From Fundamentals to Building Your Own Intelligent System

AI & MACHINE LEARNING BOOTCAMP 2025

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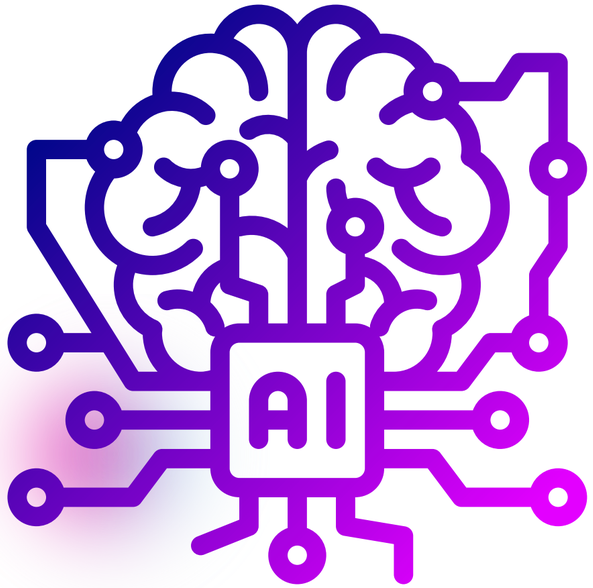


MACHINE LEARNING

CLASSIFIER

Credit: Sebastian Raschka

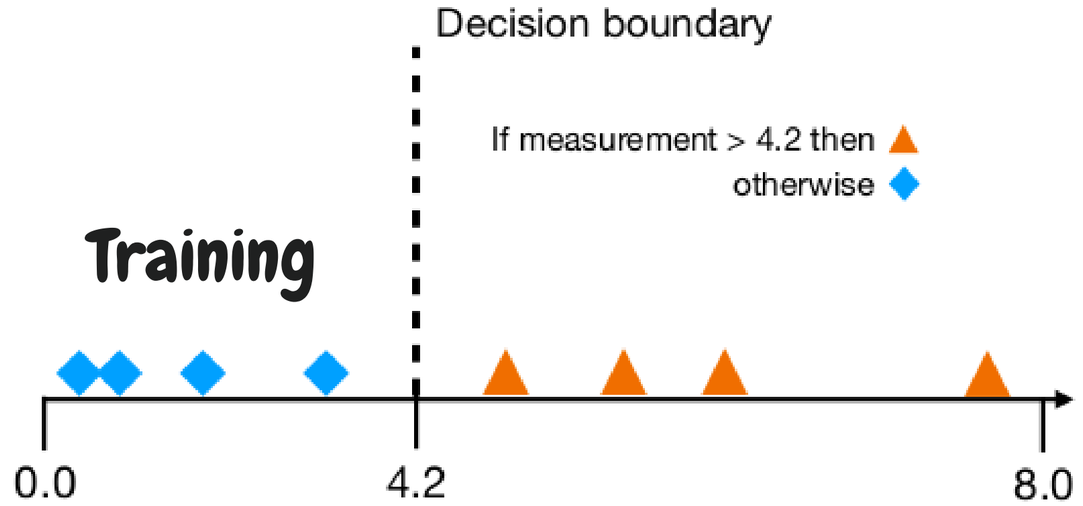
Binary Classification - with one feature variable

Inputs

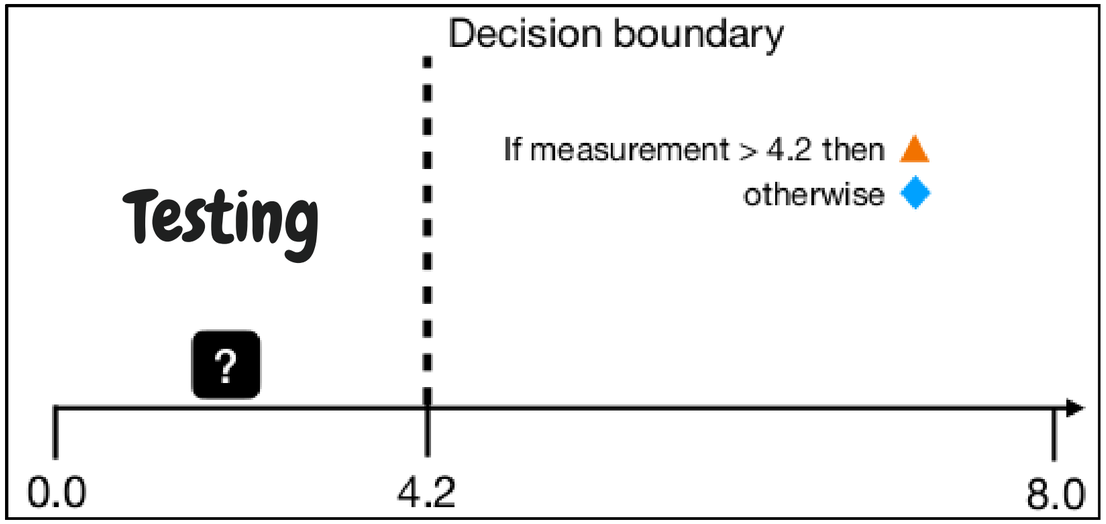
Measurement
1.4
1.1
5.1
6.2
9.9
2.2
3.3
7.2

Labels

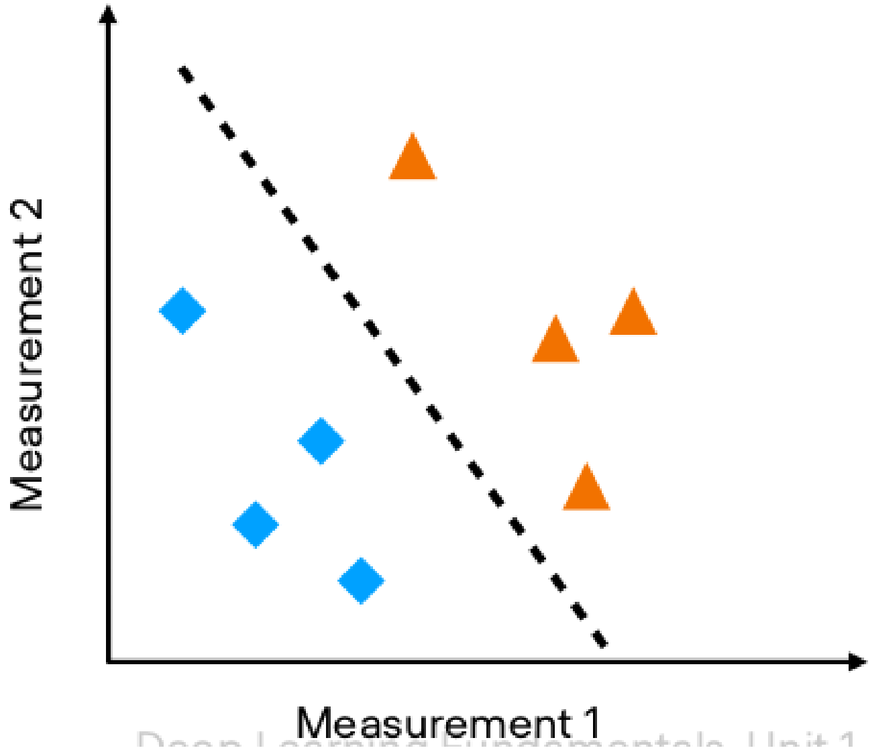
0
0
1
1
1
0
0
1

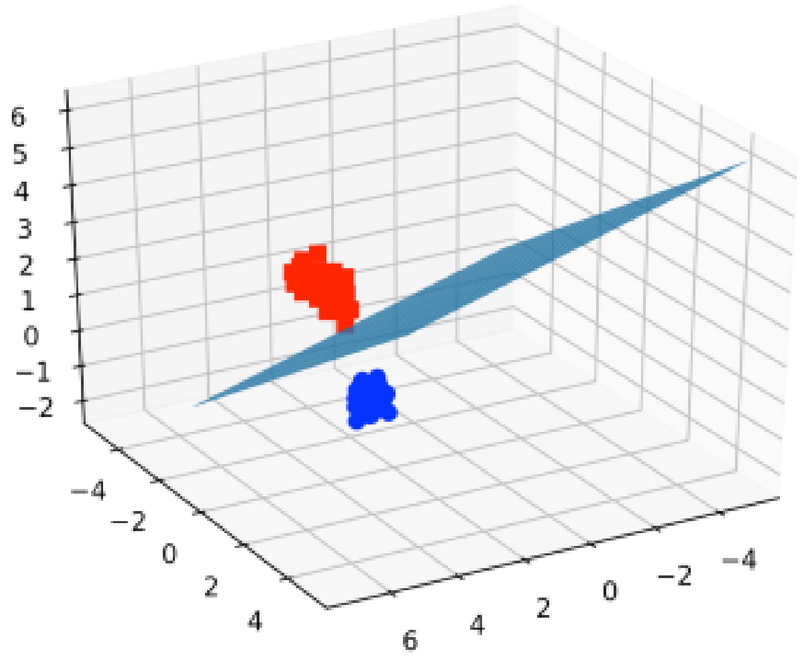


- Spam / not-Spam
- Cat or dog
- Loan approved or not

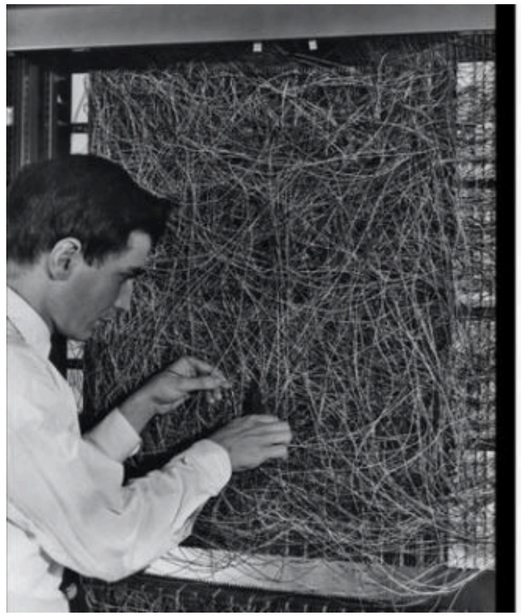


Binary Classification - with 2/3 feature variables





Perceptron - The earliest ML algorithm



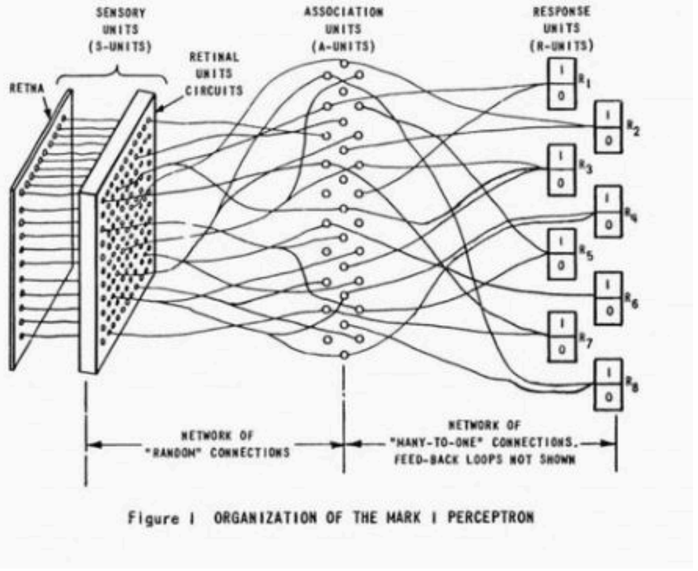
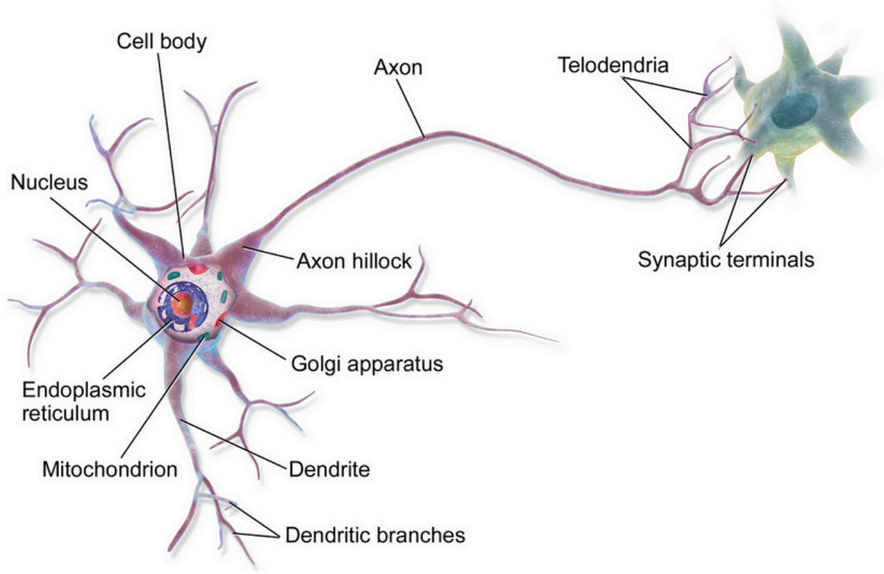


Figure 1 ORGANIZATION OF THE MARK I PERCEPTRON



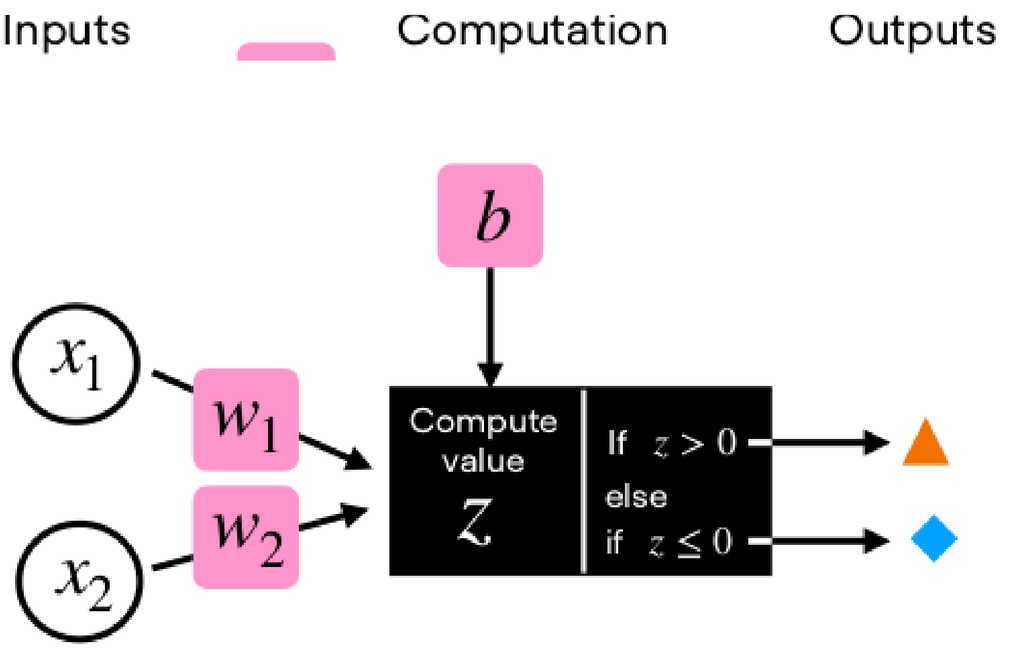
Inspired by human brain
(but not a copy)

Perceptron Structure

📊 Student Exam Classification Data

STUDENT	STUDY HOURS (X1)	PREP EXAMS (X2)	FINAL EXAM RESULT (Z)
Student 1	5	2	Fail
Student 2	7	6	Pass
Student 3	16	5	Pass
Student 4	14	2	Pass
Student 5	12	7	Pass
Student 6	7	4	Pass
Student 7	4	4	Pass
Student 8	19	2	Pass
Student 9	4	8	Fail
Student 10	8	4	Fail
Student 11	8	1	Fail
Student 12	3	3	Fail

AVG STUDY HOURS	AVG PREP EXAMS	PASS RATE	TOTAL STUDENTS
8.9	4.2	58%	12



$$x_1 \times w_1 + x_2 \times w_2 + b = z$$

Perceptron - Learning model parameters

1. Define training set

2. Initialize model weights and bias to zero

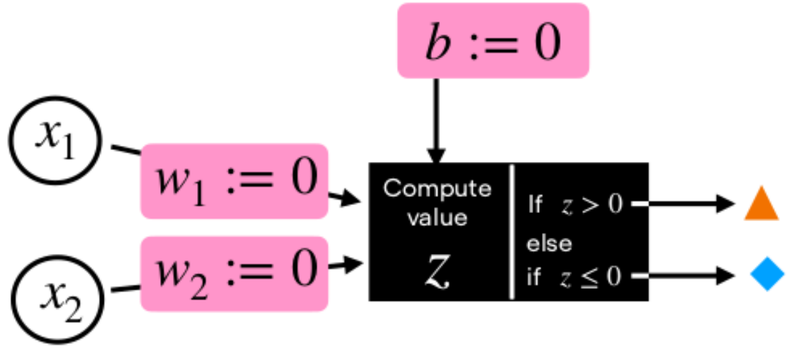
3. For every training epoch:

   a) For every training example $\langle \mathbf{x}^{[i]}, y^{[i]} \rangle \in \mathcal{D}$:

   (i) Make a prediction

   (ii) Compute the error

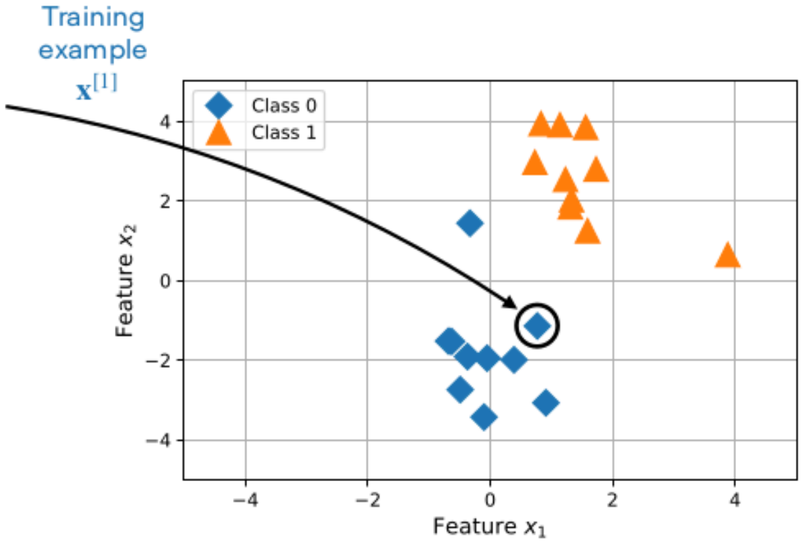
   (iii) Update the weights based on the error



$$x_1 \times 0 + x_2 \times 0 + 0 = 0$$

x_1	x_2
0.77	1.14
-0.33	1.44
0.91	-3.07
-0.37	-1.91
-0.63	-1.53
0.39	-1.99
...	...
1.33	2.03

y
0
0
0
0
0
0
...
1



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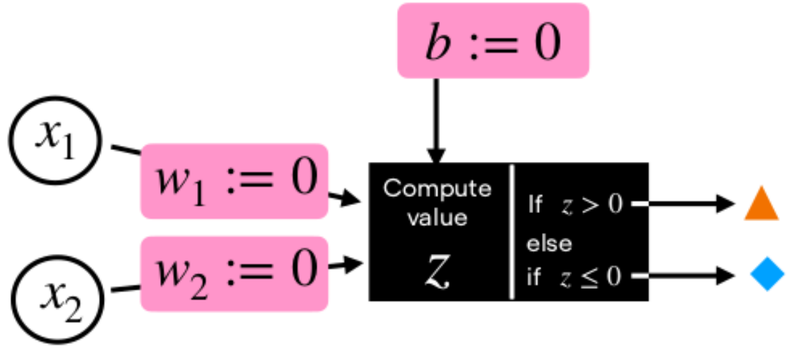
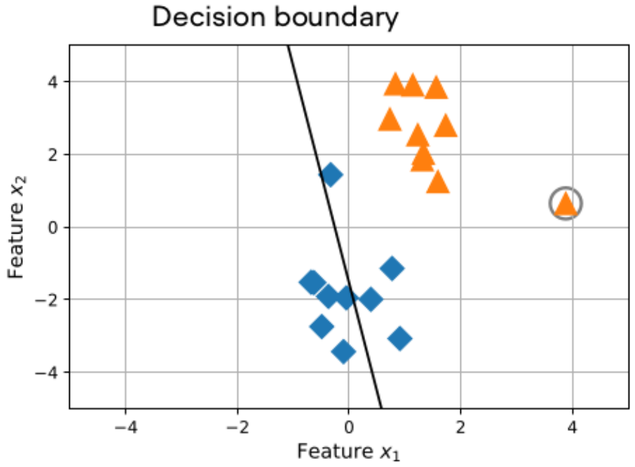
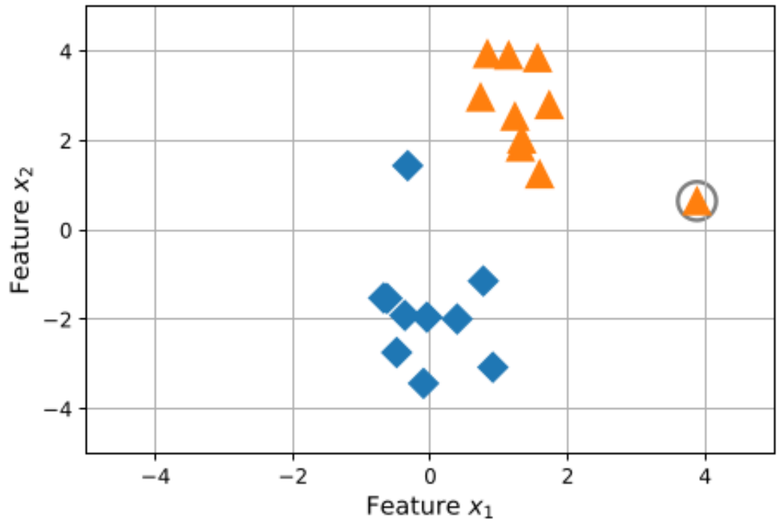


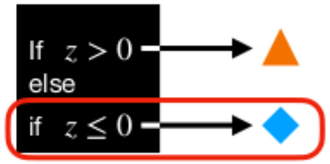
$$x_1 \times 0 + x_2 \times 0 + 0 = 0$$

Initial Result





$z = 0$



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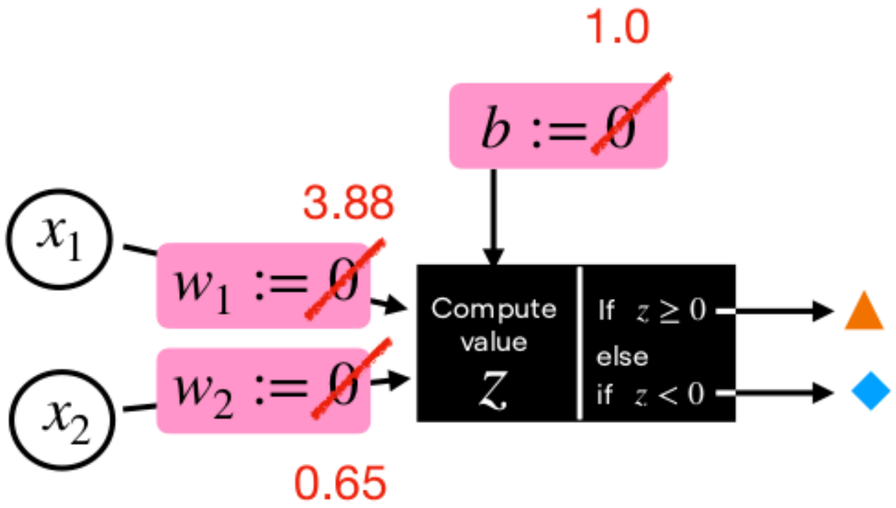

End Result