

Weights & Biases

30 November 2024 20:39

Linear Regression

weight / coefficients and bias (intercept)

Weights and Biases

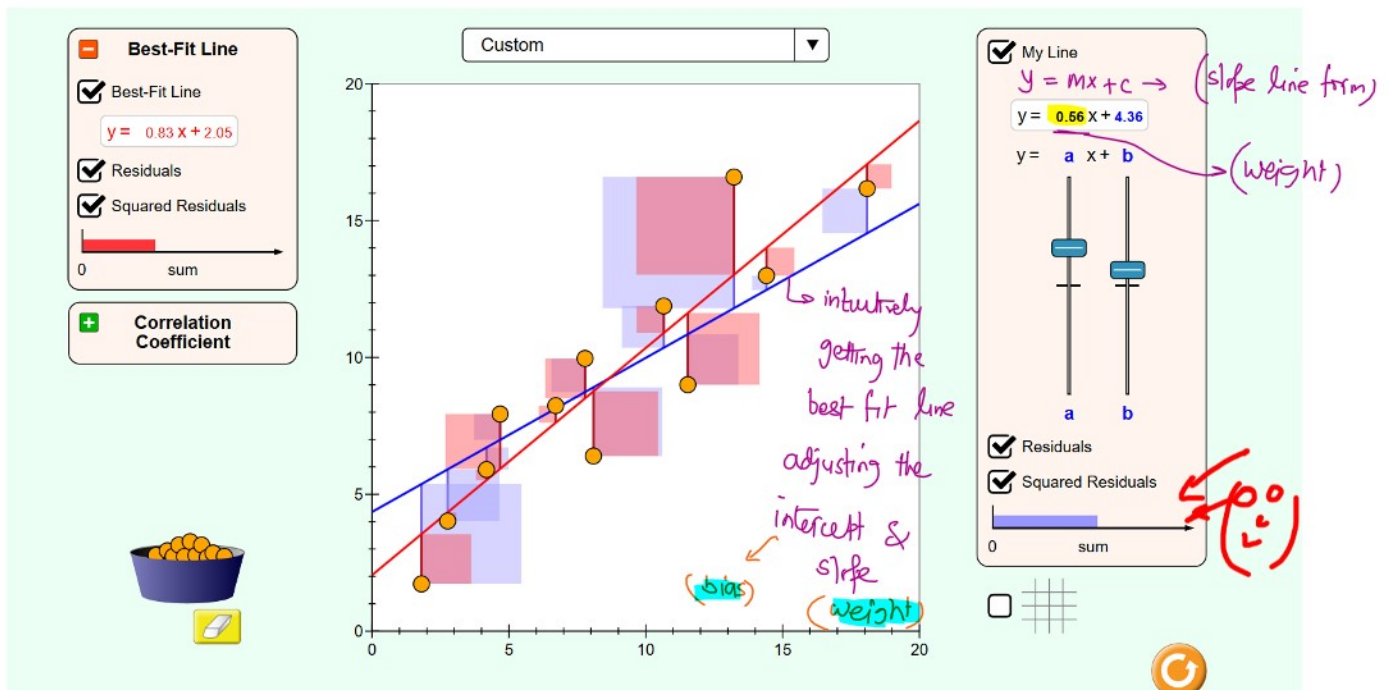
(Radio analogy)



* Linear Regression → first algorithm

$$y = (\hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \dots + \hat{\beta}_n x_n)$$

intercept (constant) coefficients



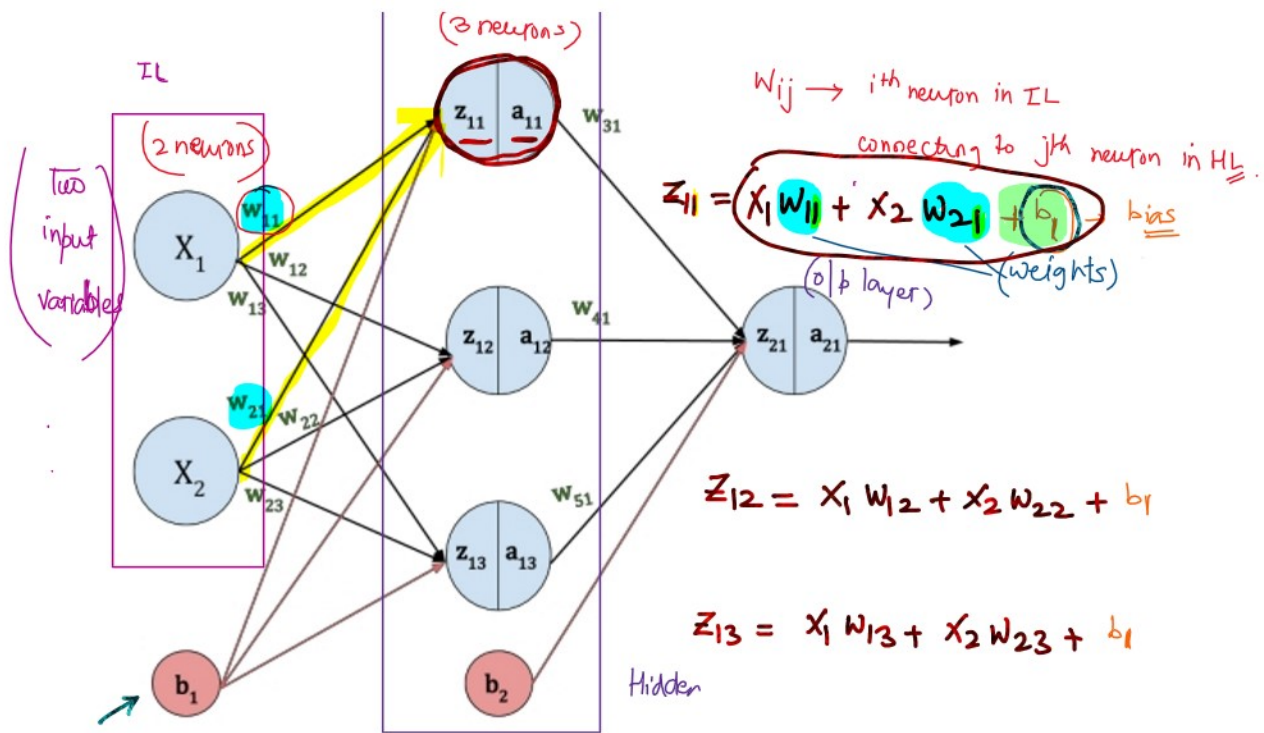
COLORADO APP to demo Linear Regression

Imitation Game

↳ Alan Turing
↳ (ENIGMA) → Encrypt
 → Decrypt

(knobs & dials)





where z_{11}, z_{12}, z_{13} are the intermediate neuron value.

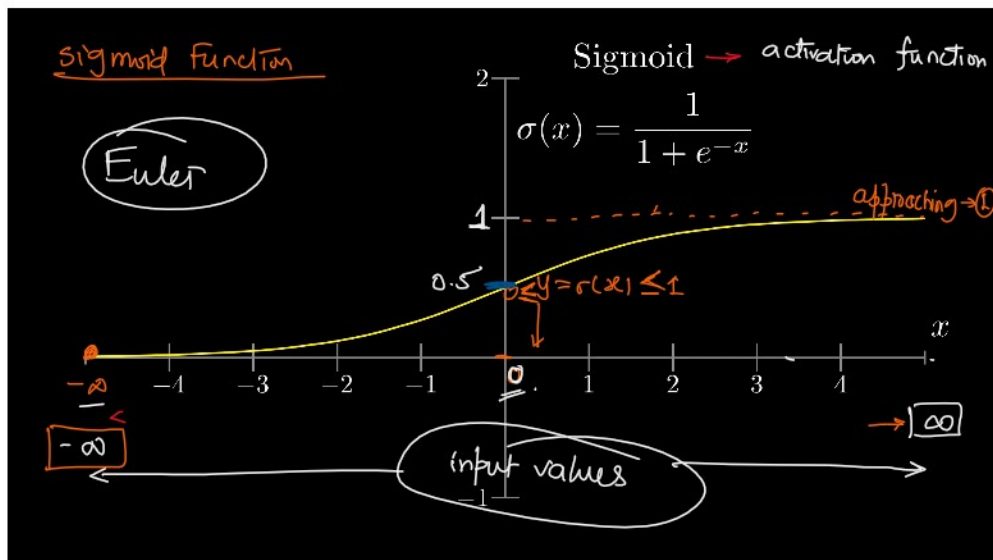
Activation function (Sigmoid)

$$a_{11} = \sigma(z_{11})$$

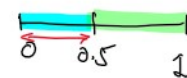
$$a_{12} = \sigma(z_{12})$$

$$a_{13} = \sigma(z_{13})$$

activation functions



limits

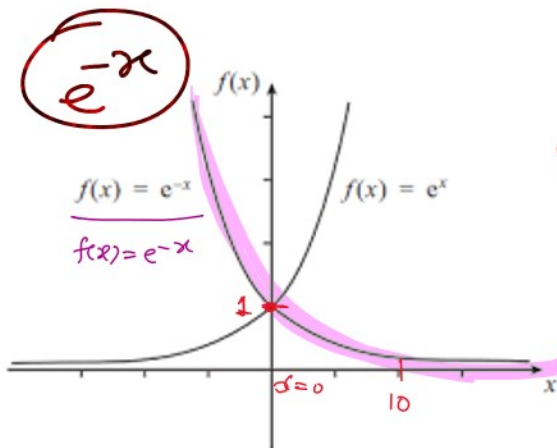
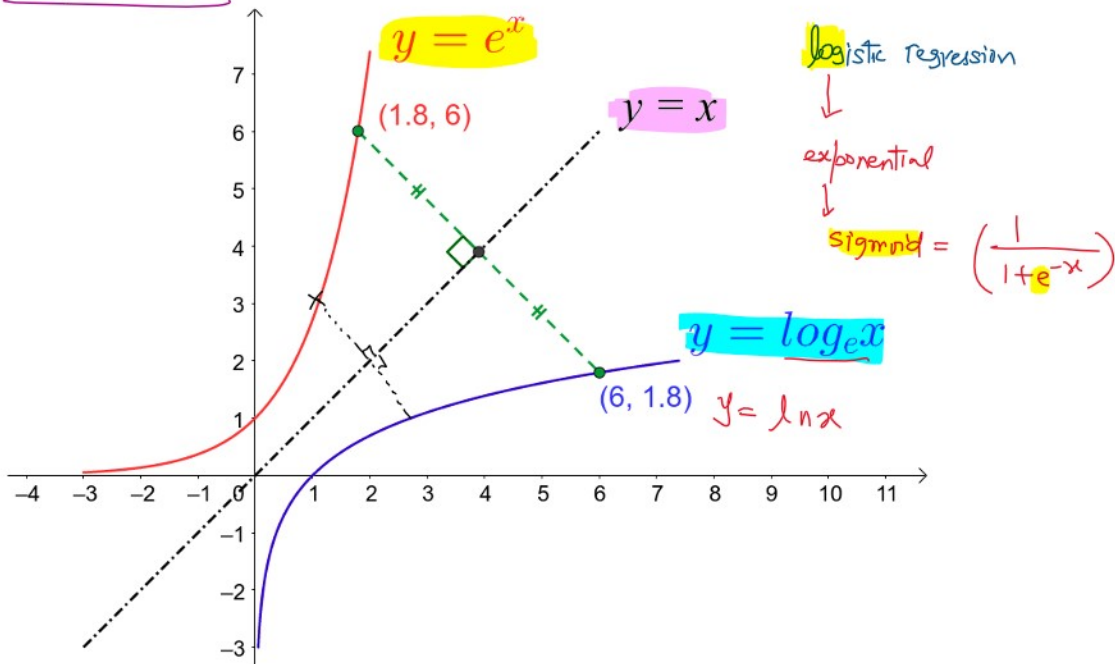


$0 \leq \sigma(x) < 0.5 \rightarrow \text{class \# 0}$
 $0.5 \leq \sigma(x) \leq 1 \rightarrow \text{class \# 1}$

$$\sigma(x) = \left(\frac{1}{1 + e^{-x}} \right) : \text{sigmoid function.}$$

Exponential Function

Inverse Functions



$e^{-x} \rightarrow$ put $x=0$ $e^0 = 1$

$$e^{-10} \approx (2.71)^{-10}$$

$$\approx$$

$$0.00004539992 \approx 0$$

$$\approx 4.5 \times 10^{-5} \rightarrow 0$$

$$e^{-\infty} \rightarrow \frac{1}{e^{\infty}} \rightarrow \frac{1}{\infty} = 0$$

Sigmoid function

$$\sigma(x) = \left(\frac{1}{1 + e^{-x}} \right)$$

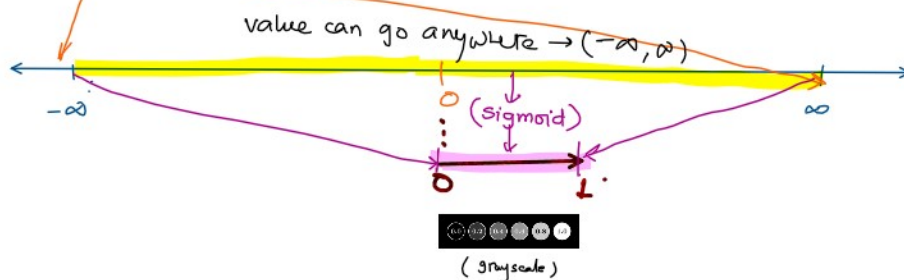
Put $x=0 \rightarrow \sigma(0) = \frac{1}{1+e^{-0}} = \frac{1}{1+e^0} = \frac{1}{1+1} = \left(\frac{1}{2}\right) = 0.5$

Put $x \rightarrow \infty \quad \sigma(\infty) = \frac{1}{1+e^{-\infty}} = \frac{1}{1+\cancel{\left(\frac{1}{e^{\infty}}\right)}^0} = 1$

Put $x \rightarrow -\infty \quad \sigma(-\infty) = \frac{1}{1+e^{-(-\infty)}} = \frac{1}{1+e^{\infty}} = \frac{1}{1+\infty} = \frac{1}{\infty} \rightarrow 0$

connecting to jth neuron in H_L .

$$Z_{ij} = x_1 w_{1j} + x_2 w_{2j} + b_j \rightarrow \text{bias}$$



8 bit data type $\rightarrow 2^8 = 256$

0-255 \rightarrow 256 combinations

0	2	15	0	0	11	10	0	0	0	9	9	0	0	0
0	0	0	4	60	157	236	255	255	177	95	61	32	0	0
0	10	16	119	238	255	244	245	243	250	249	255	222	103	10
0	14	170	255	255	244	254	255	253	245	255	249	253	251	124
2	98	255	228	255	251	254	211	141	116	122	215	251	238	253
13	217	243	255	155	33	226	52	2	0	10	13	232	255	36
16	229	252	254	49	12	0	0	7	7	0	70	237	252	235
6	141	245	255	212	25	11	9	3	0	115	236	243	255	137
0	87	252	250	248	215	60	0	1	121	252	255	248	144	6
0	13	113	255	255	245	255	182	181	248	252	242	208	36	0
1	0	5	117	251	255	241	255	247	255	241	162	17	0	7
0	0	0	4	58	251	255	246	254	253	255	120	11	0	1
0	0	0	4	97	255	255	255	248	252	255	244	255	182	10
0	22	205	252	246	251	241	100	24	113	255	245	255	194	9
0	111	255	242	255	158	24	0	0	6	39	255	232	230	56
0	218	251	250	137	7	11	0	0	2	62	255	250	125	3
0	173	255	255	101	9	20	0	13	3	13	182	251	245	61
0	107	251	241	255	230	98	55	19	118	217	248	253	255	52
0	18	145	250	255	247	255	255	255	249	255	240	255	125	0
0	0	23	113	215	255	250	248	255	255	248	248	118	14	12
0	0	6	1	0	52	153	233	255	252	147	37	0	0	4
0	0	5	5	0	0	0	0	0	14	1	0	6	6	0

$x_{100} = 252$
 $w_{100} = -1.8$
 $b_{100} = 0.5$

$\sigma(x) \rightarrow 0 \text{ to } 1$

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

$$\sigma(0) = 0.5$$

$$\sigma(-453) = \frac{1}{1+e^{-(-453)}}$$

$$= 252 * (-1.8) + 0.5$$

$$= 252 * (-1.8) + 0.5 = -453.1$$

$$(-453.1) \rightarrow -453$$

$$\sigma(-453) = \frac{1}{1+e^{-(-453)}}$$

$$= \frac{1}{1+e^{453}} = 0$$

$$e^{453} = 5.437513e+196$$

$$5.4 \times 10^{196} \approx \infty$$

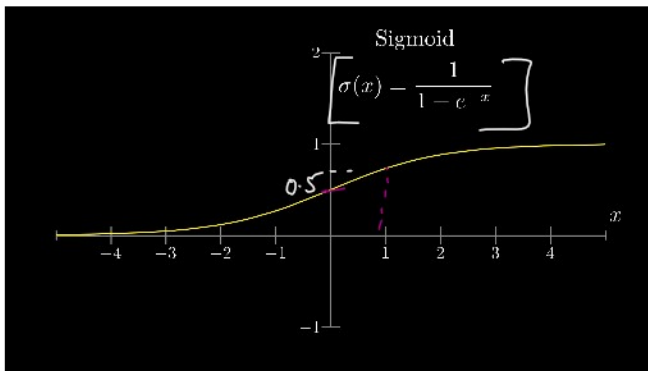
$$= \frac{1}{\infty} = 0$$

$$5.4 \times 10^{196} \approx \infty$$

$$= \frac{1}{\infty} = 0$$

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

$x < 0 \rightarrow 0 \text{ to } 0.5$
 $x = 0 \rightarrow \underline{0.5}$
 $x > 0 \rightarrow 0.5 \text{ to } 1$



$$x = 0 \rightarrow 0.5$$

$$x = 1 \rightarrow \frac{1}{1 + e^{-1}} = \frac{1}{1 + \exp(-1)} \approx 0.73$$

10 times

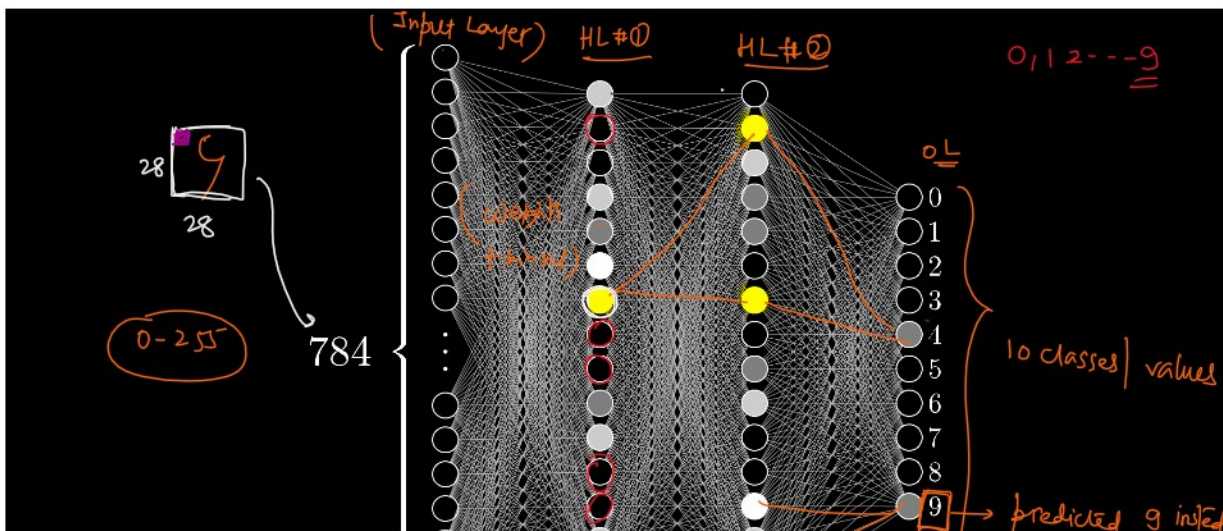
$$x = 10 \rightarrow \frac{1}{1 + e^{-10}} \approx 0.99$$

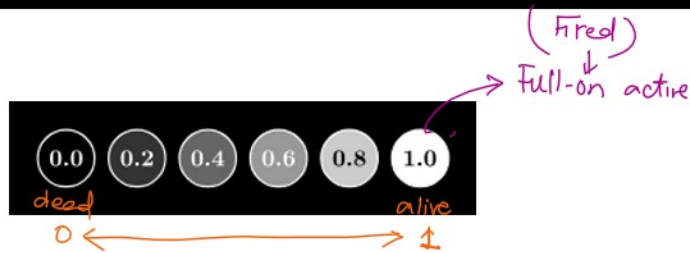
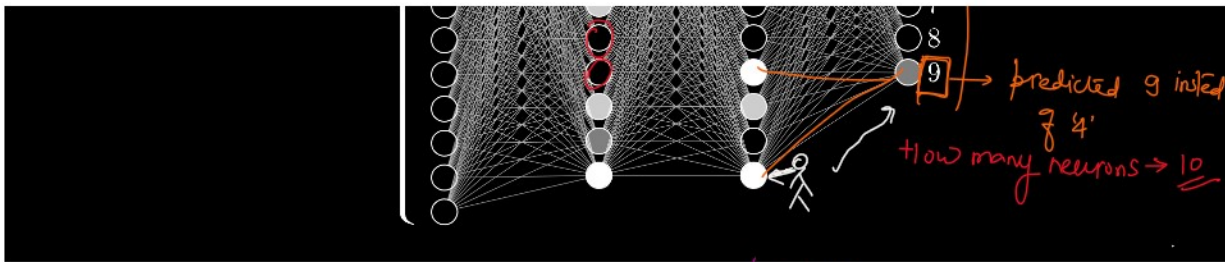
25 times

$$\frac{1}{1 + (e^{(-1)})} = 0.73105857863$$

$$\frac{1}{1 + (e^{(-10)})} = 0.99995460213$$

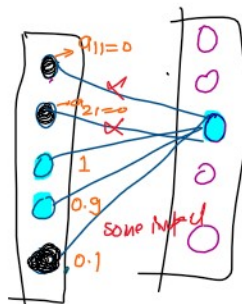
$$0.99 / 0.73 = 1.3562$$





If the neuron in the first hidden layer is **ON**,
 a positive weight (ex: $w_{11} = 2.07$) suggests
 that the neuron in the second hidden layer should
 also be **ON**

Similarly a negative weight (ex: $w_{71} = -1.84$) suggests
 that the neuron in the second layer should be off.



$$a_{11} \times w_{12} + a_{21} \times w_{22} + \dots$$