

Playing Flappy Bird with Neuroevolution

Game UI, Network Training \w MATLAB

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重建思维过程

a.k.a Rise of the Flappy bird

→选题原因 → 学科经典

→查找文献 (Mission Failed)

→为了学习神经网络 → 重修生物

→为了学习进化算法 → 学习 JavaScript

→为了找Bug → 数据可视化 → 研究搭建图形化 Flappy Bird 界面

→第一次进化成功

→为了提高进化效率 → 优化进化算法

→不足分析

→前景展望

“六大流派”

机器学习玩转Flappy Bird全书

Flappy Bird.m

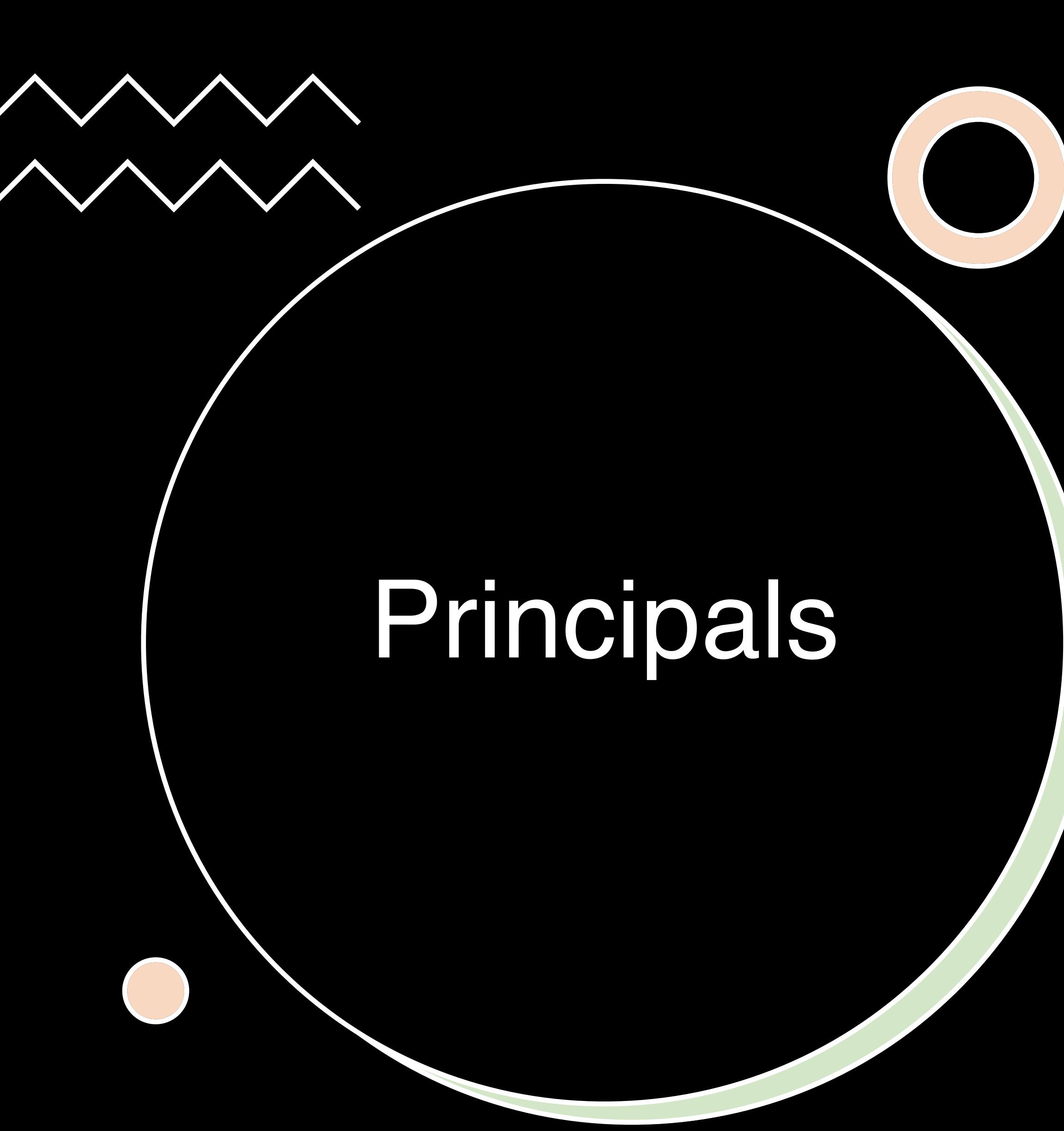
RoteAugen / flappy-bird-for-matlab

But what is a Neural Network?

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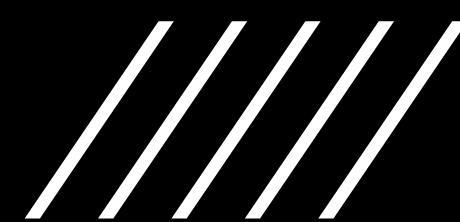
@tang, zhou



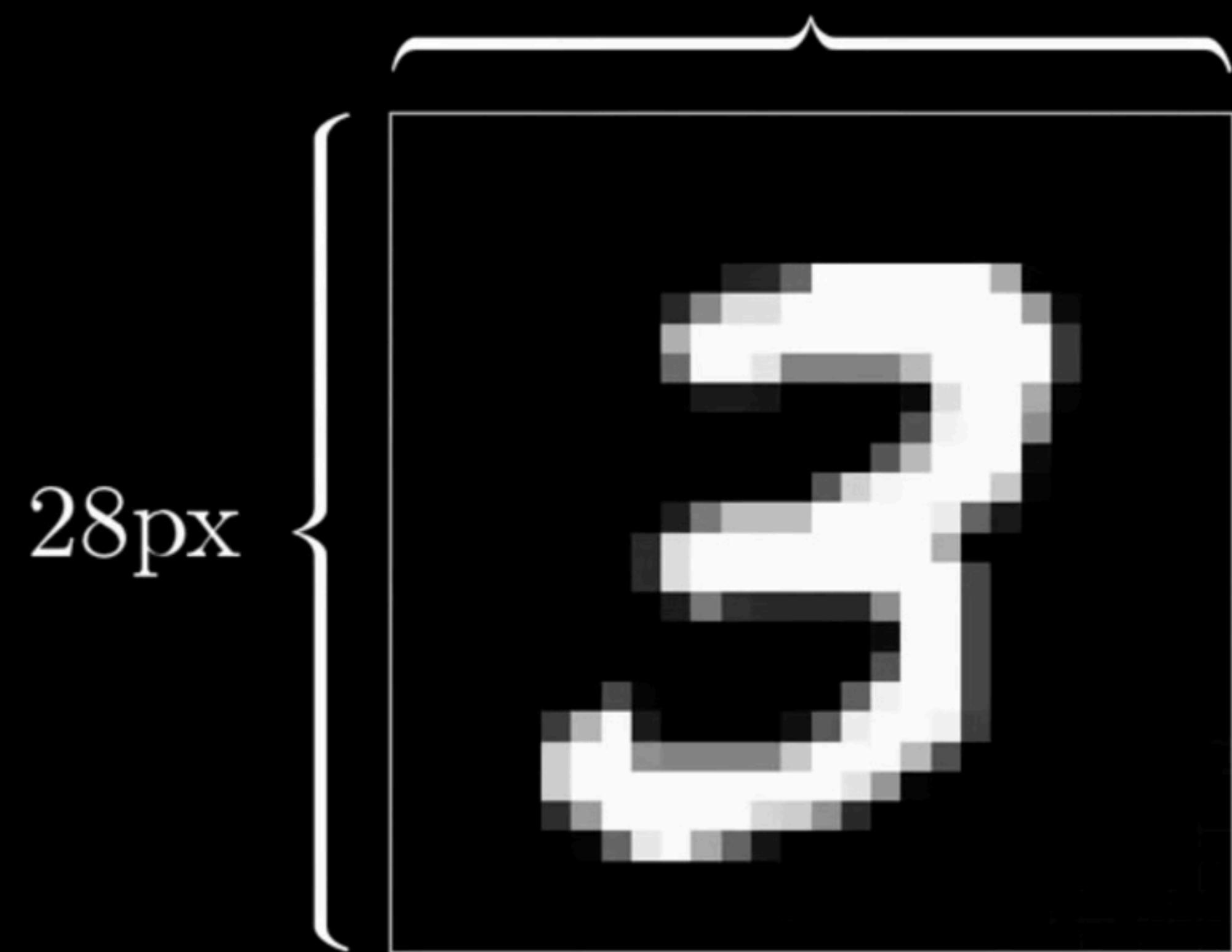


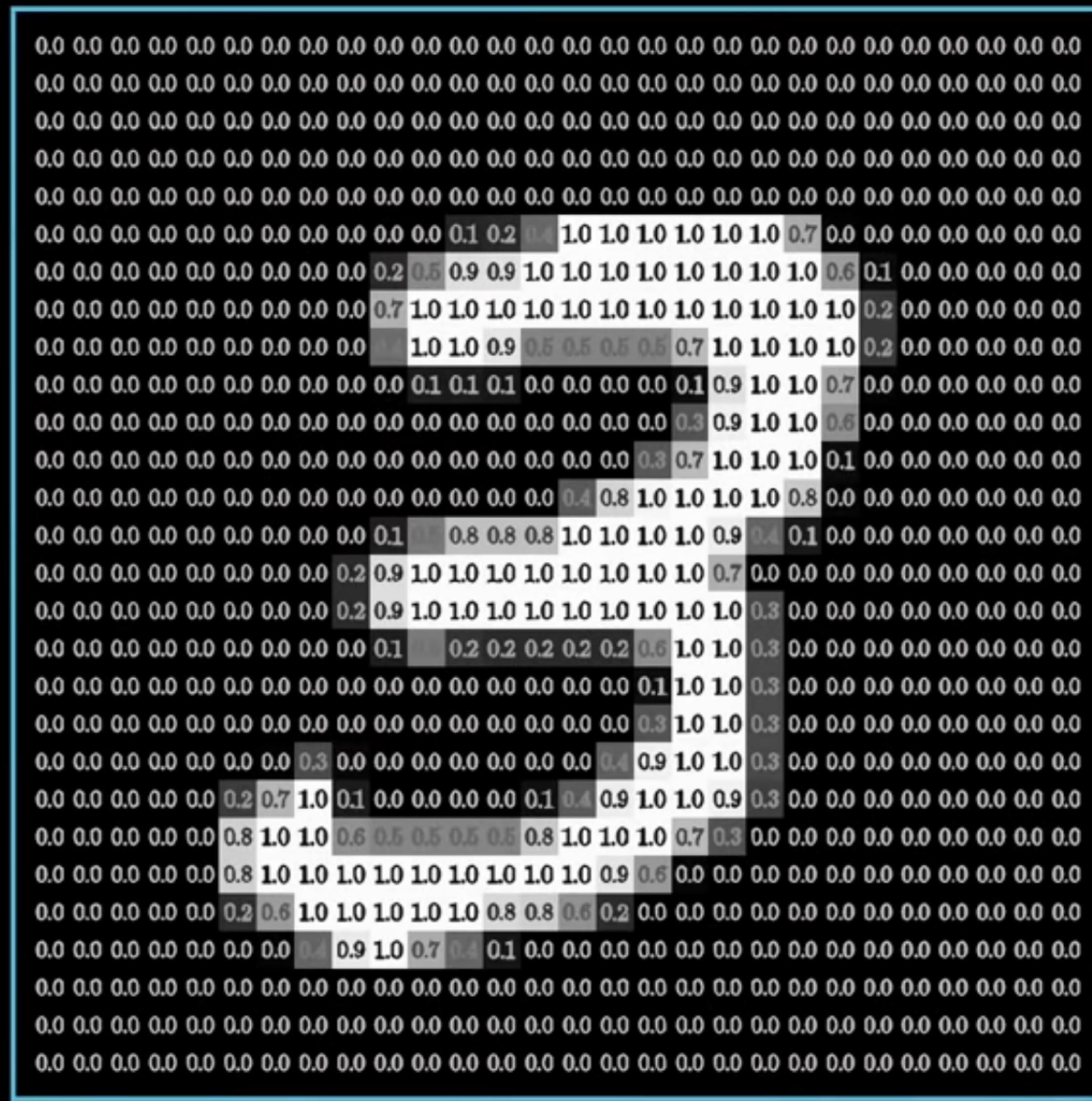
Principals

神经网络是具有适应性的简单单元组成的广泛并行互连的网络，它的组织能够模拟生物神经系统对真实世界物体所做出的交互反应。



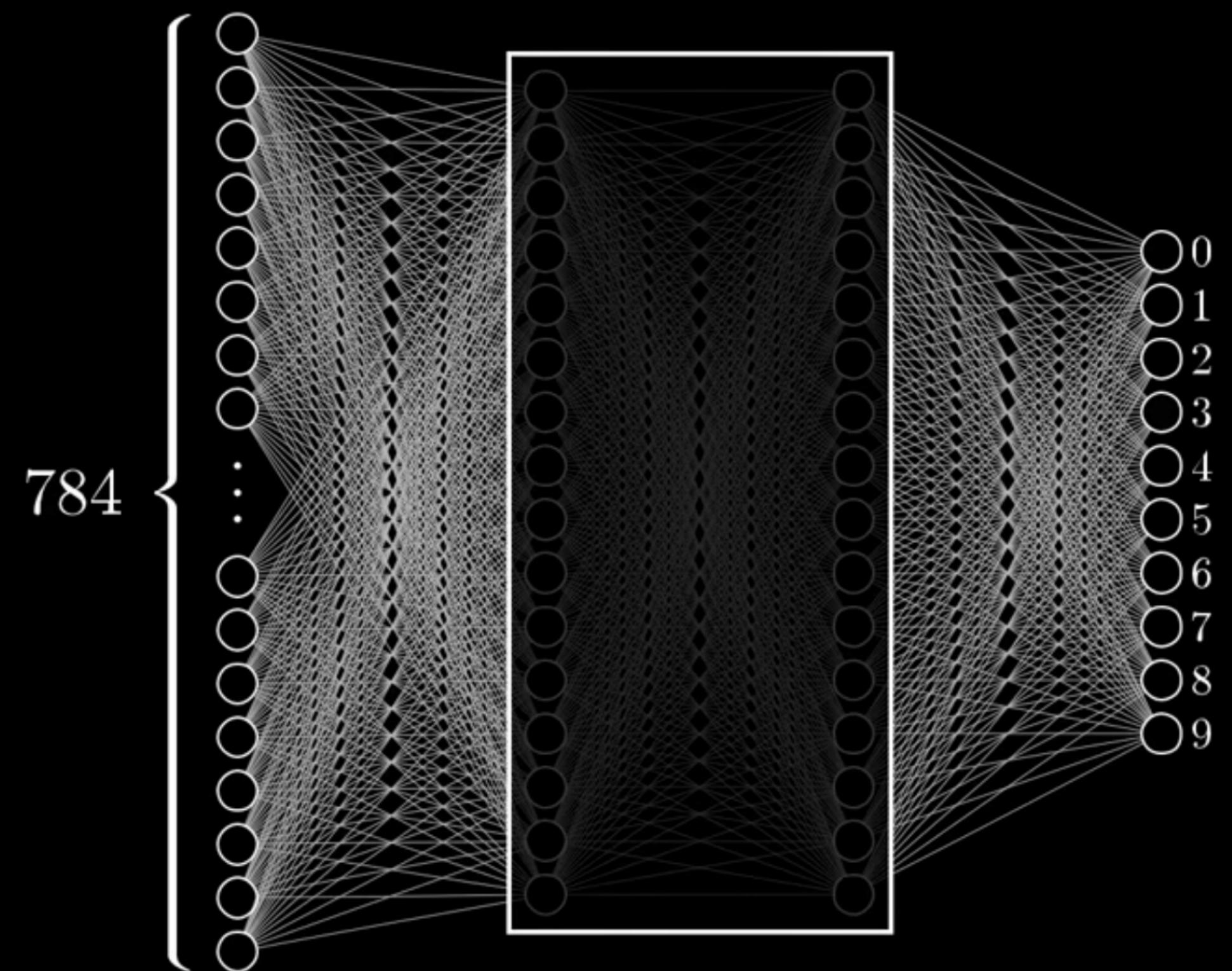
28px





0
1
2
3
4
5
6
7
8
9

...rather than treating this as a black box



$$q = \text{○} + \text{l}$$

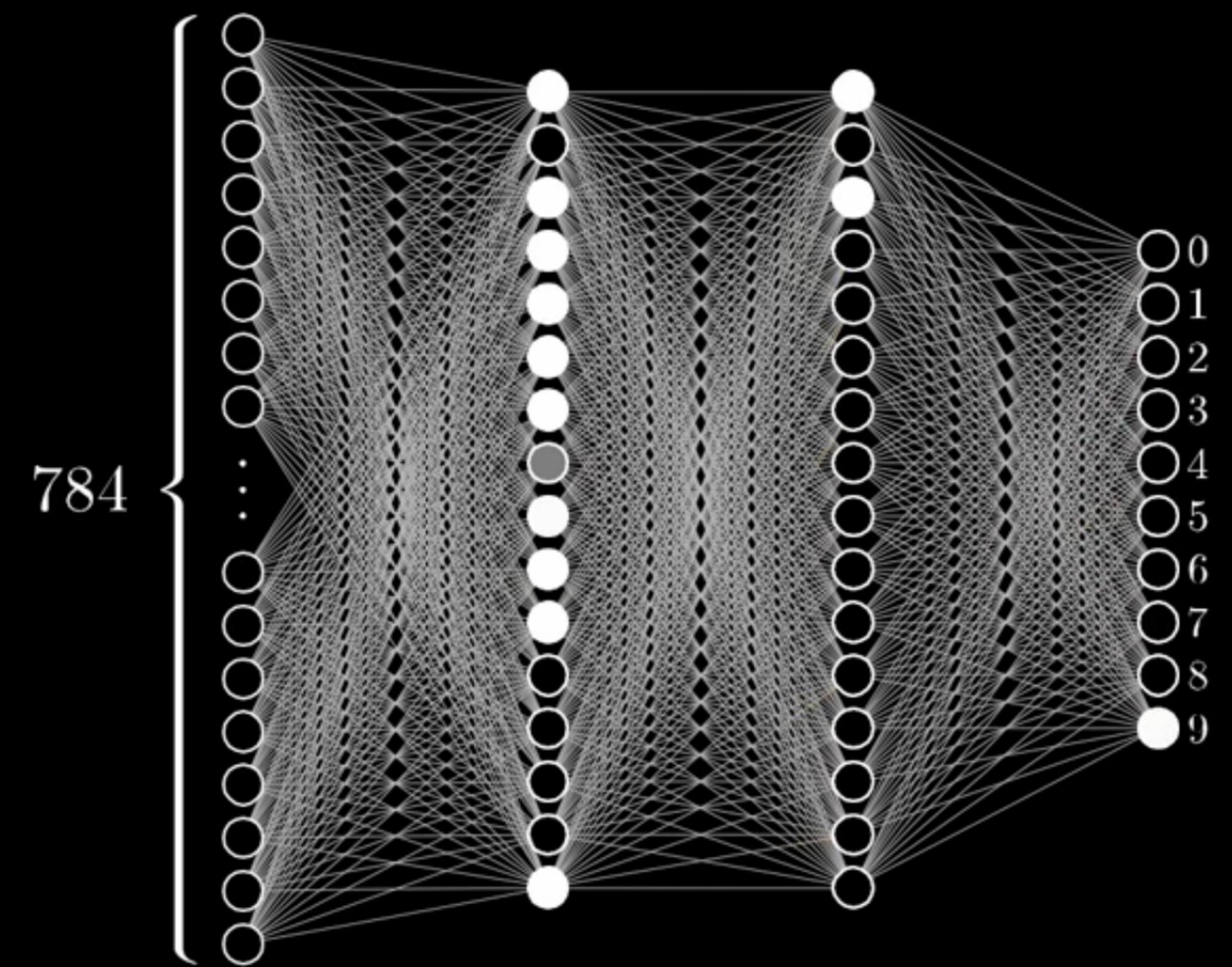
$$g = \text{○} + \text{o}$$

$$4 = \text{l} + \text{f} + \text{-}$$



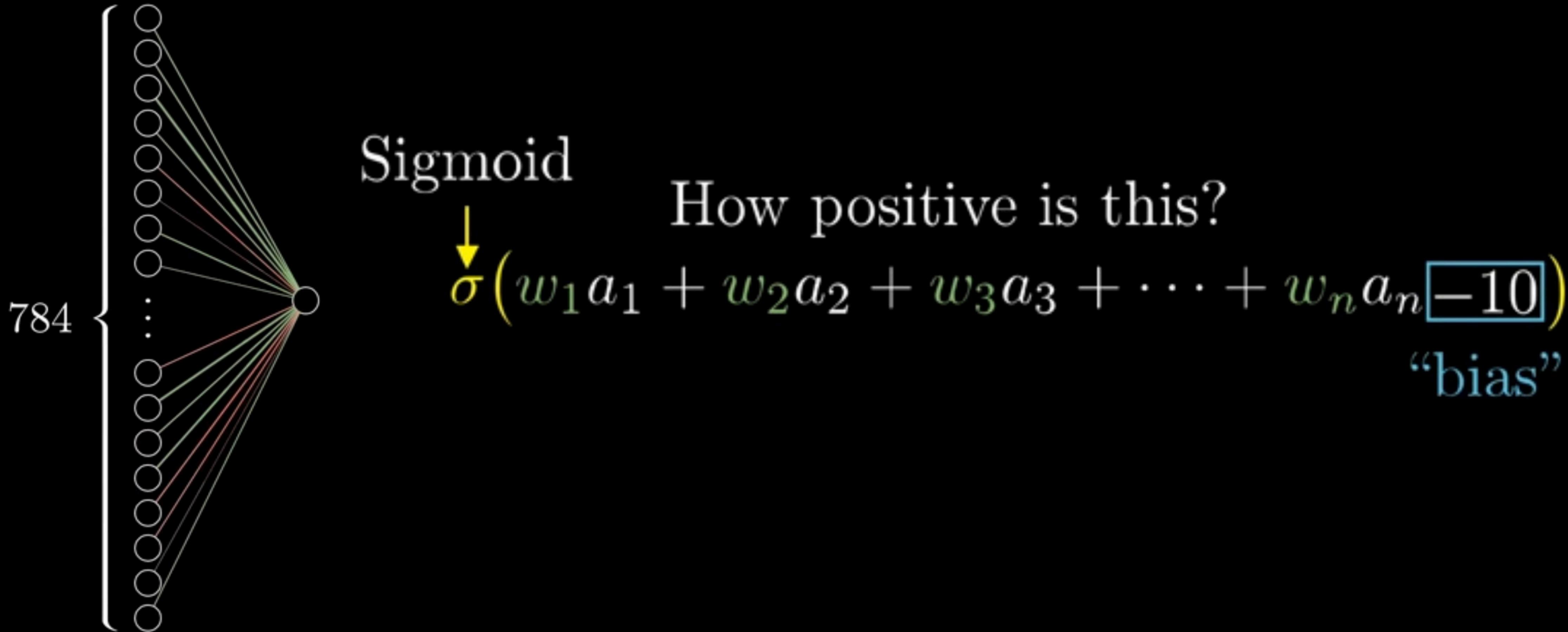
$$\text{[Image of a donut]} = \text{[Image of a blue pen]} + \text{[Image of a green pen]} + \text{[Image of a yellow pen]} + \text{[Image of an orange pen]} + \text{[Image of a red pen]}$$

$$\text{[Image of a pen]} = \text{[Image of a pink pen]} + \text{[Image of a purple pen]} + \text{[Image of a brown pen]}$$



Hidden layer—patterns

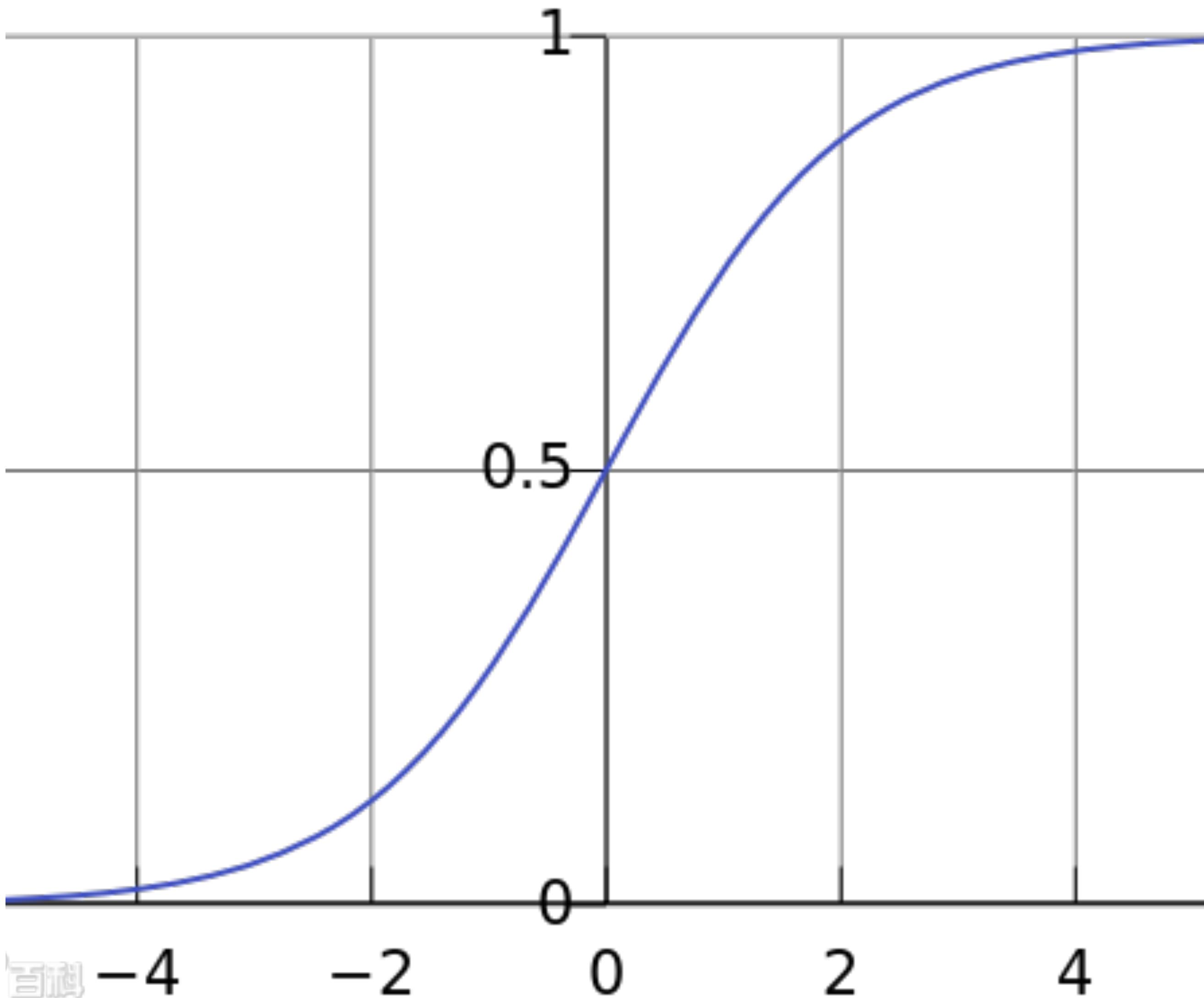
算法实现



Logistic Activation

a.k.a Sigmoid Function

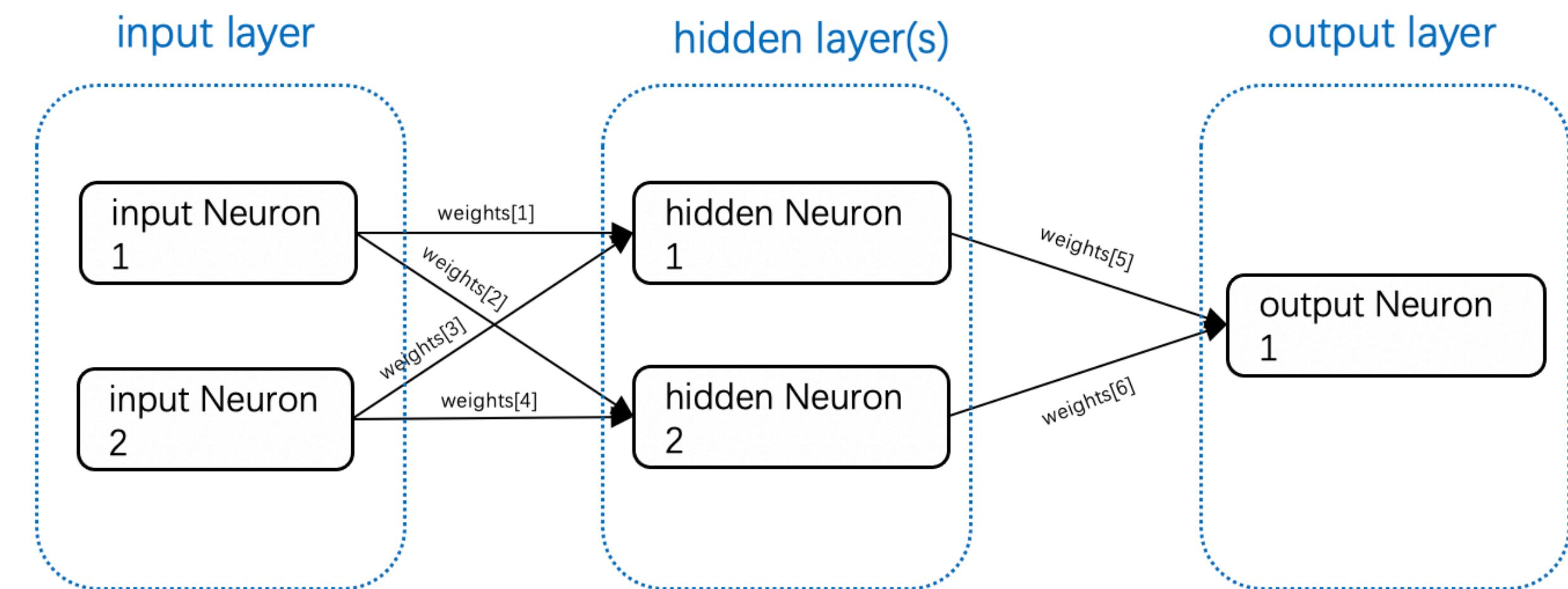
$$P(t) = \frac{1}{1 + e^{-t}}$$



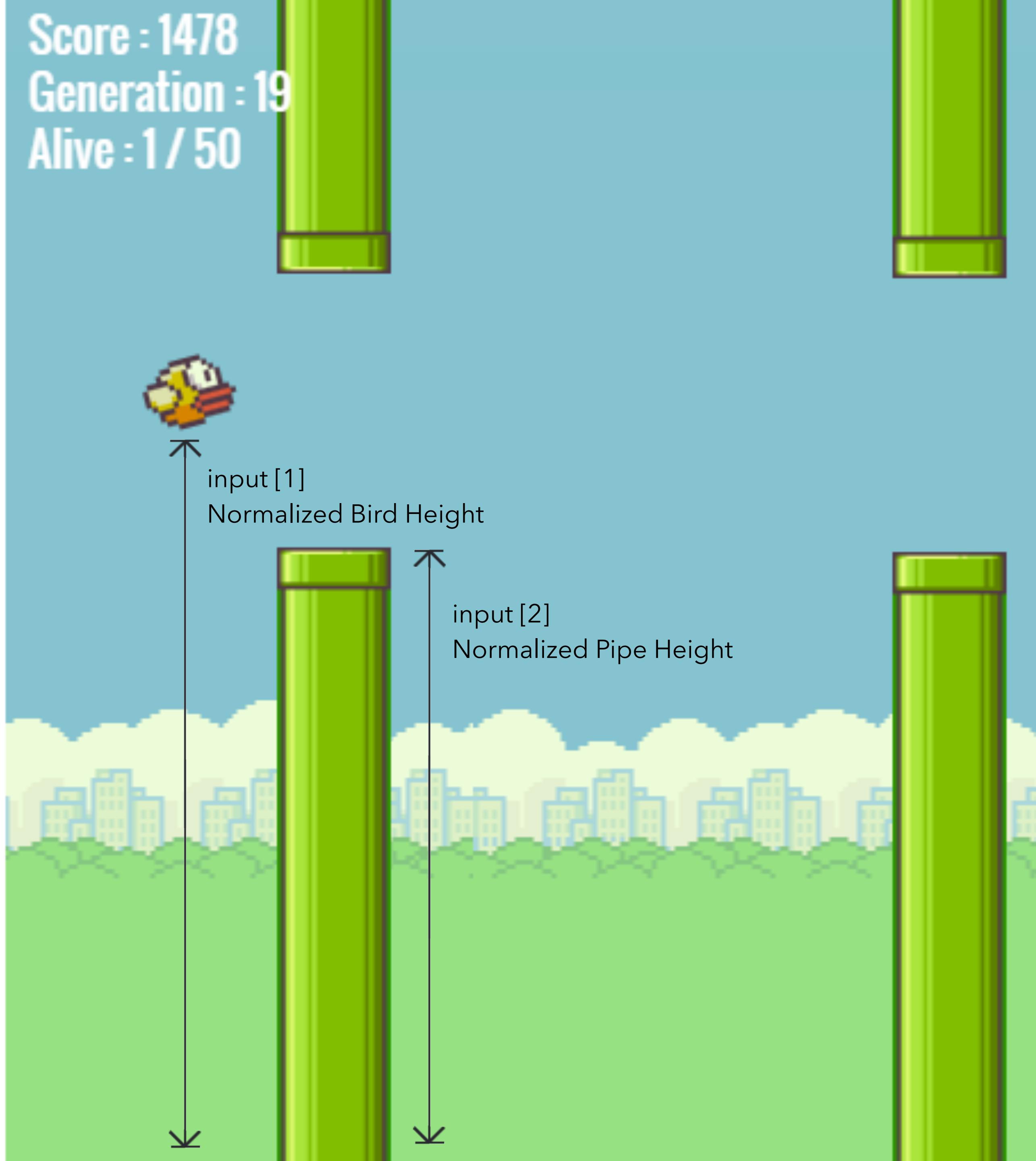
Flappy Network Topological Structure

weights Matrix_[1x6] = [w1,w2,w3,w4,w5,w6]

genome Matrix_[1x7] = [w1,w2,w3,w4,w5,w6, **score**]



$$res = \sum_{i=1}^2 weights[i + 4] \times \sum_{j=1}^2 input[j] \times weights[j + (i - 1) \times 2]$$



JavaScript

which we won't get into at present

JS vs ML

雷锋 VS 雷峰塔

Neuroevolution Class

Computation Functions

- activation(input);
- randomClamped();
- networkCompute();
- addGenome(genome);
- breedGenome(genome1, genome2);
- generateFirstGeneration();
- generateNextGeneration();
- nextGeneration();

「遇事不决图形化」

...应该不难?

(which later proved to be absolutely false)

Flappy Bird.m

「Handle」句柄

figure, axes, image, set(@params), drawnow;

Game UI Class (Parent)

Complemented by Bird Class & Game Class

- isItEnd();
- gameStart();
- gameUpdate();
- Callbacks:
 - CloseReqFcn(hObject,eventdata,handles)
 - FPSButtonPushedFcn(hObject,eventdata,handles) x 5

Score: 35

Max Score: 95

Generation: 5

Alive: 50



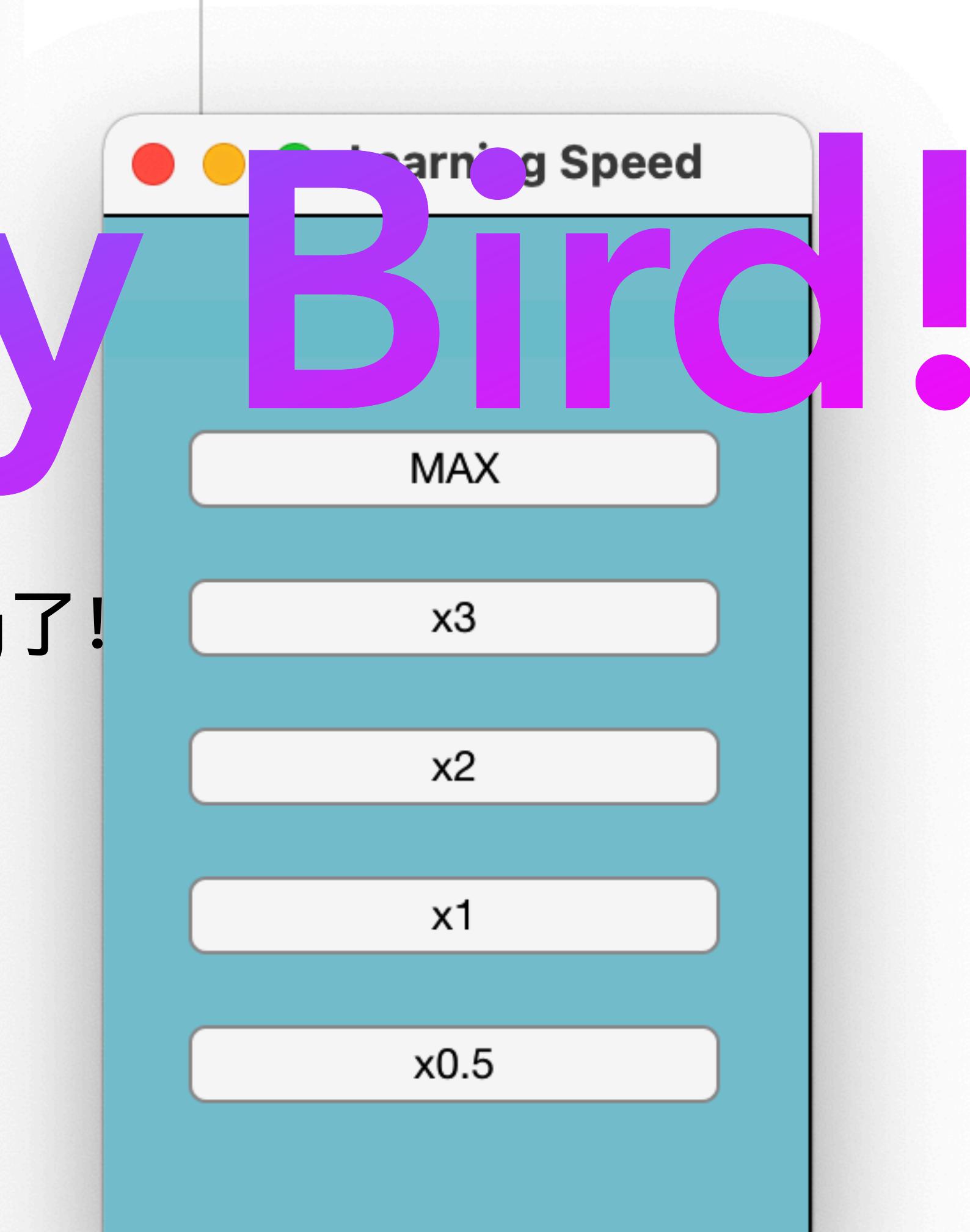
My Flappy Bird!



终于可以快乐地debug了!



s, column 7 = score, line = genomes



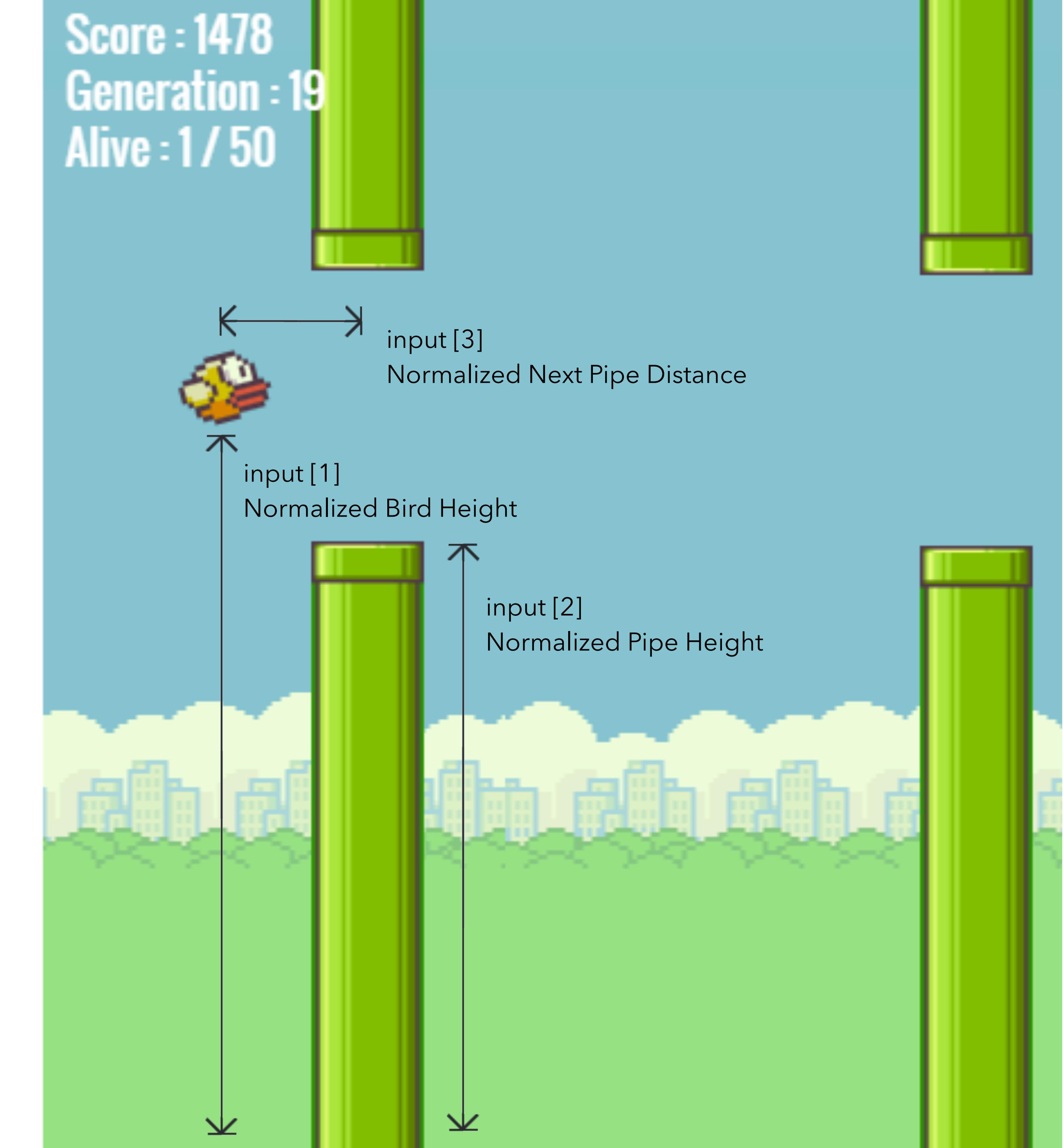
Demo

Optimization

最难部分在于到达第一根管子
引入regenerateFlag和shitCount

不足分析

输入参数是否最优?
→尝试加入pipe.x-bird.x



```

%% Variable Initialization
function initVariables()
    NeuroEvo.network = [2,2,1];
    NeuroEvo.population = 50;
    NeuroEvo.elitism = 0.2;
    NeuroEvo.randomBehaviour = 0.2;
    NeuroEvo.mutationRate = 0.1;
    NeuroEvo.mutationRange = 0.5;
    NeuroEvo.scoreSort = -1;
    NeuroEvo.genome = []; % [1 7] array, column 1~6 =
    NeuroEvo.genome2add = [];
    NeuroEvo.prevGenome = [];

    Game.score = 0;
    Game.maxScore = 0;
    Game.width = 500;
    Game.height = 512;
    Game.spawnInterval = 70;
    Game.interval = 0;
    Game.generation = 0;
    Game.alives = 0;
    Game.backgroundSpeed = 0.5;
    Game.backgroundx = 0;
    Game.birds = [];
    Game.pipes = [];
    Game.minimumScoreLimit = 105;
    Game.shitCount = 0;
    Game.regenerateFlag = false;
    Game.backgroundRefreshFlag = false;
end

```

动态随机\精英常数

→与maxScore一阶导负\正相关

**We cannot solve our problems with the same
thinking we used when we created them.**

- Albert Einstein

Thanks for listening!

「Rise of the Flappy Bird」

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