

Neural Network: A Story Less Known

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What to expect ?

The story of WHY, HOW and WHEN

Why are we here?

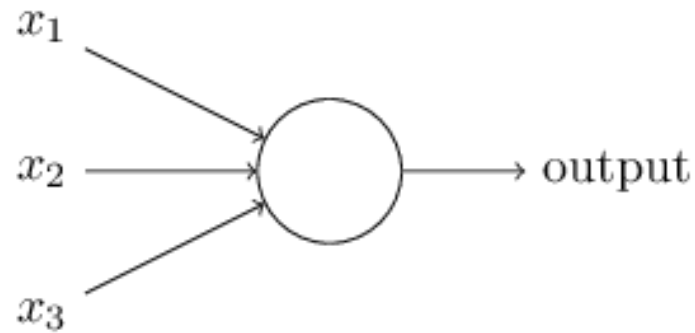
- The credit of we sitting here together goes to Dr. Allan Turing whom I guess everyone knows for the obvious movie “Imitation Game”
- But the exact reason of we sitting here together is his paper “Computing Machinery and Intelligence”.
- If anyone interested here to talk about the philosophical and technical view point of artificial intelligence, I can talk for a day.

Who are we? How are we different?

- Machine Learning is AI people doing data analysis.
- Data Mining is database people doing data analysis.
- Applied Statistics is statisticians doing data analysis Infographics is Graphic Designers doing data analysis.
- Data Journalism is Journalists doing data analysis.
- Econometrics is Economists doing data analysis (and here you can win a Nobel Prize).
- Psychometrics is Psychologists doing data analysis.
- Chemometrics are Chemists doing data analysis.
- Bioinformatics is Biologists doing data analysis.

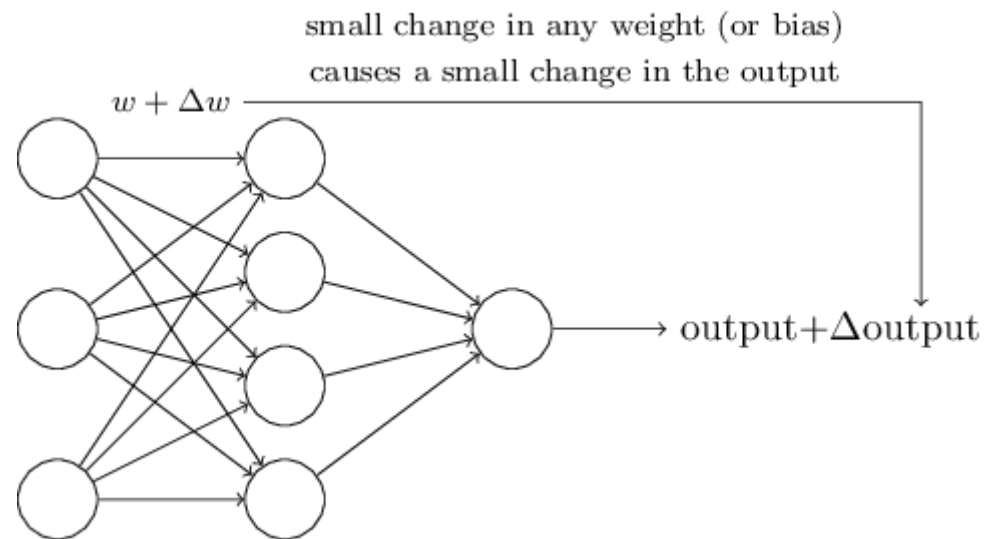
The story of Neural Network

- Warren McCulloch and Walter Pitts are credited with designing neural network for first time. It was called perceptron. We created a new type of logic gate.

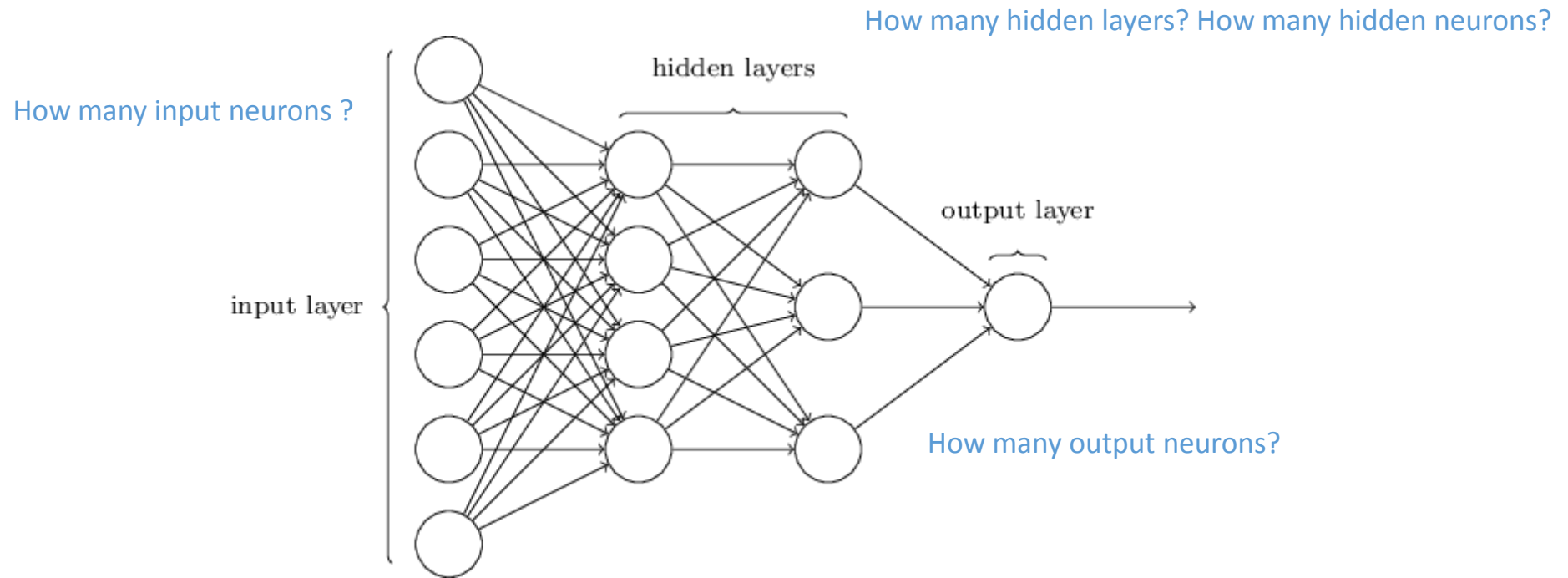


Why there was a need for activation function?

- We needed to automate the change in weight so that, it would configurable itself to give expected output.
- It can be any smooth function



Why are our hands not free when talking of topology?



Why we needed cost function?

- We needed to find the appropriate weights. So we needed kind of god who would decide which weight is ok.
- Cost function plays god in neural network.

Why we used MSE for cost function?

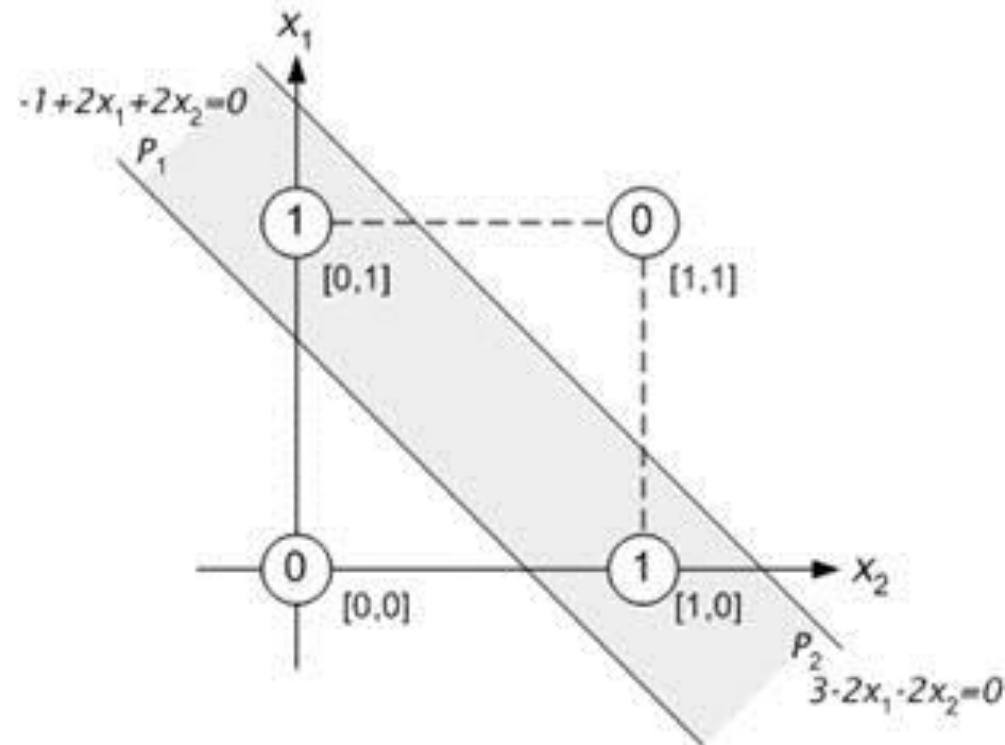
- If you are working for let say image recognition, so the most obvious cost function would be correct number of output.
- Because it is not a function of weights and inputs. Any change in number correct output wont say anything about weights and biases.

Why we used gradient descent for minimizing MSE ?

- When we talk of minimizing , the obvious thing that comes to mind is calculus ?
- Gradient descent is an iterative algorithm which is actually hill climbing in reverse.

Is the multi-layer NN so hard to visualize ?

This is why mathematicians hate it.



When to use feed-forward and recurrent network?

- If the data is temporally independent, use feed-forward.
- If the data is a time-series problem like predicting weather, predicting fuel requirement use recurrent.

Why back-propagation is important?

- Consider a case, cost function would have been function of weight alone. So the approximation would have been something like :

$$\frac{\partial C}{\partial w_j} \approx \frac{C(w + \epsilon e_j) - C(w)}{\epsilon}$$

So in order to calculate one weight, we would have to calculate all other weights. BP is a clever way of restricting the dependency of previous layer. So of time complexity of network is $O(f)$, then BP would be $O(2f) \approx O(f)$

Neural Network as a classifier ?

- It is considered best for complex classification because of its ability to map complex relationships.
- Image classification is probably the most difficult classification because alone, pixel formation after feature extraction doesn't mean anything.

Neural Network as Image classifier

- Image segmentation
- Feature Detection
- Feature Extraction
- Feature Normalization
- Network Initialization
- Training
- Validation
- Testing
- Simple Example in Matlab

Why Neural Network is important?

- It can approximate any continuous function.
- It is a big claim and here at the link is a prove of it.

<http://neuralnetworksanddeeplearning.com/chap4.html>

Where are we heading?

- What's in future nobody knows. But the future of neural network seems pretty promising.
- Deep Neural Network and Hierarchical temporal model.
- Evolvable hardware (parallel and interconnect network)

Deep Learning and HTM

- What's in future nobody knows. But the future of neural network seems pretty promising.
- Three big giants in AI (IBM, Google and Numenta) are believing the same thing which is an extension of neural network)

