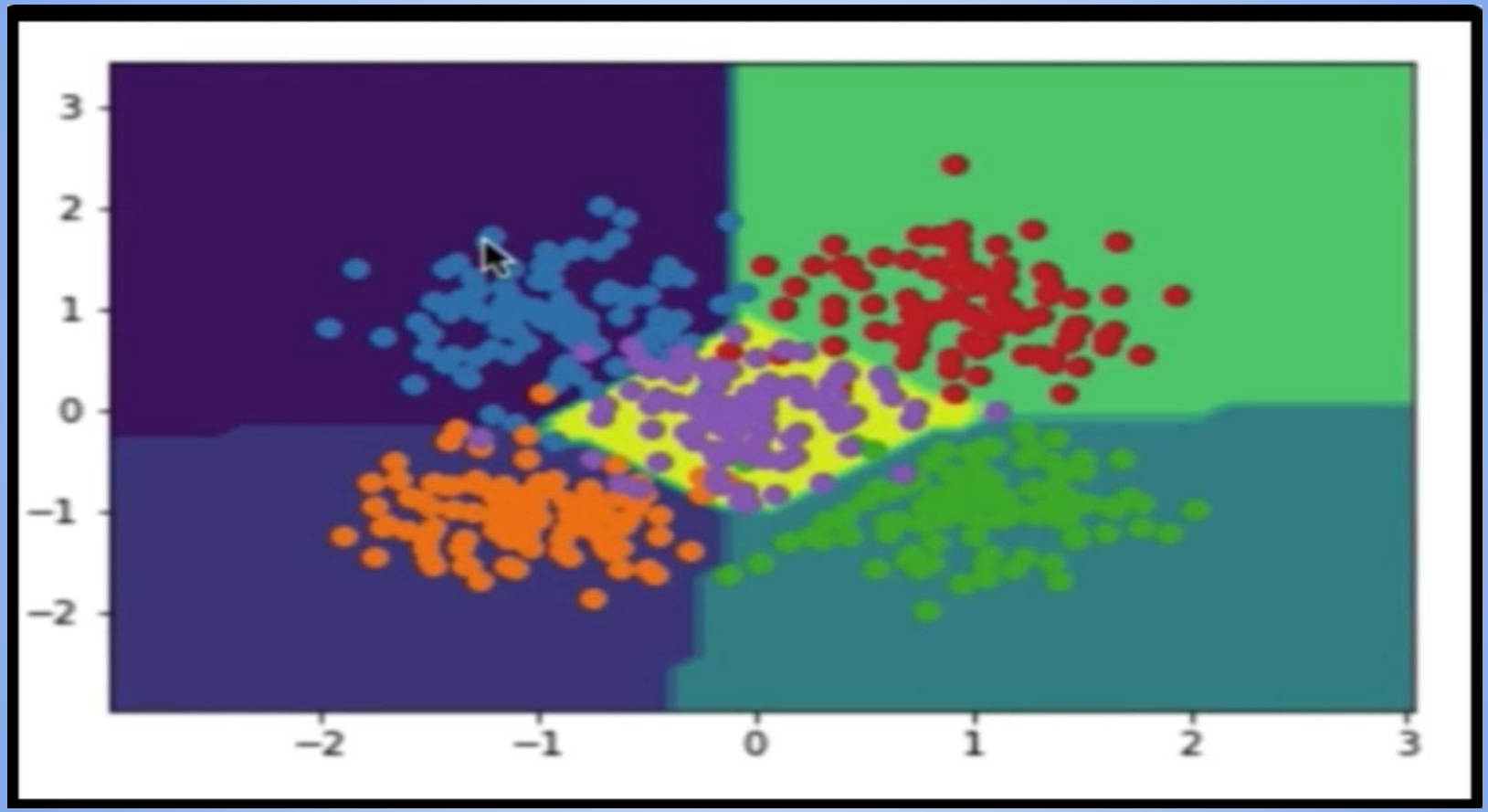
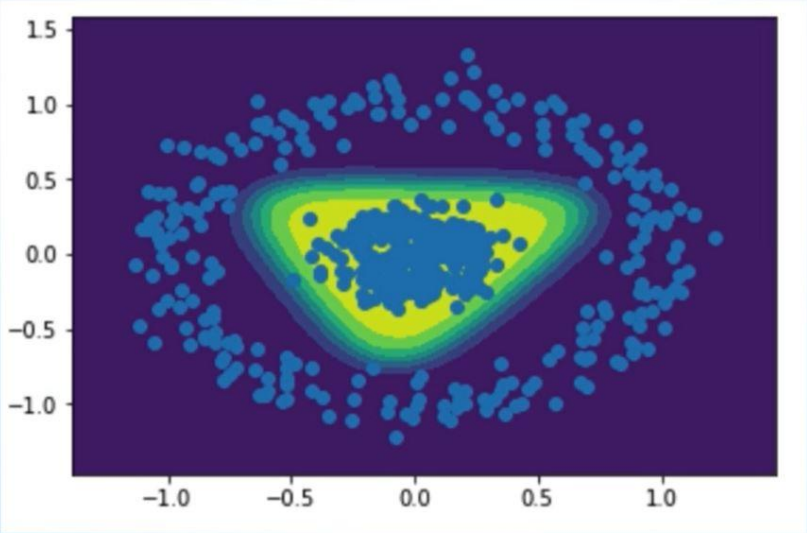
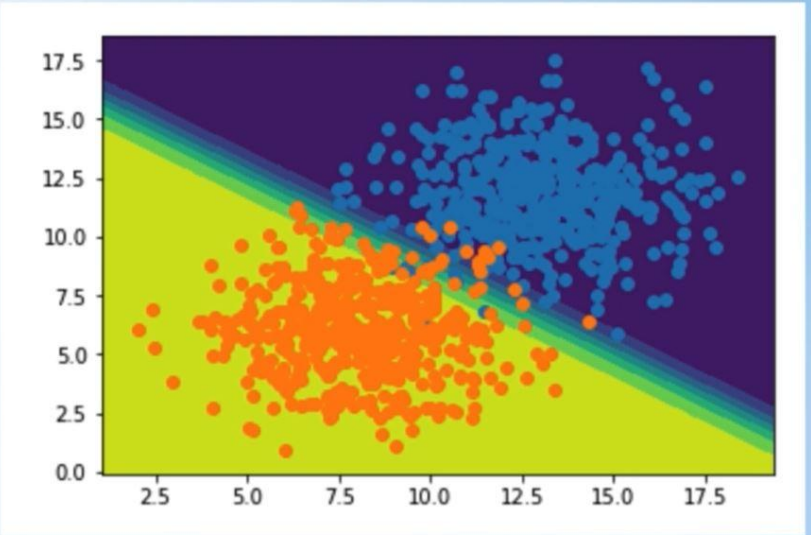
Deep Learning

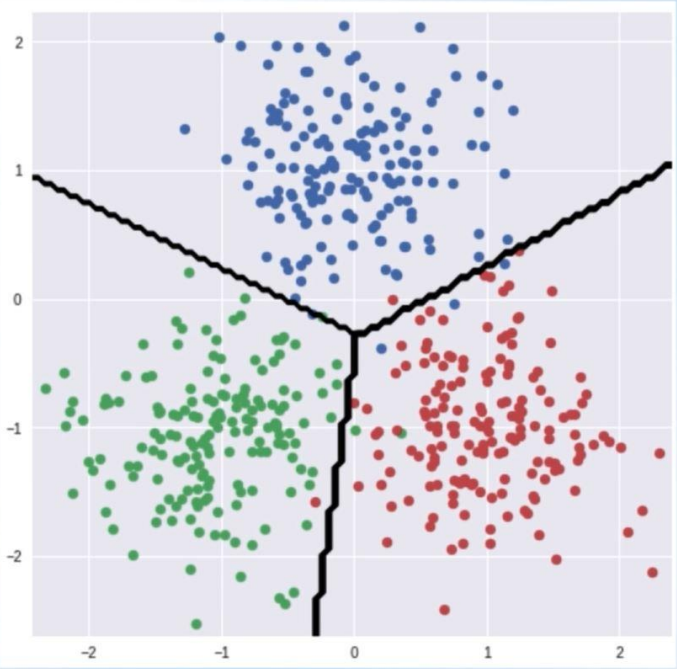

3
2
1
0
−1
−2
−2
−1
0
1
2
3

Softmax

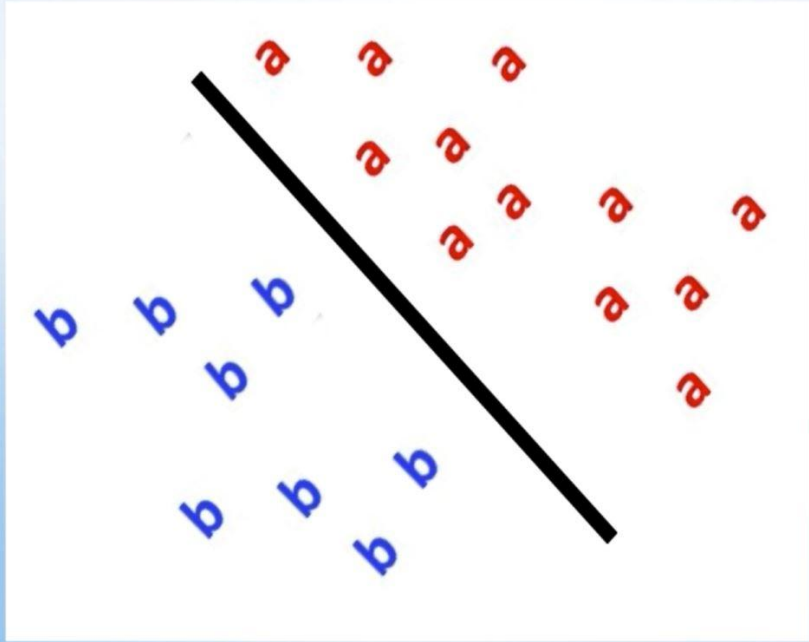

1.5
1.0
0.5
0.0
−0.5
−1.0
−1.0
−0.5
0.0
0.5
1.0


17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

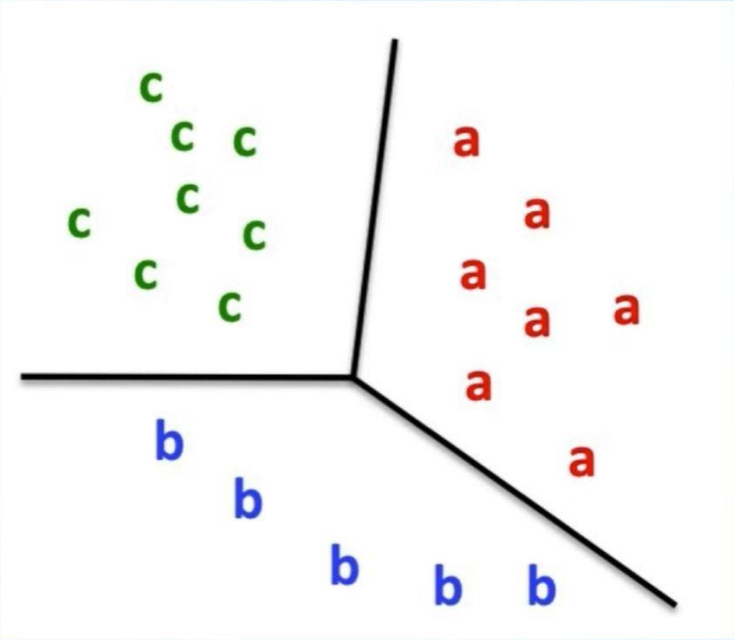
Softmax

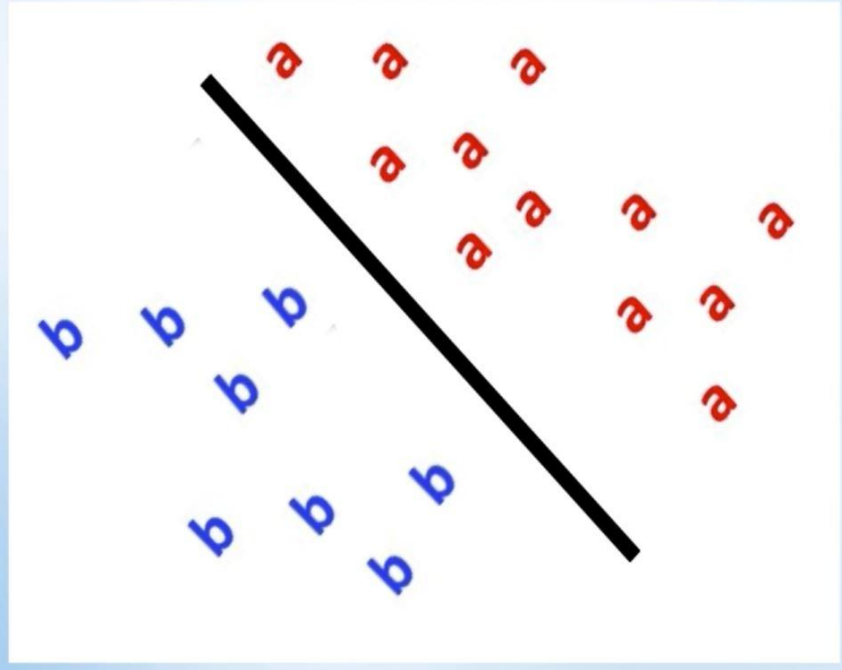


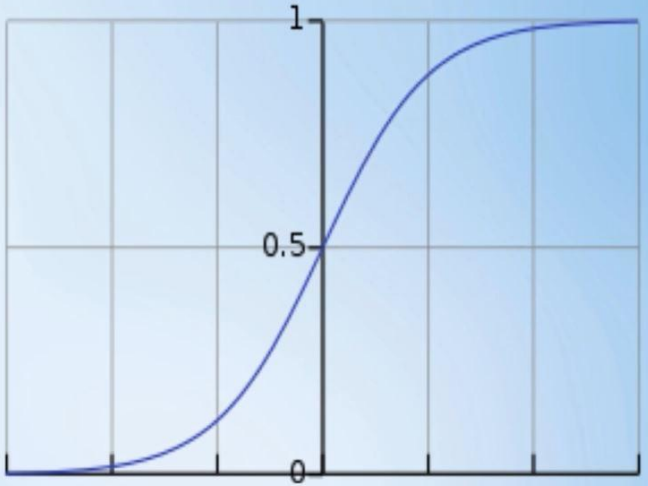
Binary

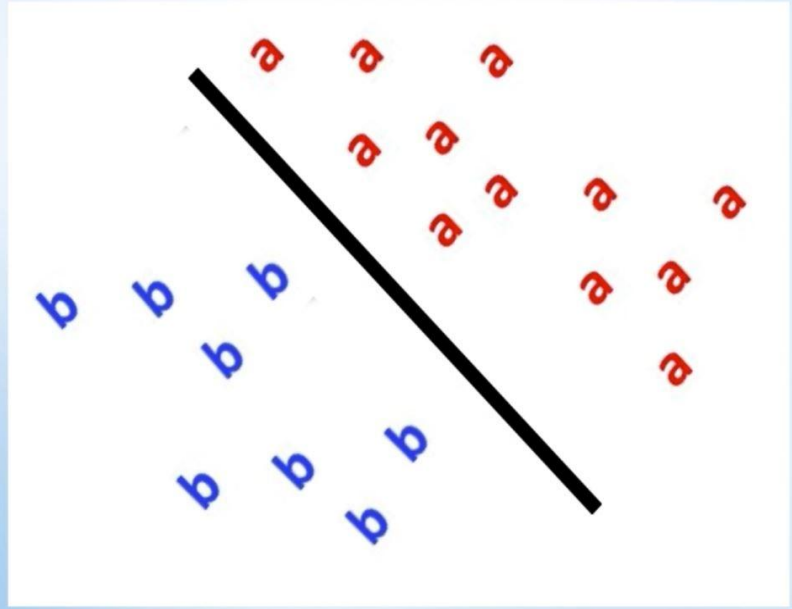


Multiclass



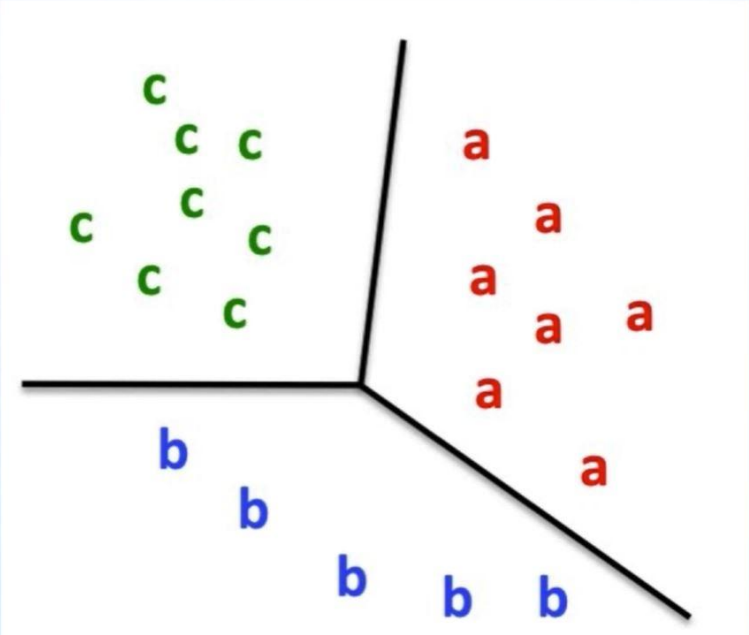

a
a
a
a
a
a
a
a
a
a
a
b
b
b
b
b
b
b
b

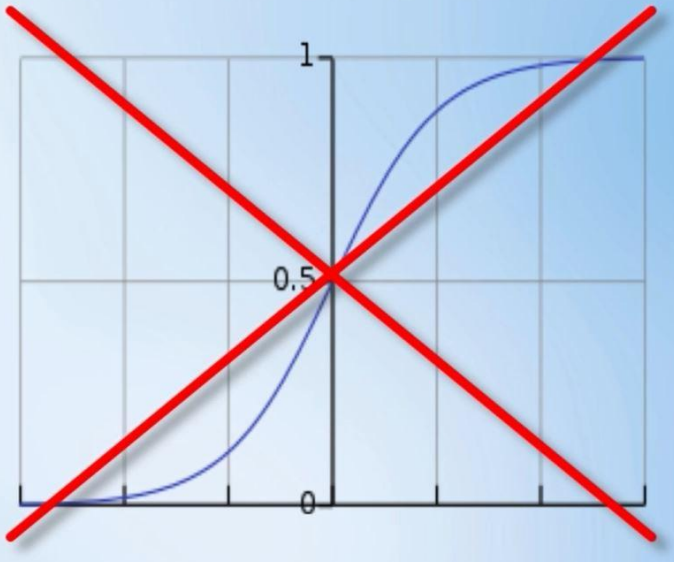

1
0.5
0



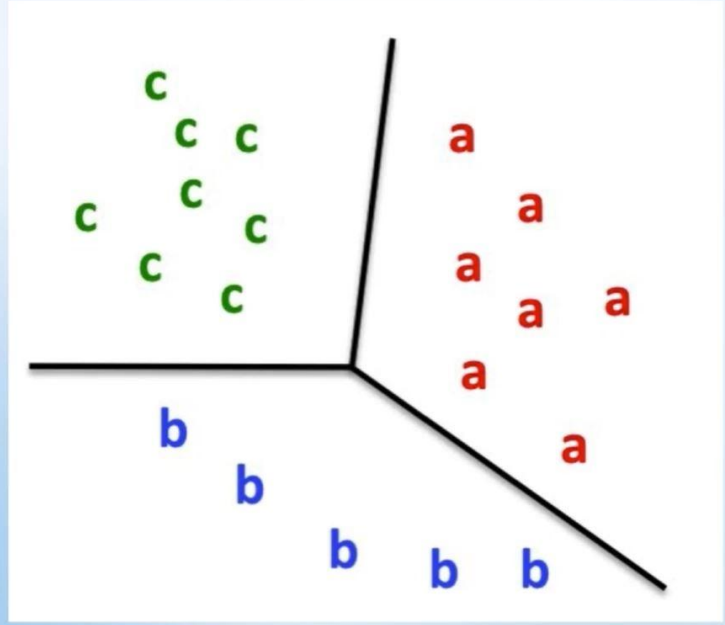
$$S(x) = e^x/(1 + e^x)$$

Multiclass

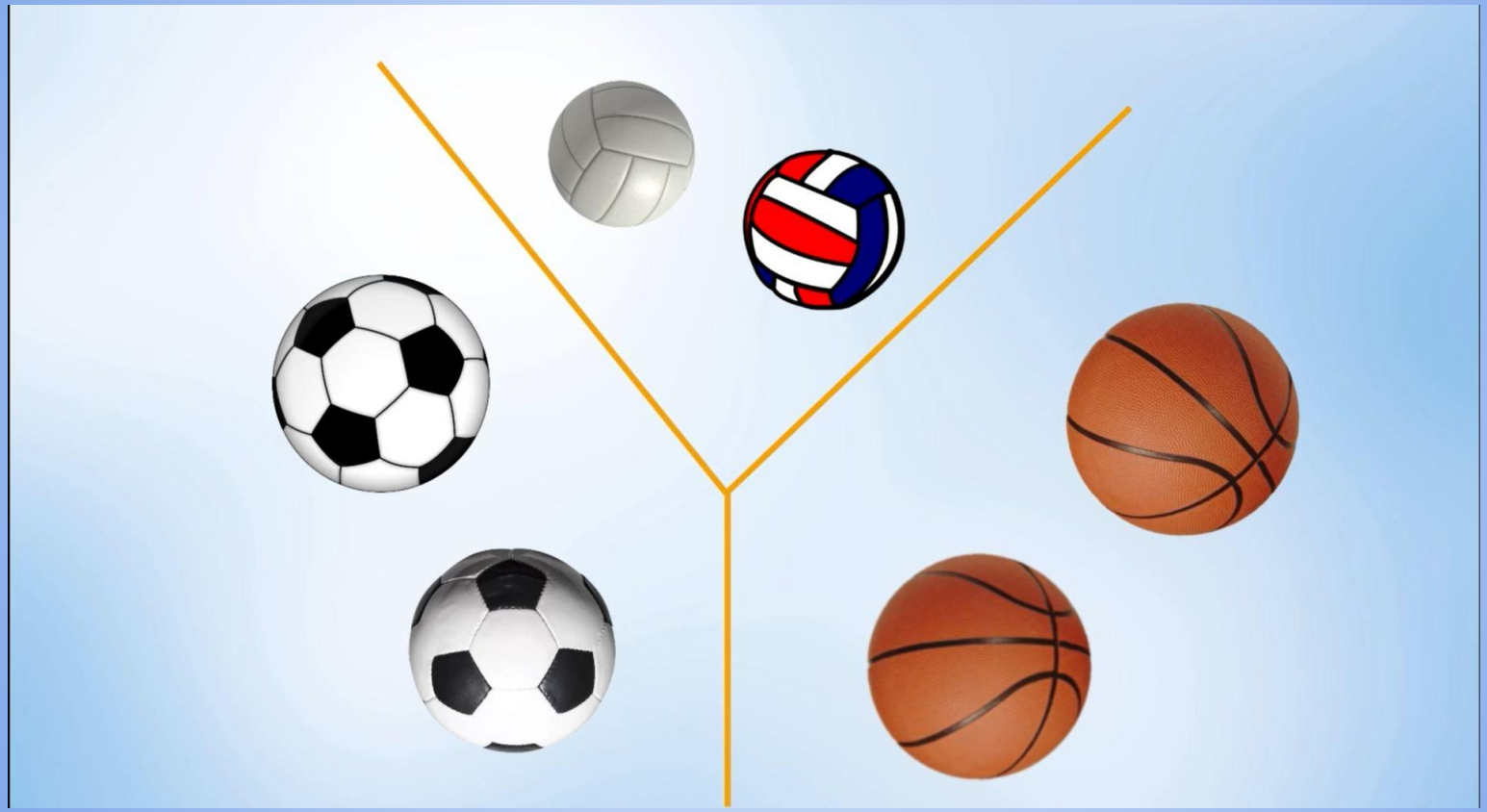


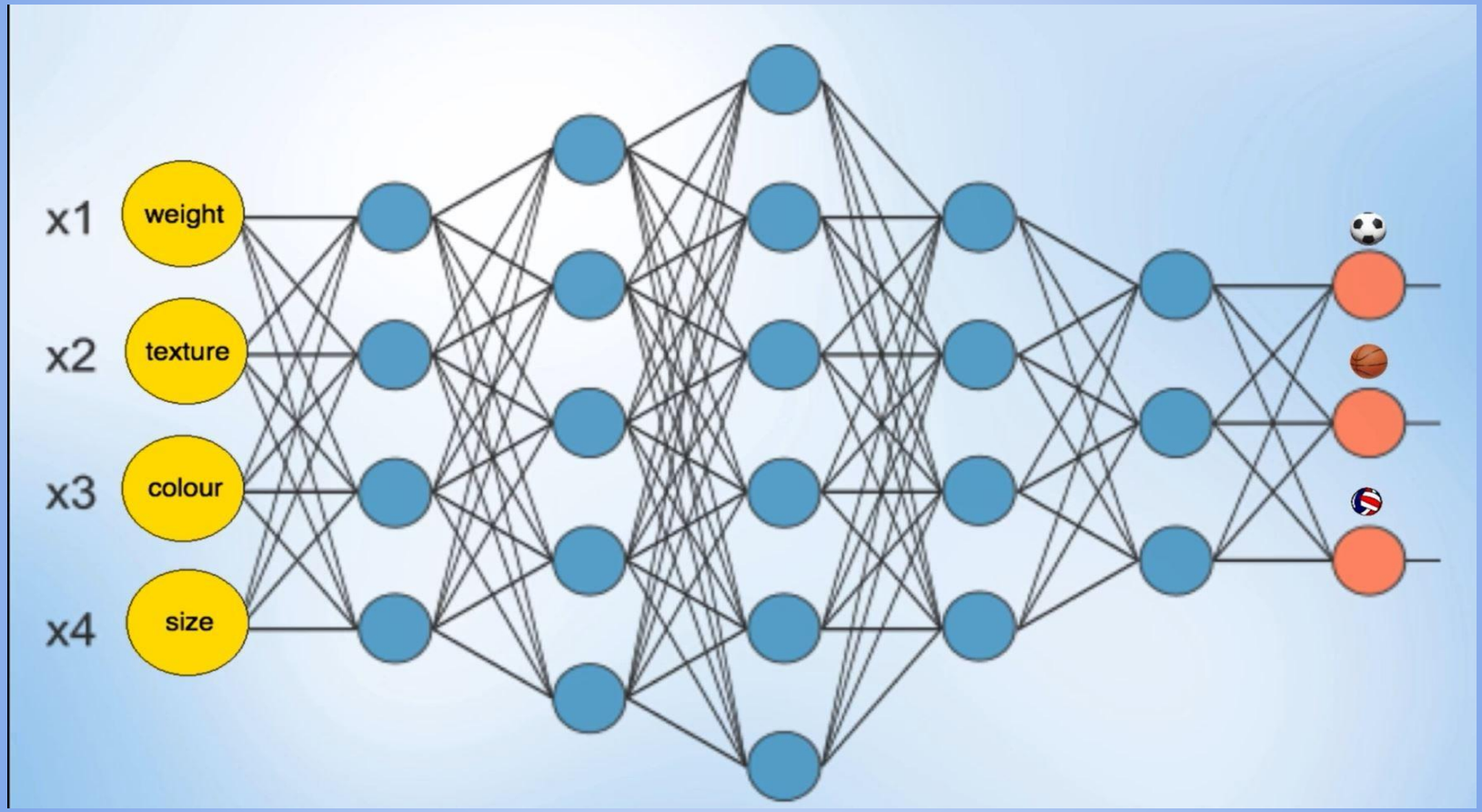


Multiclass



Softmax




x1
weight
x2
texture
x3
colour
x4
size

2

1

0

2 > 1 > 0

2 1 0

1. Relative magnitudes must be maintained

2. All Probabilities must add up to 1

$$P(score\ m) = e^m / \sum_{i=1}^{n} e^i$$

2

1

0

$$P(score\ m) = e^m / \sum_{i=1}^{n} e^i$$

2

1

0

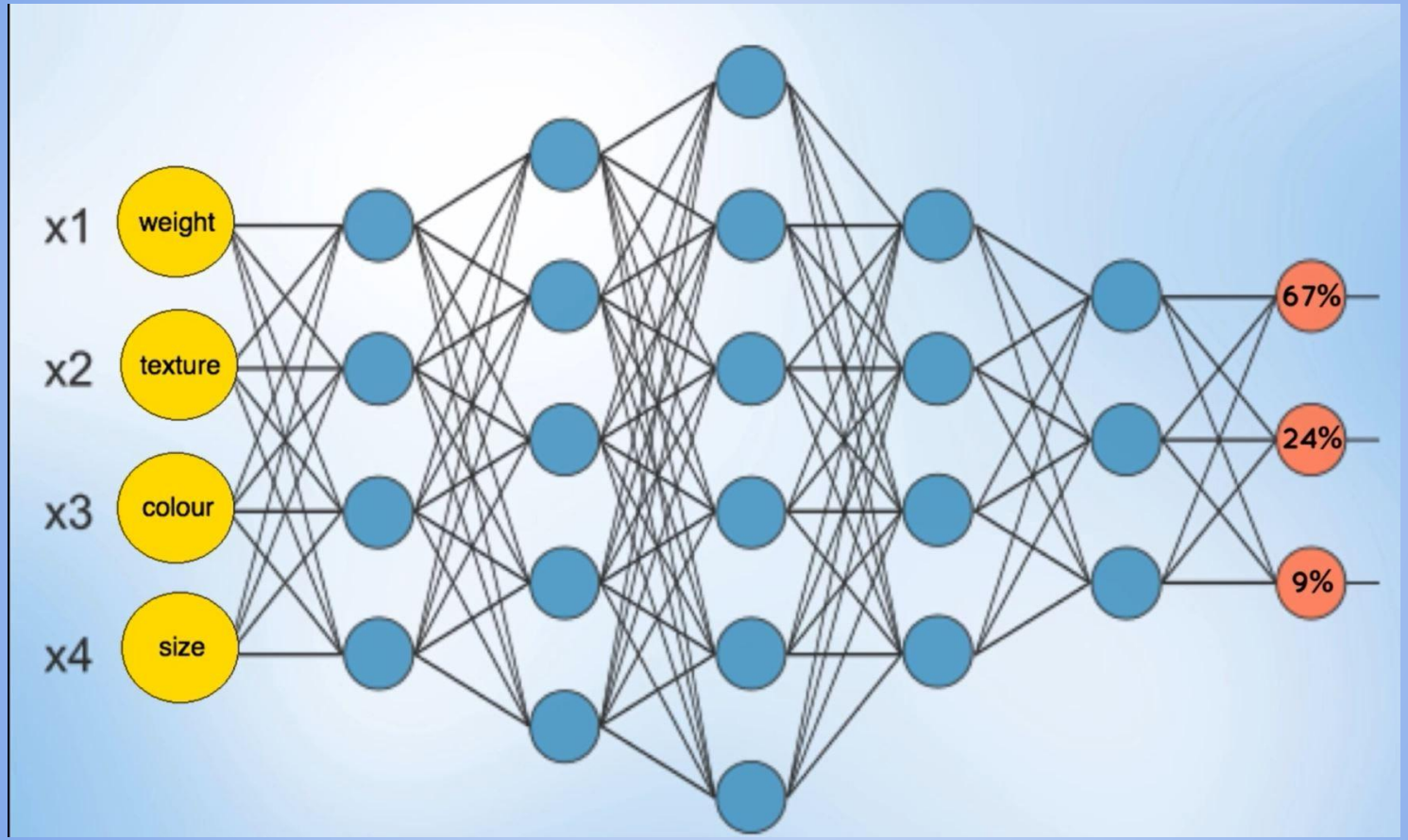
$$\frac{e^m}{e^2 + e^1 + e^0}$$

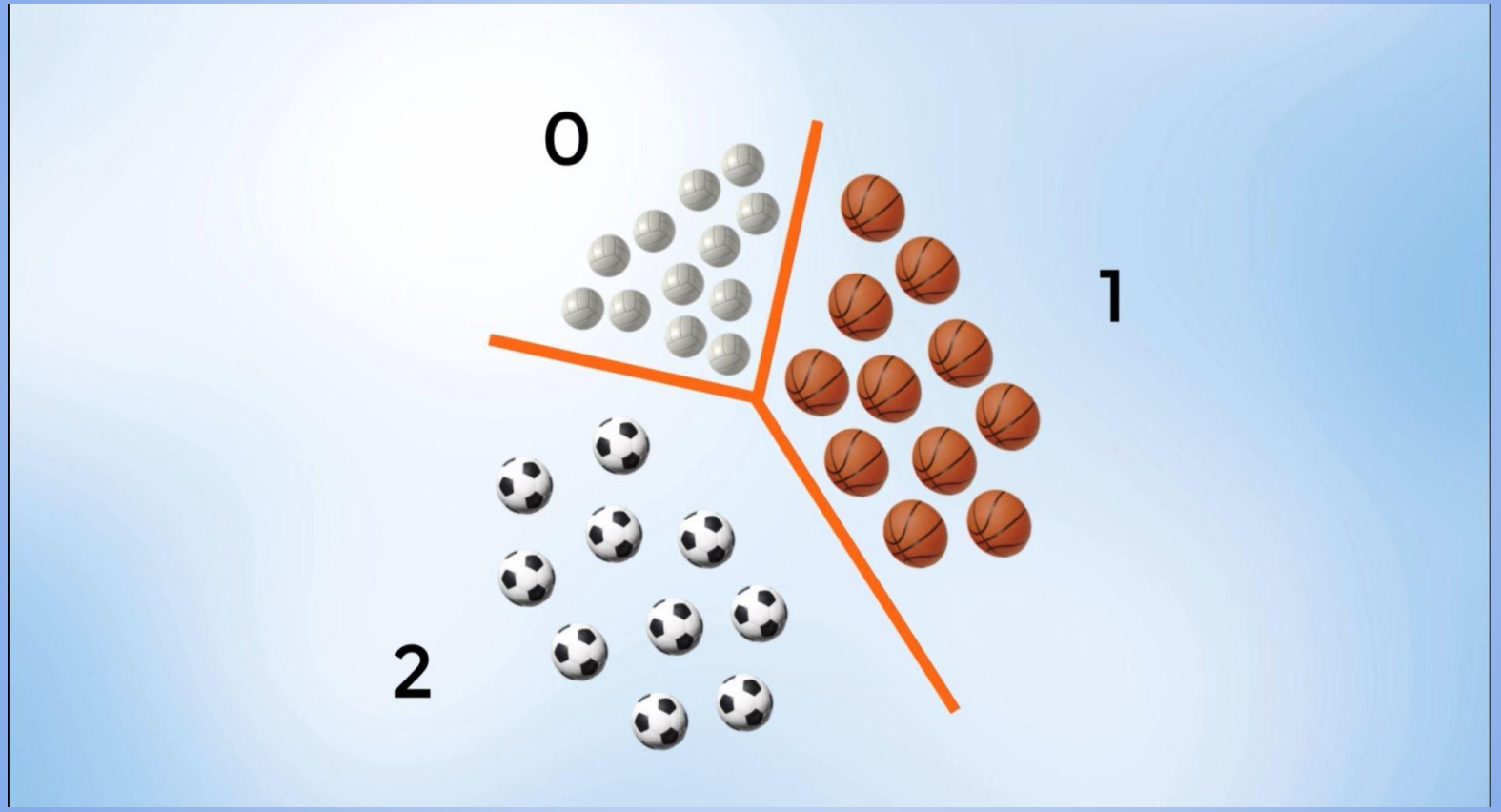
$$P(score\ m) = e^m / \sum_{i=1}^{n} e^i$$

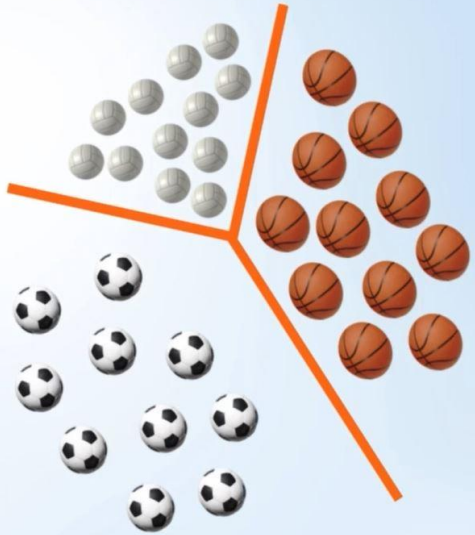
67%

24%

0.09


x1
weight
x2
texture
x3
colour
x4
size
67%
24%
9%


0
1
2



Ball Type	Value	Value	Value
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

Ball Type	Value	Value	Value
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$



Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	0.4	0.3	0.5
Basketball	0.2	0.6	0.3
Volleyball	0.4	0.1	0.2



Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	0.4	0.3	0.5
Basketball	0.2	0.6	0.3
Volleyball	0.4	0.1	0.2

$$-(\ln(0.4) + \ln(0.6) + \ln(0.2)) = 3.04$$

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy

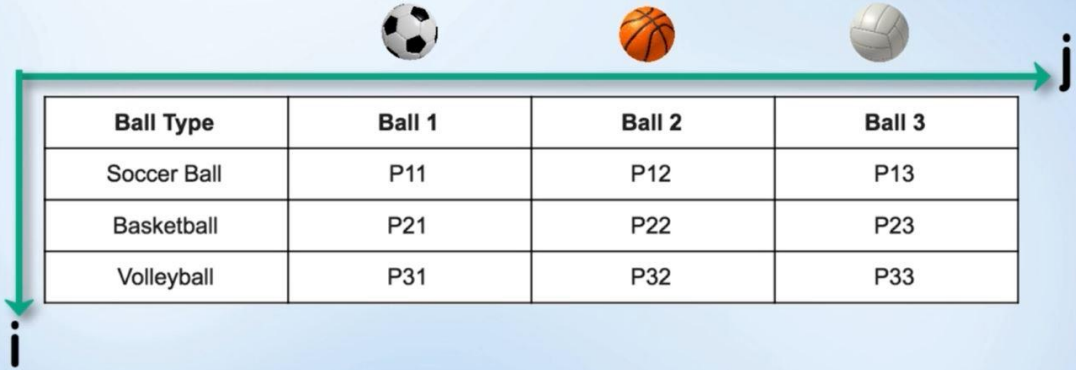


Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	0.4	0.3	0.5
Basketball	0.2	0.6	0.3
Volleyball	0.4	0.1	0.2

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy

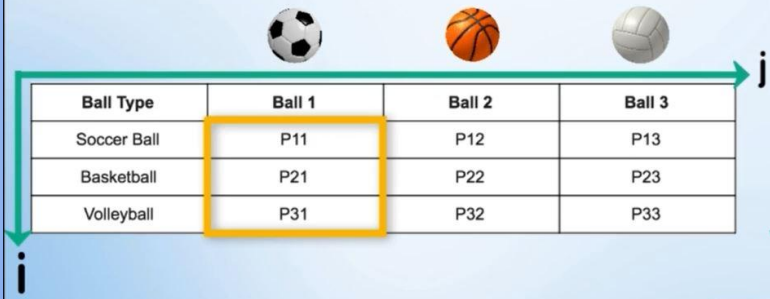


Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	P11	P12	P13
Basketball	P21	P22	P23
Volleyball	P31	P32	P33

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy



Ball Type	Ball 1	Ball 2	Ball 3
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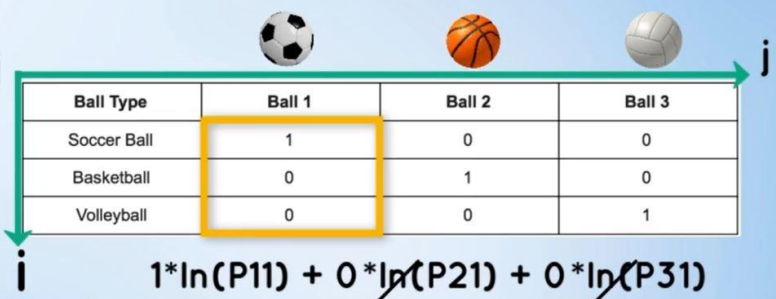
Basketball	P21	P22	P23
Volleyball	P31	P32	P33



Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

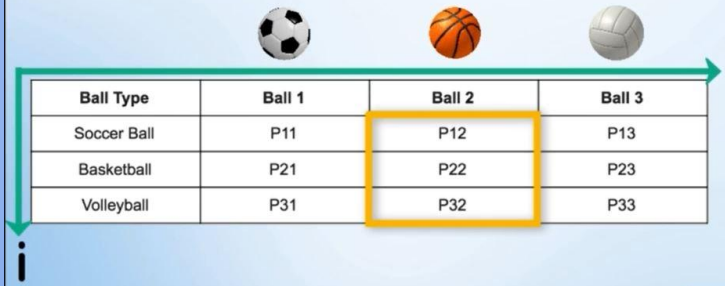
$$1*\ln(P11) + 0*\ln(P21) + 0*\ln(P31)$$

$$\sum_{j=1}^{m} y_{ij}\ln(p_{ij})$$

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy



Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	P11	P12	P13
Basketball	P21	P22	P23
Volleyball	P31	P32	P33

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

$$\sum_{j=1}^{m} y_{ij} \ln(p_{ij})$$

1*ln(P11)

0*ln(P12) + 1*ln(P22) + 0*ln(P32)

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy

j

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	P11	P12	P13
Basketball	P21	P22	P23
Volleyball	P31	P32	P33

i

j

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

i

1*ln(P11) + 1*ln(P22) + 1*ln(P33)

$$\sum_{i=1}^{n}\sum_{j=1}^{m_i} \ln(p_{ij})$$

Binary Cross Entropy

$$Cross\ Entropy = -\sum_{i=1}^{m} yiln(pi) + (1 - yi)ln(1 - pi)$$

Categorical Cross Entropy

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	P11	P12	P13
Basketball	P21	P22	P23
Volleyball	P31	P32	P33

i

j

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	1	0	0
Basketball	0	1	0
Volleyball	0	0	1

i

-(1*ln(0.4) + 1*ln(0.6) + 1*ln(0.2)) = 3.04

Ball Type	Ball 1	Ball 2	Ball 3
Soccer Ball	0.4	0.3	0.5
Basketball	0.2	0.6	0.3
Volleyball	0.4	0.1	0.2

$$-\sum_{i=1}^{n}\sum_{j=1}^{m} \ln(p_{ij})$$

Autoencoder