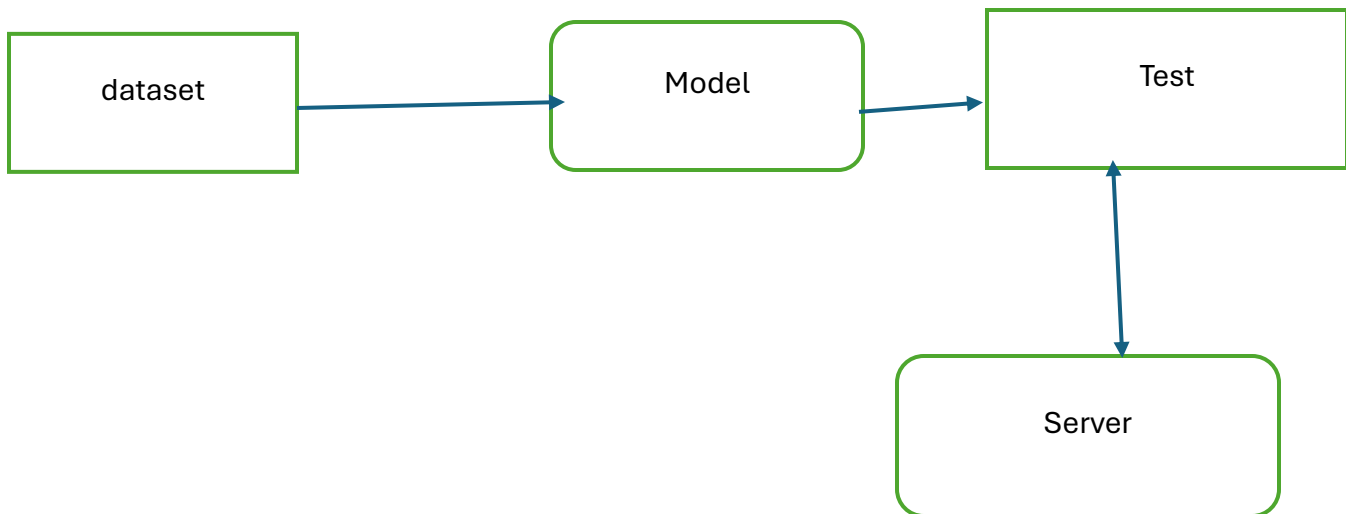


Online Learning Indepth



Offline main hum model ko train karnay kay bad server per deploy kartay hai or agar dobara update karna ho kuch tu pehlai server per hum offline hhotay hain uskay bad main waisay ho modek ko train karakay dobara server phir hum upload kartay hain

Likin Online hain model ki training kay sath ki server per deploy kar sakhtay hain agar naya data aye tu hum doran Online hai usko update karsakhtay hain

Roman Urdu + English — simple & clear explanation

★ Roman Urdu Explanation

Learning Rate machine learning (specially Gradient Descent) ka ek **hyperparameter** hota hai jo batata hai ke **model apni galti ko kitni tezi se sudharta hai**.

Jab model training kar raha hota hai, wo **error (loss)** ko kam karne ke liye steps leta hai.

Learning rate decide karta hai ke ek step kitna bara hoga.

✓ Agar Learning Rate zyada ho (bohat bara):

- Model **bohat tez jump** karta hai
- Galti se **door chala jata hai**
- Training **unstable** ho jati hai

- Loss **upar neeche hilta rehta hai**
- Kabhi kabhi model **fail bhi ho jata hai**

✓ **Agar Learning Rate bohat chhota ho:**

- Model bohat **slow** seekhta hai
- Training ko bohat **time lagta hai**
- Kabhi kabhi **local minima** mein stuck ho jata hai

✓ **Agar Learning Rate bilkul balance ho:**

- Model **smoothly** seekhta hai
- Loss **tezi se kam** hota hai
- Best results milte hain

⚙ **Formula ke sath simple concept**

Gradient Descent update rule:

$$w_{\text{new}} = w_{\text{old}} - \eta \cdot \frac{\partial L}{\partial w}$$

Yahan:

- (w) = model ka weight
- (η) = learning rate
- $(\frac{\partial L}{\partial w})$ = loss ka gradient (slope)

📌 **Real-Life Example (Easy)**

Socho tum bike chala ke **downhill** ja rahe ho aur brakes laga rahe ho:

- **Zyada brake pressure (large learning rate)** → bike hil jaati hai, gir sakte ho
- **Bohat halka brake pressure (small learning rate)** → bike rukne mein bohat time laga degi
- **Sahi brake pressure (optimal learning rate)** → bike smoothly ruk jaati hai

Yehi **learning rate** model ko smoothly best point (minimum loss) tak le jata hai.

Final Short Answer (Exam Line)

Learning rate is a hyperparameter that controls how much the model adjusts its weights during training. It determines the step size in gradient descent.

Agar chaho to main learning rate ka **diagram** bhi bana doon?