
Introduction to Neural Networks

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NTUOSS TGIFHacks #119



Agenda

Introduction

What is Data?

Forward Propagation

Activation Functions

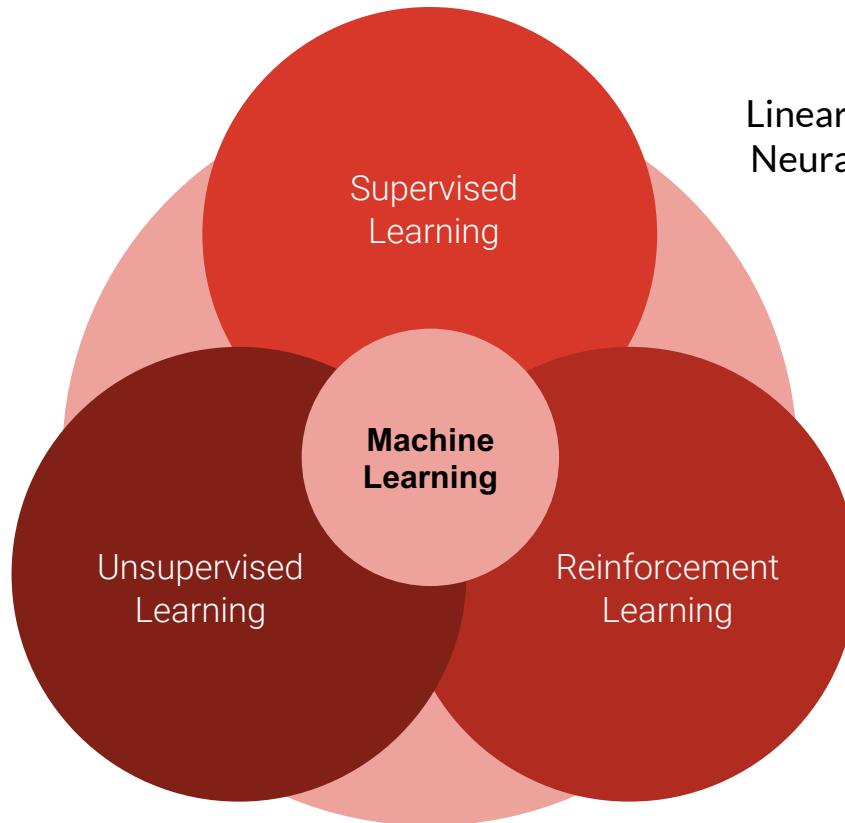
Cost & Loss

Training a Network

Code – Iris Data Set

Remarks

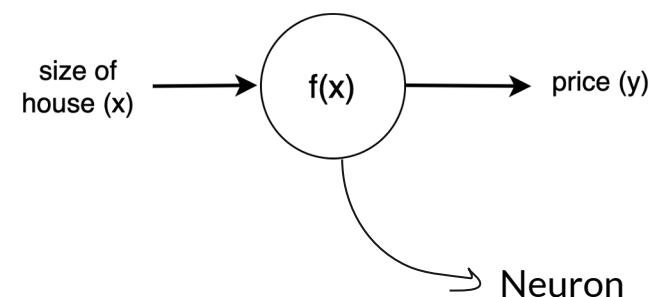
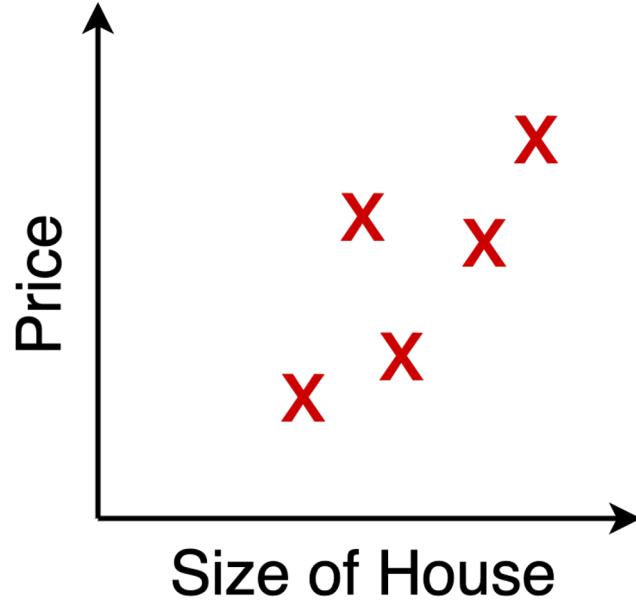
Beyond the workshop



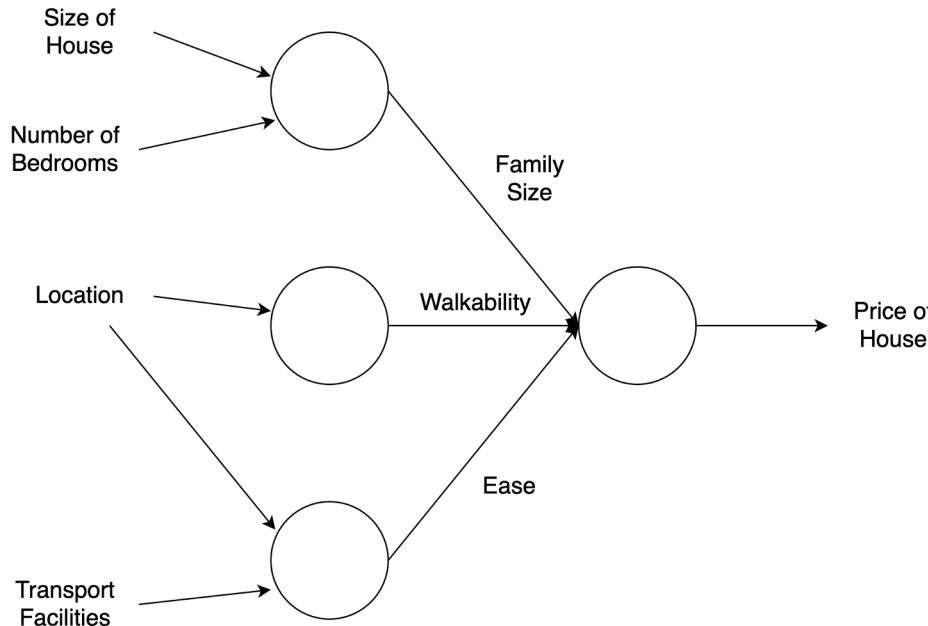
Linear Regression
Neural Networks

K-Means Clustering
Anomaly Detection

What exactly is a **Neural Network**?



What exactly is a **Neural Network**?

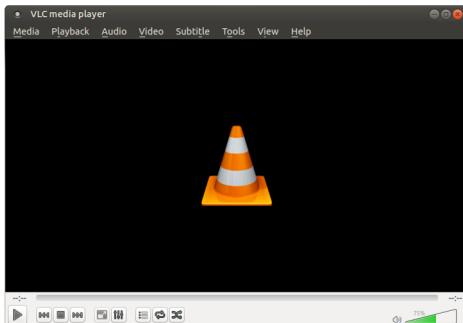




Data Definition (Structured)

Size of House	# Bedrooms	Location	Transport	Price
1400 sq feet	4	Orchard	MRT, Bus	SGD 22,000
700 sq feet	2	Jurong	Bus	SGD 15,000
...

Data Definition (Unstructured)

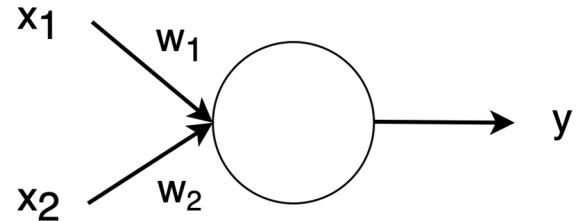


Inline lists, which are sequential in nature, just like enumerated lists, but are *a*) formatted within their paragraph; *b*) usually labelled with letters; and *c*) usually have the final item prefixed with ‘and’ or ‘or’, like this example.

Forward Propagation

$$\begin{aligned} z &= (w_1x_1) + (w_2x_2) + \cdots + (w_nx_n) + b \\ &= xTw + b \end{aligned}$$

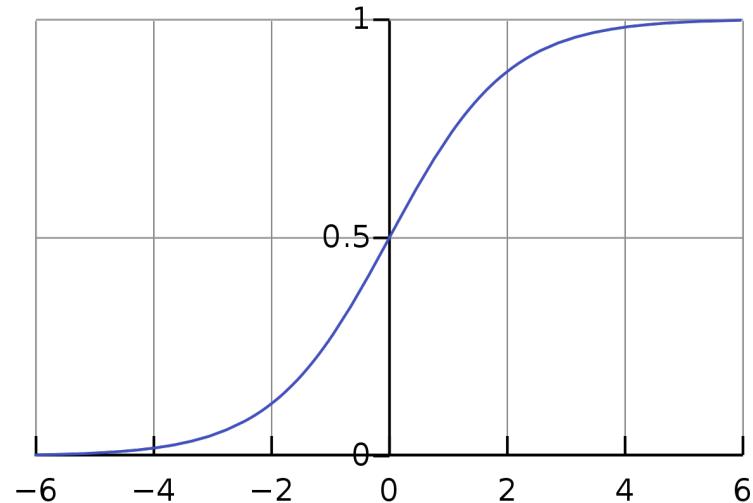
$$a = y = g(z)$$



Activation Functions

Sigmoid

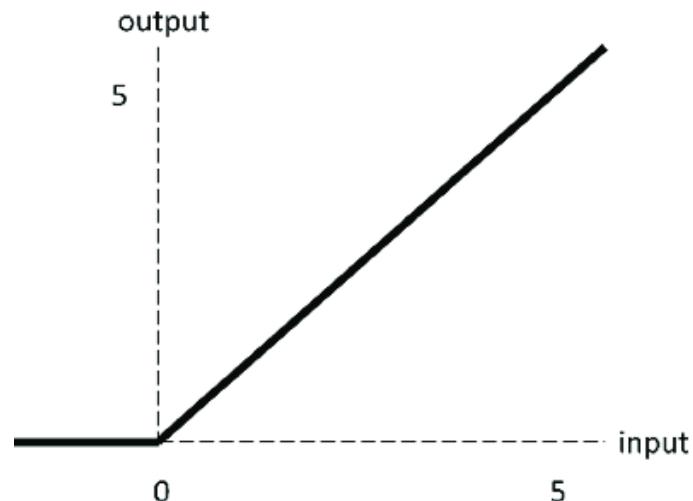
$$g(z) = \frac{1}{1 + e^{-z}}$$



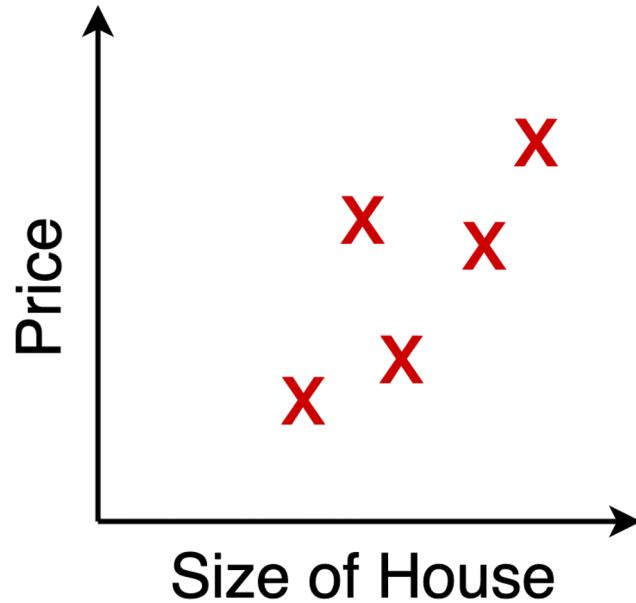
Activation Functions

ReLU

$$g(z) = \max(0, z)$$

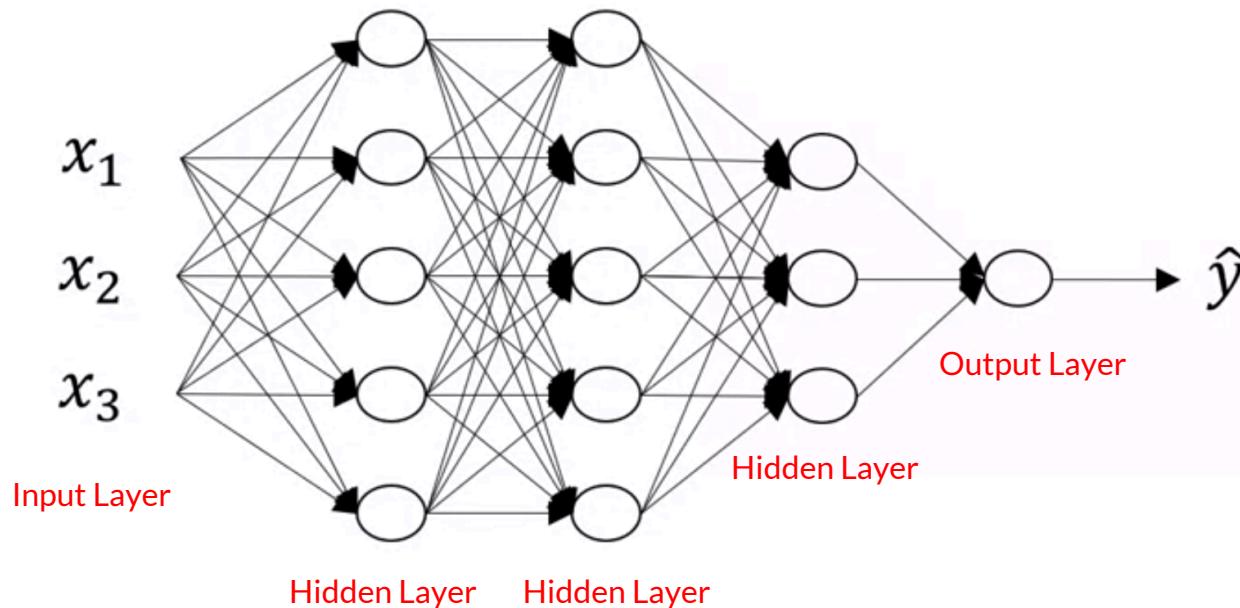


But why?



- Turn unbounded output to bounded output.
- Introduce Non-Linearity.

Deep Neural Networks

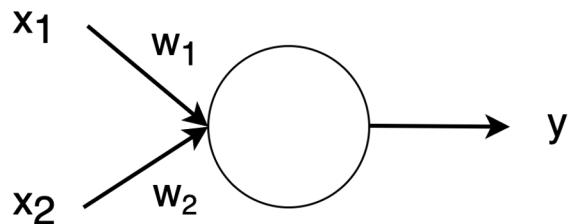


Loss Function



Squared Error

$$\text{loss}(\text{target}, \text{prediction}) = (\text{prediction} - \text{target})^2$$



price of house = 16,000 SGD

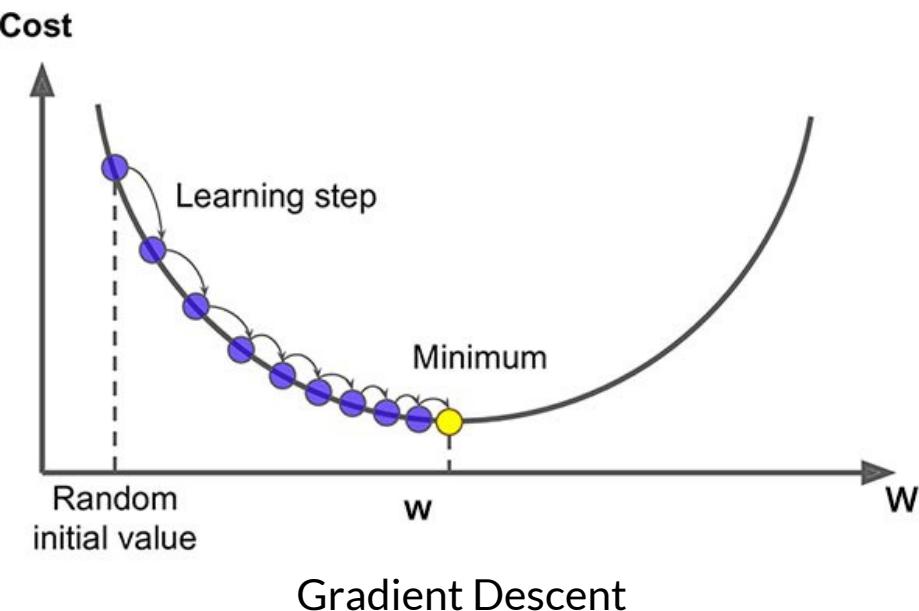
predicted price = 17,000 SGD

$$\begin{aligned}\text{loss} &= (\text{prediction} - \text{target})^2 \\ &= (17,000 - 16,000)^2\end{aligned}$$

Cost Function

$$cost = \frac{1}{2m} \sum_{1}^{m} L(\text{target}, \text{prediction})$$

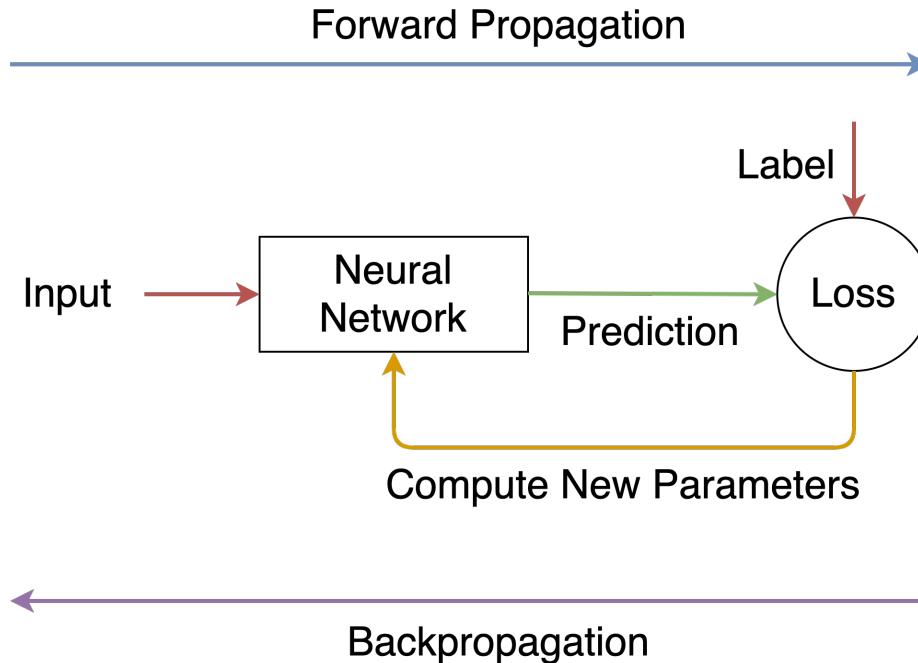
Aim – Minimize cost





How to train models?

The Big Picture





Data (e.g., a CSV file)

Size of House	# Bedrooms	Location	Transport	Price
1400 sq feet	4	Orchard	MRT, Bus	SGD 22,000
700 sq feet	2	Jurong	Bus	SGD 15,000
...



How to train models?

- All the weights (w_1, w_2, \dots, w_n) and biases (b_1, b_2, \dots, b_n) are initialized randomly.*
- Each entry in the dataset is ran through the model through the process of forward propagation and backpropagation.
- A loss function indicates the goodness of the estimate the neural networks makes.
- The model runs through the dataset several times in a random manner (epochs).
- An independent test set is used to evaluate the performance of the model.

* There can be other types of initializations as well.



Coding Exercises:

github.com/guptajay/NTUOSS-Neural-Networks-Workshop

Iris Flower Data Set



Iris Virginica



Iris Versicolor



Iris Setosa



Iris Flower Data Set

Sepal Length	Sepal Width	Petal Length	Petal Width	Species
5.1	3.5	1.4	0.2	Iris setosa
7.0	3.2	4.7	1.4	Iris versicolor
...

Remarks

- Neural Networks is a way of doing Machine Learning, in which a machine learns to do a task by learning from data i.e., training examples.
- It is a vast topic and we have barely skimmed through the fundamental topics governing neural network algorithms.
- Neural Networks is a relatively mature field, with most commercial systems that are run using Machine Learning, use some form of Neural Nets.
- If you are keen to learn more, I highly recommend that you start with the [Deep Learning Specialization on Coursera](#).



Beyond this Workshop

We have barely scratched the surface.

- **Deep Learning:** ICLR
- **Computer Vision:** CVPR/ECCV/ICCV
- **Natural Language Processing:** ACL/EMNLP
- **Robotics:** ICRA
- **General AI:** AAAI, NeurIPS



Beyond this Workshop

We have barely scratched the surface.

- [Deep Learning Specialization \(Coursera\)](#)
- [TensorFlow Developer Professional Certificate](#)
- [Stanford University, CS230 Course](#)
- [Deep Learning, book by Ian Goodfellow et al.](#)



References

- Deep Learning Specialization - <https://www.coursera.org/specializations/deep-learning>
- Beginner Introduction to Neural Networks -
https://www.youtube.com/playlist?list=PLxt59R_fWVzT9bDxA76AHm3ig0Gg9S3So
- Activation Functions in Neural Networks - <https://www.geeksforgeeks.org/activation-functions-neural-networks/>



Thank you.

