Binary Cross-Entropy Loss

Loss Function:

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

⚠ Penalizes wrong predictions heavily

∪ Convex function: Guaranteed global minimum

⚖ Asymmetric penalty: Confident wrong predictions costly

If y = 1

Loss:

$$-\log(\hat{y})$$

Minimized when $\hat{y} \to 1$

If y = 0

Loss:

$$-\log(1-\hat{y})$$

Minimized when $\hat{y} \to 0$

💡 Asymmetric penalty structure

💰 Confident wrong predictions are costly

Total Loss: Average over all training examples

📊 Interactive 3D Loss Surface

Drag to rotate • Scroll to zoom

Reset View Toggle Wireframe Auto Rotate

Interact with the 3D surface: Click and drag to rotate, scroll to zoom in/out

3D Surface Visualization: This interactive plot shows the Binary Cross-Entropy loss landscape with **X-axis: y (True Label, 0 or 1)** **Z-axis: ŷ (Predicted Value, 0-1)** **Y-axis: Loss (BCE)**

The surface is **not convex** in the traditional sense when visualized this way. Note the two "valleys" at (0,0) and (1,1) where predictions match true labels. Colors: **Blue (low loss)** → **Yellow** → **Red (high loss)**