Basic Machine Learning Methods: Part 1

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Outline

- Definitions & Terminology
- Linear Regression
- K Nearest Neighbors Classification
- Perceptron Method Classification

Definitions & Terminology

- **Machine learning is automatic programming.**

- **Machine learning programs automatically create other programs!**

Definitions & Terminology

- Machine learning is useful when creating programs is inconvenient, impractical or impossible for humans.

- Humans programmers have speed and complexity limitations.

Definitions & Terminology

- **Supervised learning is automatic programming of mathematical functions.**

- **Can be vector, matrix and tensor functions.**

Definitions & Terminology

- Requires input output pairs to “train” or “learn” a “model”.

Definitions & Terminology

- **Regression implies continuous mathematical functions.**
- **Can draw plots without lifting your pencil.**
- **Examples include linear and cosine functions.**

Definitions & Terminology

- **Classification implies piecewise constant mathematical functions.**

- **Imagine staircase plots.**

- **Examples include rounding and sign functions.**

Linear Regression

- **Automatically programs linear functions.**

- **Can be linear functions of multiple input and output variables!**

K Nearest Neighbors Classification

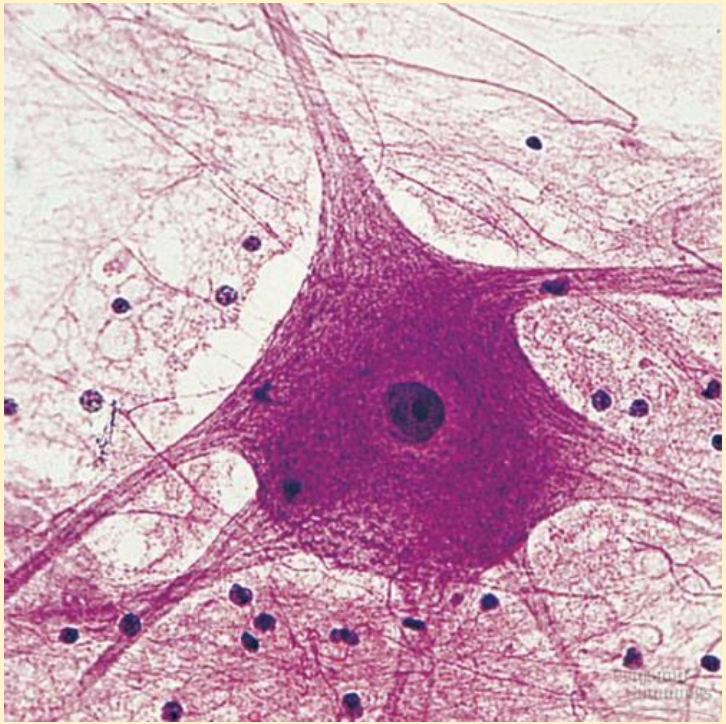
- Simply finds the most similar elements!

- Easy to understand but has performance issues with large datasets.

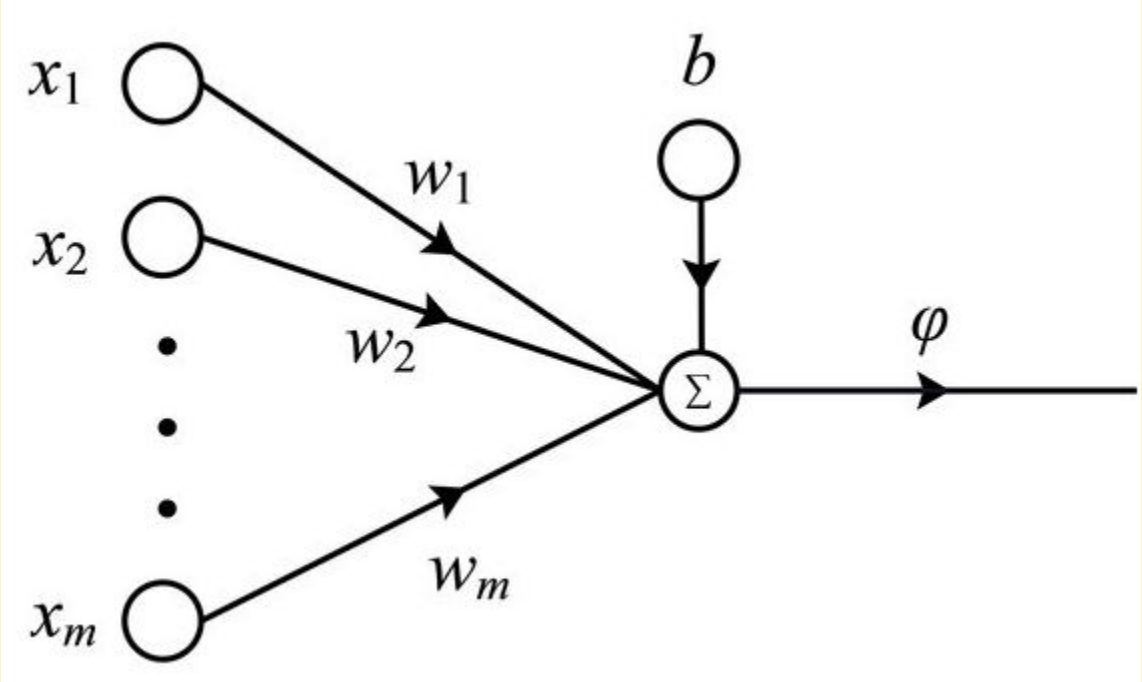
Perceptron Method Classification

- linear classification method
- Corresponds to an idealized neuron.
- Foundation of artificial neural networks!

Perceptron Method Classification



Perceptron Method Classification



Perceptron Method Classification

- Perceptrons have weights and biases.
- Find the sign of $w_1 i_1 + w_2 i_2 + w_3 i_3 + \ldots + b$.

Perceptron Method Classification

- The algorithm finds weights and biases based on given data.

Perceptron Method Classification

- Imagine having to descend a mountain in the dark with a small flashlight.

- The mountain may have ridges, valleys and trees.

Perceptron Method Classification

- For every input output pair (i, o), we determine $l(o - P)$ where l is the “learning rate” and P is the output of the perceptron.

Perceptron Method Classification

I	*o*	*P*	*I(o - P)*
0.01	1	1	0
0.01	1	0	0.01
0.01	0	1	-0.01
0.01	0	0	0

Perceptron Method Classification

- The *l(o - P)i* vector will be added to the weights vector.

- *l(o - P)* will be added to the bias.