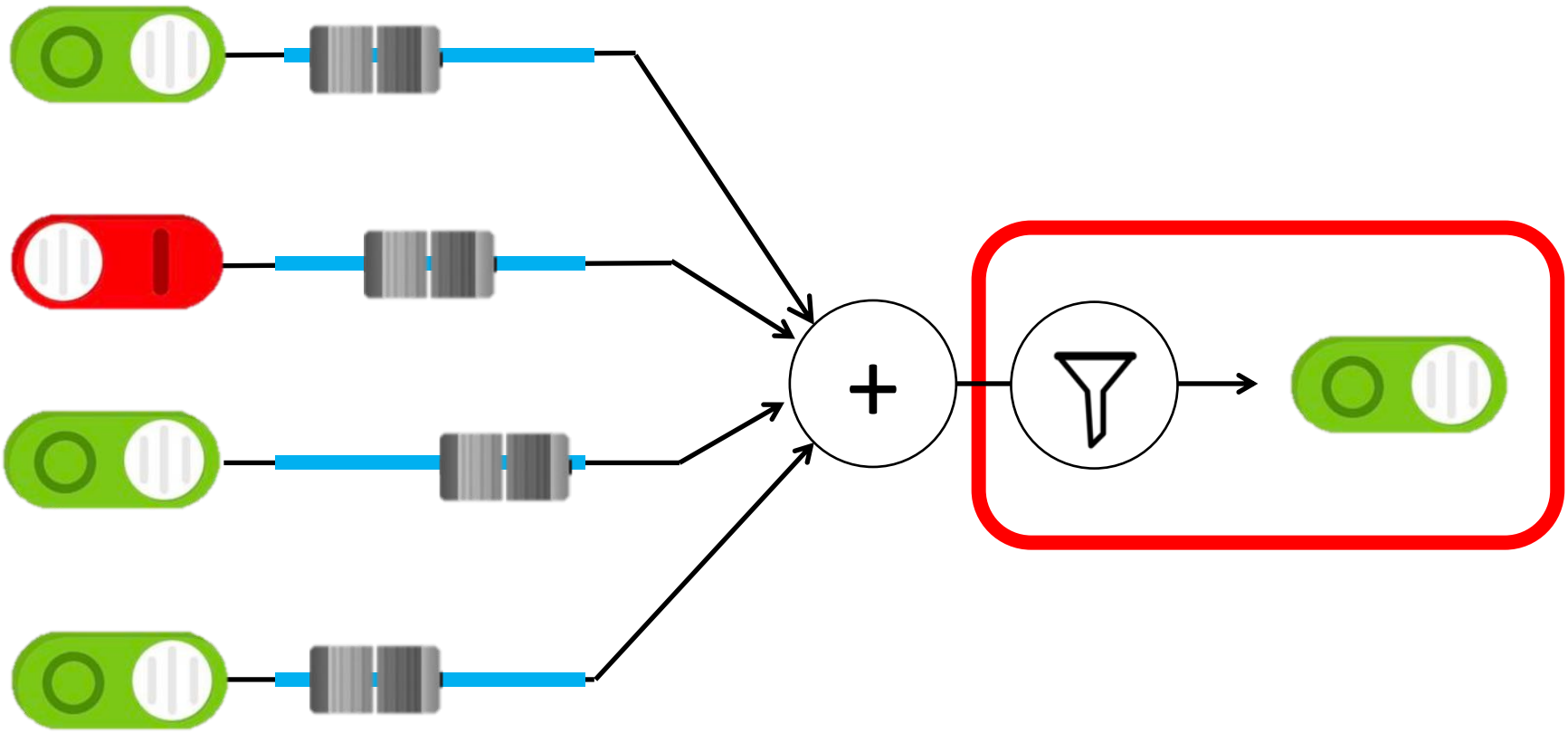


Weighted Sum

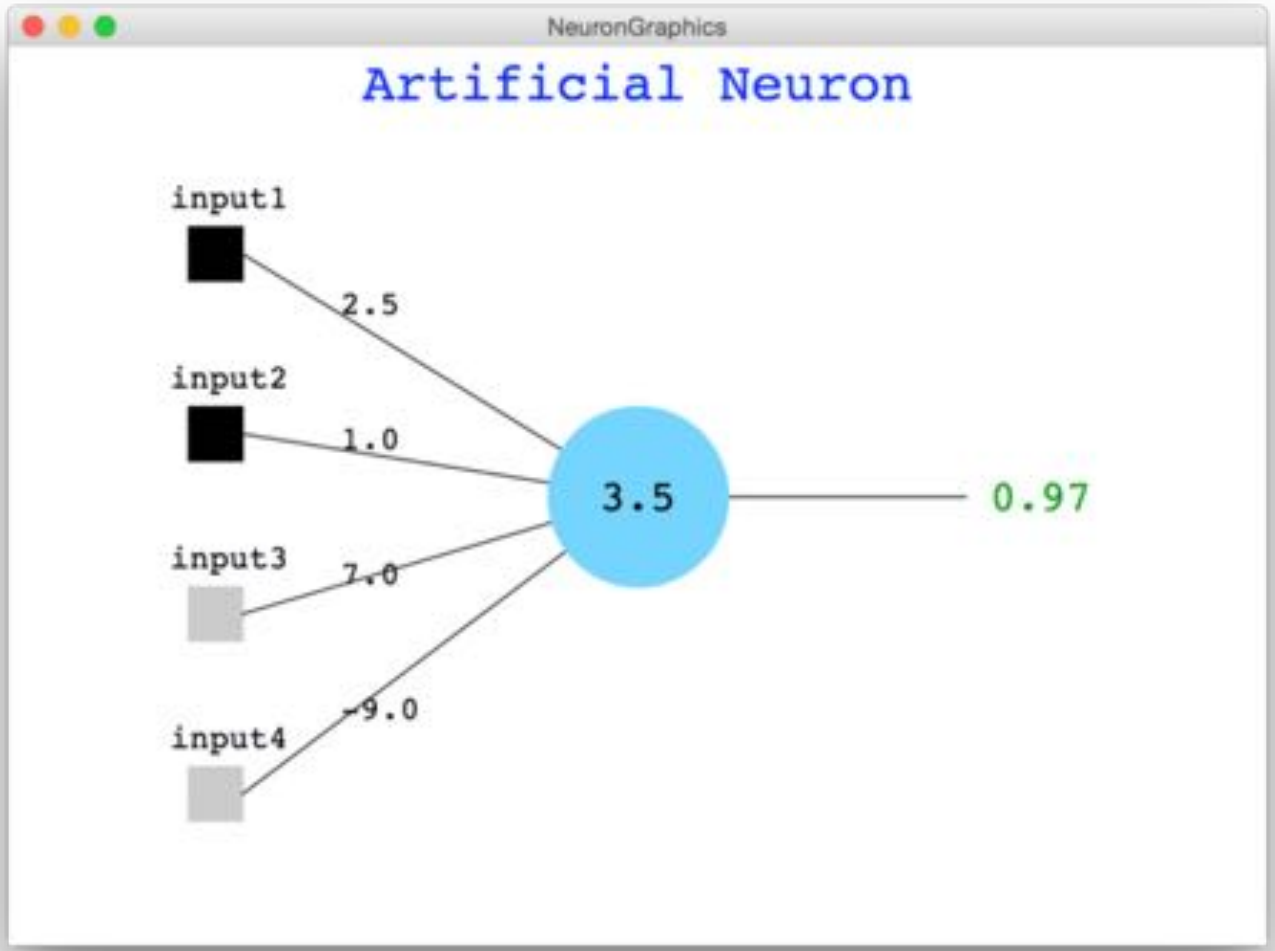


```
double weightedSum = 0;
weightedSum = weightedSum  + input0 * weight0;
weightedSum = weightedSum  + input1 * weight1;
weightedSum = weightedSum  + input2 * weight2;
weightedSum = weightedSum  + input3 * weight3;
```

Filter and Output

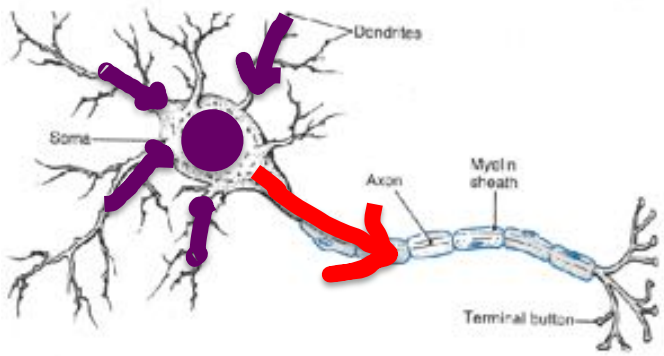


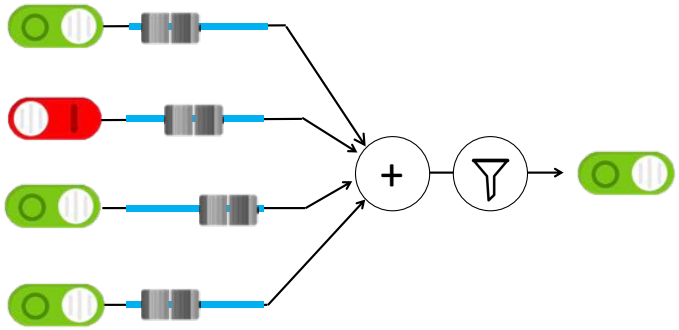
Java Demo


NeuronGraphics
Artificial Neuron
input1
input2
input3
input4
2.5
1.0
7.0
-9.0
3.5
0.97

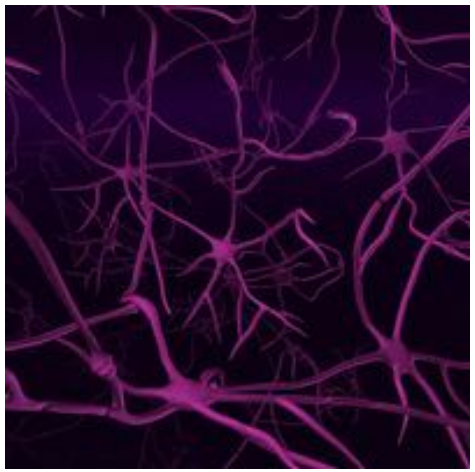
Biological Basis for Neural Networks

- A neuron





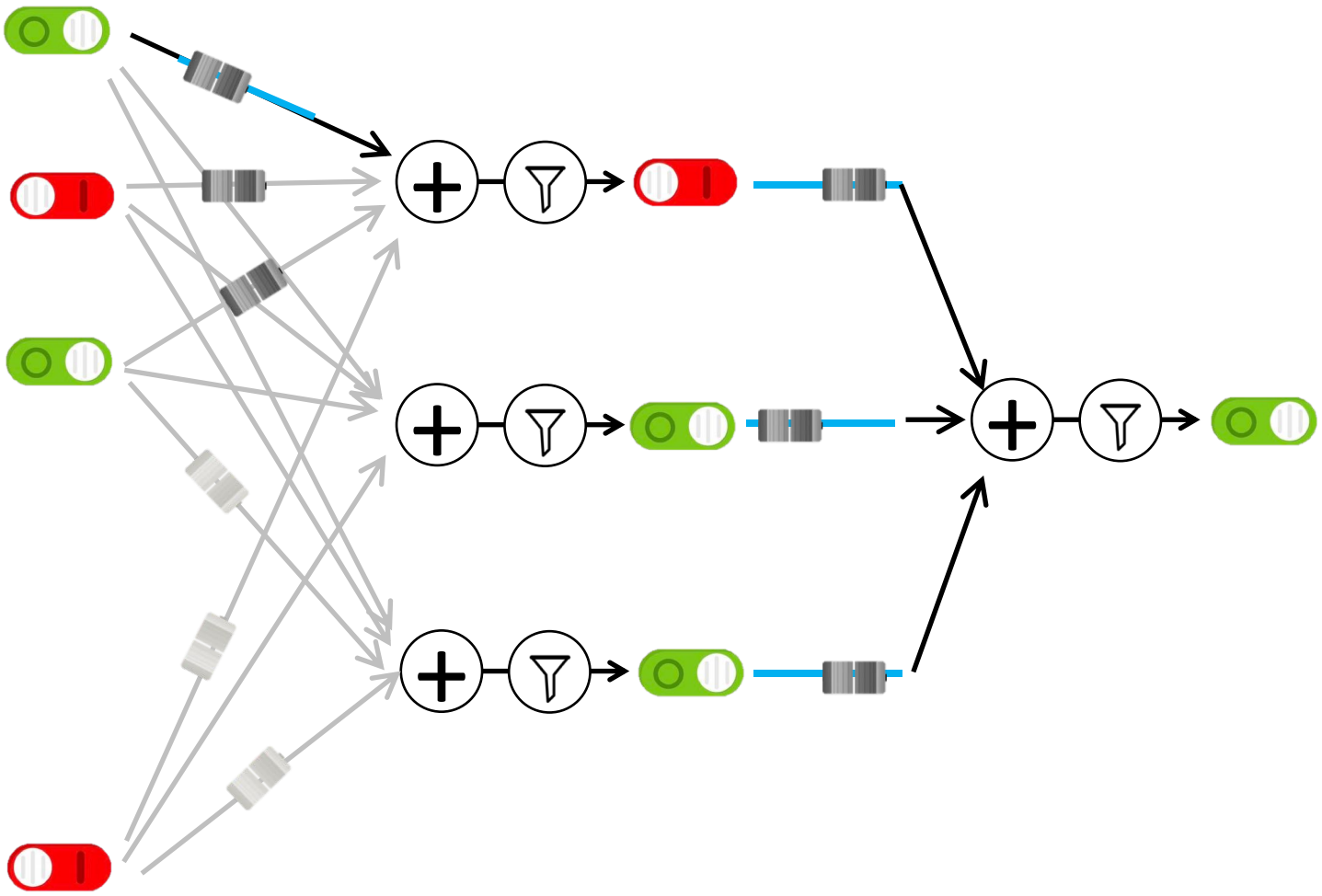
- Your brain



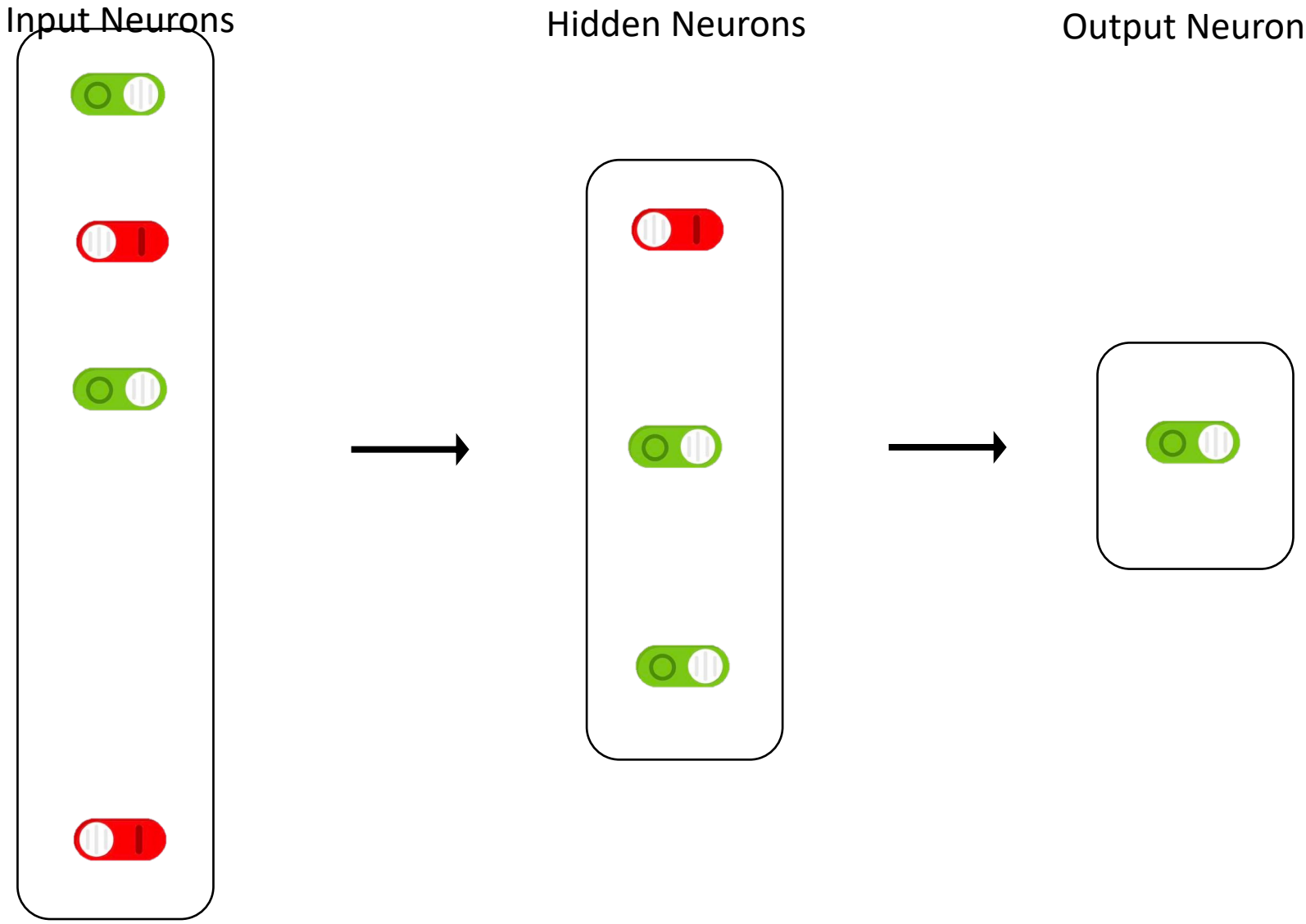
???

Actually, it's probably someone else's brain

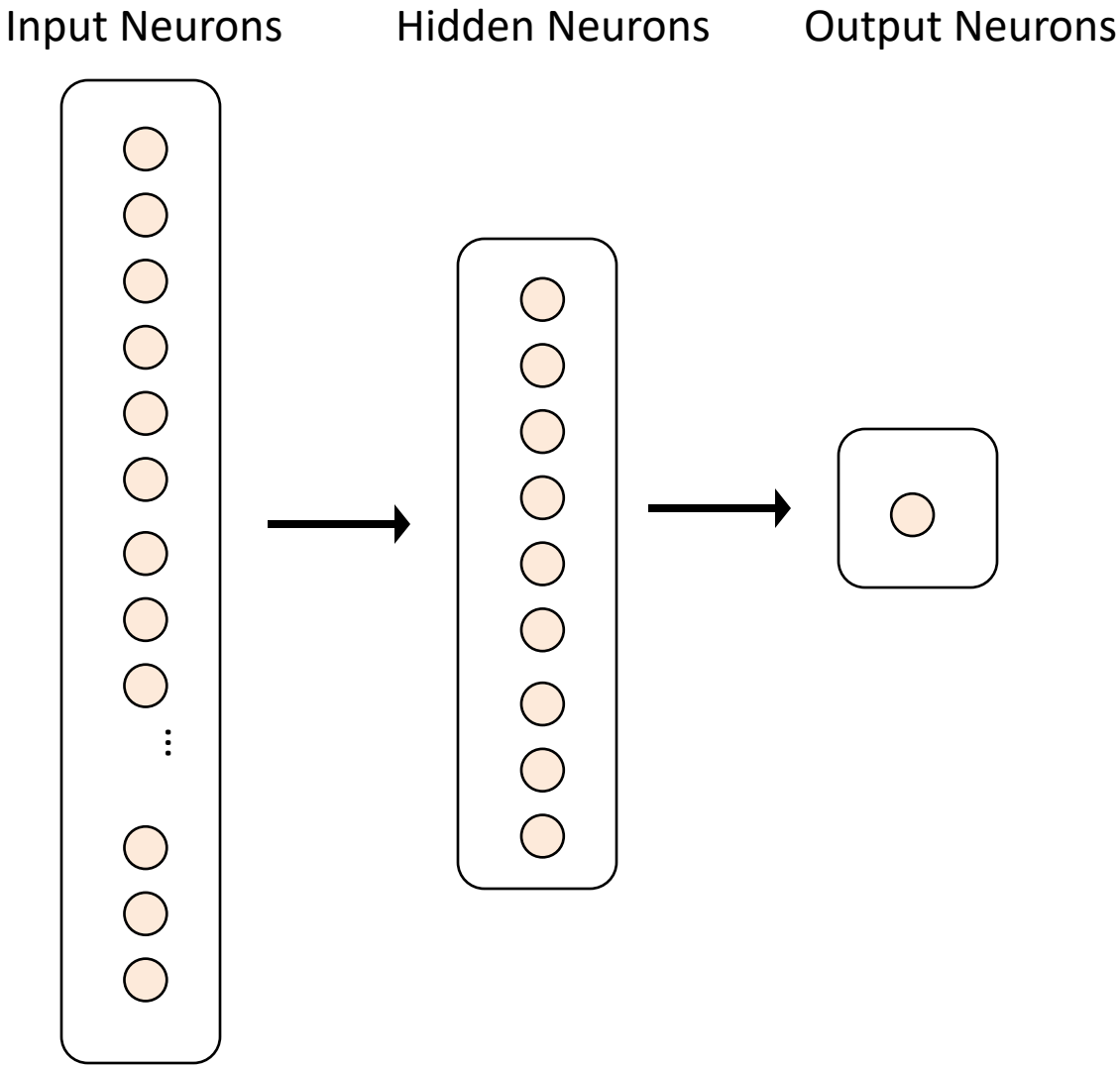
Put Many Together



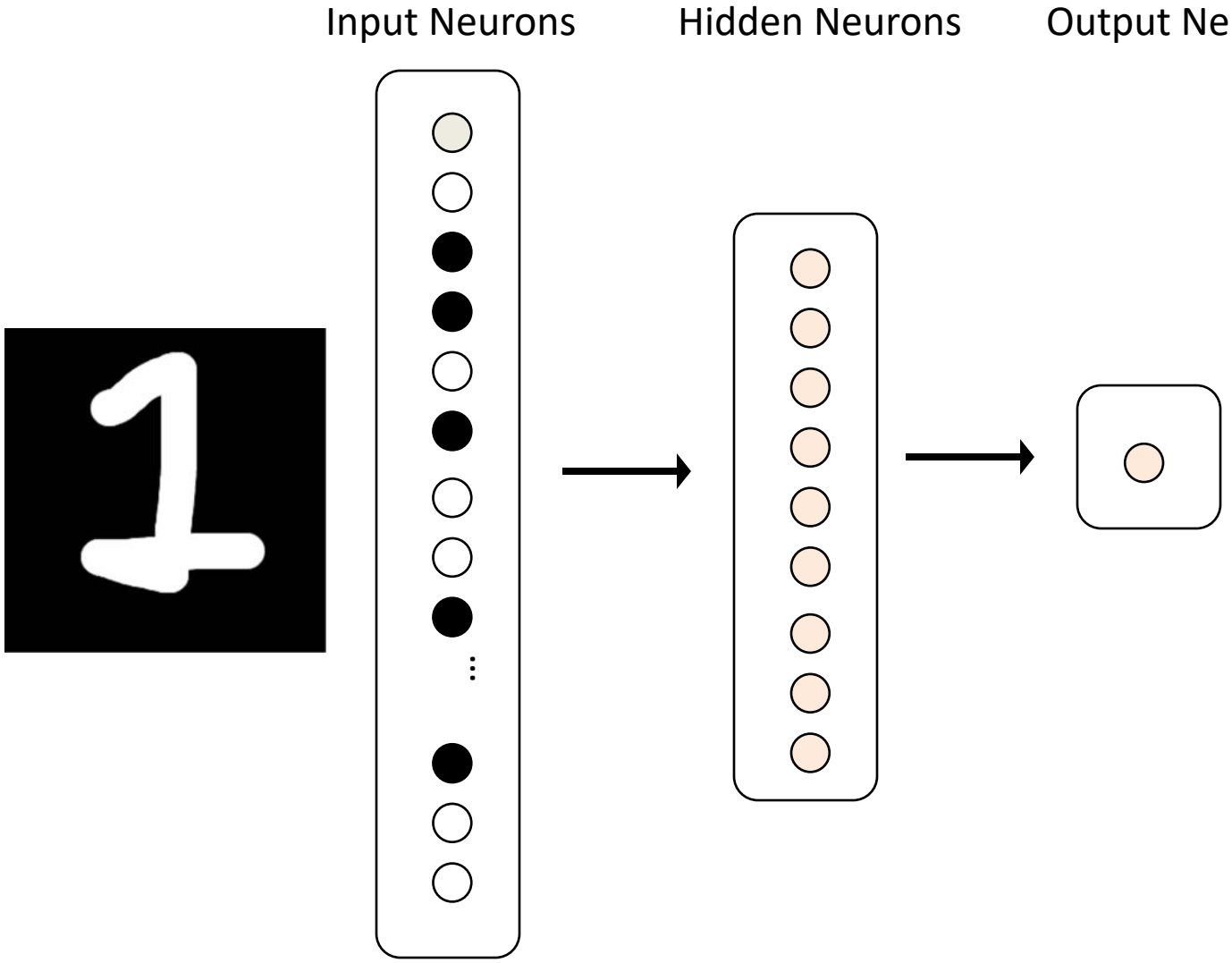
Put Many Together



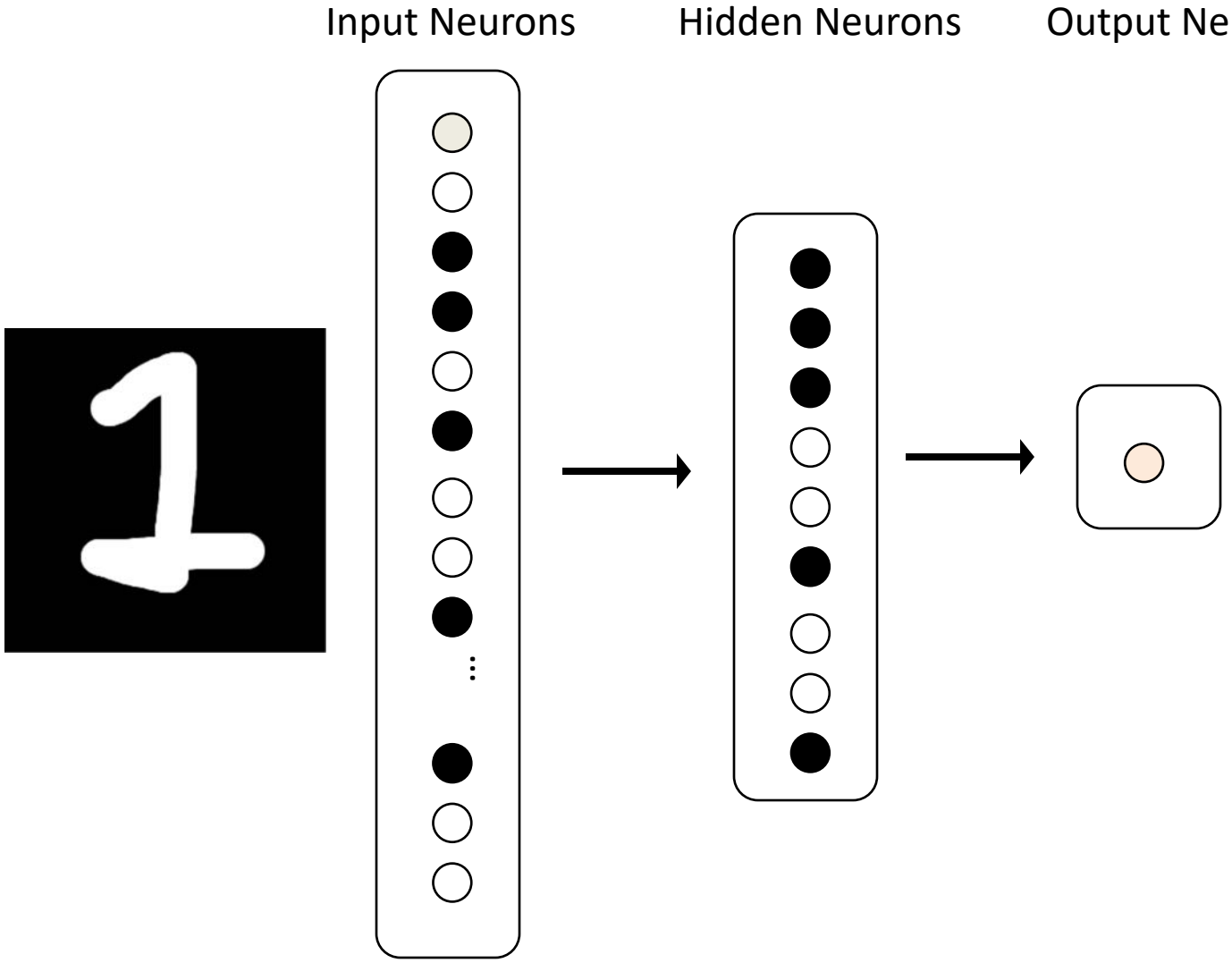
Making a Prediction



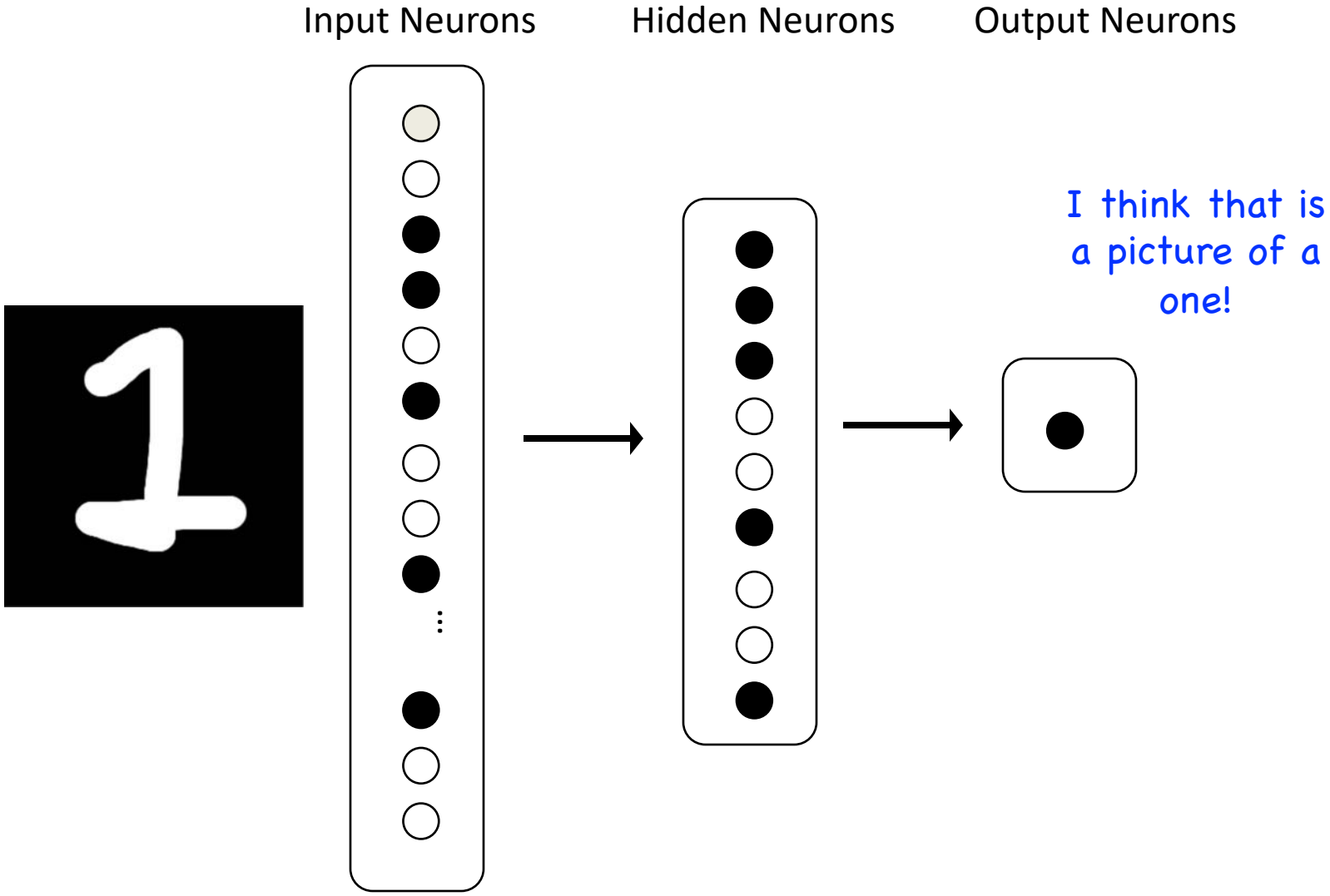
Making a Prediction



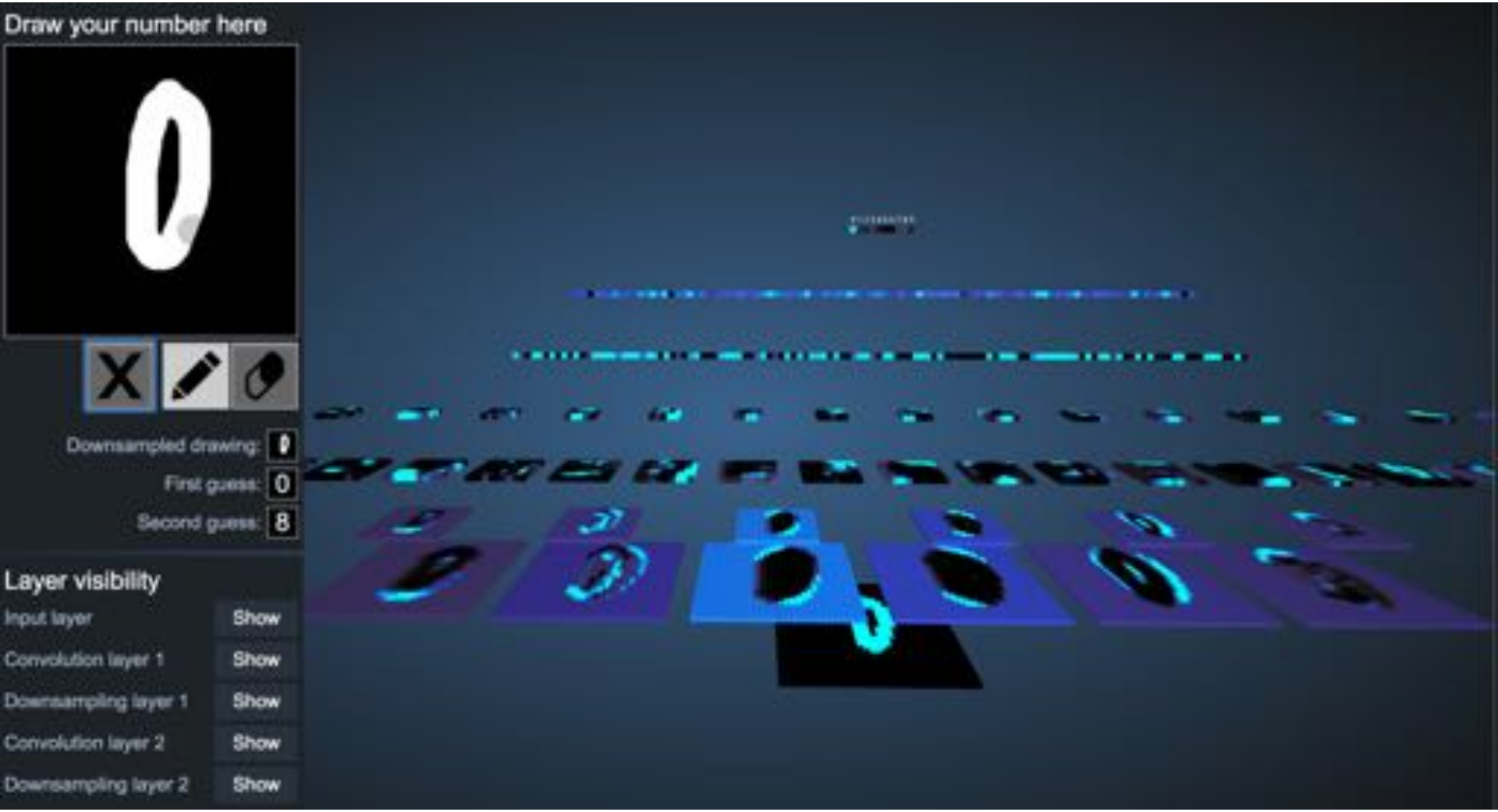
Making a Prediction



Making a Prediction

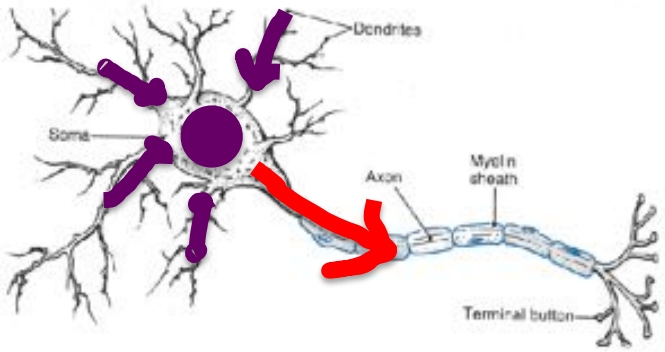


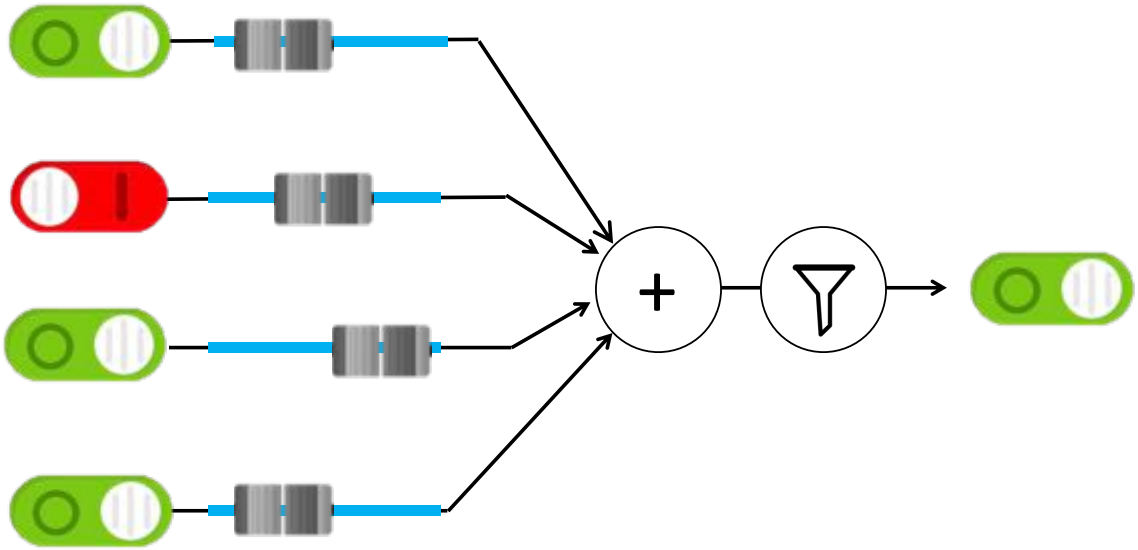
Demonstration



http://scs.ryerson.ca/~aharley/vis/conv/

Great Idea: Artificial Neurons





Neural Networks get their intelligence from their sliders (parameters)

Two Great Ideas

1. Artificial Neurons

2. Learn by Example

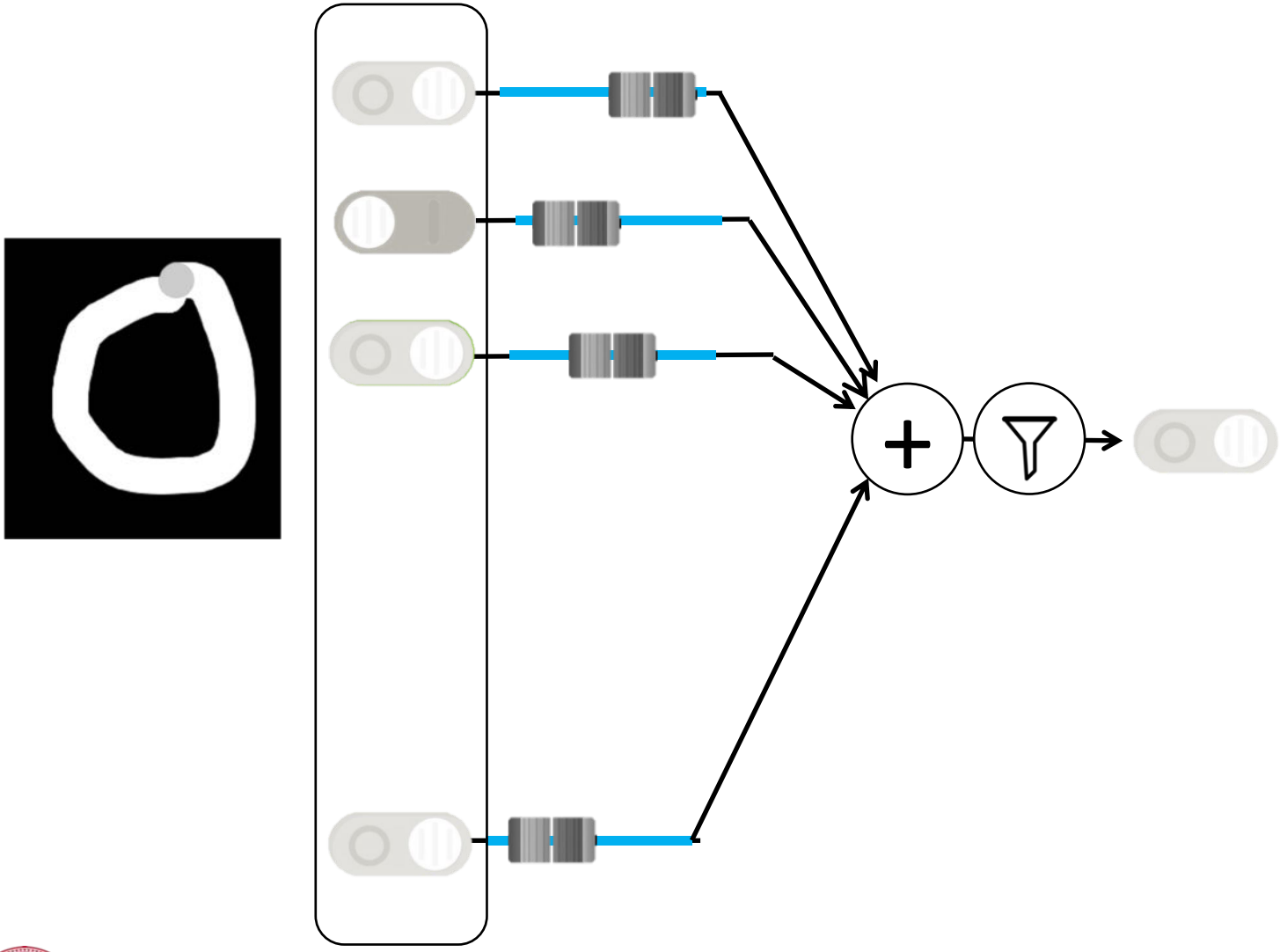
Two Great Ideas

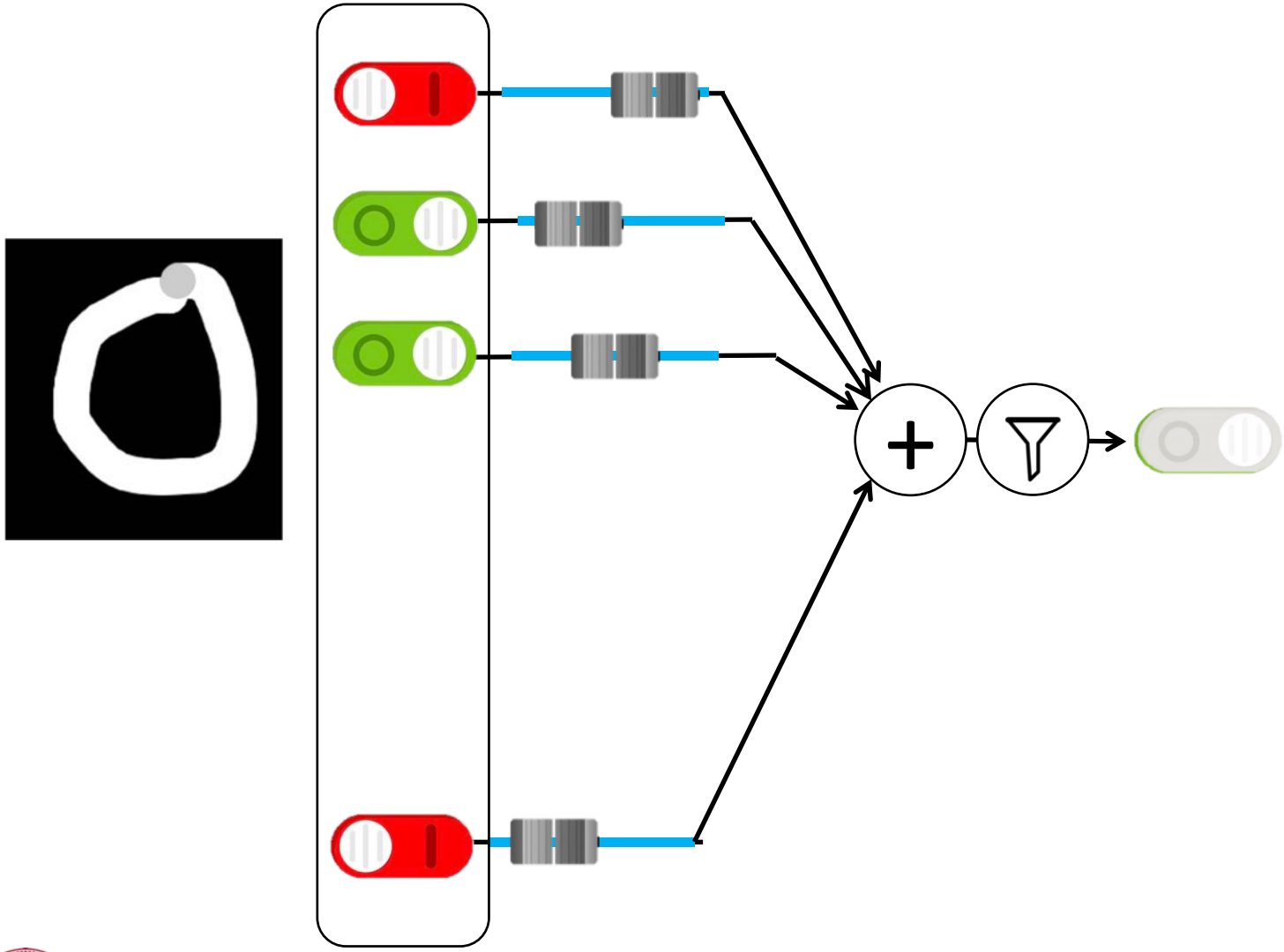
1. Artificial Neurons

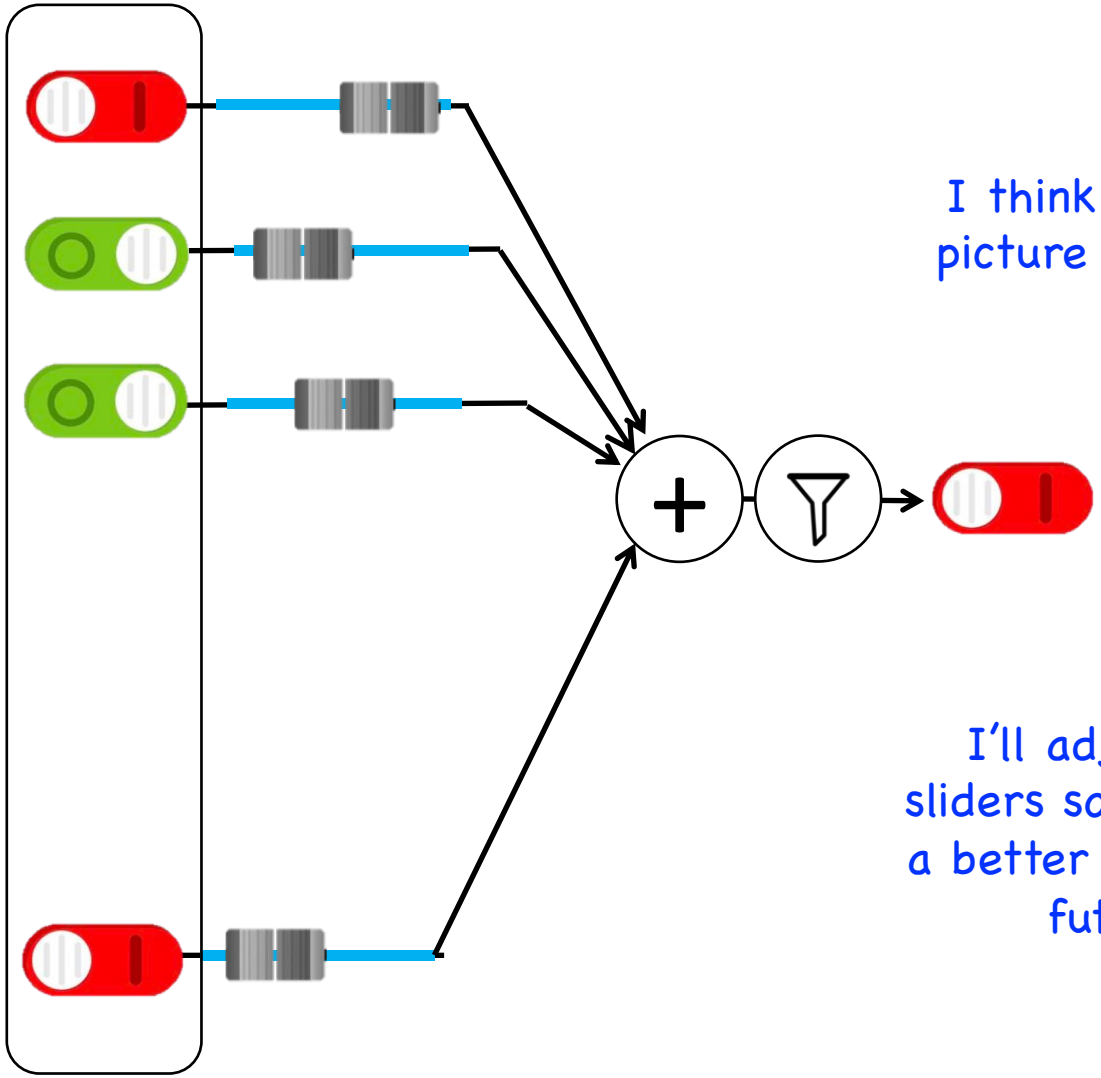
2. Learn by Example

2. Learn From Experience

Learn by Example



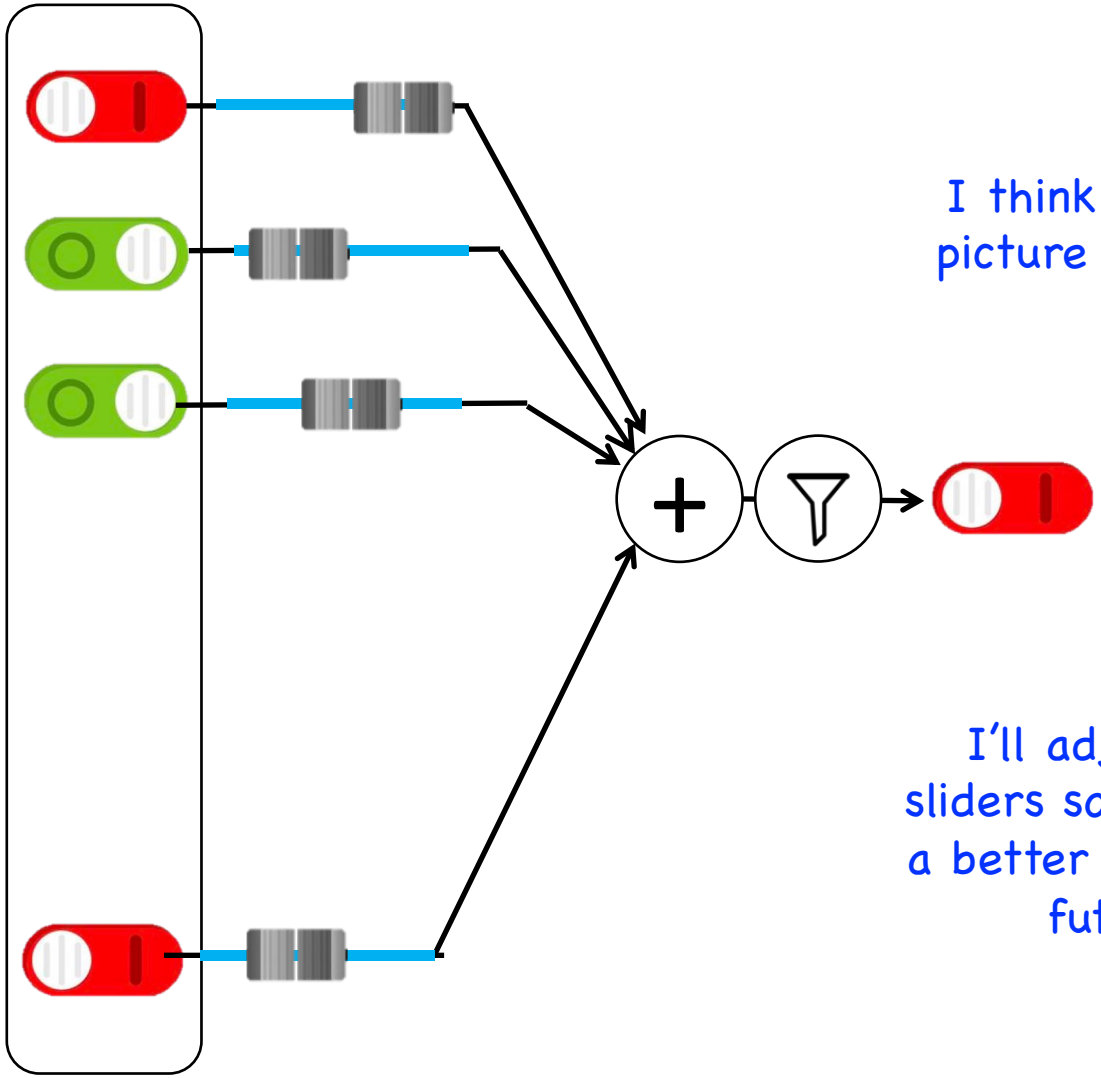




I think that is a picture of a **One**!

What do you mean it's actually a **Zero**?

I'll adjust my sliders so that I do a better job in the future



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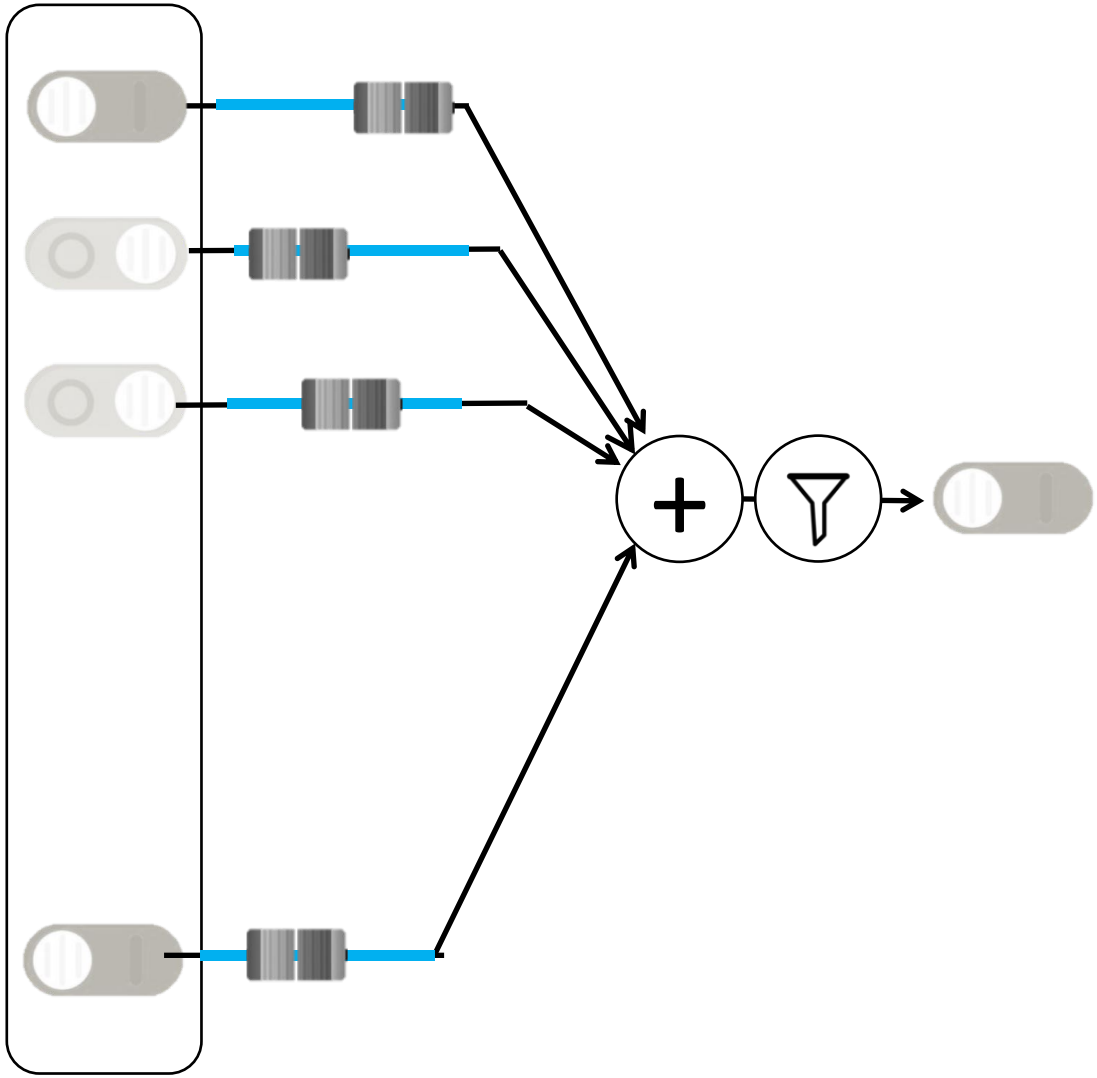
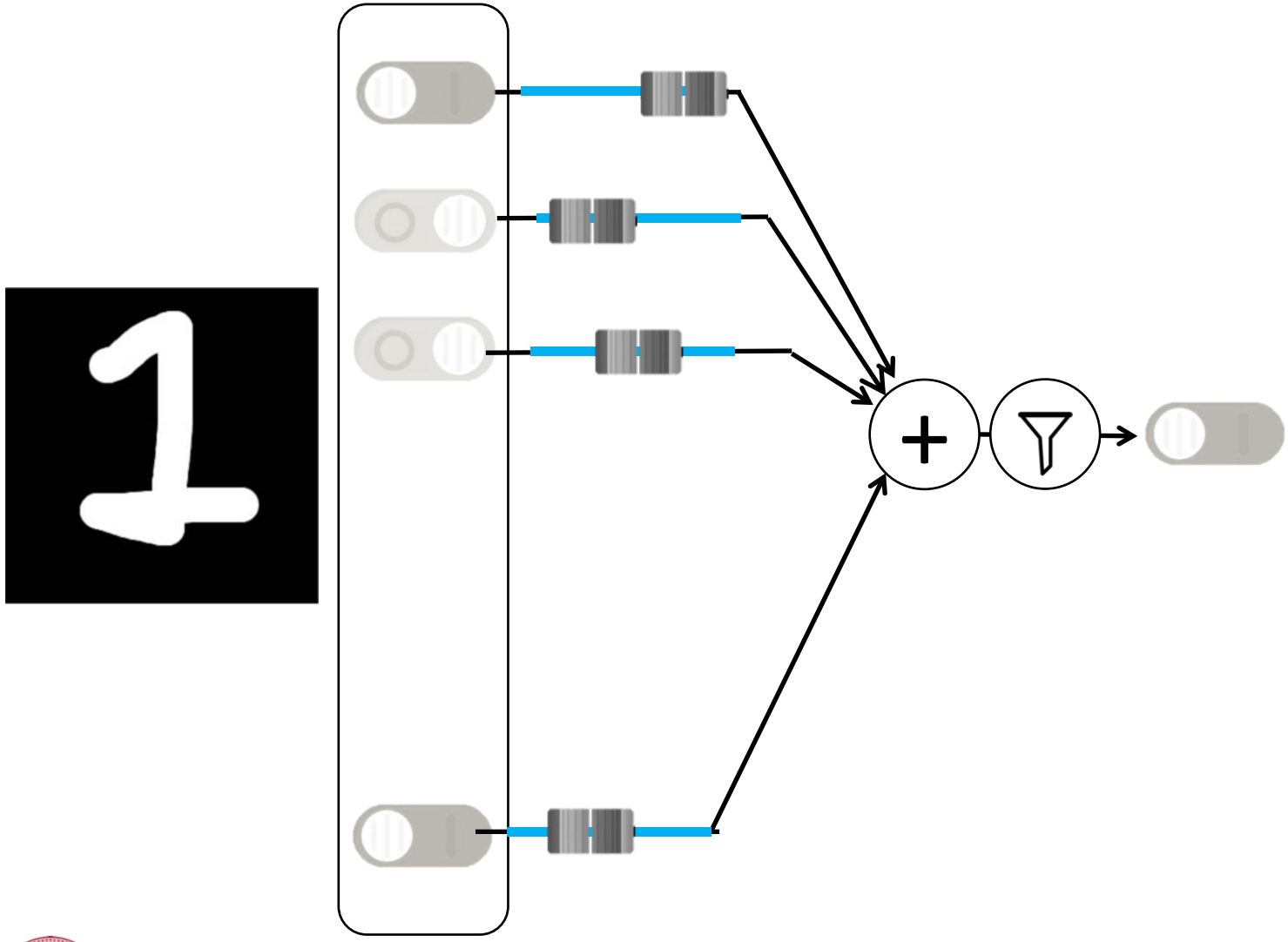
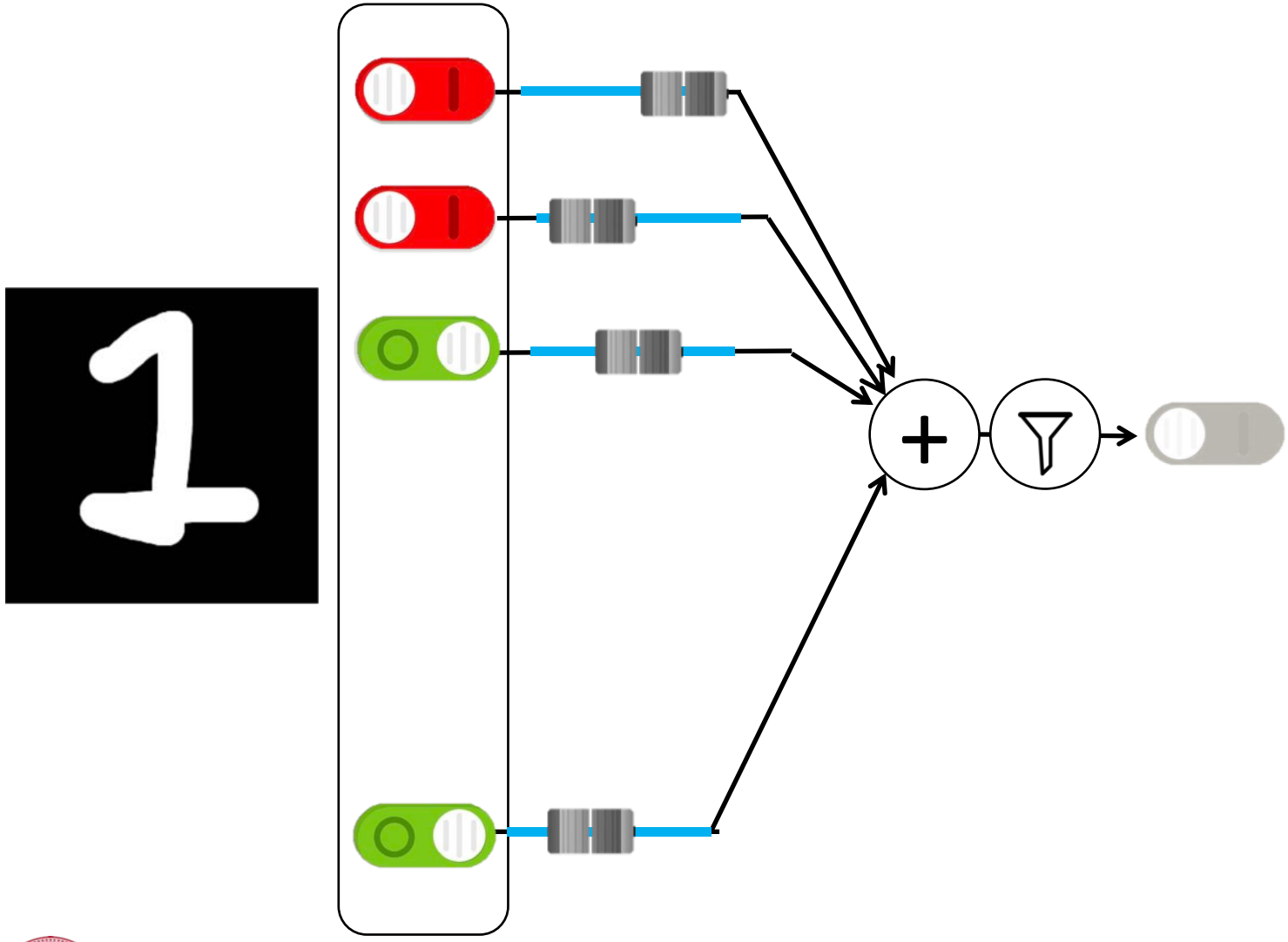
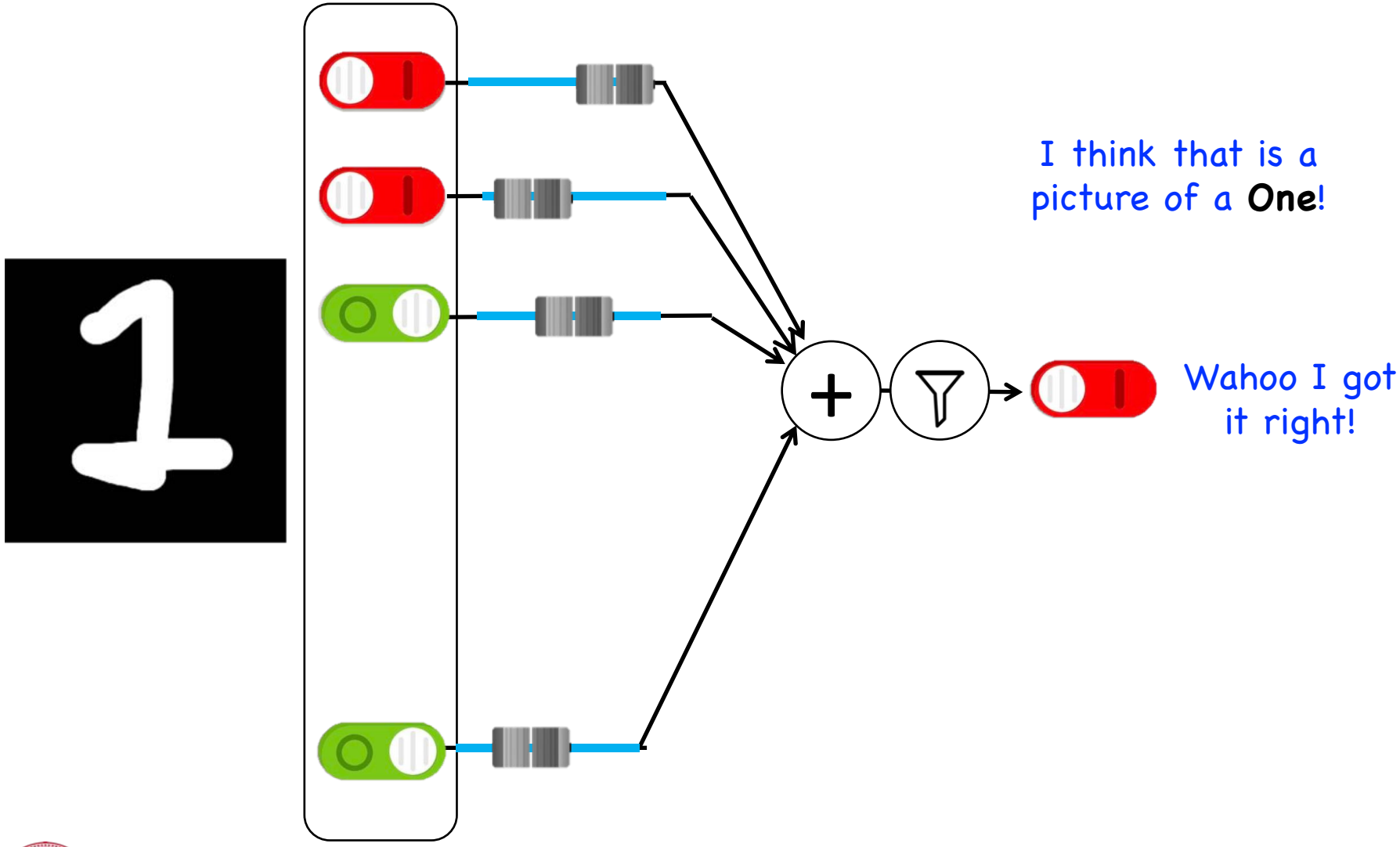
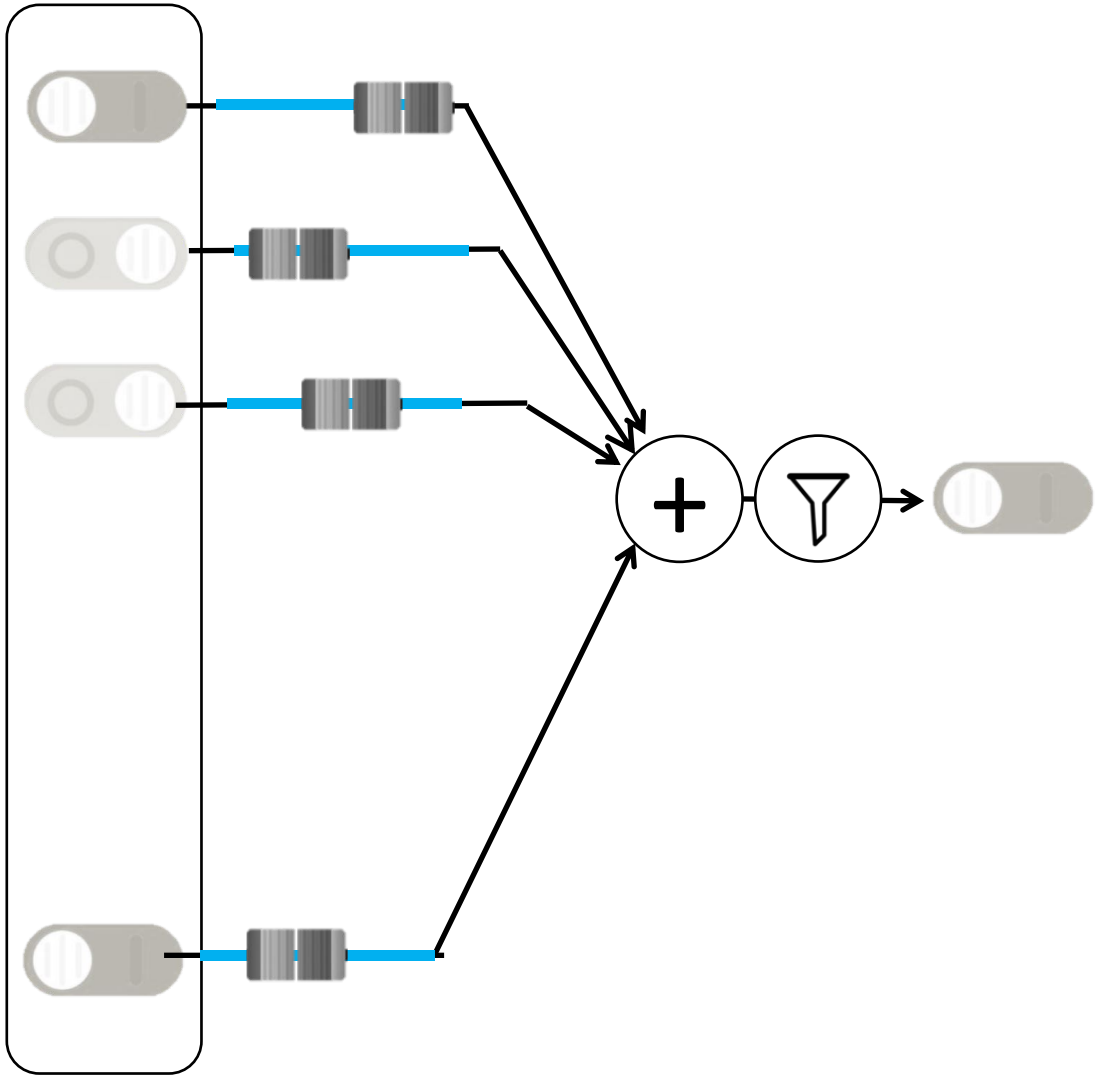
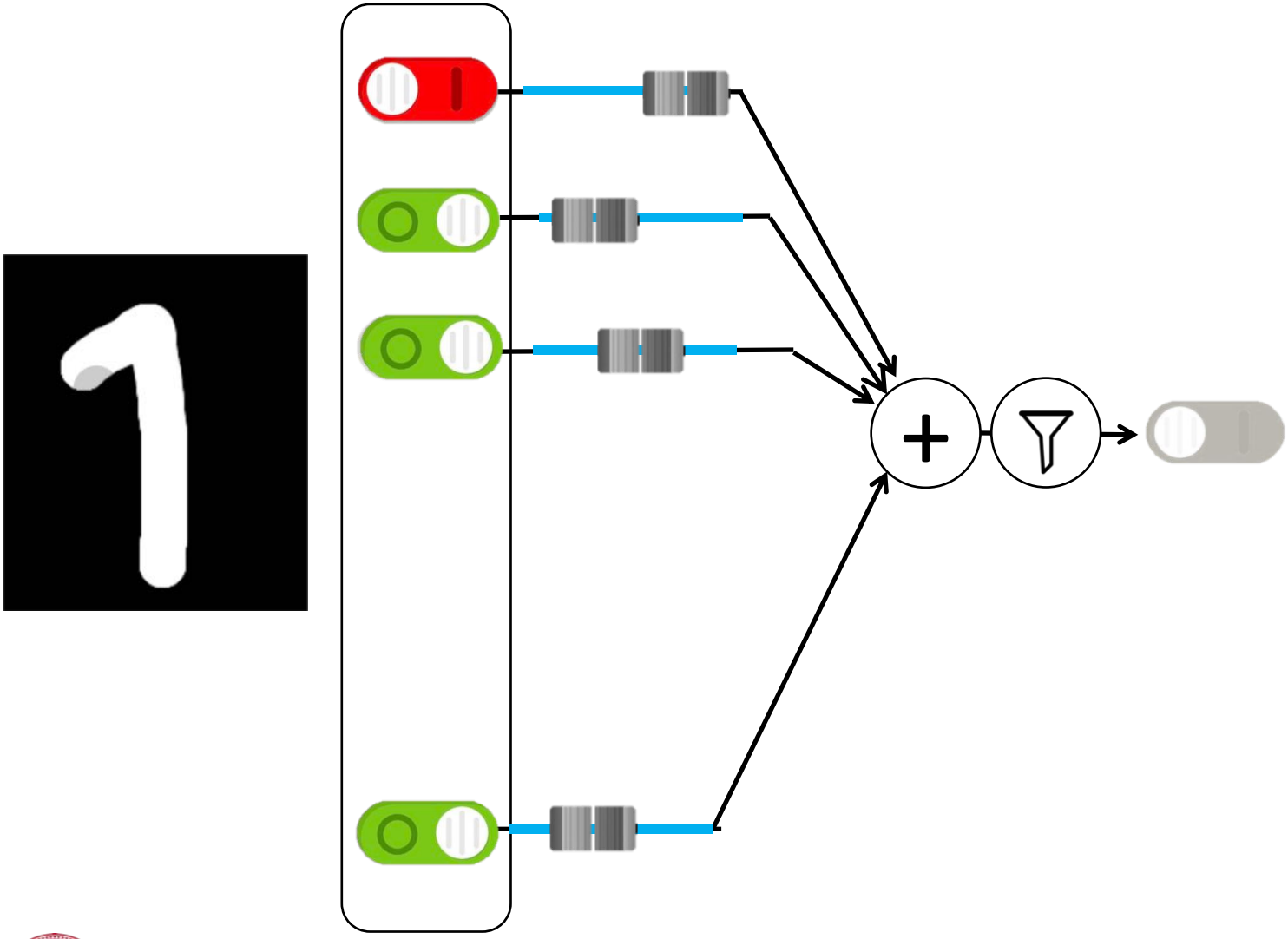


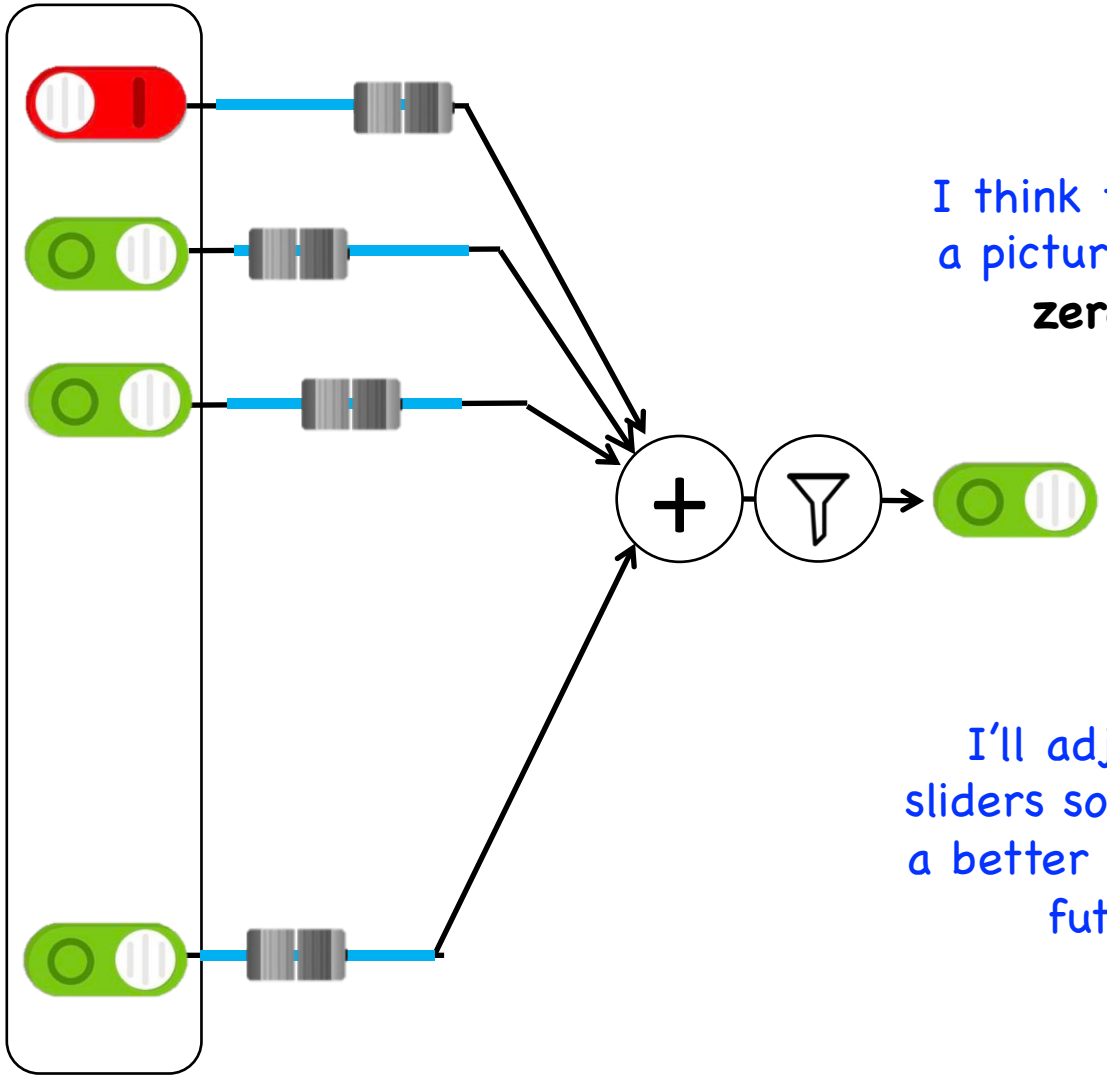





I think that is a picture of a **One**!
Wahoo I got it right!







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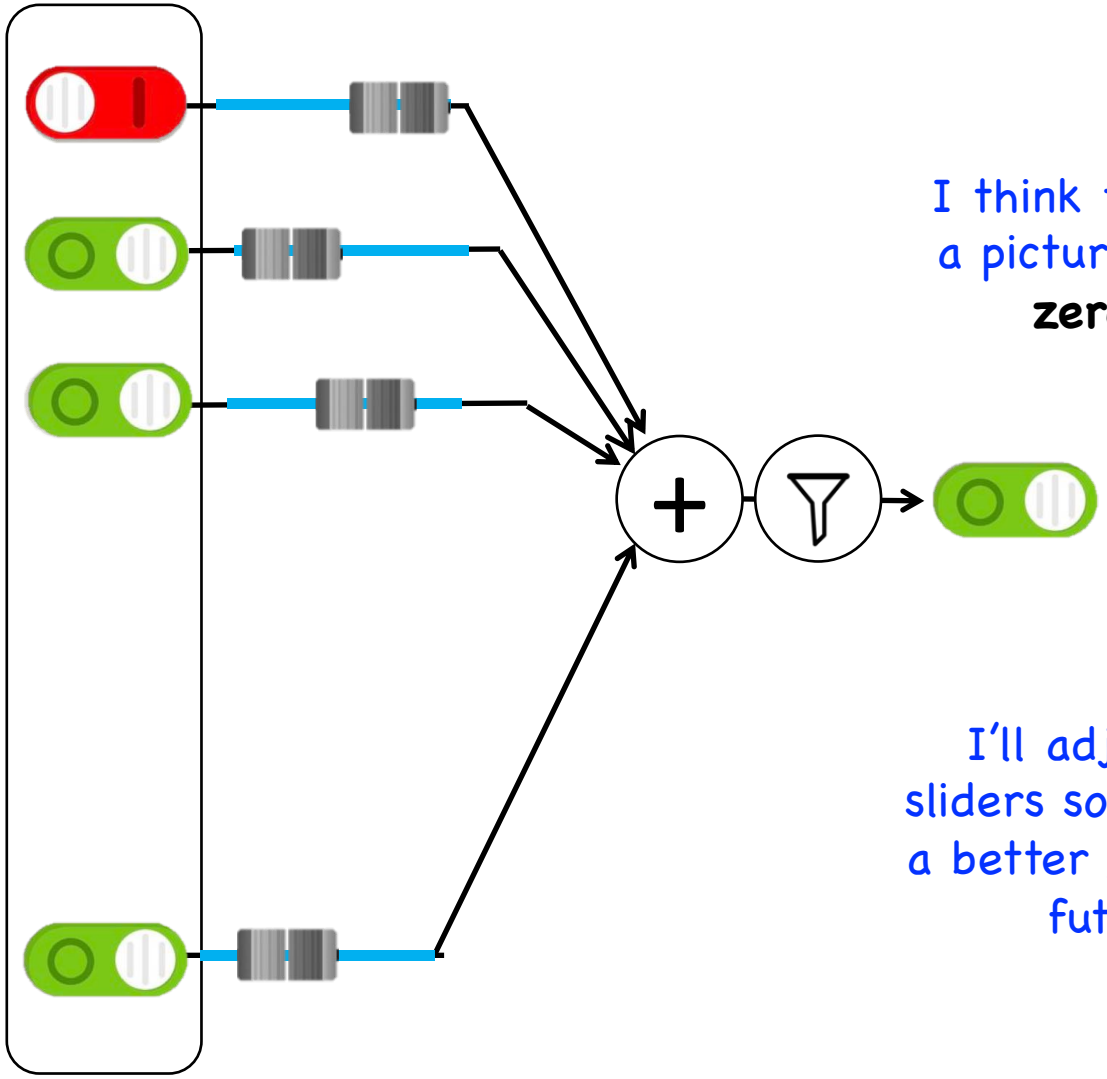
What do you mean it's actually a **one**?

I'll adjust my sliders so that I do a better job in the future



I think that is a picture of a **zero**!

What do you mean it's actually a **one**?

I'll adjust my sliders so that I do a better job in the future

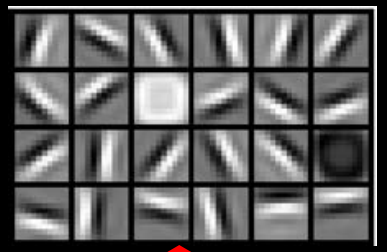
Study Hard!

Visualize the Sliders

Training set: Aligned images of faces.

object models

object parts (combination of edges)



edges

pixels

[Honglak Lee]

Woah… that’s like a brain…

True.

Decomposition

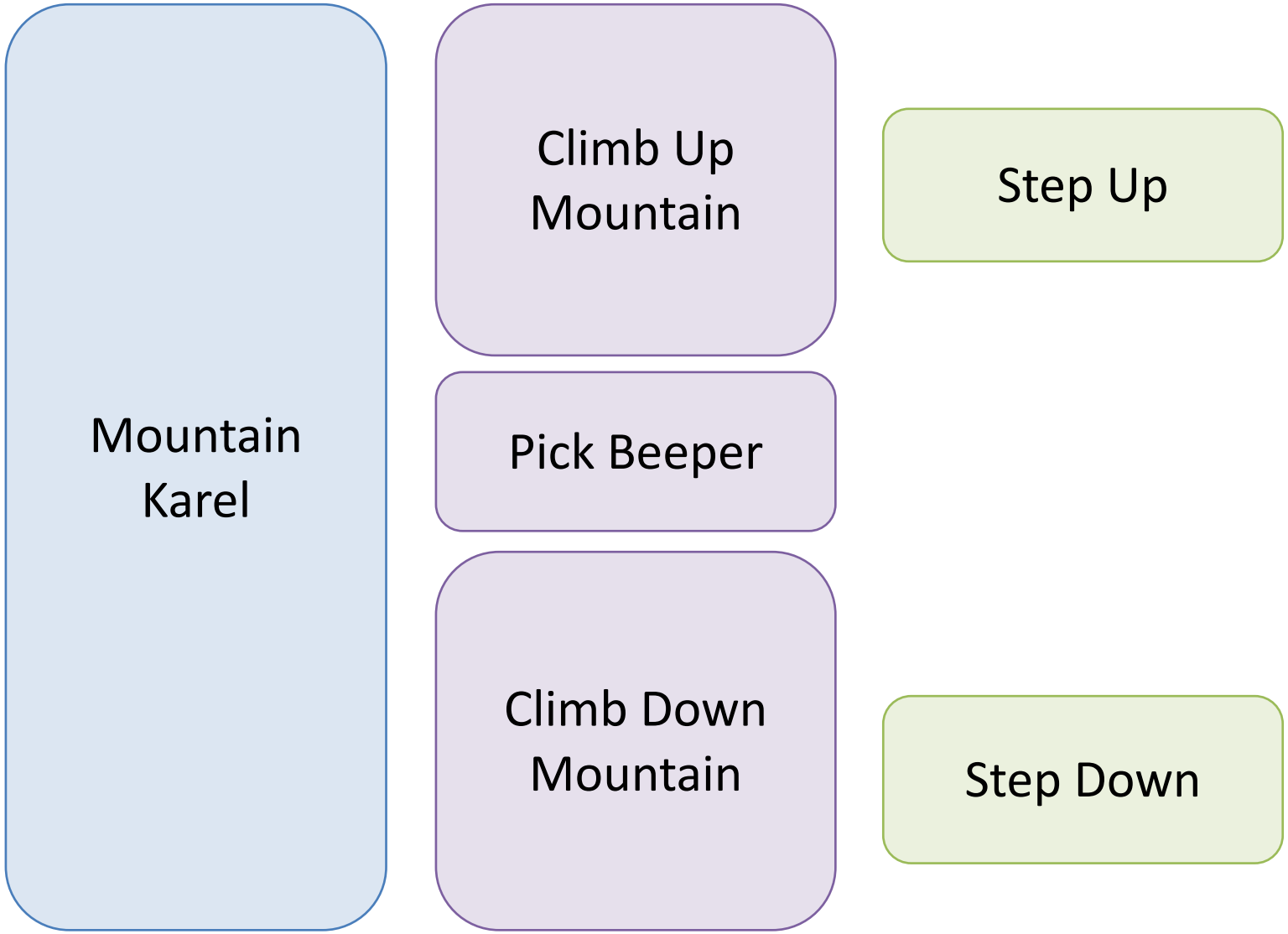


Image Net Classification

…
smoothhound, smoothhound shark, Mustelus mustelus
American smooth dogfish, Mustelus canis
Florida smoothhound, Mustelus norrisi
whitetip shark, reef whitetip shark, Triaenodon obseus
Atlantic spiny dogfish, Squalus acanthias
Pacific spiny dogfish, Squalus suckleyi
hammerhead, hammerhead shark
smooth hammerhead, Sphyrna zygaena
smalleye hammerhead, Sphyrna tudes
shovelhead, bonnethead, bonnet shark, Sphyrna tiburo
angel shark, angelfish, Squatina squatina, monkfish
electric ray, crampfish, numbfish, torpedo
smalltooth sawfish, Pristis pectinatus
guitarfish
roughtail stingray, Dasyatis centroura
butterfly ray
eagle ray
spotted eagle ray, spotted ray, Aetobatus narinari
cownose ray, cow-nosed ray, Rhinoptera bonasus
manta, manta ray, devilfish
Atlantic manta, Manta birostris
devil ray, Mobula hypostoma
grey skate, gray skate, Raja batis
little skate, Raja erinacea
…

Stingray

Mantaray

0.005%

Random guess

1.5%

Pre Neural Networks

?

GoogLeNet

Le, et al., *Building high-level features using large-scale unsupervised learning*. ICML 2012

0.005%

Random guess

1.5%

Pre Neural Networks

43.9%

GoogLeNet

Szegedy et al, Going Deeper With Convolutions, CVPR 2015

0.005%

Random guess

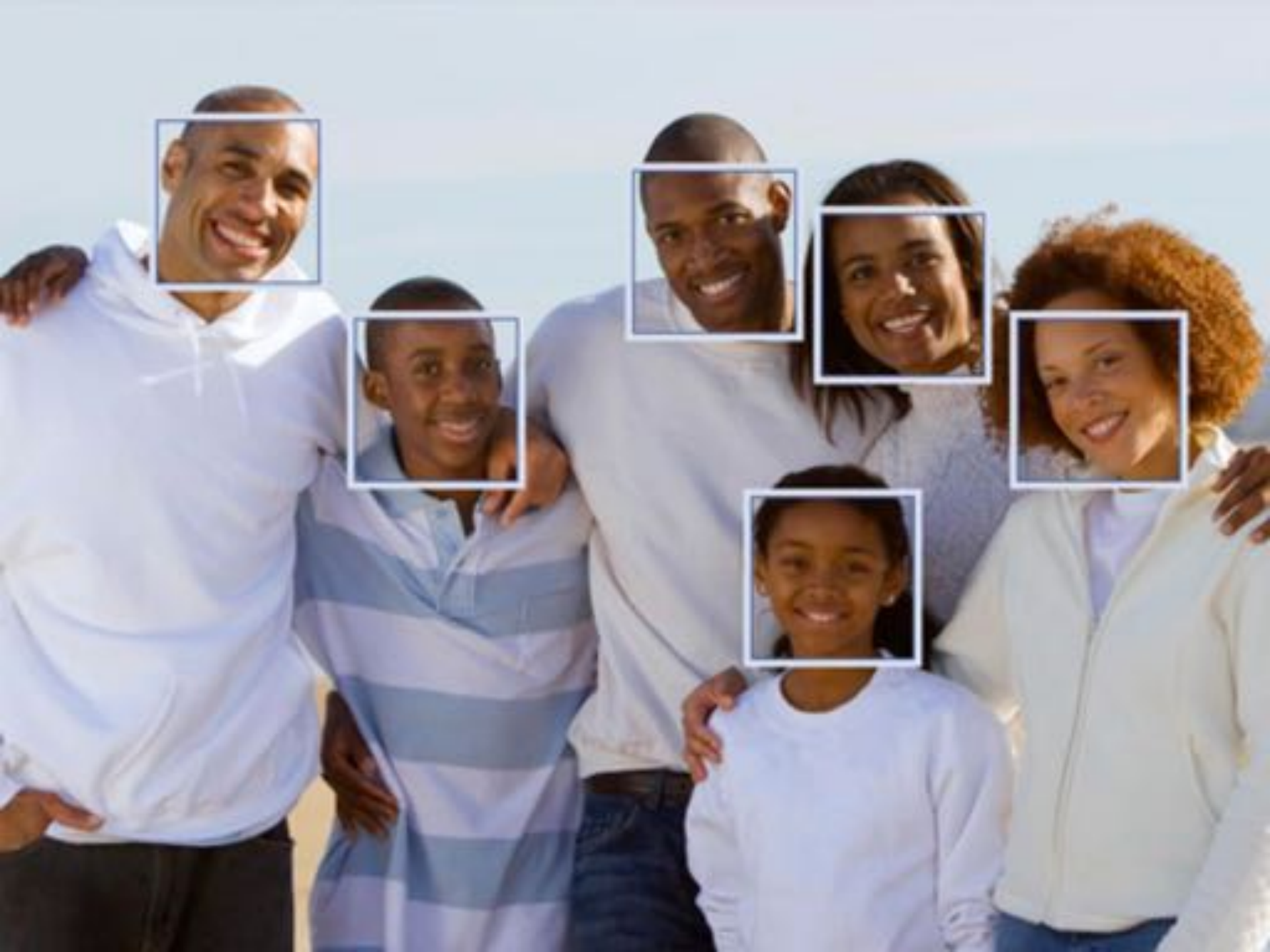
1.5%

Pre Neural Networks

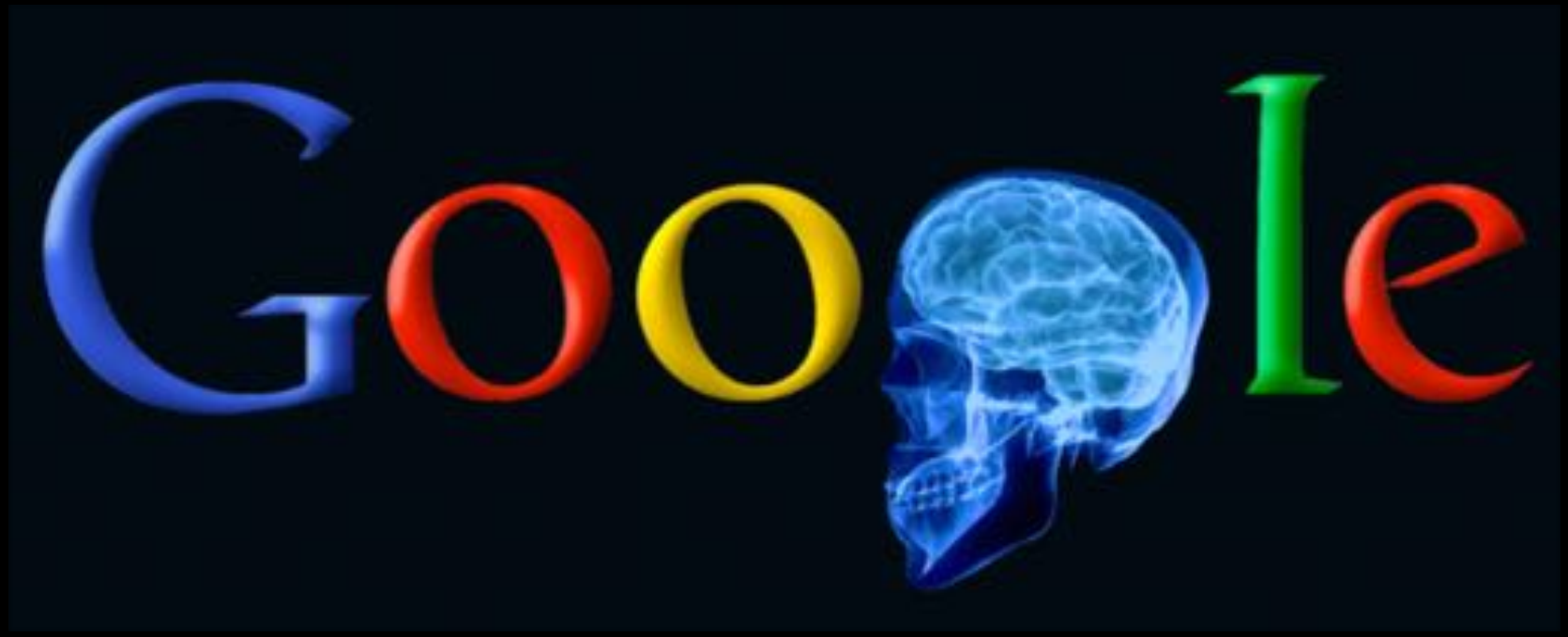
66.3%

2016

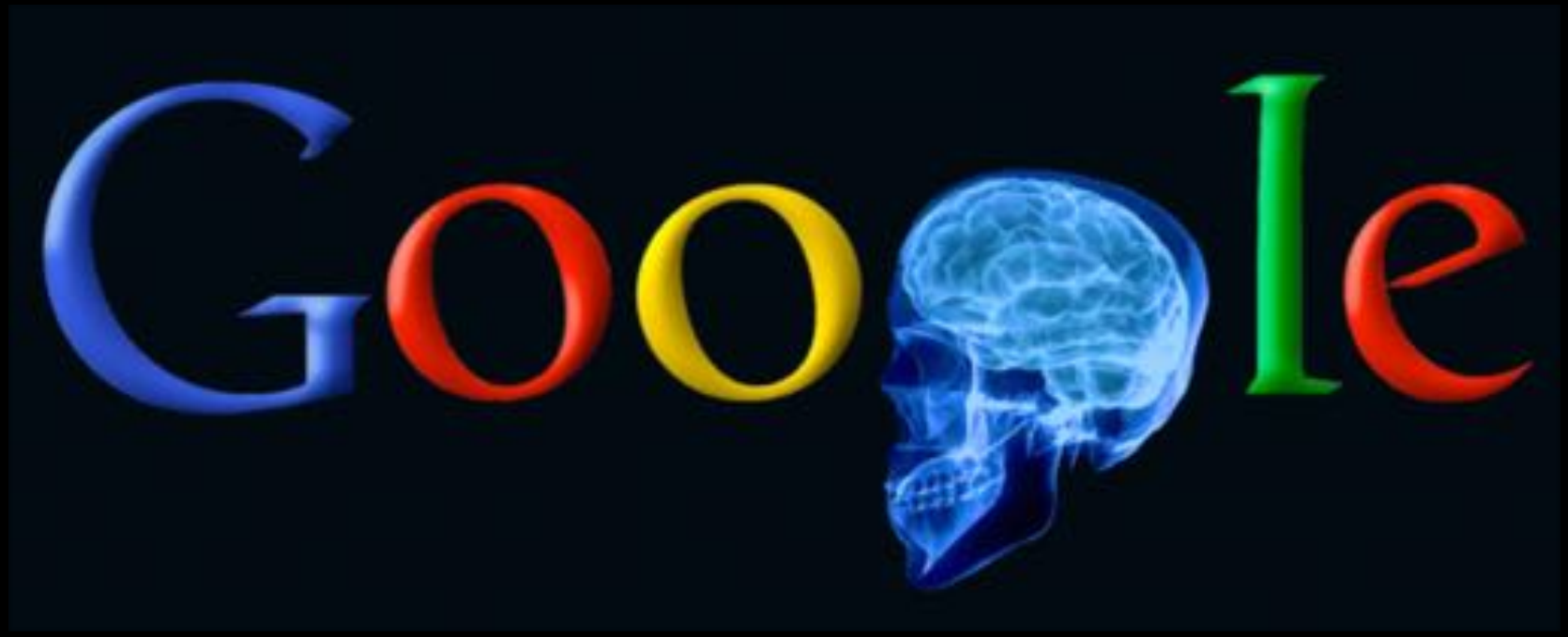
http://image-net.org/challenges/LSVRC/2016/results



Google Brain



Google Brain



1 Trillion Artificial Neurons

A Neuron That Fires When It Sees Cats

Top stimuli from the test set

Optimal stimulus
by numerical optimization

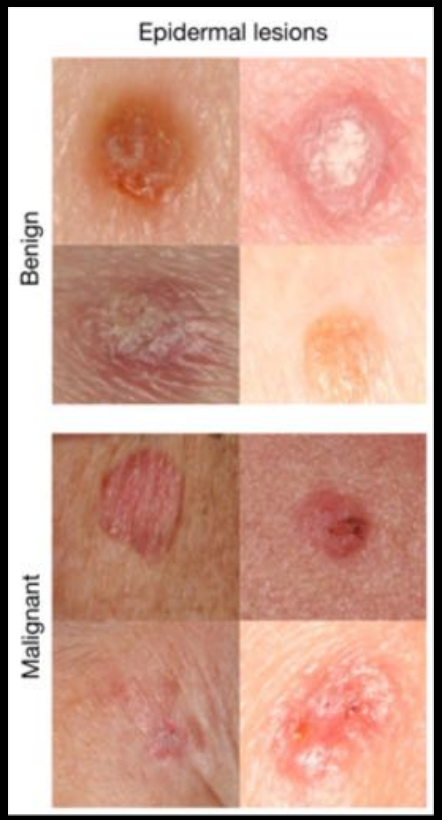
Le, et al., *Building high-level features using large-scale unsupervised learning*. ICML 2012


HIRE THE SMARTEST PEOPLE IN THE WORLD
INVENT CAT DETECTOR
memegenerator.net

Other Neurons

Le, et al., *Building high-level features using large-scale unsupervised learning*. ICML 2012

It can be useful



An algorithm learned to detect skin cancer from photo, better than the worlds top expert.

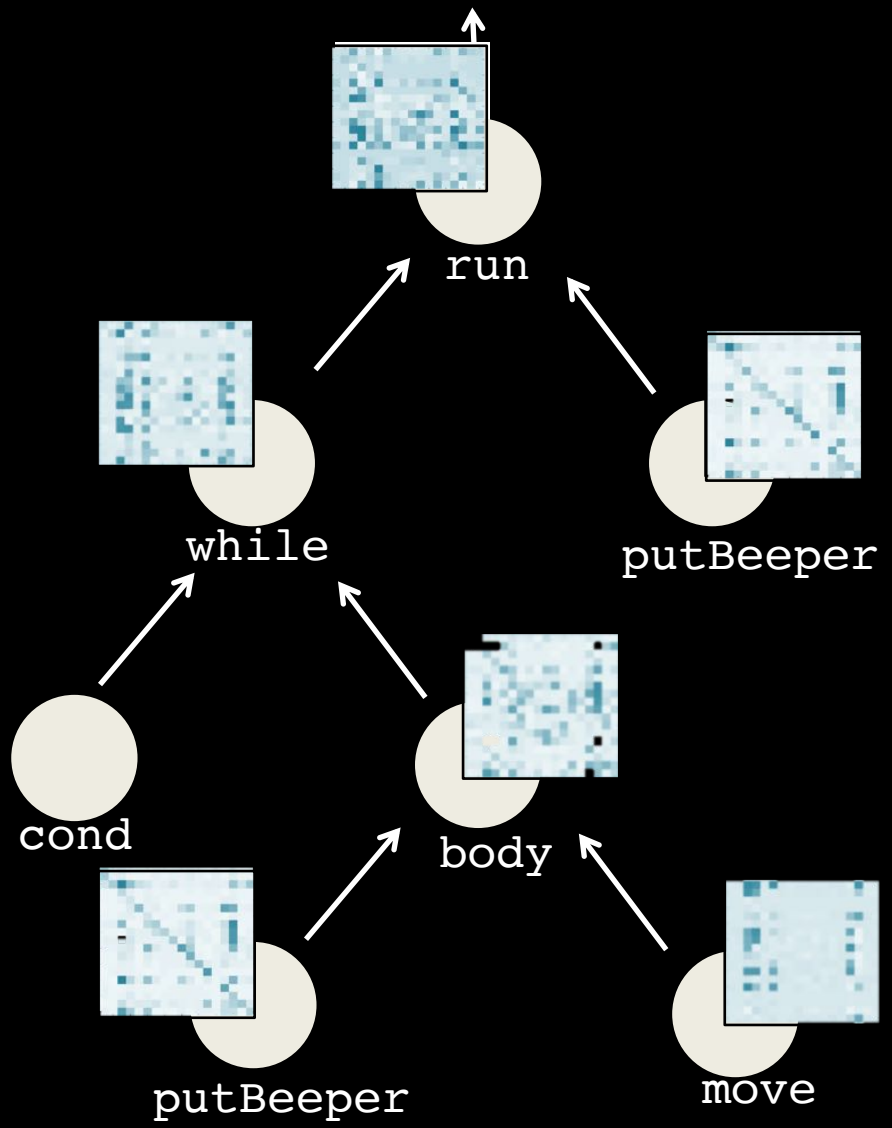
Developed last year

Esteva, Andre, et al. "Dermatologist-level classification of skin cancer with deep neural networks." *Nature* 542.7639 (2017): 115-118.

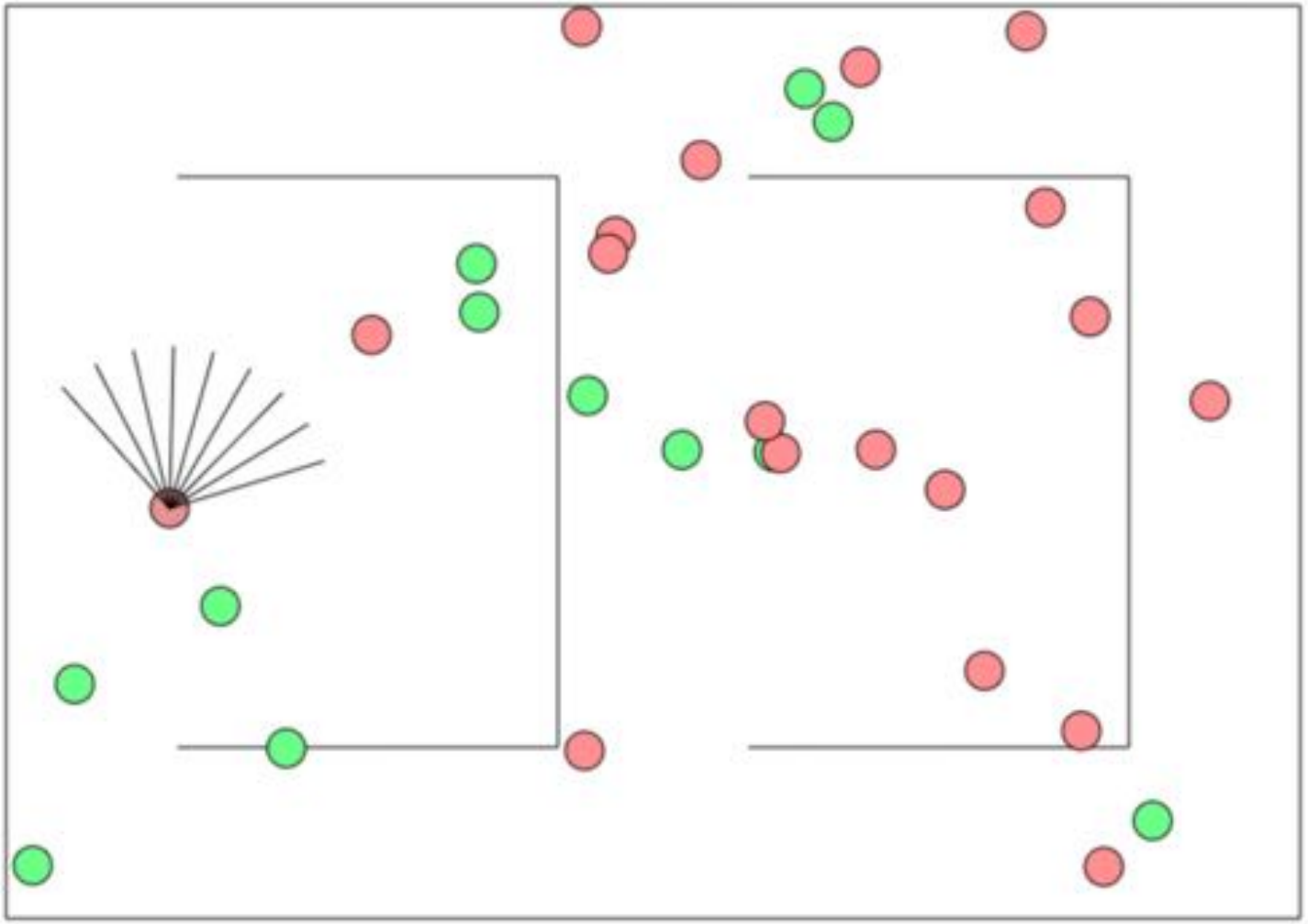
Helping Students Learn to Program

```
// User defined method
private void run() {
   while(isClear()){
      putBeeper();
      move();
   }
   putBeeper();
}
```

It looks like you have a fencepost error!



Beyond Harry Potter Hats



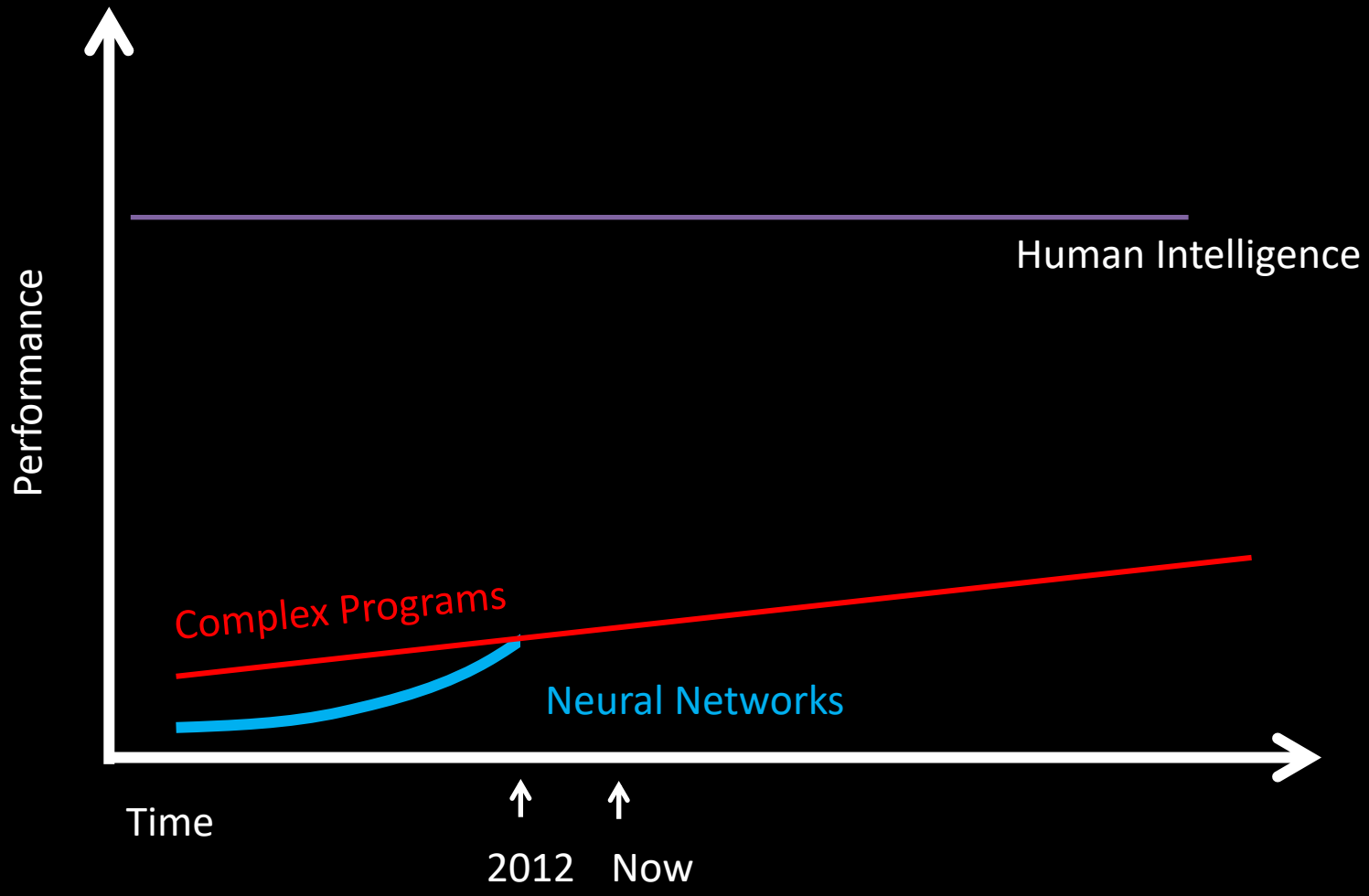
http://cs.stanford.edu/people/karpathy/convnetjs/demo/rldemo.html

más allá de la clasificación

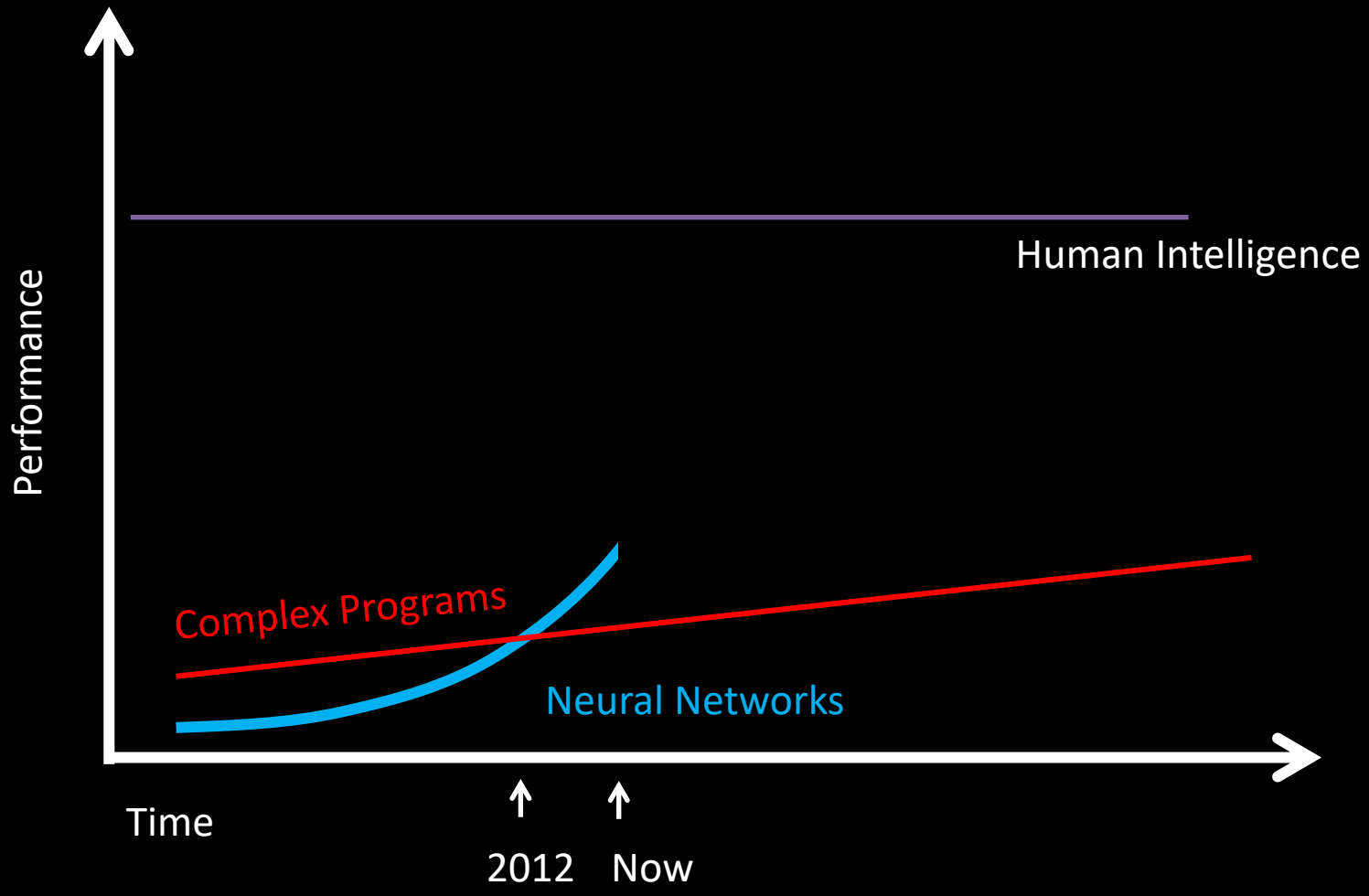
Starting out - 10 minutes of training

The algorithm tries to hit the ball back, but
it is yet too clumsy to manage.

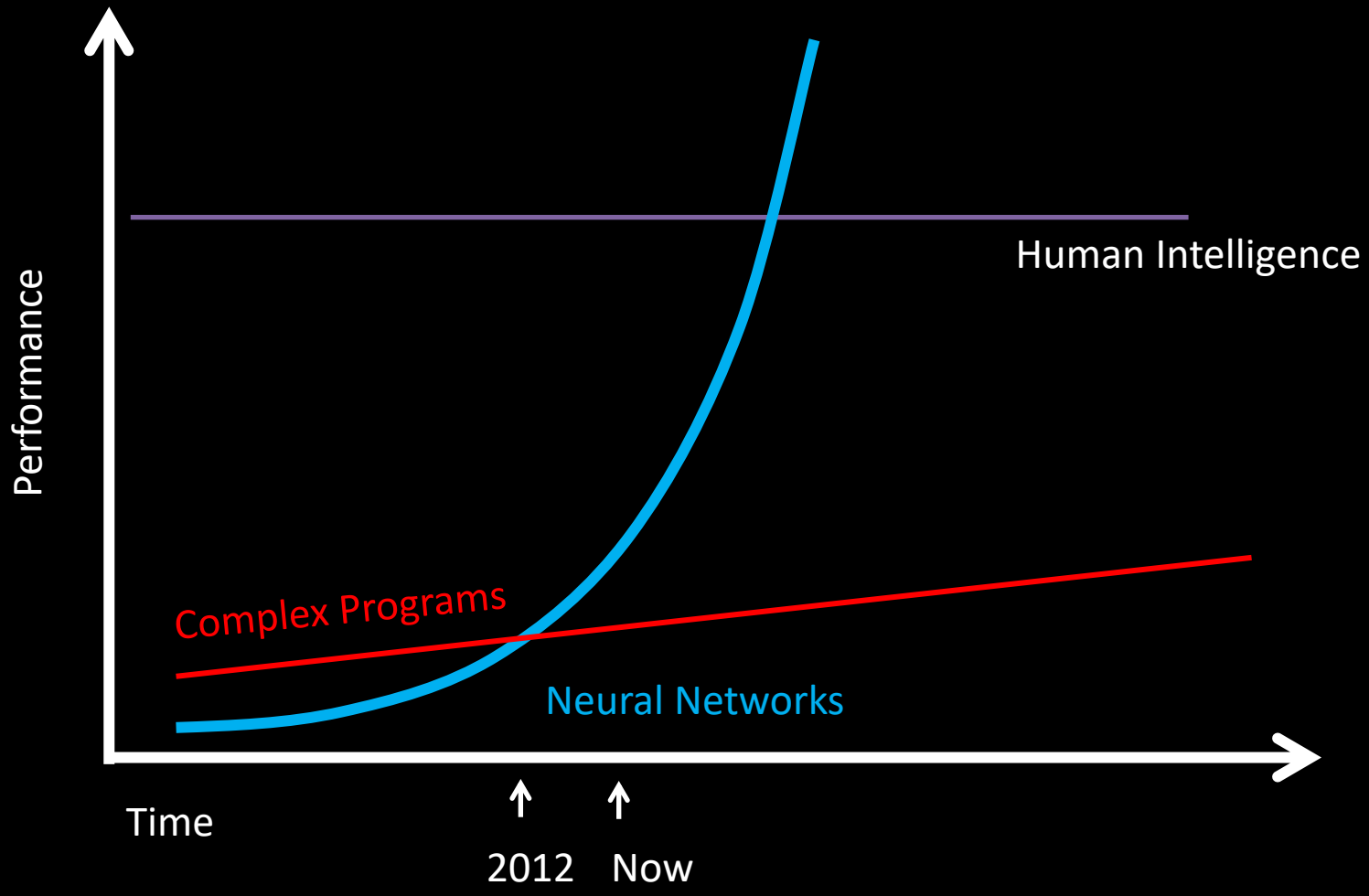
The Future of AI



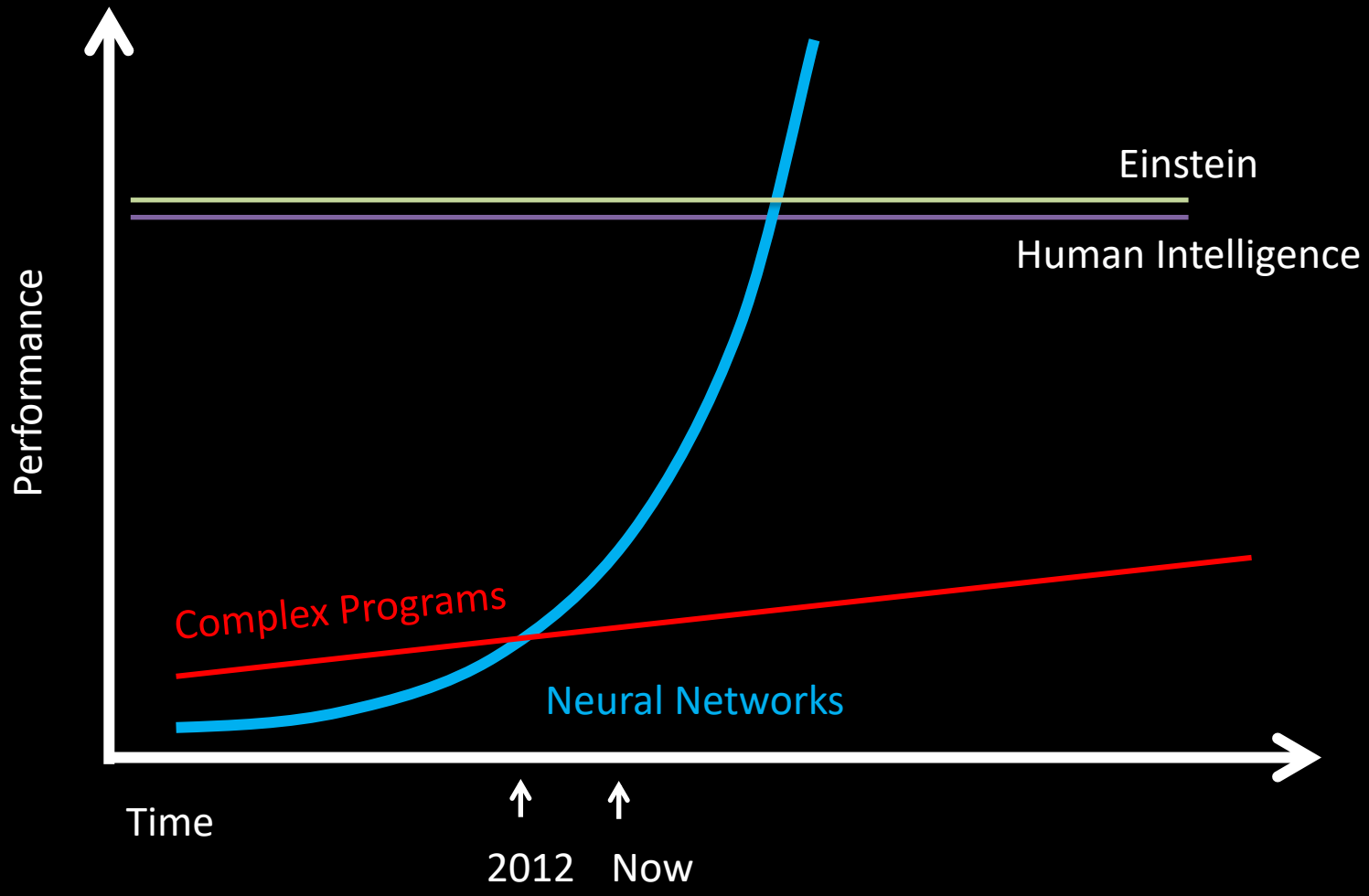
The Future of AI



The Future of AI



The Future of AI



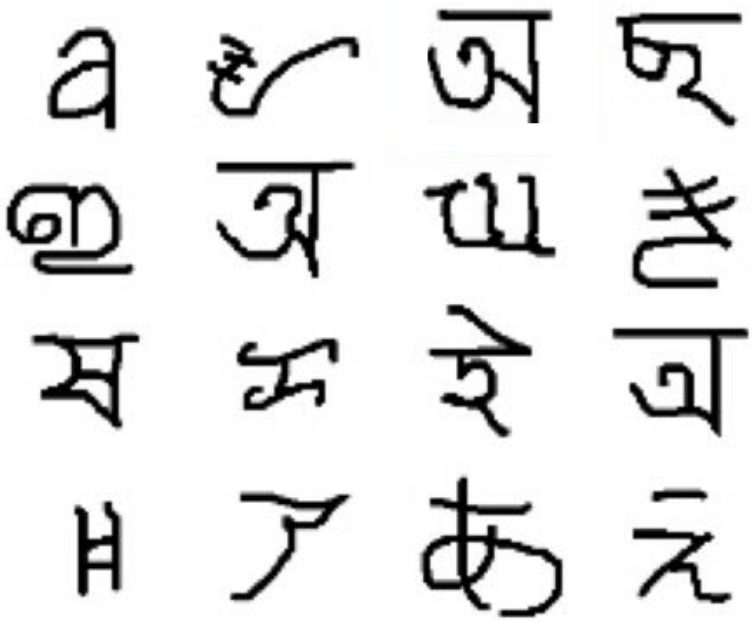
Open Problems?

Machine Learning Uses a Lot of Data

One Shot Learning

Single training example:

Test set:



One Shot Learning

Single training example:

Where is my robot?

… coming soon

Should I study AI?

Powerful technology

Now is an amazing time

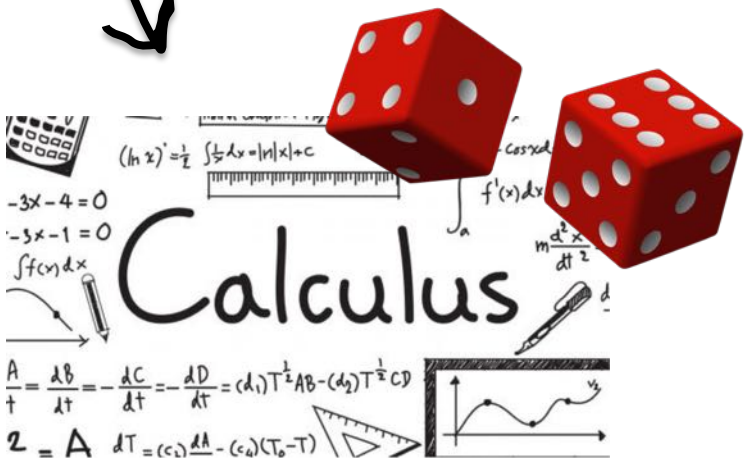
Know It So You Can Beat It

Little math

Todos son bienvenidos

Road towards AI

Libraries to use AI



Mathematics to invent AI

Next Step:

Nimm

```
There are 20 stones left
Player 1 would you like to remove 1 or 2 stones? 2

There are 18 stones left
Player 2 would you like to remove 1 or 2 stones? 2

There are 16 stones left
Player 1 would you like to remove 1 or 2 stones? 1

There are 15 stones left
Player 2 would you like to remove 1 or 2 stones? 2

...


Player 1 wins!
```


WALL·E


The End?