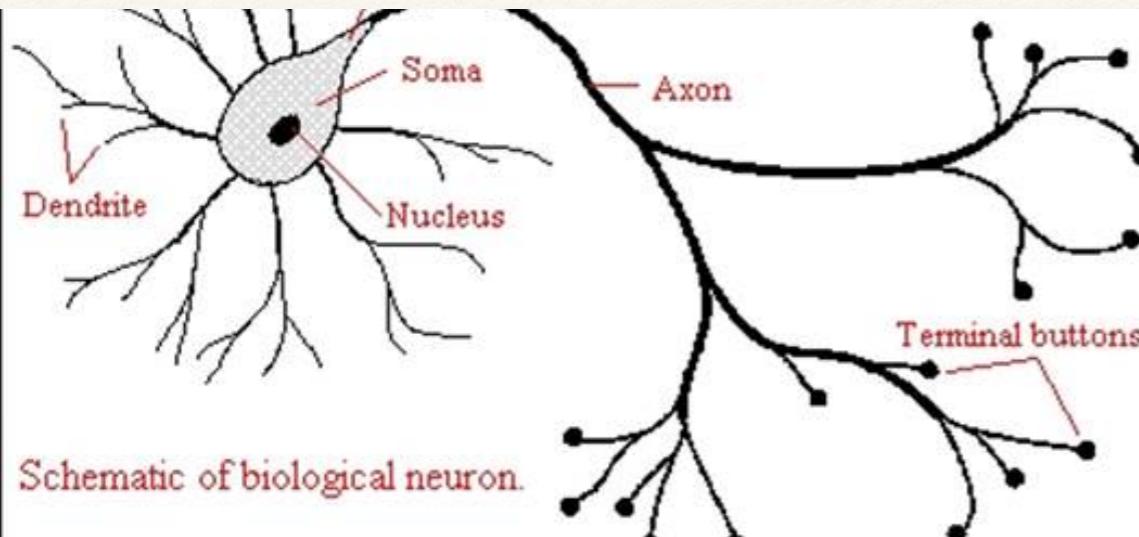


Artificial Neural Nets

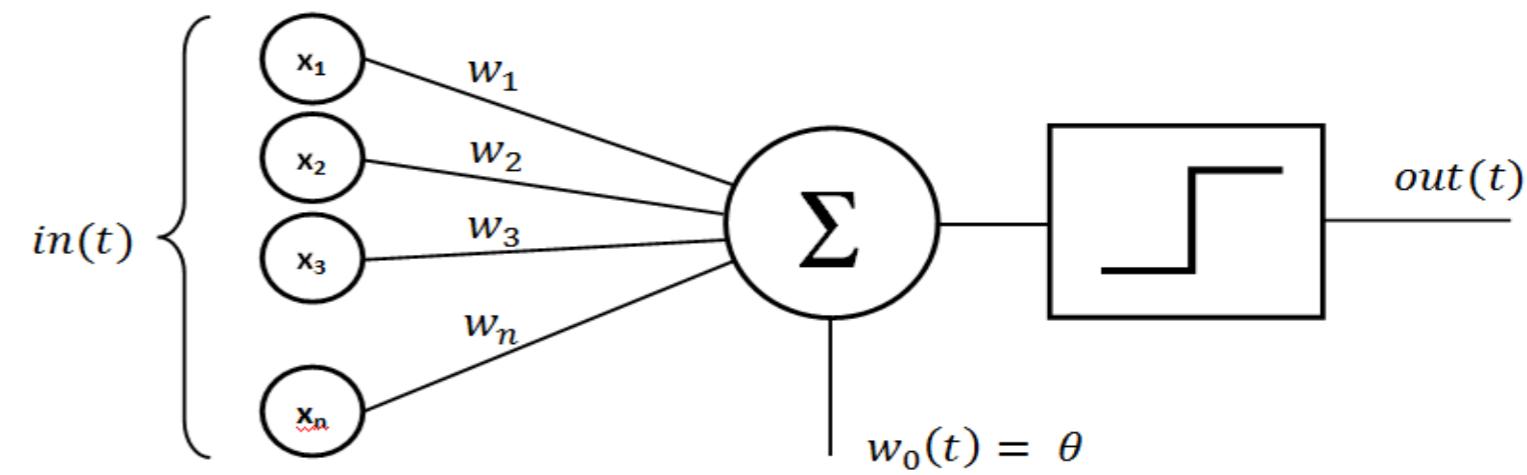
Deep Learning

Short introduction into the
world of neural networks.

Aleksandr Tavgen. Software Architect Playtech.



Biological Neuron



Perceptron

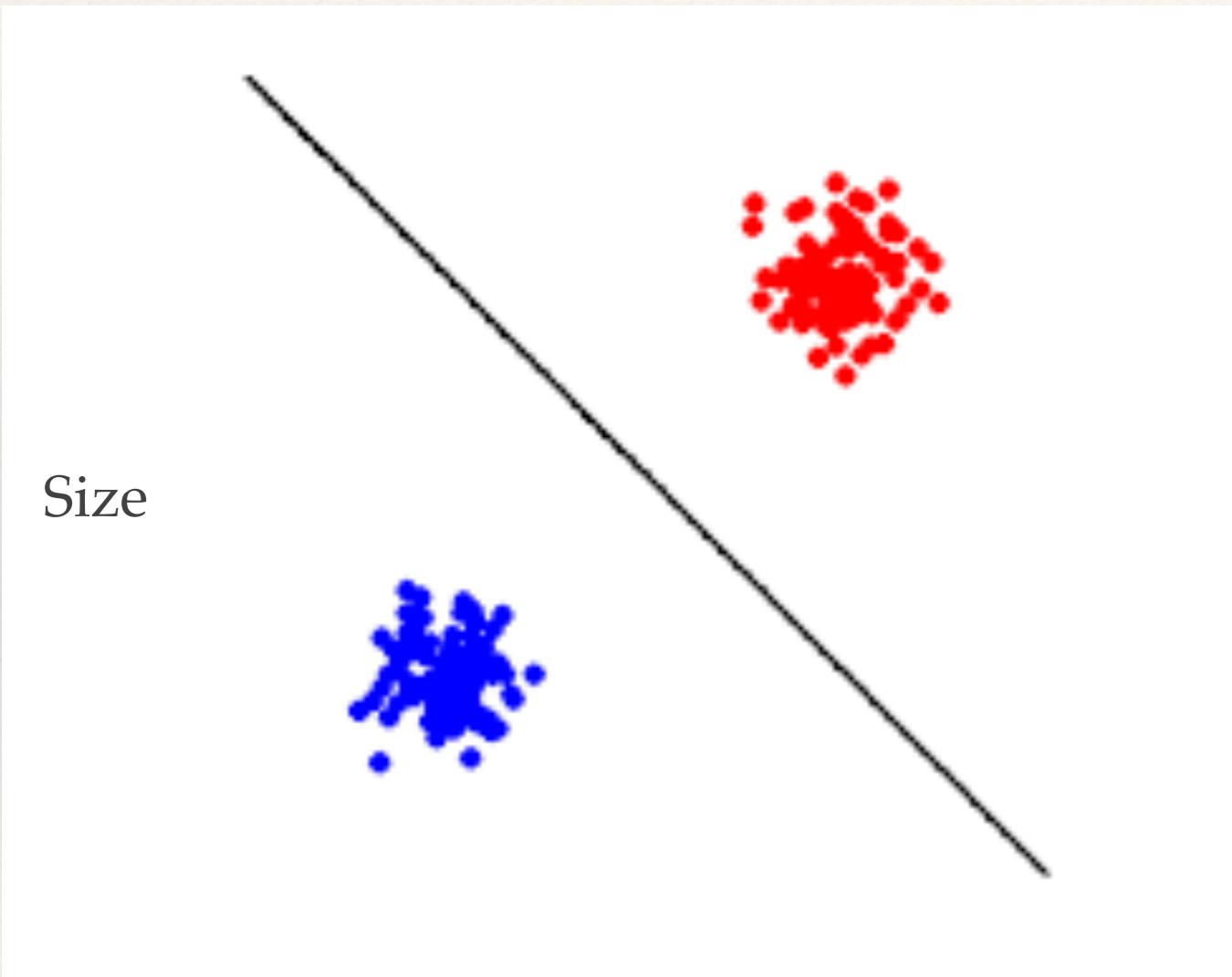
Perceptron is an algorithm for classification, but it could be seen as an abstract model of neuron, inspired by real neuron.

It can separate data finding the line, plane, hyperplane, that minimizes amount of classification errors.

First use case - Perceptron was designed for image recognition: it had an array of 400 photocells, randomly connected to the "neurons". US Navy wanted to detect military objects on the fotos.

FAILED

Linear Classification



How to separate cows from chickens?

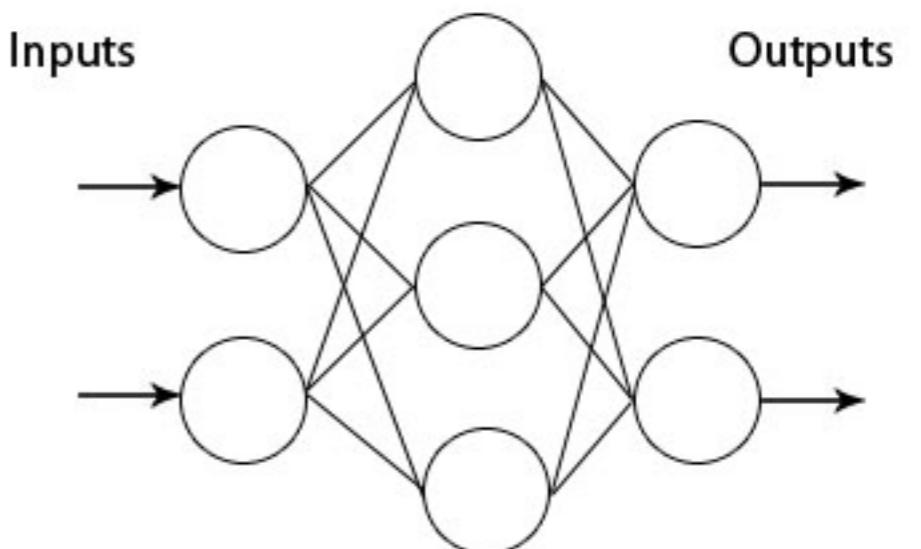


?

Weight
Blue - Chicks

Red - Cows

Multi Layer Perceptron

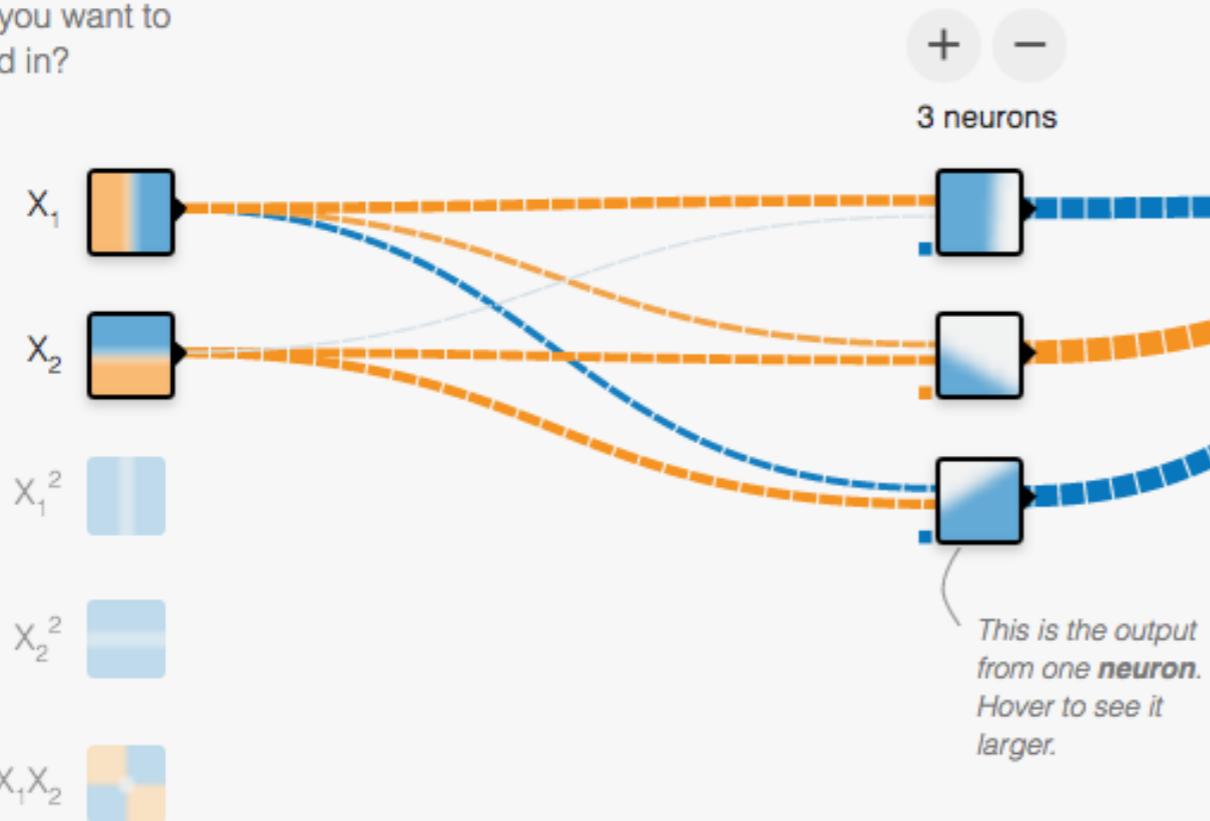


- ❖ Additional layers gives a possibility to fit any data distribution
- ❖ Let see it!

FEATURES

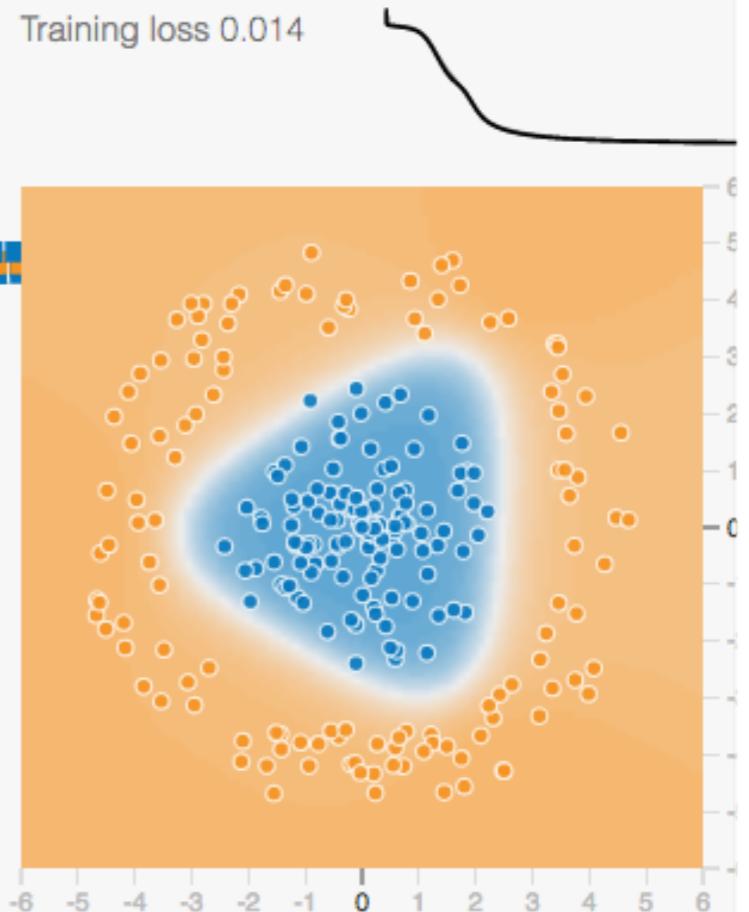
Which properties do you want to feed in?

1 HIDDEN LAYER



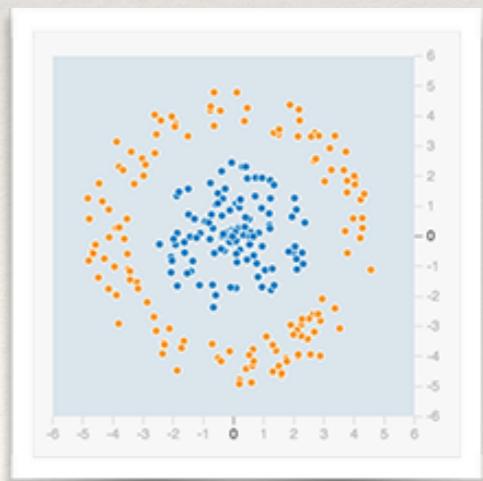
OUTPUT

Training loss 0.014



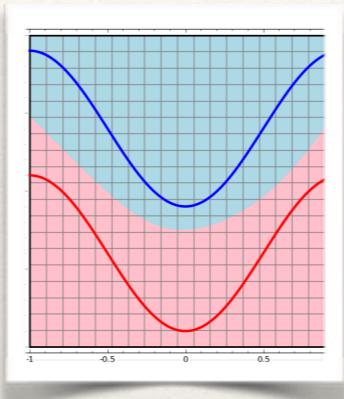
More neurons, more features to extract.

Data Manifolds

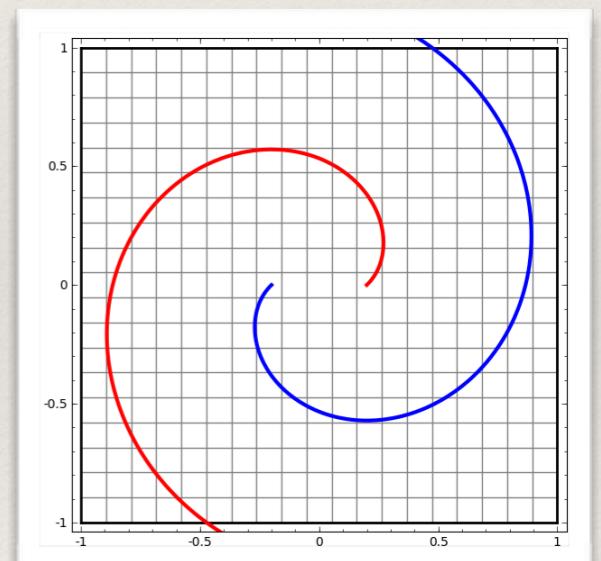
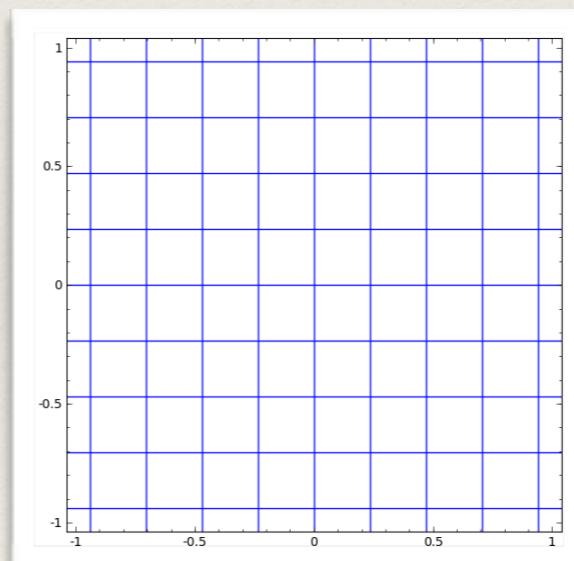
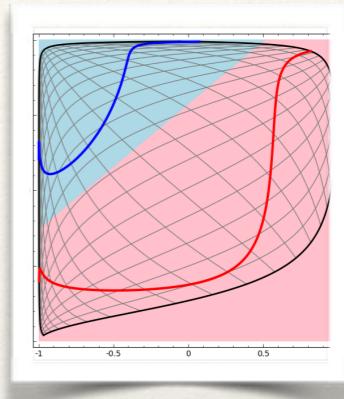


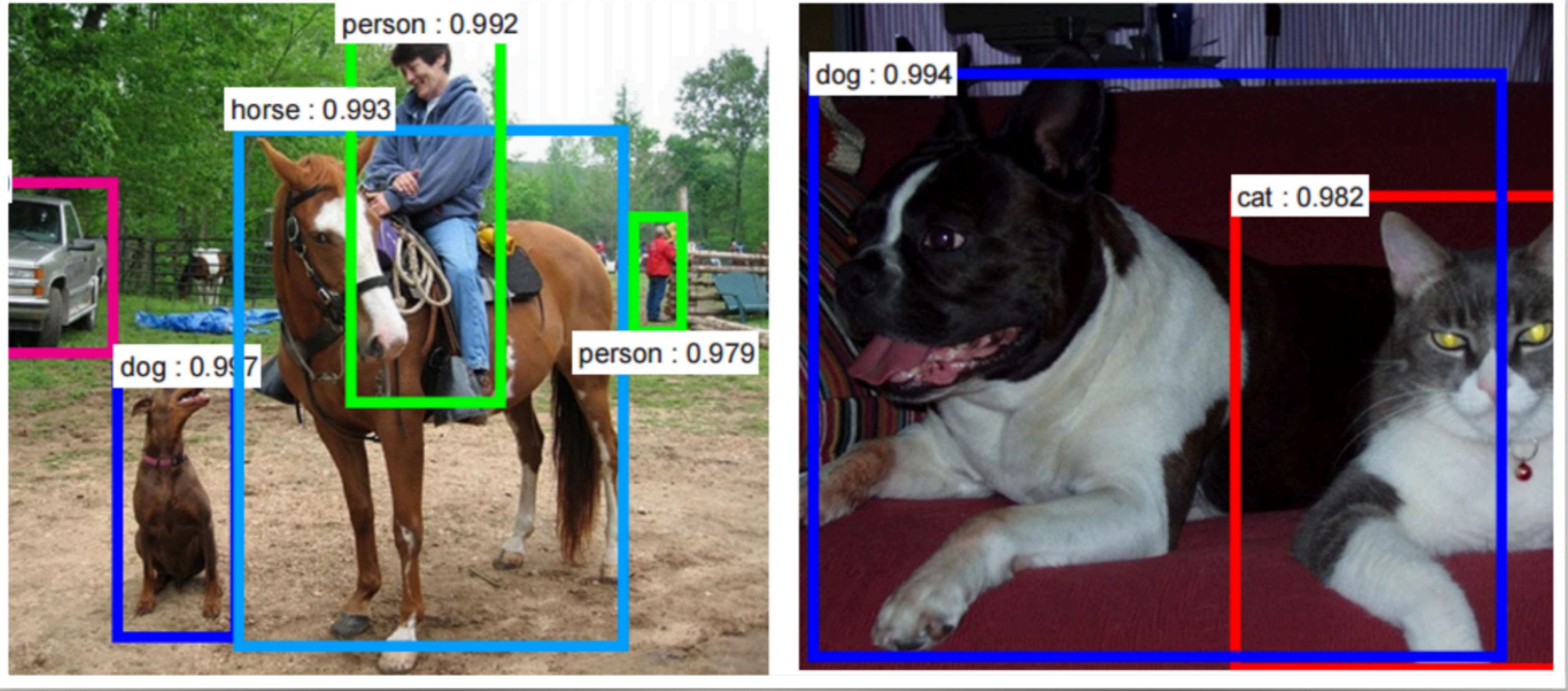
Topology

- ❖ It is affine transformation
- ❖ As rubber plane deformations
- ❖ <http://cs.stanford.edu/people/karpathy/convnetjs//demo/classify2d.html>
- ❖ Complex Data example



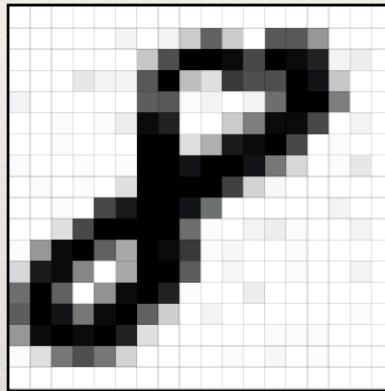
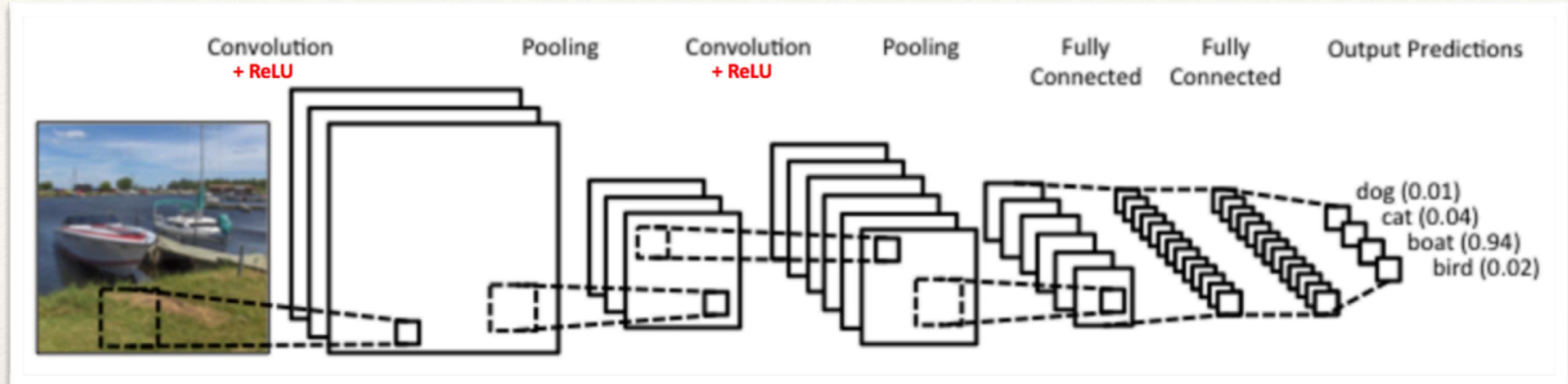
or





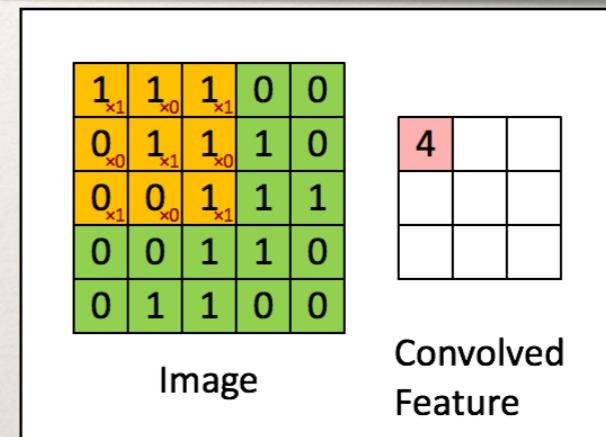
Convolutional Neural Networks

How do they see?



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

1	0	1
0	1	0
1	0	1



Essentially, every image can be represented as a matrix of pixel values.

Image matrix

Convolution Matrix

Convolution Process

ConvNets derive their name from the “convolution” operator. The primary purpose of Convolution in case of a ConvNet is to extract features from the input image. Convolution preserves the spatial relationship between pixels by learning image features using small squares of input data.

Examples of Convolution

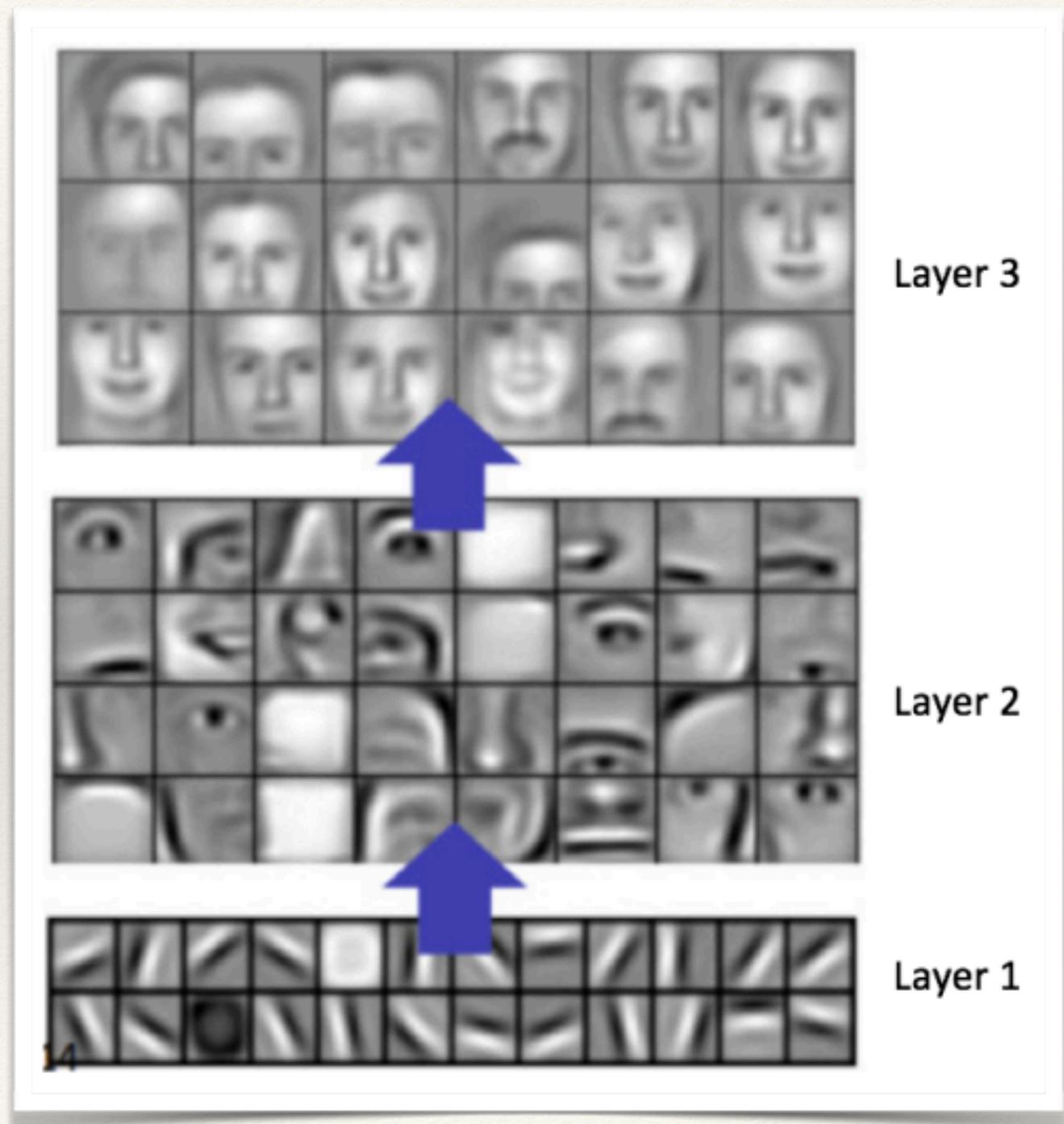
Image Filters.



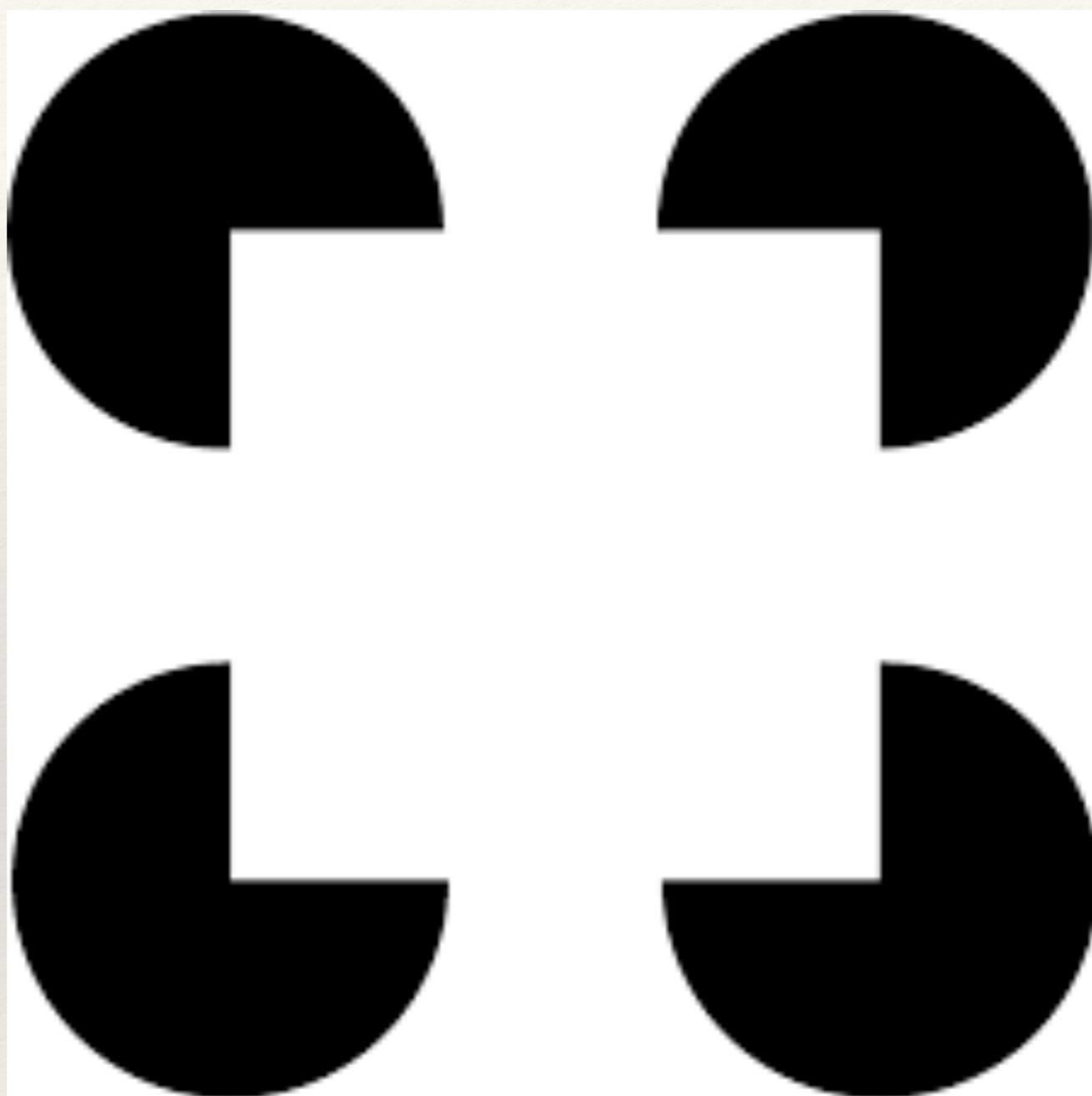
Operation	Filter	Convolved Image
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	
Box blur (normalized)	$\frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	
Gaussian blur (approximation)	$\frac{1}{16} \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$	

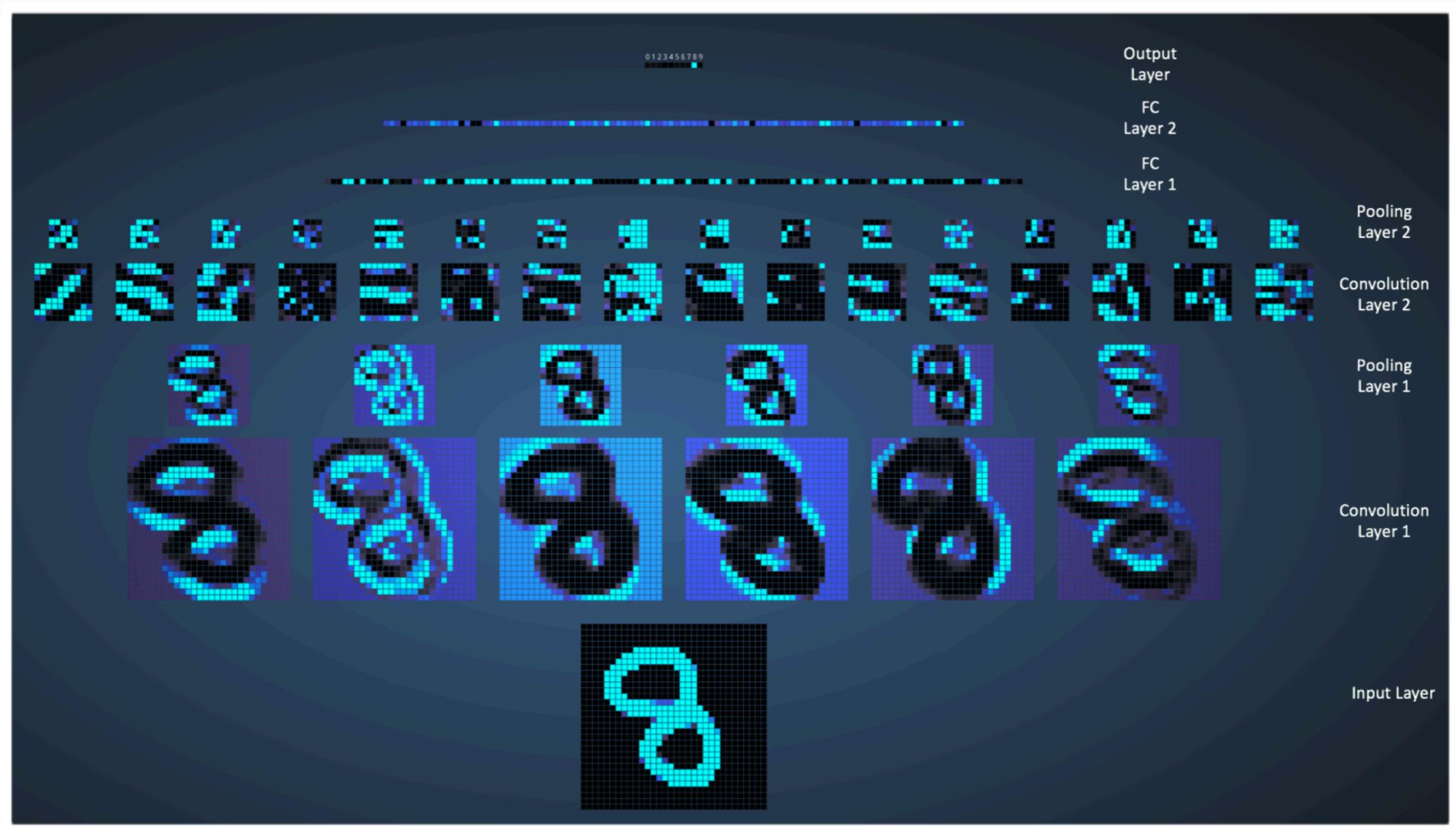
Layers as features

- ❖ Layers can learn features.
- ❖ From low level, as strokes
- ❖ To higher ones, edges, eyes, faces.
- ❖ Marylin Monroe neuron.



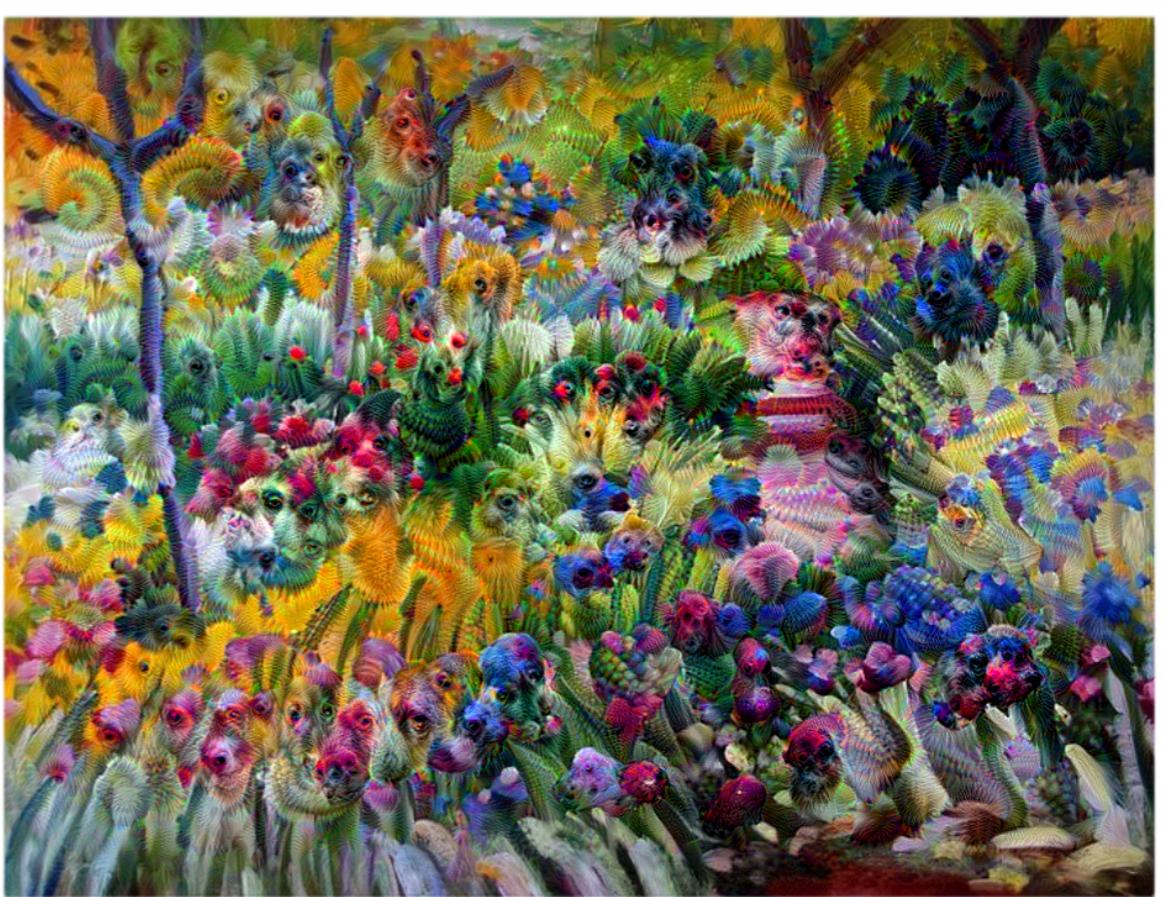
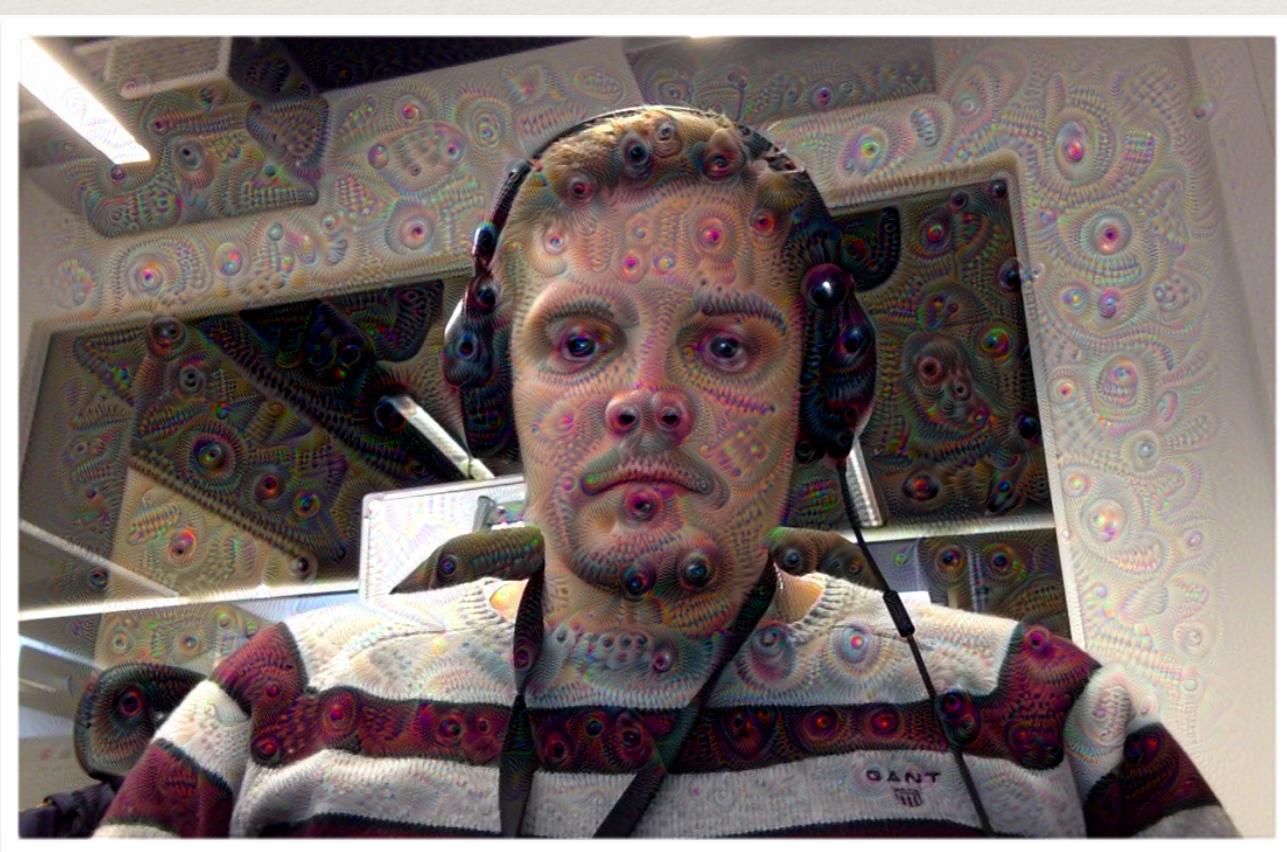
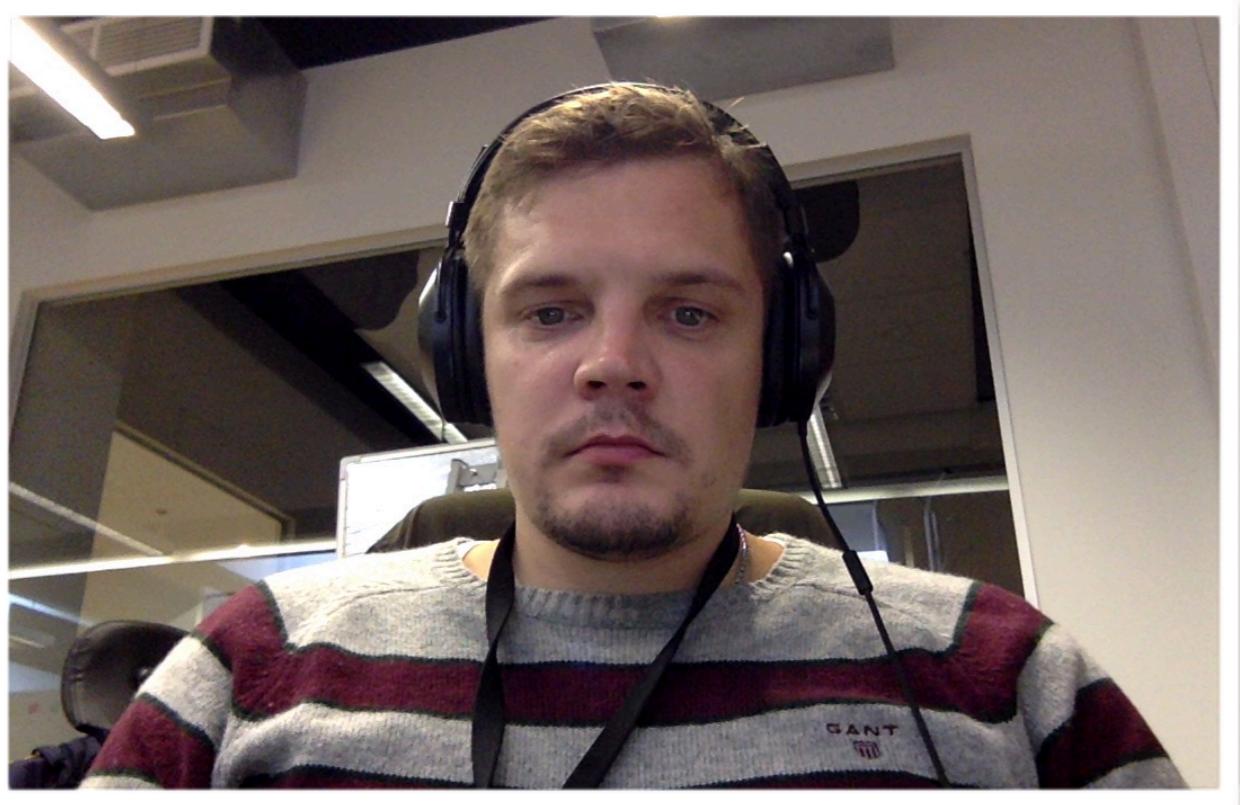
There is no square here!



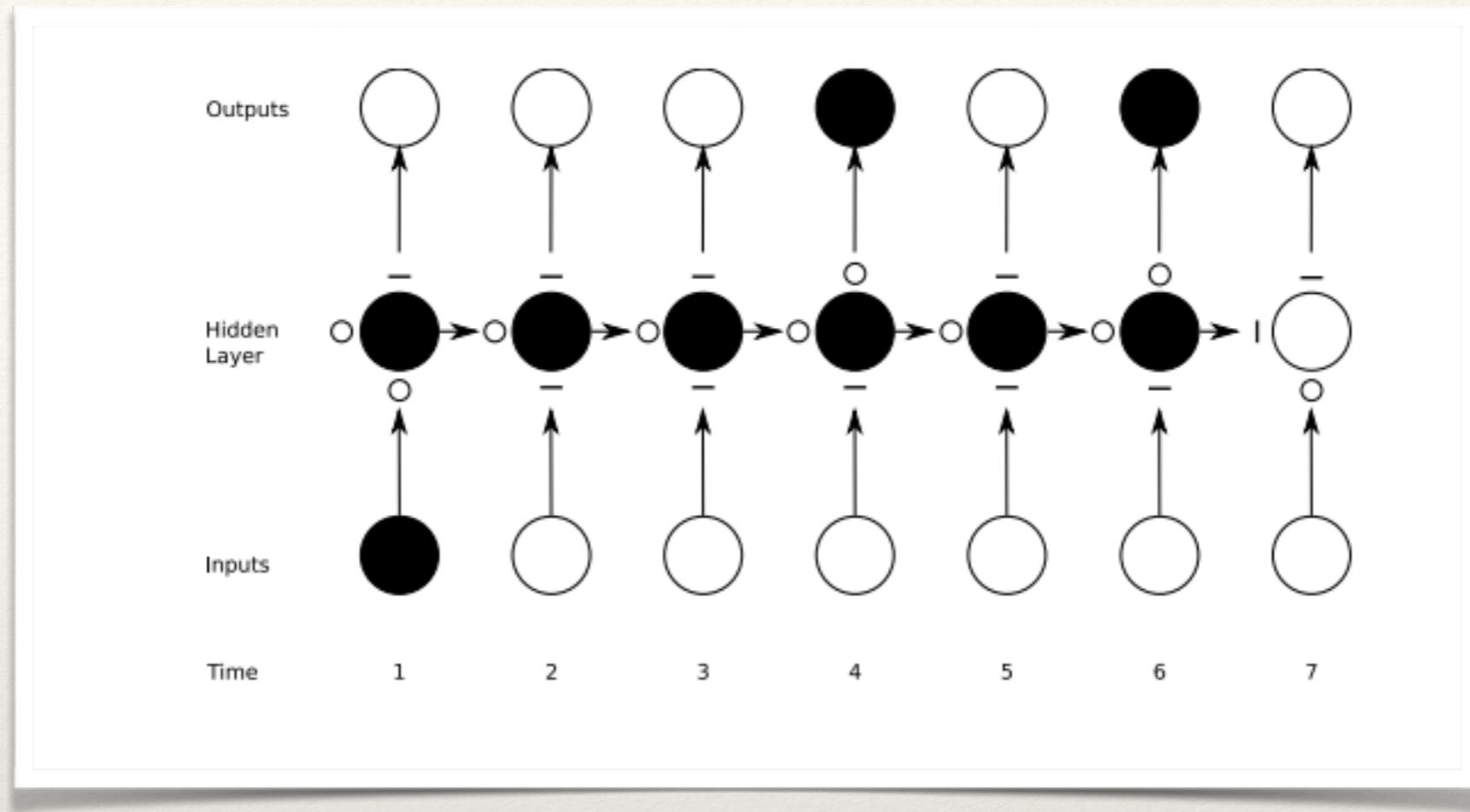


Live examples.

- ❖ <http://scs.ryerson.ca/~aharley/vis/conv/>
- ❖ <https://experiments.withgoogle.com/ai/what-neural-nets-see>
- ❖ Deep Dream and Tensor Flow
- ❖ <http://cs.stanford.edu/people/karpathy/ilsvrc/>



- ❖ The oft-cited resemblance of the imagery to LSD- and psilocybin-induced hallucinations is suggestive of a functional resemblance between artificial neural networks and particular layers of the visual cortex.



Adding temporary structure

Recurrent Neural Nets

Recurrent Neural Networks

- ❖ Can learn text as a stream of characters
- ❖ Can capture music structure
- ❖ Can store state

Trained on Linux Source code

```
static int indicate_policy(void)
{
    int error;
    if (fd == MARN_EPT) {
        /*
         * The kernel blank will coeld it to userspace.
         */
        if (ss->segment < mem_total)
            unblock_graph_and_set_blocked();
        else
            ret = 1;
        goto bail;
    }
    segaddr = in_SB(in.addr);
    selector = seg / 16;
    setup_works = true;
    for (i = 0; i < blocks; i++) {
        seq = buf[i++];
        bpf = bd->bd.next + i * search;
        if (fd) {
            current = blocked;
        }
    }
    rw->name = "Getjbbregs";
    bprm_self_clearl(&iv->version);
    regs->new = blocks[(BPF_STATS << info->historidac)] | PFMR_CLOBATHINC_SECONDS << 12;
    return segtable;
}
```

Wikipedia XMLs

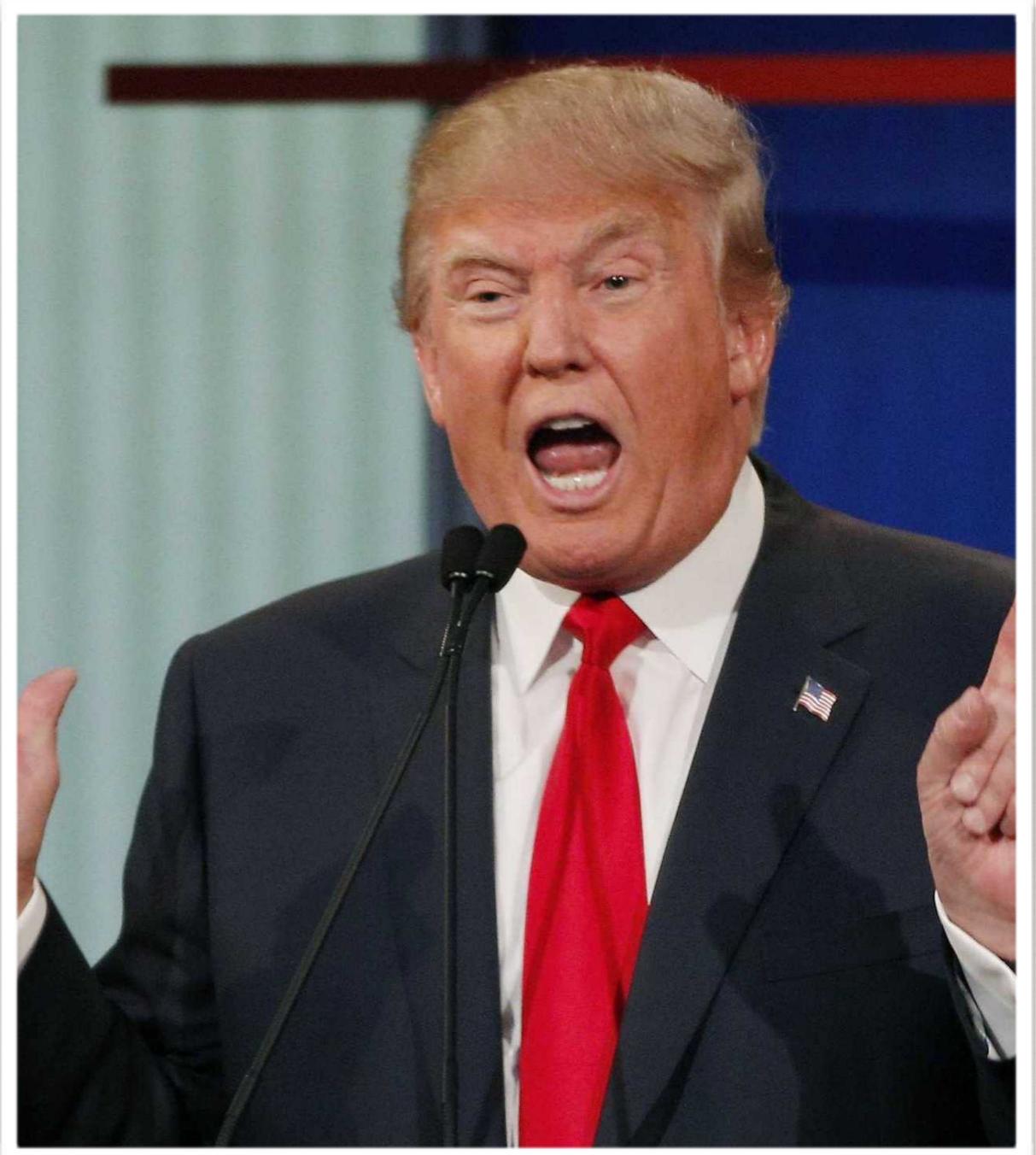
```
<page>
  <title>Antichrist</title>
  <id>865</id>
  <revision>
    <id>15900676</id>
    <timestamp>2002-08-03T18:14:12Z</timestamp>
    <contributor>
      <username>Paris</username>
      <id>23</id>
    </contributor>
    <minor />
    <comment>Automated conversion</comment>
    <text xml:space="preserve">#REDIRECT [[Christianity]]</text>
  </revision>
</page>
```

Some music as well

- ❖ <https://deepjazz.io/>
- ❖ <https://soundcloud.com/kchoi-research/sets/lstmmetallica-drums>

Trump's Speech generator

- ❖ Trained on Trump election speeches from June 2016 to November 2016.



What is going on underway.

At the beginning model does not know anything about text and language structure

----- Sample 1 -----

Lefs mint alo she g tor, torink.han, aulb bollg rurr Atans ir'd ciI anlot, ade dos rhant eot taoscare werang
he ca m hltayeu.,hare they Woy theaplier horet
iul pe neaf it Yf therg. hhat anoy souk, thau do y R0 Bury f
if. haveyhaled Dhorlsy Ato thinanse rank fourile Dani0n Ttovale yhinl ans anu he B

it is starting to get an idea about words separated by spaces. And got some knowledge about some simple words.

----- Sample 2 -----

aly Eo, He, to bakk st I stire I'micgobbsh brond thet we sthe mikadionee bans. Whether job lyok,.
Whon not I ouuk.
Wewer they sas I dait ond we polntryoiggsiof, waoe have ithale. I bale bockuyte seemer I dant you I Fout whey
We kuow Soush Wharay nestibigiof, You knik is you know, boxw staretho bad

I, not, job, - some of the learned words, it looks like some text.

----- Sample 3 -----

cy doing to whit stoll.
Ho just to deed to was very minioned, now, Fome is a soild say and is is soudd and If no want nonkouahvion. if you
beeming thet take is our tough us iss could feor youlk to at Lend and we do toted to start to pasted to doind the we
it.
I jind and I spongly stection Caread.

Looks more like English

What is going on underway.

Completed 340 minibatches of size 32x1000 characters

----- Sample 4 -----

Second. They left you asses, believe me, but I will have great people. I selling us some --
and you see something youve seen deterner to Mexico, we are building interest.

100,000. Im not going to be so bad.

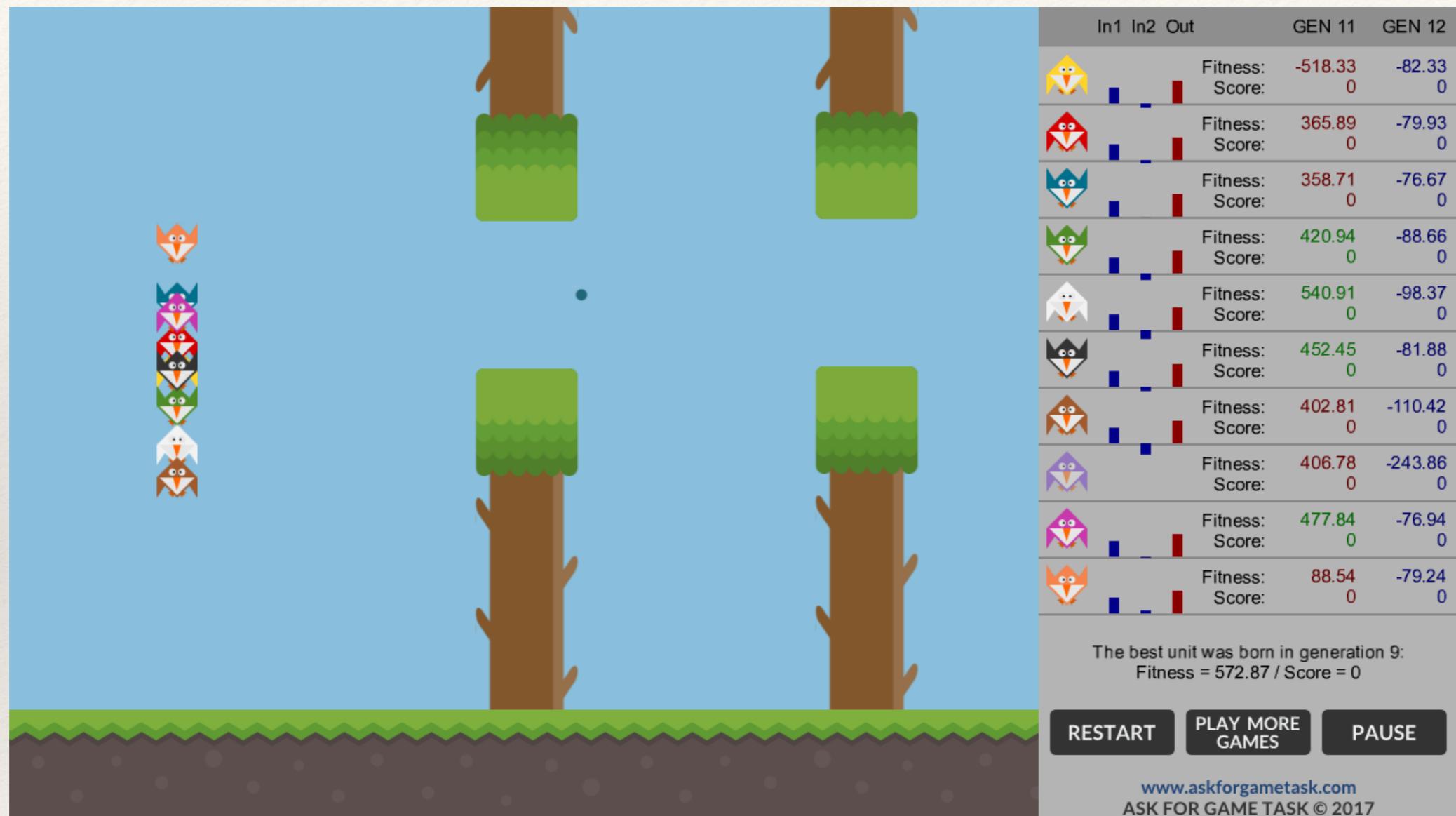
It was so proud of me. Incredible and or their cities which I kept the same wealthy. They dont want them, were
the world companies.

Yes, they get the fraud, except people deals 100. Its like never respaved us. Thats what were going to do an
orfone thats seen this.

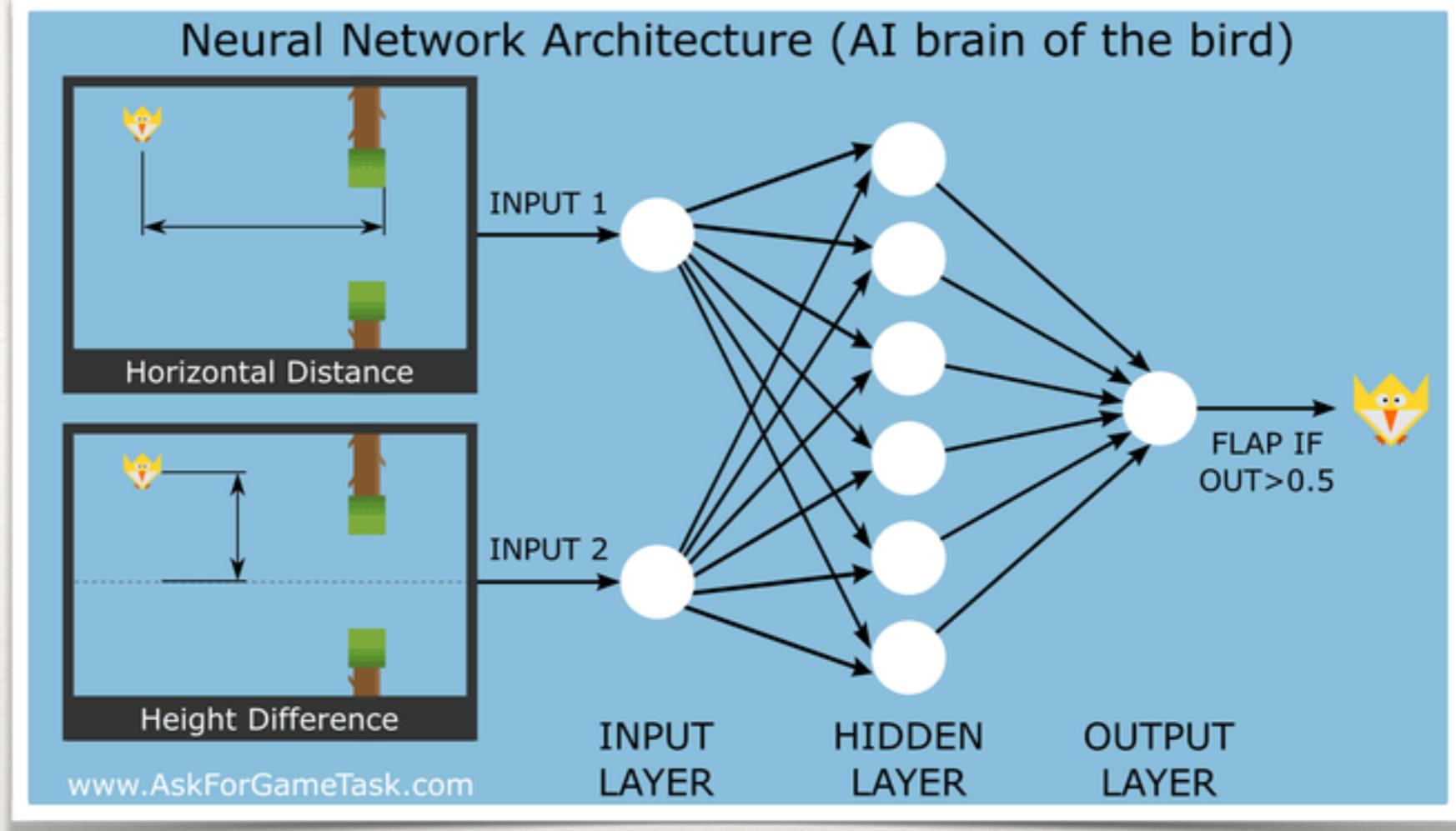
So we're going to run. But I was going to have all the manufacturing things as you know what we're not going
to be very soon to this country starting a president land the country. It's the committed to say the
greatest state. You know, I like Iran is so badly. I said, "I'm not as you know what? Why aren't doing my
sad by having any of the place so well, you look at 78%, I've done and they're coming in the Hispanics are
so many. The different state and then I mean, it's not going to be these people that are politicians that
they said, "You know, every poll said "We will bring it. I think we don't want to talk about the stupid new
of this country. We love it of money. It's running the cary America great.

Let see some output.....

Reinforcement Learning



Flappy Bird Evolution



How to learn to fly using genetic algorithm

Neural Model of a Bird

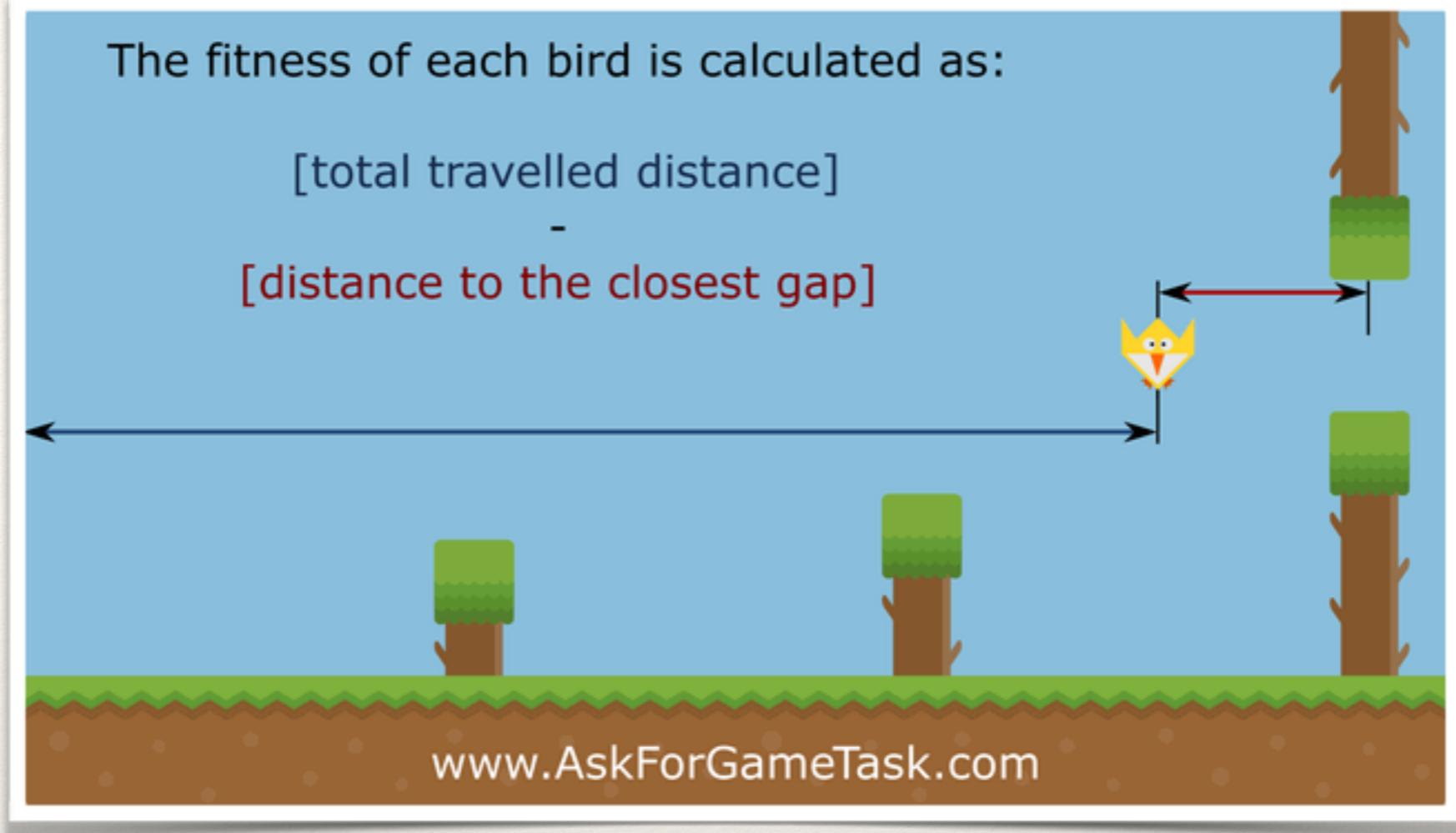
Best live longer

The fitness of each bird is calculated as:

[total travelled distance]

-

[distance to the closest gap]



Evolution of best models

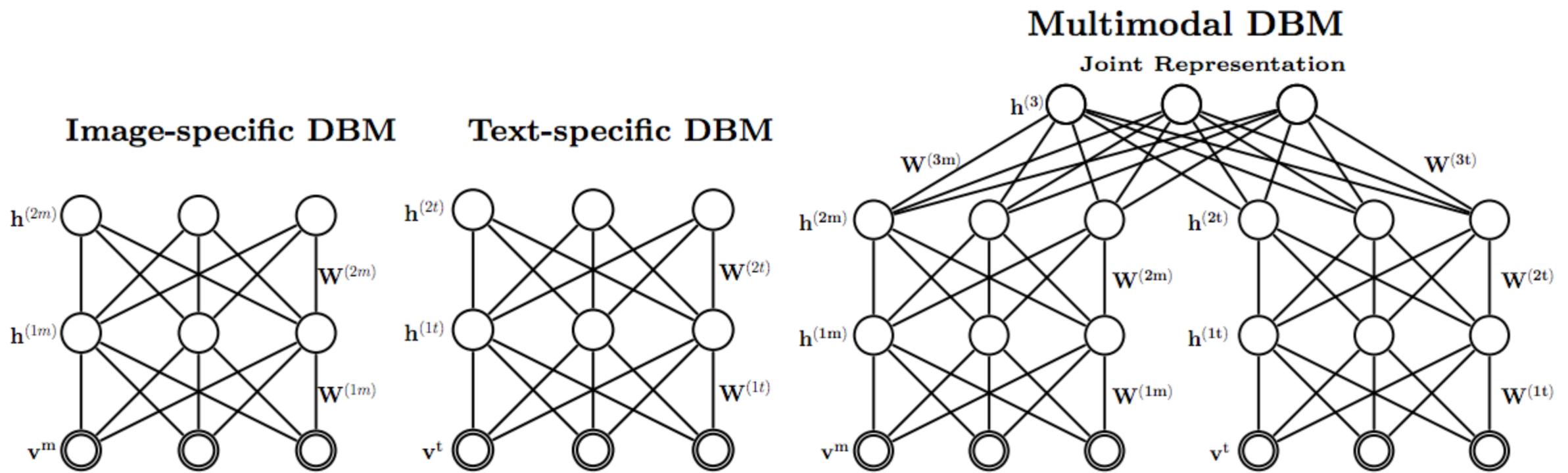
Select best fitness

add mutations

https://www.youtube.com/watch?time_continue=128&v=aeWmdojEJf0

<http://www.askforgametask.com/html5/tutorials/flappy/>

Multimodal Learning



<http://jmlr.org/papers/volume15/srivastava14b/srivastava14b.pdf>

Questions?