Missing data handling is an important part of data preparation because missing values may degrade the performance of machine learning models.

Dealing with missing data requires careful thought, and there are numerous options to take.

Here are some popular techniques for dealing with missing data:

Deletion of Missing Data:

- Listwise Deletion: Also known as complete-case analysis, this involves removing entire rows with missing values. While simple, this method can lead to a significant loss of data, especially if the missing values are spread across many rows.
- Pairwise Deletion: This method retains observations with complete data for specific analyses. It keeps the available data for each pairwise comparison in the analysis. However, it may lead to different sample sizes for different analyses, which can impact the results.

Imputation Techniques:

- Mean, Median, or Mode Imputation: Replace missing values with the mean, median, or mode of the non-missing values in the same feature. This approach is straightforward but assumes that the data is missing at random (MAR) and can introduce bias if the missingness is not MAR.
- Forward Fill (or Backward Fill): Propagate the last (forward fill) or next (backward fill) valid observation to fill missing values. This method is useful when missing values occur in sequences or time series data.
- Interpolation: Use interpolation methods (e.g., linear, polynomial) to estimate missing values based on the values of neighboring data points. This approach is suitable for

time-series or sequential data.

- K-Nearest Neighbors (KNN) Imputation: Replace missing values with the average of k-nearest neighboring data points. KNN imputation takes into account the similarity between samples to estimate missing values.
- Regression Imputation: Predict missing values using regression models based on other available features. This approach assumes a linear relationship between the missing feature and the other features.

Special Values or Flags:

- Assign a special value or a specific flag to represent missing data, such as “NaN” or “-1.”

Multiple Imputation:

- Generate multiple plausible imputed datasets, each with different estimated values for missing data. Analyze each dataset separately and combine results to obtain more robust estimates and account for uncertainty.

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