Write at least 300 words explaining the types of decision trees algorithms and applications.

Decision trees are a popular supervised machine learning method that it is applied to both regression and classification problems. The former it is used to predict a quantitative response (a continuous target variable, for example: income), while the latter it is used to predict a qualitative response (categorical target variables that are divided into categories, for examples: yes or no). (James et al., 2013)

These two types of decision trees are generically referred to as **Classification and Regression Tree (CART)**, which is a non-parametric algorithm that forms a tree base on a set or collection of rules. “It was developed by Breiman *et al.* (1984) and it is characterized by the fact that it constructs binary trees, namely each internal node has exactly two outgoing edges. The splits are selected using Twoing Criteria and the obtained tree is pruned by Cost-Complexity Pruning.” (Rokach, 2008)

Additionally to CART, other notable algorithms are: ID3, C4.5, Chi-Square automatic interaction detection (CHAID), and MARS. The ID3 algorithm uses information gain as splitting criteria to grow the tree until it is not greater than zero. This algorithm is very simple, and it does not apply pruning procedure nor does it handle numeric attributes (Rokach, 2008). The C4.5, develop by the same author (Quinlan in 1993), is an evolution of the ID3 which uses gain ratio as splitting criteria and it ceases to grow when the split is below a defined threshold (Rokach, 2008).

Roughly by the same period, Kass (1980) develop the CHAID algorithm which is a decision tree technique that uses adjusted significance testing (Bonferroni adjustment) to “(…) find the pair of values that is least significantly different with respect to the target value. For each selected pair of values, CHAID checks if the *p* value obtained is greater than a certain merge threshold. I the Answer is positive, it merges the values and searches for an additional potential pair to be merge.” (Rokach, 2008).

Finally, the MARS algorithm is a non-parametric regression analysis develop by Friedman in 1991. In essence, the technique is constructed using a multiple regression function that is approximated by using linear splines and tensor products (Rokach, 2008). Although these are some of the most popular decision trees algorithm, there are other available techniques like: QUEST, CAL5, FACT, LMDT, T1, and PUBLIC.

The above procedures are use, in the end, to construct a “if…then…else” structure that makes it easy to determine the category or variable of interest that the researcher is investigation. Among the multiple applications of decisions trees, it is possible to give the following examples: to analysis the effect a drug efficiency by a pharmaceutical company, to predict the price of a house taking into consideration several inputs, to evaluate growth opportunities using historical sales data, to predict a type of plant, o identify the relationships between a household and its electricity consumptions, and to identify and detect Fraudulent Financial Statements.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning* (Vol. 103). Springer New York. https://doi.org/10.1007/978-1-4614-7138-7

Rokach, L. (2008). *Data Mining with Decision Trees: Theory and Applications*. World Scientific.