

## 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 functional 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)**

**Mini Screen**

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
201	Gyeon Compounds	Maintenance	104

Fullscreen				
GYEON — Inventory Management System				
<input type="text" value="Product Number (required)"/> Search				
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	
110	Q2 Pure EVO	Coating & Wax	145	
111	Q2 Purify Coat	Coating & Wax	146	
204	Q2M Bathe+	Maintenance	165	
207	Q2M Clay Bars EVO	Maintenance	168	
112	Q2 Quick View	Coating & Wax	179	
202	Q2M APC	Maintenance	186	
108	Q2 PPF EVO	Coating & Wax	189	
102	Q2 FabricCoat	Coating & Wax	199	
114	Q2 Tire	Coating & Wax	199	
208	Q2M Clay Lube REDEFINED	Maintenance	200	
209	Q2M Cure	Maintenance	200	

## 2. Adding Items into the database

<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Product Number (required):</b>  <input type="text" value="101"/> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Name:</b>  <input type="text" value="Q2 CanCoat EVO"/> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Category:</b>  <input style="width: 150px;" type="text" value="Coating &amp; Wax"/>  <div style="background-color: #f0f0f0; padding: 5px; border: 1px solid #ccc; width: 150px; margin-top: 5px;"> <input style="margin-right: 10px;" type="button" value="Coating &amp; Wax"/>  <input type="button" value="Maintenance"/>  <input type="button" value="Compounds"/>  <input type="button" value="Pads"/>  <input type="button" value="Accessories"/> </div> </div> <div style="text-align: center; background-color: #5050cc; color: white; padding: 5px; margin-bottom: 10px;"> <input type="button" value="Add Item"/> </div>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Product Number (required):</b>  <input type="text" value="101"/> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Name:</b>  <input type="text" value="Q2 CanCoat EVO"/> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Category:</b>  <input style="width: 150px;" type="text" value="Coating &amp; Wax"/>  <div style="background-color: #f0f0f0; padding: 5px; border: 1px solid #ccc; width: 150px; margin-top: 5px;"> <input style="margin-right: 10px;" type="button" value="Coating &amp; Wax"/>  <input type="button" value="Maintenance"/>  <input type="button" value="Compounds"/>  <input type="button" value="Pads"/>  <input type="button" value="Accessories"/> </div> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <b>Quantity:</b>  <input type="text" value="131"/> </div> <div style="text-align: center; background-color: #5050cc; color: white; padding: 5px; margin-bottom: 10px;"> <input type="button" value="Add Item"/> </div>																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Prod #</th> <th style="width: 40%;">Name</th> <th style="width: 20%;">Category</th> <th style="width: 25%;">Qty</th> </tr> </thead> <tbody> <tr> <td>101</td> <td>Q2 CanCoat EVO</td> <td>Coating &amp; Wax</td> <td>131</td> </tr> <tr> <td>102</td> <td>Q2 FabricCoat</td> <td>Coating &amp; Wax</td> <td>199</td> </tr> <tr> <td>103</td> <td>Q2 LeatherCoatReDefined</td> <td>Coating &amp; Wax</td> <td>145</td> </tr> </tbody> </table>		Prod #	Name	Category	Qty	101	Q2 CanCoat EVO	Coating & Wax	131	102	Q2 FabricCoat	Coating & Wax	199	103	Q2 LeatherCoatReDefined	Coating & Wax	145
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

The screenshot shows the GYEON Inventory Management System interface. A modal dialog box titled "Confirm Delete" is open, asking "Delete 'Q2 CanCoat EVO' from inventory?". The "Yes" button is highlighted.

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

Below the table, there is a search bar and a list of products:

- Product Number (required): 101
- Name: Q2 CanCoat EVO
- Category: Coating & Wax
- Quantity: 131
- Add Item
- Update Selected
- Delete Selected
- Sort by Prod #

The main window title is "GYEON — Inventory Management System" and the date/time is "2025-12-12 20:01:34".

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

The screenshot shows the GYEON Inventory Management System interface. A modal dialog box is open, allowing the user to change the product details. The "Category" dropdown is set to "Maintenance". The "Quantity" field is set to "120".

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

Below the table, there are two side-by-side forms for updating the product:

**Left Form (Original Product):**

- Product Number (required): 101
- Name: Q2 CanCoat EVO
- Category: Maintenance
- Coating & Wax
- Maintenance
- Compounds
- Pads
- Accessories
- Add Item

**Right Form (Updated Product):**

- Product Number (required): 101
- Name: Q2 CanCoat EVO
- Category: Maintenance
- Quantity: 120
- Add Item

At the bottom, there is a search bar and a table showing the updated product list:

Prod #	Name	Category	Qty
101	Q2 CanCoat EVO	Maintenance	120
102	Q2 FabricCoat	Coating & Wax	100

## 5. Sorting By Product Number

The left screenshot shows the inventory list sorted by Product Number (Prod #). The right screenshot shows the same list after applying a sort operation.

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 Brite	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

## 6. Sorting By Name

The left screenshot shows the inventory list sorted by Name. The right screenshot shows the same list after applying a sort operation.

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 Brite	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

## 7. Sorting By Quantity

The left screenshot shows the inventory list sorted by Quantity. The right screenshot shows the same list after applying a sort operation.

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
201	Gyeon Compounds	Maintenance	104

#### 8. Sorting By Category

The screenshot shows two overlapping windows. The top window is titled 'Filter by Category' and contains a dropdown menu labeled 'Select category:' with several options: 'Coating & Wax', 'Maintenance', 'Pads', 'Accessories', and 'Compounds'. The 'Coating & Wax' option is highlighted with a blue selection bar. Below this window is another window titled 'Filter Results' with the message 'Showing 17 item(s) in category 'Coating & Wax''. An 'OK' button is visible in the bottom right corner of the 'Filter Results' window. A large table below the 'Filter Results' window displays 17 items, each with columns for Prod #, Name, Category, and Qty. The table includes items like Q2 CanCoat EVO, Q2 FabricCoat, and Q2 Wax. At the bottom of the table are buttons for 'I Inventory', 'Export As...', and 'Clear All'.

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

#### 9. Search Look Up Feature

The screenshot shows a search interface with a search bar at the top containing the text 'tire'. Below the search bar is a table with four rows of data, each consisting of columns for Prod #, Name, Category, and Qty. The table includes items like Q2 Tire, Q2M Tire Applicator, and Q2M Tire Brush. The 'Category' column for the first item is 'Coating & Wax', while for the other two items it is 'Accessories'.

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



## 11. Load Inventory

The screenshot shows the Gyeon Inventory Management System Application interface. On the left, there is a sidebar with input fields for Product Number (required), Name, Category, and Quantity, along with buttons for Add Item, Update Selected, Delete Selected, and sorting options (Sort by Prod #, Sort by Name, Sort by Quantity, Sort by Category). Below these are Save Inventory, Load Inventory, Export As..., and Clear All buttons. On the right, there is a table with columns Prod #, Name, Category, and Qty, and a search bar above it. At the bottom, there is a file explorer window titled 'gyeon\_inventory' showing the file 'gyeon inventory.json'. A context menu is open over this file with the option 'Move to gyeon\_inventory'. A modal dialog at the bottom displays the message 'Loaded' with an information icon and the text 'Inventory loaded from: c:\Users\Mawan\Downloads\Gyeon Inventory Management System Application\1\_Source Code Files\gyeon\_inventory\gyeon inventory.json.' An 'OK' button is at the bottom right of the modal.

Product Number (required):

Name:

Category:

Quantity:

Add Item

Update Selected

Delete Selected

Sort by Prod #

Sort by Name

Sort by Quantity

Sort by Category

Save Inventory

Load Inventory

Export As...

Clear All

gyeon\_inventory

Home

Gallery

OneDrive - Personal

Desktop

Downloads

Documents

Pictures

Music

Videos

gyeon\_inventory

Gyeon Inventory I

This folder is empty.

Loaded

i

Inventory loaded from: c:\Users\Mawan\Downloads\Gyeon Inventory Management System Application\1\_Source Code Files\gyeon\_inventory\gyeon inventory.json.

OK

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

