

---

# Introduction to Neural Networks

Jay Gupta, HackOSS, Vice-Chair  
NTUOSS TGIFHacks #117



# Agenda

Introduction

What is Data?

Forward Propagation

Activation Functions

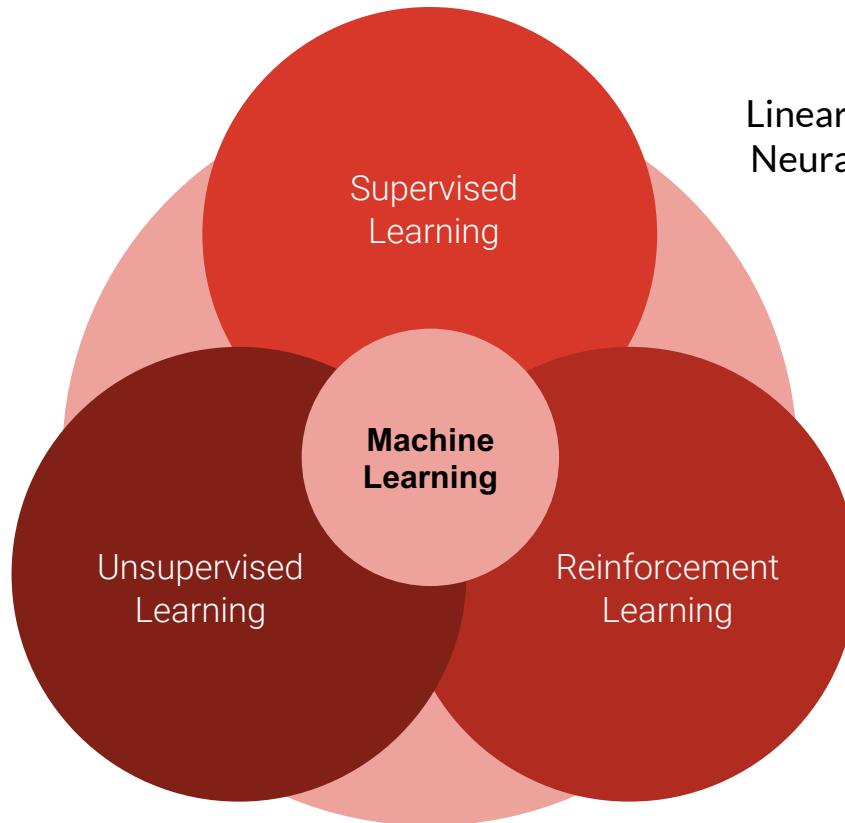
Cost & Loss

Training a Network

**Code** – Iris Data Set

Remarks

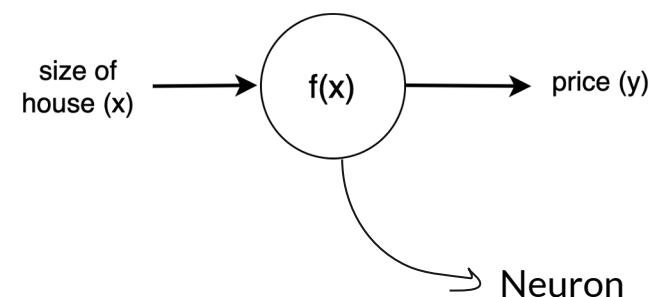
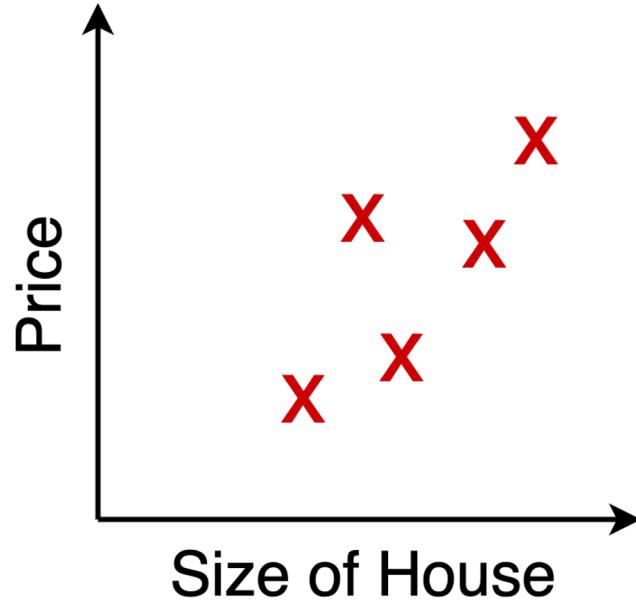
Beyond the workshop



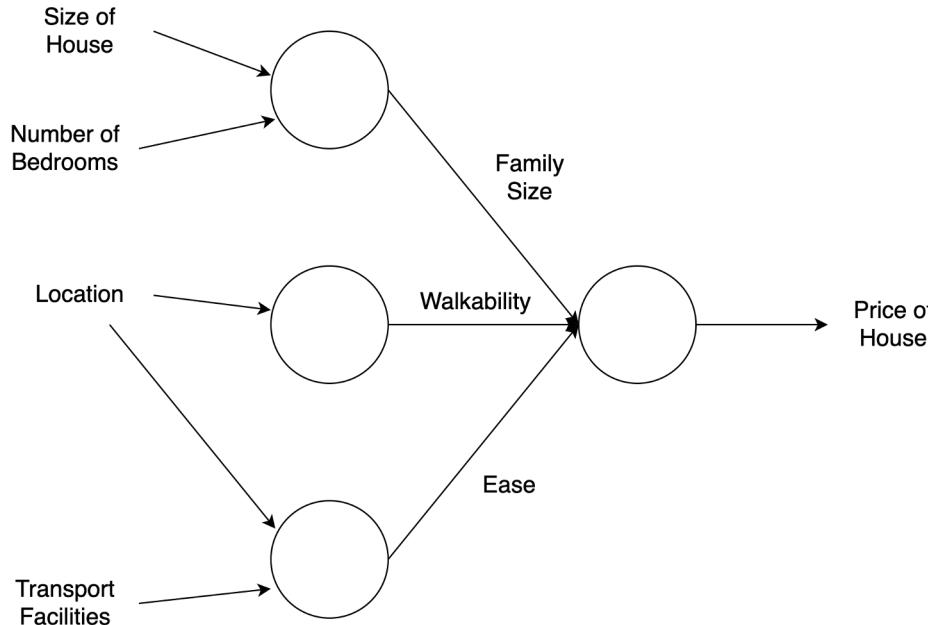
Linear Regression  
Neural Networks

K-Means Clustering  
Anomaly Detection

# What exactly is a **Neural Network**?



# What exactly is a **Neural Network**?



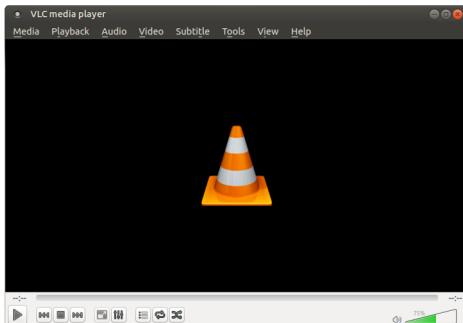


---

# Data Definition (Structured)

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

# Data Definition (Unstructured)

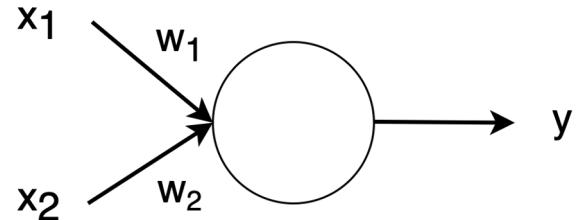


***Inline lists***, which are sequential in nature, just like enumerated lists, but are *a*) formatted within their paragraph; *b*) usually labelled with letters; and *c*) usually have the final item prefixed with ‘and’ or ‘or’, like this example.

# Forward Propagation

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

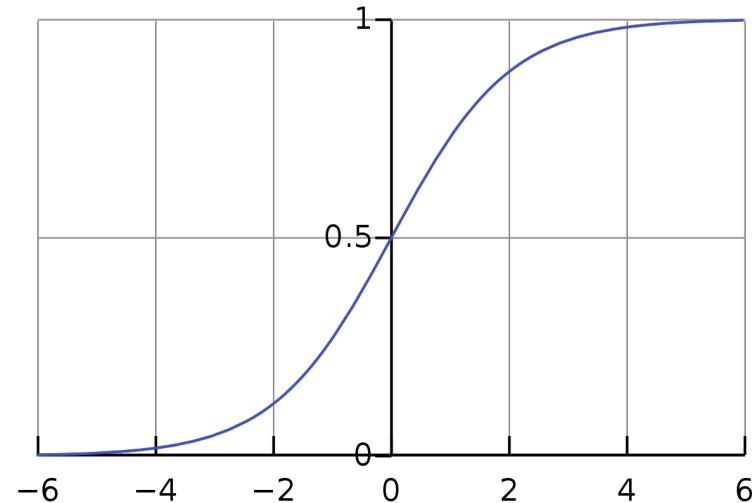
$$a = y = g(z)$$



# Activation Functions

## Sigmoid

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

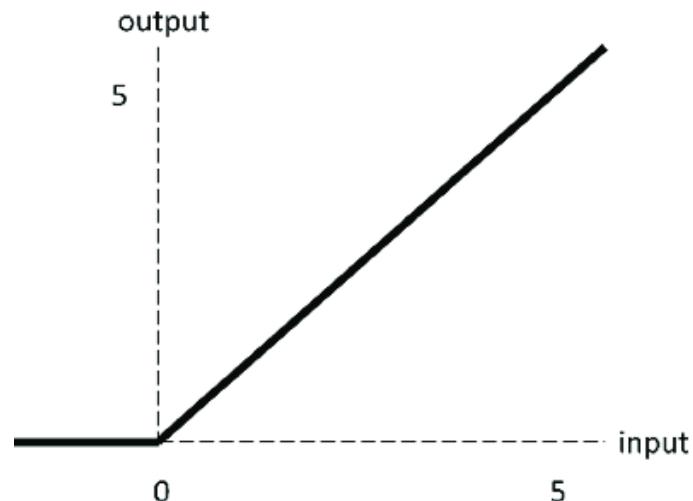


# Activation Functions

---

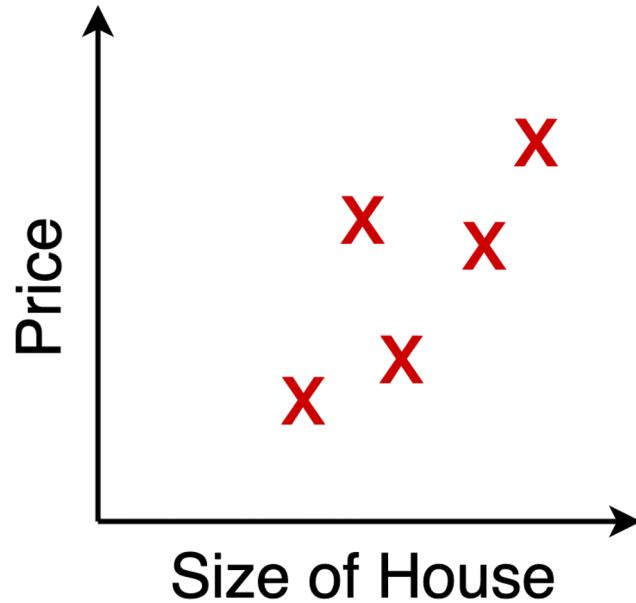
ReLU

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



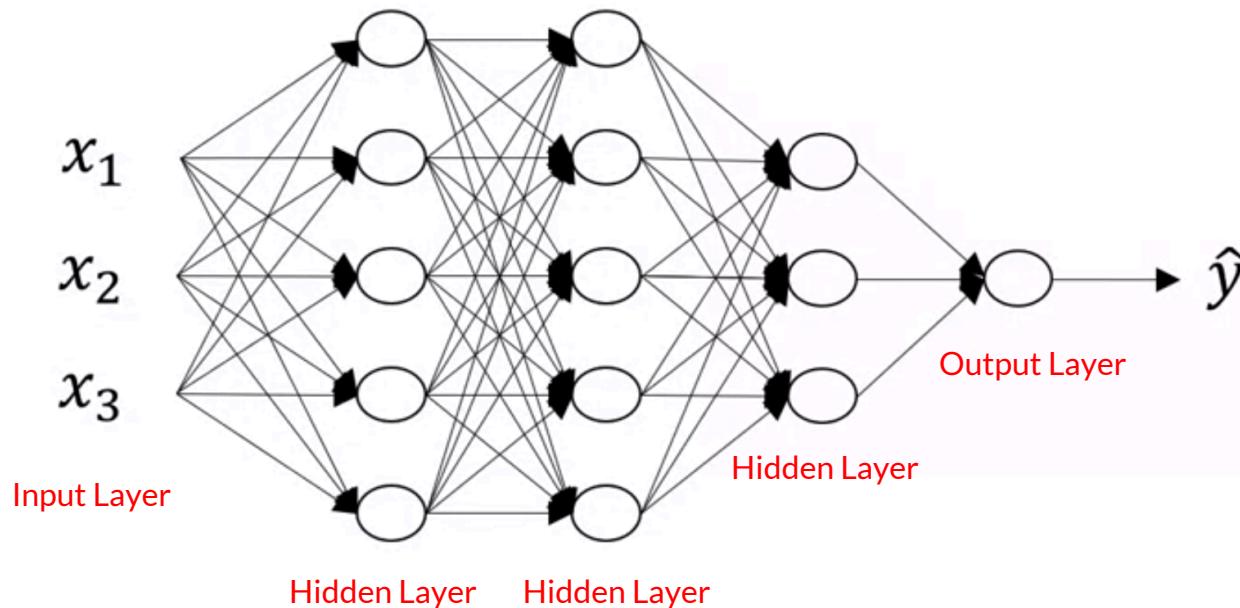
# But why?

---



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

# Deep Neural Networks



# Loss Function

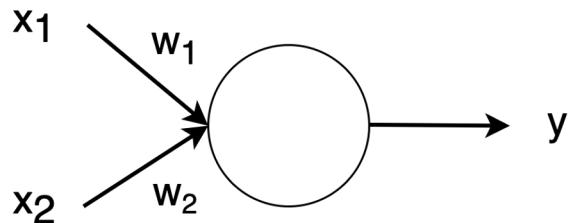
---



# Squared Error

---

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



*price of house = 16,000 SGD*

*predicted price = 17,000 SGD*

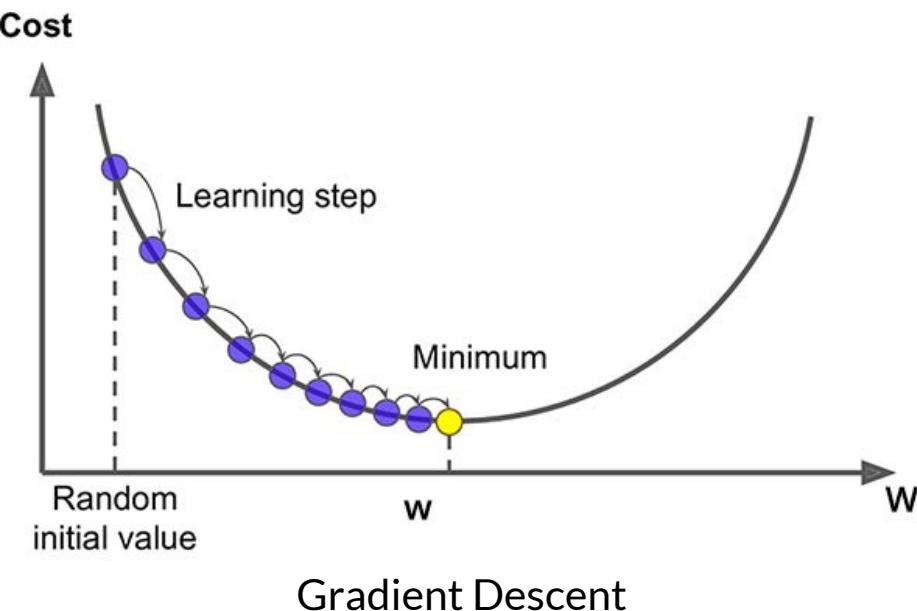
$$\begin{aligned}\text{loss} &= (\text{prediction} - \text{target})^2 \\ &= (17,000 - 16,000)^2\end{aligned}$$

# Cost Function

---

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

**Aim** – Minimize cost

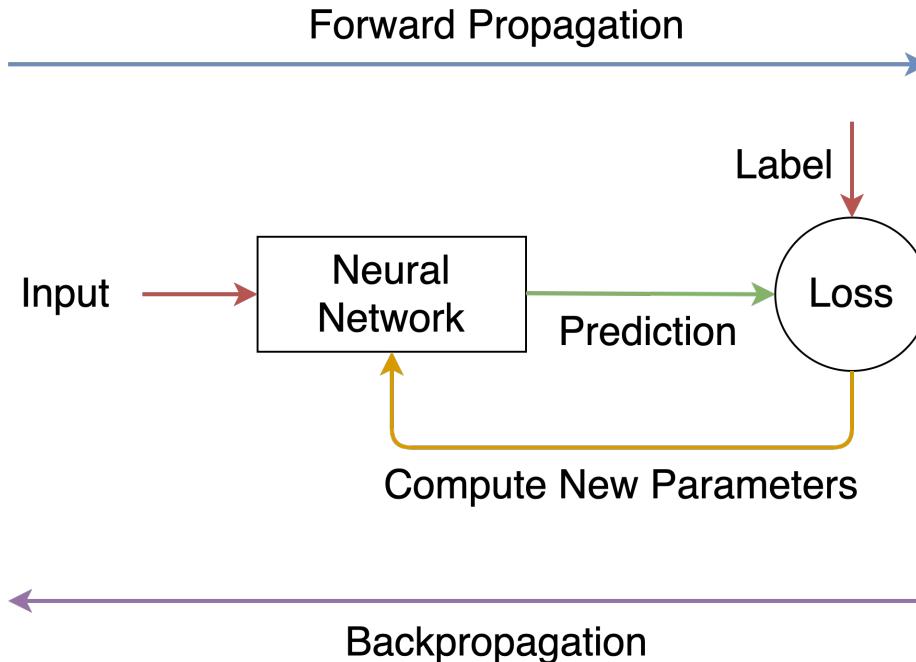




# How to train models?

# 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](https://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 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](https://www.youtube.com/playlist?list=PLxt59R_fWVzT9bDxA76AHm3ig0Gg9S3So)
- Activation Functions in Neural Networks - <https://www.geeksforgeeks.org/activation-functions-neural-networks/>



---

Thank you.

