### **Logistic Regression Algorithm**

Logistic Regression is a statistical method used for binary classification, where the goal is to predict the probability of a data point belonging to one of two classes.

1. **Input**:
   * A dataset with input features (independent variables) and a binary target variable (dependent variable) that indicates the class (usually 0 or 1).
2. **Steps**:

**Step 1**: **Initialize Parameters**  
Start by initializing the model parameters (weights) for each input feature. These are often initialized to small random values or zero.

**Step 2**: **Compute the Linear Combination**  
For each data point, compute the weighted sum of the input features. This is a linear combination of the features and their corresponding weights (including a bias term).

**Step 3**: **Apply the Sigmoid Function**  
The result of the linear combination is passed through a sigmoid function, which outputs a probability value between 0 and 1. The sigmoid function ensures that the output can be interpreted as the probability of the data point belonging to the positive class (1).

**Step 4**: **Calculate the Error**  
Calculate the difference between the predicted probability and the actual class label (0 or 1). This is typically done using a loss function, such as cross-entropy, that measures how far the prediction is from the actual label.

**Step 5**: **Update the Parameters**  
Adjust the model parameters (weights) to reduce the error. This is typically done using optimization methods like gradient descent, which updates the parameters in the direction that minimizes the error.

**Step 6**: **Repeat Steps 2–5**  
Continue iterating over the dataset, calculating the predictions, errors, and adjusting the parameters until the model converges (i.e., the parameters no longer change significantly).

1. **Stopping Conditions**:
   * The model parameters stabilize and do not change significantly.
   * A maximum number of iterations is reached.

**Conclusion**

Logistic Regression is a fundamental and widely used algorithm in artificial intelligence for classification tasks. Despite its simplicity, it provides strong predictive capabilities, particularly for binary and multinomial classification problems. Its foundation in statistical principles allows for interpretable results, making it a preferred choice in domains like medical diagnosis, fraud detection, and sentiment analysis.

**Key Takeaways:**

**Effective for Linear Classification** – Works well when the relationship between input features and the target variable is approximately linear.  
**Interpretable and Computationally Efficient** – Offers clear insights into feature importance while being faster than complex models.  
**Limited to Linearly Separable Data** – Struggles with complex patterns, often requiring feature engineering or integration with non-linear models.

Despite its limitations, Logistic Regression remains a vital tool in AI, often serving as a baseline model for classification problems. With advancements in machine learning, it continues to be used alongside more sophisticated algorithms for enhanced predictive performance.