Foundations of Machine Learning

Neural Networks

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References

- Pattern Recognition and Machine Learning by Christopher Bishop

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- https://eduassistpro.github.i
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The Human Brain

- Highly complex, non-linear, and parallel "computer"
- Structural constituents: neurons
- The structure of the brain is extremely complex and not fully understood
-
-
- the artificial neural network (ANN)
- The human brain is the inspiration for ANNs t
  cannot say ANNs actually replicate the bra
  well, they are extremely simplified
- Great video about the brain
  `https://www.youtube.com/watch?v=nvXuq9jRWKE`

biological neuron

artificial neuron

History of Neural Networks: McCulloch-Pitts Model

- 1943 McCulloch and Pitts introduced the first model of an extremely simple artificial neuron.
- The inputs and outputs could be either a zero or a one.
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- transmitted (output of 1) or not (output of 0)
- The McCulloch-Pitts model lacked a mec
which was crucial for it to be usable for AI.
- Link to the Original Paper `https://link.springer.com/article/10.1007%2FBF02478259`

History of the Perceptron

- 1957 Rosenblatt introduced the perceptron which was an electronic device constructed using biological principles and

- 1969 Marvin Minsky and Seymour Papert published the book "Perceptrons" which proved some limit perceptron (that linear functions cannot ones) having a big effect on the community.

History of the Perceptron

- Initially the perceptron seemed promising, but it was quickly shown that perceptrons could not be used to classify many classes of patterns.
-

  far greater power.
- The popularity of neural networks resurg
- Today deep learning is state of the art for man

  in machine learning.

The Perceptron

Source: http://www.andreykurenkov.com/writing/ai/a-brief-history-of-neural-nets-and-deep-learning/

The Perceptron Algorithm

Begin Initialize

Set all of the weights w_i to small random numbers

Training

For T iterations (or until the convergence criteria is met):

$$y_j = f\left(\sum_{i=0}^{m} w_i x_{ij}\right) = \begin{cases} 1 & \text{if } w\,x > 0 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

Update each weight as follows:

$$w_i \leftarrow w_i - \eta(y_j - t_j) \cdot x_{ij} \tag{2}$$

Example

- Solve the logical AND function using the perceptron algorithm.

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  - Given $b = 1, w_1 = 0, w_2 = 0, \eta = 0.1$, find a solution

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