

DESIGN AND ANALYSIS OF ALGORITHM GROUP PROJECT OPTIMAL INVENTORY MANAGEMENT PROJECT

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PROJECT OVERVIEW

- Scenario: Retail store inventory management.
- Objective: Balance inventory levels to meet demand, minimize costs, and optimize operations.



IMPORTANCE OF OPTIMAL INVENTORY MANAGEMENT

- Customer Satisfaction: Ensuring products are available.
- Cost Efficiency: Minimizing holding costs and stockouts.
- Operational Efficiency: Effective planning and forecasting.

PROBLEM SPECIFICATION

MAIN OBJECTIVE

Determine
optimal inventory
levels over time.

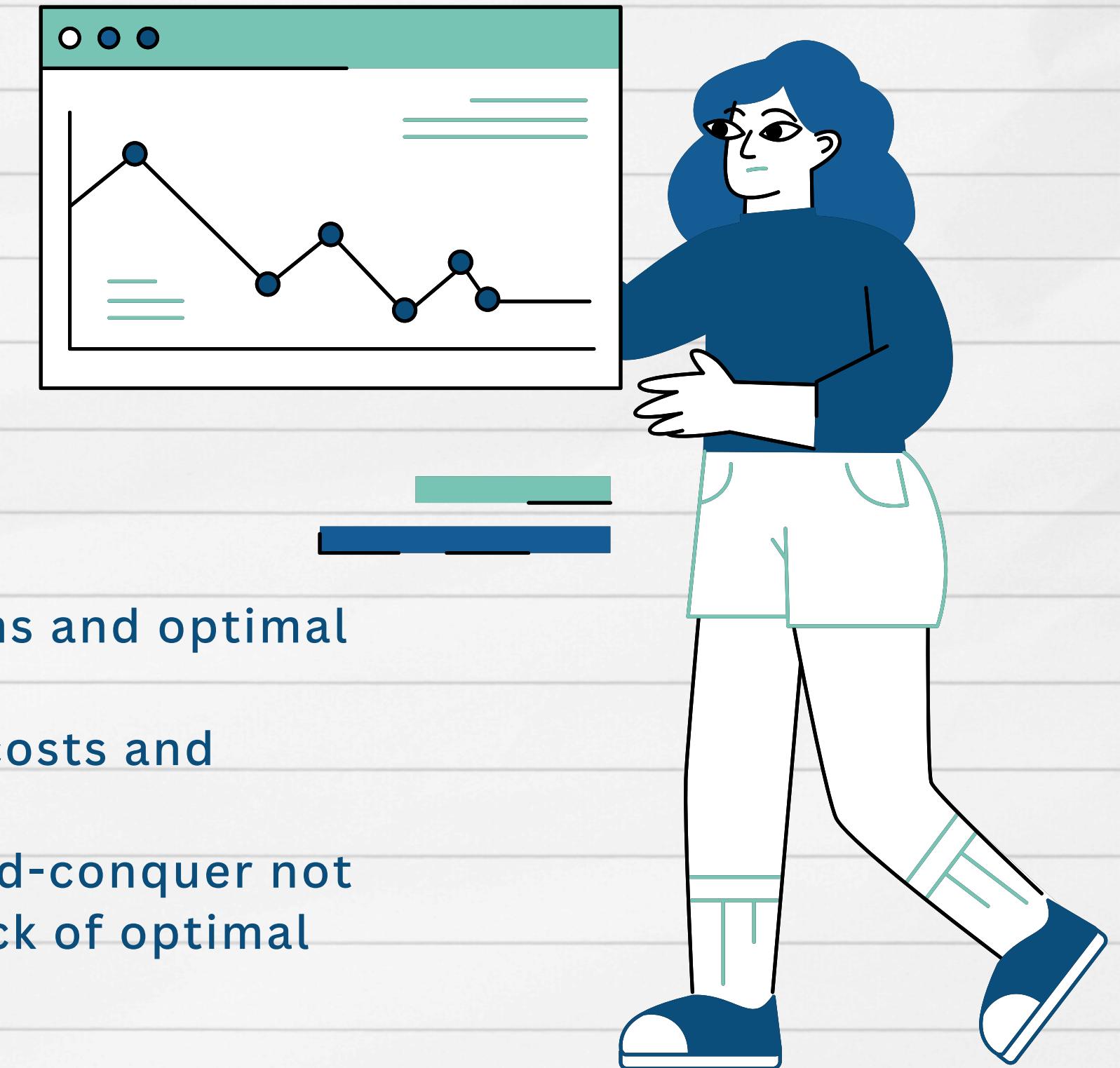
CONSTRAINTS

Lead time, safety
stock, daily
demand
variability.

ALGORITHM SELECTION

Dynamic Programming (DP):

- Strengths: Handles overlapping subproblems and optimal substructure.
- Suitability: Efficiently computes minimum costs and restocking plans.
- Comparison: Greedy, sorting, and divide-and-conquer not suitable due to future dependencies and lack of optimal substructure.



ALGORITHM DESIGN

- State Representation: DP table (day, currentStock) for minimum cost.
- Transition: Decision-making based on costs (holding, stockout, restocking).
- Implementation: Java program using `InventoryItem` class and `InventoryManagementDP` class.

OUTPUT

GENERATING INVENTORY RESTOCK PLAN FOR ITEM A...

DAY-BY-DAY INVENTORY PLAN FOR ITEM A:

DAY 1: RESTOCK 0 UNITS
DAY 2: RESTOCK 0 UNITS
DAY 3: RESTOCK 0 UNITS
DAY 4: RESTOCK 0 UNITS
DAY 5: RESTOCK 0 UNITS
DAY 6: RESTOCK 5 UNITS
DAY 7: RESTOCK 0 UNITS

EXECUTION TIME: 68 MS

CALCULATING MINIMUM INVENTORY COST FOR ITEM B...

MINIMUM INVENTORY COST: 1075

GENERATING INVENTORY RESTOCK PLAN FOR ITEM B...

DAY-BY-DAY INVENTORY PLAN FOR ITEM B:

DAY 1: RESTOCK 0 UNITS
DAY 2: RESTOCK 0 UNITS
DAY 3: RESTOCK 0 UNITS
DAY 4: RESTOCK 0 UNITS
DAY 5: RESTOCK 0 UNITS
DAY 6: RESTOCK 10 UNITS
DAY 7: RESTOCK 30 UNITS
DAY 8: RESTOCK 25 UNITS
DAY 9: RESTOCK 20 UNITS

EXECUTION TIME: 58 MS

GENERATING INVENTORY RESTOCK PLAN FOR ITEM C...

DAY-BY-DAY INVENTORY PLAN FOR ITEM C:

DAY 1: RESTOCK 0 UNITS
DAY 2: RESTOCK 0 UNITS
DAY 3: RESTOCK 0 UNITS
DAY 4: RESTOCK 60 UNITS
DAY 5: RESTOCK 90 UNITS
DAY 6: RESTOCK 100 UNITS
DAY 7: RESTOCK 110 UNITS
DAY 8: RESTOCK 120 UNITS
DAY 9: RESTOCK 130 UNITS

EXECUTION TIME: 25 MS

CALCULATING MINIMUM INVENTORY COST FOR ITEM D...

MINIMUM INVENTORY COST: 805

GENERATING INVENTORY RESTOCK PLAN FOR ITEM D...

DAY-BY-DAY INVENTORY PLAN FOR ITEM D:

DAY 1: RESTOCK 0 UNITS
DAY 2: RESTOCK 0 UNITS
DAY 3: RESTOCK 0 UNITS
DAY 4: RESTOCK 0 UNITS
DAY 5: RESTOCK 20 UNITS
DAY 6: RESTOCK 35 UNITS
DAY 7: RESTOCK 40 UNITS

EXECUTION TIME: 16 MS

CALCULATING MINIMUM INVENTORY COST FOR ITEM E...

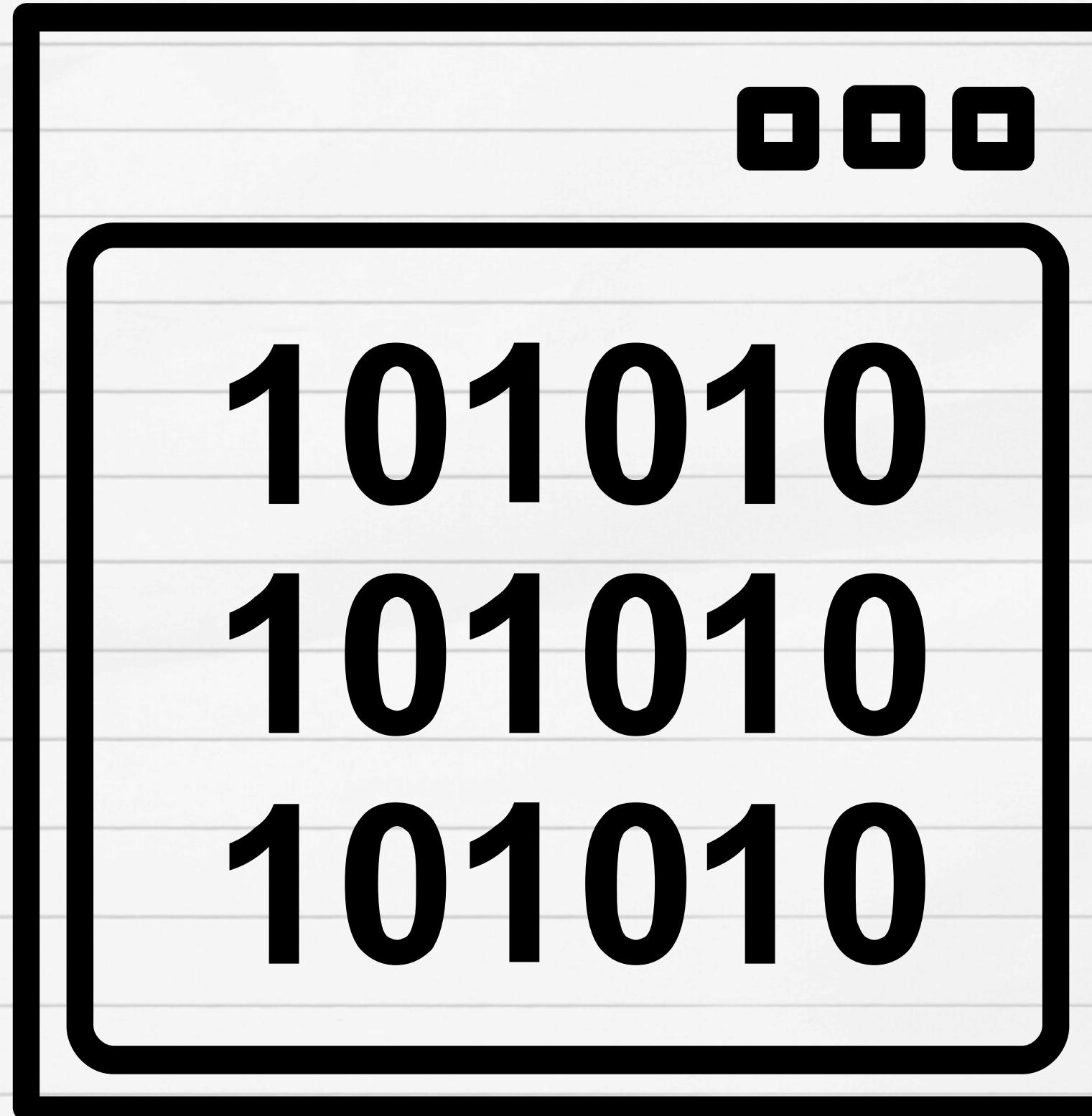
MINIMUM INVENTORY COST: 1600

GENERATING INVENTORY RESTOCK PLAN FOR ITEM E...

DAY-BY-DAY INVENTORY PLAN FOR ITEM E:

DAY 1: RESTOCK 0 UNITS
DAY 2: RESTOCK 0 UNITS
DAY 3: RESTOCK 0 UNITS
DAY 4: RESTOCK 0 UNITS
DAY 5: RESTOCK 25 UNITS
DAY 6: RESTOCK 30 UNITS
DAY 7: RESTOCK 35 UNITS
DAY 8: RESTOCK 40 UNITS
DAY 9: RESTOCK 45 UNITS
DAY 10: RESTOCK 50 UNITS
DAY 11: RESTOCK 55 UNITS

EXECUTION TIME: 13 MS



ALGORITHM ANALYSIS

- Correctness: DP ensures optimal solutions by reusing subproblem solutions.
- Time Complexity: $O(n * S)$ where n is number of days and S is maximum stock level.
- Execution Efficiency: Demonstrated by execution times (e.g., 200 ms total).

RESULTS AND OUTPUT



- Minimum Inventory Cost: Calculated for each item (ItemA to ItemE).
- Restocking Plan: Day-by-day strategy to maintain optimal inventory levels.

CONCLUSION

- Achievements: Successfully applied DP to solve inventory management.
- Benefits: Minimized costs, optimized inventory levels, improved efficiency.
- Future Directions: Expand to real-time data integration, scalability improvements.



ONLINE PORTFOLIO AND DEMONSTRATION

<https://github.com/damderis/InventoryManagement>

**THANK
YOU VERY
MUCH!**