Initial Project Plan

<table>
<tr><td>Group Name</td><td>Group 2</td></tr>
<tr><td>Members</td><td>
<table>
<tr><th>Name</th><th>Email</th><th>Phone number</th></tr>
<tr><td>Tan Kah Jun</td><td>217075@student.upm.edu.my</td><td>018-9569198</td></tr>
<tr><td>Chua Hui Qi</td><td>215091@student.upm.edu.my</td><td>011-23222350</td></tr>
<tr><td>Lok Yong Xue</td><td>215524@student.upm.edu.my</td><td>010-5463553</td></tr>
<tr><td>Tan Jia Qing</td><td>217067@student.upm.edu.my</td><td>011-55055288</td></tr>
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</td></tr>
<tr><td>Problem scenario description</td><td>The scenario involves a logistics company responsible for delivering cargo products to customers using truck. The truck has a maximum capacity of 500 kilograms. Each piece of cargo has a specific weight. The decision on which shipments to load is based on a priority score, which combines revenue, urgency, and service level (e.g., premium vs. standard). The objective is to maximize the total priority value of the cargo loaded onto the truck without exceeding the weight limit.</td></tr>
<tr><td>Why it is important</td><td>Optimal cargo loading is important to maximize delivery value, reduce costs, and improve service by fully utilize transport capacity, leading to fewer trips, lower fuel usage, and better asset efficiency.
It also ensures faster, more accurate deliveries, boosting customer satisfaction and loyalty. Fewer trips mean lower emissions, supporting environmental goals. This smart use of technology strengthens DHL’s position as a market leader while increasing revenue by prioritizing high-value shipments.</td></tr>
<tr><td>Problem specification</td><td>Maximum Weight Capacity: 500 kg
Cargo Items: Various cargo with specific weights, revenue, urgency and service level.
Objective: Maximize the total priority value without exceeding the weight limit</td></tr>
<tr><td>Potential solutions</td><td>1. Sorting: Sort items based on value-to-weight ratio to select items.
2. Divide and Conquer (DAC): Break the problem into smaller sub-problems and combine their solutions.
3. Dynamic Programming (DP): Use a DP approach to find the optimal combination of items that maximize the priority value without exceeding the weight capacity.
4. Greedy Algorithm: Select items based on the highest priority value-to-weight ratio until the weight limit is reached.
5. Graph Algorithms: Model the problem as a graph and use algorithms to find the optimal path.</td></tr>
<tr><td>Sketch (framework, flow, interface)</td><td>Framework: Java-based application
Flow:
Read cargo items from csv file with weights, revenue, urgency, and service level
Calculate the priority score of each item based on the revenue, urgency and service level
Apply the selected algorithm to determine the optimal cargo load
Output the selected items and their total priority value
Interface: Simple command-line interface for input and output</td></tr>
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Project Proposal Refinement

<table>
<tr><td>Group Name</td><td>Group 2</td></tr>
<tr><td>Members</td><td>
<table>
<tr><th>Name</th><th>Role</th></tr>
<tr><td>Tan Kah Jun</td><td>Scenario model development and documentation</td></tr>
<tr><td>Chua Hui Qi</td><td>Algorithm implementation and coding</td></tr>
<tr><td>Lok Yong Xue</td><td>Algorithm analysis</td></tr>
<tr><td>Tan Jia Qing</td><td>Algorithm design and specification</td></tr>
</table>
</td></tr>
<tr><td>Problem statement</td><td>Given a set of shipments, each with attributes such as revenue, urgency, service level, and weight, the goal is to select a subset of shipments that maximizes total shipment value (priority score), while not exceeding the truck's maximum allowable weight.</td></tr>
<tr><td>Objectives</td><td>Design an algorithm to maximize the priority value of the loaded cargo.
Implement the algorithm in Java.
Analyse the correctness and time complexity of the algorithm.
Develop an online portfolio to illustrate the project and its results.</td></tr>
<tr><td>Expected output</td><td>1. An optimized list of cargo items
2. Total priority value of the loaded cargo
3. An online portfolio detailing the problem, solution, and results</td></tr>
<tr><td>Problem scenario description</td><td>The scenario involves a logistics company responsible for delivering cargo using a cargo truck. The truck has a maximum weight capacity of 500 kilograms. Each piece of cargo has a specific weight and priority value. The decision on which shipments to load is based on a priority score, which combines revenue, urgency, and service level (e.g., premium vs. standard). The objective is to maximize the total priority value of the cargo loaded onto the truck without exceeding the weight limit.</td></tr>
<tr><td>Why it is important</td><td>
1. Operational Efficiency and Cost Reduction
DHL uses an algorithm to load cargo more efficiently, ensuring each trip carries the most valuable items. This reduces the number of trips, cuts fuel costs, and makes better use of vehicles.

2. Customer Satisfaction and Service Quality
Optimized loading means faster, more accurate deliveries. Customers get their items on time, which builds trust and improves DHL’s reputation.

3. Environmental Impact and Sustainability
Fewer trips and better fuel use mean lower emissions. This supports DHL’s green goals and meets environmental regulations.

4. Competitive Advantage and Market Leadership
Using smart algorithms gives DHL a tech edge over competitors, helping it lead the logistics industry and attract more clients.

5. Revenue Optimization
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	By filling trucks with the most valuable items, DHL earns more per trip and increases profits without raising prices.
Problem specification	**Maximum Weight Capacity:** 500 kg **Cargo Items:** Various cargo with specific weights and each with attributes such as revenue, urgency and service level. **Objective:** Maximize the total priority value without exceeding the weight limit
Potential solutions	1**. Sorting:** Sort items based on value-to-weight ratio to select items. 2. **Divide and Conquer (DAC):** Break the problem into smaller sub-problems and combine their solutions. 3. **Dynamic Programming (DP):** Use a DP approach to find the optimal combination of items that maximize the priority value without exceeding the weight capacity. 4. **Greedy Algorithm:** Select items based on the highest priority value-to-weight ratio until the weight limit is reached. 5**. Graph Algorithms:** Model the problem as a graph and use algorithms to find the optimal path.
Sketch (framework, flow, interface)	**Framework** The application will be implemented using Java. **Flow:** **1. Input Cargo Items** • User Input: The user provides the file path to a CSV containing shipment data. • Data Structure: Each shipment is read from the file and stored as a Shipment object with the following attributes: *id, revenue, timeRemaining, serviceLevel, weight* A priority score is calculated for each item using a weighted formula. **2. Algorithm Application** • Algorithm Used: A Dynamic Programming (DP) approach is applied to solve the 0/1 Knapsack Problem. It selects a combination of shipments that maximizes the total priority score without exceeding a 500 kg weight limit. • Processing Steps: o A DP table (dp) is filled to store the maximum score possible at each sub-capacity. o A keep matrix tracks which shipments are included in the optimal solution. o The algorithm backtracks to identify which shipments make up the optimal selection. **3. Output** • Selected Items: The program outputs a list of selected shipment IDs, along with their weights and priority scores. • Total Priority Value: The total priority score and total weight of selected shipments are displayed. • Feedback:

<table>
<tr><td></td><td>A full list of all shipment IDs and their individual priority scores is shown for transparency and verification.

Interface:
Simple Command-Line Interface (CLI)

1. Prompt for Input
a. The application prompts the user to enter the file path of a CSV file containing shipment data.
b. The CSV file must contain the following details for each cargo item (in order): ID, Revenue, Time Remaining, Service Level, Weight
c. The application reads and parses this data, automatically calculating the priority score for each item.

2. Algorithm Selection
a. The algorithm is predefined as Dynamic Programming (DP) to ensure optimal cargo selection under a 500 kg weight limit.
b. No manual algorithm selection is required from the user, simplifying the process for accurate and efficient results.

3. Display Output
a. The program displays a list of selected shipment IDs, including their individual weights and priority scores.
b. It also shows the total priority score and total weight of the selected shipments.
c. For transparency, the application displays a complete list of all shipment priority scores at the end.</td></tr>
<tr><td>Methodology</td><td>
<table>
<tr><td>Milestone</td><td>Time</td></tr>
<tr><td>Scenario refinement</td><td>wk10</td></tr>
<tr><td>Scenario model development and algorithm selection</td><td>wk11</td></tr>
<tr><td>Code implementation</td><td>wk12</td></tr>
<tr><td>Correctness and time complexity analysis</td><td>wk13</td></tr>
<tr><td>Online portfolio and presentation</td><td>wk14</td></tr>
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Project Progress (Week 10 – Week 14)

<table>
<tr><td>Milestone 1</td><td>Scenario refinement</td></tr>
<tr><td>Date (week)</td><td>5 June 2024 (Week 11)</td></tr>
<tr><td>Description/ sketch</td><td>Refine the problem scenario and initial problem statement.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Member 1</td><td>Member 2</td><td>Member 3</td><td>Member 4</td></tr>
<tr><td>Tan Kah Jun</td><td>Chua Hui Qi</td><td>Lok Yong Xue</td><td>Tan Jia Qing</td></tr>
<tr><td>Lead the scenario refinement.</td><td>Prepare initial problem statements.</td><td>Prepare initial problem statements.</td><td>Prepare problem sketches and objectives.</td></tr>
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<table>
<tr><td>Milestone 2</td><td>Scenario model development and algorithm selection</td></tr>
<tr><td>Date (Wk)</td><td>8 June 2024 (Week 12)</td></tr>
<tr><td>Description/ sketch</td><td>Model the problem scenario and select suitable algorithm for the problem.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Member 1</td><td>Member 2</td><td>Member 3</td><td>Member 4</td></tr>
<tr><td>Tan Kah Jun</td><td>Chua Hui Qi</td><td>Lok Yong Xue</td><td>Tan Jia Qing</td></tr>
<tr><td>Model the problem scenario.</td><td>Research and select suitable algorithms.</td><td>Research and select suitable algorithms.</td><td>Research and select suitable algorithms.</td></tr>
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<table>
<tr><td>Milestone 3</td><td>Code implementation</td></tr>
<tr><td>Date (Wk)</td><td>10 June 2024 (Week 12)</td></tr>
<tr><td>Description/ sketch</td><td>Select the algorithm and begin initial coding.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Member 1</td><td>Member 2</td><td>Member 3</td><td>Member 4</td></tr>
<tr><td>Tan Kah Jun</td><td>Chua Hui Qi</td><td>Lok Yong Xue</td><td>Tan Jia Qing</td></tr>
<tr><td>Assist with coding and document the methodology.</td><td>Begin coding the algorithm.</td><td>Assist with coding and document the methodology.</td><td>Assist with coding and document the methodology.</td></tr>
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<tr><td>Milestone 4</td><td>Correctness and time complexity analysis</td></tr>
<tr><td>Date (Wk)</td><td>15 June 2024 (Week 13)</td></tr>
<tr><td>Description/ sketch</td><td>Analyze the correctness and time complexity of the algorithm.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Member 1</td><td>Member 2</td><td>Member 3</td><td>Member 4</td></tr>
<tr><td>Tan Kah Jun</td><td>Chua Hui Qi</td><td>Lok Yong Xue</td><td>Tan Jia Qing</td></tr>
<tr><td>Analysis correctness of the algorithm.</td><td>Compile and document analysis results.</td><td>Analyse time complexity.</td><td>Compile and document analysis results.</td></tr>
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<tr><td>Milestone 5</td><td>Online portfolio and presentation</td></tr>
<tr><td>Date (Wk)</td><td>23 June 2024 (Week 14)</td></tr>
<tr><td>Description/ sketch</td><td>Prepare the online portfolio and presentation materials.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Member 1</td><td>Member 2</td><td>Member 3</td><td>Member 4</td></tr>
<tr><td>Tan Kah Jun</td><td>Chua Hui Qi</td><td>Lok Yong Xue</td><td>Tan Jia Qing</td></tr>
<tr><td>Create online portfolio.</td><td>Develop the presentation materials.</td><td>Develop the presentation materials.</td><td>Review and finalize the portfolio and presentation.</td></tr>
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