Logistic Regression-2

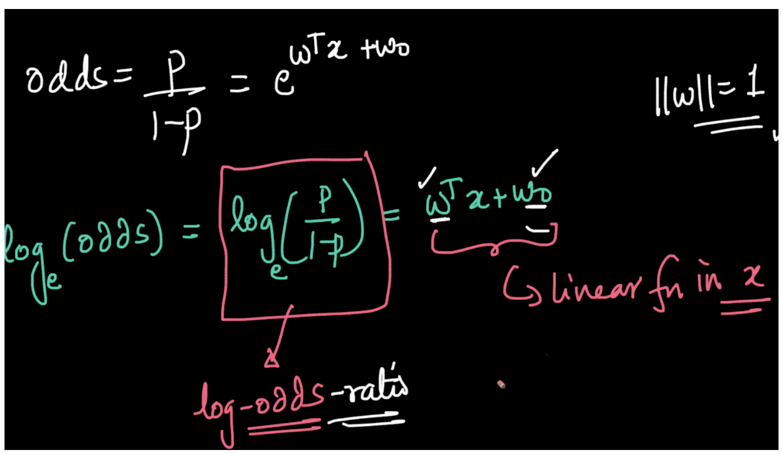
What if we want to predict the odds of $y_i = 1$ vs $y_i = 0$?

Log-odds: Shows how the model is similar to a linear model which is predicting log odds of $y_i = 1 \; vs \; y_i = 0$, defined as **:**

$$log_e(odds) = \log[\frac{p}{1-p}] \; ; \; p = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{e^{z_i}+1} \; and \; 1 - p = \frac{1}{e^{z_i}+1}$$

On substituting the value of p and 1-p, and solving it we get

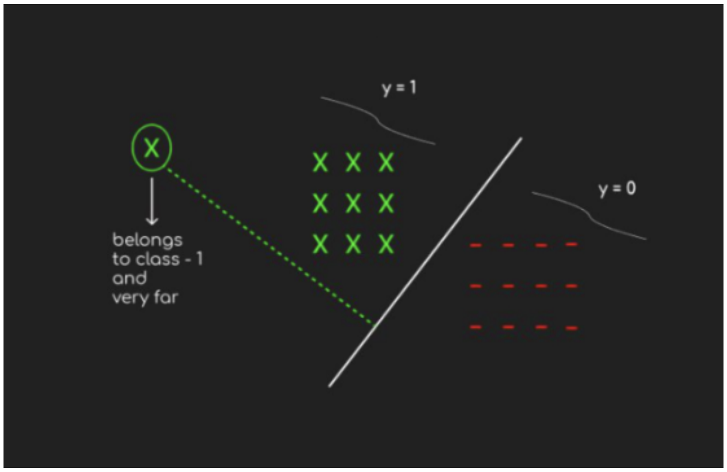
$$log_e(odds) = \log_e[e^{z_i}] = z_i = w^t x_i + w_0$$

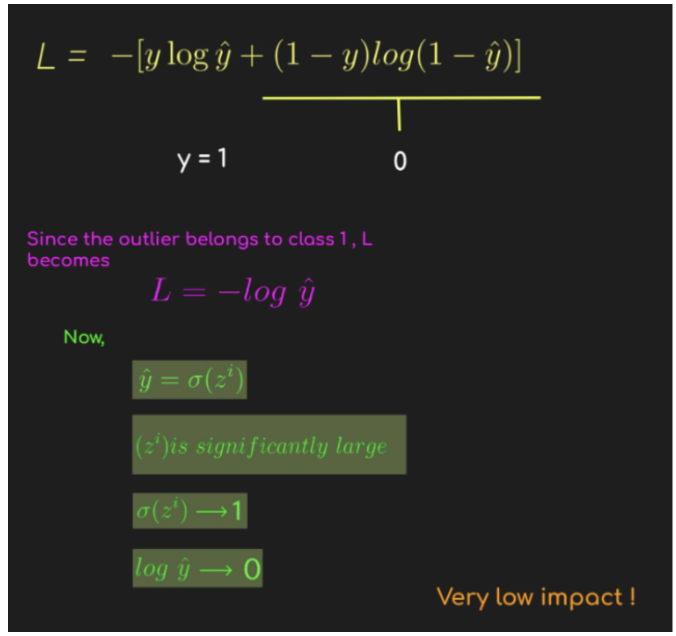


Note: Hence the name Regression in Logistic Regression.

Does Outlier Impact Logistic Regression?

Case 1: When an outlier is on the correct side

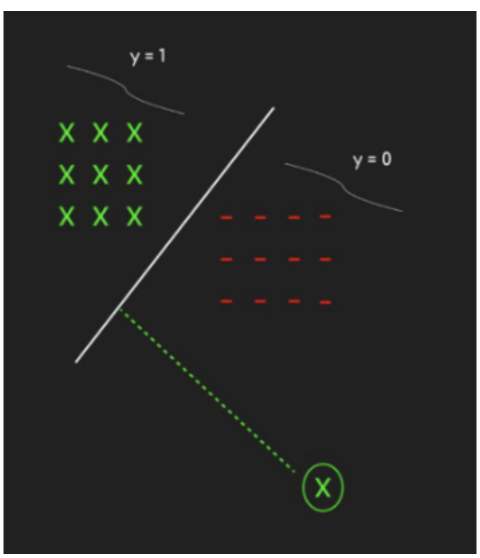


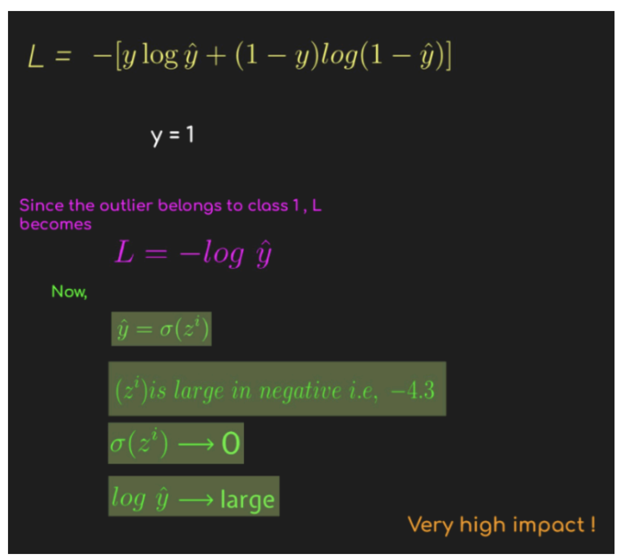


The loss value comes out to be very small.

Conclusion: The impact of the outlier is very low on the hyperplane.

Case 2: When the outlier is on the opposite side.





Loss values come out to be large.

Conclusion: Hyperplane will shift its position to minimize its loss => Huge impact on hyperplane.

Is there any way to use Logistic Regression for multiclass classification?

- **One vs Rest Method:**
  - For $y_i = \{1, 2, 3......, K\}$, generate k-binary logistic Regression models
  - We train a total of K models i.e. class 1 vs rest, class 2 vs rest
    - Such that i^{th} class is given label = 1
    - Other classes are given label = 0 when training the i^{th} model
  - Final prediction -> Argmax of all of the predictions made by each model