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Course: CSCE 4350.001

Project Phase 1: Project Proposal

Project Description

The Retail Auto Parts System project is a database centric application designed by undergrad students to computerize the operations of a small auto parts company. The hypothetical premise of this project is that the business is currently operating with paper records using limited computational capabilities. Our system will be designed to process:

- Customer orders and payments. (In Customer Mode)
- Record inventory management, purchases, and supplier records. (In Store Mode)
- Employee management and reports. (In Store Mode)

Purpose of phase I

The purpose of this phase is to identify and document all problems, solutions, hardware choices, and software choices. It will also document the project timeline, the System Requirement Analysis, and all team member's roles and contributions. This proposal will articulate the concept of the Retail Auto Parts System into a clear actionable plan with a timeline. By evaluating and establishing all aspects of the system into a clear plan, the team will have a structured method for tracking progress.

Project Timeline

Project Phase	Tasks	Due Date	Deliverables
Phase 1	Analysis and Conceptual Design	10/03/2025	Proposal report
Phase 2	Logical and Physical database design	10/31/2025	ER diagram, Schema Diagram
Phase 3	System implementation and testing	11/21/2025	Final System Product
Phase 4	Final Presentation	12/05/2025	Power Point Presentation and Demonstration

Problem Encountered and Solutions

Problem 1: Technology Stack Selection
Choosing between different DBMS options (MySQL, PostgreSQL, MongoDB) and web frameworks
Solutions: After evaluating requirements, we selected PostgreSQL for its robust ACID compliance, excellent handling of complex queries, and strong support for relational data modeling essential for inventory management. For the web framework, we chose a modern stack that balances performance with developer productivity.
Why choose PostgreSQL: PostgreSQL offers some advanced features like JSONB support for flexible data storage, transaction handling, and scalability. Additionally, it's open source, well-documented, and has strong community support.

Hardware Requirements

Workstation: Laptop or Desktop
Operating System: Windows/macOS/Linux
Network: connectivity between frontend, backend, and database.

Software and Technology Stack

Database Management System

- PostgreSQL
- Enterprise-grade features, ACID compliance, excellent performance with complex queries
- pgAdmin 4 for database administration

Backend Development

- Framework: Python with Django
- RESTful API design

Frontend Development

- HTML/CSS/Javascript
- Django templates for web interface, creates menu system

System Requirement Analysis

The system must have two modes of operations, “Customer mode” and “Store mode”.
Customer Mode:

- The system must allow ordering products online
- The system shall support payment
- The system shall store customer’s personal information (name, address, phone, email) for billing.
- The system shall have user and password authentication (for both customers and employees).
- The system shall allow customers to browse existing products.
- The system shall contain a search system.
- The system shall display details when a product is selected (price, quantity, new/used, ect).
- The system shall store customer history activity.
- The system shall have a “shopping cart” function.

Store mode:

- The system shall store employee information (add/change/delete).
- The system shall have employee log in authentication.
- The system must have a section to:
    - Order new products, reorder, cancel orders, and handle returns.
    - Update database for personnel and parts information.
    - Generate reports on products and employee status.
    - Include delivery information such as order date, delivery date, payment method, and cancellations.

The system shall be menu-driven.

Database Design Overview

Initial draft identifying core entities:

- Customer(Customer_ID, Customer_name, Address, Phone, Email, Username, Password)
- Employee(Employee_ID, Employee_name, Role, Login_ID, Password)
- Auto Parts(Part_ID, Part_name, Quantity, Category, Condition)
- Order(Oder_ID, Customer_ID, Order_date, Payment_Method, Total_amount)
- Supplier(Delivery, Supplier_name, Supplier_Contact_info)
- Delivery(Delivery_ID, Order_ID, Date, Status.)

Phase I: Planning and Analysis

- Requirements gathering
- Technology stack selection
- Team formation and role assignment
- Initial documentation
- Deliverable: Phase I Report

Phase II: Database Design and Implementation

- Create detailed Entity-Relationship (ER) diagrams
- Design normalized relational schema with all constraints
- Implement database in PostgreSQL
- Populate with sample/test data
- Validate database design through testing

Phase III: System Development, Testing & Deployment

- Develop backend API and business logic
- Create frontend user interface
- Integrate all system components
- Perform comprehensive testing
- Deploy to production environment
- Create user documentation

Phase IV: Final Presentation

- Present the complete project to the class
- Demonstrate functionality and project outcomes

Team Member Contribution

Quoc Nhan Tra – Requirements & Frontend Specialist

- Phase I (Analysis & Conceptual Design):
    - Collect user requirements (customer/store mode features).
    - Draft system requirement analysis section.
    - Help with hardware/software/DBMS selection.
- Phase II (Database Design):
    - Contribute to ER diagrams by focusing on customer- and store-facing entities (e.g., Customers, Orders, Payments).
    - Help normalize relations and refine schema.

- Phase III (Implementation & Testing):
    - Develop frontend (UI/UX) for customer/store menus.
    - Connect frontend forms to backend API.
    - Write test cases for user interaction (login, search, ordering).
- Programming Focus: Frontend development, user input validation, integration with backend.

Binod Chhantyal – Database & Backend Specialist

- Phase I:
    - Research DBMS options and justify choice (MySQL, PostgreSQL, etc.).
    - Contribute to system plan and data flow.
- Phase II:
    - Contribute to ER diagram and schema design (tables, keys, constraints).
    - Insert sample data for testing.
- Phase III:
    - Implement backend API (CRUD, authentication, reports).
    - Optimize SQL queries and indexing.
    - Test queries and backend response.
- Programming Focus: Database schema creation, SQL queries, backend API.

Solomon Rosenfeld – System Integrator & Tester

- Phase I:
    - Document project plan and timeline.
    - Draft Phase I proposal with contribution requirements with other members.
- Phase II:
    - Assist with schema designs and integrity checks (foreign keys, normalization).
    - Prepare ER/schema diagrams for the report.
- Phase III:
    - Develop/Program business logic (order processing, employee management).
    - Develop system integration (connecting frontend, backend, and database).
    - Lead system testing & demonstrations
- Programming Focus: Middleware code, integration testing, error handling.

Project Phase 2: Logical and Physical Database Design

Introduction/Purpose of Phase II

The purpose of this phase is to expand on the problems encountered in Phase I, document revisions to the Phase I report, and team member contribution. It will also document the ER Diagrams, Schema Diagram, and the results of the database schema creation. By expanding on these aspects, the team will be able to further refine the architecture of the software and improve the problematic aspects.

Phase 1 and Revisions

Initially, we agreed on using PostgreSQL as our DBMS. However, we encountered problems while using pgAdmin 4, and in the end decided to switch to DBeaver as our database administration tool, as it is more intuitive and functional. Additionally, after analyzing the project requirements, we identified additional core entities and attributes which were added to the ER diagram and relational schema.

Problems Encountered and Solutions

Problem 1: Relationship complexities, such as some many to many relationships caused anomalies.
Solution: In order to clear this problem, we created junction tables such as the case with Inventory and Orderitem with composite primary keys. For example, the primary key in Inventory is created with (store_id, part_id), which becomes a unique key. This method helps eliminate duplicates and helps maintain integrity.

Problem 2: When we first started defining objects we faced difficulty determining which should become entities and which should be attributes. Some data overlapped, and several attributes were unintentionally excluded. Each time we revised the ER diagram, new dependencies appeared that we forgot which requires updating the schema.
Solution: We had to go back and carefully review the project requirements and clearly identify the entity's purpose. In the end we created a list defining the entities and attributes one by one as required by the project outline, then began to proceed from there.

Documentation Produced in Phase II

Defining entities and attributes

- **Store** — store_id (PK), name, phone, address_line1/2, city, state, postal_code
- **Customer** — customer_id (PK), full_name, customer_email, customer_phone, created_at, username, password
- **Employee** — employee_id (PK), store_id (FK), full_name, role, email, username, password
- **Supplier** — supplier_id (PK), name, contact_email, phone, Address
- **Auto_Part** — part_id (PK), name, category, condition, unit_price, reorder_level
- **Inventory** — (store_id, part_id) (PK, FK), quantity_on_hand
- **Purchase_Order**— po_id (PK), store_id (FK), supplier_id (FK), order_date, expected_date, status
- **Order_Item** — (po_id, part_id) (PK, FKs), quantity, unit_cost
- **Customer_Order** — order_id (PK), customer_id (FK), store_id (FK), order_date, status
- **OrderItem** (assoc.) — (order_id, part_id) (PK, FKs), qty, unit_price
- **Payment** — payment_id (PK), order_id (FK), payment_method, amount, paid_date, card_last_four_digit, authentication_code
- **Delivery** — delivery_id (PK), order_id (FK), ship_date, delivery_date, employee_id(FK), tracking_number, deilvery_status
- **ReturnItem** — return_id (PK), order_id (FK), part_id (FK), quantity, reason, created_date

Entity-Relationship Diagram

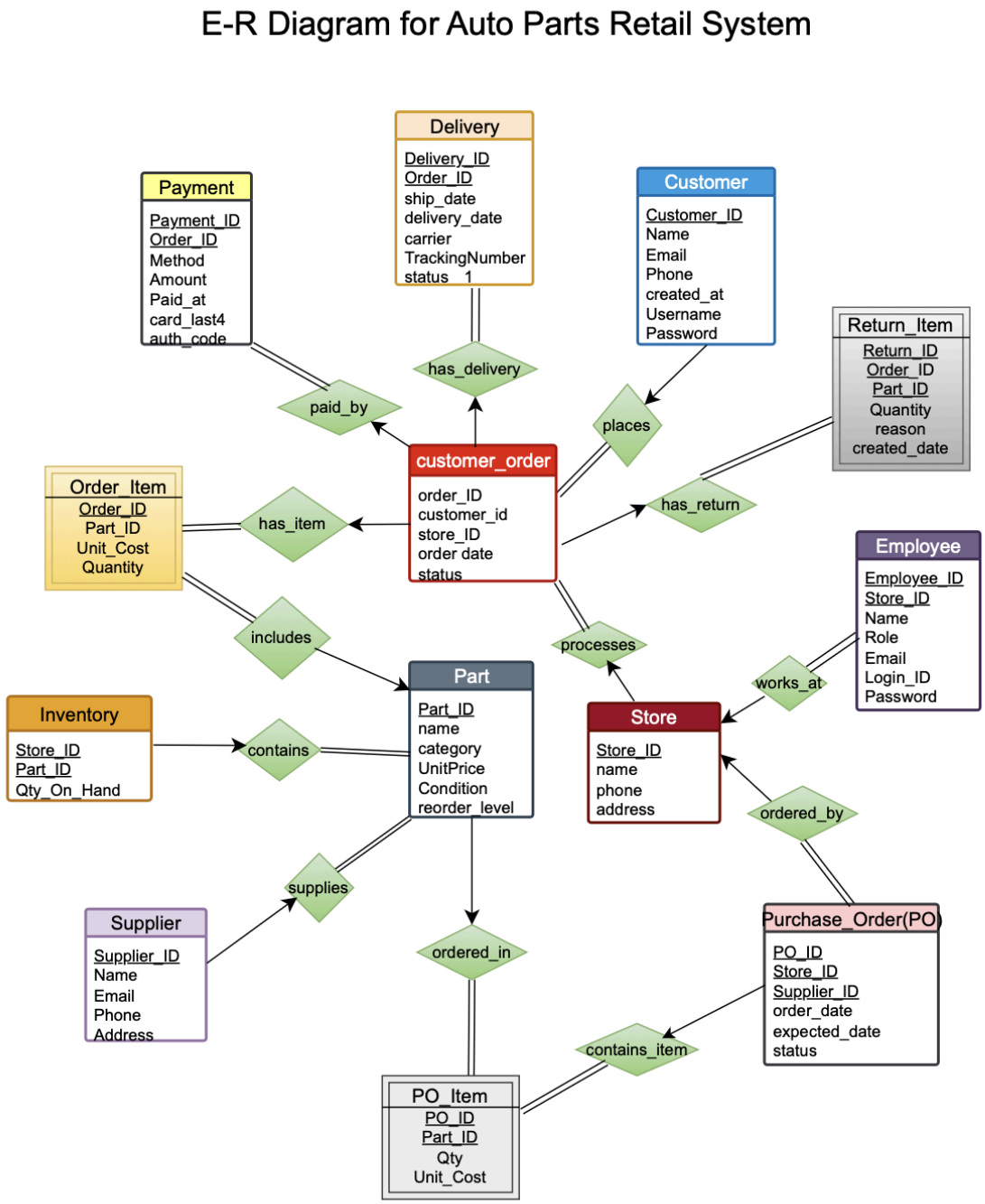


Figure1: E-R diagram

Relational Schema

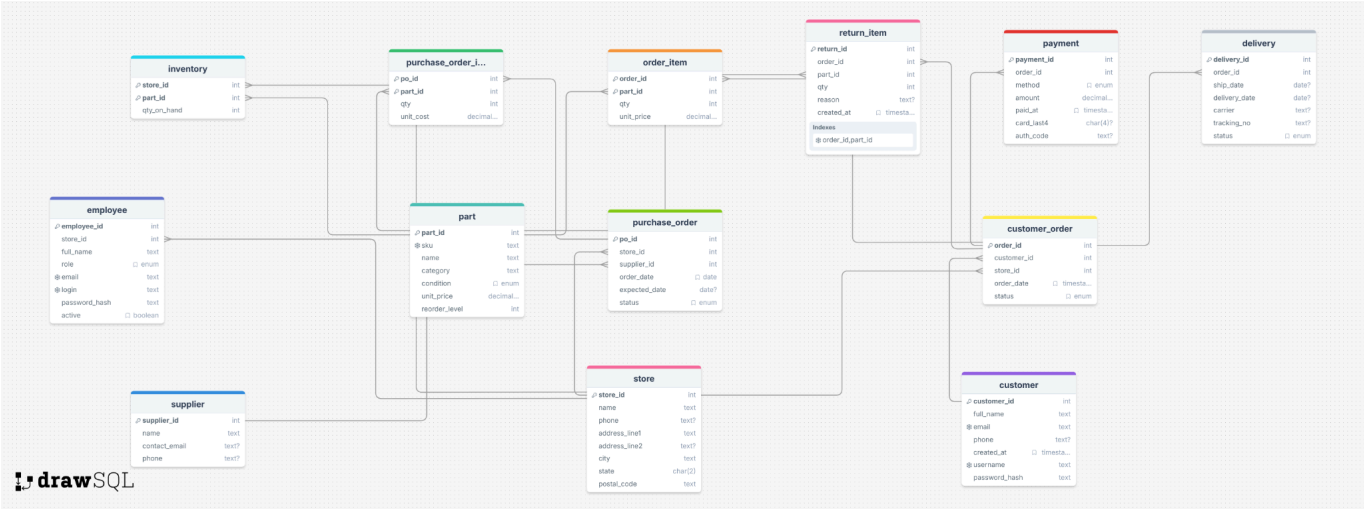
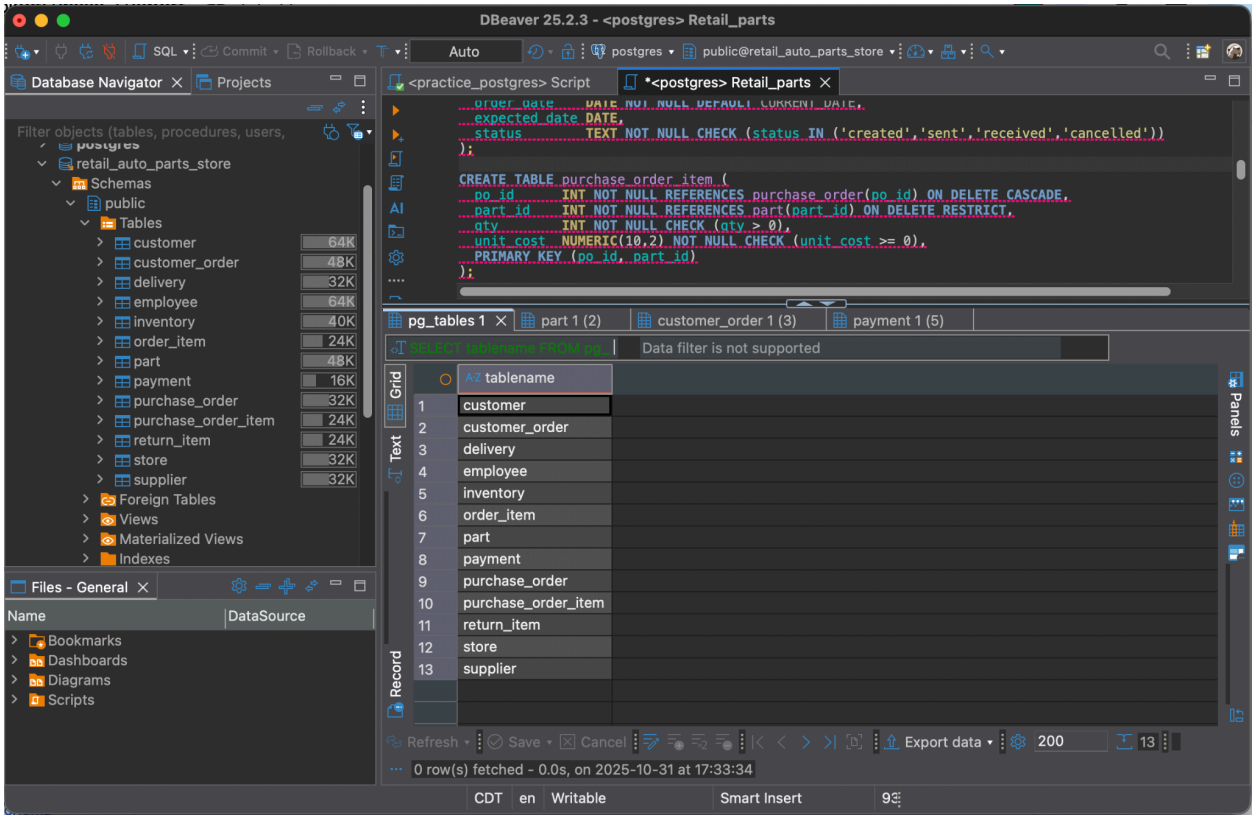


Figure 2: Relational Schema Diagram

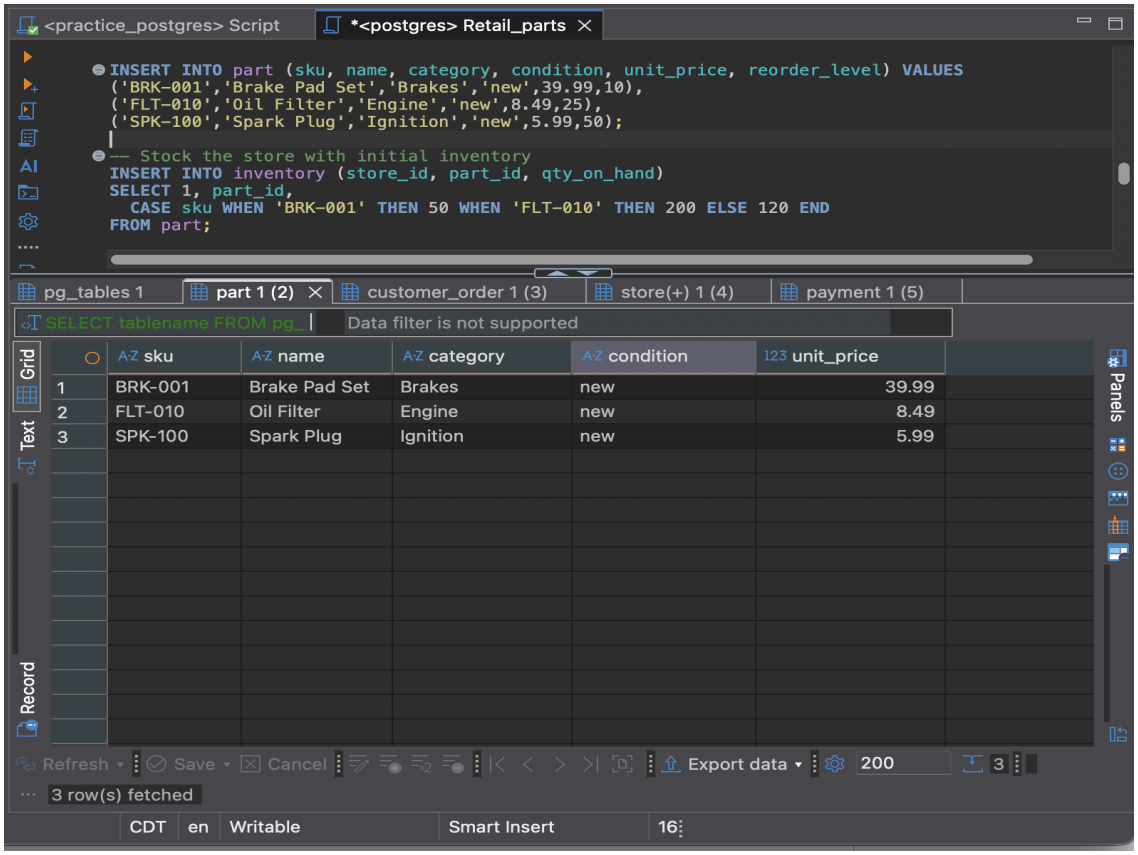
Sample Data and Output Results

CREATE TABLE



Parts table output

```
SELECT sku, name, category, condition, unit_price FROM part ORDER BY name;
```



Team Member Contribution

Quoc Nhan Tra

- Implemented tables in PostgreSQL
- Helped define entity, attributes, and datatypes
- Tested queries and provided samples with screenshots
- Aided in compiling Phase II report

Binod Chhantyal

- Drew ER diagram
- Designed relational schema
- Defined entity, attributes, and datatypes

Solomon Rosenfeld

- Validated normalization process
- aided in establishing referential integrity
- Compiled Phase II report

Conclusion

In phase II, we were able to successfully create an executable relational database schema. The database we created enforces strong integrity constraints, and supports major operations required by the Retail Auto Parts System. The ER and Schema diagrams illustrate a conceptual map for the logical model. Additionally, we were able to produce screenshots using sample data for execution to confirm the database is working within the scope of the designs and constraints. Lastly, improvements to planning the software architecture were made through identifying problems surfaced from practical testing and implementation.

Project Phase 3: System Implementation, Testing & Demonstration

1.Introduction

1.1 Project Overview

This document presents the comprehensive Phase III report for the Retail Auto Parts System, a database-driven software solution designed to modernize and streamline the operations of a small auto parts retail company. The system addresses the critical need to transition from a paper-driven environment to a fully computerized operation that supports business expansion and multi-store management.

1.2 Purpose of Phase III

Phase III represents the culmination of our development efforts, focusing on the complete implementation, rigorous testing, and demonstration of the Retail Auto Parts System. This phase builds upon the conceptual design from Phase I and the logical/physical database design from Phase II, delivering a fully functional product that meets all specified requirements and operational needs.

1.3 System Architecture

The implemented system consists of three core components:

Backend: Django 4.2, Django REST Framework, PostgreSQL
Frontend: Django templates (HTML/CSS), simple JS fetch for login
Database: PostgreSQL

The system supports two distinct operational modes:

- **Customer Mode:** Web-based interface for customers to browse parts, place orders, manage accounts, and track deliveries
- **Store Mode:** Employee interface for inventory management, order processing, report generation, and administrative functions

Revisions

Since the Phase II report, there has been no additional revisions to the chosen technology stack for the project. The frameworks that were outlined in the design phase have been satisfactory for the requirements of the system functions. After the design phase, the practical implementations were made by closely following the design of the entity and attribute diagrams that were prepared.

In the implementation point of this phase, there were minor revisions made that arose from encountered problems. These were small scale choices and not representative of the broad scope of the system design. These smaller scale revisions are outlined in the next section below.

Problems Encountered and Solutions

Problem 1: During early stages of implementation, customers and employees login even though their credentials exist and are valid. This is the result of Django storing passwords using secure hashing algorithms by default, and initially the passwords were stored in plaintext, inserted into PostgreSQL tables. As a result, Django's authentication cannot compare hashed passwords with plain text, causing the failed login attempts.
Solution: To resolve this issue, we used Django's built in standardized password handling. make_password() was used to hash all existing passwords, and check_password() was used during authentication to check user credentials.

Problem 2: When users attempted to filter auto parts by category or conditions, the catalog often crashed. This was caused by missing URL parameters, for example, visiting **/catalog/?category=** sent blank values, which the view processes as a normal filter.
Solution: We updated catalog view logic to handle cases where filters were not provided or are empty. This was done by adding a default/fallback query such as **AutoPart.object.all()**. Additionally, we had to make sure that request parameters exist before filtering, using conditional filters when parameters are valid. Finally, the frontend links were updated to ensure they send valid string query.

Problem 3: When the navigation bar was being implemented to include more features, the Logout link disappeared. This was due to changes made in base.html where conditional blocks determined whether the user was logged in or not. When the sign in logic was being updated, the logout block was unintentionally removed, causing users to be permanently stuck "signed in", without a way to sign out.
Solution: In the end, we had to rebuild the navigation bar to differentiate between being logged in and logged out. Signed in was displayed when no user sessions existed, and Logout was displayed for users who have been authenticated.

Problem 4: While integrating the frontend with the database, several inconsistencies appeared in the data. These inconsistencies include auto parts referencing non-existent store ID, displaying blanks, and PostgreSQL sequences becoming out of sync with manually inserted items.
Solution: In the end we had to reset the database and reset SQL settings. After resetting all the data input and starting fresh, we created sample auto parts, customers, and employees accounts directly through Django. This created a reliable foundation dataset that works across all features.

Documentation Produced in Phase III

System Setup Instructions

1. Clone the repository and navigate to the backend directory:
   - **git clone**
   - cd retail-auto-parts-system-main/backend
2. Create a Python virtual environment:
   - **python3 -m venv .venv**
   Activate the virtual environment:
   • On macOS/Linux:
   - **source .venv/bin/activate**
   • On Windows (PowerShell):
   - **.venv/Scripts/Activate.ps1**
3. Install required Python packages:
   - **pip install -r requirements.txt**
4. Apply database migrations and start the system:
   Run migrations:
   - **python3 manage.py migrate**
   Create an admin (superuser) account:
   - **python3 manage.py createsuperuser**
   Launch the application server:
   - **python3 manage.py runserver**
5. Access the system through a web browser:
   Home Page: http://127.0.0.1:8000/
   Customer Login: http://127.0.0.1:8000/customer/login/
   Employee Login: http://127.0.0.1:8000/employee/login/
   Admin Panel (superuser only): http://127.0.0.1:8000/admin/

Getting Started

1. Access the Django Admin Panel
   Open the following URL in a browser:
   http://127.0.0.1:8000/admin/
   Log in using the superuser credentials created during setup.

2. Create a Customer Account
   Inside the Django admin dashboard:
   • Select “Customers” from the sidebar
   • Click “Add Customer”
   • Enter all required fields (full name, email, phone, username, password, etc.)
   • Save the record
   This account can now be used to log into the customer-facing website.

3. Log in as a Customer
   After adding some auto parts to the database:
   • Log out of the admin panel
   • Go to: http://127.0.0.1:8000/customer/login/
   • Enter the customer username and password created earlier

4. Begin using the customer features:
   Once logged in, the customer may:
   • Browse and search available auto parts
   • Filter by category or condition
   • View detailed product information
   • Add items to the shopping cart
   • Complete purchases
   • Review past orders through the order history page

Figure1: Django Administration page login: http://127.0.0.1:8000/admin/

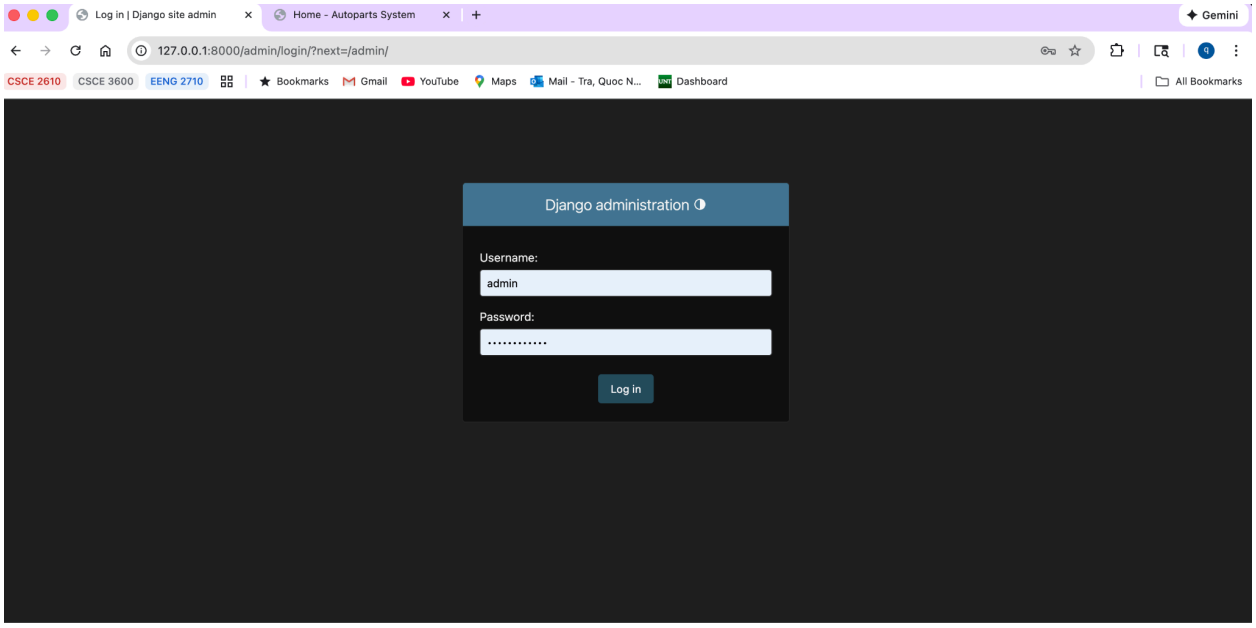


Figure2: Django Main Dashboard

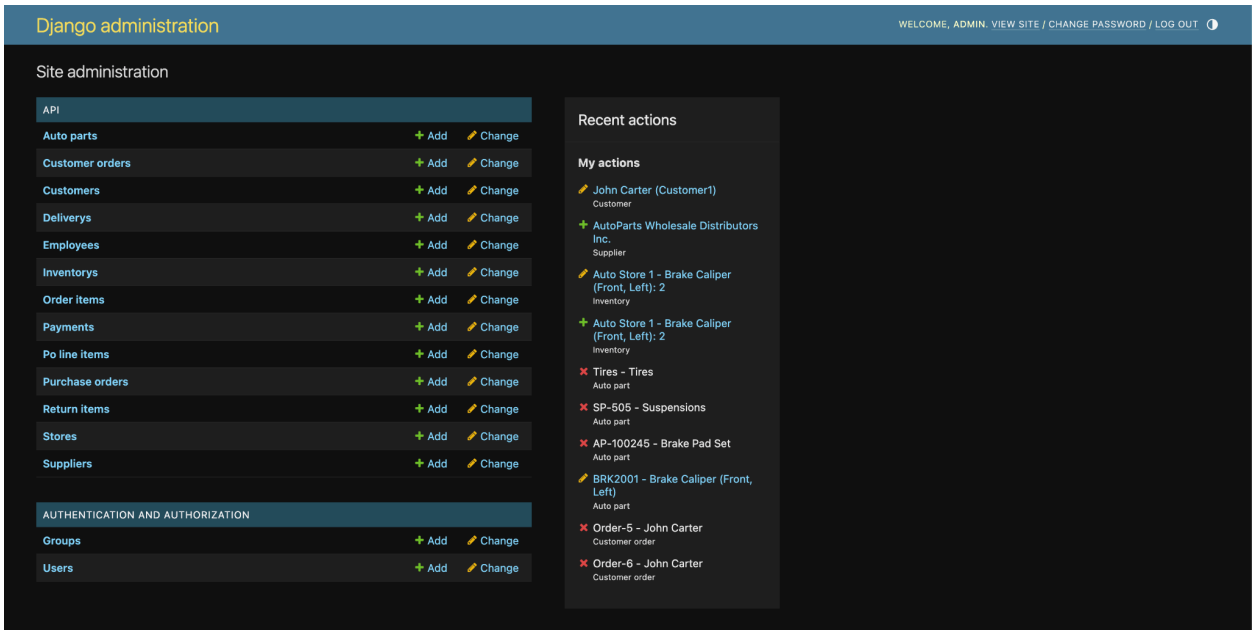


Figure3: Django Customer API: Create Customer Accounts with Authentication Credential

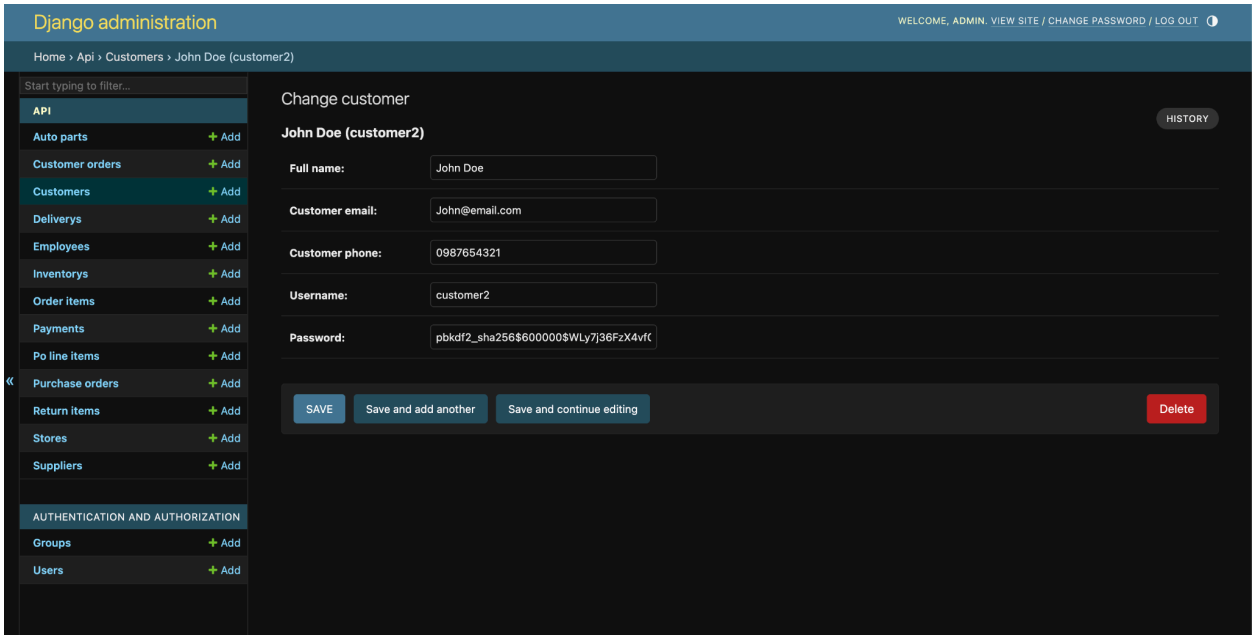


Figure4: Populate Database with Auto Parts

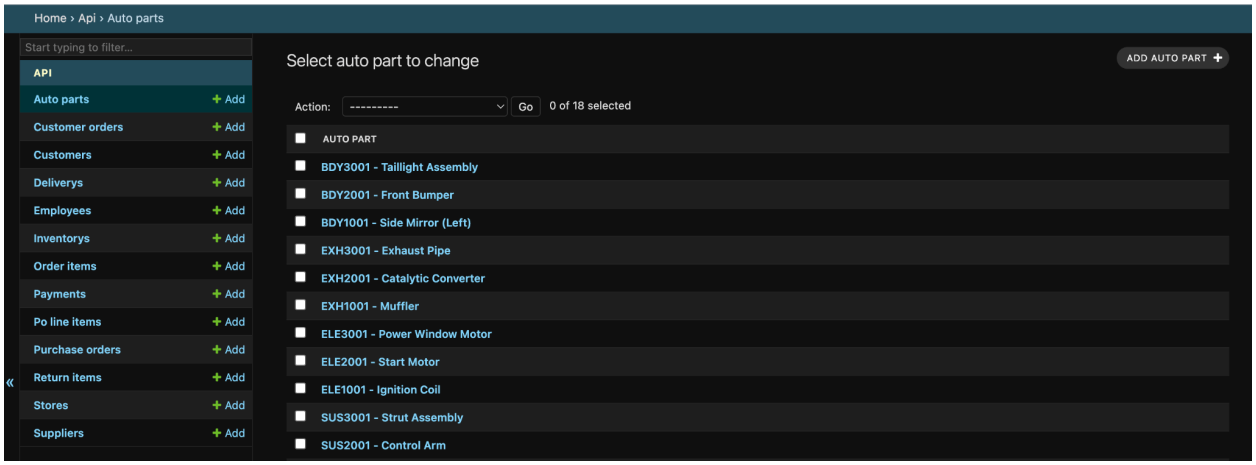


Figure5: Create Users/Managers

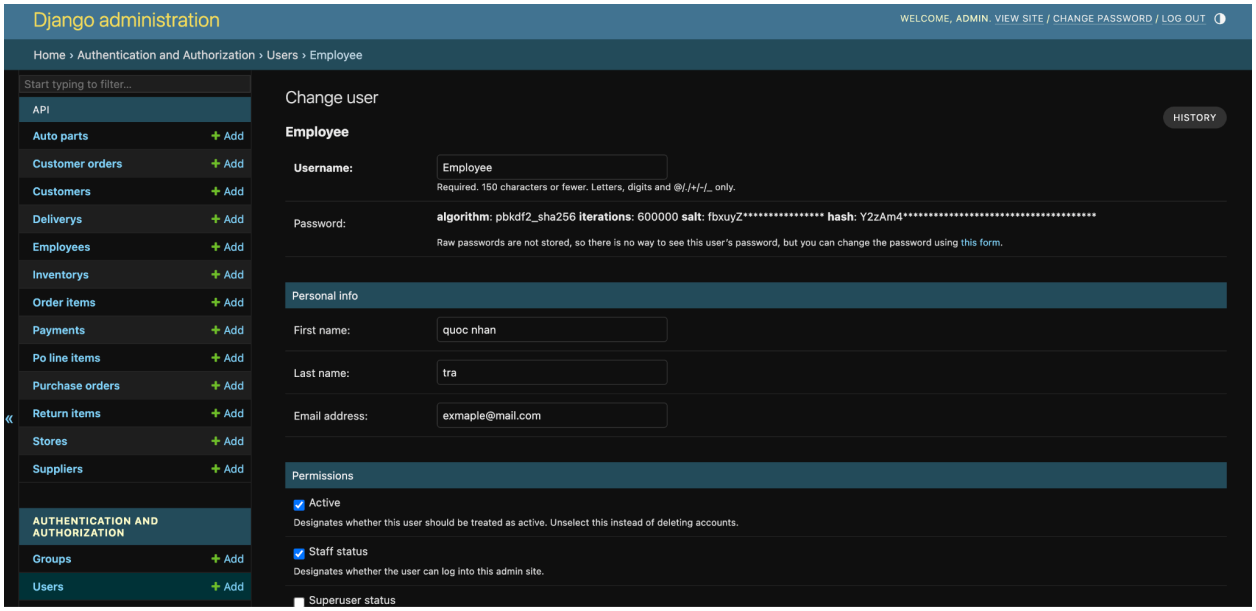


Figure6: Assign Employees Role

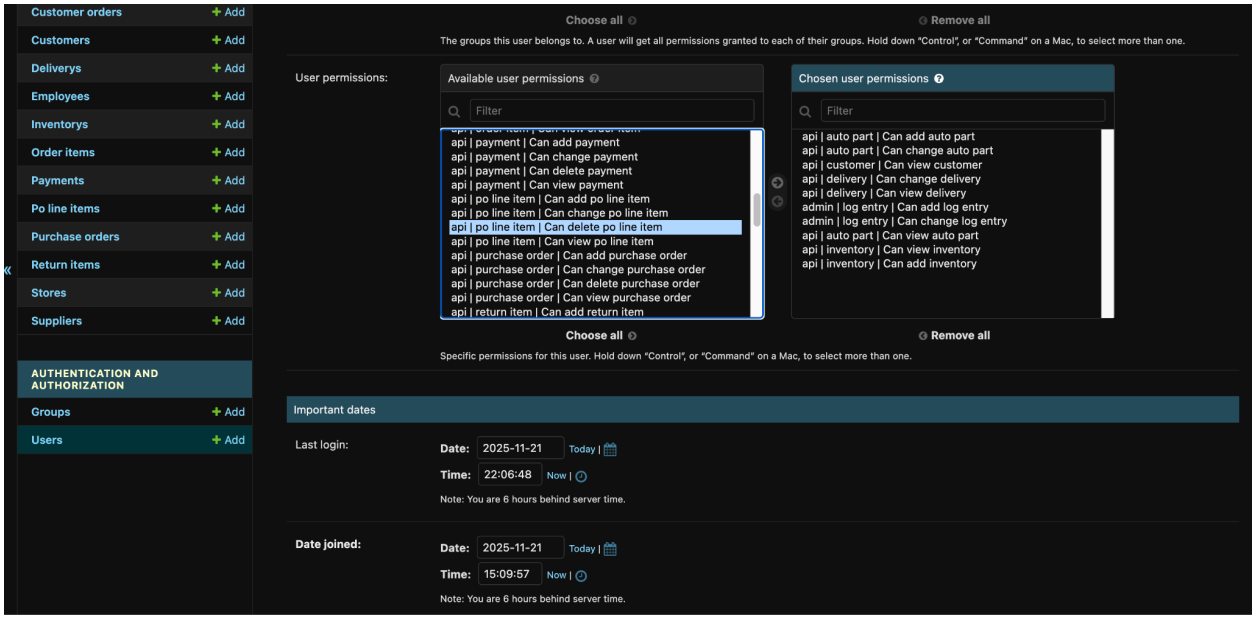


Figure7: Retail-Auto-Parts-System Home: http://127.0.0.1:8000/

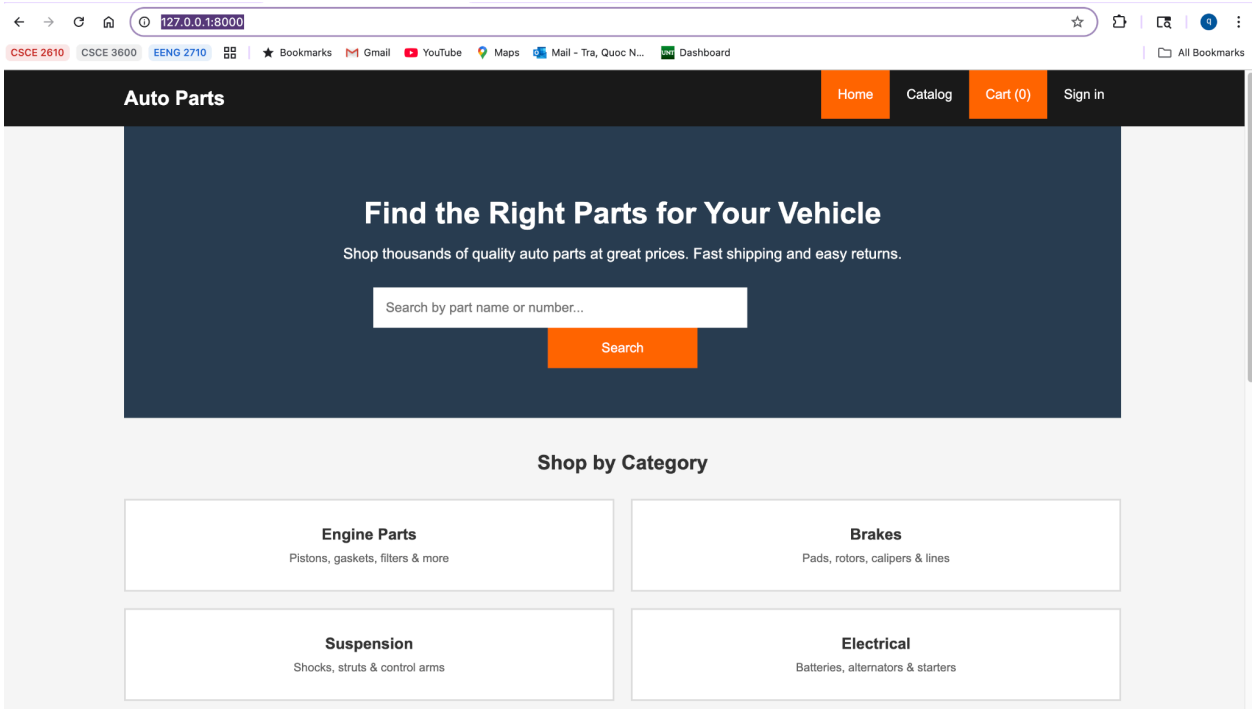


Figure8: Public Facing Customer Website: http://127.0.0.1:8000/customer/login/

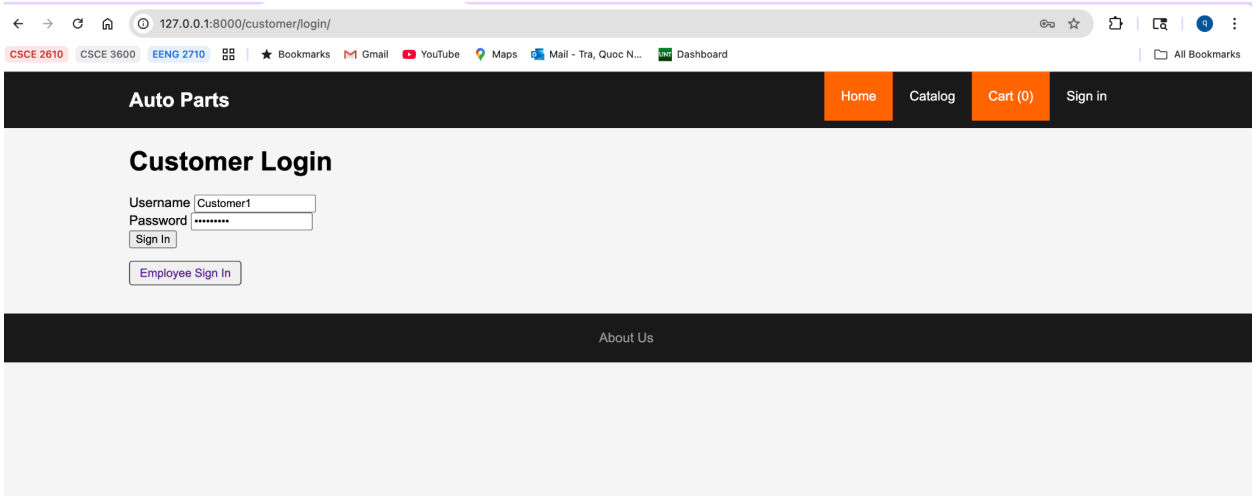


Figure9: User Log in and Search: by name or ID

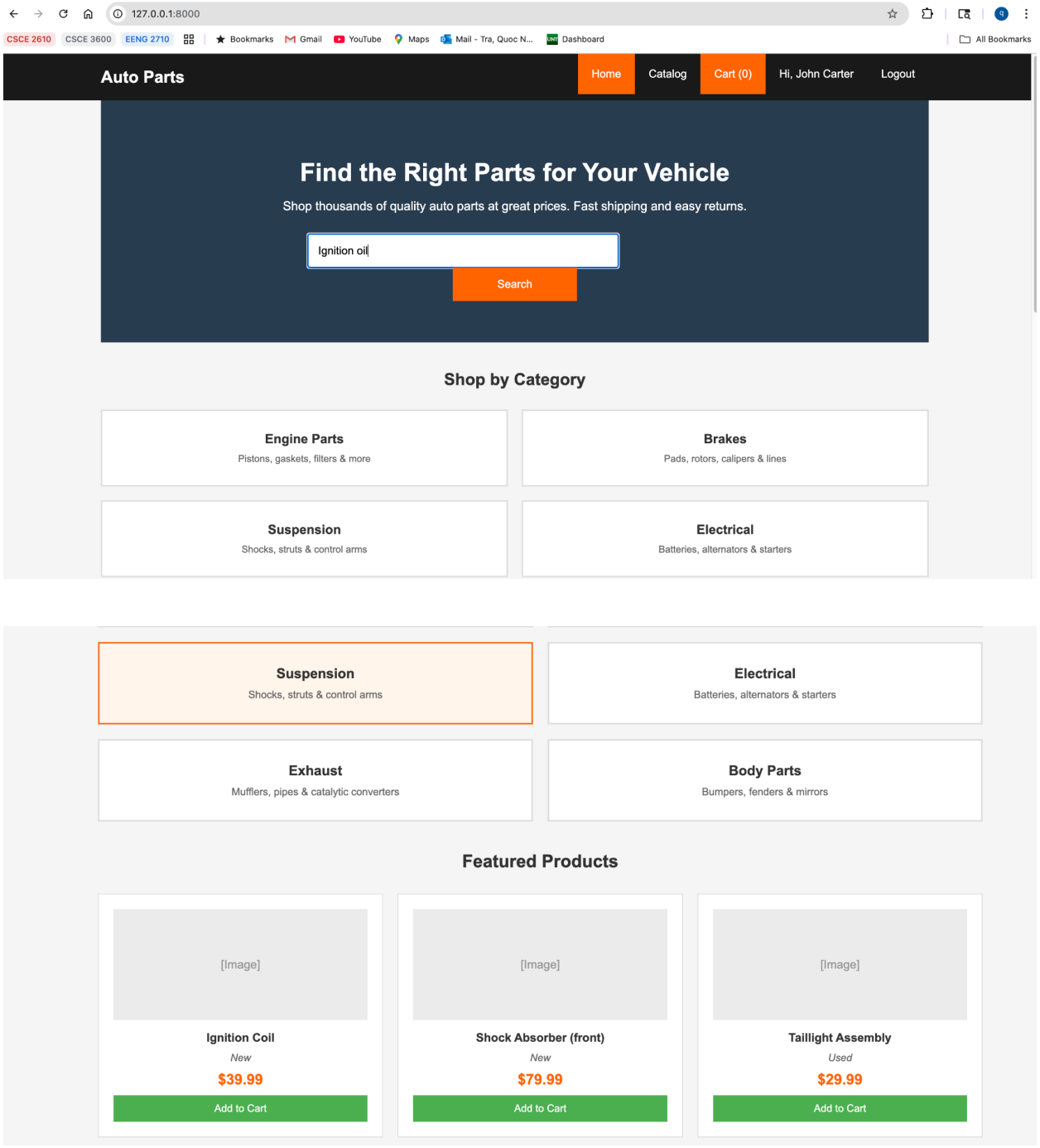


Figure10: Dedicated Catalog Page with Filters

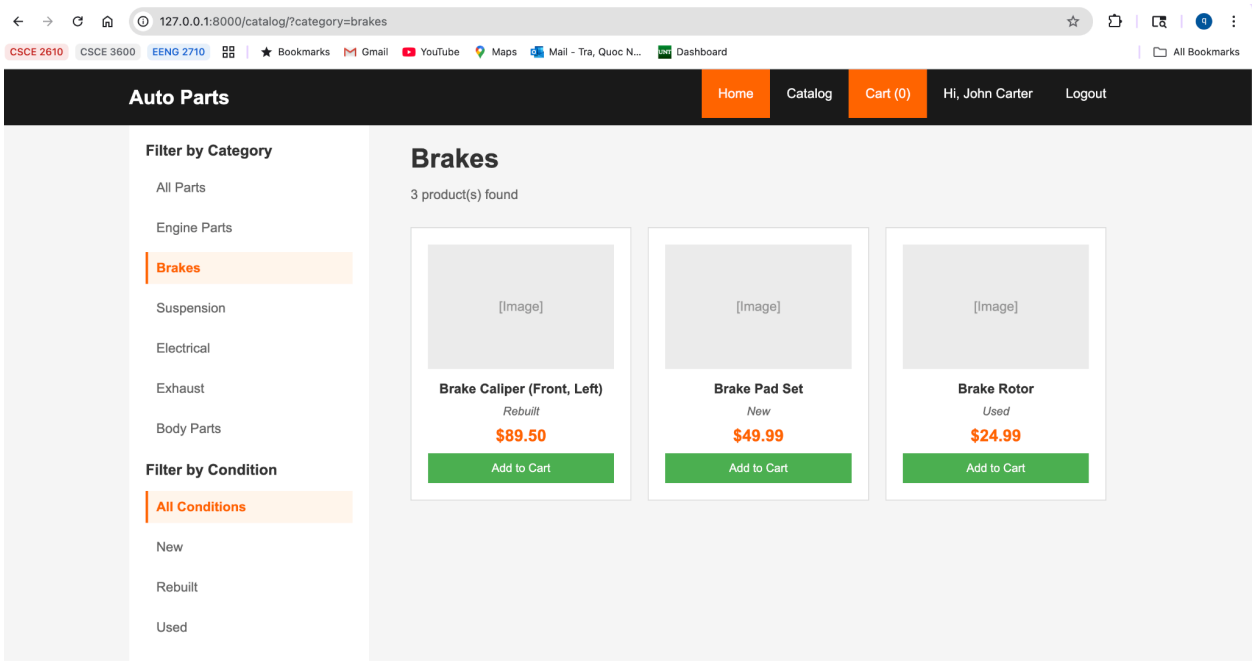


Figure11: Add-to-Cart Function

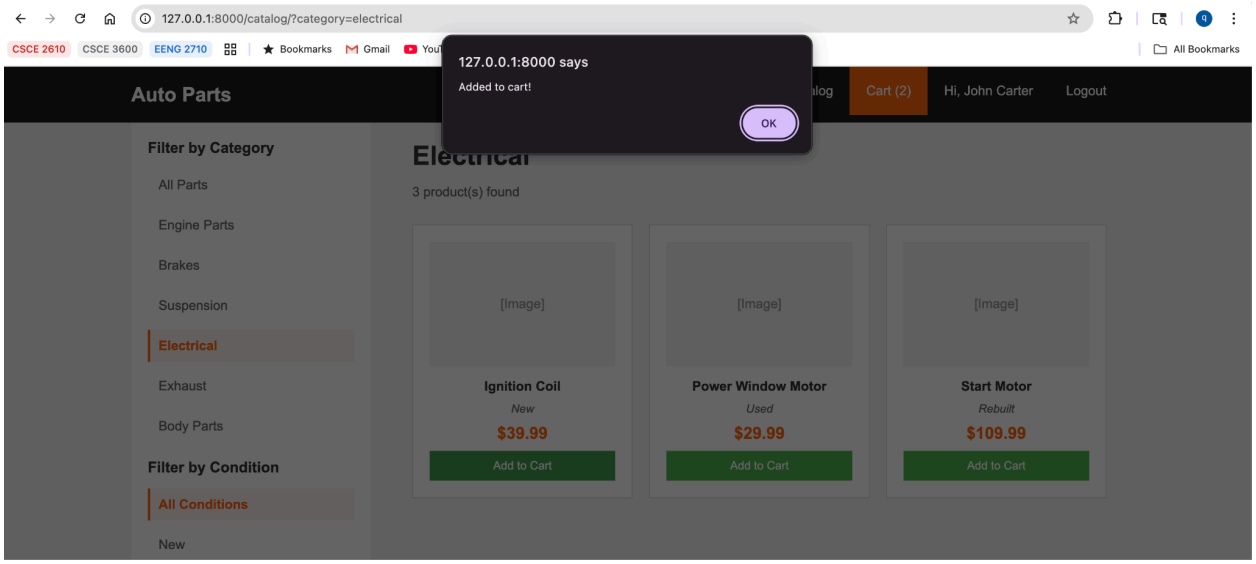


Figure12: Place Order and Payment

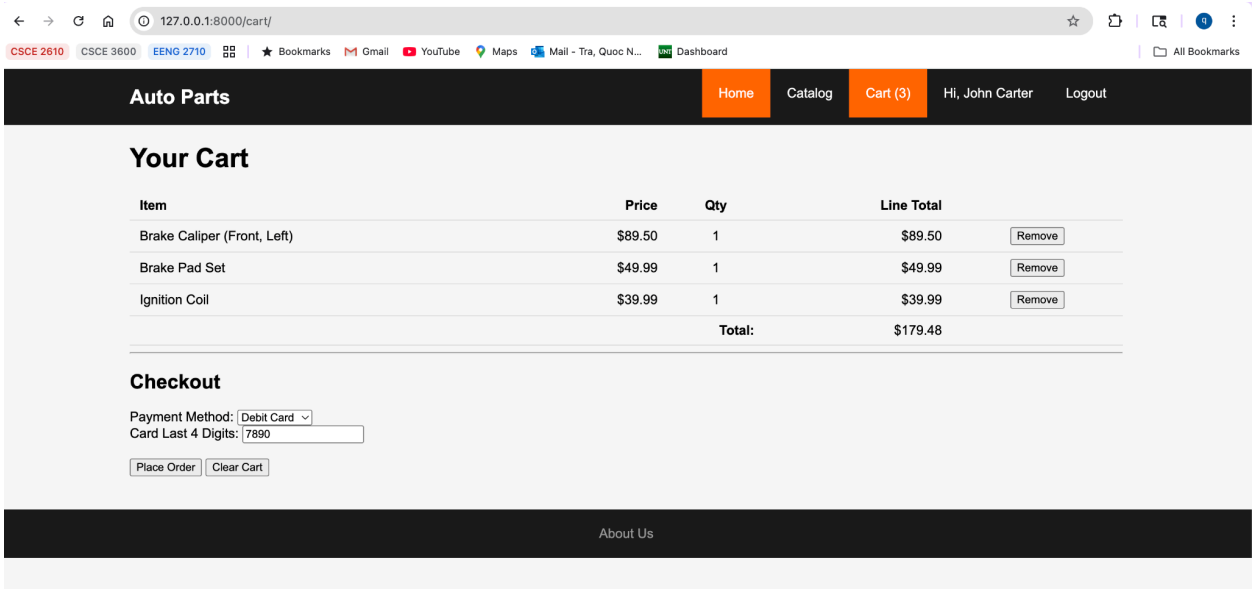


Figure13: View Customer History

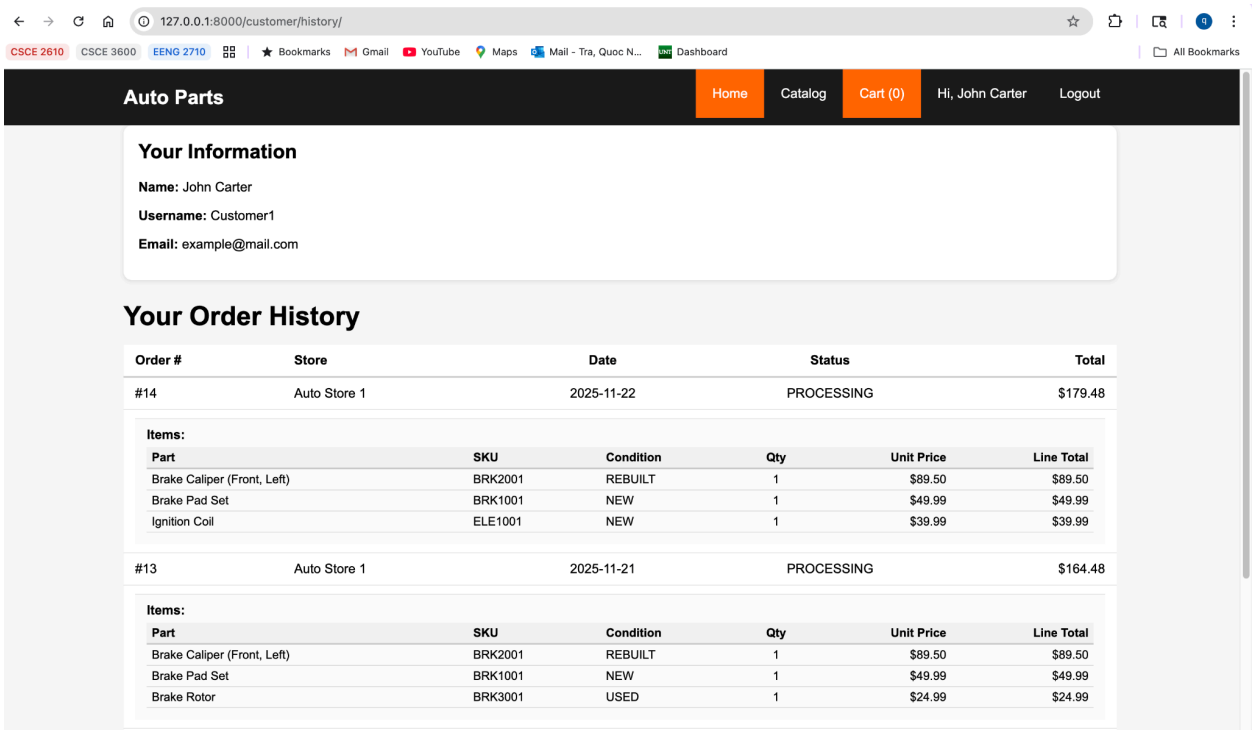


Figure14: Employee Order Management From Public Site

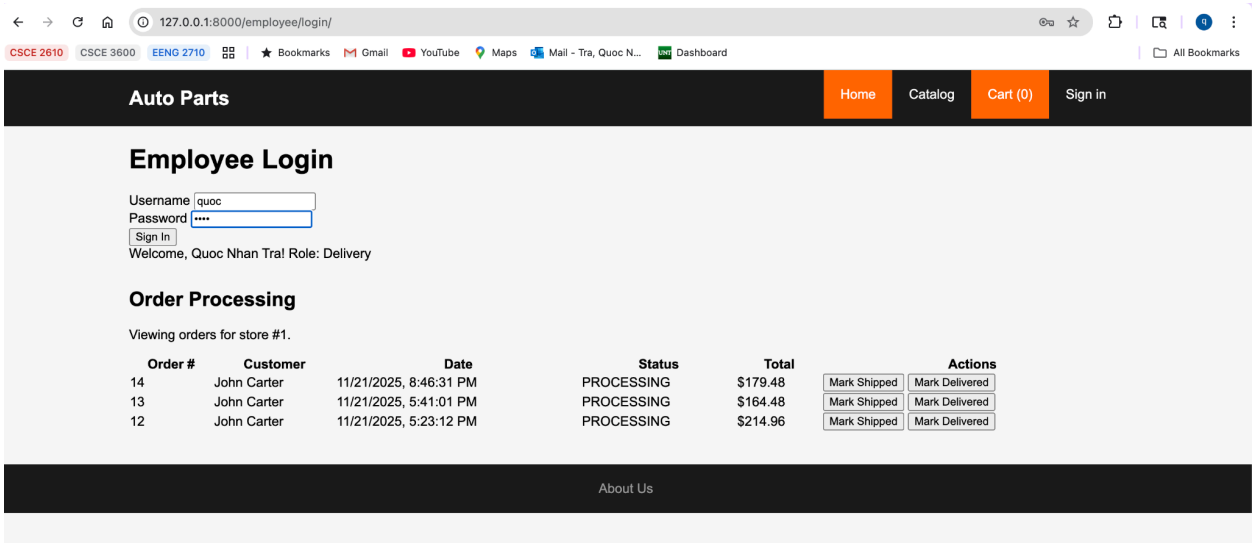


Figure15: Employee Sign In From Admin Site

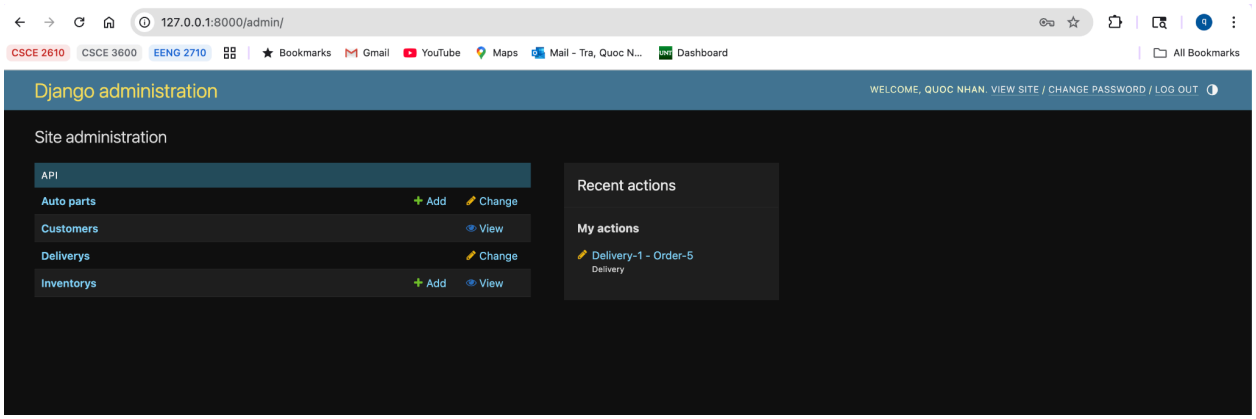


Figure16: Employee Order Management from Admin Site

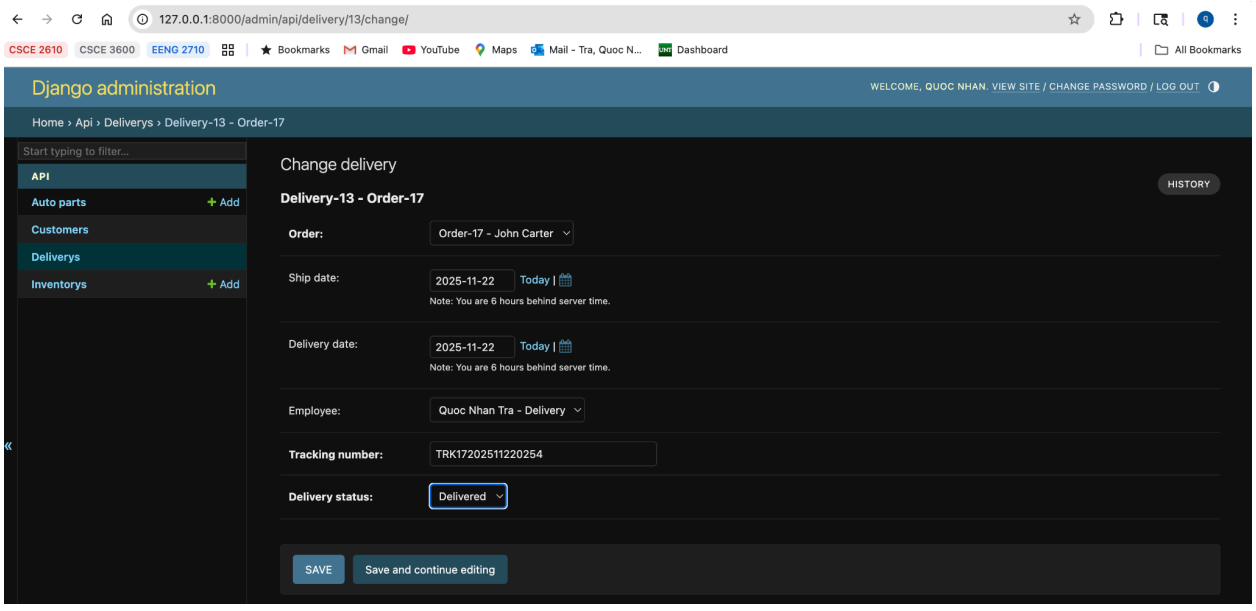


Figure17: Employee Stocking Inventory

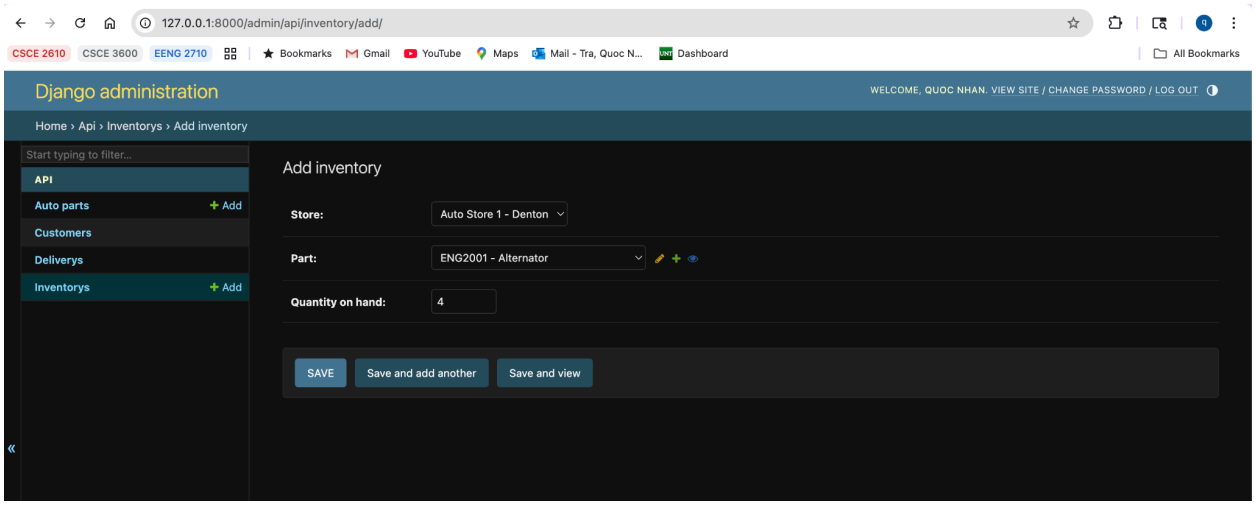
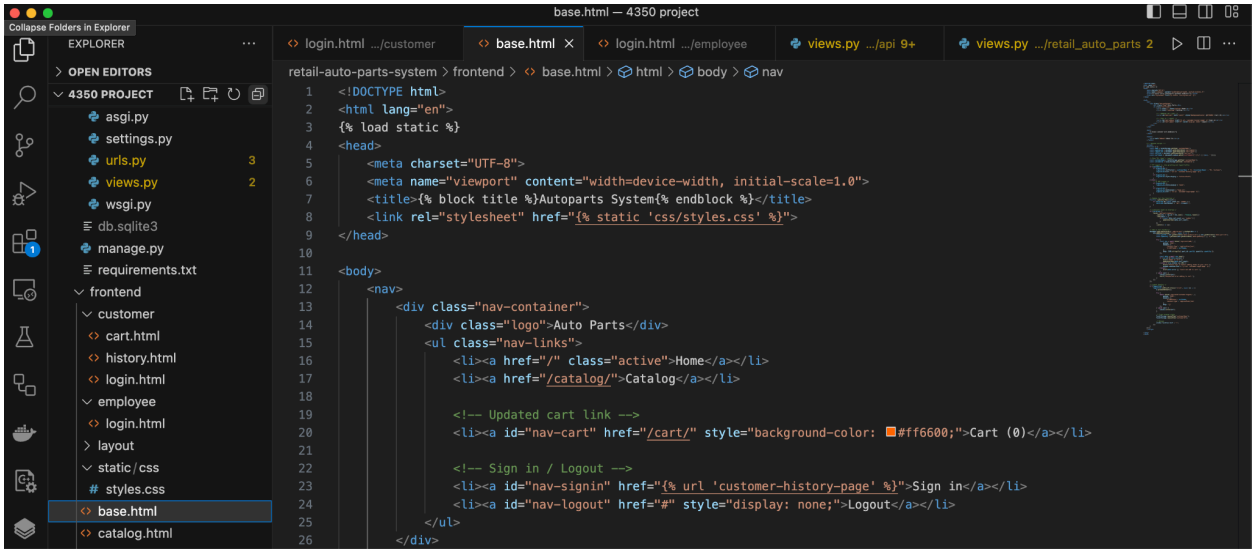
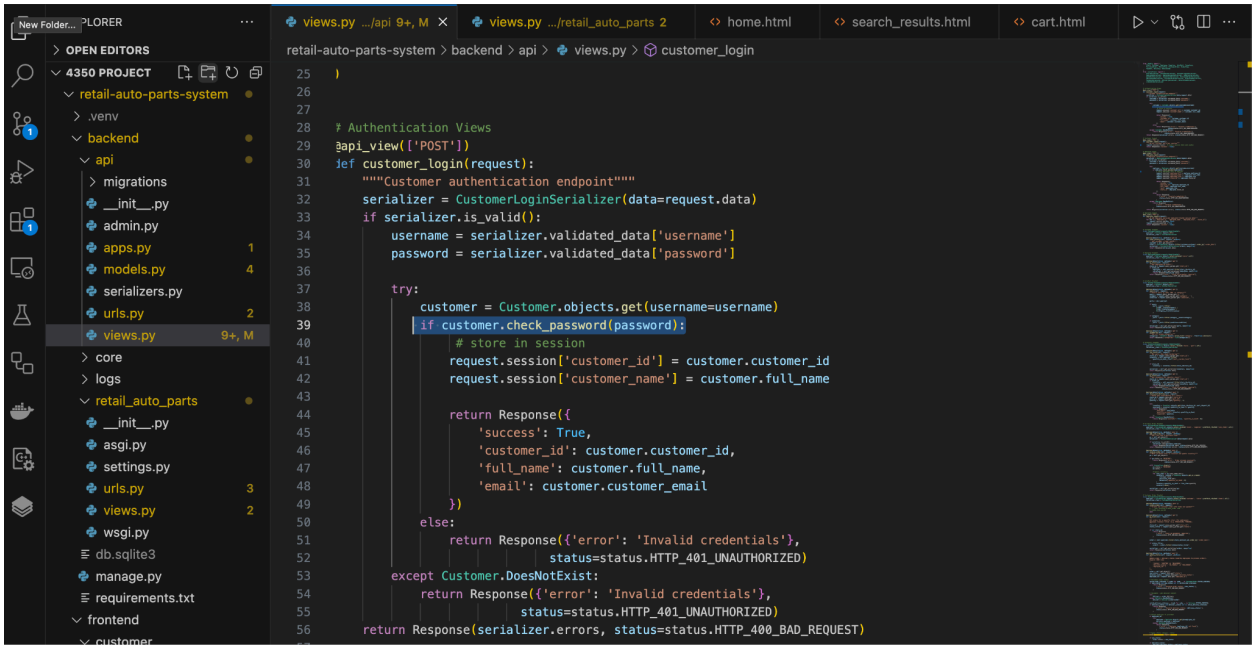


Figure18: frontend/base.html



Master layout for the website: all other pages, home.html, catalog.html, cart.html extend this file. Defines the main page layout, containing links to home, catalog, customer login and logout.

Figure19: backend/api/views.py



Contains logic for handling user requests for websites, URLs visited by users are each connected to a view function responsible for reading and writing the data stored in the database, processing, and returning an HTML page or redirect. In the **customer_login** views function is responsible for authenticating customers with usernames and passwords. It receives the information from the frontend, validates it by checking it against the database, and then establishes a session for the user.

Figure20: backend/api/urls.py

```python
# Create router and register viewsets
router = DefaultRouter()
router.register(r'customers', views.CustomerViewSet, basename='customer')
router.register(r'employees', views.EmployeeViewSet, basename='employee')
router.register(r'parts', views.AutoPartViewSet, basename='autopart')
router.register(r'inventory', views.InventoryViewSet, basename='inventory')
router.register(r'purchase-orders', views.PurchaseOrderViewSet, basename='purchaseorder')
router.register(r'customer-orders', views.CustomerOrderViewSet, basename='customerorder')

urlpatterns = [

    # include router URLs
    path('', include(router.urls)),

    # Authentication endpoints
    path('auth/customer/login/', views.customer_login, name='customer-login'),
    path('auth/employee/login/', views.employee_login, name='employee-login'),

    path('auth/customer/login/', views.customer_login, name='customer-login-api'),
    path('auth/customer/logout/', views.customer_logout, name='customer-logout-api'),

    # Report endpoints
    path('reports/daily-sales/', views.daily_sales_report, name='daily-sales-report'),
    path('reports/inventory/', views.inventory_report, name='inventory-report'),
    path('reports/employee-performance/', views.employee_performance_report, name='employee-performance-report')


    path('cart/add/', views.cart_add, name='cart-add-api'),
    path('cart/summary/', views.cart_summary, name='cart-summary-api'),
    path('cart/clear/', views.cart_clear, name='cart-clear-api'),
    path('cart/remove/', views.cart_remove, name='cart-remove-api'),
    path('cart/checkout/', views.cart_checkout, name='cart-checkout-api'),
]
```

Defines URL routing path for the api, mapping specific paths such as **auth/customer/** and **/cart/remove/** to view functions in views.py

Team Member Contributions

Quoc Nhan Tra: Full-Stack (frontend & backend) Development

- Built public customer-facing webpage UI (home page, catalog, cart, order history).
- Developed backend logic supporting catalog filtering, product search, and cart operations.
- Integrated frontend templates with Django backend views and database models.
- Designed global site navigation and fixed incorrect routing issues (e.g., logout button).
- Performed debugging including fixing catalog filter errors and eliminating duplicate alert banners.

- Assisted testing user workflows, and ensuring smooth customer/employee mode transitions.

Binod Chhantyal: Backend & Database Development
- Implemented backend CRUD functionality for products, employees, orders, and suppliers.
- Developed authentication for customers and employees.
- Created the business logic for purchase orders and payments.
- Refined SQL queries and improved indexing for large catalog and order operations.
- Defined Django models and managed database migrations to reflect the schema generated in Phase II.
- Performed backend integration of API and testing data consistency.

Solomon Rosenfeld: Frontend Development & System Testing
- Built Store Mode frontend pages including employee dashboards and management interfaces.
- Prepared system-wide base files for UI.
- Implemented frontend UI for customers operations, search menu, catalog page, and item cards.
- Integrated UI components with backend logic for order management and delivery workflows.
- Conducted comprehensive end-to-end testing of all system modules (customer and store modes).
- Ensured database consistency by validating workflows such as checkout, delivery, and returns.
- Prepared demonstration for final presentation.

Conclusion

In Phase III, the Retail Auto Parts System was completely implemented in its entirety, with a fully functioning product that satisfies all specified requirements and operational needs. The team built a database centric retail and inventory management system web application for the purpose to computerize the operations of a small auto parts company. It is complete with two modes: Customer Mode that supports the functions of browsing products, placing orders, managing accounts, and tracking deliveries; and Store Mode that supports inventory management, order processing, report generation, and administrative functions. We maintained the architecture design choices from

Phase II and, with the guidance of the design charts, we have successfully realized our vision outlined from the initial proposal.