

**GROUP PROJECT**

**Learning outcomes:**

1. Search for and organize information in the form of an algorithm for a computer problem as the following: (LL)
   1. Analyse the problem to suggest a solution by choosing a suitable algorithm design technique.
   2. Develop skills to reason about and prove properties of algorithms such as their correctness and running time.

**Instructions:**

1. General instructions:
   1. Create an original scenario (you can be inspired by examples on the internet or used in the course, but the detailing of the story should be created fresh by your team of 3 people) that requires an optimal solution.
   2. Explain why finding an optimal solution for this scenario is important.
   3. Review the suitability of sorting, DAC, DP, greedy and graph algorithms as a solution paradigm for the chosen problem by stating their strengths and weaknesses.
   4. Design the algorithm to solve the problem and explain the idea of your algorithm paradigm by emphasising which part needs **recurrence** and the function for the **optimization**.
   5. Define the algorithm specification.
   6. Develop a program Java language.
   7. Provide an analysis of the **algorithm’s correctness** as well as **time complexity** (best, average and worst time) by using asymptotic notation.
   8. Develop an online portfolio (using google sites or github or google colab or any suitable tool) with the following steps/content:
      1. Illustrate the problem.
      2. Explain your algorithm paradigm and show the **pseudocode**. You may provide your code in the portfolio if you wish.
      3. Demonstrate your program and describe the output.
      4. Describe the algorithm analysis.
   9. Deliver a presentation in week 14.
   10. Submit the following through Putrablast before the presentation
       1. Link to your online portfolio
       2. A zip file of your codes
       3. Filled project progress (refer APPENDIX)
2. Please make sure each member’s workload is fairly distributed and good project management is exercised. The weight of the project is 20%. Peer-based evaluation (5 marks) will be utilised besides the evaluations through filled progress monitoring (10 marks), online portfolio in github (50 marks) and presentation (15 marks).
3. Follow the following algorithm specification steps:

* Problem definition based on the chosen scenario (tell your story by choosing a geographical setting, type of disaster, damage impact, highlight the importance of AAD in the scenario and provide illustrations, state the goal and expected output to support the decision making)
* Development of a model for the chosen scenario (state the data type, state the objective function and constraints, provide examples and other requirements based on the scenario such as objective, space, time or value constraints.
* Specification of an Algorithm (state which topic and algorithm have you selected and why, include comparison of several other options and discuss the suitability of your proposed solution)
* Designing an Algorithm (provide a pseudocode and/or flowchart and use illustrations to help you)
* Checking the correctness of an Algorithm (asymptomatic, recurrence)
* Analysis of an Algorithm (growth of function for worst, best, average analysis)
* Implementation of an Algorithm.
* Program testing (provide a demo based on your story of the chosen scenario)
* Documentation through online portfolio.

1. Tips for completing the project
   1. Understanding of the AAD topics including examples of problems and list of algorithms that each topic covers is a MUST to ensure you can design the solution based on the instructions given.
   2. The “How Might We (HMW) technique” launches brainstorms by asking questions that seed your idea. Eg, HMW maximize the profit from building on this location by optimising the selection from a list of property options? From this question, your group may discuss potential situations and solutions. Then, discuss the possible algorithms to be used for this problem.
   3. You need to work collaboratively and be encouraged to use various materials around you as your reference (please make sure you include a good bibliography list in your documentation). During discussion, you may use ideas reviewing techniques such as identifying the “Pluses, Potential, Concerns, Options (PPCO)”.

Pluses: What are (at least) three things you like about the idea?

Potentials: What are (at least) three good things that might result if the idea were implemented?

Concerns: What are some concerns you have about the idea (phrased as a question starting with “How to…” or “How might…”)

Options or Overcome the concerns: What are some ideas you have for how to fix the concerns you just noted?

Or, you may use the Strength, Weakness, Opportunities, Threats (SWOT) technique.

* 1. Time management and each member’s dedication is the key to the group’s success.
  2. Use your creativity and critical thinking skills to design the algorithms and communicate it well in written and verbal format.

APPENDIX

**Initial Project Plan (week 10, submission date: 31 May 2024)**

| Group Name | First Call |
| --- | --- |
| Members | | Name | Email | Phone number | | --- | --- | --- | | MUHAMMAD ANAS BIN MOHD MARZUKI | 212125@student.upm.edu.my | 019-3581305 | | ADAM IDRIS BIN MOHAMAD ISMOL | 212077@student.upm.edu.my | 019-6963060 | | IZWAN HUSAINY BIN MOHAMAD | 210081@student.upm.edu.my | 014-3232103 | |
| Problem scenario description | As a retail store inventory manager, the goal is to balance inventory levels to satisfy customer demand, avoid running out of stock, and minimize the costs of holding excessive inventory. |
| Why it is important | Solving all the problems is crucial for maintaining customer satisfaction, maximizing sales and revenue, protecting the store’s reputation, optimizing costs, improving operational efficiency, and facilitating effective forecasting and planning. |
| Problem specification | The problem that needs to be solved in the context of optimal inventory management for a retail store is to determine the optimal inventory levels for each time period. The objective is to meet customer demand, minimize stockouts, and reduce carrying costs associated with excess inventory. |
| Potential solutions | Find/Create an algorithm to provide an estimate on how long a stock would last, timing when to restock, and amount of restock needed to satisfy demand that it wouldn’t lead to stockout (no stock).  Stock life depends on expected current demand, timing needs to consider the lead time by manufacturer, avoiding stockout in the future requires estimating future demand. |
| Sketch (framework, flow, interface) |  |

**Project Proposal Refinement (week 11, submission date: 7 June 2023)**

| Group Name |  |
| --- | --- |
| Members | | **Name** | **Role** | | --- | --- | | MUHAMMAD ANAS BIN MOHD MARZUKI | Group Leader | | ADAM IDRIS BIN MOHAMAD ISMOL | Developer and analyser | | IZWAN HUSAINY BIN MOHAMAD | Report Writer | |
| Problem statement | To solve the problem of having to manually plan when to order the product and the quantity of the order to have an optimal most of the time. |
| Objectives | The goal of inventory management is to strike a balance between satisfying consumer demand and cutting down on inventory expenditures. It entails keeping enough inventory on hand to complete customer orders without going overboard or running out of goods. |
| Expected output | When inventory needs to be restocked, the quantity of the inventory that is needed, and reorder status. |
| Problem scenario description | As a retail store inventory manager, the goal is to balance inventory levels to satisfy customer demand, avoid running out of stock, and minimize the costs of holding excessive inventory. |
| Why it is important | Solving all the problems is crucial for maintaining customer satisfaction, maximizing sales and revenue, protecting the store’s reputation, optimizing costs, improving operational efficiency, and facilitating effective forecasting and planning. |
| Problem specification | The problem that needs to be solved in the context of optimal inventory management for a retail store is to determine the optimal inventory levels for each period. The objective is to meet customer demand, minimize stockouts, and reduce carrying costs associated with excess inventory. |
| Potential solutions | Find/Create an algorithm to provide an estimate on how long a stock would last, the timing when to restock, and the amount of restocking needed to satisfy demand so that it wouldn’t lead to stockout (no stock).  Stock life depends on expected current demand, timing needs to consider the lead time by the manufacturer, avoiding stockout in the future requires estimating future demand |
| Sketch (framework, flow, interface) |  |
| Methodology | | Milestone | Time | | --- | --- | | Recruit group members and decide the main problem for initial proposal | wk10 | | Find suitable algorithms and examples of solutions. | wk11 | | Design and analyse the chosen algorithm | wk12 | | Collect data regarding demand and lead time as input data | wk12 | | Develop the coding using java language and debugging code error | wk12 | | Create online portfolio in Google Sites | wk13 | | Make a presentation | wk14 | |

**Project Progress (Week 10 – Week 14)**

| **Milestone 1** | Recruit group members and decide the main problem for initial proposal |
| --- | --- |
| **Date (wk 10)** | 27 May 2024 |
| **Description/**  **sketch** | After the group leader has been successful in recruiting members from their classmates. Then we decided on choosing the primary issue for the initial proposal. We performed group talks, consensus-building exercises, and brainstorming sessions during this decision-making process. These activities were facilitated by the group leader by promoting open communication, actively hearing everyone's opinions, and directing the group towards a consensus choice. The chosen issue needs to be pertinent, significant, and in line with the group's overarching goals and members' interests. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 2** | Find suitable algorithms and examples of solutions. Discuss in group on how the problem in the project relates to the solution and the sample problems. |
| --- | --- |
| **Date (Wk 11)** | 3 June 2024 |
| **Description/**  **sketch** | Discuss in group on how the problem in the project relates to the solution and the sample problems |
|
| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 3** | Design and analyze the chosen algorithm |
| --- | --- |
| **Date (Wk 12)** | 10 June 2024 |
| **Description/**  **sketch** | We have designed an algorithm that produces the point when to restock the item, and how much to order.  It requires the daily sales of each product and its lead time. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 4** | Collect data regarding demand and lead time as input data. |
| --- | --- |
| **Date (Wk 12)** | 12 June 2024 |
| **Description/**  **sketch** | From the algorithm that has been created, we have collected daily sales of each product and lead time. The data needs to be accurate and reliable.  Also need to regularly review and update our data to account for changing market conditions, customer preferences, and supplier performances. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 5** | Develop the coding using Java language and debugging code errors. |
| --- | --- |
| **Date (Wk 12)** | 14 June 2024 |
| **Description/**  **sketch** | We have developed an inventory management system using Java with a merge sort algorithm. The data was read from the data.txt file. The file contains the item's name, item's lead time, day on safety stock, current stock, and sales history per day. The output of this program is when to order the items, how many items need to be restocked, and the reorder status. We also debugged the code at the part that was needed. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 6** | Create an online portfolio in Google Sites. |
| --- | --- |
| **Date (Wk 13)** | 18 June 2024 |
| **Description/**  **sketch** | We have created a portfolio to present the project about Optimal Inventory Management. We have stated all the information about the project, which is problem definition, development of the problem model, algorithm specification, designing the algorithm, correctness of the algorithm, algorithm analysis, implementation, and program testing. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |

| **Milestone 7** | Make a presentation. |
| --- | --- |
| **Date (Wk 14)** | 26 June 2024 |
| **Description/**  **sketch** | We presented the online portfolio to the class. We talk about the problem related to inventory management, which is either overstock or stockout. We show the algorithm that we have created, show its functionality that could solve the problem, and also give the algorithm's analysis. |
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| **Role** | | Member 1 | Member 2 | Member 3 | | --- | --- | --- | | Group Leader | Developer and analyser | Report Writer | |