Neural Networks

Mohana Meher
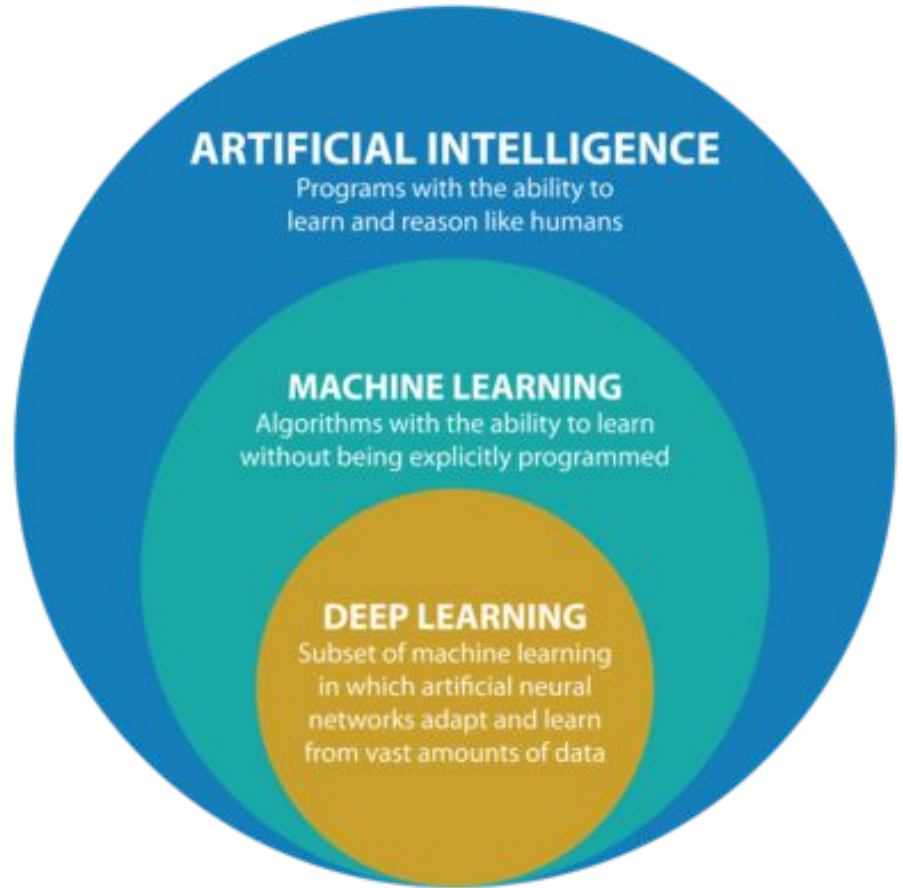
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BVRIT Hyderabad College of Engineering for Women

Agenda

- Deep Learning
- Neural Networks
- Perceptron Learning Algorithm - Analogy
- Gradient Descent
- Back Propagation
- Training a Neural Network
- Variants of Neural Network
- Applications of Neural Networks

Deep Learning

ARTIFICIAL INTELLIGENCE
Programs with the ability to
learn and reason like humans

MACHINE LEARNING
Algorithms with the ability to learn
without being explicitly programmed

DEEP LEARNING
Subset of machine learning
in which artificial neural
networks adapt and learn
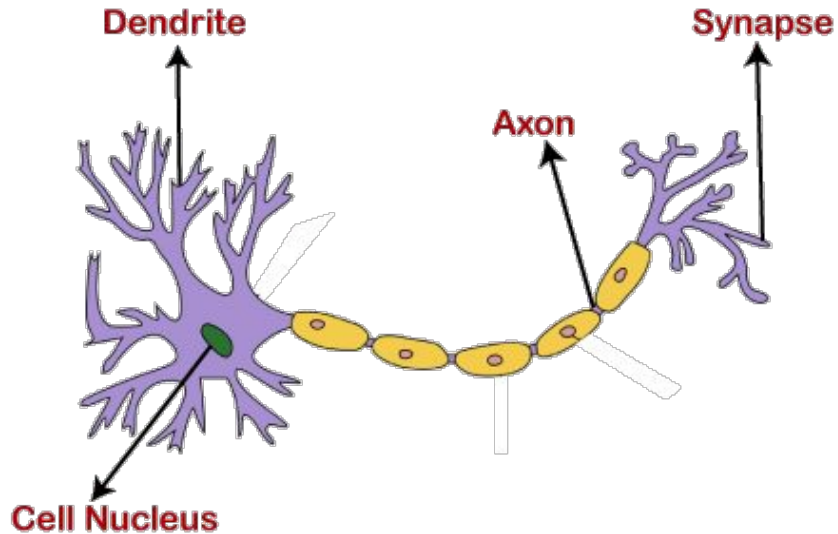from vast amounts of data

Why Neural Networks?

With Neural Networks computers can do things that we don't exactly know how to do.
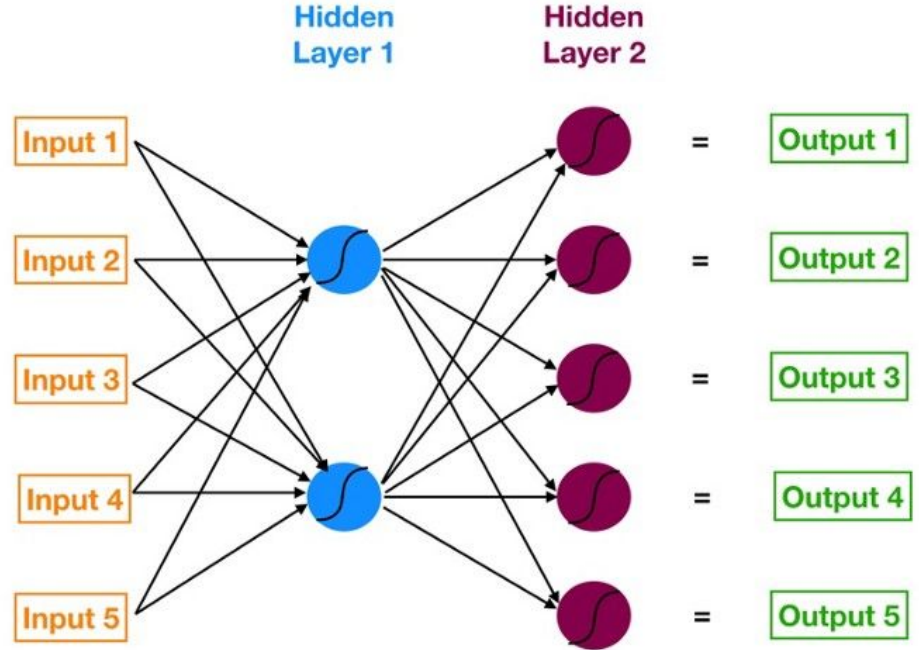
Motivation behind Neural Networks

The building block of neural net is a neuron. An artificial neuron works the same way a biological neuron works.
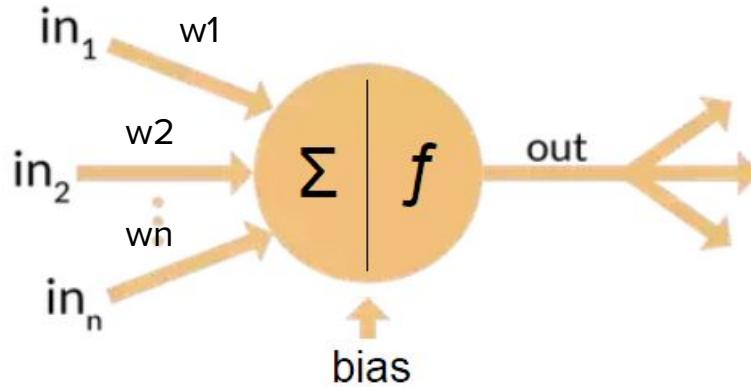
Neural Networks

Neural networks are multi-layer networks of neurons (the blue and magenta nodes in the chart below) that we use to classify things, make predictions, etc.

Perceptron

Activation Functions

Hyper Tangent Function

$\tanh(x)$

ReLU Function

$\max(0, x)$

Sigmoid Function

$\sigma(x) = \frac{1}{1+e^{-x}}$
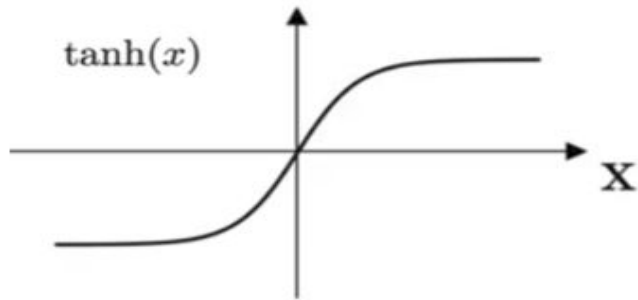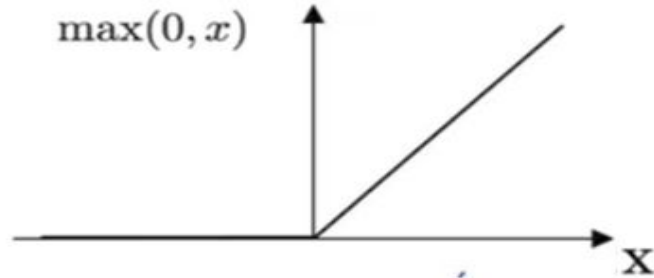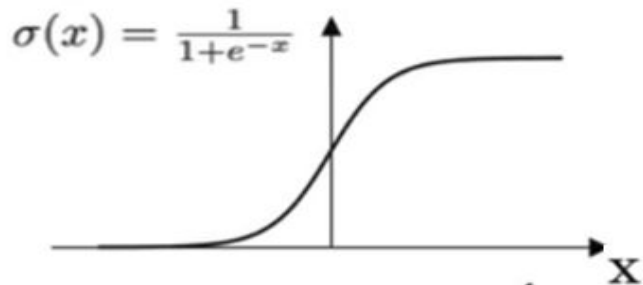
Identity Function

$f(x) = x$
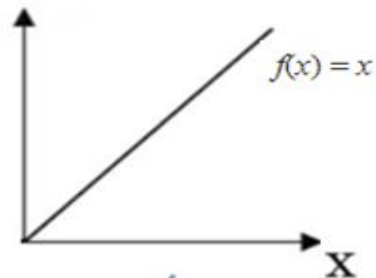
Escape Marriage Analogy

1. Settled with Job
2. Performance in Academics
3. Going abroad for higher studies

Inputs

X1 > Doing a Job

1   0
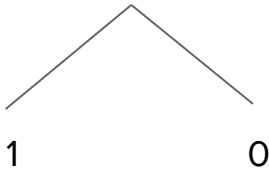
X2 > performance in Academics

1   0

X3 > Went abroad

1   0
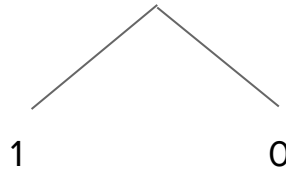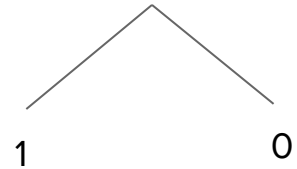
Weights

| W1 = 2, W2 = 2, W3 = 6 | W1 = 2, W2 = 2, W3 = 6 |

Threshold = 5

Threshold = 3

It will fire if you're going to abroad and will not fire if you're not going abroad irrespective of other inputs.

It will fire if X3 or other two inputs are high

W1 > Weight associated with input X1
W2 > Weight associated with input X2
W3 > Weight associated with input X3

Weights

$2x0 + 2x0 + 6x1 = 6$

W1 = 2, W2 = 2, W3 = 6

$2x0 + 2x0 + 6x1 = 6$

W1 = 2, W2 = 2, W3 = 6

$2x1 + 2x1 + 6x0 = 4$

Threshold = 5

Threshold = 3

It will fire if you're going to abroad and will not fire if you're not going abroad irrespective of other inputs.

It will fire if X3 or other two inputs are high

W1 > Weight associated with input X1
W2 > Weight associated with input X2
W3 > Weight associated with input X3

Neural Networks - Example

28 x 28

784 pixels

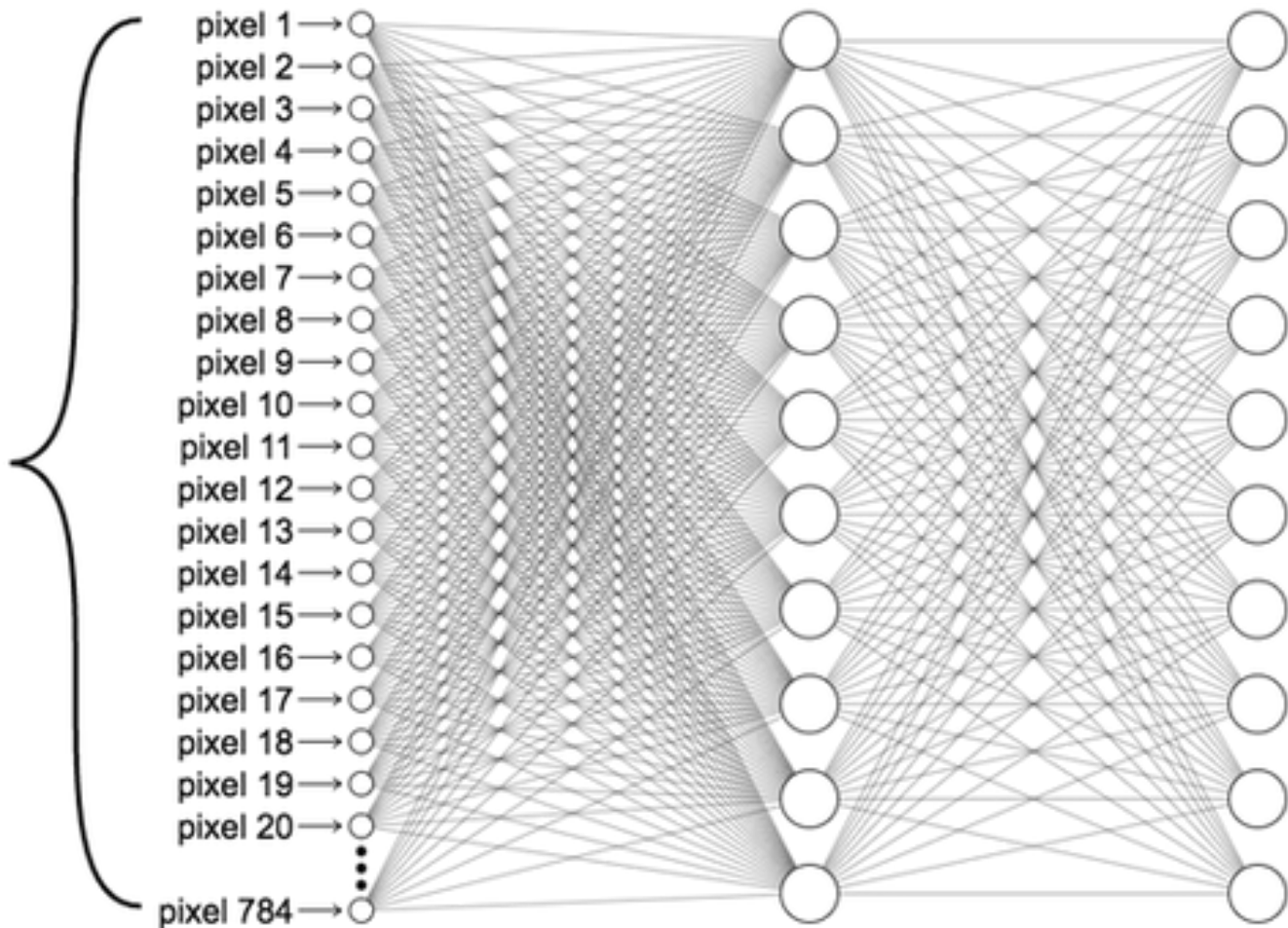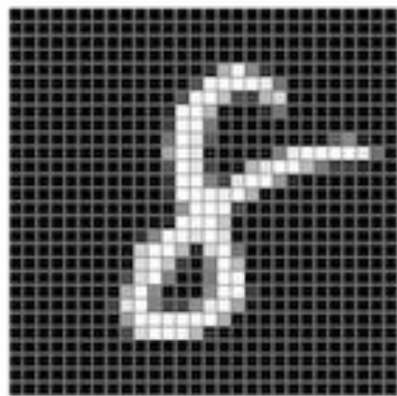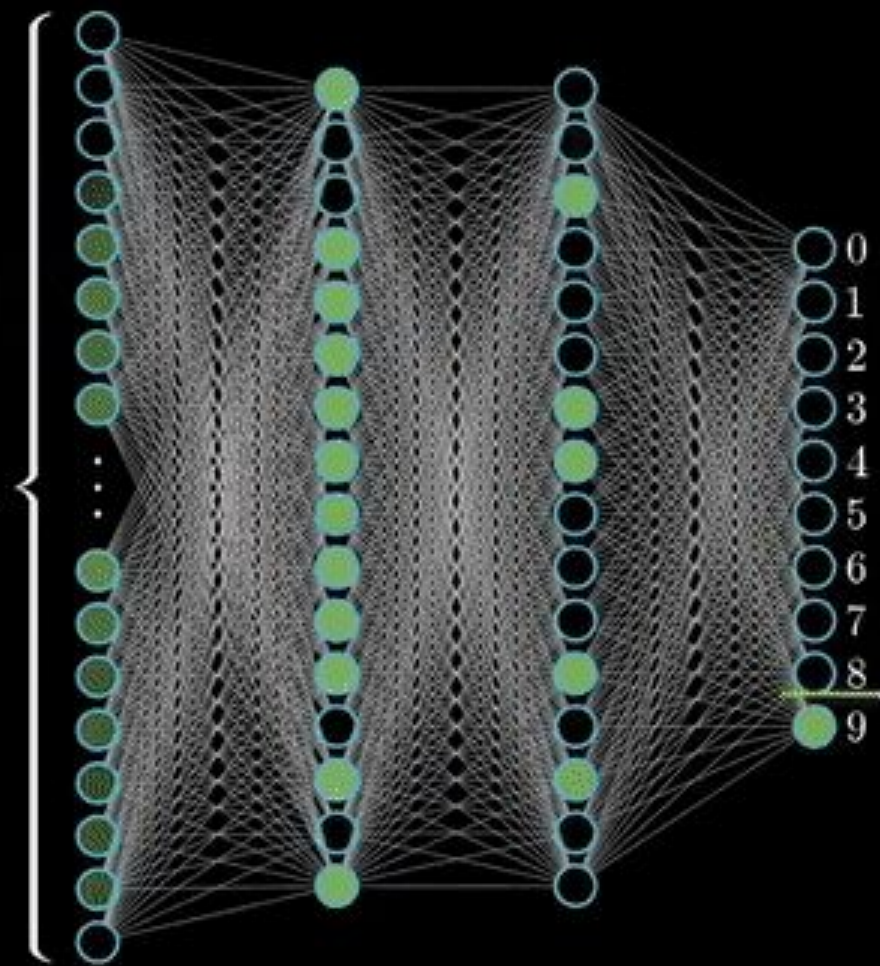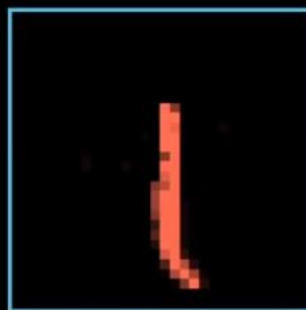|																											
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	4	62	146	182	254	254	181	176	139	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	34	186	253	217	208	136	136	136	166	232	99	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	61	242	208	111	3	0	0	0	0	0	18	32	107	43	0	0	0	0	0	0
0	0	0	0	0	0	0	0	156	242	23	0	0	0	0	0	0	0	13	191	181	6	0	0	0	0	0	0
0	0	0	0	0	0	0	0	121	255	98	3	0	0	0	0	0	8	194	225	12	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	169	253	120	3	0	0	0	0	128	247	51	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	3	111	244	169	19	0	14	131	249	117	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	59	241	235	72	142	229	66	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	25	218	254	231	36	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	133	253	221	33	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	19	237	111	196	217	19	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	174	138	0	23	193	204	18	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	96	224	0	0	0	25	218	169	3	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	215	138	0	0	0	0	86	253	99	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	215	97	0	0	0	0	3	162	214	11	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	215	97	0	0	0	0	0	118	253	68	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	185	157	0	0	0	0	0	40	254	98	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	50	244	61	0	0	0	0	112	244	58	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	174	251	142	59	83	167	244	111	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	6	133	253	253	253	169	61	3	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

pixel 1 →
pixel 2 →
pixel 3 →
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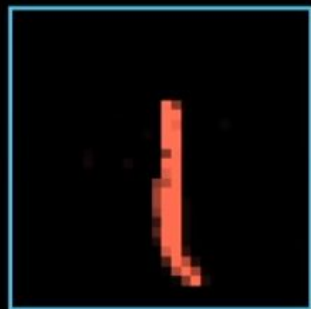pixel 15 →
pixel 16 →
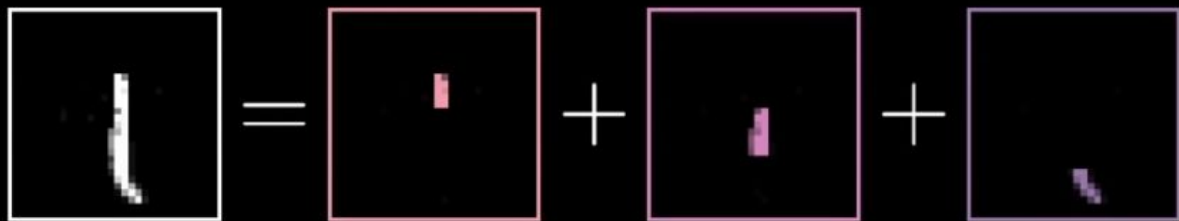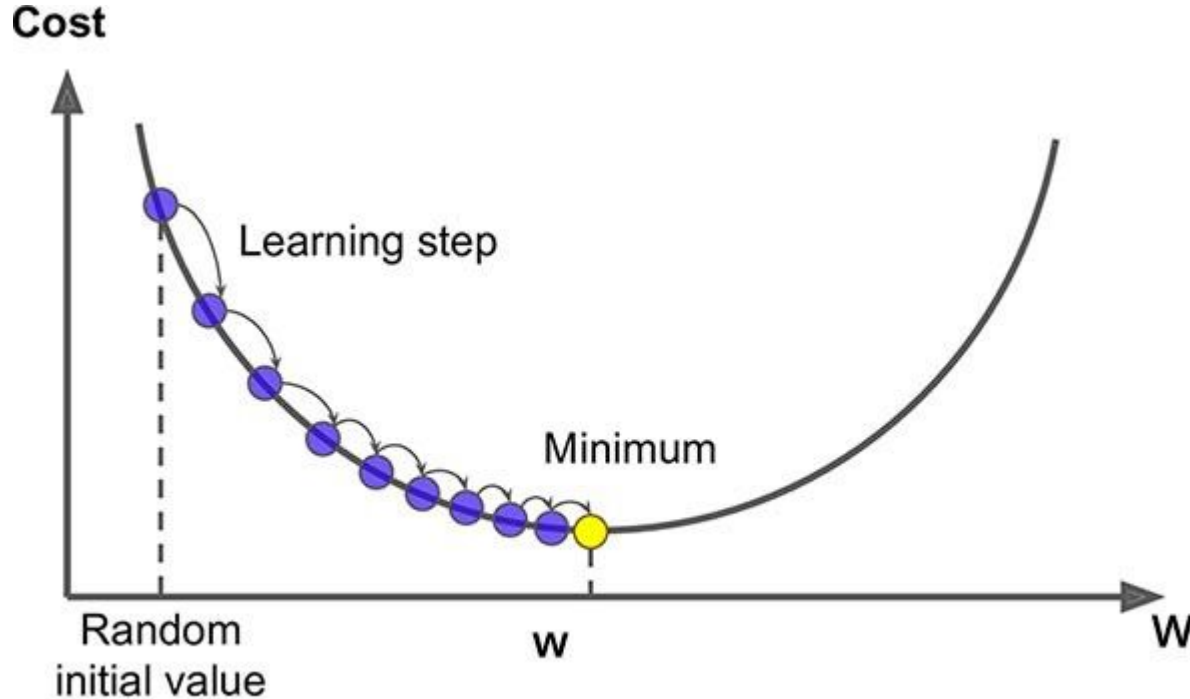pixel 17 →
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pixel 19 →
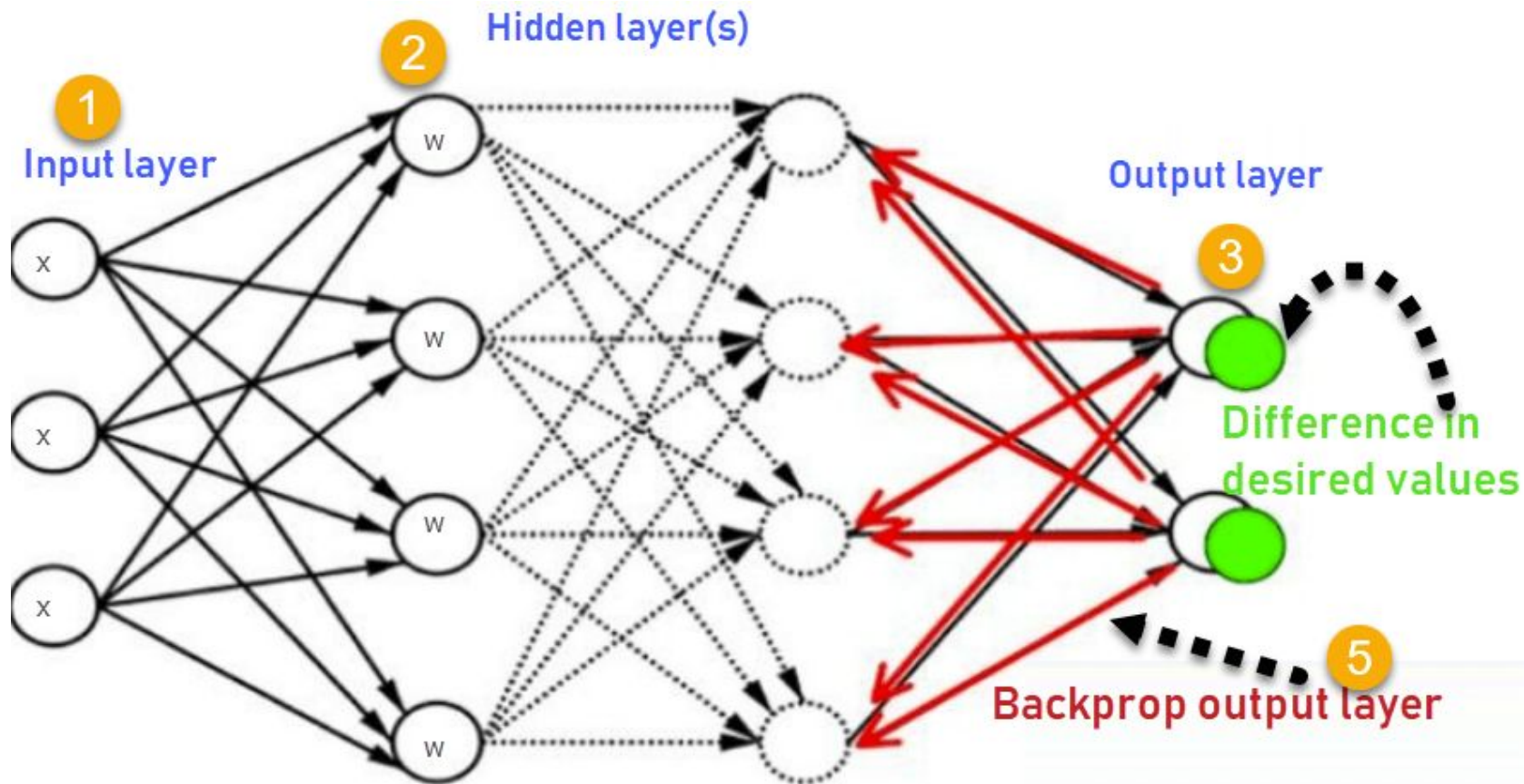pixel 20 →
pixel 784 →

Layer 1

Training a neural network


- Absolute Error
- Mean squared error(MSE)
- Gradient Descent
- Back Propagation

Back Propagation

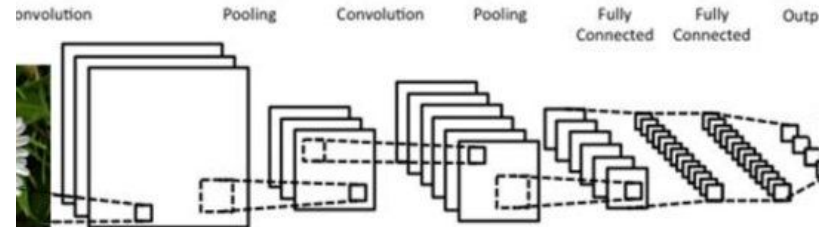# Variants of Neural Networks

1. Convolutional Neural Networks (CNNs)
2. Long Short Term Memory Networks (LSTMs)
3. Recurrent Neural Networks (RNNs)
4. Generative Adversarial Networks (GANs)
5. Radial Basis Function Networks (RBFNs)
6. Multilayer Perceptrons (MLPs)
7. Self Organizing Maps (SOMs)
8. Deep Belief Networks (DBNs)
9. Restricted Boltzmann Machines(RBMs)
10. Autoencoders
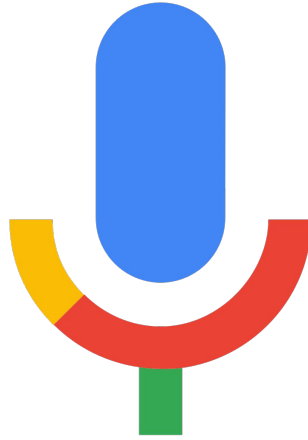

Artificial Neural Network (ANN)
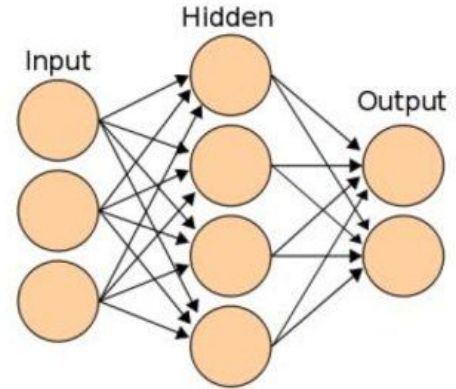
Convolutional Neural Network (CNN)

Applications of Neural Networks

Speech Recognition

Marketing

Face Recognition

Healthcare

References

http://neuralnetworksanddeeplearning.com/

- Free online book

https://www.youtube.com/channel/UCYO_jab_esuFRV4b17AJtAw

- 3Blue1Brown, by Grant Sanderson, is some combination of math and entertainment

THANK YOU