Machine Learning

LAB

Lab #9

Classification(Logistic Regression)

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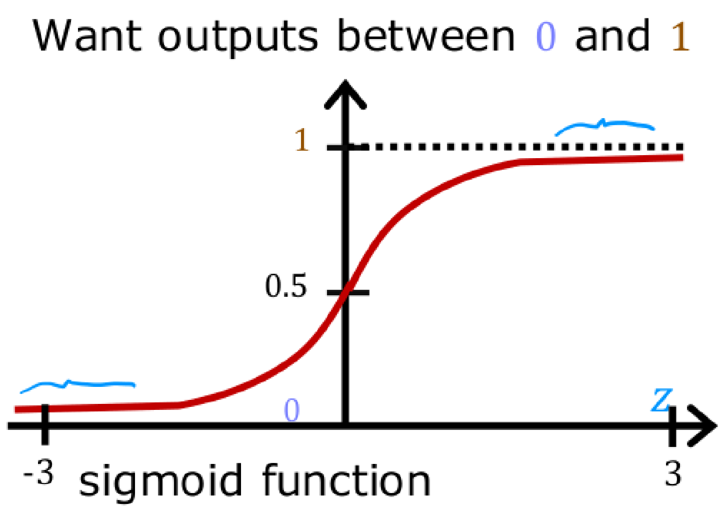
1. **Logistic Regression:**
   - Logistic regression is a classification algorithm used to predict the probability of a binary outcome (1/0, Yes/No, True/False).
   - **Logit Function**: P(y=1|X)= $\dfrac{1}{1 + e^{-(\vec{w}\cdot\vec{x}+b)}}$ <------ hypothesis of logistic regression.
   - **Decision Boundary**:
     - If P(y=1|X)>0.5 predict class 1.
     - Else, predict class 0.
   - Difference from linear regression: Linear regression is for continuous outcomes, whereas logistic regression is for categorical outcomes.
   - Use case scenarios: Medical diagnosis(malignant or benign), spam detection, etc.

1.2 Logistic Function and Sigmoid Curve:

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



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   - Explain how it maps any real-valued number into a range between 0 and 1.

2. **Mathematical Foundation: Cost Function:**

$$= -\frac{1}{m}\sum_{i=1}^{m}\left[y^{(i)}\log\left(f_{\vec{w},b}\left(\vec{x}^{(i)}\right)\right) + \left(1 - y^{(i)}\right)\log\left(1 - f_{\vec{w},b}\left(\vec{x}^{(i)}\right)\right)\right]$$

Where

$$f_{\vec{w},b}(\vec{x}) = \frac{1}{1 + e^{(-\vec{w}\cdot\vec{x}+b)}}$$

3. **Gradient Descent:**

repeat {

looks like linear regression!

$$w_j = w_j - \alpha\left[\frac{1}{m}\sum_{i=1}^{m}\left(f_{\vec{w},b}\left(\vec{x}^{(i)}\right) - y^{(i)}\right)x_j^{(i)}\right]$$

$$b = b - \alpha\left[\frac{1}{m}\sum_{i=1}^{m}\left(f_{\vec{w},b}\left(\vec{x}^{(i)}\right) - y^{(i)}\right)\right]$$

} simultaneous updates

Same concepts:

- Monitor gradient descent (learning curve)
- Vectorized implementation
- Feature scaling

Linear regression $f_{\vec{w},b}(\vec{x}) = \vec{w}\cdot\vec{x} + b$

Logistic regression $f_{\vec{w},b}(\vec{x}) = \frac{1}{1 + e^{(-\vec{w}\cdot\vec{x}+b)}}$