

DCSN04C – FULL PROJECT REPORT

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SECTION: IT201NIS	

PROJECT TITLE:

“A Car Detailing Shop Inventory Management System Using Python, Tkinter (for GUI), and Applying Data Structure Algorithms”

PROBLEM STATEMENT AND OBJECTIVES:

This project aims to develop and simulate a creative and fully functionable Inventory Management System for a car detailing shop brand **GYEON** - this is not an affiliate but used for education purposes only. The program will focus on tracking essential supply of GYEON products. The objective of this project aims to create functions that the operator of the program will be able to execute such as:

- (1) **Performing CRUD functions;**
- (2) **Validate numeric quantities and allow adjustments;**
- (3) **Enable fast lookup;**
- (4) **Support sorting and category filtering;**
- (5) **Have the ability to save, load, export metadata;**
- (6) **Use a list of dictionaries for storage;**
- (7) **Provide a clear interface with helpful validation messages and modal controls;**
- (8) **Lastly, to produce a readable export summary of data inputted from the system**

The data will be categorized by their product number, name, type, quantity, and category – with anti-duplicate product number feature and fast search lookups. This program will be created in Python incorporating Tkinter properties for making the GUI for the inventory management system, and file handling to append data, update, delete, and read from a Json file.

DATA STRUCTURES and ALGORITHMS USED: (FULL UPDATED REPORT)

1. **List Algorithm (Array)** – This is where each item or object recorded/ stored in a list shows proper data structure usage which will hold the 3 basic operations with a time complexity of $O(n)$ for lookups, the CRUD functions are:
 - a. **Add Operation** – Append / Insert at correct position of element.
 - b. **Delete Operation** – Using linear search algorithm in removing/shifting elements.
 - c. **Update/Search Operation** – Using linear search while modifying the field elements.
2. **Searching for an Item (Linear Search)** – $O(n)$ on worst case; This is where operators can search for an item by name.
3. **Sorting Inventory (Bubble Sort or Selection Sort)** – $O(n^2)$ time complexity; This is where stored items can be sorted by name, by product name, by quantity, or by category.
4. **Optional Features:**
 - Dictionary** – each item is a dictionary with keys in the product number, name, category, quantity convenient for creating fields and JSON persistence.
 - Hash Table** – This helps in storing items keyed by name which makes search faster.
5. **Added Structure: Grouping/Aggregation** – Makes a summary built for iterating the list in computing the totals per category in exporting data.

6. **FILE I/O USED: JSON** – persistence in use of JSON file will write temporary files and also adding `os.replace()` to reduce corruption risk.

CHALLENGES FACED AND SOLUTIONS:

- **Duplicate product numbers:**
 - The app originally allowed identical `product_number` values which breaks identification; I made `product_number` required and added uniqueness checks in `add_item()` and `update_selected()` to prevent collisions while noting this enforces stricter UX trade-offs.
- **Sorting by product number not working:**
 - Sorting ignored `product_number`; I added a `product_number` branch to `bubble_sort()` and allowed "product_number" in `sort_items()` so ordering now behaves predictably by the stored string.
- **Category filter UX was error-prone:**
 - Free-text prompts caused typos and missed matches; I replaced it with a modal `ttk.Combobox` so users choose an existing category, improving discoverability and reducing input errors.
- **Search scope was too narrow:**
 - Early search only matched names; I extended `realtime_filter()` and the search dialog to match both name and `product_number`, which keeps the UI simple but preserves $O(n)$ search cost.
- **Export lacked human summary:**
 - Exports were raw lists; the exporter now writes `exported_at` and a summary with totals and readable per-category product statements (e.g., "P001 — Gyeon Ceramic Detailer (Qty: 5)"), improving auditability for reviewers.
- **Risky file writes:**
 - Direct writes risk corruption on failure; `save_to_file()` now writes to a temp file and uses `os.replace()` for an atomic swap, which is safer but assumes the underlying filesystem supports atomic replace.
- **Quantity parsing and validation:**
 - Non-integer quantities could break numeric sorts and totals; I added input validation on add/update and defensive parsing in reports/exports so bad values default to 0 rather than crash.
- **Selection mapping when filtered:**
 - Treeview iids can lose their index mapping when filtered; `_get_selected_index()` falls back to `linear_search()` by name so actions still map to the correct inventory entry (with the limitation that duplicate names remain ambiguous).
- **Testing import friction:**
 - The main script's filename (spaces) made `pytest` imports unreliable; I updated `test_algorithms.py` to load the script by file path using `importlib.util`, which keeps tests runnable without renaming but is less idiomatic than importing a proper package module.

TESTING METHODOLOGY AND RESULTS:

With a simple manual instruction, the application was able to run smoothly without any troubles.

This was my guide in evaluating and assessing all the parts of the system of this application:

1. Launch app.

2. Add three items:

- 101, Q2 CanCoat EVO, Coating & Wax, 130
- 202, Gyeon Compounds, Maintenance, 103
- 301, Q2M Compound, Compounds, 199

(Show duplicate Product Number blocking.)

3. Update one item quantity (select row -> change qty -> Update Selected).
4. Realtime search: Lets find Q2 CanCoat EVO or its product number. so lets type "101" to show by product number; type part of name to search by name.
5. Sort: click Sort by Prod #, Sort by Name, Sort by Quantity (show order changes).
6. Category filter: click Sort by Category -> choose a category to show only that category.
7. Export inventory as JSON, then Load Inventory to verify persistence.
8. Clear All (confirm) to show file removal.

CONCLUSIONS & FUTURE WORK:

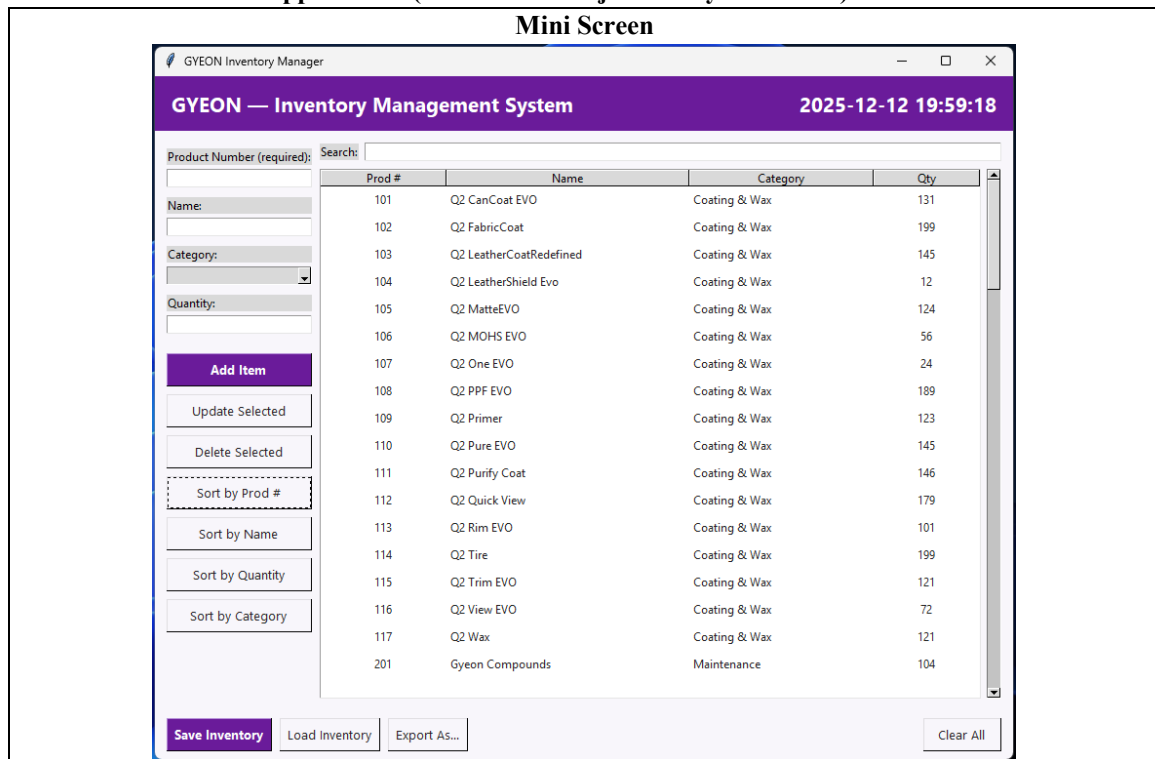
- use SQLite for larger datasets, enable CSV import/export, use hash map for faster search

ACCESS GITHUB TO VIEW PROJECT ZIP FILE AND VIDEO DEMO PRESENTATIONS:

<https://github.com/KOBEJAMESMAWANAY/Gyeon-Inventory-Management-System>

SAMPLE SCREENSHOTS OF THE APPLICATION:

1. Main Overview of the Application: (Window can adjust to any resolution)



Fullscreen

GYEON — Inventory Management System					2025
Product Number (required):	Search:				
Name:		Prod #	Name	Category	Qty
Category:		104	Q2 LeatherShield Evo	Coating & Wax	12
Quantity:		107	Q2 One EVO	Coating & Wax	24
		212	Q2M Fabric Cleaner	Maintenance	46
		106	Q2 MOHS EVO	Coating & Wax	56
		203	Q2M Bathe	Maintenance	71
		304	Q2M Block Applicator	Accessories	71
		116	Q2 View EVO	Coating & Wax	72
		303	Q2M Bald Wipe EVO	Accessories	94
		113	Q2 Rim EVO	Coating & Wax	101
		206	Q2M Ceramic Detailer	Maintenance	103
		201	Gyeon Compounds	Maintenance	104
		115	Q2 Trim EVO	Coating & Wax	121
		109	Q2 Wax	Coating & Wax	121
		105	Q2 Primer	Coating & Wax	123
		101	Q2 MatteEVO	Coating & Wax	124
		205	Q2 CanCoat EVO	Coating & Wax	131
		103	Q2M Bug & Grime	Maintenance	141
		110	Q2 LeatherCoatRedefined	Coating & Wax	145
		111	Q2 Pure EVO	Coating & Wax	145
		204	Q2 Purify Coat	Coating & Wax	146
		207	Q2M Bathe+	Maintenance	165
		112	Q2M Clay Bars EVO	Maintenance	168
		202	Q2 Quick View	Coating & Wax	179
		108	Q2M APC	Maintenance	186
		102	Q2 PPF EVO	Coating & Wax	189
		114	Q2 FabricCoat	Coating & Wax	199
		208	Q2 Tire	Coating & Wax	199
		209	Q2M Clay Lube REDEFINED	Maintenance	200
			Q2M Cure	Maintenance	200

2. Adding Items into the database

Product Number (required): <input type="text" value="101"/> Name: <input type="text" value="Q2 CanCoat EVO"/> Category: <input type="text" value="Coating & Wax"/> Coating & Wax Maintenance Compounds Pads Accessories <input type="button" value="Add Item"/>	Product Number (required): <input type="text" value="101"/> Name: <input type="text" value="Q2 CanCoat EVO"/> Category: <input type="text" value="Coating & Wax"/> Coating & Wax Maintenance Compounds Pads Accessories <input type="button" value="Add Item"/>
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Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145

3. Deleting Items into the database

Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145

Product Number (required):

Name:

Category:

Quantity:

Prod #

101 Q2 CanCoat EVO

102 Q2 FabricCoat

103 Q2 LeatherCoatRedefined

104 Q2 LeatherShield Evo

105 Q2 MatteEVO

106 Q2 MOHS EVO

107 Q2 One EVO

Confirm Delete

Delete 'Q2 CanCoat EVO' from inventory?

GYEON Inventory Manager

GYEON — Inventory Management System 2025-12-12 20:01:34

Product Number (required):

Name:

Category:

Quantity:

Prod #	Name	Category	Qty
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145
104	Q2 LeatherShield Evo	Coating & Wax	12
105	Q2 MatteEVO	Coating & Wax	124
106	Q2 MOHS EVO	Coating & Wax	56
107	Q2 One EVO	Coating & Wax	24
108	Q2 PPF EVO	Coating & Wax	189
109	Q2 Primer	Coating & Wax	123
110	Q2 Pure EVO	Coating & Wax	145
111	Q2 Purify Coat	Coating & Wax	146

4. Updating Items into the database (change category or quantity)

Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145

Product Number (required):

Name:

Category:

Quantity:

Product Number (required):

Name:

Category:

Quantity:

Search:

Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Maintenance	120
102	Q2 FabricCoat	Coating & Wax	199

5. Sorting By Product Number

GYEON — Inventory Management System 2025-12-12 20:04:26

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
104	Q2 LeatherShield Evo	Coating & Wax	12
107	Q2 One EVO	Coating & Wax	24
212	Q2M Fabric Cleaner	Maintenance	46
106	Q2 MOHS EVO	Coating & Wax	56
203	Q2M Bathe	Maintenance	71
504	Q2M Block Applicator	Accessories	71
116	Q2 View EVO	Coating & Wax	72
503	Q2M Bald Wipe EVO	Accessories	94
113	Q2 Rim EVO	Coating & Wax	101
206	Q2M Ceramic Detailer	Maintenance	103
201	Gyeon Compounds	Maintenance	104
115	Q2 Trim EVO	Coating & Wax	121
117	Q2 Wax	Coating & Wax	121
109	Q2 Primer	Coating & Wax	123
105	Q2 MatteEVO	Coating & Wax	124
101	Q2 CarCoat EVO	Coating & Wax	131
205	Q2M Bug & Grime	Maintenance	141
103	Q2 LeatherCoatRedefined	Coating & Wax	145

Save Inventory **Load Inventory** **Export As...** **Clear All**

GYEON — Inventory Management System 2025-12-12 20:04:44

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
101	Q2 CarCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145
104	Q2 LeatherShield Evo	Coating & Wax	12
105	Q2 MatteEVO	Coating & Wax	124
106	Q2 MOHS EVO	Coating & Wax	56
107	Q2 One EVO	Coating & Wax	24
108	Q2 PPF EVO	Coating & Wax	189
109	Q2 Primer	Coating & Wax	123
110	Q2 Pure EVO	Coating & Wax	145
111	Q2 Purify Coat	Coating & Wax	146
112	Q2 Quick View	Coating & Wax	179
113	Q2 Rim EVO	Coating & Wax	101
114	Q2 Tire	Coating & Wax	199
115	Q2 Trim EVO	Coating & Wax	121
116	Q2 View EVO	Coating & Wax	72
117	Q2 Wax	Coating & Wax	121
201	Gyeon Compounds	Maintenance	104

Save Inventory **Load Inventory** **Export As...** **Clear All**

6. Sorting By Name

GYEON — Inventory Management System 2025-12-12 20:04:26

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
104	Q2 LeatherShield Evo	Coating & Wax	12
107	Q2 One EVO	Coating & Wax	24
212	Q2M Fabric Cleaner	Maintenance	46
106	Q2 MOHS EVO	Coating & Wax	56
203	Q2M Bathe	Maintenance	71
504	Q2M Block Applicator	Accessories	71
116	Q2 View EVO	Coating & Wax	72
503	Q2M Bald Wipe EVO	Accessories	94
113	Q2 Rim EVO	Coating & Wax	101
206	Q2M Ceramic Detailer	Maintenance	103
201	Gyeon Compounds	Maintenance	104
115	Q2 Trim EVO	Coating & Wax	121
117	Q2 Wax	Coating & Wax	121
109	Q2 Primer	Coating & Wax	123
105	Q2 MatteEVO	Coating & Wax	124
101	Q2 CarCoat EVO	Coating & Wax	131
205	Q2M Bug & Grime	Maintenance	141
103	Q2 LeatherCoatRedefined	Coating & Wax	145

Save Inventory **Load Inventory** **Export As...** **Clear All**

GYEON — Inventory Management System 2025-12-12 20:05:45

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
201	Gyeon Compounds	Maintenance	104
101	Q2 CarCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145
104	Q2 LeatherShield Evo	Coating & Wax	12
105	Q2 MatteEVO	Coating & Wax	124
106	Q2 MOHS EVO	Coating & Wax	56
107	Q2 One EVO	Coating & Wax	24
108	Q2 PPF EVO	Coating & Wax	189
109	Q2 Primer	Coating & Wax	123
110	Q2 Pure EVO	Coating & Wax	145
111	Q2 Purify Coat	Coating & Wax	146
112	Q2 Quick View	Coating & Wax	179
113	Q2 Rim EVO	Coating & Wax	101
114	Q2 Tire	Coating & Wax	199
115	Q2 Trim EVO	Coating & Wax	121
116	Q2 View EVO	Coating & Wax	72
117	Q2 Wax	Coating & Wax	121

Save Inventory **Load Inventory** **Export As...** **Clear All**

7. Sorting By Quantity

GYEON — Inventory Management System 2025-12-12 20:07:11

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
101	Q2 CarCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145
104	Q2 LeatherShield Evo	Coating & Wax	12
105	Q2 MatteEVO	Coating & Wax	124
106	Q2 MOHS EVO	Coating & Wax	56
107	Q2 One EVO	Coating & Wax	24
108	Q2 PPF EVO	Coating & Wax	189
109	Q2 Primer	Coating & Wax	123
110	Q2 Pure EVO	Coating & Wax	145
111	Q2 Purify Coat	Coating & Wax	146
112	Q2 Quick View	Coating & Wax	179
113	Q2 Rim EVO	Coating & Wax	101
114	Q2 Tire	Coating & Wax	199
115	Q2 Trim EVO	Coating & Wax	121
116	Q2 View EVO	Coating & Wax	72
117	Q2 Wax	Coating & Wax	121
201	Gyeon Compounds	Maintenance	104

Save Inventory **Load Inventory** **Export As...** **Clear All**

GYEON — Inventory Management System 2025-12-12 20:06:45

Product Number (required): Search

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

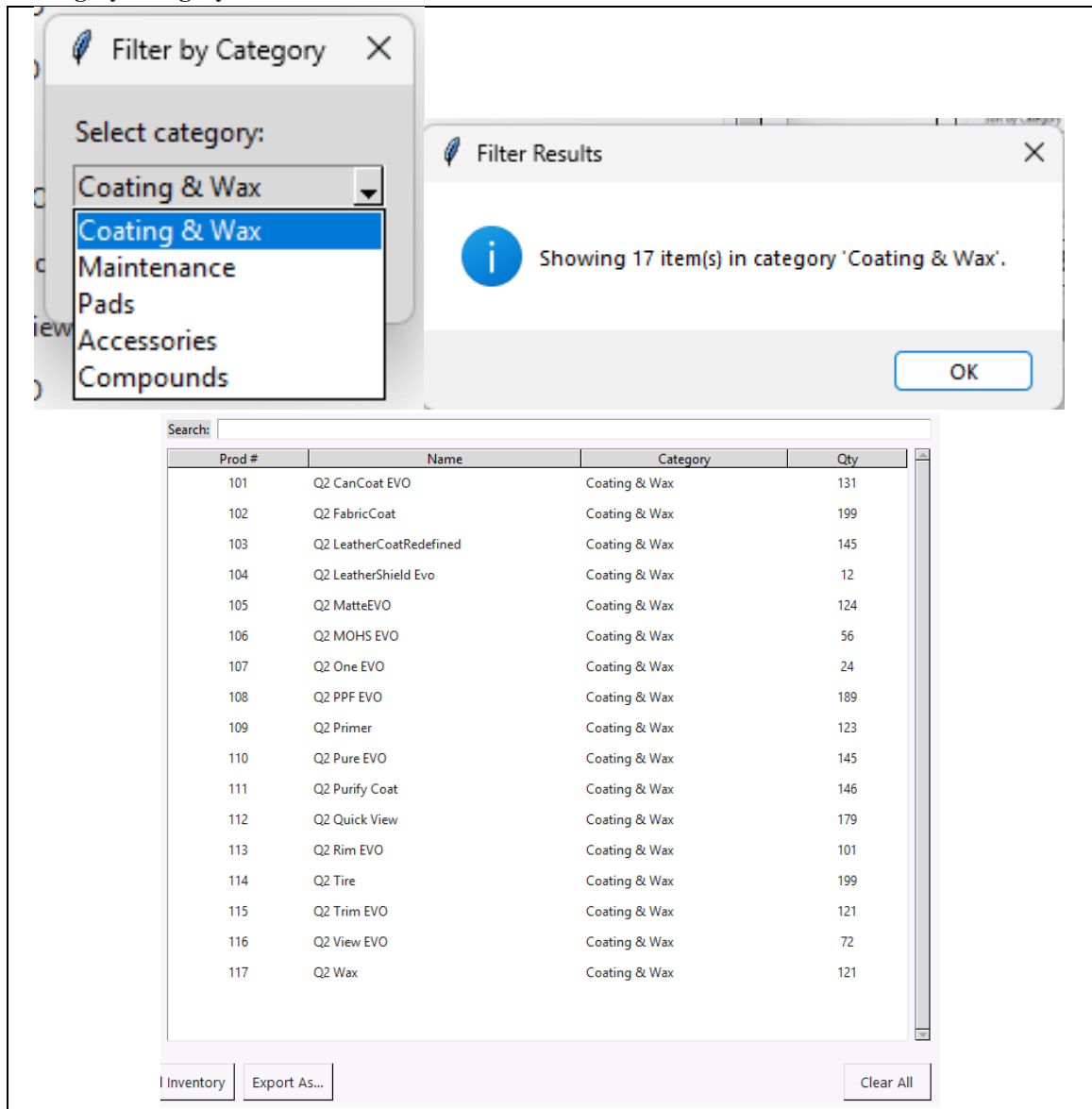
Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty
104	Q2 LeatherShield Evo	Coating & Wax	12
107	Q2 One EVO	Coating & Wax	24
212	Q2M Fabric Cleaner	Maintenance	46
106	Q2 MOHS EVO	Coating & Wax	56
203	Q2M Bathe	Maintenance	71
504	Q2M Block Applicator	Accessories	71
116	Q2 View EVO	Coating & Wax	72
503	Q2M Bald Wipe EVO	Accessories	94
113	Q2 Rim EVO	Coating & Wax	101
206	Q2M Ceramic Detailer	Maintenance	103
201	Gyeon Compounds	Maintenance	104
115	Q2 Trim EVO	Coating & Wax	121
117	Q2 Wax	Coating & Wax	121
109	Q2 Primer	Coating & Wax	123
105	Q2 MatteEVO	Coating & Wax	124
101	Q2 CarCoat EVO	Coating & Wax	131
205	Q2M Bug & Grime	Maintenance	141
103	Q2 LeatherCoatRedefined	Coating & Wax	145

Save Inventory **Load Inventory** **Export As...** **Clear All**

8. Sorting By Category



Filter by Category

Select category:

- Coating & Wax
- Maintenance
- Pads
- Accessories
- Compounds

Filter Results

Showing 17 item(s) in category 'Coating & Wax'.

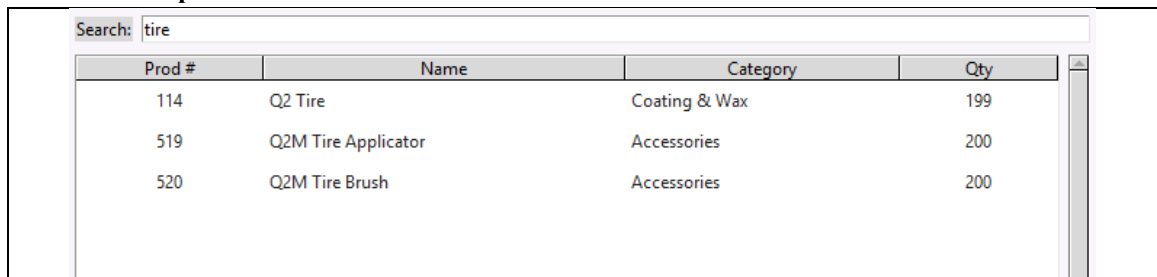
OK

Search:

Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Coating & Wax	131
102	Q2 FabricCoat	Coating & Wax	199
103	Q2 LeatherCoatRedefined	Coating & Wax	145
104	Q2 LeatherShield Evo	Coating & Wax	12
105	Q2 MatteEVO	Coating & Wax	124
106	Q2 MOHS EVO	Coating & Wax	56
107	Q2 One EVO	Coating & Wax	24
108	Q2 PPF EVO	Coating & Wax	189
109	Q2 Primer	Coating & Wax	123
110	Q2 Pure EVO	Coating & Wax	145
111	Q2 Purify Coat	Coating & Wax	146
112	Q2 Quick View	Coating & Wax	179
113	Q2 Rim EVO	Coating & Wax	101
114	Q2 Tire	Coating & Wax	199
115	Q2 Trim EVO	Coating & Wax	121
116	Q2 View EVO	Coating & Wax	72
117	Q2 Wax	Coating & Wax	121

Inventory Export As... Clear All

9. Search Look Up Feature



Search: tire



Prod #	Name	Category	Qty
114	Q2 Tire	Coating & Wax	199
519	Q2M Tire Applicator	Accessories	200
520	Q2M Tire Brush	Accessories	200


Search: q2m

Prod #	Name	Category	Qty
202	Q2M APC	Maintenance	186
203	Q2M Bathe	Maintenance	71
204	Q2M Bathe+	Maintenance	165
205	Q2M Bug & Grime	Maintenance	141
206	Q2M Ceramic Detailer	Maintenance	103
207	Q2M Clay Bars EVO	Maintenance	168
208	Q2M Clay Lube REDEFINED	Maintenance	200
209	Q2M Cure	Maintenance	200
210	Q2M Cure Matte	Maintenance	200
211	Q2M Eco Wash	Maintenance	200
212	Q2M Fabric Cleaner	Maintenance	46
213	Q2M Foam	Maintenance	200
214	Q2M Glass	Maintenance	200
215	Q2M Glass+	Maintenance	200
216	Q2M Interior Detailer	Maintenance	200
217	Q2M Iron REDEFINED	Maintenance	200
218	Q2M Iron Wheel Cleaner	Maintenance	200
219	Q2M Leather Cleaner Natural	Maintenance	200

Inventory Export As... Clear All

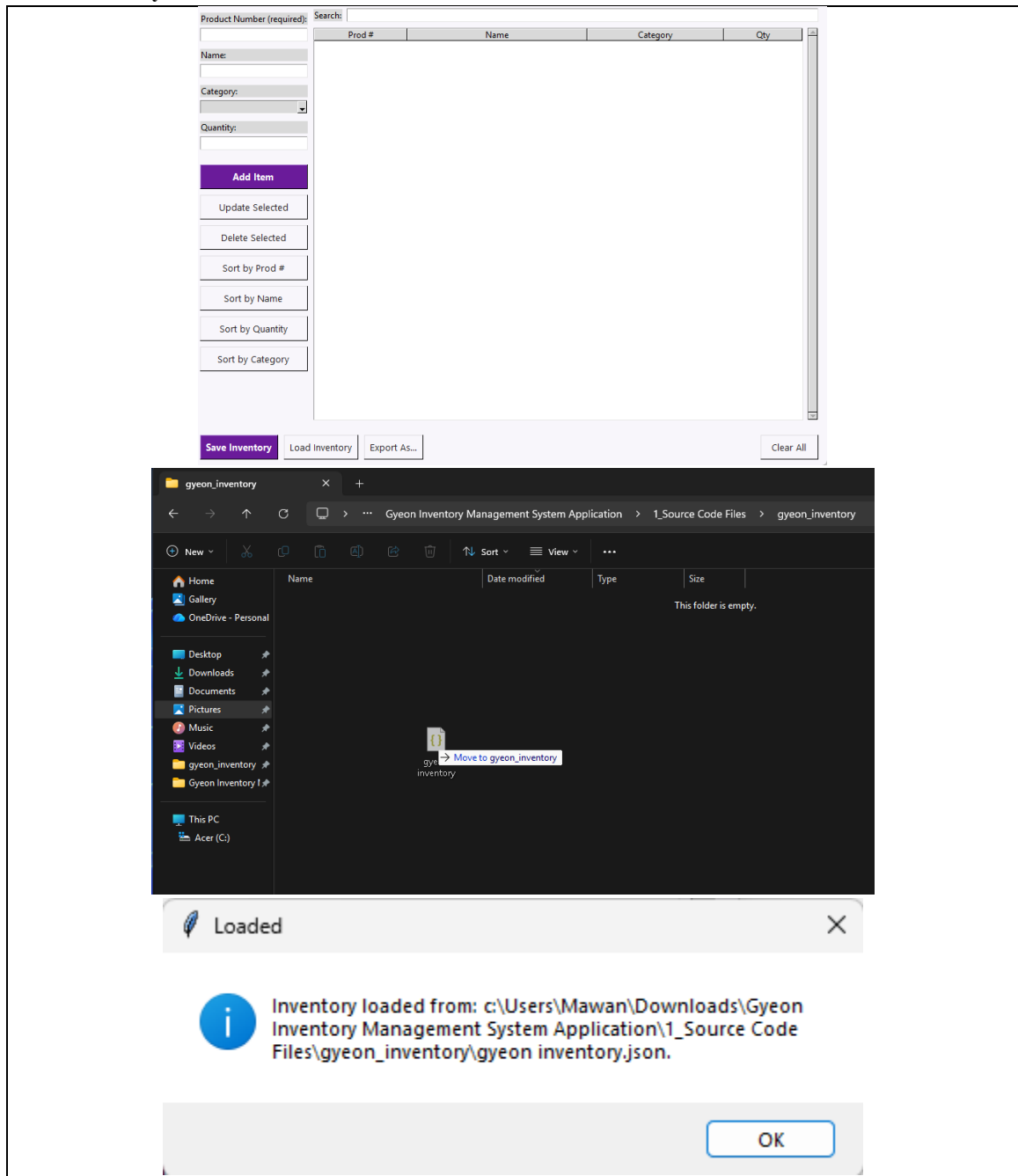
10. Save Inventory

 Saved 

 Inventory saved to: c:\Users\Mawan\Downloads\Gyeon Inventory Management System Application\1_Source Code Files\gyeon_inventory\gyeon inventory.json

OK


11. Load Inventory



Prod #	Name	Category	Qty
104	Q2 LeatherShield Evo	Coating & Wax	12
107	Q2 One EVO	Coating & Wax	24
212	Q2M Fabric Cleaner	Maintenance	46
106	Q2 MOHS EVO	Coating & Wax	56
203	Q2M Bathe	Maintenance	71
504	Q2M Block Applicator	Accessories	71
116	Q2 View EVO	Coating & Wax	72
503	Q2M Bald Wipe EVO	Accessories	94
113	Q2 Rim EVO	Coating & Wax	101
206	Q2M Ceramic Detailer	Maintenance	103
201	Gyeon Compounds	Maintenance	104
115	Q2 Trim EVO	Coating & Wax	121
117	Q2 Wax	Coating & Wax	121
109	Q2 Primer	Coating & Wax	123
105	Q2 MatteEVO	Coating & Wax	124
101	Q2 CanCoat EVO	Coating & Wax	131
205	Q2M Bug & Grime	Maintenance	141
103	Q2 LeatherCoatRedefined	Coating & Wax	145

12. Clear All Database

Confirm

 Clear ALL inventory? This cannot be undone.

Yes

No

GYEON Inventory Manager

GYEON — Inventory Management System2025-12-12 20:18:57

Product Number (required):

Search:

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Prod #	Name	Category	Qty

Save Inventory

Load Inventory

Export As...

Clear All