**Product Shelf Layout Optimization System User Guide**

**System Introduction**

The Shelf Layout Optimization System is an intelligent tool based on shopping basket data analysis. Using association rules and graph neural network technology, it helps merchants optimize shelf placement, improving customer shopping efficiency and cross-buying rates. The system supports data upload, shelf layout design, product allocation, and intelligent optimization.

**Installation and Deployment**

**Environmental requirements**

* Python 3.8+
* Dependency packages: see requirements.txt (can be installed via pip install -r requirements.txt)

**Start the application**

Bash python app.py

Access the system: Open the browser <http://127.0.0.1:5000>

**Operation process**

**1. Data upload**

* Click the **[Data Upload]** option in the navigation bar
* Click the **[Choose File]** button in the upload area to upload the file containing the shopping cart data (common data formats are supported)
* After successful upload, the system will automatically parse the data and jump to the **[Data Summary]** page

**2. View data summary**

On the Data Summary page, you can view the following information:

* Total transactions: The total number of transaction records analyzed by the system
* Product Type: The total number of products included in the data
* Average number of items in each transaction: The average number of items in each transaction
* Top 10 Popular Products: Displays the 10 most popular products through a bar chart
* Product distribution: Use pie charts to show the proportion of different categories of products

**3. Shelf layout editing**

* Click the navigation bar **[Shelf Layout]** to enter the editing page
* Click on the shelf location in the 10×10 grid (grey grids indicate selectable shelves)
* Notes:
  + Each shelf can hold up to 4 types of products
  + The system will prompt the minimum number of shelves required (calculated based on the total number of products)
* Action buttons:
  + **[Clear Selection]**: Cancel all selected shelf positions
  + **[Save layout and continue]**: Confirm the shelf layout and proceed to the next step

**4. Original product layout input**

After completing the shelf layout settings, the system will automatically enter the original product layout input page:

* The system generates a product allocation form for each selected shelf
* Select the products to be placed on each shelf (multiple selections are allowed, up to 4 types)
* Accessibility:
  + **[Automatically allocate remaining products]**: The system randomly allocates unallocated products to the remaining shelves
  + **[Clear Allocation]**: Cancel all product allocations
* After completing all product allocations, click **[Save original layout and optimize]** to submit the system for optimization calculation

**5. View optimization results**

After the optimization is completed, the system will display the optimized shelf layout:

* An optimized 10×10 grid layout showing the products on each shelf
* Layout optimization instructions:
  + Highly related products have been placed in adjacent locations
  + Popular products are placed in more accessible locations
  + Products of the same category are grouped together
* Optimization effect: Displays the expected increase in cross-purchase rate after optimization

**6. Check product association rules**

* Click the navigation bar **[Recommendation Rules]** to view the product association rules
* Association rules with different confidence levels can be filtered using the "confidence threshold"
* Association rules show the purchase associations between products and can be used to guide promotional activities and shelf placement.

**Functional Description**

**Grid layout operations**

* A 10×10 grid representing the store's shelf layout
* In the optimized layout, each shelf can display up to 4 products, and the excess will be prompted as "full"
* Hover your mouse over the product name to see the full name

**Data processing**

The system automatically analyzes shopping basket data and extracts product association rules, which mainly include:

* The purchase association strength between products
* Product popularity
* Shopping cart combination mode

**Optimization principle**

The system optimizes shelves based on the following principles:

1. Highly related products (often purchased together) are placed in adjacent locations
2. Popular products are placed in more accessible locations
3. Items of the same category are grouped together to make it easier for customers to find them.