MACHINE LEARNING

Q1 to Q15 are subjective answer type questions, Answer them briefly.

1. R-squared or Residual Sum of Squares (RSS) which one of these two is a better measure of goodness of fit model in regression and why?

   R square is better. The value of R-sq is always between 0 (0%) and 1 (100%). The bigger the value better the fit.

2. What are TSS (Total Sum of Squares), ESS (Explained Sum of Squares) and RSS (Residual Sum of Squares) in regression. Also mention the equation relating these three metrics with each other.

   TSS: The total sum of squares (TSS) measures how much variation there is in the observed data, while the residual sum of squares measures the variation in the error between the observed data and modeled values.
   ESS:The explained sum of squares (ESS) is the sum of the squares of the deviations of the predicted values from the mean value of a response variable, in a standard regression model.
   RSS: The residual sum of squares (RSS) is a statistical technique used to measure the amount of variance in a data set that is not explained by a regression model itself. Instead, it estimates the variance in the residuals, or error term.
   Total sum of squares (TSS) = explained sum of squares (ESS) + residual sum of squares (RSS).

3. What is the need of regularization in machine learning?
   Regularization refers to techniques that are used to calibrate machine learning models in order to minimize the adjusted loss function and prevent overfitting or underfitting. Using Regularization, we can fit our machine learning model appropriately on a given test set and hence reduce the errors in it.

4. What is Gini–impurity index?
   Gini Impurity is a measurement used to build Decision Trees to determine how the features of a dataset should split nodes to form the tree. More precisely, the Gini Impurity of a dataset is a number between 0-0.5, which indicates the likelihood of new, random data being misclassified if it were given a random class label according to the class distribution in the dataset.

5. Are unregularized decision-trees prone to overfitting? If yes, why?
6. What is an ensemble technique in machine learning?
   Ensemble methods is a machine learning technique that combines several base models in order to produce one optimal predictive model . To better understand this definition lets take a step back into ultimate goal of machine learning and model building.

7. What is the difference between Bagging and Boosting techniques?
   Bagging is a technique for reducing prediction variance by producing additional data for training from a dataset by combining repetitions with combinations to create multi-sets of the original data. Boosting is an iterative strategy for adjusting an observation's weight based on the previous classification.

8. What is out-of-bag error in random forests?
   The out-of-bag (OOB) error is the average error for each calculated using predictions from the trees that do not contain in their respective bootstrap sample.

9. What is K-fold cross-validation?
   K-fold Cross-Validation is when the dataset is split into a K number of folds and is used to evaluate the model's ability when given new data. K refers to the number of groups the data sample is split into. For example, if you see that the k-value is 5, we can call this a 5-fold cross-validation.

10. What is hyper parameter tuning in machine learning and why it is done?
    Hyperparameter tuning consists of finding a set of optimal hyperparameter values for a learning

algorithm while applying this optimized algorithm to any data set. That combination of hyperparameters maximizes the model's performance, minimizing a predefined loss function to produce better results with fewer errors.

11. What issues can occur if we have a large learning rate in Gradient Descent?
    If learning rate is too large, gradient descent can overshoot the minimum. It may fail to converge and even diverge.

12. Can we use Logistic Regression for classification of Non-Linear Data? If not, why?
    Logistic regression can not be used in non linear data or else it will result in overfitting.

13. Differentiate between Adaboost and Gradient Boosting.

Adaboost	Gradient Boost
An additive model where shortcomings of previous models are identified by high-weight data points.	An additive model where shortcomings of previous models are identified by the gradient.
The trees are usually grown as decision stumps.	The trees are grown to a greater depth usually ranging from 8 to 32 terminal nodes.
Each classifier has different weights assigned to the final prediction based on its performance.	All classifiers are weighed equally and their predictive capacity is restricted with learning rate to increase accuracy.
It gives weights to both classifiers and observations thus capturing maximum variance within data.	It builds trees on previous classifier's residuals thus capturing variance in data.

14. What is bias-variance trade off in machine learning?
    the bias–variance tradeoff is the property of a model that the variance of the parameter estimated across samples can be reduced by increasing the bias in the estimated parameters.

15. Give short description each of Linear, RBF, Polynomial kernels used in SVM.
    Linear SVM: Linear SVM is used for linearly separable data, which means if a dataset can be classified into two classes by using a single straight line, then such data is termed as linearly separable data, and classifier is used called as Linear SVM classifier.
    RBF short for Radial Basis Function Kernel is a very powerful kernel used in SVM. Unlike linear or polynomial kernels, RBF is more complex and efficient at the same time that it can combine multiple polynomial kernels multiple times of different degrees to project the non-linearly separable data into higher dimensional space so that it can be separable using a hyperplane.
    In machine learning, the polynomial kernel is a kernel function commonly used with support vector machines (SVMs) and other kernelized models, that represents the similarity of vectors (training samples) in a feature space over polynomials of the original variables, allowing learning of non-linear models.