

Project Title	Warehouse Space Optimization using Smart Clustering
Domain	Supply Chain Optimization / IoT / Industrial AI
Skills take away From This Project	<ul style="list-style-type: none"> • Unsupervised Learning (Clustering) • Handling Mixed Data (Numerical + Categorical) • Data Cleaning (nulls, outliers) • Real-world application of ML in logistics

Problem Statement:

Modern warehouses face significant challenges in managing large volumes of diverse inventory. Products vary widely in size, shape, and demand frequency, often leading to inefficient space usage and increased retrieval times. Traditional storage systems do not dynamically adapt to these variations, causing bottlenecks in operations and delays in order fulfillment.

The objective of this project is to **design a clustering algorithm** that groups products based on their **physical dimensions** (height, width, depth) and **average daily demand**. By identifying natural groupings of products with similar storage and retrieval profiles, warehouse managers can:

- Assign products to optimal storage zones (e.g., high-demand, compact items placed near exit points).
- Improve inventory layout for faster picking and packing.
- Reduce space wastage by grouping items with similar shapes and sizes.

Business Use Cases:

- **Automated Storage Systems:** Clustering similar-sized, high-demand items for efficient shelving.
- **Warehouse Layout Design:** Allocate space dynamically based on product clusters.
- **Inventory Segmentation:** Group products by movement speed or space footprint.
- **Smart Robots:** Improve navigation efficiency by reducing retrieval time.

Approach:

1. **Data Cleaning & Imputation:** Handle nulls, outliers, and categorical values.
2. **Feature Scaling:** Normalize product dimensions and demand.
3. **Clustering:** Apply K-Means to find optimal product groupings.
4. **Dimensionality Reduction:** Use PCA for visualization.
5. **Cluster Profiling:** Analyze each group's characteristics and suggest warehouse zones.

Skill Up. Level Up

Results:

- Visualized clusters of products based on size and demand.
- Identification of optimal product groupings for warehouse space planning.
- Business recommendations for warehouse layout based on cluster profiles.

- Host on streamlit (optional).

Project Evaluation metrics:

- Visual separation in plots
- Logical interpretability of clusters
- Documentation of cluster insights



Technical Tags:

Clustering, Unsupervised Learning, K-Means, PCA, t-SNE, Logistics, Warehouse Optimization, Scikit-learn

Data Set:

<https://drive.google.com/file/d/1aVGfhHzmpQC6OsrgisFF738ReQoajofp/view?usp=sharing>

Data Set Explanation:

- Generated with realistic warehouse product stats

- Includes nulls and outliers to simulate messy industrial data
- Categorical feature (`Product Category`) can be used to validate clusters
- Requires preprocessing and dimensionality reduction before clustering

Project Deliverables:

- Cleaned and visualized dataset
- Clustering model with evaluation
- Cluster visualization (PCA/)
- Business insights from cluster profiling
- Final report + code notebook

Project Guidelines:

- Clean modular code with proper scaling and EDA
- Use plots (seaborn/matplotlib) for intuitive understanding
- Keep code well-commented and outputs clean

Timeline:

2 weeks



PROJECT DOUBT CLARIFICATION SESSION (PROJECT AND CLASS DOUBTS)

About Session: The Project Doubt Clarification Session is a helpful resource for resolving questions and concerns about projects and class topics. It provides support in understanding project requirements, addressing code issues, and clarifying class concepts. The session aims to enhance comprehension and provide guidance to overcome challenges effectively.

Note: Book the slot at least before 12:00 Pm on the same day

Timing: Saturday (5:00PM to 7:00PM)

Booking link : <https://forms.gle/NtkQ4UV9cBV7Ac3C8>

LIVE EVALUATION SESSION (CAPSTONE AND FINAL PROJECT)

About Session: The Live Evaluation Session for Capstone and Final Projects allows participants to showcase their projects and receive real-time feedback for improvement. It assesses project quality and provides an opportunity for discussion and evaluation.

Note: This form will Open on Saturday and Sunday Only on Every Week

Timing: Monday-Saturday (11:30PM to 12:30PM)

Booking link : <https://forms.gle/1m2Gsro41fLtZurRA>