

# **MOTOR INSURANCE PART MAPPING AND RECOMENDATION**

Enhancing Claim Verification & Standardization

Welcome

# Agenda

- **Overview of Topics:**

- Business Objective & Case Background
- Methodology & Data Standardization
- Data Classification & Part Mapping
- Outputs, Analysis & Insights
- Limitations & Future Scope



# Introduction:

- **Case Background:**
  - AutoSure Insurance's rapid claim settlements are hindered by inconsistent part names.
  - Examples: “Left Door” vs. “Driver-Side Door”.
- **Business Case:**
  - Standardize part nomenclature.
  - Develop a system to dynamically recommend the top 5 likely damaged parts.
  - Aim: Streamline claim verification, reduce fraud, and improve customer trust.

# Methodology

## Process Flow:

- **Data Collection:**
  - Gather CSV files from surveyors and garages (including primary parts data).
- **Data Cleaning & Standardization:**
  - Use simple text processing (like fuzzy matching and text cleaning) to make part names consistent.
- **Data Integration:**
  - Combine the datasets so that surveyor parts can be matched with garage parts.
- **Analytics & Visualization:**
  - Use tools like Pandas, NumPy, Matplotlib, and Seaborn to analyze the data and create visual charts.
- **Recommendation Engine:**
  - Use algorithms (like decision trees and association rule mining) to suggest additional parts based on historical data.

# Methodology

## Data Preparation:

- **Data Cleaning:**
  - Remove duplicates and fill in missing values.
- **Normalization:**
  - Standardize part names using set rules or a predefined dictionary.
- **Segmentation:**
  - Divide the data by claim date and group parts into primary and secondary categories.



# Data Standardization

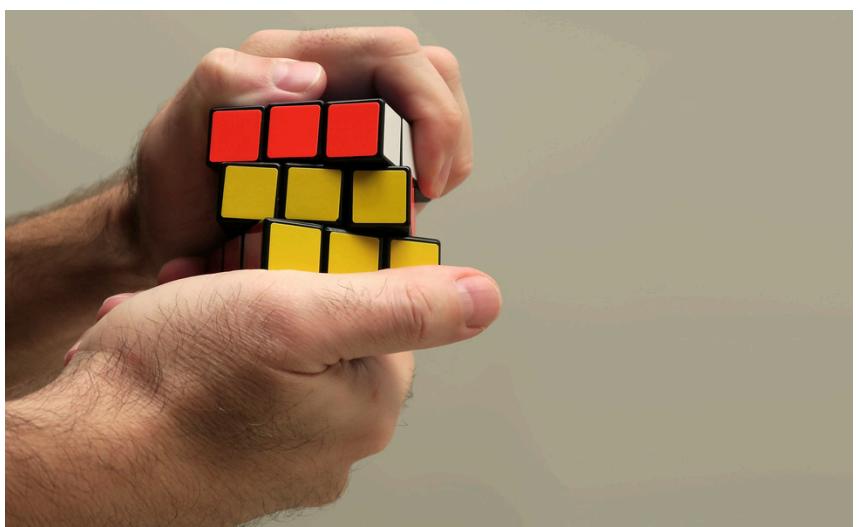
## Key Steps:

Data Loading: Import raw surveyor and garage CSVs.



## Text Cleaning:

- Lowercase conversion
- Remove special characters (e.g., |, -)
- Whitespace normalization
- Expand abbreviations (e.g., “rh” → “right”)
- Numeric Standardization: Convert IDs to integer format; remove scientific notation.



## Output:

- Standardized fields: clean\_key (surveyor) & clean\_value (garage).

# Data Classification

- **Objective:**
  - Categorize part descriptions into meaningful groups.
- **Process:**
  - Preprocess text (cleaning, normalization, synonym handling).
  - Group parts by common terminology (e.g., Doors, Bumpers, Mirrors).
  - Use semantic analysis (Sentence Transformers) for context-based grouping.
  - Apply rule-based and fuzzy matching for low-confidence items.
- **Output:**
  - Classified mapping file (e.g., classified\_data.csv) with categories.



# Part Mapping Process

- **Objective:**
  - Establish accurate correspondence between surveyor and garage part names.
- **Techniques:**
  - Dictionary-Based Mapping:
    - Use a predefined synonym dictionary (synonyms.json) to standardize names.
- **Fuzzy Matching:**
  - Leverage Levenshtein Distance and FuzzyWuzzy for approximate matches.
- **Semantic Similarity:**
  - Compute embeddings and cosine similarity to refine matches.
- **Output:**
  - Final mapping CSV (mapping.csv) with paired part names and similarity scores.
  - Unmatched items flagged for manual review.

# Outputs & Analysis

- **Mapping Summary Report:**
  - Side-by-side comparisons (e.g., "Left Door" vs. "Driver-Side Door").
  - Frequency counts and percentage distributions.
- **Visualizations:**
  - Bar charts for top 10 frequently damaged parts.
  - Pie charts for claim distribution by part category.
- **Insights:**
  - Improved matching accuracy.
  - Identification of high-risk parts for further review.



# Dictionary:

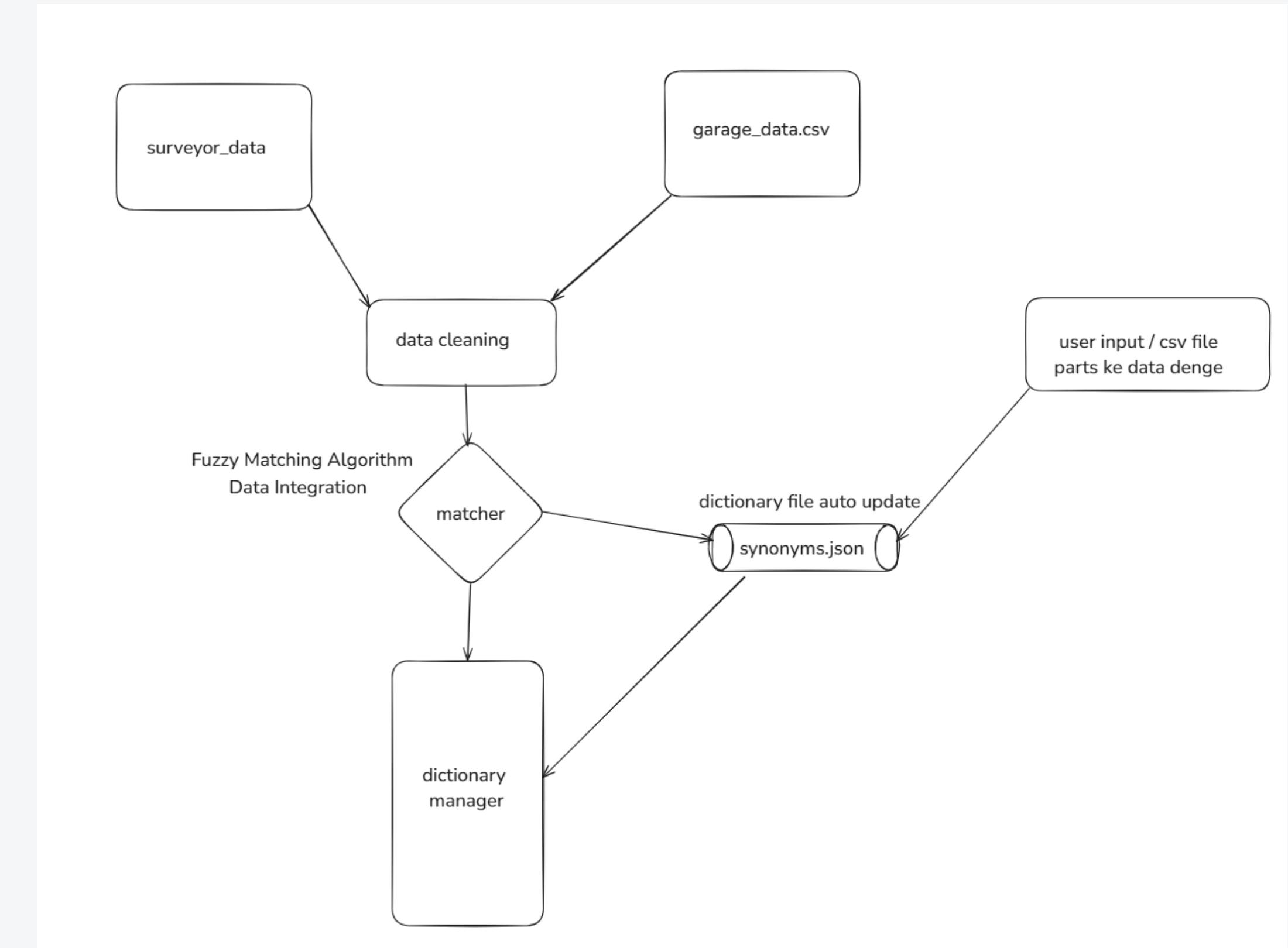
- Example of a dictionary:

```
{  
    "Bumper Front": [  
        "front bumper",  
        "bumper front upper",  
        "bumper front lower",  
        "front bumper protector"  
        "bumper front primary"  
    ],  
    "Rear Door": [  
        "back door",  
        "trunk door",  
        "rear panel door",  
        "tailgate door"  
    ],
```

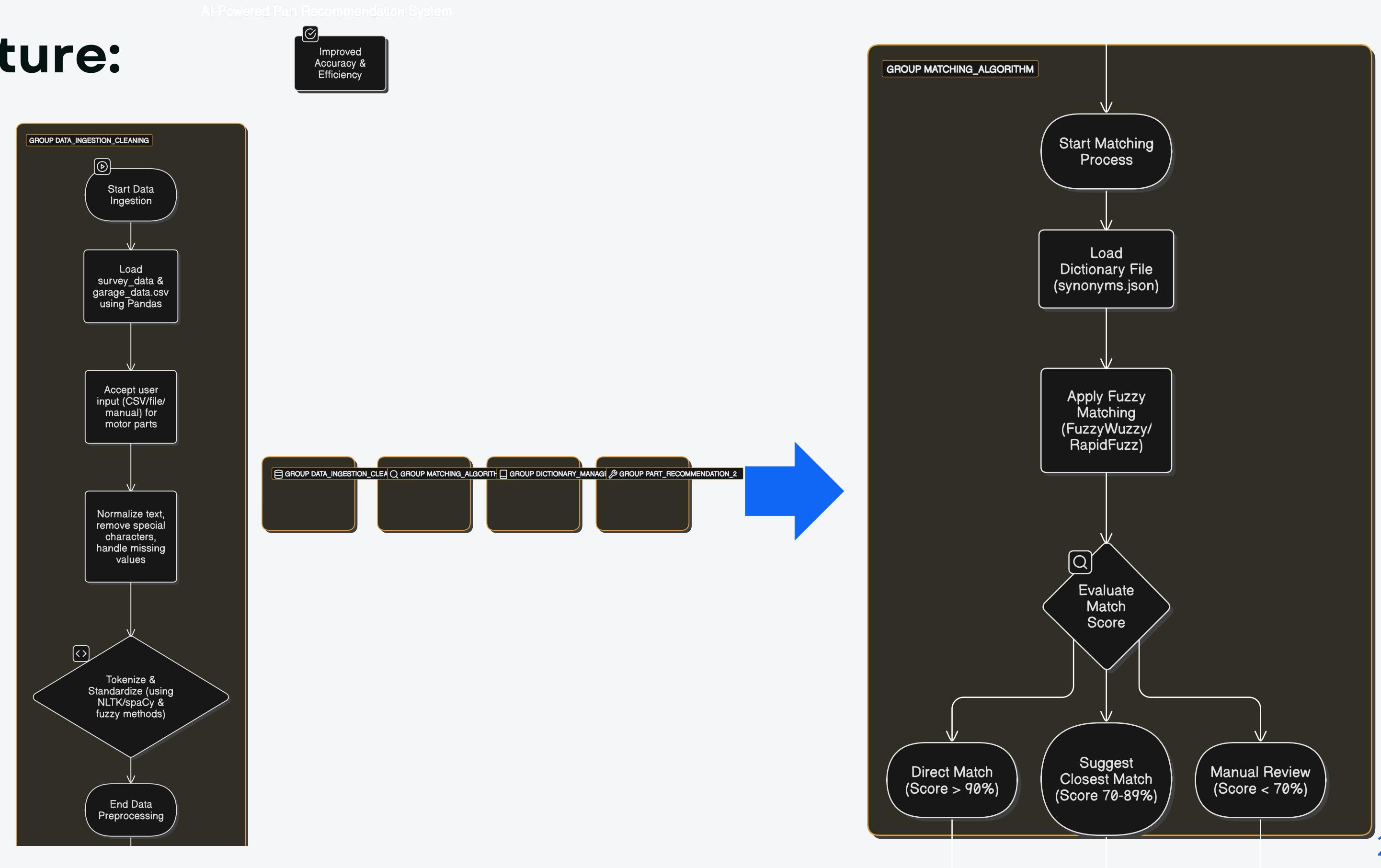
```
    "Side Mirror": [  
        "left mirror",  
        "right mirror",  
        "driver-side mirror",  
        "passenger-side mirror"  
    ],  
    "Front Fender": [  
        "front wing",  
        "front side panel",  
        "fender panel",  
        "front side guard"  
    ]  
}
```

# WorkFlow:

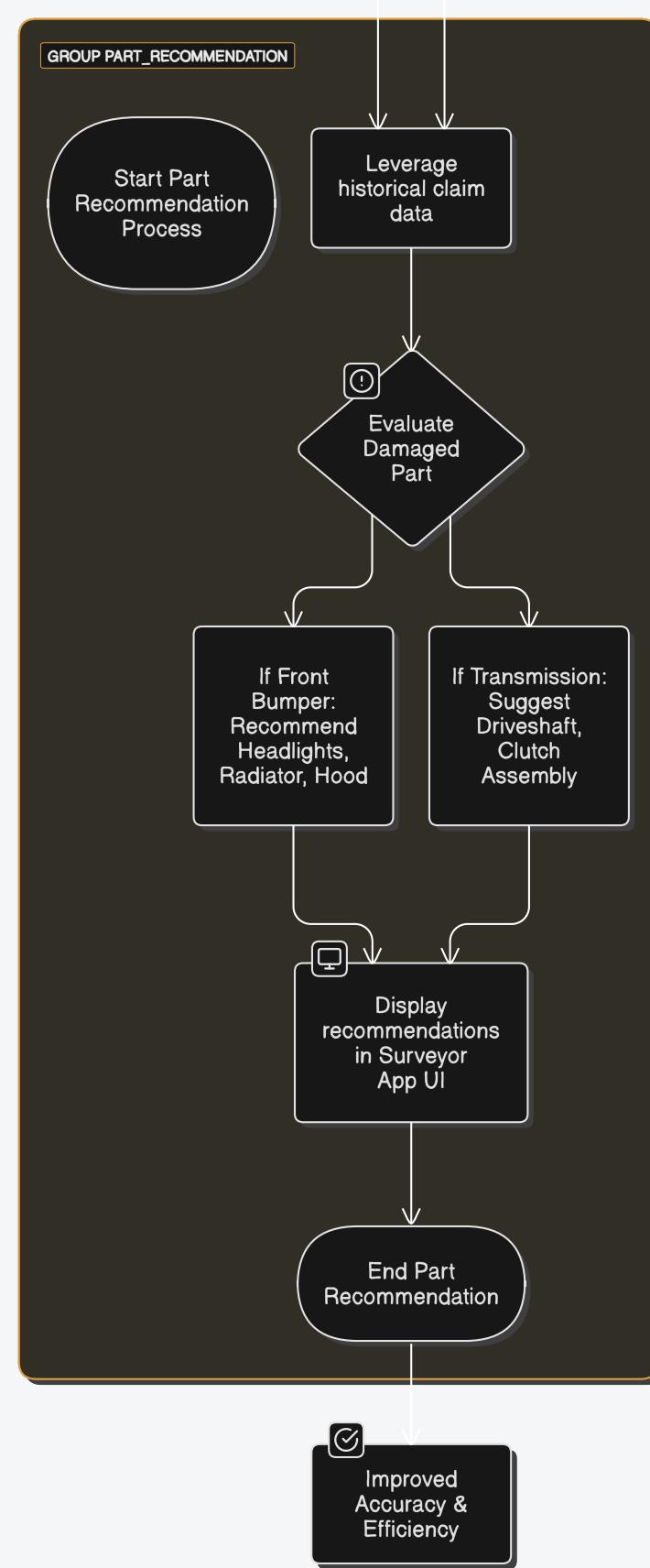
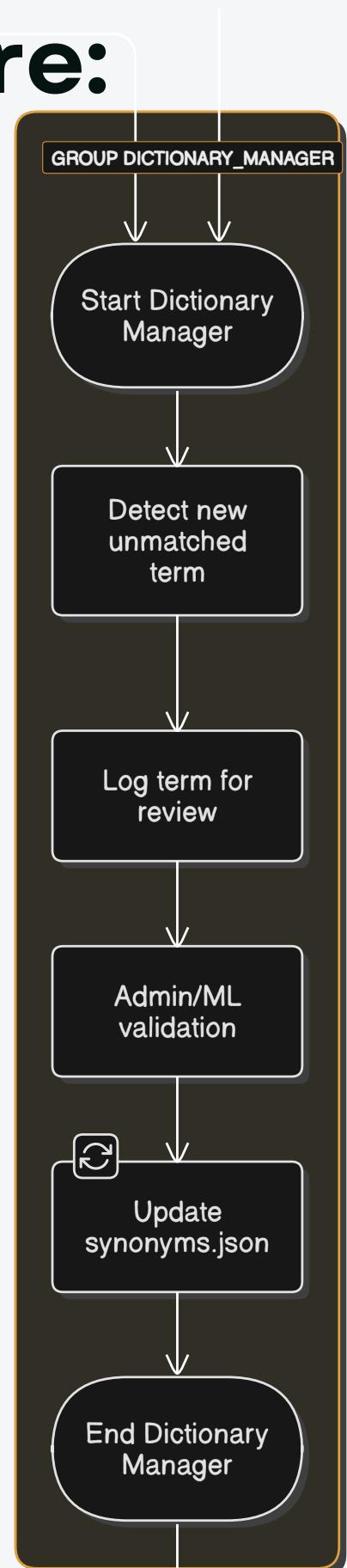
- Mind Mapping



# Architecture:



# Architecture:



# Invoice:

Vehicle Parts Price Analysis By the Survey Agent		
Report Number: INV-20250215-050223 Date: 2025-02-15		
Vehicle Model: 23103		
Part Description	Price Range	Occurrences
165 70R14 Duraplus Gy	\$3142.18	1
165 80 R14 65 Amazer 3G TI Apoll	\$3310.93	1
165 80R14 Duraplus	\$3392.96	1
165 80R14 Duraplus Gy	\$3194.53 - \$3392.96	3
165 80R14 S248 Bs	\$3671.87 - \$3939.84	2
165 80R14 S248 Bs Tyre	\$1969.00	1
165 80R14S248	\$3671.87	1
185 65R15 Ecopia Ep150	\$4822.65	1
3M Car Brite Clean	\$1067.79	1
Absorber 1	\$531.25	1
Abs Control Unit	\$2511.71	1
Absorber	\$425.00 - \$531.00	6
Absorber Assembly Rear Shock	\$1972.00	1
Wire Comp B	\$190.00 - \$190.67	4
Wiring Harness Engine	\$7906.77	1
Wiring Harness Floor	\$2243.22	2
Wiring Harness Main	\$10762.00 - \$10762.71	2
Wiring Repair Kit 1	\$190.67	1
Wi Glass	\$3618.60	1
Whtstrip Rear	\$488.20	1
<b>Total Parts Purchased</b>	<b>10514</b>	
<b>Total Amount Spent</b>	<b>\$15623641.71</b>	
Vehicle Model: 30135		
Part Description	Price Range	Occurrences
215 60 R16 95H Alinac 4Gs TI	\$6182.03	1
Absorber 1	\$156.25	1
Absorber Assembly Rear Shock	\$2488.28	1
Absorber Comp Front	\$718.75	1
Absorber Comp Front Bumper	\$718.00	1
Absorber Comp Front Bumper Lower	\$718.75	1
Absorber Comp Front Right	\$718.75	1
Absorber Comp Front Right Bmp Lower	\$718.75	1
Wire Passenger B	\$317.80	1
Wire Rear Park Sensor	\$1426.27	1
Wire Sleeve	\$17.18	1
Wiring Harness Main	\$17423.72	3
Ws Glass	\$4067.90	1
<b>Total Parts Purchased</b>	<b>4454</b>	
<b>Total Amount Spent</b>	<b>\$9677553.76</b>	
Vehicle Parts Price Analysis By the Garage Agent		
Report Number: INV-20250215-045006 Date: 2025-02-15		
Vehicle Model: 23103		
Part Description	Price Range	Occurrences
165 80 R14 65 Amazer 3G TI Apoll	\$2534.37 - \$3310.93	2
165 80R14 Duraplus Gy	\$2805.46 - \$2861.71	4
165 80R14 Ecopia Ep150 Bs	\$3034.37	8
165 80R14 Milaze Cest	\$2405.46	1
165 80R14 S248 Bs	\$3160.15	4
165 80R14 Ux Royale 85T TI JK	\$2435.15 - \$2628.90	2
3M Degreaser Cloth	\$23.43	1
71711M76M00 5Pk	\$1347.65	1
Absorber Assembly Rear Shock Alto	\$679.68	1
Ac Gas 340 Floron	\$271.18 - \$283.89	11
Ac Gas 450	\$394.06	1
Ac Gas 450Gm Srf	\$377.11 - \$394.06	24
Adhesive Dentride	\$11.71	1
Adhesive Instant Fix	\$3.90 - \$7.81	4
Air Drying Sealant	\$625.42 - \$707.62	41
Window Balancer Alto	\$321.09	1
Window Balancer Alto L	\$321.09	1
Windshield Glass Rear	\$216.01 - \$2682.20	3
Wiper Kit Dr New Swift	\$622.88	1
Wire Comp B	\$183.89 - \$190.67	4
Xtrem Vision Bulb H112V 60 55W	\$456.30 - \$460.16	2
Xtreme Exterior Microfibre Cloth	\$157.14	2
Xtreme Tradition Sponge	\$127.11	2
<b>Total Parts Purchased</b>	<b>7343</b>	
<b>Total Amount Spent</b>	<b>\$7322975.64</b>	
Vehicle Model: 30135		
Part Description	Price Range	Occurrences
205 60R16 92H Elanzo Nxt JK	\$4725.00	3
215 60R16 Ux Royale JK	\$4697.65	4
3M Double Gum	\$546.87	1
Absorber Assembly Rear Shock	\$1351.56 - \$2302.34	4
Absorber Front Right Bumper Lower	\$1422.65	1
Ac Gas 340 Floron	\$271.18 - \$394.06	7
Ac Gas 450Gm Srf	\$377.11 - \$394.06	13
Adhesive Instant Fix	\$7.81	1
Air Drying Sealant	\$625.42 - \$686.44	17
Wheel Comp 16X6J	\$1171.87	1
Wheel Comp Al 16X6 1 2J	\$5460.93	7
Windshield Glass Rear	\$703.12 - \$3359.32	3
Wire B	\$308.47	1
Wire Comp Glow Cont	\$262.71	2
Wire Passenger Air Bag	\$492.18	1
<b>Total Parts Purchased</b>	<b>3117</b>	
<b>Total Amount Spent</b>	<b>\$4353478.71</b>	
<b>Grand Total Across All Vehicles: \$25301195.47</b>		
<b>Grand Total Across All Vehicles: \$11676454.35</b>		

# Comparing Invoices:

## Invoice Comparison Report

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### Matching Parts in Both Files

VEHICLE_MODEL_CODE	PART_NAME	Garage_min_price	Garage_max_price	Garage_occurrences	Survey_min_price	Survey_max_price	Survey_occurrences
23103	165 80 r14 85 amazer 3g tl apoll	2534.37	3310.93	2.0	3310.93	3310.93	1.0
23103	165 80r14 duraplus gy	2805.46	2861.71	4.0	3194.53	3392.96	3.0
23103	165 80r14 s248 bs	3160.15	3160.15	4.0	3671.87	3939.84	2.0
23103	ac gas 340 florin	271.18	283.89	11.0	394.06	394.06	1.0
23103	ac gas 450m srf	377.11	394.06	24.0	394.06	516.94	4.0
23103	air drying sealant	625.42	707.62	41.0	88.45	1415.24	26.0
23103	air drying sealer pu 92	620.16	707.62	32.0	707.62	707.63	2.0
23103	amaron battery 42b20l	3644.53	3644.53	1.0	3925.00	3925.00	1.0
23103	arm assembly front right wiper asst	465.25	478.81	6.0	478.81	478.81	1.0
23103	arm assembly front suspension l	1054.68	1097.65	6.0	1093.00	1097.65	7.0
23103	arm assembly front suspension right	1015.62	1074.21	9.0	1093.75	1843.75	13.0
23103	bar front stabilizer	1164.06	1183.59	3.0	1078.12	1335.93	5.0
23103	beam assembly rear sprsn	9179.68	9897.65	4.0	13040.00	13040.00	1.0
23103	bearing clutch release	453.12	453.12	1.0	467.96	467.96	2.0
23103	bearing input shaft	103.38	103.38	1.0	105.46	114.40	3.0
23103	belt assembly front right l	2667.96	2902.34	14.0	3195.31	3195.31	1.0
23103	belt assembly front right right	2925.78	3289.06	14.0	3195.31	4015.00	2.0
23103	bezel front fog lamp left hand	75.00	269.53	4.0	75.00	500.00	10.0
23103	blade assembly wiper	433.59	483.05	4.0	432.20	491.62	2.0
23103	blade assembly wiper driver	456.77	466.10	3.0	415.25	474.57	2.0
23103	bolt	1.56	8.59	70.0	9.00	58.00	11.0
23103	bolt spsnsn arm front right bushing	100.78	100.78	1.0	201.56	201.56	1.0
23103	box assembly junction	3238.13	3238.13	1.0	3465.25	4245.00	2.0
23103	box assembly strg gear	6531.25	6531.25	1.0	8445.00	8445.00	1.0
23103	box assystrg gear	6375.00	6375.00	1.0	6734.37	6761.71	4.0
23103	box comp glove	515.62	515.62	1.0	515.62	515.62	2.0
23103	base saddle mount	n/a	n/a	n/a	n/a	n/a	n/a
30135	wire b	308.47	308.47	1.0	317.00	317.39	2.0

### Unique to Garage Data

VEHICLE_MODEL_CODE	PART_NAME	Garage_min_price	Garage_max_price	Garage_occurrences
23103	165 80r14 ecopia ep150 bs	3034.37	3034.37	8.0
23103	165 80r14 milaze ceat	2405.46	2405.46	1.0
23103	165 80r14 ux royale 85t tl jk	2435.15	2628.90	2.0
23103	3m degreaser cloth	23.43	23.43	1.0
23103	71711m76m00 5pk	1347.65	1347.65	1.0
23103	absorber assembly rear shock alto	679.68	679.68	1.0
23103	ac gas 450	394.06	394.06	1.0
23103	adhesive dentride	11.71	11.71	1.0
23103	adhesive instant fix	3.90	7.81	4.0
23103	amaron battery 38b20l	3339.06	3339.06	1.0
23103	antifreeze coating reg	275.42	275.42	1.0

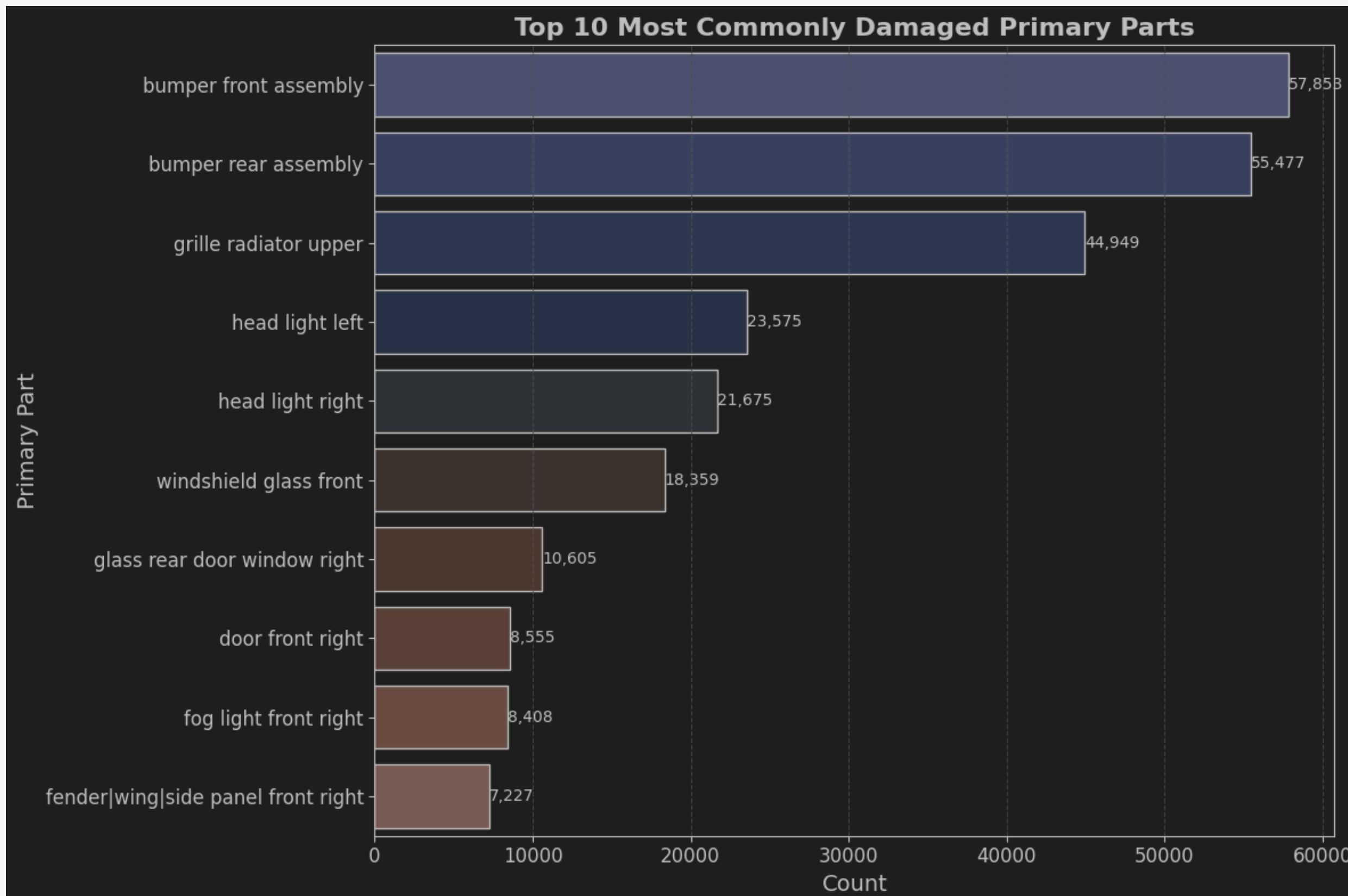
30135	valve assembly c vacuum control	868.75	953.12	2.0
30135	valve n95 face mask	72.32	72.32	1.0
30135	valve pcv	55.46	55.46	1.0
30135	wax top kit 100ml	295.76	295.76	6.0
30135	weatherstrip rr door inner l	160.15	160.15	1.0
30135	wheel 13x4 1 2j	1246.09	1246.09	2.0
30135	wheel comp 16x6j	1171.87	1171.87	1.0
30135	wheel comp al 16x6 1 2j	5460.93	5460.93	7.0
30135	wire comp glow cont	262.71	262.71	2.0
30135	wire passenger air bag	492.18	492.18	1.0

### Unique to Survey Data

VEHICLE_MODEL_CODE	PART_NAME	Survey_min_price	Survey_max_price	Survey_occurrences
23103	165 70r14 duraplus gy	3142.18	3142.18	1.0
23103	165 80r14 duraplus	3392.96	3392.96	1.0
23103	165 80r14 s248 bs tyre	1969.00	1969.00	1.0
23103	165 80r14s248	3671.87	3671.87	1.0
23103	185 65r15 ecopia ep150	4822.65	4822.65	1.0
23103	3m car brite clean	1067.79	1067.79	1.0
23103	absorber 1	531.25	531.25	1.0
23103	abs control unit	2511.71	2511.71	1.0
23103	absorber	425.00	531.00	6.0
23103	absorber assembly rear shock	1972.00	1972.00	1.0
23103	absorber comp	531.25	531.25	1.0
23103	absorber comp front bpr lower	531.25	531.25	1.0
23103	absorber comp front right	531.25	531.25	1.0
23103	absorber comp front right bmp lower	531.25	531.25	5.0
23103	absorber comp front right bmp lower	531.25	531.25	1.0
23103	absorber comp front right bmp lower	531.25	531.25	1.0
23103	absorber comp front right bpr lower	531.25	531.25	1.0

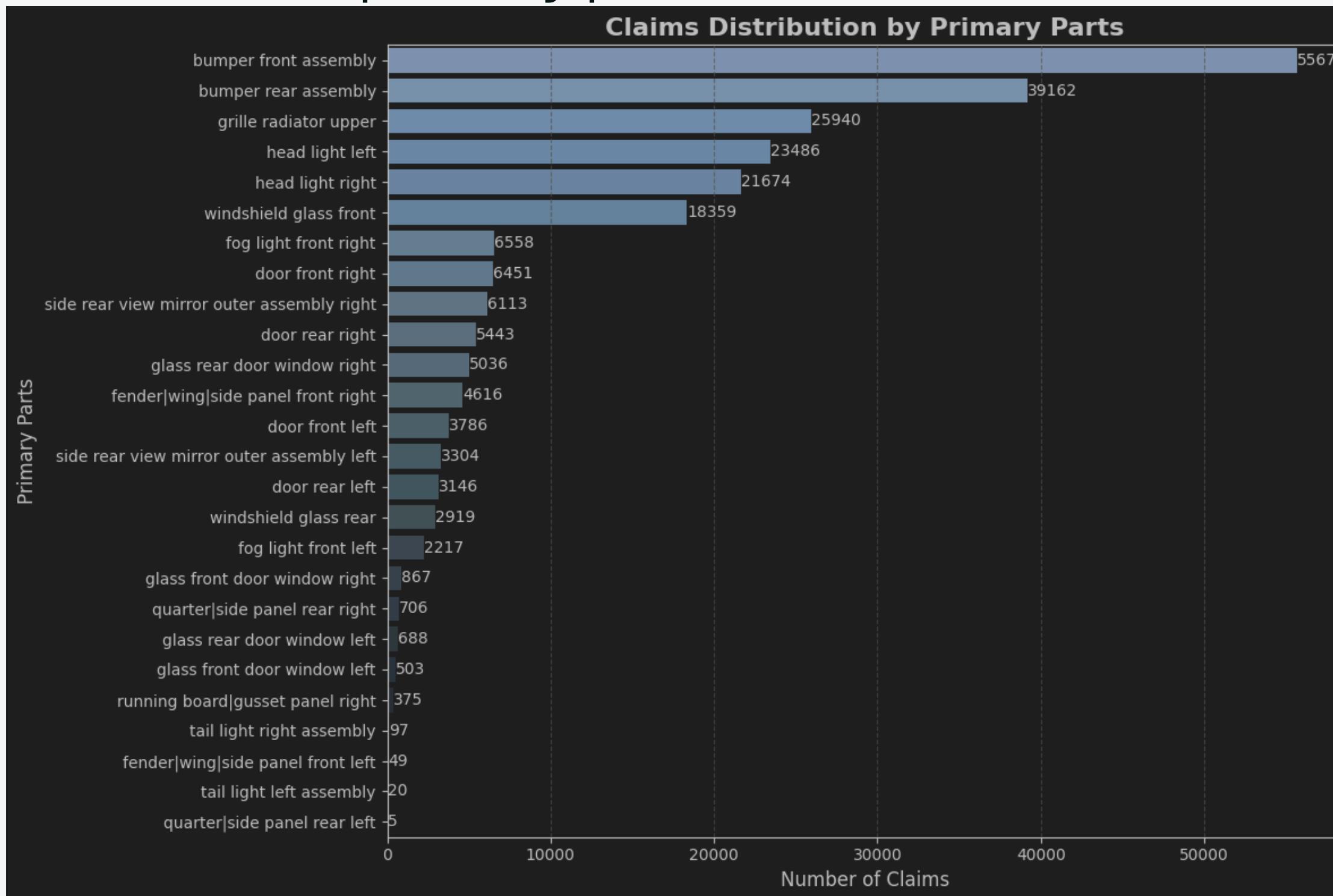
# Additional Questions:

- Most Commonly Damaged Parts: List parts with their count and percentage.



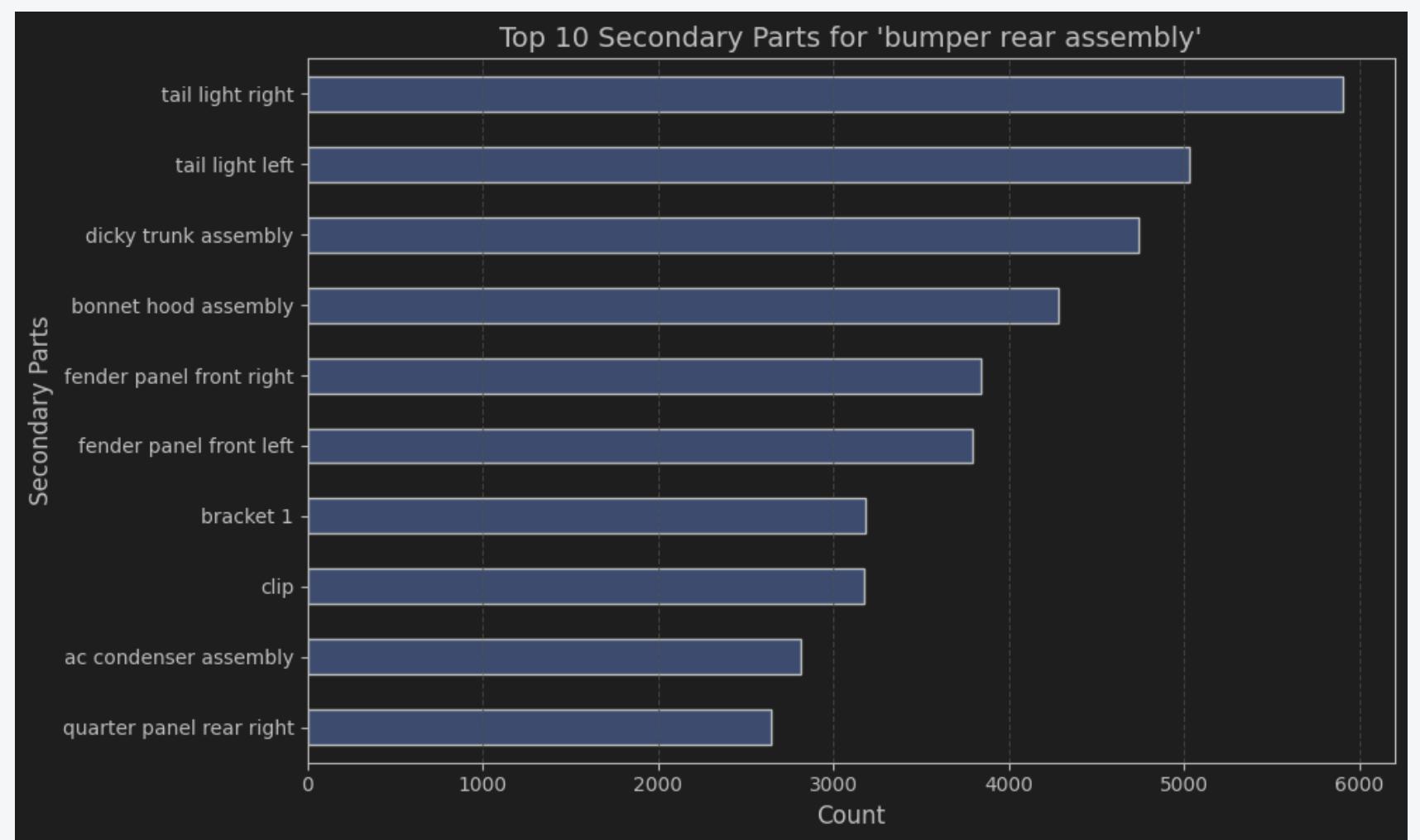
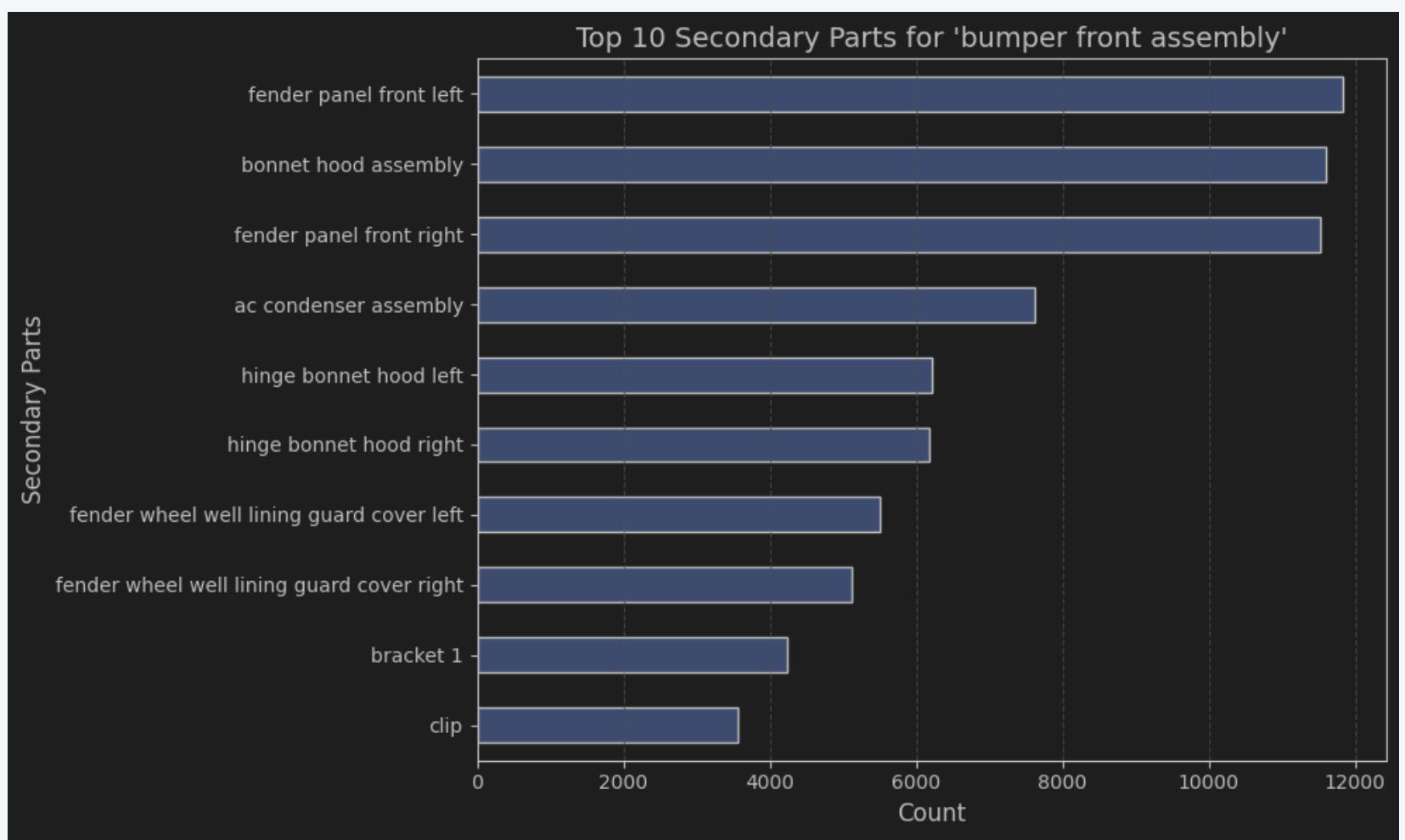
# Additional Questions:

- Claims Distribution (Primary Parts): Analyze surveyor data to find how claims are distributed across primary parts.



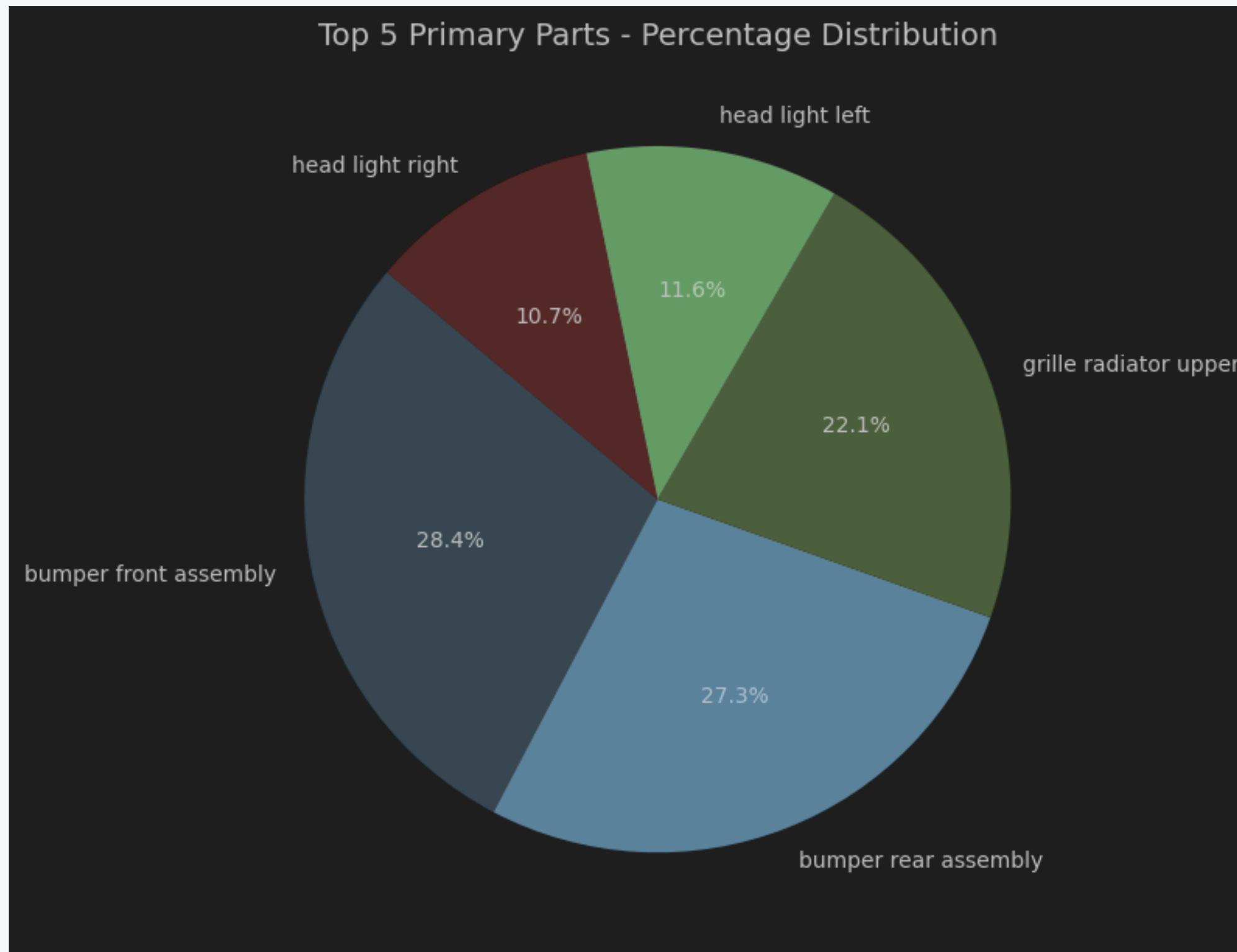
# Additional Questions:

- Top 10 Secondary Parts: For each primary part, list the top 10 associated secondary parts with claim counts.



## Additional Questions:

- Top 5 Primary parts - Percentage Distribution



## Refer:

- LINK: -

[https://github.com/JAmanOG/Case-2\\_ScriptDevs](https://github.com/JAmanOG/Case-2_ScriptDevs)

**Visit the link above for a better visual representation and complete source code developed during this hackathon.**

# Limitations & Future Scope

- **Limitations:**
  - Data Quality: Inherent inconsistencies and missing values.
  - Algorithm Challenges: Fuzzy matching may yield false positives/negatives.
  - Integration: Real-time mapping system constraints.
- **Future Enhancements:**
  - Advanced ML Models (e.g., NER with BERT).
  - Continuous feedback loop for dictionary updates.
  - Expansion to other insurance claim types.
  - Enhanced interactive dashboards for real-time monitoring.

# Conclusion & Q&A:

- Conclusion:
  - Standardized part mapping improves claim accuracy and operational efficiency.
  - The dynamic recommendation system streamlines surveyor processes and reduces fraud.
- Business Impact:
  - Faster claim settlements.
  - Reduced manual intervention.
  - Data-driven decision-making.
- Q&A:
  - Invite questions and feedback.

# Thank you!

The End