# Results

A)Look for the missing values in all the columns and either impute them (replace with mean,median, or mode) or drop them. Justify your action for this task.

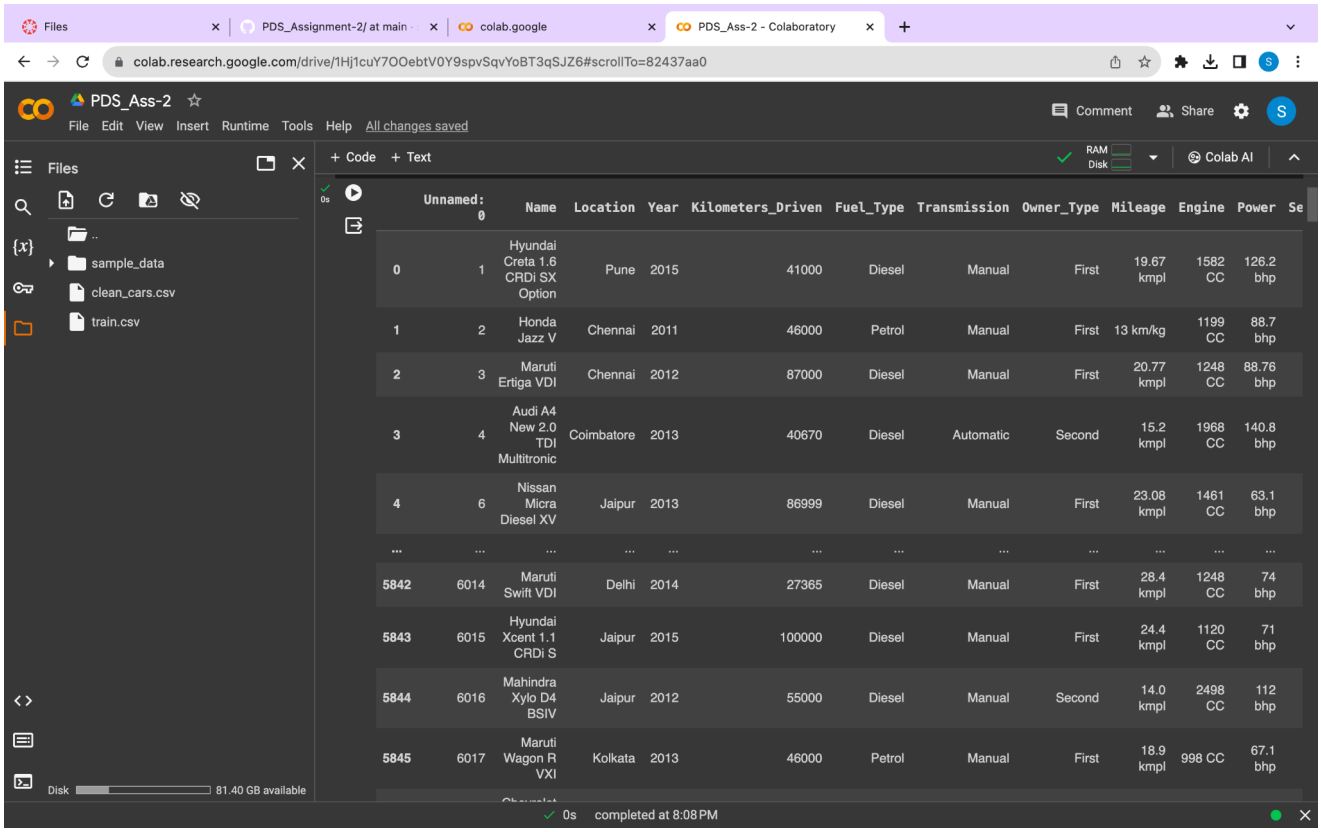
1. **Verify Any Missing Data:**
   Each column's missing values are counted using the formula {missing_values = car_data.isnull().sum()}.
   - The count of missing values for each column is shown by using {print(missing_values)}.

2. **Find Missing Values in Columns:**
   - The list "missing_columns" is generated empty.
   - It adds the missing values to the list by iteratively going over the columns.

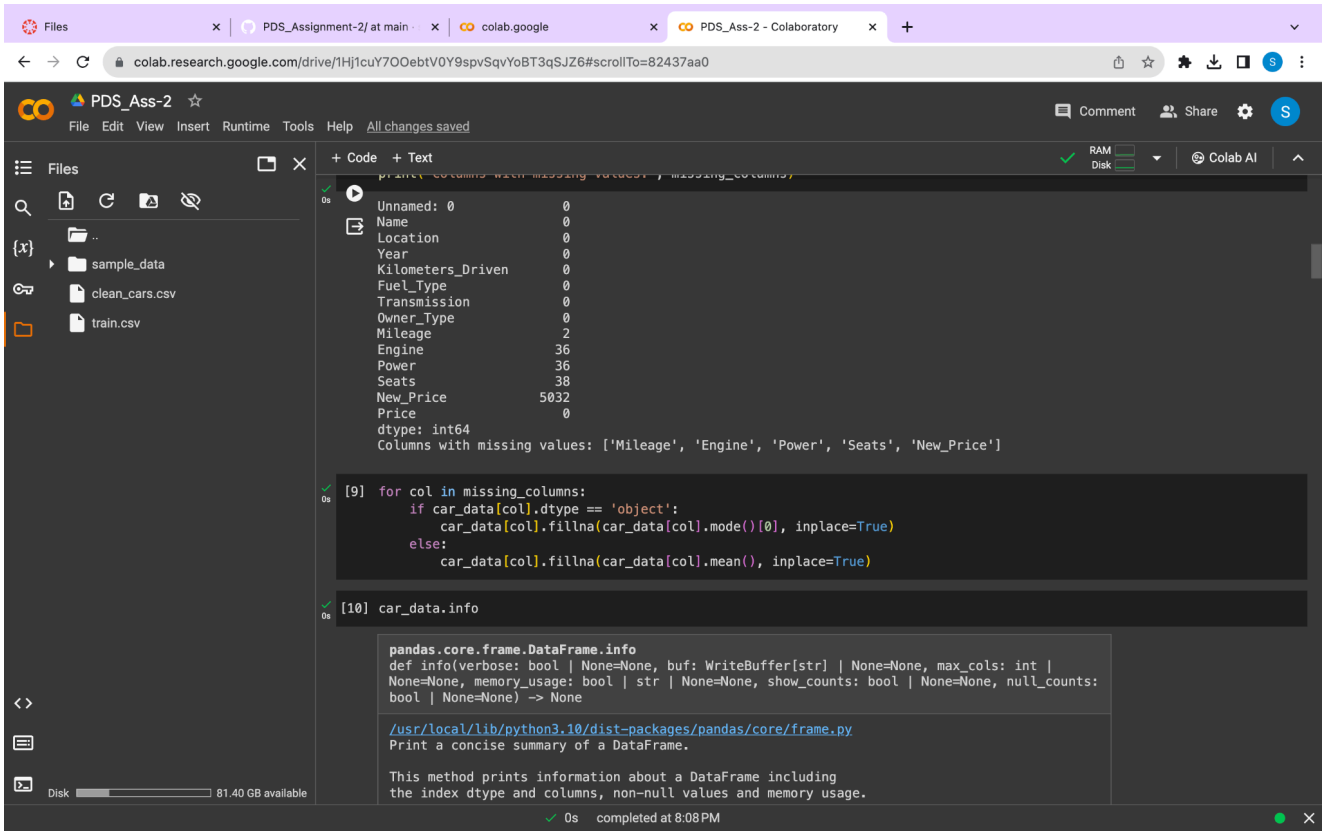
3. **Impute Missing Values:** 'missing_columns' is iterated through.
   - Uses the mode to fill in the missing values for object-type columns.
   - Uses the mean to fill in any missing values in non-object columns.

4. **Display Details about the Dataset:** - Post-imputation dataset details (non-null counts, data types, memory utilization) are displayed using `car_data.info()}.

Essentially, this function provides insights into the updated dataset and assures completeness by substituting acceptable measures for missing values.




| | Unnamed: 0 | Name | Location | Year | Kilometers_Driven | Fuel_Type | Transmission | Owner_Type | Mileage | Engine | Power | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | Hyundai Creta 1.6 CRDi SX Option | Pune | 2015 | 41000 | Diesel | Manual | First | 19.67 kmpl | 1582 CC | 126.2 bhp | |
| 1 | 2 | Honda Jazz V | Chennai | 2011 | 46000 | Petrol | Manual | First | 13 km/kg | 1199 CC | 88.7 bhp | |
| 2 | 3 | Maruti Ertiga VDI | Chennai | 2012 | 87000 | Diesel | Manual | First | 20.77 kmpl | 1248 CC | 88.76 bhp | |
| 3 | 4 | Audi A4 New 2.0 TDI Multitronic | Coimbatore | 2013 | 40670 | Diesel | Automatic | Second | 15.2 kmpl | 1968 CC | 140.8 bhp | |
| 4 | 6 | Nissan Micra Diesel XV | Jaipur | 2013 | 86999 | Diesel | Manual | First | 23.08 kmpl | 1461 CC | 63.1 bhp | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5842 | 6014 | Maruti Swift VDI | Delhi | 2014 | 27365 | Diesel | Manual | First | 28.4 kmpl | 1248 CC | 74 bhp | |
| 5843 | 6015 | Hyundai Xcent 1.1 CRDi S | Jaipur | 2015 | 100000 | Diesel | Manual | First | 24.4 kmpl | 1120 CC | 71 bhp | |
| 5844 | 6016 | Mahindra Xylo D4 BSIV | Jaipur | 2012 | 55000 | Diesel | Manual | Second | 14.0 kmpl | 2498 CC | 112 bhp | |
| 5845 | 6017 | Maruti Wagon R VXI | Kolkata | 2013 | 46000 | Petrol | Manual | First | 18.9 kmpl | 998 CC | 67.1 bhp | |



B)Remove the units from some of the attributes and only keep the numerical values (for example remove kmpl from “Mileage”, CC from “Engine”, bhp from “Power”, and lakh from “New_price”).

1. **Exploration of Data Types**
   - Each column's data types are captured by `column_data_typ = car_data.dtypes}.
   - The data types are displayed via `print(column_data_typ)}.

2. **Conversion of Data Type:** - Using `.astype(str)}, the selected columns ('Mileage, Engine, Power, and New Price') are transformed to string type.

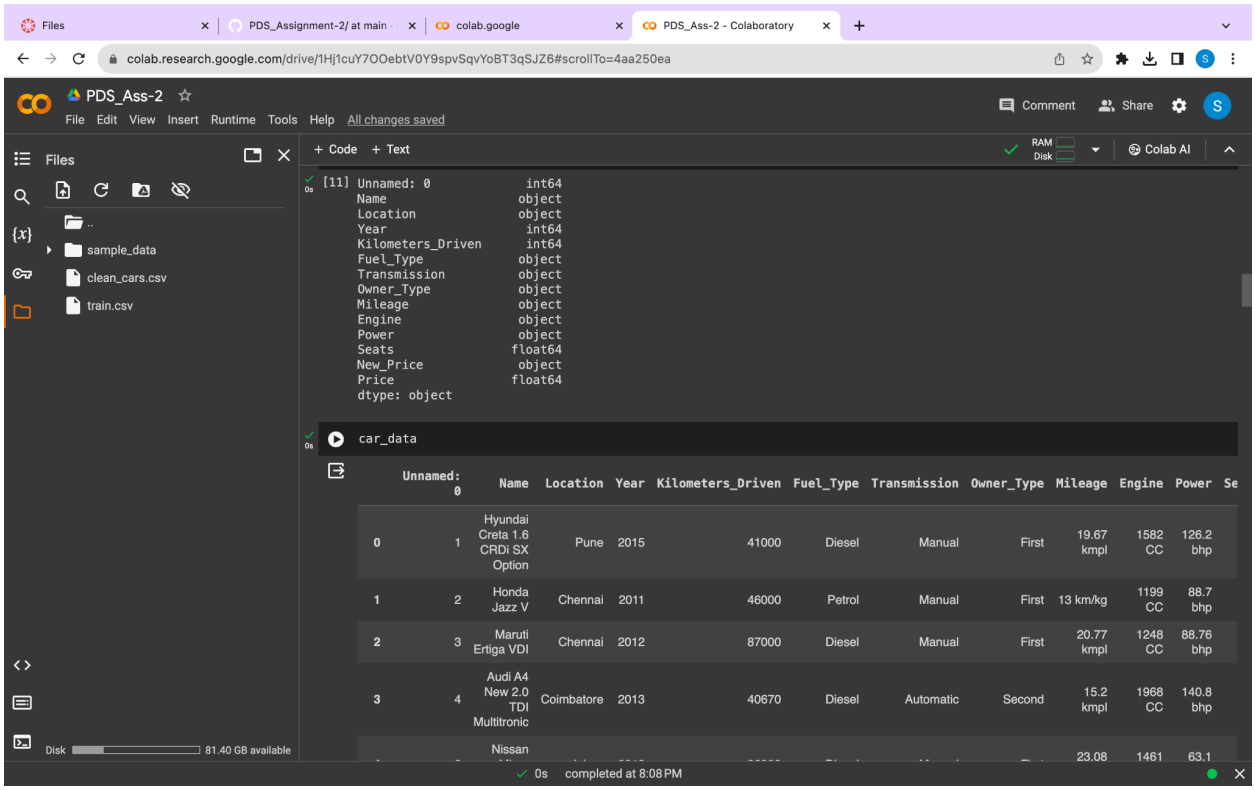
3. **Extract Numerical Values:** - Using a regular expression, numerical values are taken out of the strings and transformed to float for the 'Mileage' column.

4. **Clean "Engine" Column:** - "CC" is removed and "Engine" values are converted to numeric values. Erroneous inputs are forced to NaN.

5. **Handle Missing 'Engine' Values:** - If a value is missing in the 'Engine' column, it is changed to integer type and supplied with a default value (0).

6. **Extract Numerical Values for 'Power', 'New_Price':** - A regular expression is used to extract numerical values from the 'Power' and 'New_Price' columns, which are then converted to float.

7. **Final DataFrame:** - The updated 'car_data' DataFrame is shown, displaying the value extractions and data type conversions that were made.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[11] Unnamed: 0 int64
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Location object
Year int64
Kilometers_Driven int64
Fuel_Type object
Transmission object
Owner_Type object
Mileage object
Engine object
Power object
Seats float64
New_Price object
Price float64
dtype: object
car_data
Unnamed: 0 Name Location Year Kilometers_Driven Fuel_Type Transmission Owner_Type Mileage Engine Power Se
0 1 Hyundai Creta 1.6 CRDi SX Option Pune 2015 41000 Diesel Manual First 19.67 kmpl 1582 CC 126.2 bhp
1 2 Honda Jazz V Chennai 2011 46000 Petrol Manual First 13 km/kg 1199 CC 88.7 bhp
2 3 Maruti Ertiga VDI Chennai 2012 87000 Diesel Manual First 20.77 kmpl 1248 CC 88.76 bhp
3 4 Audi A4 New 2.0 TDI Multitronic Coimbatore 2013 40670 Diesel Automatic Second 15.2 kmpl 1968 CC 140.8 bhp
Nissan 23.08 1461 63.1
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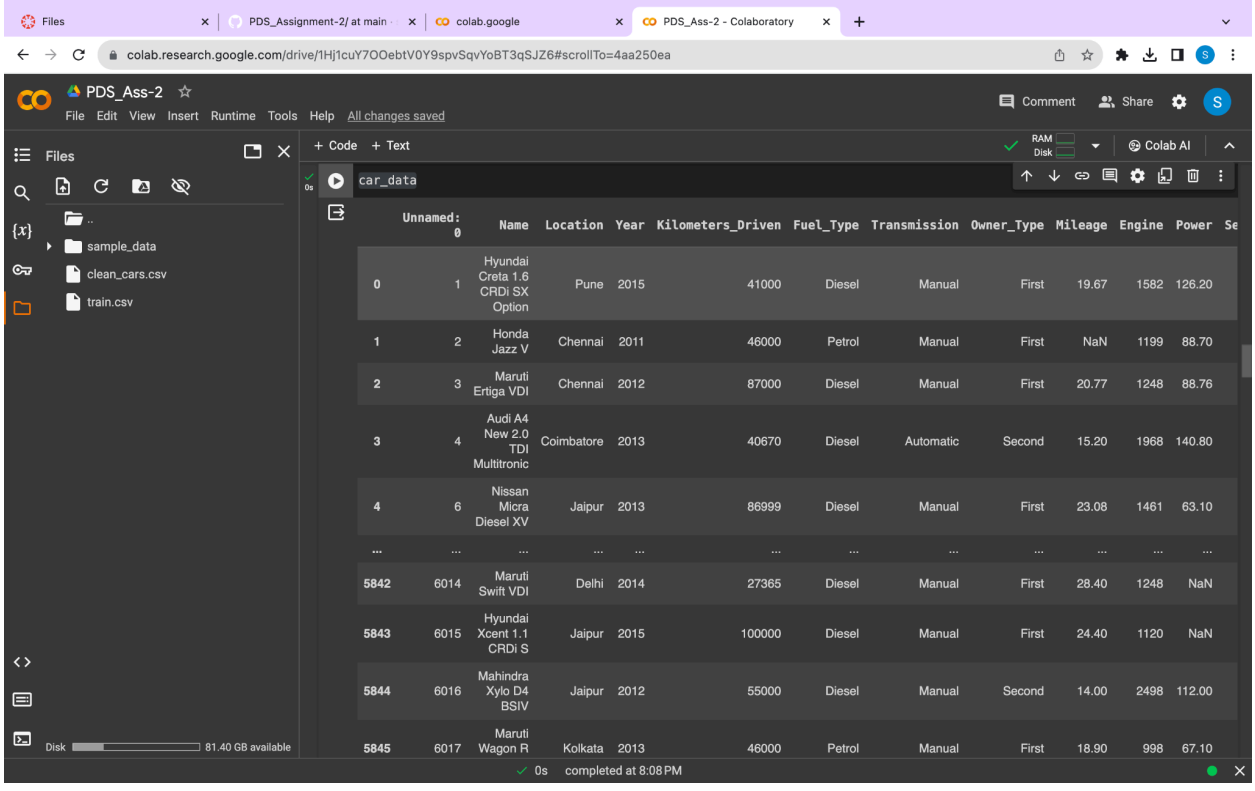
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clean_cars.csv
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car_data
Unnamed: 0 Name Location Year Kilometers_Driven Fuel_Type Transmission Owner_Type Mileage Engine Power Se
0 1 Hyundai Creta 1.6 CRDi SX Option Pune 2015 41000 Diesel Manual First 19.67 1582 126.20
1 2 Honda Jazz V Chennai 2011 46000 Petrol Manual First NaN 1199 88.70
2 3 Maruti Ertiga VDI Chennai 2012 87000 Diesel Manual First 20.77 1248 88.76
3 4 Audi A4 New 2.0 TDI Multitronic Coimbatore 2013 40670 Diesel Automatic Second 15.20 1968 140.80
4 6 Nissan Micra Diesel XV Jaipur 2013 86999 Diesel Manual First 23.08 1461 63.10
... ... ... ... ... ... ... ... ... ... ... ... ...
5842 6014 Maruti Swift VDI Delhi 2014 27365 Diesel Manual First 28.40 1248 NaN
5843 6015 Hyundai Xcent 1.1 CRDi S Jaipur 2015 100000 Diesel Manual First 24.40 1120 NaN
5844 6016 Mahindra Xylo D4 BSIV Jaipur 2012 55000 Diesel Manual Second 14.00 2498 112.00
5845 6017 Maruti Wagon R Kolkata 2013 46000 Petrol Manual First 18.90 998 67.10
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C)Change the categorical variables (“Fuel_Type” and “Transmission”) into numerical one hot encoded value.

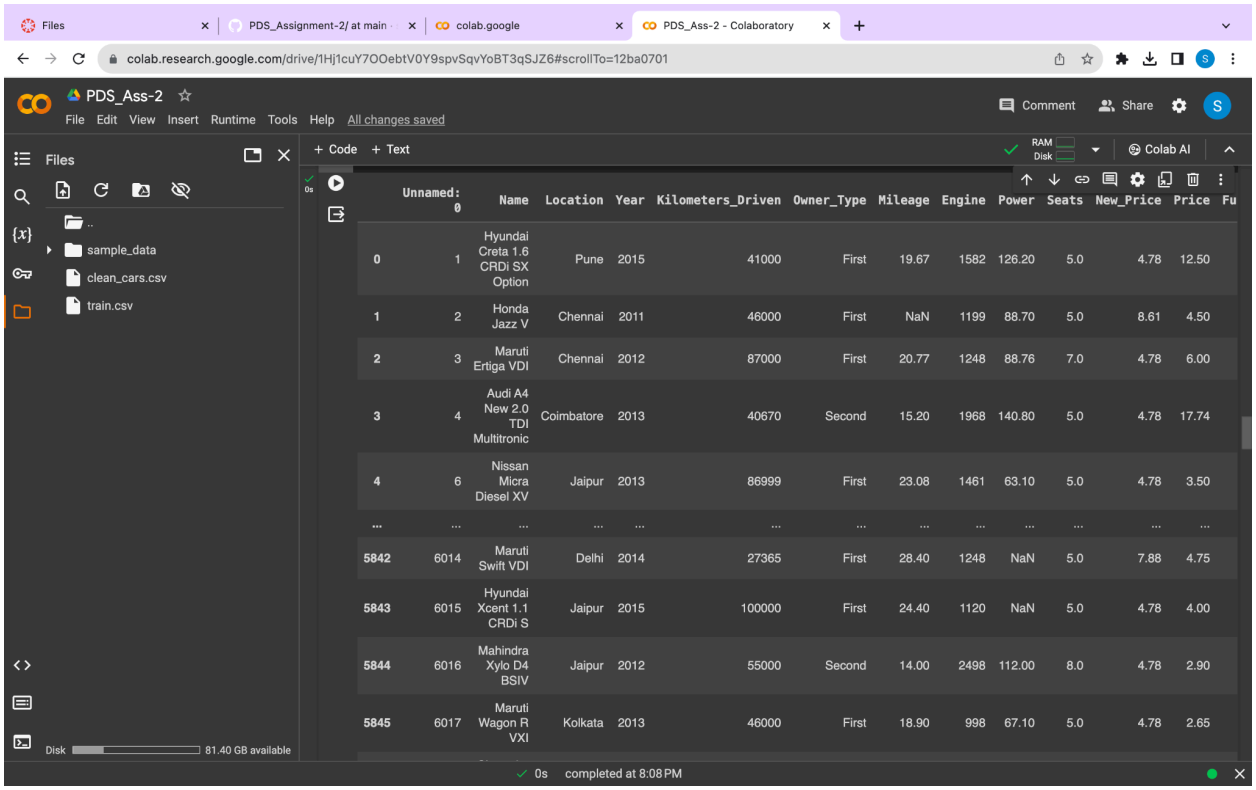
1. **Encoding of Labels:**
Makes use of `LabelEncoder()` to convert the 'Transmission' and 'Fuel_Type' columns into numerical labels.
- Inserts the encoded labels into the newly created columns "Transmission_Label" and "Fuel_Type_Label."

2. **Encoding One-Hot:**
- Uses `OneHotEncoder()` to create binary vectors from the label-encoded columns.
Makes two distinct DataFrames ('transmission_encoded_df' and 'fuel_type_encoded_df') for every new binary vector.

3. **Concatenation:** - Merges the one-hot encoded DataFrames with the original 'car_data' DataFrame.

4. Eliminate Superfluous Columns:
- Eliminates the label-encoded columns ('Fuel_Type_Label', 'Transmission_Label') and the original categorical columns ('Fuel_Type', 'Transmission').

5. **Final DataFrame:** - Shows the updated "car_data" DataFrame with one-hot encoded representations of "Transmission" and "Fuel Type."



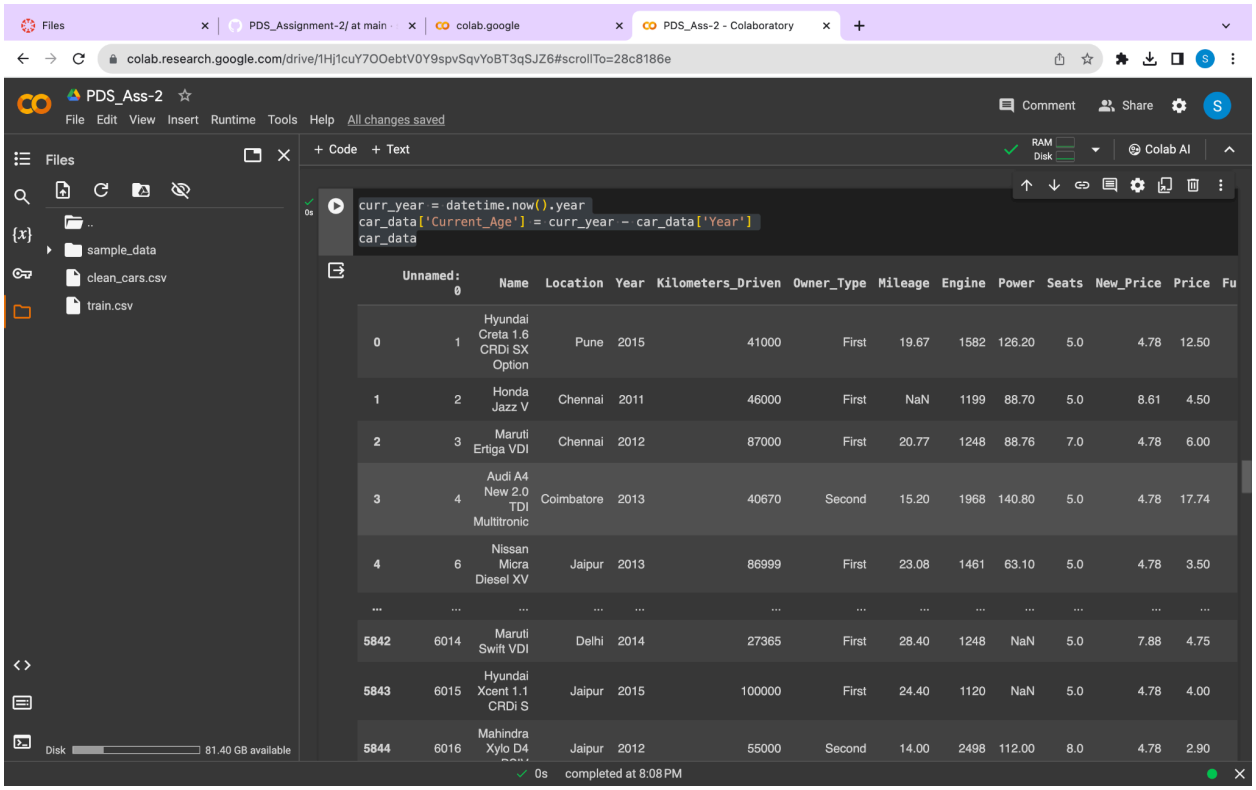

| | Unnamed: 0 | Name | Location | Year | Kilometers_Driven | Owner_Type | Mileage | Engine | Power | Seats | New_Price | Price | Fu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | Hyundai Creta 1.6 CRDi SX Option | Pune | 2015 | 41000 | First | 19.67 | 1582 | 126.20 | 5.0 | 4.78 | 12.50 | |
| 1 | 2 | Honda Jazz V | Chennai | 2011 | 46000 | First | NaN | 1199 | 88.70 | 5.0 | 8.61 | 4.50 | |
| 2 | 3 | Maruti Ertiga VDI | Chennai | 2012 | 87000 | First | 20.77 | 1248 | 88.76 | 7.0 | 4.78 | 6.00 | |
| 3 | 4 | Audi A4 New 2.0 TDI Multitronic | Coimbatore | 2013 | 40670 | Second | 15.20 | 1968 | 140.80 | 5.0 | 4.78 | 17.74 | |
| 4 | 6 | Nissan Micra Diesel XV | Jaipur | 2013 | 86999 | First | 23.08 | 1461 | 63.10 | 5.0 | 4.78 | 3.50 | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5842 | 6014 | Maruti Swift VDI | Delhi | 2014 | 27365 | First | 28.40 | 1248 | NaN | 5.0 | 7.88 | 4.75 | |
| 5843 | 6015 | Hyundai Xcent 1.1 CRDi S | Jaipur | 2015 | 100000 | First | 24.40 | 1120 | NaN | 5.0 | 4.78 | 4.00 | |
| 5844 | 6016 | Mahindra Xylo D4 BSIV | Jaipur | 2012 | 55000 | Second | 14.00 | 2498 | 112.00 | 8.0 | 4.78 | 2.90 | |
| 5845 | 6017 | Maruti Wagon R VXI | Kolkata | 2013 | 46000 | First | 18.90 | 998 | 67.10 | 5.0 | 4.78 | 2.65 | |

D)Create one more feature and add this column to the dataset (you can use mutate function in R for this). For example, you can calculate the current age of the car by subtracting “Year” value from the current year.

1. **Current Year Calculation:** - Using the `datetime` module, `curr_year = datetime.now().year} retrieves the current year.

2. **Determine Age of Car:**
Each car's age is calculated by deducting its production year (found in the 'Year' column) from the current year using the formula {car_data['Current_Age'] = curr_year - car_data['Year']}.

3. **Result:** - The age of each automobile is now displayed in a new column called "Current_Age" in the updated "car_data" DataFrame.




| | Unnamed: 0 | Name | Location | Year | Kilometers_Driven | Owner_Type | Mileage | Engine | Power | Seats | New_Price | Price | Fu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | Hyundai Creta 1.6 CRDi SX Option | Pune | 2015 | 41000 | First | 19.67 | 1582 | 126.20 | 5.0 | 4.78 | 12.50 | |
| 1 | 2 | Honda Jazz V | Chennai | 2011 | 46000 | First | NaN | 1199 | 88.70 | 5.0 | 8.61 | 4.50 | |
| 2 | 3 | Maruti Ertiga VDI | Chennai | 2012 | 87000 | First | 20.77 | 1248 | 88.76 | 7.0 | 4.78 | 6.00 | |
| 3 | 4 | Audi A4 New 2.0 TDI Multitronic | Coimbatore | 2013 | 40670 | Second | 15.20 | 1968 | 140.80 | 5.0 | 4.78 | 17.74 | |
| 4 | 6 | Nissan Micra Diesel XV | Jaipur | 2013 | 86999 | First | 23.08 | 1461 | 63.10 | 5.0 | 4.78 | 3.50 | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5842 | 6014 | Maruti Swift VDI | Delhi | 2014 | 27365 | First | 28.40 | 1248 | NaN | 5.0 | 7.88 | 4.75 | |
| 5843 | 6015 | Hyundai Xcent 1.1 CRDi S | Jaipur | 2015 | 100000 | First | 24.40 | 1120 | NaN | 5.0 | 4.78 | 4.00 | |
| 5844 | 6016 | Mahindra Xylo D4 | Jaipur | 2012 | 55000 | Second | 14.00 | 2498 | 112.00 | 8.0 | 4.78 | 2.90 | |

E)Perform select, filter, rename, mutate, arrange and summarize with group by operations (or their equivalent operations in python) on this dataset.

1. **Choosing a Column:**
   - {car_data = select_data[['Year, 'Name,' Price, 'Engine,' Location]]Name, Year, Price, Engine, and Location are the columns that are chosen, and they are then saved in a new DataFrame by {.

**Data Filtering:** - The dataset is filtered to include only rows where the 'Location' is 'Chennai' using the formula {filt_data = car_data[car_data['Location'] == 'Chennai']}.

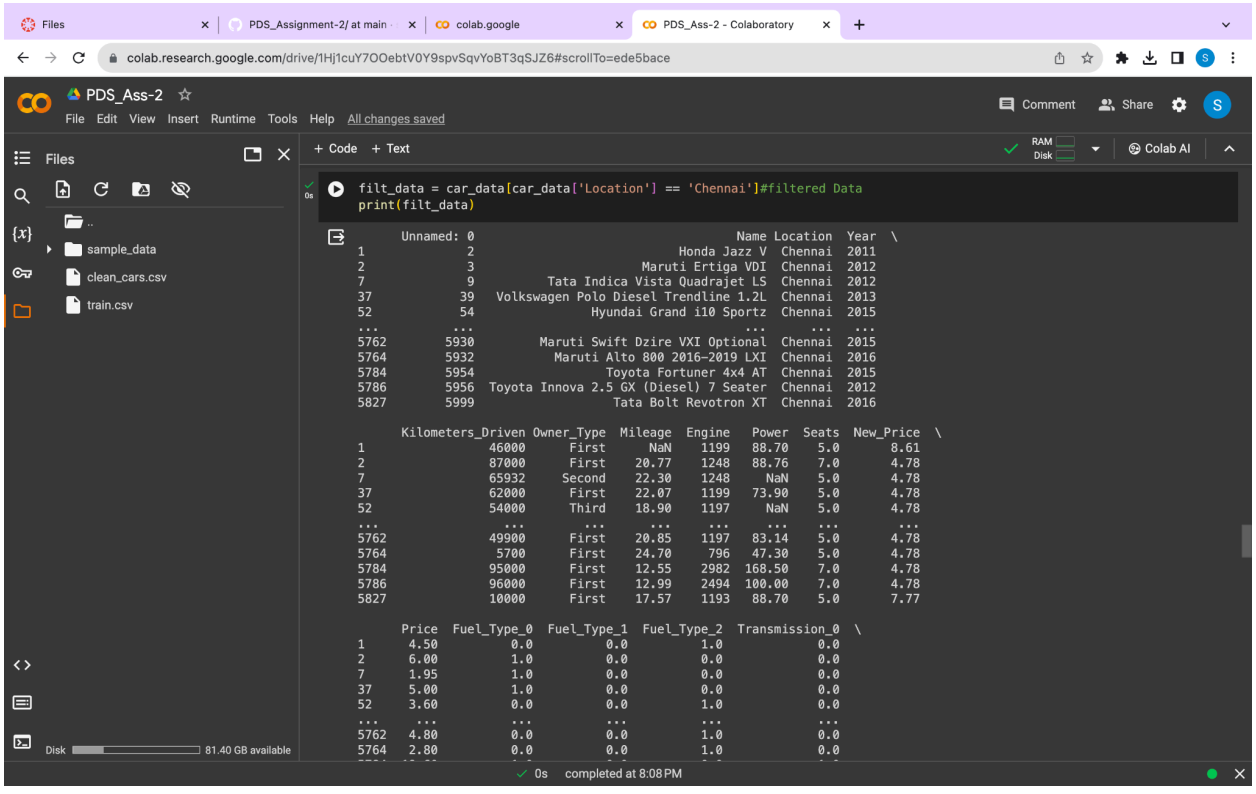
3. **Renaming of Columns:**
   - The 'New Price' column is renamed to 'NewPriceCAR' by running the command `car_data = car_data.rename(columns={'New_Price': 'NewPriceCAR'})}.

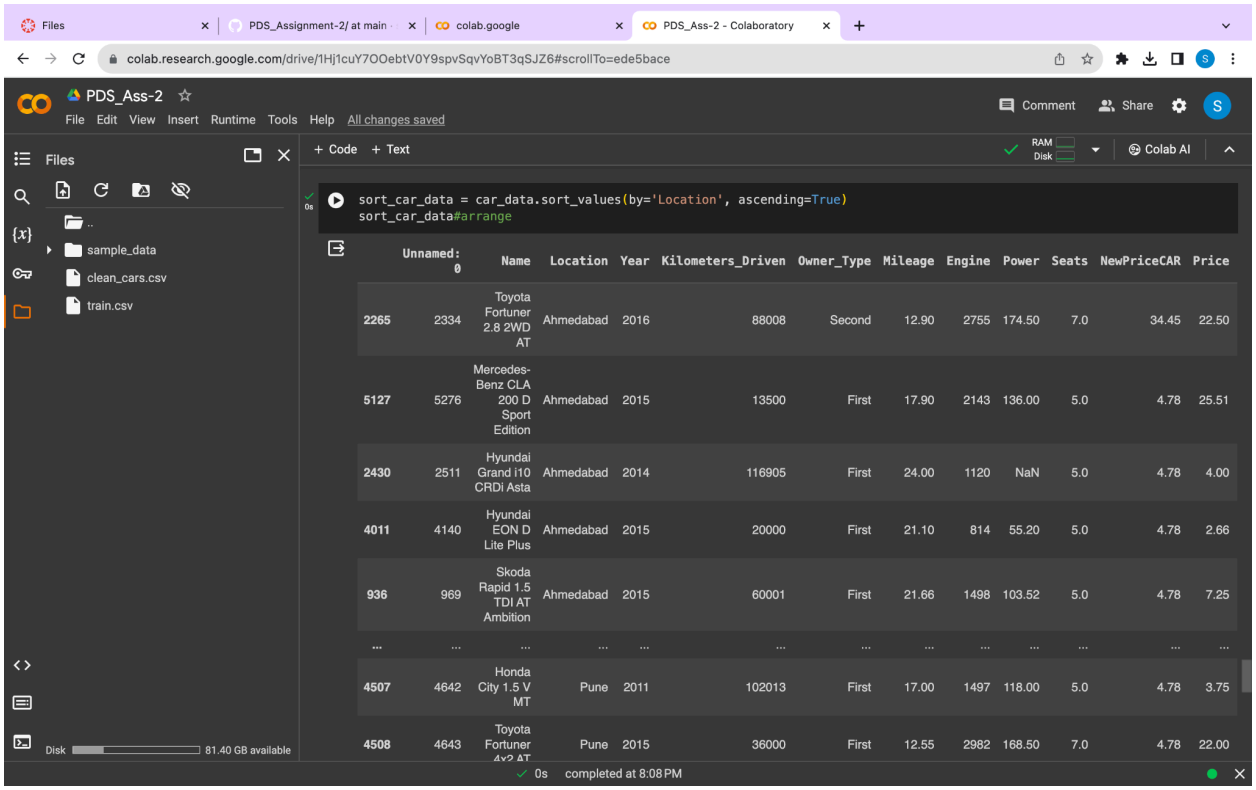
- {car_data['NewIncreseprice'] = car_data['NewPriceCAR'] 4 **Column Operation:**Column 'NewPriceCAR' is multiplied by three to create a new column 'NewIncreseprice' using the formula *3{.

5. **Data Sorting:**
   - The dataset is sorted in ascending order using the 'Location' column by sort_car_data = car_data.sort_values(by='Location', ascending=True)}.

6. **Aggregation and Grouping:**
   - {grouped_summary = car_data.groupby('Year').The data is grouped by 'Year' and the average of the 'Mileage' for each group is computed using the formula agg(Average_MPG=('Mileage','mean'))}.

7. **CSV Saving:**
The adjusted 'car_data' DataFrame is saved to a CSV file called 'clean_cars.csv' with the command `car_data.to_csv('clean_cars.csv', index=False)}.






| | Unnamed: 0 | Name | Location | Year | Kilometers_Driven | Owner_Type | Mileage | Engine | Power | Seats | NewPriceCAR | Price |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2265 | 2334 | Toyota Fortuner 2.8 2WD AT | Ahmedabad | 2016 | 88008 | Second | 12.90 | 2755 | 174.50 | 7.0 | 34.45 | 22.50 |
| 5127 | 5276 | Mercedes-Benz CLA 200 D Sport Edition | Ahmedabad | 2015 | 13500 | First | 17.90 | 2143 | 136.00 | 5.0 | 4.78 | 25.51 |
| 2430 | 2511 | Hyundai Grand i10 CRDi Asta | Ahmedabad | 2014 | 116905 | First | 24.00 | 1120 | NaN | 5.0 | 4.78 | 4.00 |
| 4011 | 4140 | Hyundai EON D Lite Plus | Ahmedabad | 2015 | 20000 | First | 21.10 | 814 | 55.20 | 5.0 | 4.78 | 2.66 |
| 936 | 969 | Skoda Rapid 1.5 TDI AT Ambition | Ahmedabad | 2015 | 60001 | First | 21.66 | 1498 | 103.52 | 5.0 | 4.78 | 7.25 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 4507 | 4642 | Honda City 1.5 V MT | Pune | 2011 | 102013 | First | 17.00 | 1497 | 118.00 | 5.0 | 4.78 | 3.75 |
| 4508 | 4643 | Toyota Fortuner 4x2 AT | Pune | 2015 | 36000 | First | 12.55 | 2982 | 168.50 | 7.0 | 4.78 | 22.00 |