

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!

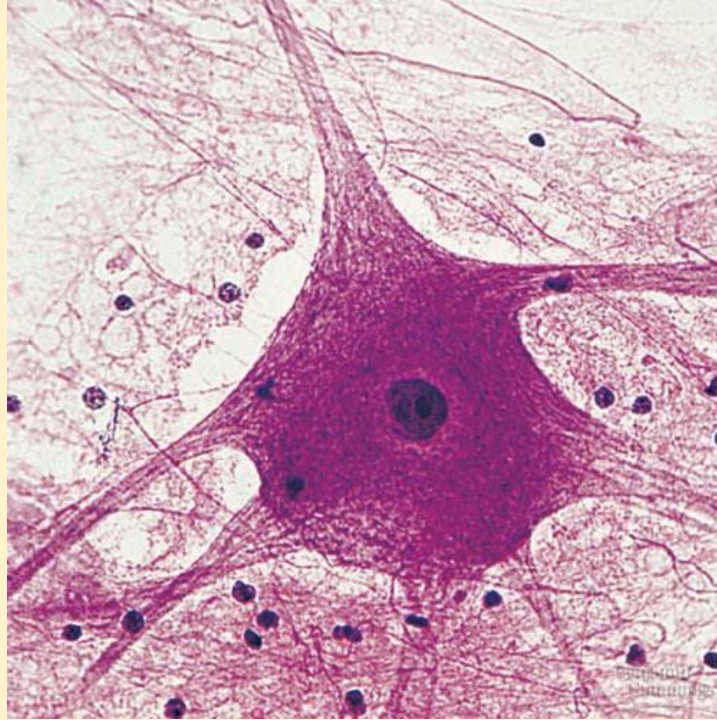
K Nearest Neighbors Classification

- Simply finds the most similar elements!
- Easy to understand but has performance issues with large datasets.

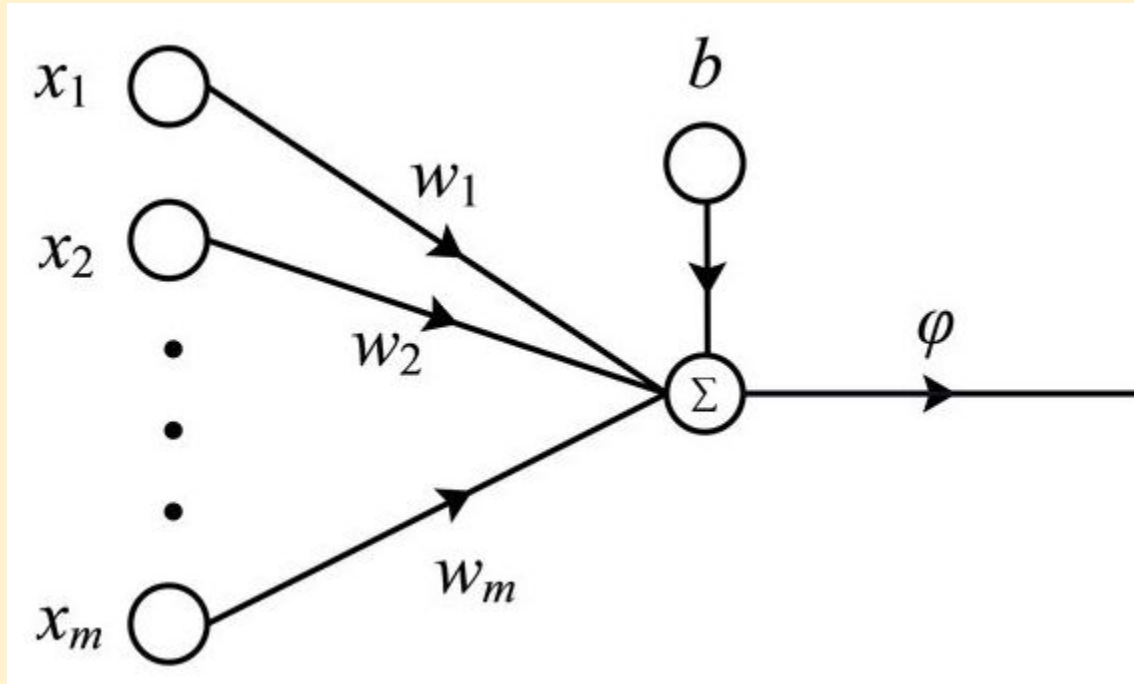
Perceptron Method Classification

- 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 $w_1 i_1 + w_2 i_2 + w_3 i_3 + \dots + b$.

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>I</i>	<i>o</i>	<i>P</i>	<i>$I(o - P)$</i>
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.