AML S1E5

model loss ↓ ↑ accuracy ↑↓

What are Loss Functions?

A loss function is a mathematical function that measures the difference between the predicted values from a machine learning model and the actual target values.

The goal of training is to minimize this difference, i.e., the loss.

$\hat{y}$ y

$y - \hat{y} = \text{loss}$

2) MSE MAE → Regression ; CE BCE → classification

1) MAE → Mean Absolute Error

y	$\hat{y}$	$\lvert y - \hat{y} \rvert$
3	2	$\lvert 3-2 \rvert = 1$
2	1	$\lvert 2-1 \rvert = 1$
1	2	$\lvert 1-2 \rvert = 1$
4	4	$= 0$

ignore signs

$\frac{1+1+1+0}{4} = \frac{3}{4} = 0.75$

$$MAE = \frac{1}{n}\sum_{i=1}^{n} \lvert y - \hat{y} \rvert$$

Regression DNN

Adv → It is sensitive to outliers

Disadv derivative = 0

Class → IQ ↑ CPI ↑

IQ ↓ CPI ↑

Model → loss function → MAE → derivative = 0

→ maths → derivative → GD

Mean Square Error :→

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y - \hat{y})^2$$

→ differentiable
→ easier to minimize

→ Regression
→ ANN
→ CNN

ADV

large errors
penalizes large errors

$y - \hat{y}$

y	$\hat{y}$	
3	1 →	$(1)^2$
3	2 →	$(1)^2$
6	1 →	$(5)^2$ → 25

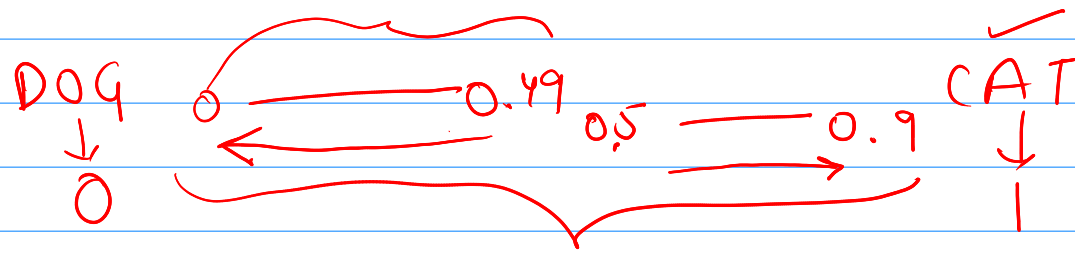
Classification :→

Binary classification

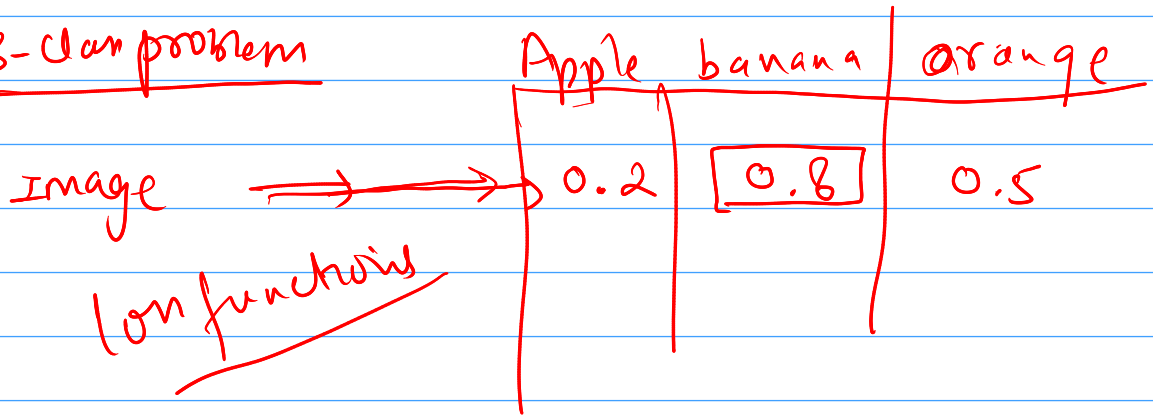
Image → Dog
→ Cat

Multi class classification

Image → Apple
→ Banana
→ orange.



3-class problem



1) Binary cross entropy :→

$$BCE = \frac{1}{n}\sum_{i=1}^{n} -\left[y \log \hat{y} + (1-y)\log(1-\hat{y})\right]$$

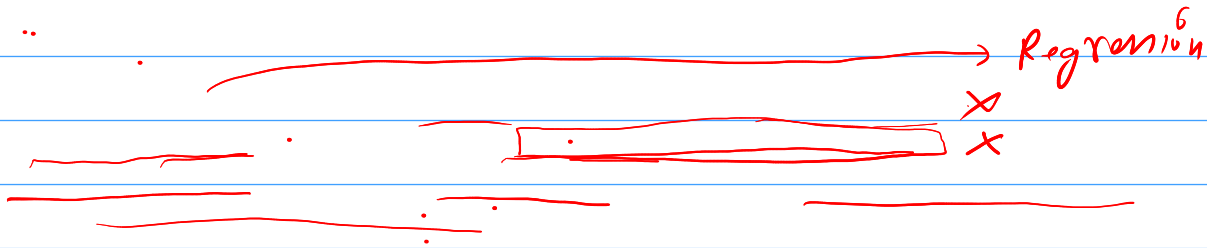
→ Binary classification tasks.

Cross Entropy :→

↳ multiclass classification

$$CE = -\frac{1}{n}\sum_{i=1}^{n} y \log \hat{y}$$

Practice Questions



Q2: Consider a binary classification problem where the true label y=1, and the predicted probability y^=0.9. Calculate the Binary Cross-Entropy Loss.

a) 0.105
b) 0.210
c) 0.010
d) 0.150

$$BCE = -[y \log \hat{y} + (1-y) \log (\hat{y})]$$

$$-[1 \log(0.9) + 0 \log(\,)]$$

$$-\log 0.9 \approx -(-0.105)$$

$$= +0.105$$

Q3: In a 3-class classification problem, the true label is [0,1,0], and the predicted probabilities are [0.2,0.5,0.3]. What is the Cross-Entropy Loss?

a) 0.693
b) 0.301
c) 0.500
d) 0.477

$$\text{true} = [\underset{A}{0} \quad \underset{B}{1} \quad \underset{C}{0}] \rightarrow \text{Image}$$

$$[0.2 \quad 0.5 \quad 0.3]$$

$$-[y \log \hat{y} + \dots]$$

$$-[0 \times \log 0.2 + 1 \times \log 0.5 + 0 \times \log 0.3]$$

$$-[\log(0.5)]$$

$$-(-0.60) = +0.60$$

Q4: For a regression task, the true value is y=4.5, and the predicted value is y^=5.2. Calculate the Mean Squared Error (MSE) for this single data point.

a) 0.49
b) 0.25
c) 0.64
d) 0.81

$$(y - \hat{y})^2$$

$$= (4.5 - 5.2)^2$$

$$= ?$$

$$0$$

Regression
- MAE
- MSE

Classification
- BCE
- CE (Multi)