

Neural Networks and Source Extractor

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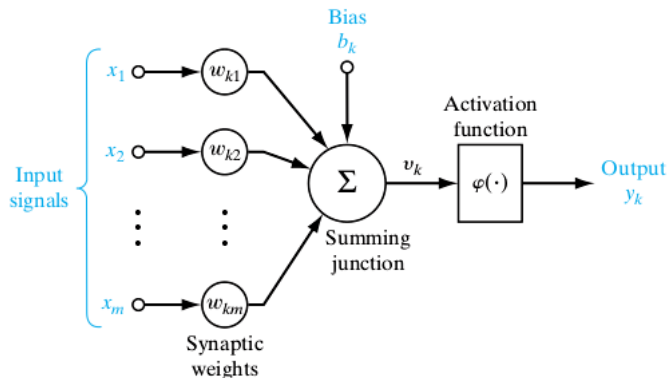
November 5, 2015

Introduction

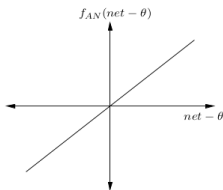
- Started off in 1940s.
- Gained popularity in 1980s because of advances in computer hardware.
- Artificial Neural Networks(NN) are based on biological NN model.
- Artificial NN have some sort of associated learning rule.

Basic Structure

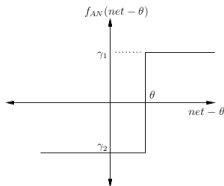
- Artificial Neuron Model



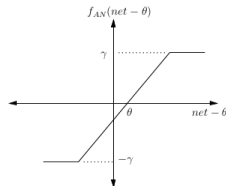
• Activation Functions



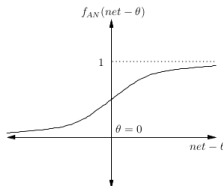
(a) Linear function



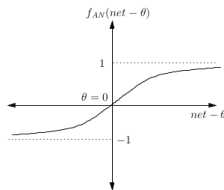
(b) Step function



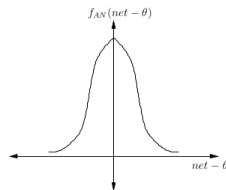
(c) Ramp function



(d) Sigmoid function



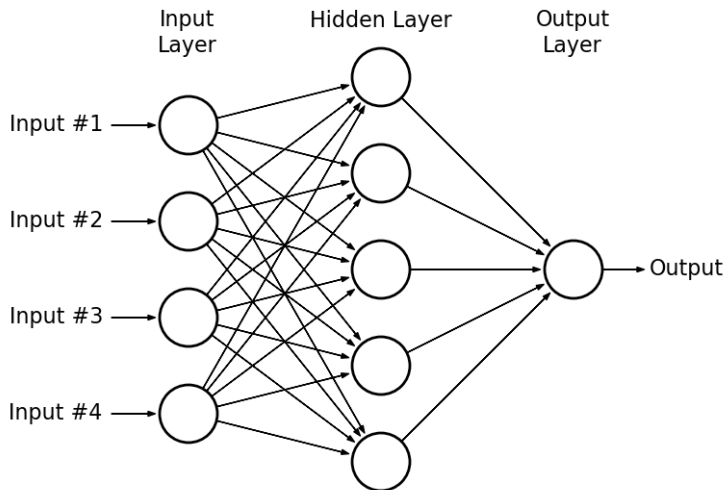
(e) Hyperbolic tangent function



(f) Gaussian function

Basic Structure

- Artificial NN



Applications of NN

- Classification
- Recognition (Speech, Handwritten characters)
- Function Approximation

How Neural Networks Work?

- A simple example: Learning an AND gate.

How to train your Neural Network?

- Use Gradient Descent.

$$E(\vec{w}) = \sum_{d \in D} (t_d - O_d)^2$$

where,

$$O_d = \phi(\vec{w} \cdot \vec{x}_d)$$

- For every training sample update the weights according to the following rule:

$$\Delta w = -\eta \nabla E[\vec{w}]$$

and η is your learning rate.

Deep Neural Networks!

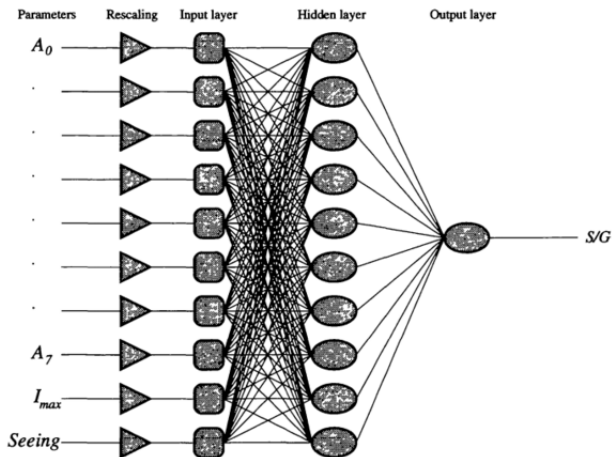
- Now, we can have a bunch of neurons feeding to a bunch of other neurons and so on.
- The layers between the input and the output nodes are called Hidden Layers.
- Artificial NN with multiple hidden layers are called Deep Neural Networks.

Image Recognition

- Problem Statement : Classify objects into stars and galaxies
- First Step : Extract features from the images (i.e. \vec{x}_d)
 - Should be invariant under translation and rotation
 - Robust against noise, image distortion, and influence from nearby objects
 - Should efficiently classify!
- Parameters that fulfil these conditions are the Isophotal Areas.

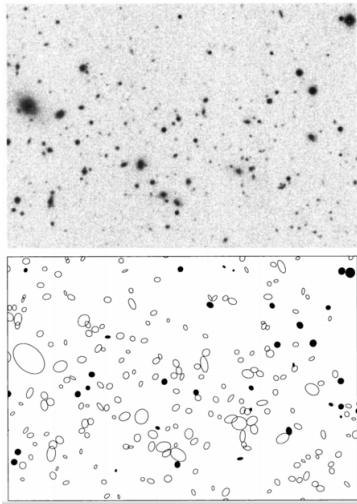
- Input :
 1. 8 Isophotal Areas A_0, A_1, \dots, A_7 . Works better for dim objects, bright stars, and deblended images.
 2. I_{max}
 3. 1 control parameter Seeing
- Total 10 input parameters

Source Extractor



- The output of the classifier NN gives a confidence
- The NN for the Source Extractor was trained with 10^6 Images. It took around 15 mins. to train the network.
- The trained NN is now used in a feed-forward manner to classify the objects in the image.

Source Extractor



The End