Dockership

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Basic Understanding (Overview)

- The goal is to develop an application that provides the most optimal solution for loading/unloading containers and balancing ships at Mr. Keogh's port in Long Beach.
- We are replacing the current manual method of creating operation lists with a computerized system.
- The application should track actions in a log file that records every operation with a timestamp (plain ASCII text).
- A recovery protocol is required for seamless resumption after power cuts.

Efficiency is critical

- Every minute in the loading/unloading process is wasted money, so faster solutions are essential to save costs.

Port Operations and Manifest Management

- The port handles one X2 class ship at a time, running 24/7 with three 8-hour shifts.
- Ships have symmetrical layouts (12x8), with some unavailable slots marked as NAN and open slots as UNUSED.
- Duplicate container names are allowed; the system finds the cheapest solution for duplicates.
- Manifest must be edited after each operation and renamed with "OUTBOUND" before sending to the captain.
- The manifest is a plain text file, usually viewed in Notepad, and must meet legal accuracy requirements.

Basic Understanding (Problem Specifics)

1. Manifest Handling

- Manifest Email: Received at least a few hours before docking, containing container positions and weights.
- File Format: A .txt file in row/column layout.
- File Naming: Includes the ship's name; if changes occur, "OUTBOUND" is added to the name.
- File Editing: System automatically updates the manifest during container moves and allows it to be downloaded.

2. Loading/Unloading Ship Containers:

- Manifest Upload: Operator uploads the manifest and adds container load/offload info.
- Optimal Moves: System suggests the best sequence for efficient loading/unloading.
- Manifest Update: Changes are automatically made and the updated manifest is downloadable.

3. Balancing the Ship

- Balance Check: System checks if the ship's sides are within ±10% of each other.
- Best Moves: If needed, it suggests the best moves to balance the ship's weight.
- Container Placement: Position doesn't impact balance.
- Empty Containers: Counted as 0 weight for balance.
- SIFT Protocol: If balancing is impossible, the system uses SIFT to legally balance, though slower.

Basic Understanding (Problem Specifics)

4. Container Moving Costs

- In-Ship & Buffer Moves: Costs 1 minute per cell moved.
- Ship-to-Buffer: Movement cost plus 4 minutes.
- Ship-to-Truck: Movement cost plus 2 minutes.
- Idle Cost: Cost applies even when the crane is empty.

5. Log File Requirements

- Automatic Logging: Tracks every event, including manifest changes and container movements.
- File Format: Logs are in plain ASCII text, with no manual edits allowed.
- Content: Logs include date, time, manifest changes, and container movements.
- File Naming: Logs follow the format KeoghsPort20XX.txt.

Basic Understanding

6. Hardware and Environment

- Low-Spec/Barebones All-in-One PC
- Minimal Software: Chrome browser, Notepad, and built-in calculator
- Fast ethernet is available
- Power cuts do occur
- Working environment/crane tower is noisy

7. Employee Overview and Shift Conditions

- Equal opportunity employment/employees. High school education minimum.
- Basic English proficiency, not necessarily their first language.
- Work in 8-hour shifts (12 to 8, 8 to 4, 4 to 12).
- No security concerns: access controlled via yard security.
- Simple sign-in process, no passwords required.
- Double shifts possible if covering for others.
- Cab always staffed 24/7.

Stakeholders

1. **Mr. Keogh:** Owner of the Port
2. **Crane Operators:** Dockside crane operators or stevedores, who are employees responsible for loading and unloading cargo at the port.
3. **Ship Owners:** Own and operate the ships carrying the cargo.
4. **Truckers:** Transport cargo from the port to its final destination.
5. **Container Owners:** Shipping container proprietors or leasing companies who own the containers transported on the ship.
6. **Customs Officials:** Handle import/export processes for goods crossing international borders.
7. **Lawyers & Insurance Companies:** Address legal and insurance matters related to container responsibilities.

Assumptions

1. The manifest will always be correct and accurate.
2. We know the weight of each container.
3. Containers must be moved and organized to optimize loading and unloading.
4. Need to minimize buffer usage and ensure the truck holding area is clear before the
5. ship departs.
6. Program needs to work on a basic and minimalistic hardware PC.
7. If there are short power cut, the software should recover seamlessly with no loss of
8. operational data.
9. All containers are treated equally.
10. All containers are the same size.
11. Service is always operational with one person in the cabin at all times.

    The program must be in English and only English.

    Logs are refreshed every year.

Inputs

1. Manifest File:
    a. A text (.txt) document that contains information about each container, including its name and position. *and weight*
2. User Actions:
    a. Container Selection: which containers to load/unload
    b *Container Movement: where to move the containers*
3. User Identification:
    a. Sign in name of the operator

Outputs

1. Manifest Update
    a. Updated txt file that reflects changes made during operation
    b Downloadable manifest
2. Records
    a. Log file that records what happened during the operation
3. Operation Visualization
    a. Animation and visual representation of the containers loading and unloading to show movement of the containers

Scenario 1: Routine Load/Unload Operation with Slight Complexity

Description: A routine day where a ship, *CanardII*, arrives with a moderate number of containers. The transfer list includes unloading three specific containers and loading two others.

Steps:

1. The logs will be updated after every step.
2. The operator receives a transfer list that mentions unloading two "Walmart" containers and one "Ford truck parts" container and loading two empty containers from *John Deere I* and *John Deere II*.
3. The ship arrives at 3 PM. The manifest is loaded, showing the current placement of containers. The operator sees that one of the Walmart containers is in a difficult-to-reach slot (e.g., row 8, column 12).
4. One of the trucks that should pick up a "Walmart" container has a flat tire and is delayed. The operator decides to move the container to the buffer temporarily.
5. The application decides the optimal sequence of moves and possibly use the buffer to improve efficiency.
6. The operator follows the moves given by the application and completes the task.
7. The application updates the manifest as containers are moved, and at the end, a log is generated detailing the operations.

Scenario 2: Balance Operation with Extreme Weight Disparity

Description: A ship, *HMS Balance*, arrives with a significant imbalance due to two extremely heavy containers and several much lighter ones. The goal is to balance the ship without any loading or unloading, based on the legal definition of balance.

Steps:

1. The logs will be updated after every step.
2. The manifest shows that two containers weigh 20,000 kg each, and the remaining six weigh between 100 and 500 kg. The port side has one of the heavy containers, while the starboard side has the other.
3. The operator uses the balance operation to bring the ship within the legal 10% balance requirement. The system calculates the optimal moves.
4. It is impossible to perfectly balance the ship due to the extreme weight difference, so the operator must use the "SIFT" operation to achieve a legally acceptable balance.
5. The system computes the fastest path to achieve this balance, minimizing the need to move all containers to the buffer.
6. Once the balance is achieved, the manifest is updated to reflect the new positioning, and a log is generated showing all moves and the final balance status.

Scenario 3: Unexpected Power Outage During a Critical Operation

Description: During an offload operation for *The QueenMary* , a sudden power outage occurs, and the system must recover seamlessly when power is restored.

Steps:

1. The logs will be updated after every step.
2. The operator is in the middle of offloading a container labeled "Amazon Kitchen Supplies" when the power goes out. The container is halfway between the ship and the truck.
3. When the power comes back after a brief outage, the maintenance plan decided handles the crash and the system restores the session.
4. The operator's position and current operation are resumed, and the container placement is accurately restored on the manifest.
5. The operator completes the offload and continues with the rest of the operations as listed in the transfer list.
6. After the operation, the manifest is updated, and the log reflects the power outage and the container status during the interruption.

Scenario 4: Full Unload and Partial Reload with No Buffer Usage

Description: A ship, *Pacific Voyager* , arrives and requires full offloading of all containers. Only a few containers are loaded back onto the ship.

Steps:

1. The logs will be updated after every step.
2. The ship arrives at 7 AM with 60 containers. The manifest reflects a full ship grid, and the transfer list specifies offloading all containers related to "Walmart Electronics" and "Target Furniture."
3. The operator uses the system to determine the most efficient sequence for unloading all the containers while balancing the load temporarily, as the transfer list only asks for partial reloading.
4. As the containers are unloaded, trucks arrive as planned, picking up the containers as they are moved off the ship.
5. Once the unloading is completed, the operator loads only five containers specified in the transfer list (e.g., "General Mills Empty", "Kia Engines") into the ship.
6. After completion, the manifest is updated to reflect the new state of the ship, and the log captures all container movements.

Scenario 5: Multiple Container Movements Within the Ship for Rebalancing

Description: A ship, *Atlantic Glory*, arrives with a request to rebalance containers without off-loading or loading new containers.

Steps:

1. The logs will be updated after every step.
2. The manifest shows 40 containers on the ship, and the transfer list specifies that no containers will be unloaded or loaded. However, it requires the ship to be balanced before departure.
3. The ship is significantly unbalanced, with the port side carrying heavier containers than the starboard side.
4. The operator uses the application to calculate the optimal moves to legally balance the ship. This involves moving three containers from the port side to starboard, using the least amount of crane movement to save time and minimize cost.
5. The operator executes the moves as instructed by the system, ensuring the legal definition of balance is met.
6. Once the balance is achieved, the manifest is updated, and the log records all container moves with timestamps.

Scenario 6: Shift Handover During a Ship Loading Operation

Description: A shift handover occurs in the middle of an ongoing operation. The new operator must seamlessly continue the operation.

Steps:

1. The logs will be updated after every step.
2. At 11:30 PM, the operator is in the middle of loading containers onto the ship *Northern Explorer*. The transfer list specifies loading 12 containers of various types (e.g., "Walmart Automotive Parts", "Ford Transmission Units").
3. The current operator is halfway through the task when their shift ends at midnight. The system must allow the new operator to sign in and seamlessly continue where the previous operator left off.
4. The new operator logs in at 12:00 AM and sees the current progress in the application, including which containers have already been loaded and the sequence of pending containers.
5. The new operator continues with the loading process, with the system updating the manifest in real-time as containers are placed in their designated slots.
6. The manifest is finalized at the end of the operation, reflecting all loaded containers, and a complete log of the shift handover and container movements is generated.

Maintenance Plan

Goal: Ensure the system remains efficient, reliable, and minimizes downtime.

While we cannot anticipate every eventuality, we recognize that the following issues may necessitate updates or changes to the system in the coming years:

- Log File Adjustments: If regulatory requirements change regarding the storage and format of log files, particularly if they mandate encryption or additional data types, the system will need to be updated to comply.
- Container Handling Protocols: If new technology (such as fully automated cranes or improved container sensors) is introduced at the port, the system must adapt to ensure optimal efficiency in loading/unloading and balancing.
- Manifest Regulations: If legal requirements change for manifest formatting or content accuracy, the software will need adjustments to handle these modifications automatically.

Maintenance Plan

We will make any changes required to handle the above issues, for free, within five years of delivery.

Backup Storage Changes: If there are advances in storage solutions that affect how port data is backed up or recovered, updates to the backup system will be necessary.
Power Outage Protocols: If more robust power outage recovery mechanisms become available, they will be integrated into the system to minimize downtime.

We will make any necessary changes to address these issues, for a nominal fee, not exceeding 10% of our original delivery costs.

Training and Documentation

On-site Training: We will conduct hands-on training for all staff involved in port operations, this will in hand take at most 15 minutes to understand system use, manifest handling, and log management. This will cover both day-to-day tasks and more advanced features.

Documentation: A detailed user manual will be provided, including:

- Step-by-step guides for uploading, editing, and managing manifests.
- Instructions for logging operations and retrieving data.
- Troubleshooting tips for common issues.

Continuous Support: Post-implementation support will include regular check-ins and refresher training as needed.

Compliance with Regulation

- Data Handling and Security: The system will comply with all regulations regarding data privacy and protection, ensuring compliance with industry standards.
- Manifest Accuracy: The system will meet or exceed all legal requirements for manifest accuracy and retention, including adherence to international shipping and trade laws.
- Environmental Standards: Compliance with regulations on energy efficiency and waste management, ensuring minimal environmental impact during operations.
- Audit Trail: The system will provide a detailed audit trail for all transactions and container movements, complying with port authority requirements for transparency and accountability.

Acceptance Testing

- Functionality Verification
  a. Visual representation of ship's container layout is accurate and user-friendly
  b. Container balancing algorithm maintains weight distribution on both sides of the ship
  c. Crane operations are correctly simulated for container transfers
- Performance Metrics
  d. System recovers from brief power outages (up to 1 minute) without data loss and maintains previous state
  e. Container movements are efficiently calculated and displayed
  f. Application runs smoothly on low-end hardware
  g. Ship must be equally balanced.

Acceptance Testing (cont . . .)

- User Interface
  a. Interface is accessible and color-blind friendly
  b. Operators can easily input and dismiss manifests
  c. Logging system accurately records user access and actions
- Compliance
  a. Manifest processing adheres to the provided standard format
  b. Application operates exclusively in English
  c. No use of unauthorized AI or LLM technologies

Contract

- We propose to develop a software application for efficient container loading, unloading, and balancing on ships
- The final deliverable will be completed on or before the *specified date*
- We may require up to five hours of Mr. Keogh's time to answer additional questions
- The application will include:
  - Visual representation of ship's container layout
  - Container balancing algorithm
  - Crane operation simulation
  - Manifest processing and generation
  - User-friendly interface for dockworkers
  - Logging system for user actions
  - Error handling for power outages and crane breakdowns
- No additional features will be accommodated at the agreed price point and delivery date
- The application will run locally on low-end hardware and operate exclusively in English
- Upon completion and final approval, all intellectual property rights, including code and design, transfer to the client
- This contract is subject to the acceptance testing criteria as outlined in the project requirements

Contract (cont . . .)

Dockership Signature: _____ *(date)*

Mr. Keough Signature: _____ *(date)*

References

1. Meeting with Mr. Keough regarding project specifications
   - 10/12/24
2. Dr. Keough's slides