EXPERIMENT NO : 5

Aim: Develop and evaluate logistic regression models for multi-class classification tasks using machine learning.

Software used: Google Colab

Theory :

1. What is Logistic Regression?

- Logistic Regression is a classification algorithm that predicts the probability of an observation belonging to a class.
- It uses the sigmoid (logistic) function in binary cases and the SoftMax function in multi-class cases.

2. Multi-Class Logistic Regression

- Logistic regression is originally designed for binary classification (yes/no, spam/not spam).
- But in the real world, many problems have more than two classes:
    - Digit recognition (0–9 → 10 classes)
    - Iris dataset (3 flower types)
    - Disease classification (Healthy, Mild, Severe, Critical)

So, we extend logistic regression to multi-class settings.
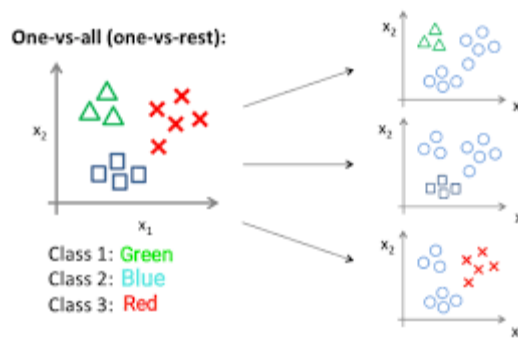
3. Example for Multinomial Logistic Regression:

(a) Which Flavour of ice cream will a person choose?

Dependent Variable:

- Vanilla
- Chocolate
- Butterscotch
- Black Current

Independent Variables:

- Gender
- Age
- Occasion
- Happiness

- Etc.

Multinomial Logistic Regression is also known as multiclass logistic regression, SoftMax regression, polytomous logistic regression, multinomial logit, maximum entropy (MaxEnt) classifier and conditional maximum entropy model.

4. Dependent Variable:

The dependent Variable can have two or more possible outcomes/classes. The dependent variables are nominal in nature means there is no any kind of ordering in target dependent classes i.e. these classes cannot be meaningfully ordered. The dependent variable to be predicted belongs to a limited set of items defined.

5. Strengths of Logistic Regression for Multi-Class

->Simple, interpretable, and efficient.
->Works well for linearly separable data.
->Probabilistic output (not just labels).
->Multinomial logistic regression (SoftMax) handles all classes simultaneously.

6. Applications of Multi-Class Logistic Regression

- Iris flower classification (Setosa, Versicolor, Virginica).

- Handwritten digit recognition (digits 0–9).

- Disease classification (Healthy, Mild, Severe).

- Sentiment analysis (Positive, Negative, Neutral).

Conclusion: Hence, we learned about develop and evaluate logistic regression models for multi-class classification tasks using machine learning.