Artificial Neuronal Networks

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Decision and Policy Analysis
Centro Internacional de Agricultura Tropical

Data analysis course, 2018

Outline

Overview of ANN

The ANN starts with ecologist in 1985. They work in the same way as the animal brain and learn from experience in a way that no conventional computer can.

- optimization
- auto - associative memory
- generalization
- data reduction
- control and reduction task

Overview of ANN

Uses:

- speech recognition
- image recognition
- chemical research
- medicine and molecular biology
- agriculture

Back Propagation Neuronal Network

It is a supervised procedure. Also called feed - forward neuronal networks or multiplayer preceptron. It allows one to predict an output object for a given input object.

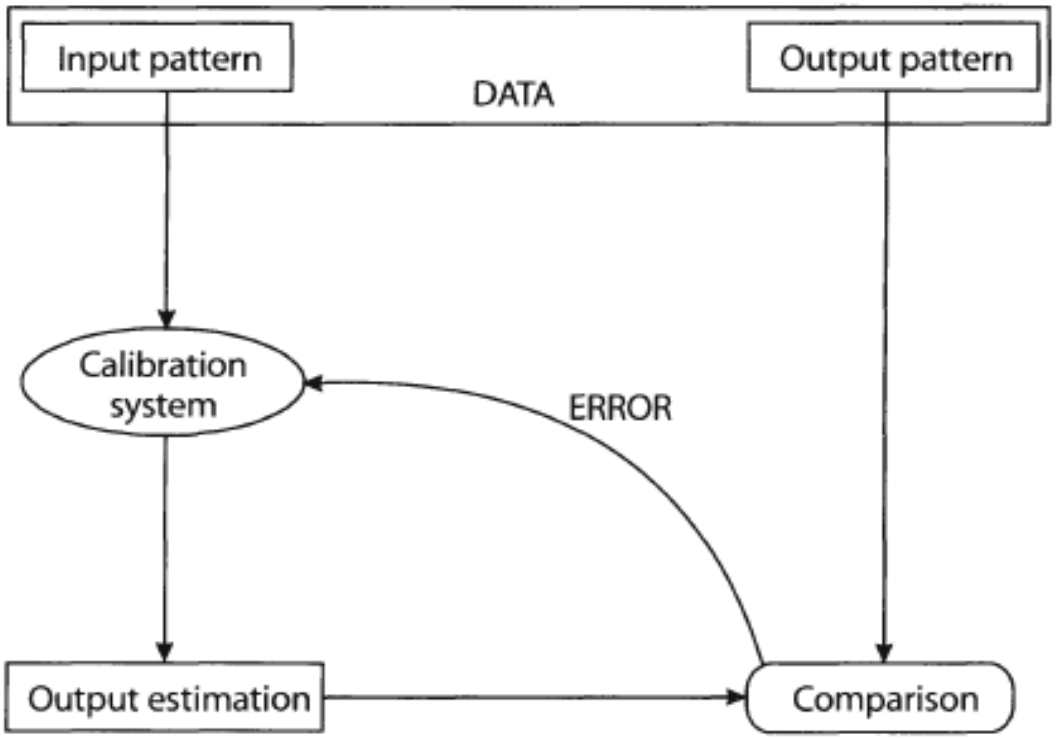


Figure: How data are used to establish the model calibration in the supervised modelling

Back Propagation Neuronal Network

Structure of BNP

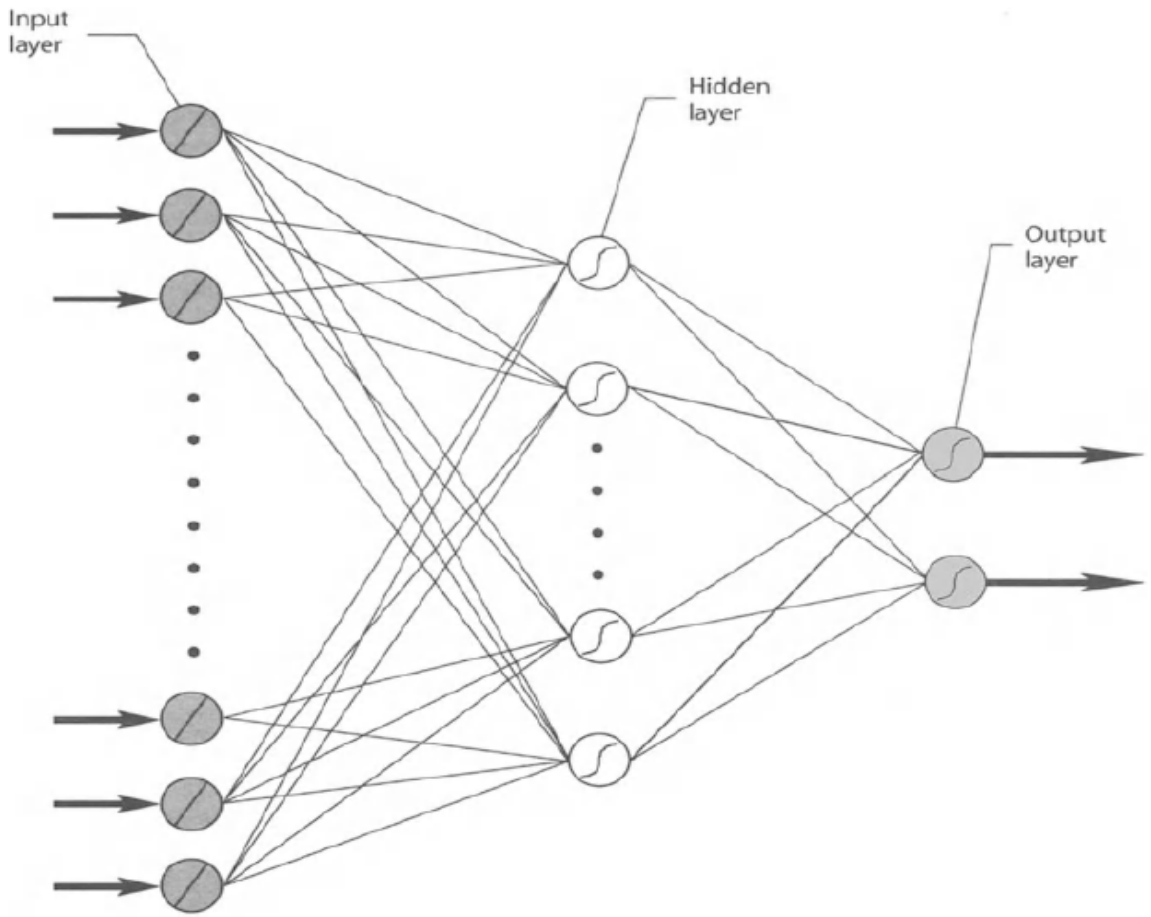


Figure: Three- layered feed forward neuronal network, with one input layer, one hidden layer, one output layer

Back Propagation Neuronal Network

BPN Algorithm

If the network gives the wrong answer then the weights are corrected so future responses of the network are more likely to be correct.

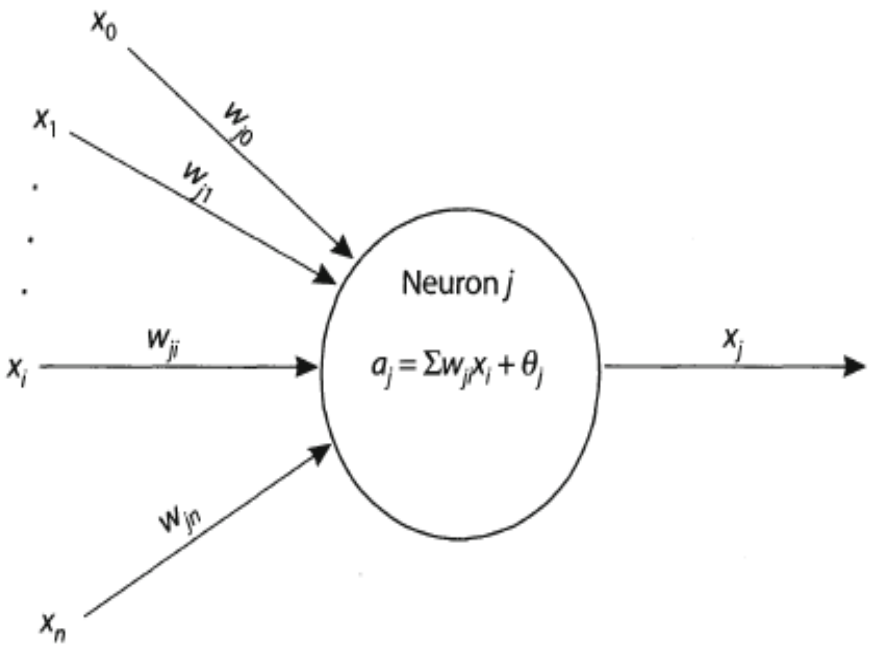


Figure: Basic processing element neuron in a network. Each input connection value x_i is associated with a weight w_{ji}

Back Propagation Neuronal Network

Transfer functions

a_i net input (activation)

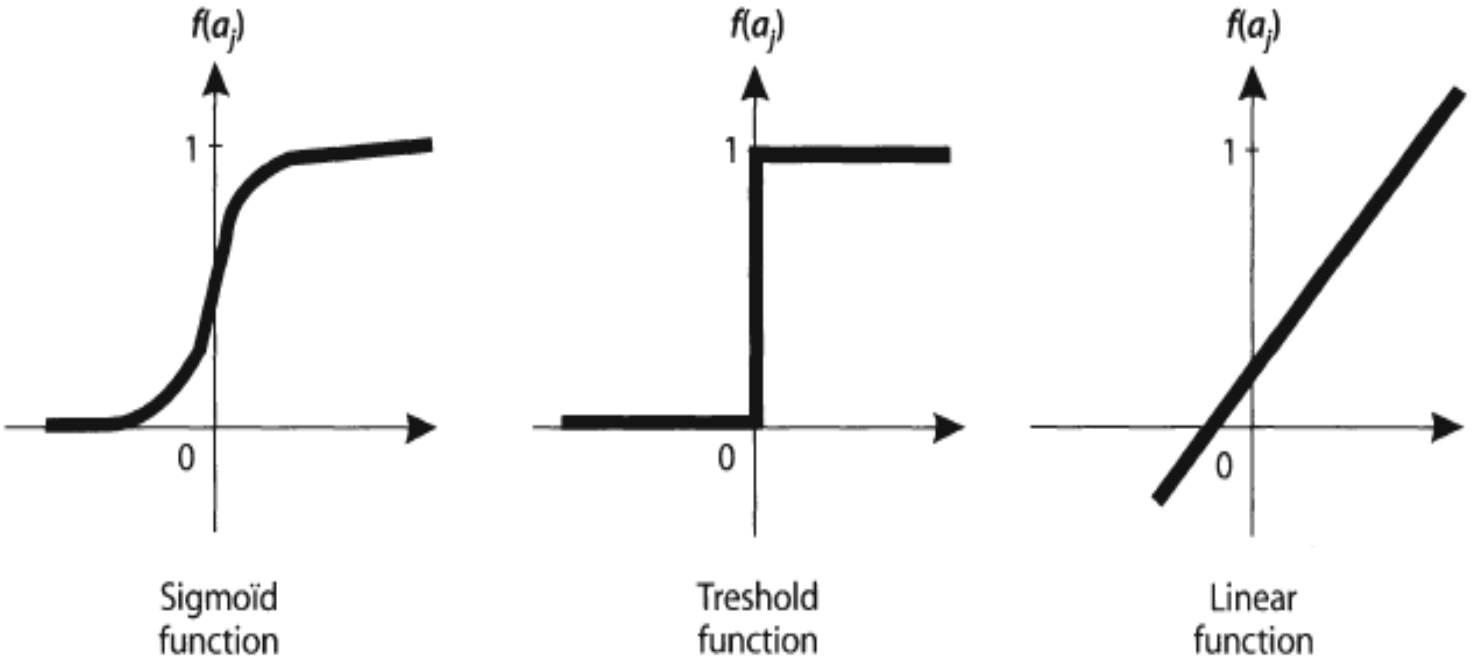


Figure: types of transfer functions

Neuron's Example

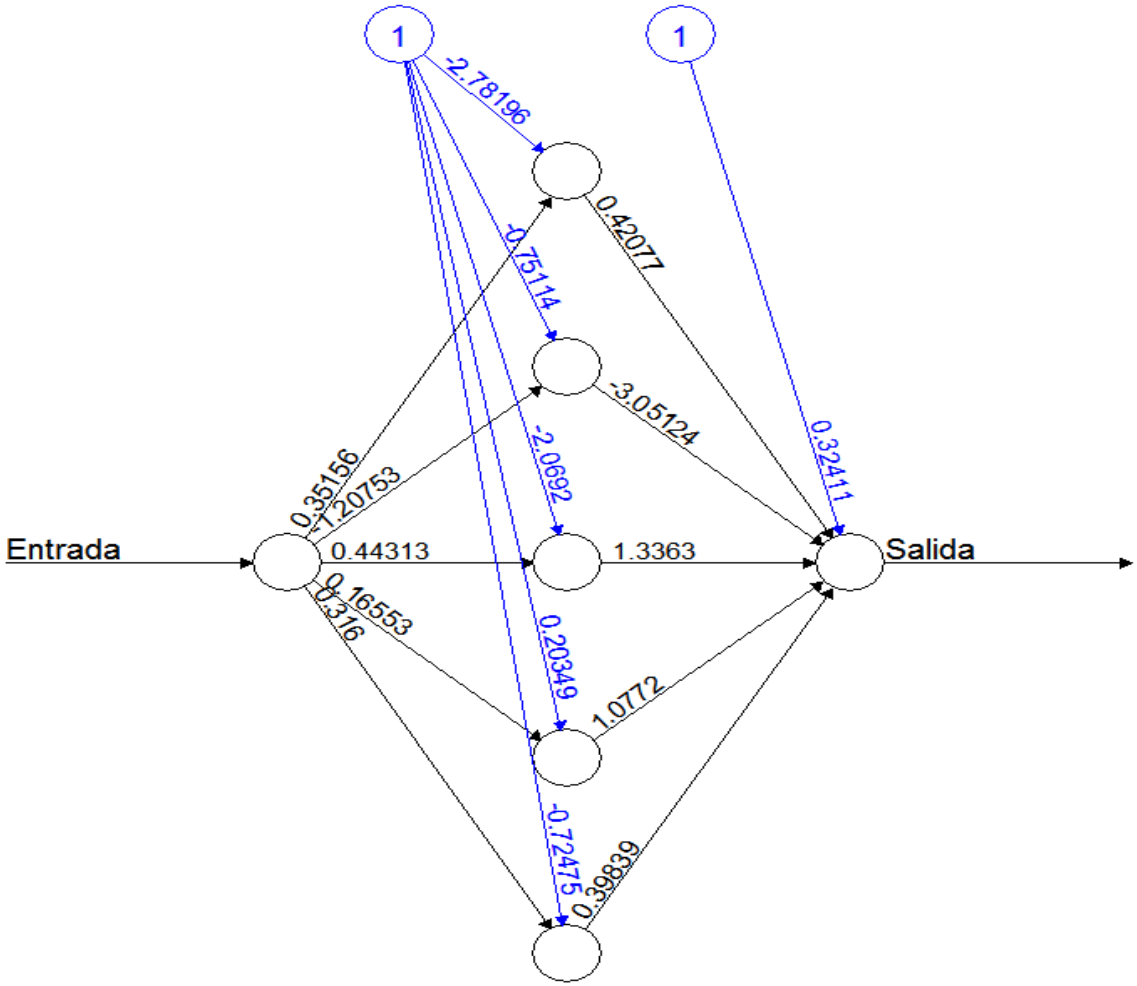
Suppose that you want to go to cinema.

Is the weather good?	$x_1 = 0$	$x_1 = 1$	$w_1 = 6$
Does your friend want to accompany you?	$x_2 = 0$	$x_2 = 1$	$w_2 = 2$
Is the festival near public transit?	$x_3 = 0$	$x_3 = 1$	$w_3 = 2$

By varying the **weights** and **threhold**, we can get different models of decision - making.

Case of study

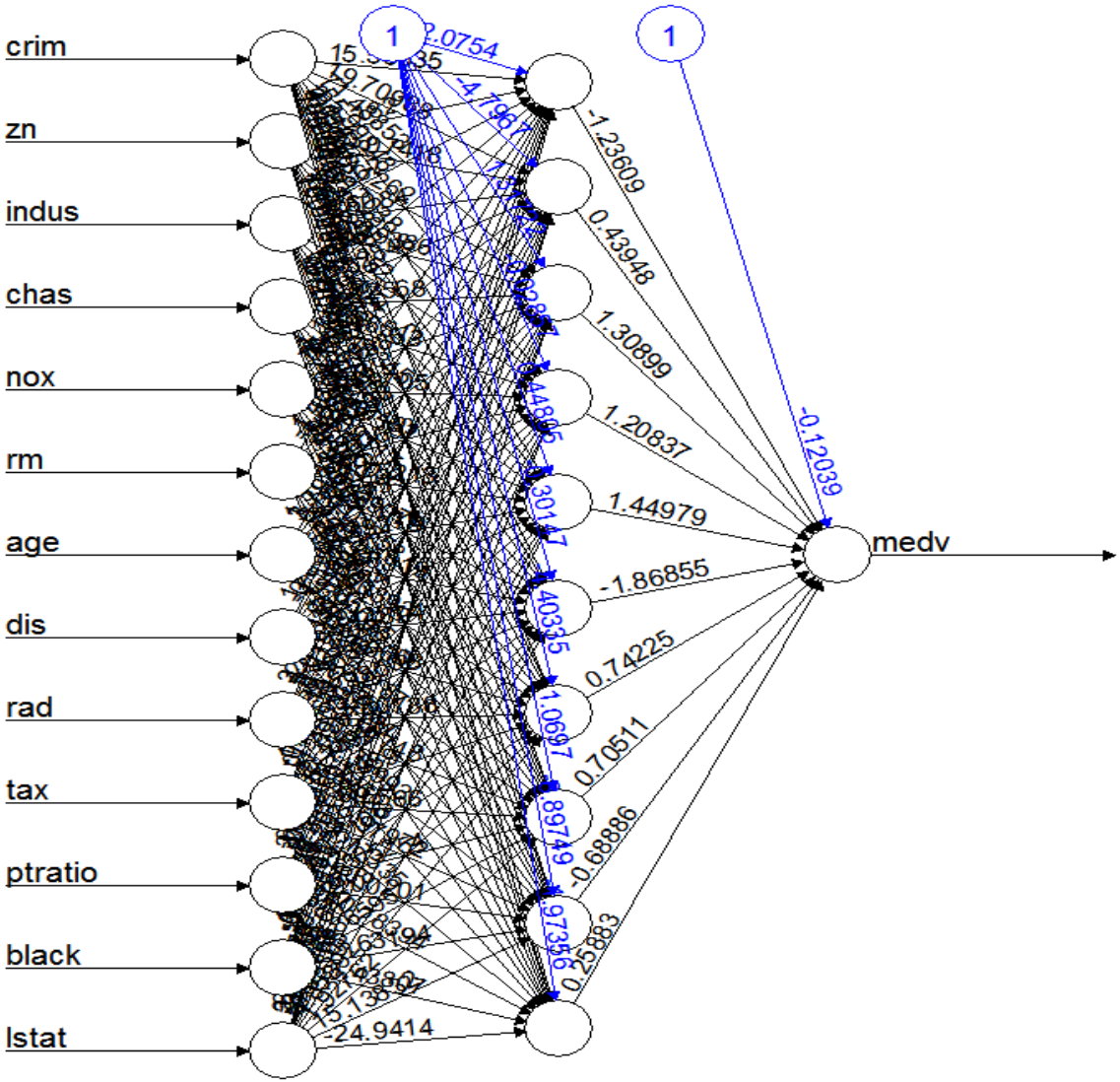
The square root



Error: 0.00171 Steps: 121

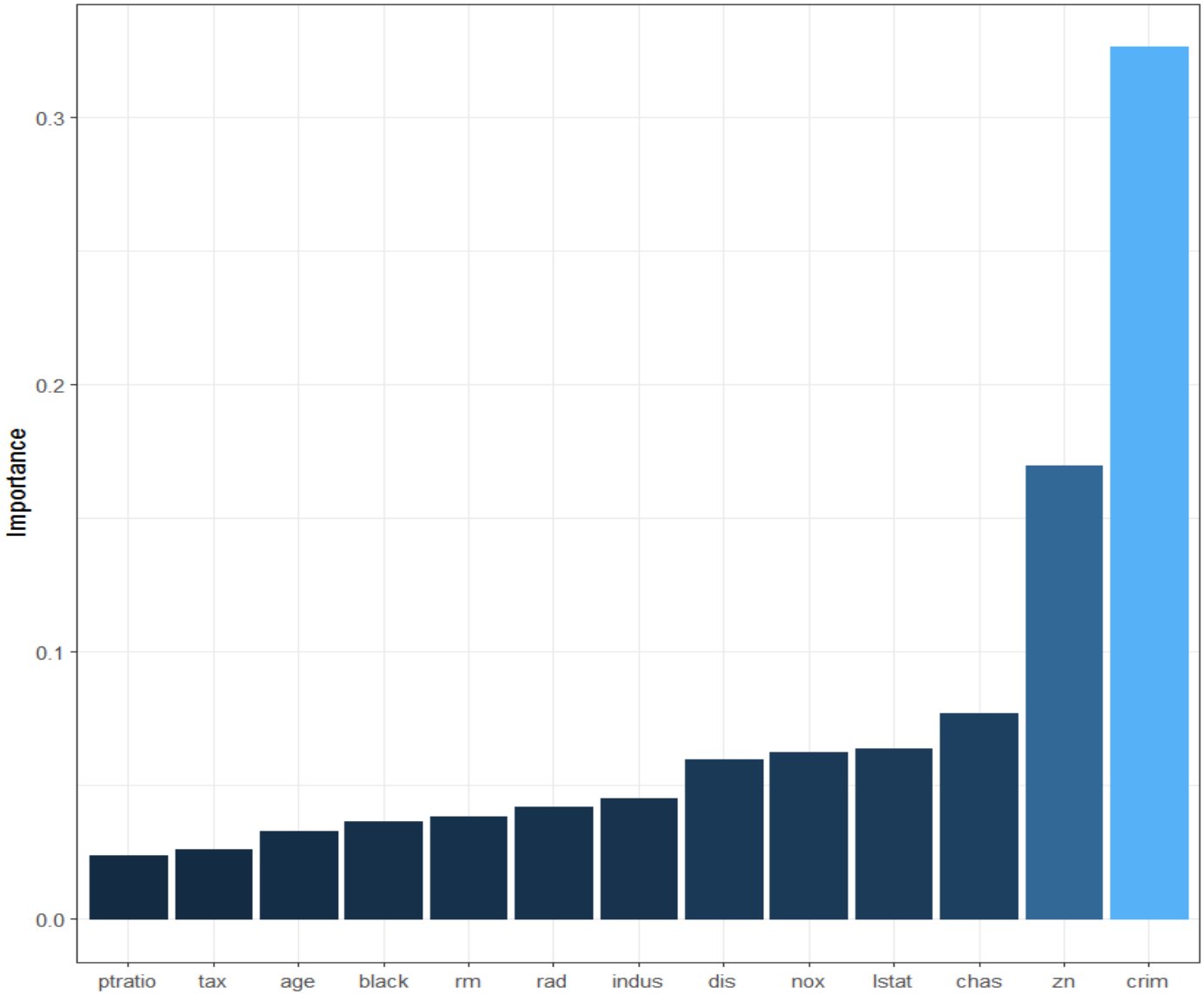
Case of study

Boston



Case of study

Boston



Pros vs Cons

Pros

- Regression and classification
- ANN are good to model with nonlinear data and large number of inputs.
- Once trained, the predictions are fast
- ANN work best with more data points

Cons

- ANN are block boxes. How much each independent variable is influencing the dependent variables.
- It is computationally very expensive
- ANN depend a lot on training data. Overfitting and generalization.

For Further Reading I


Pierre Lafaye de Micheaux.
The R Software,
Fundamentals of programming and statistical analysis
Springer, 2013.


William Sullivan
Machine Learning for Beginners Guide Algorithms


Giuseppe Ciaburro
Balaji Venkateswaran
Neural Networks with R