Data cleaning is an essential part of data preprocessing, where the focus is on identifying and rectifying errors, inconsistencies, and inaccuracies in the raw data.

Clean data is crucial for obtaining meaningful insights and building accurate machine learning models.

Data cleaning involves several steps and techniques, including:

1. Handling Missing Data:

- Identify Missing Values: Detecting and locating missing values in the dataset, represented as NaN (Not a Number) or other placeholders.
- Removing Rows or Columns: If the missing data is significant, you may consider removing entire rows or columns that contain too many missing values.
- Imputation: Filling in missing values with estimated or imputed values. Common imputation techniques include mean, median, mode imputation, or more advanced methods like k-Nearest Neighbors imputation or regression-based imputation.

2. Dealing with Outliers:

- Identify Outliers: Detecting data points that are significantly different from the rest of the data.
- Handle Outliers: Depending on the context, outliers can be corrected, removed, or transformed using techniques like truncation or capping.

3. Data Validation:

- Check Data Integrity: Ensuring that the data adheres to predefined business rules and

constraints.
- Cross-Field Validation: Verifying that relationships between different fields in the data are consistent and logical.

4. Data Type Conversion:

- Ensure Correct Data Types: Verifying that each feature or attribute is of the correct data type (e.g., numeric, categorical, date, etc.).
- Convert Data Types: Converting data to the appropriate format, such as converting dates from strings to date-time objects.

5. Handling Duplicate Data:

- Identify and Remove Duplicates: Identifying and removing duplicate records to avoid bias and data redundancy.

6. Standardization:

- Scaling Numeric Data: Scaling numerical features to a common scale, typically between 0 and 1 or using z-score normalization.

7. Encoding Categorical Variables:

- Convert Categorical Data: Converting categorical variables into numerical representations that machine learning algorithms can work with. Common techniques include one-hot encoding or label encoding.

8. Text Cleaning (for NLP):

- Tokenization: Breaking text into individual words or tokens.
- Removing Stop Words: Eliminating common words like “the,” “is,” “and” that do not carry significant meaning.
- Lemmatization or Stemming: Reducing words to their base or root form.

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