Learn Machine Learning Algorithms For Interviews

Linear Regression - Interview Preparation

Theoretical Understanding:

1. Quartile & Box plot - https://youtu.be/mZlR2UNHZOE
2. Loss Function and Gradient descent - https://youtu.be/Vb7HPvTjcMM
3. Concept of linear regression and R2 score - https://youtu.be/FbmSX3wYiJ4
4. Assumptions of Linear regression - https://youtu.be/hZ9Obgh0j9Y
5. Multicollinearity and VIF - https://youtu.be/QQWKY30XzNA
6. Polynomial regression - https://youtu.be/OJB5dIZ9Ngg
7. L1 L2 Regularization - https://youtu.be/iTcSWgBm5Yg

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1. What is the difference between the loss function and cost Function?

- Loss function: Used when we refer to the error for a single training example.
- Cost function: Used to refer to an average of the loss functions over an entire training data.

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2. Which are the various cost functions used in linear regression?

1. Mean Squared Error (MSE)
2. Mean Absolute Error (MAE)
3. Root mean squared error (RMSE)

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3. What is gradient descent?

- Gradient descent is an algorithm that finds the minimum of a function by taking repeated steps in the opposite direction of the function's gradient.
- $$w = w - \eta \frac{\partial J(w_j)}{\partial w_j}$$

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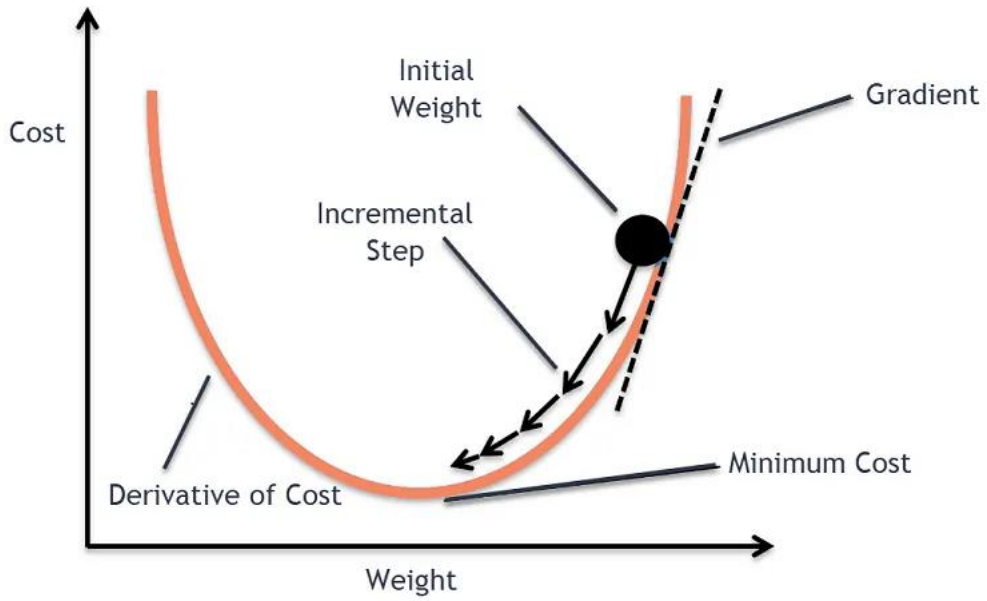

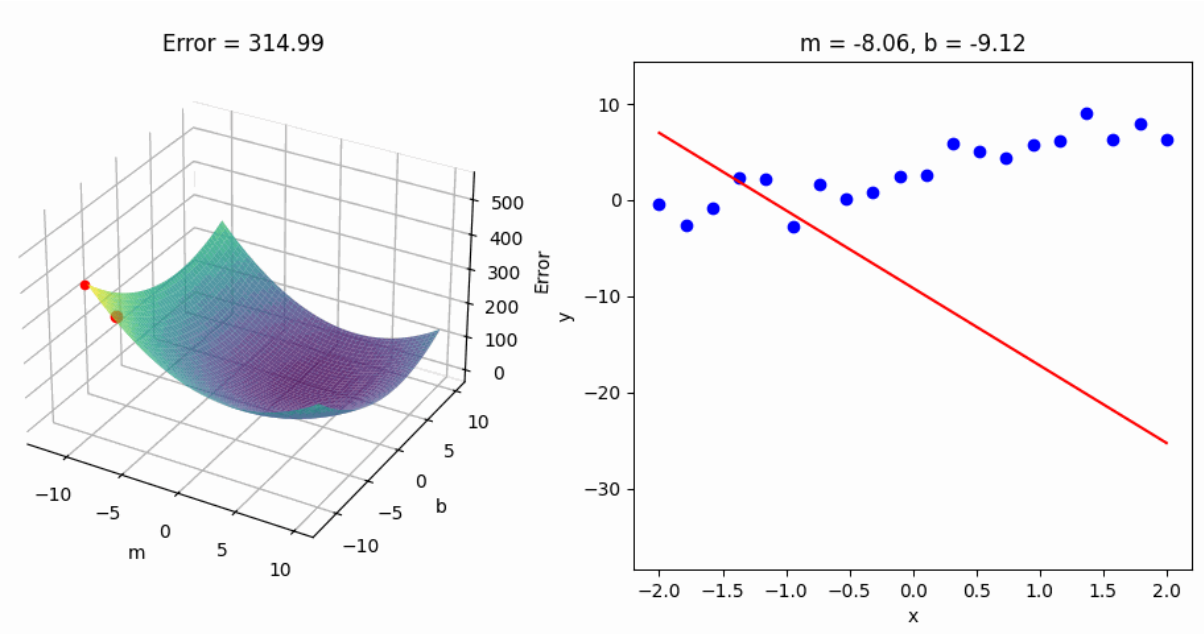

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4. What is learning rate? What is its impact on gradient descent?

- the "learning rate" is a hyperparameter that controls the size of the steps taken towards the minimum of a loss function
- High learning rate: Can cause the algorithm to oscillate or diverge, failing to converge to a solution.
- Low learning rate: May result in slow convergence, taking many iterations to reach the minimum

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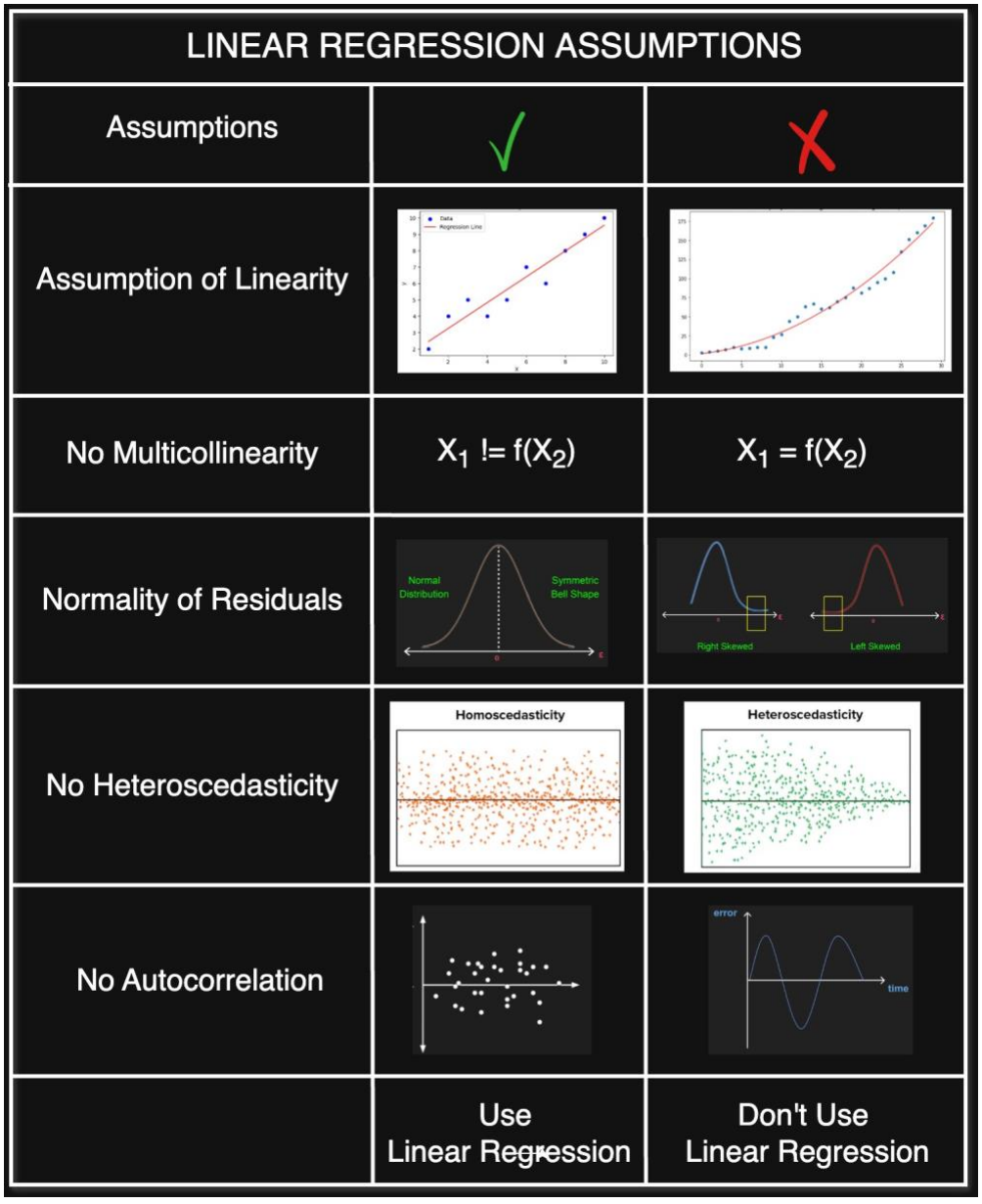
5. What Are the Basic Assumption of Linear Regression?

There are four assumptions associated with a linear regression model:

1. Assumption of Linearity: The relationship between X and the Y is to be linear.
2. No multicollinearity: There is no linear dependence between the independent variables in a model.
3. Normality of residual: Residuals in a regression model are normally distributed.
4. Homoscedasticity: The variance of residual is the same for any value of X.
5. No Autocorrelation : Residuals shound not follow any pattern with respect to time.



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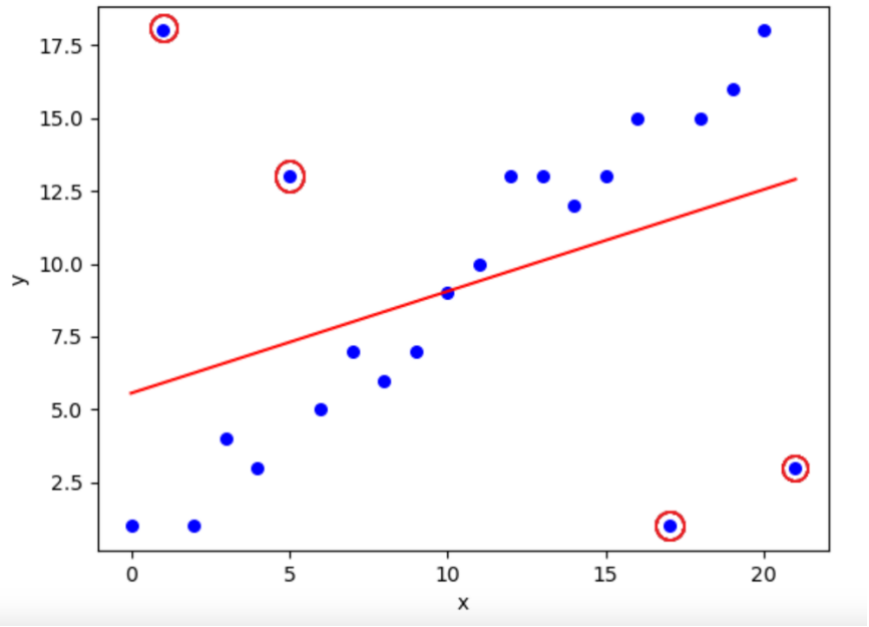
6. What are outliers? How does it affect a linear regression model?

- An outlier is a data point that is far from the rest of the data in a linear regression model.



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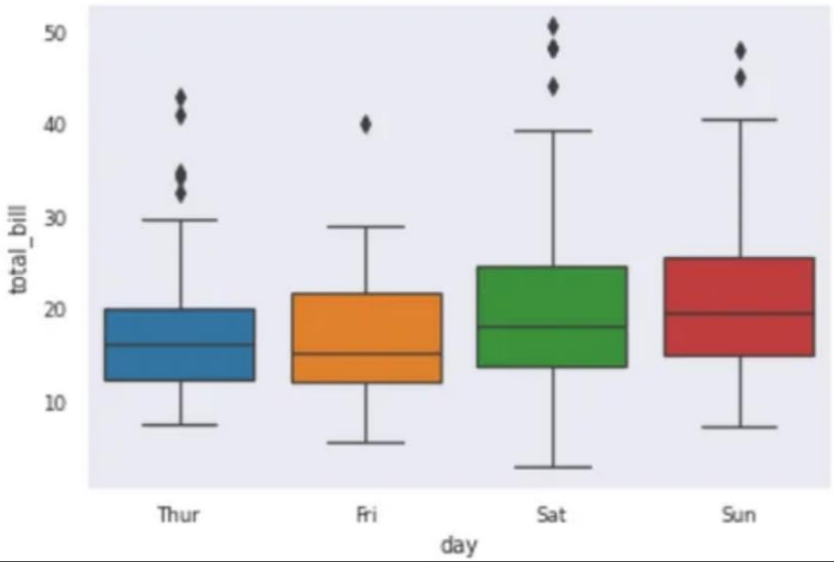
7. How do you detect and treat outliers?

- For a 2D data it is easy to visualize on the graph with scatter plot.
- For High dimensional data boxplot is the best way.



- We can either clip them or eliminate them.

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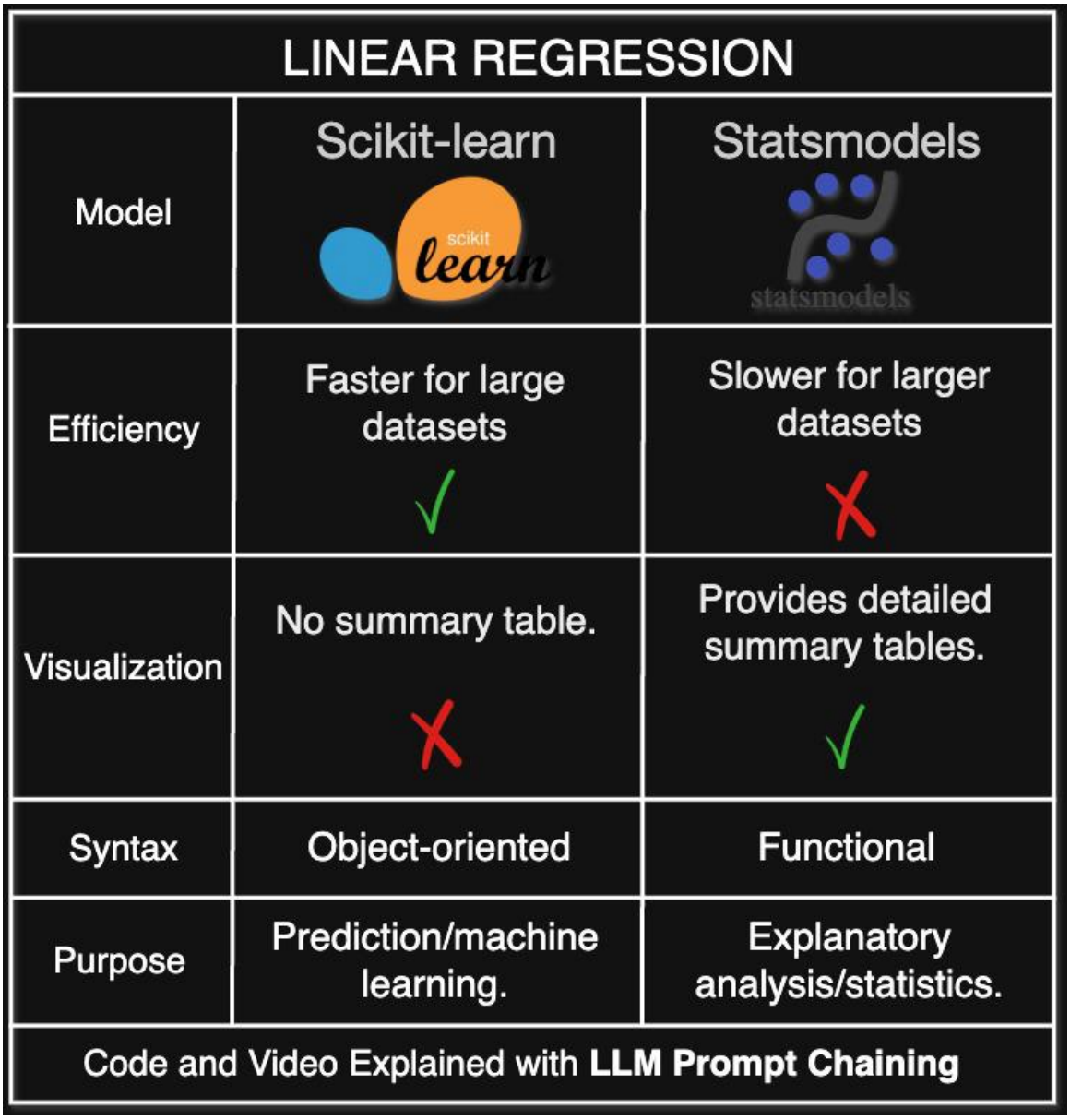
8. Which library is more useful for linear regression?



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9. what is evaluation metrics in linear regression?

- Mean Absolute Error (MAE)
- Mean Absolute Percentage Error (MAPE)
- Mean Squared Error (MSE)
- Root Mean Squared Error (RMSE)
- R-squared

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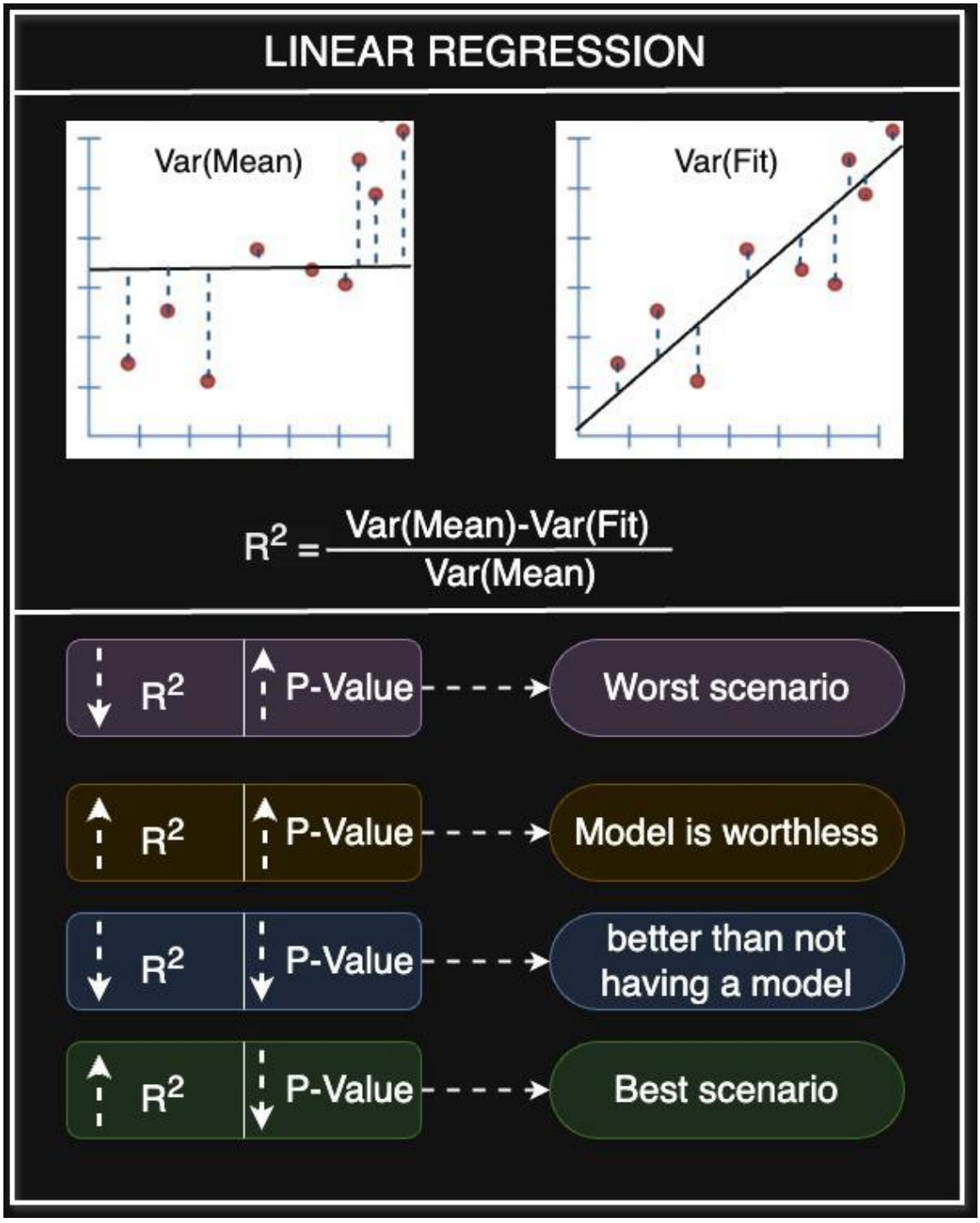
10. What is R-squared? what are the disadvantages of R-squared?



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11. What is alternative to R-squared?

- adjusted (R^2)

The formula for the adjusted (R^2) is:

$R2adj=1-((1-R2)(n-1)n-k-1)$

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Impact of Adding Relevant and Irrelevant Features on Adjusted (R^2)

- **Adding a Relevant Feature**:
    - **Impact on Adjusted (R^2)**: The increase in (R^2) is much larger than the increase in the penalty term {n - (k+1) - 1}, leading to an **increase in adjusted (R^2)**.
- **Adding an Irrelevant Feature**:
    - **Impact on Adjusted (R^2)**: The increase in the penalty term {n - (k + 1) - 1} outweighs the minimal increase in (R^2), causing adjusted (R^2) to **decrease** or **stay the same**.

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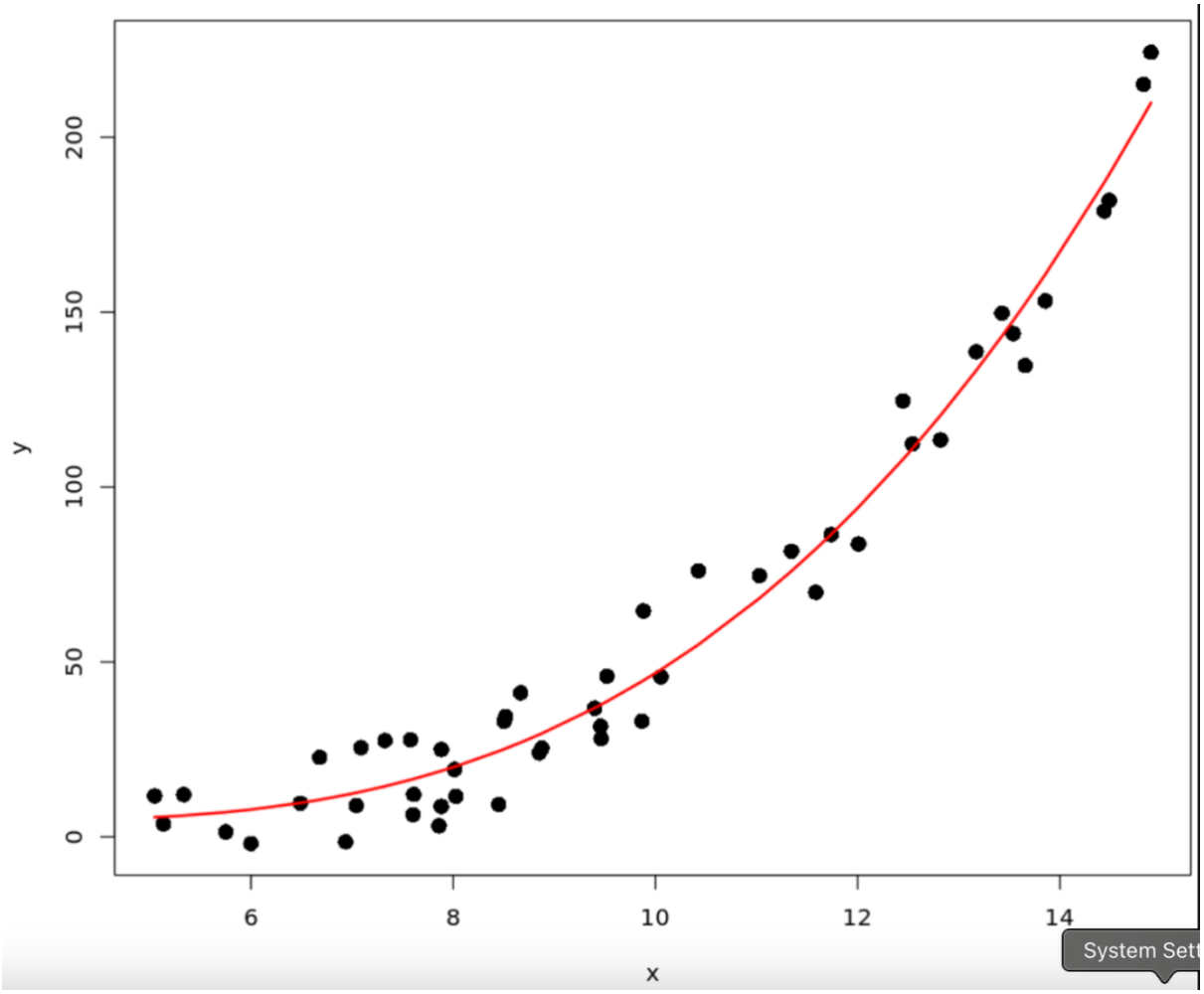
12. What is Polynomial Regression and when to use it?

- Polynomial regression is used when there is non-Linear Relationship between dependent and independent variable.



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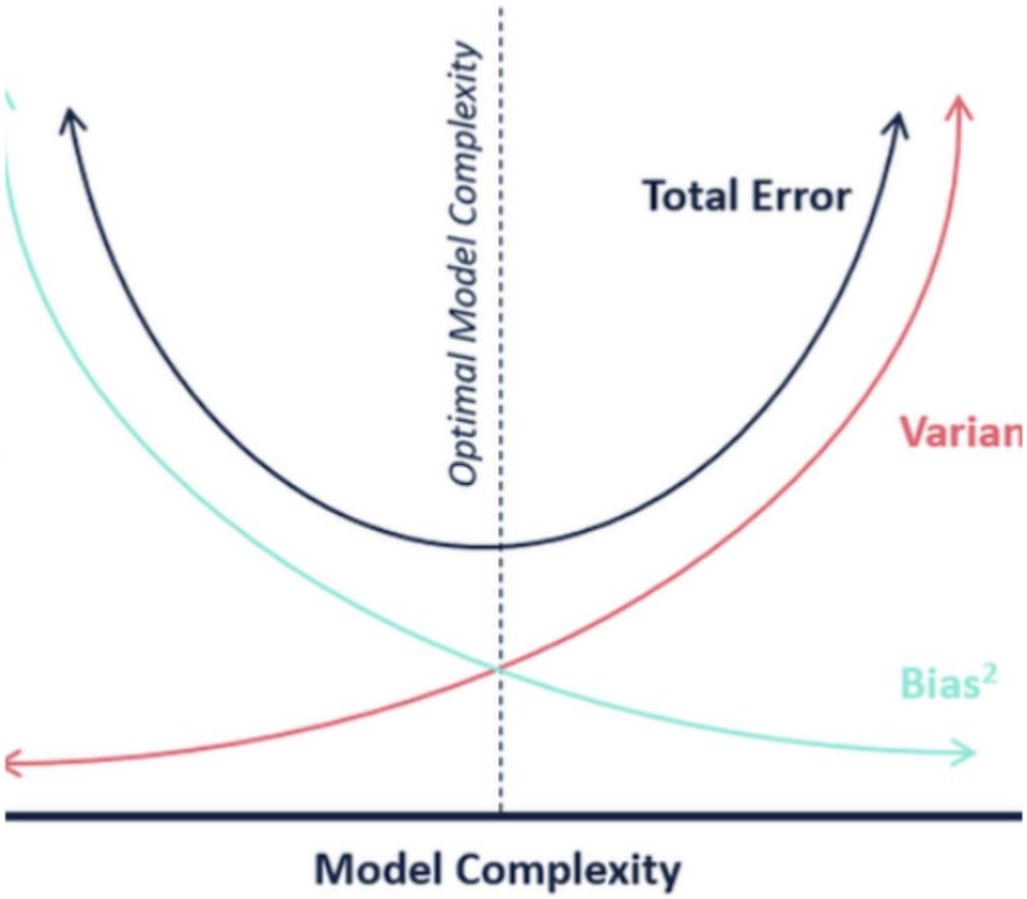
13. Explain the concept of bias-variance trade-off.

- Bias: It is defined as inability of the model to predict actual value

Bias=(Observed−Predicted)

- Variance: In machine learning, variance is the amount by which the performance of a predictive model changes when it is trained on different subsets of training data.

Variance=$(Observed-Predicted)22$



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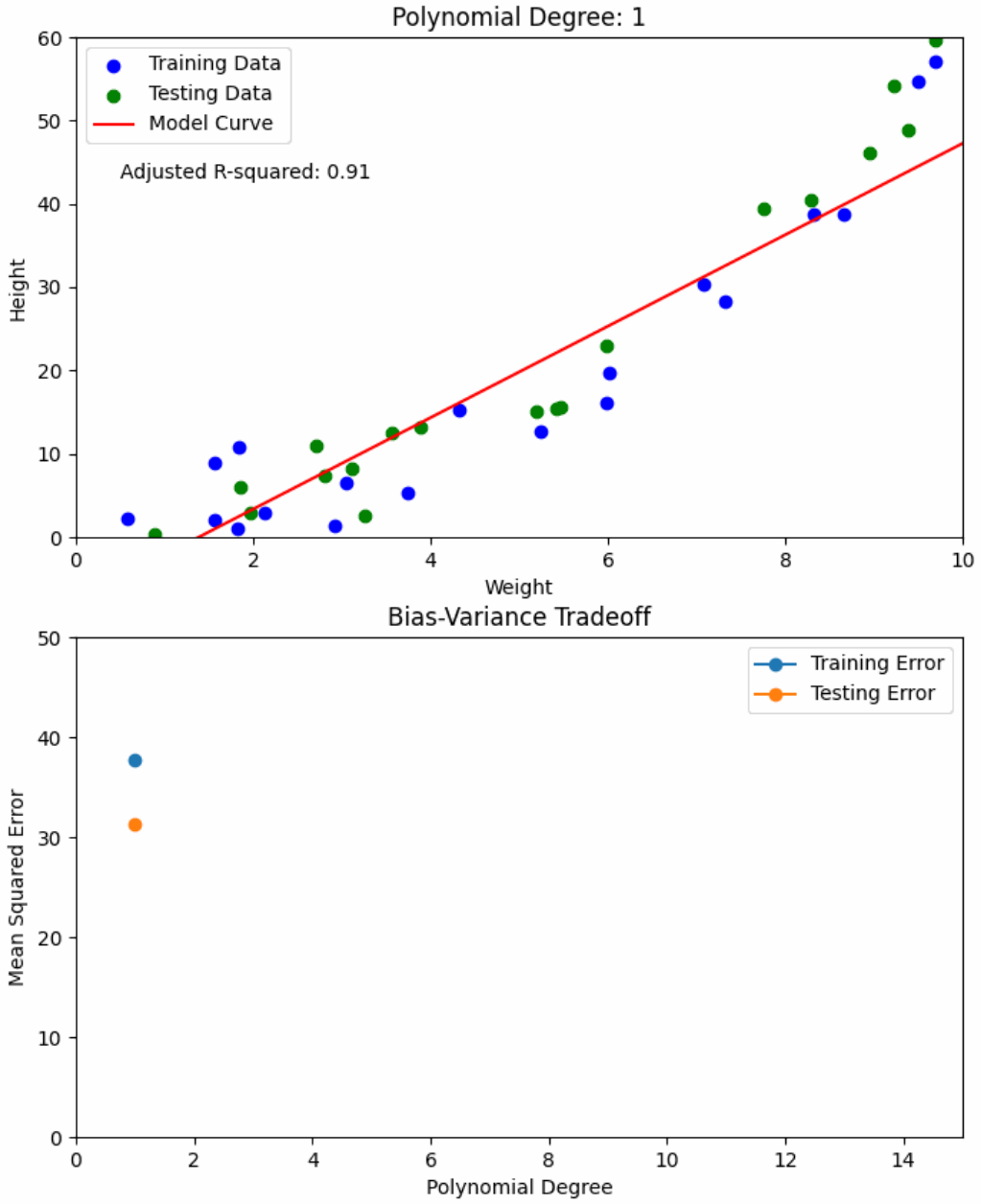

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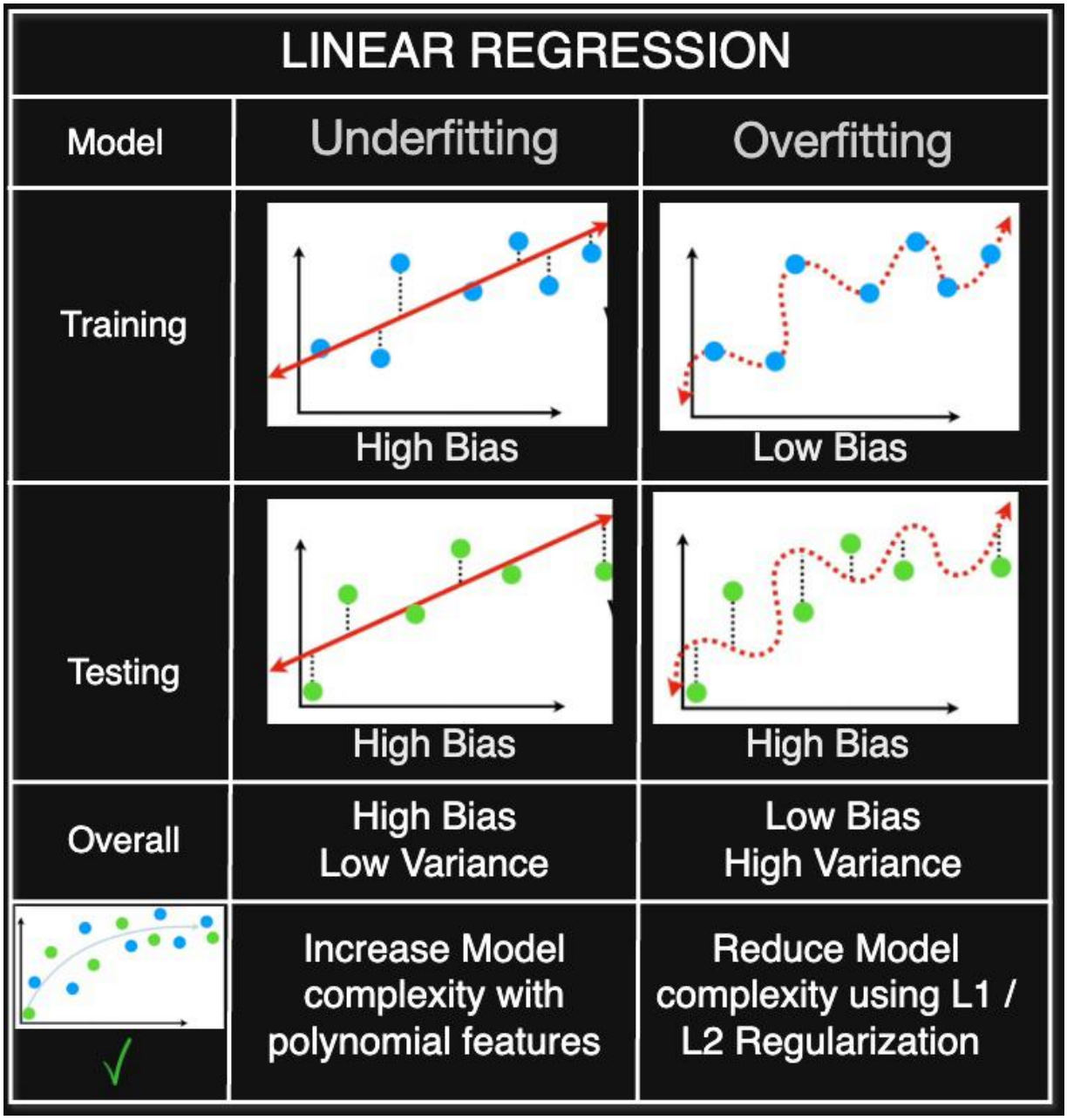
14. What is Overfitting And Underfitting? How you can identify?



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15. What is the difference between L1 and L2 regularization?

L1 and L2 Regularization Formulas

- **L1 Regularization (Lasso)**:

The overall loss function with L1 regularization is:

$$\text{cost function} = \text{MSE} + \lambda \sum_{1}^{j} | w_j |$$

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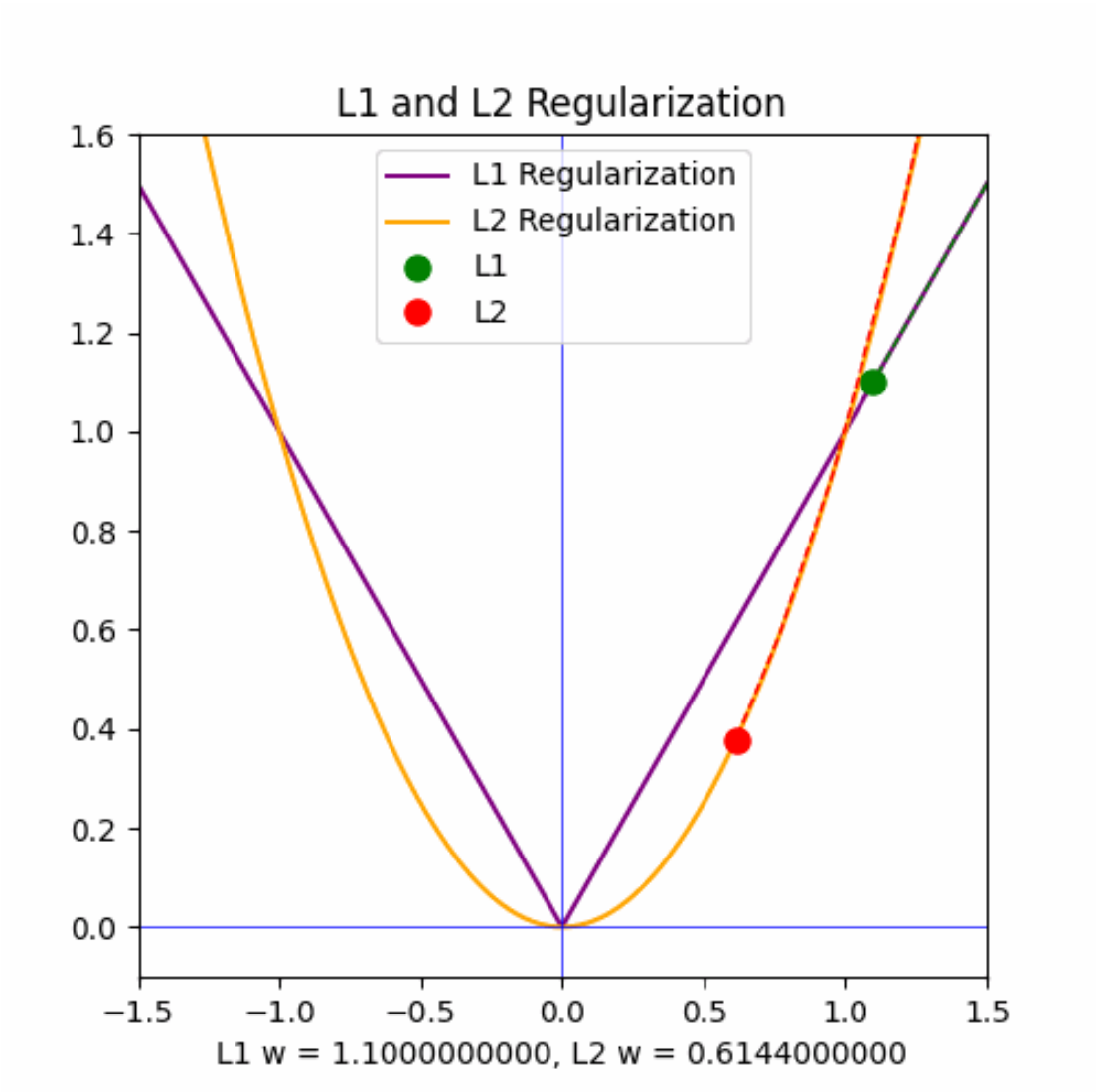
- **L2 Regularization (Ridge)**:

The overall loss function with L2 regularization is:

$$\text{cost function} = \text{MSE} + \lambda \sum_{1}^{j} (w_j)^2$$

- **Combined L1 and L2 Regularization (Elastic Net)**: A combination of both L1 and L2 regularization is sometimes used:

$$\text{cost function} = \text{MSE} + \lambda_1 \sum_{1}^{j} |w_j| + \lambda_2 \sum_{1}^{j} (w_j)^2$$



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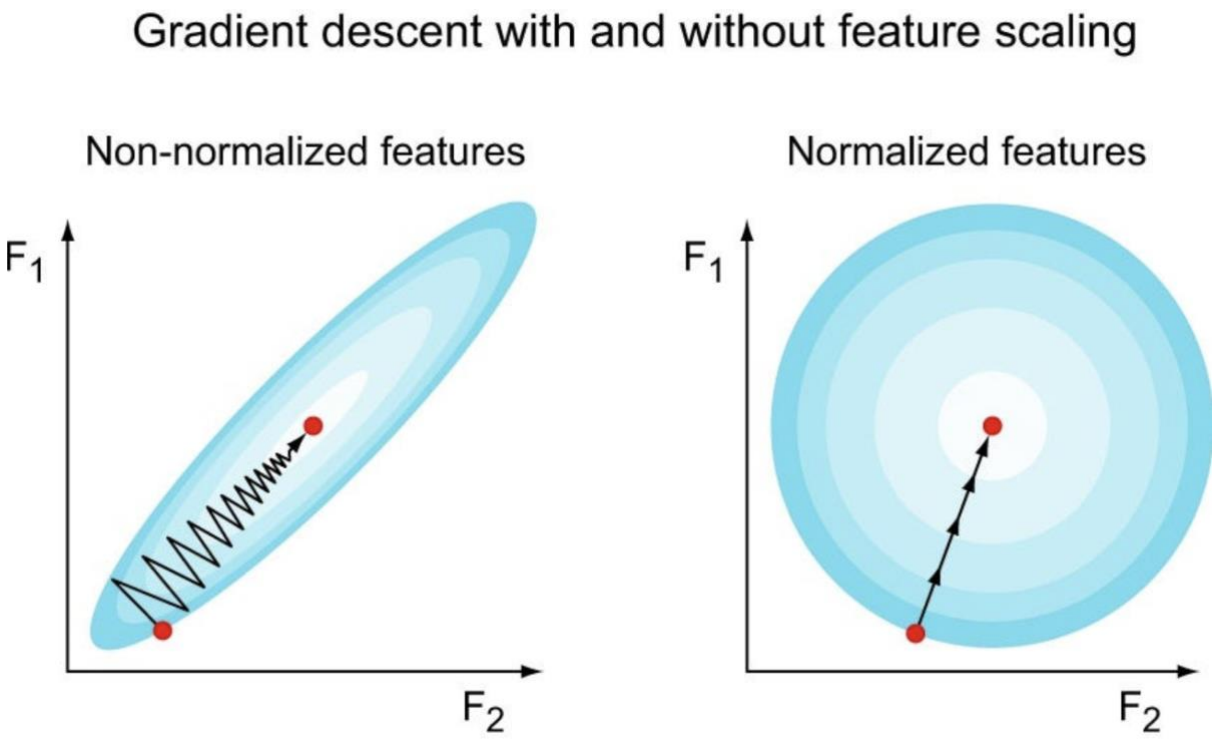
16. Whether Feature Scaling is required?

Yes



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17. What are the advantages and disadvantages of Linear Regression?

- Advantages

1. Linear regression performs exceptionally well for linearly separable data
2. Easy to implement and train the model
3. It can handle overfitting using dimensionlity reduction techniques and cross validation and regularization

- Disadvantages

1. Sometimes Lot of Feature Engineering Is required
2. If the independent features are correlated it may affect performance
3. It is often quite prone to noise and overfitting

Different Problem statement you can solve using Linear Regression

1. Pune Housing price prediction

https://www.kaggle.com/code/pritamkudale/regression

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