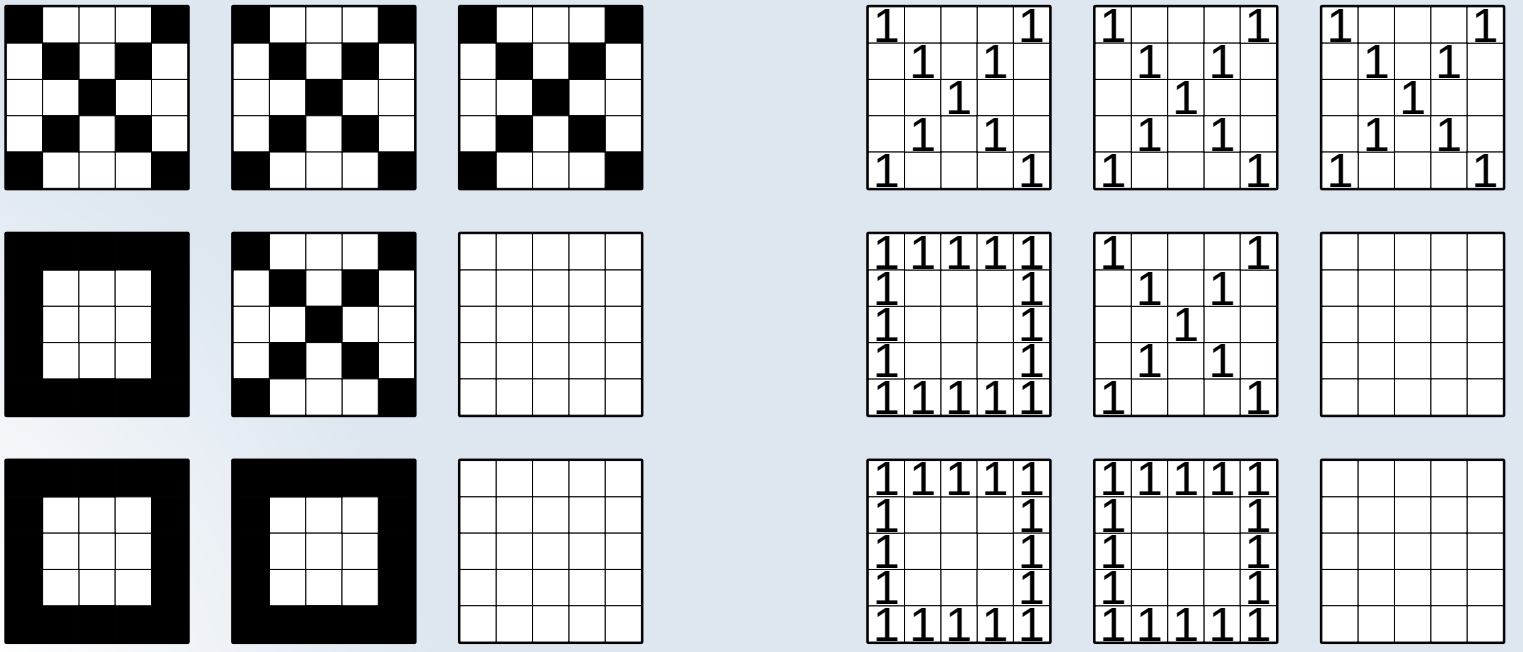
Tic-Tac-Show

Week 7 Lecture, October 29th 2025

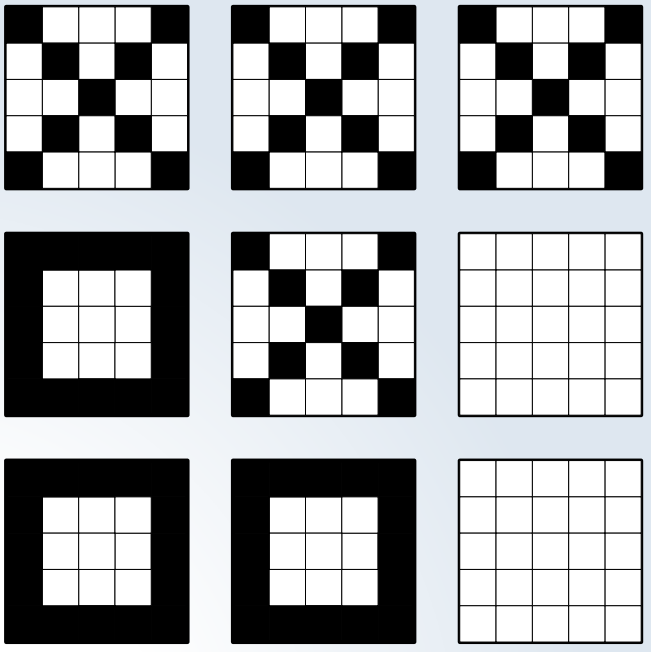
Pavlos Andreadis
University of Edinburgh, School of Informatics

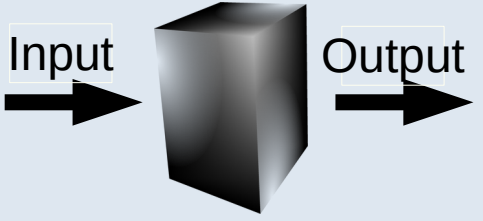
How a game of Tic-Tac-Toe might be presented (to a machine)





Goal: Detect game state from Image

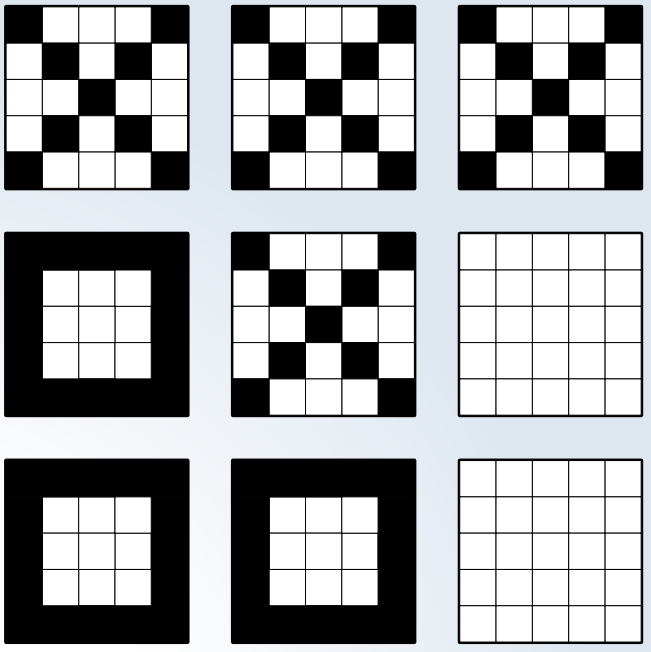


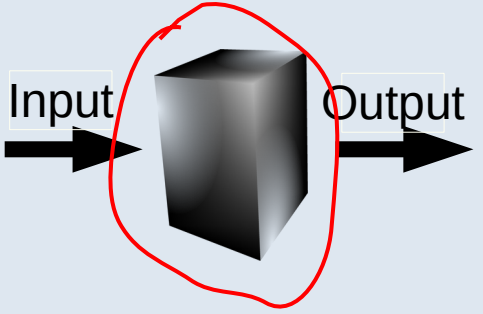


1	0

or “X wins”

Goal: Detect game state from Image





1	0

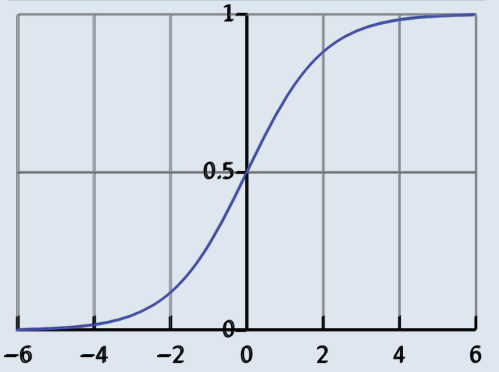
or “X wins”

Machine Learning model

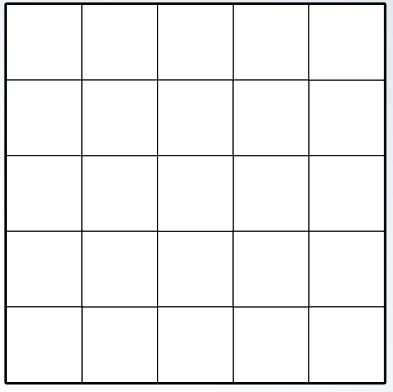
Basic Building Block: *Perceptron*

$$\sigma(z) = \frac{1}{1+e^{-z}}$$

Logistic / Sigmoid

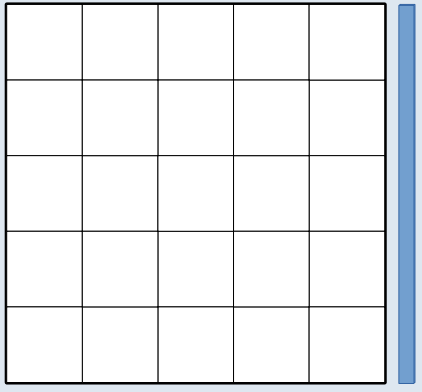


Input



x

Weights matrix



+ Bias

Output

A Perceptron for X, tested on an X

Input

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

x

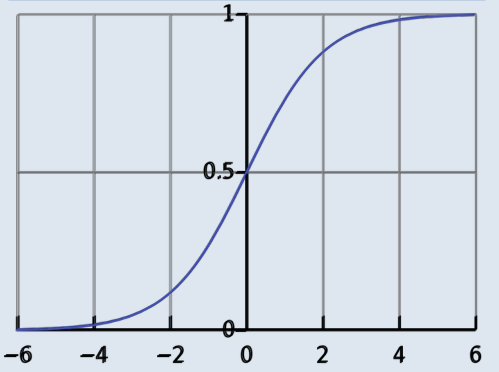
Weights matrix

8/9	0	0	0	8/9
0	8/9	0	8/9	0
0	0	8/9	0	0
0	8/9	0	8/9	0
8/9	0	0	0	8/9

- 4

4

Logistic / Sigmoid



0.98201...

A Perceptron for X, tested on an empty box

Input

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

x

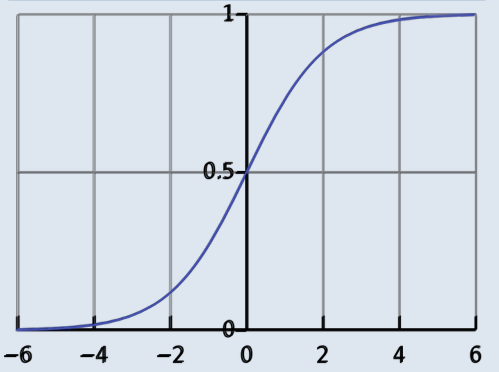
Weights matrix

8/9	0	0	0	8/9
0	8/9	0	8/9	0
0	0	8/9	0	0
0	8/9	0	8/9	0
8/9	0	0	0	8/9

- 4

-4

Logistic / Sigmoid



0.01798...

A Perceptron for X, tested on an O

Input

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

x

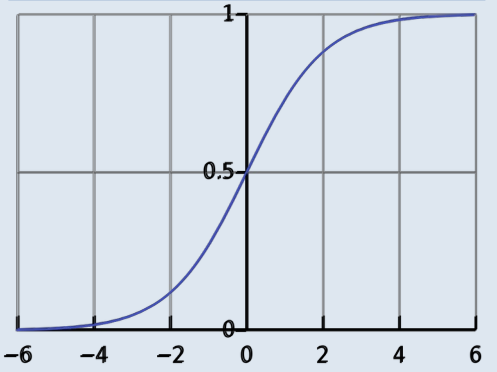
Weights matrix

8/9	0	0	0	8/9
0	8/9	0	8/9	0
0	0	8/9	0	0
0	8/9	0	8/9	0
8/9	0	0	0	8/9

- 4

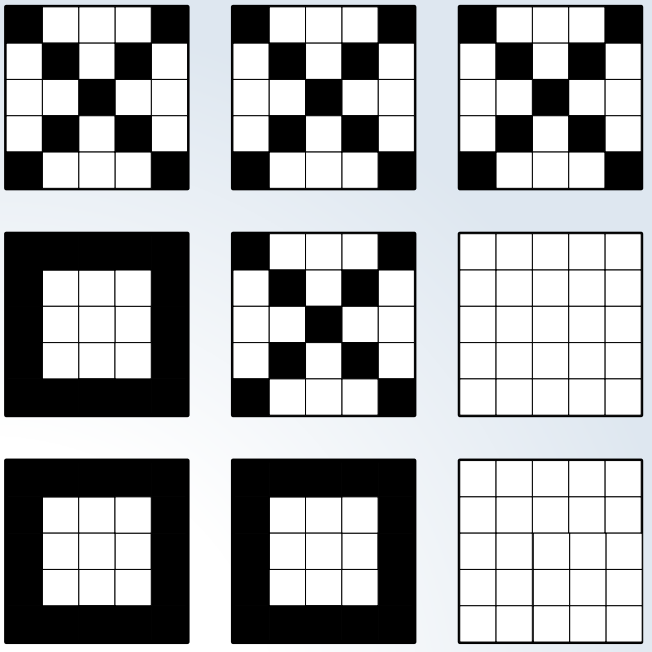
- 0.44...

Logistic / Sigmoid



0.39068...

1st Hidden Layer: Applying Perceptron across input

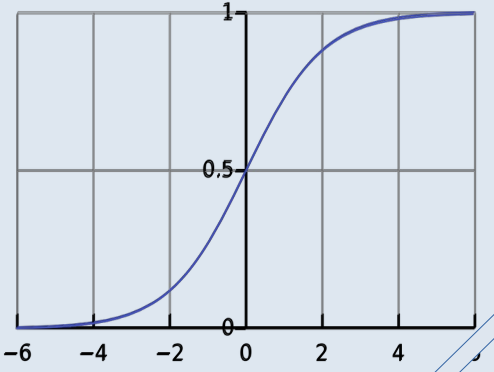


Weights matrix

8/9	0	0	0	8/9
0	8/9	0	8/9	0
0	0	8/9	0	0
0	8/9	0	8/9	0
8/9	0	0	0	8/9

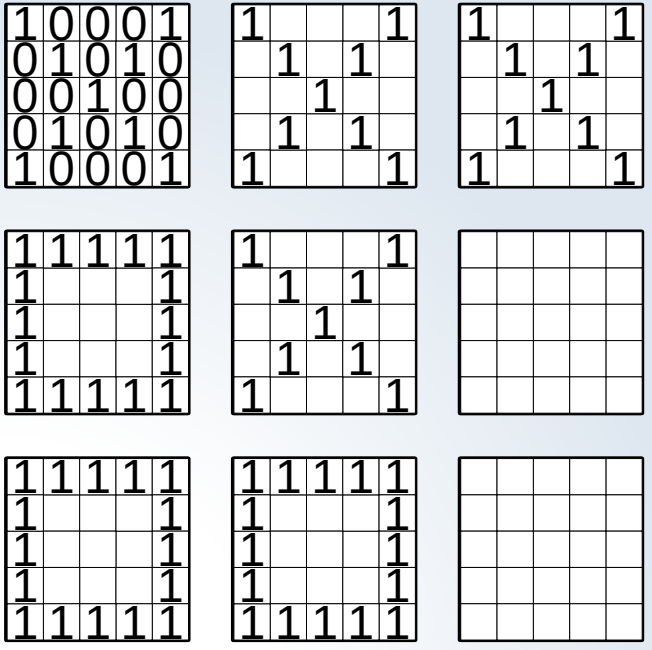
- 4

Logistic / Sigmoid



0.98	0.98	0.98
0.39	0.98	0.01
0.39	0.39	0.01

1st Hidden Layer: Applying Perceptron across input

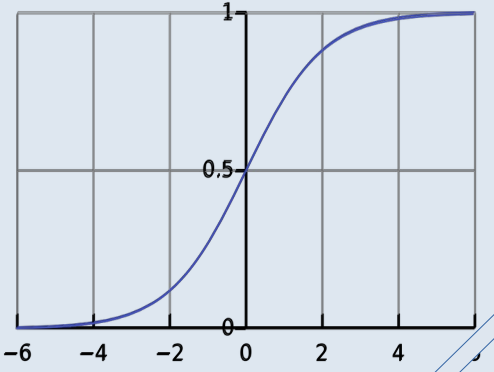


Weights matrix

8/9	0	0	0	8/9
0	8/9	0	8/9	0
0	0	8/9	0	0
0	8/9	0	8/9	0
8/9	0	0	0	8/9

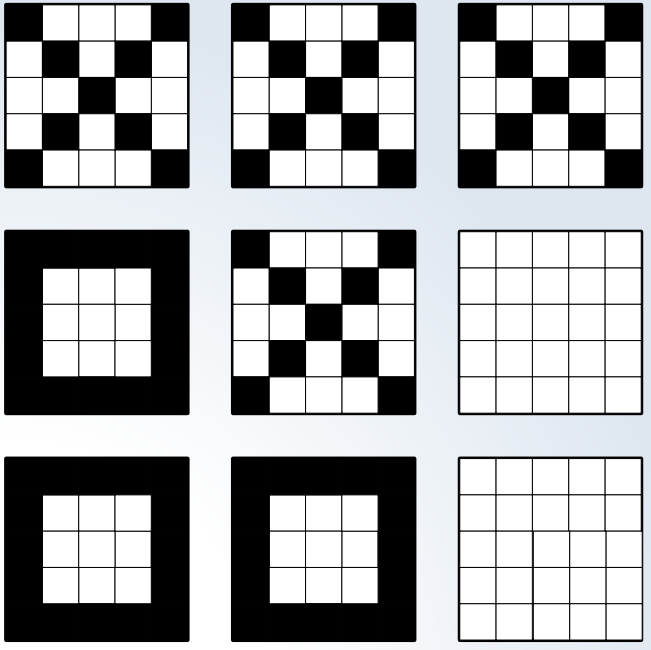
- 4

Logistic / Sigmoid



0.98	0.98	0.98
0.39	0.98	0.01
0.39	0.39	0.01

Overview of Model so far…

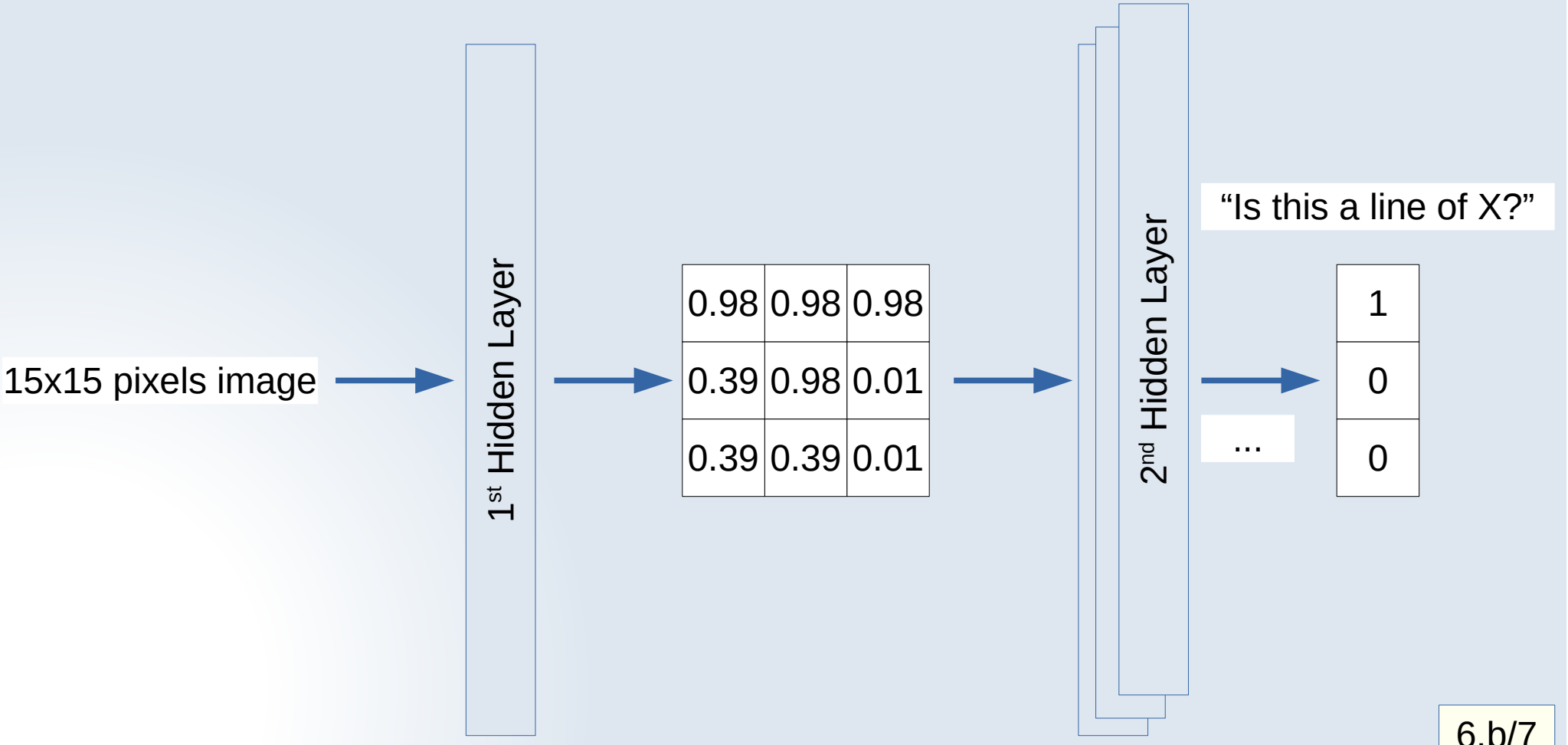


1st Hidden Layer

0.98	0.98	0.98
0.39	0.98	0.01
0.39	0.39	0.01

2nd Hidden Layer

… and Next Steps



Logical AND

Input

0.98	0.98	0.98
0.39	0.98	0.01
0.39	0.39	0.01

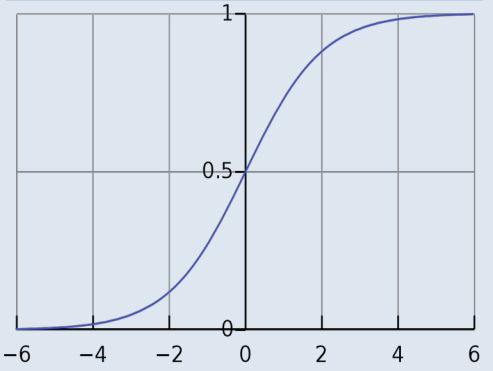
x

Weights matrix

0	0	0
0	0	0

+ Bias

Logistic / Sigmoid



Logical AND for a line of X (tested with a line of X)

Input

0.98	0.98	0.98
0.39	0.98	0.01
0.39	0.39	0.01

x

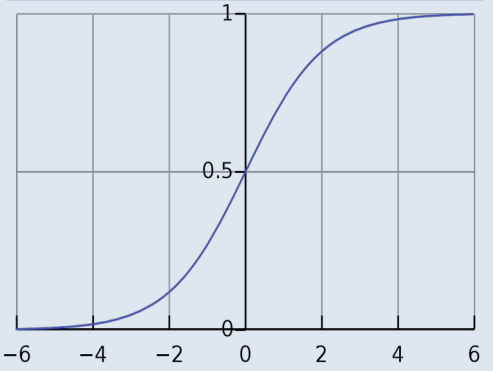
Weights matrix

5	5	5
0	0	0
0	0	0

- 12

2.7

Logistic / Sigmoid



0.9370...

Logical AND for a line of X (tested with not line of X)

Input

0.98	0.98	0.01
0.39	0.98	0.01
0.39	0.39	0.01

x

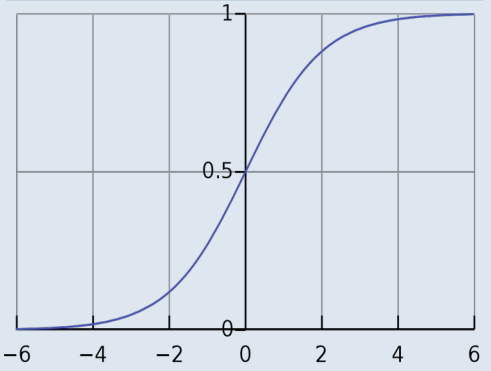
Weights matrix

5	5	5
0	0	0
0	0	0

- 12

-2.15

Logistic / Sigmoid



0.1043...

Logical AND for a line of X (Decision Boundary)

Input

0.8	0.8	0.8
0.39	0.98	0.01
0.39	0.39	0.01

x

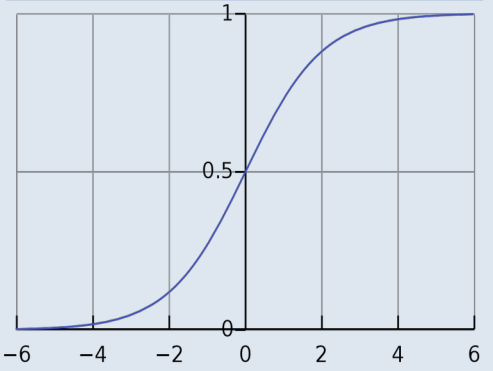
Weights matrix

5	5	5
0	0	0
0	0	0

- 12

0

Logistic / Sigmoid



0.5