

Logistic Regression

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Logistic regression is a supervised learning algorithm that predicts the probability of a binary outcome based on input features.

Sigmoid Function

The **sigmoid function** transforms input values into output values that lie between 0 and 1.

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

Cost Function

In linear regression, mean squared error is used but will give results with local minima, which will not help with non-linear tasks, like logistic regression. Logistic regression uses log loss which is derived from the maximum likelihood estimation method.

$$\text{Cost}(h_{\theta}(x), y) = -\log(1 - y + (2y - 1)h_{\theta}(x))$$

Loss over a batch size of m ,

$$J(\theta) = \frac{1}{m} \sum_{i=1}^m \text{Cost}(h_{\theta}(x), y)$$

At each epoch,

$$\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta)$$

Linear Regression	Logistic Regression
Predicts a continuous dependent variable using independent variables.	Predicts a categorical (binary) dependent variable using independent variables.
Solves regression problems.	Solves classification problems.
Uses the Least Squares estimation method for accuracy.	Uses the Maximum Likelihood estimation method for accuracy.
Fits a straight line (best-fit line) to predict the output.	Fits an S-curve (logistic function) to classify the samples.
Requires a linear relationship between the dependent and independent variables.	Does not require a linear relationship between the dependent and independent variables.