Container Handling and Ship Balancing Project

By DockerTech Co.

Slides by Ryan, Melanie, Chris, Aadil, Aarav

Contents

Problem Understanding (Basics)

Objective:

- Develop a highly efficient application for container loading, unloading, and ship balancing to replace the current manual operation list method [a]
- Tracks all actions via an action log [a]

Efficiency Requirement: Time is critical; every minute saved reduces costs, so the solution must prioritize speed.

Port Details:

- Designed for Mr. Keogh's Long Beach port [a]
- Open 24/7 with operations divided into 3 shifts [a]
- Can handle only one X2 ship at a time. X2 ships only have one bay [a]

Additional Considerations:

- Must accommodate various symmetrical ship layouts.
- No ownership of ships, trucks, or containers is required.
- Keywords like "NAN," "DNE," and "UNUSED," along with empty strings, must be avoided.
- In cases of duplicate containers, the application should identify the most cost-effective solution.
- Timestamps in the log file must be accurate to minute, which will be ensured by using the PC's system time and its connection to external time management servers with the fast ethernet connection

Problem Understanding (Logistics)

Manifest Delivery:

- A few hours before docking, the port receives an emailed manifest detailing container information, positions, and weights [a].
- The manifest is in a text file with a row-and-column layout [a].
- The file name includes the ship's name. If there are changes, the manifest is updated and renamed with "OUTBOUND" appended [a].
- The head office sends a transfer list, which tells the operator what containers are to be moved [a]

Loading and Unloading Process:

- Upload the manifest to the application [b].
- Input the loading and unloading details [b].
- The application suggests the optimal moves [b].
- Any updates made are automatically reflected in the manifest, which is downloadable once the best moves are generated [b].
- Never done along with the Ship Balancing Task [a]

Problem Understanding (Logistics cntd.)

Ship Balancing:

- Using the manifest, the application checks if balancing is required. If needed, it generates the optimal moveset to redistribute containers for balanced weight [a].
- Each side of the ship must be within ±10% of the other [a].
- Container positions are flexible [a].
- Empty containers are treated as having a near-zero weight [a].
- If exact balancing isn't achievable, a "SIFT" process is initiated [a].
- Never done with the loading and unloading task [a]

Stakeholders

- Mr. Keogh: business grows or hurt by operation success, held responsible if rules are broken
- Ship Owners: have to wait in port for operations to finish
- Crane Operators: must follow list of moves created by software
- Truck Drivers: can only pick up cargo when algorithm designates
- Customs Officials: oversee process, more work if list of operations break rules
- Customers: time waiting for products is affected by how long offloading takes
- Cargo owners: business is affected if customers dissatisfied by shipping process
- Unions: can unite together in case of unfair wages or working conditions that would impact business revenue
- Regulations inspectors: Inspect the port to make sure all legal requirements are met
- FBI: Need log file in correct format if subpoenaed to check for drug smuggling
- Insurance Company: influences safety protocols and are liable to large costs if any damages or injuries

Assumptions

- Before the ship may depart the port, the crane must be on leftmost side of the ship [b]
- All Mr. Keogh's Long Beach Port employees have a 10th grade level understanding of English [a]
- Containers are not inspected by Mr. Keogh's Long Beach Port employees [b]
- Moving a container will take longer than the trucks [b]
- If a truck that has to retrieve a unloaded container from a ship is unable to make it to the dock and Long Beach port has been notified and has sent a temporary truck on its way, it take little to no time for the truck to arrive and receive the container [b]
- Trucks can only take one container [b]
- Weather conditions are never an issue [b]
- Employees will correctly follow given instructions
- Log will be manually reset at the end of the year [b]

Inputs

Manifest:

- Highly structured .txt file sent by the ship before arrival [a]
- Details container names, cell location, and weights [a]
- Guaranteed correct [a]
- Format
    - Titled the name of the ship, but may have extra words with .txt extension
    - [y coordinate, x coordinate], {weight}, container name
    - NAN for nonexistent slots
    - UNUSED for empty slots
    - Duplicates allowed
    - Containers listed in increasing order of position from [01,01] to [08,12]
    - Can’t legally edit the English sections

Operator:

- Operator uses the transfer list to determine which containers are to be offloaded or loaded [a]
- Operator interacts with the software interface to select the containers

Computer System:

- The computer system will be the one that provides the time in PST (daylight savings time) for our application. This ensures that the time is always accurate for the logs.

Outputs Pt. 1

Order of Operations:

- The software calculates optimal moves for loading/offloading/balancing
- Gives one move at a time before operator inputs the move is completed
- Each instruction accompanied by animation

Animation:

- 2-D animation shows the operator displays operations through movement of containers across a diagram of the dock
- Shows each move one at a time

Time Estimates:

- Gives the operator estimates of how long operations will take
- Formatted in minutes

Outputs Pt. 2

Log File:

- Plain .txt file containing all atomic events with respective times edited only by the software [a].
- Every event gets a line in the log file in the following format: Date TimeMessage [c].
- Date and Time are always formatted as YYYY-MM-DD HH:MM [c].
- Tab indent between Date/Time and Message and single space between DD and HH [a].
- Time is taken to the nearest minute, rounding down [c].
- Time is in PST and Daylight Savings [c].

Updated Manifest:

- An edited version of the manifest file that reflects changes to container positions with the same formatting as original manifest [a].
- Same name as original manifest, but with OUTBOUND appended at the end [a].
- The manifest will be saved to the disk for the operator to access and send to the ship captain [a].

Scenario 1: Load/Unload

Part 1 of 6

Persona:

- Maria Hernandez is a new employee, having started at the port just two weeks ago. She works the 8 AM- 4 PM shift on Tuesdays through Saturdays. Maria lives nearby and usually arrives early for her shift and spends some time at the port before starting work

Clock In:

- Maria arrives at the port at 7:58 AM on August 15, 2024.
- She clicks on the ‘Log in’ button to clock in
- She clocks in by entering her name into the system.
- The log automatically records:

  2024-08-15 07:58 Maria Hernandez logged in

Scenario 1: Load/Unload

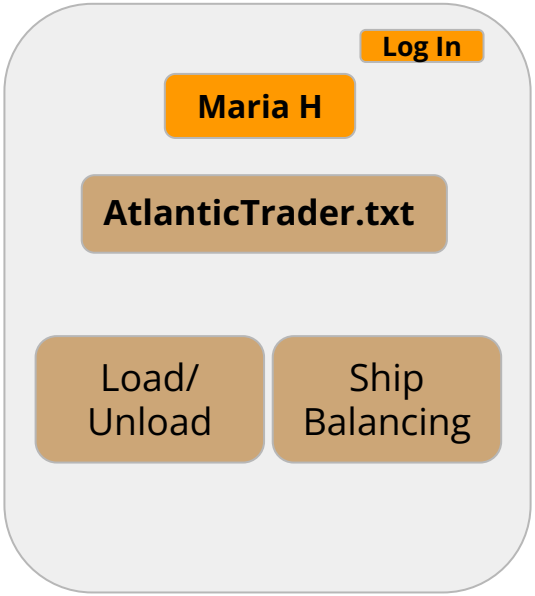
Part 2 of 6

Manifest Upload:

- At 8:17 AM, Maria receives an email with the manifest for the incoming ship, "Atlantic Trader".
- She accesses the email, downloads the manifest file named "AtlanticTrader.txt", and uploads it into the software by clicking on the ‘Upload Manifest’ button.
- The system will read the manifest and log the number of containers on the ship:

  2024-08-15 08:18 Manifest AtlanticTrader uploaded by Maria Hernandez.
  2024-08-15 08:18 Manifest AtlanticTrader has 13 containers on board

- Once the manifest has been uploaded, the screen will give an option to choose between loading/unloading and ship balancing.
- Maria will click on the ‘Load/Unload’ button

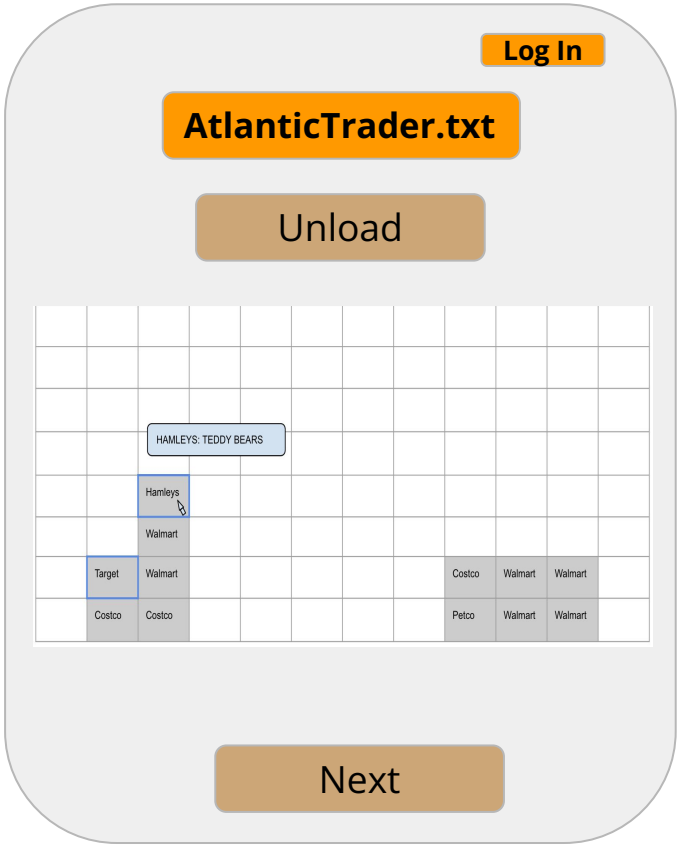


Scenario 1: Load/Unload

Part 3 of 6

Select Containers (Unload):

- The software displays a 2d grid of containers for unloading and loading
- Maria reads the transfer list to see which containers to unload or load
- The application will show the name of the containers when Maria hovers over that grid location
- Maria selects containers at coordinates [2,1] and [4,3] for unloading which have the containers from “Target” and “Hamleys”.

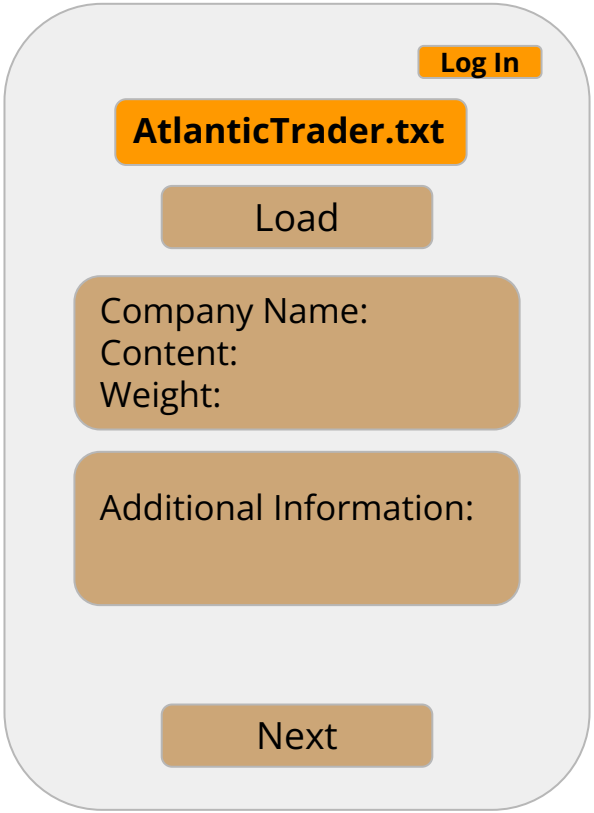


Scenario 1: Load/Unload

Part 4 of 6

Select Containers (Loading):

- For loading, she writes "Samsung Electronics" and "Blue Wave Appliances" as the company names along with the contents of the container
- Maria includes the weight of the container as well before proceeding to the next page



Scenario 1: Load/Unload

Part 5 of 6

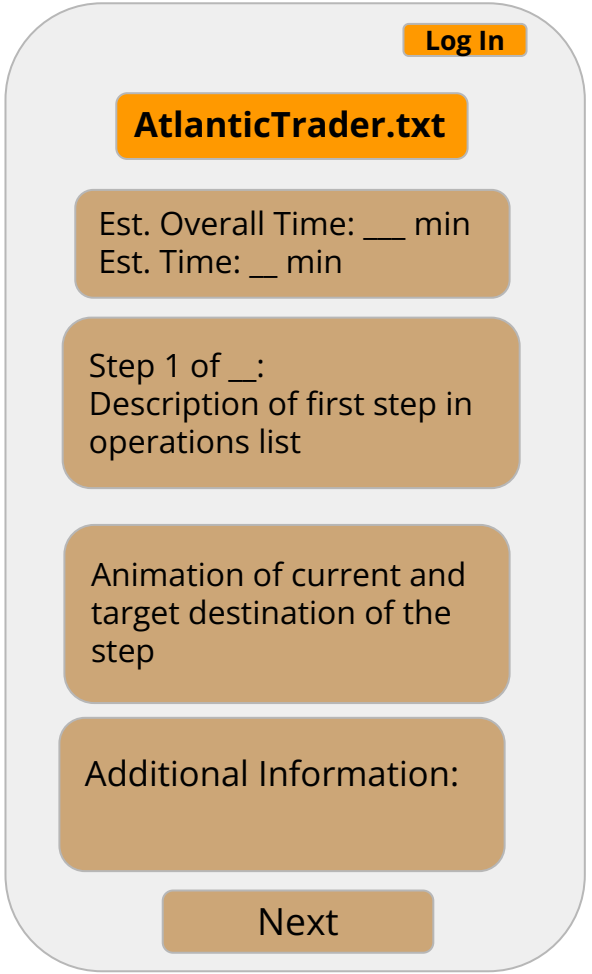
Animation:

- The application will provide an animation of the most efficient steps for unloading the 2 containers off the ship one at a time

Perform Operations:

- Maria follows the on-screen instructions to unload the containers from [02,01] and [04,03].
- After each movement, she confirms the action in the software, and the manifest updates automatically. She then loads the specified containers, one at a time, into positions [01,04] and [03,02], respectively. The system logs each step:

2024-08-15 08:23	Container “Target” offloaded
2024-08-15 08:28	Container “Hamley” offloaded
2024-08-15 08:33	Container “Samsung Electronics” is onloaded
2024-08-15 08:38	Container “Blue Wave Appliances” is onloaded



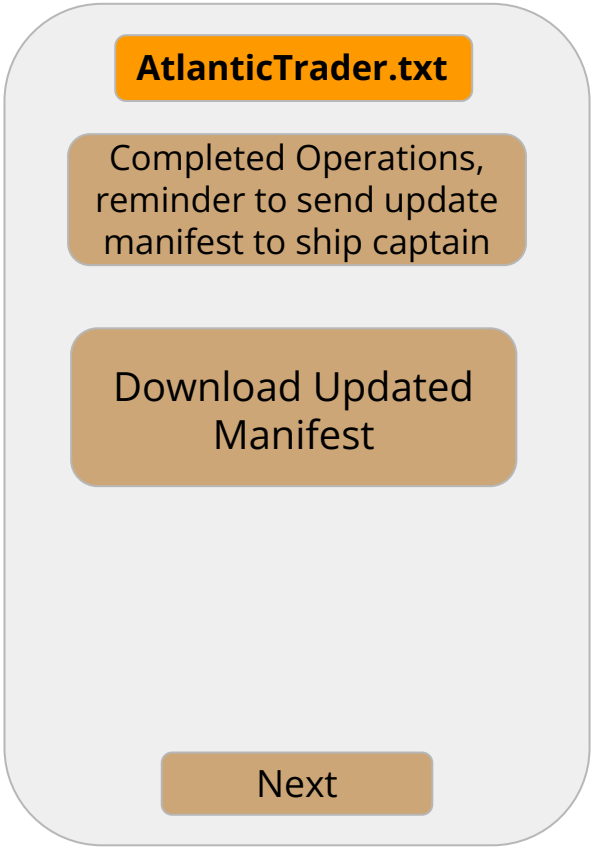
Scenario 1: Load/Unload

Part 6 of 6

Completion:

- Once all containers are loaded and offloaded Maria presses "Download Updated Manifest," which downloads as "AtlanticTraderOUTBOUND.txt" on her desktop.
- She is prompted by the system with a reminder: "Updated Manifest Saved To Disk. Please Email 'AtlanticTraderOUTBOUND.txt' To The Captain."
- Maria confirms and sends the email to the ship captain at 8:46 AM.
- The log records:

> 2024-08-15 08:23 Finished a Cycle. Manifest AtlanticTraderOUTBOUND.txt was written to desktop, and a reminder pop-up to operator to send file was displayed.



Scenario 2: Balance

Part 1 of 3

Persona:

- Alec Terry is a 3rd year economics student at CSULB working at Mr. Keogh's port over the summer to earn some extra money
- Alec typically works the 4PM -12AM shifts every Tuesday and Thursday

Clocking in:

- Alec arrives at the port at 4:05 pm on Tuesday and waits for Maria to climb down from the crane
- Alec climbs up the crane and reaches the console at 4:10 pm
- Alec logs in and the log automatically updates

2024-08-15 16:10	Maria Hernandez logged out
2024-08-15 16:10	Alec Terry logged in

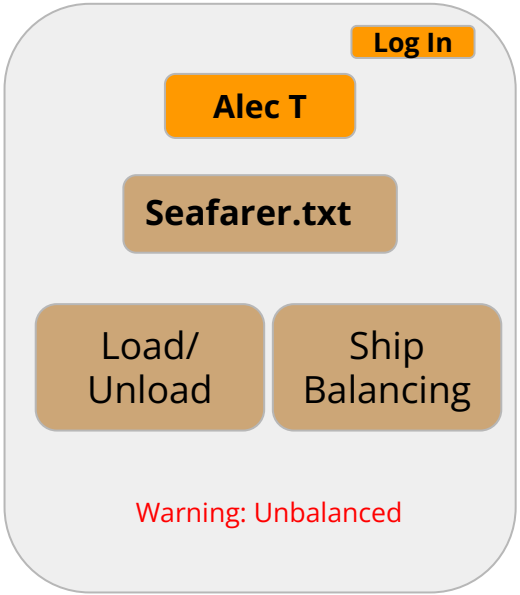
Scenario 2: Balance

Part 2 of 3

Balancing:

- Alec receives a manifest from the captain of the Seafarer at 16:25
- Alec uploads the manifest
- Alec receives a warning that the ship is unbalanced
- Alec selects the Ship Balancing option
- The most optimal steps to balance the ship are displayed to Alec in the form of an animation
- The log is updated

2024-08-15 16:25 Manifest Seafarer uploaded by Alec Terry
2024-08-15 16:28 Seafarer balanced



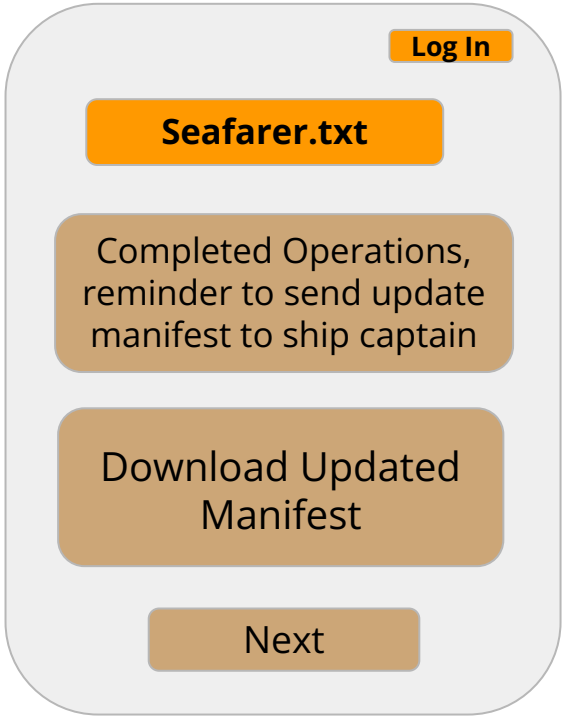
Scenario 2: Balance

Part 3 of 3

Sending the Manifest:

- The “warning: unbalanced” warning disappears and Alec is free to send the updated manifest to the captain
- Alec downloads the updated manifest
- Alec sends the manifest to the captain of the Seafarer
- The log is updated

2024-08-15 16:30 Finished a Cycle. Manifest SeafarerOUTBOUND.txt was downloaded
2024-08-15 16:30 Manifest SeafarerOUTBOUND.txt was sent to Seafarer



Scenario 3: Log Input

Part 1 of 3

Persona:

- Jared Harrickson is a seasoned employee, having worked at Mr. Keogh's port for the last 3 years.
- He works the 12AM - 8AM shift on Sundays through Thursdays.
- Jared previously worked as a TSA agent at the nearby airport but wanted a closer job to home. He found the job opening at the port and has been happy as it pays well and is a quick commute.

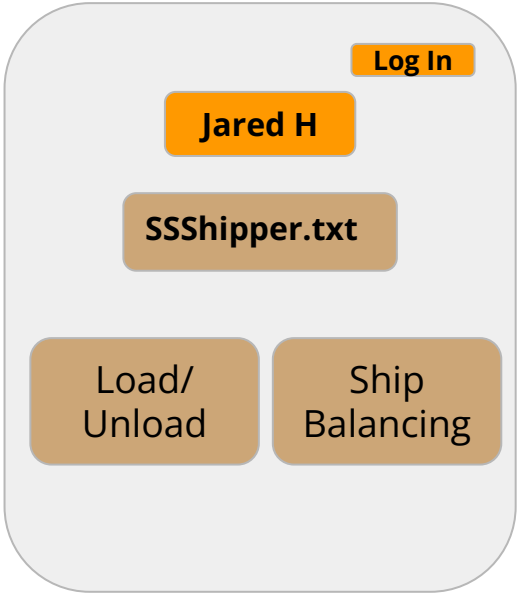
Clocking in:

- Jared arrives at the port at 12:05AM on Thursday and waits for Alec to climb down the crane.
- Jared climbs up the crane and reaches the console at 12:10AM
- Jared logs in and the log automatically updates

2024-08-15 16:30	Alec Terry logged out
2024-08-15 16:30	Jared Harrickson logged in

Scenario 3: Log Input

Part 2 of 3



Manifest Upload:

- Jared receives an email with a manifest from the incoming ship “SSShipper”
- He accesses the email, downloads the manifest file named "SSShipper.txt", and uploads it into the software by clicking on the ‘Upload Manifest’ button.
- The system will read the manifest and log the number of containers on the ship:

  2024-09-19 00:21 Manifest SSShipper uploaded by Jared Harrickson.
  2024-09-19 00:21 Manifest SSShipper has 16 containers on board.

- Once the manifest has been uploaded, the screen will give an option to choose between loading/unloading and ship balancing.
- Jared identifies that it is a load/unload task, clicks on the ‘Load/Unload’ button, and follows the steps outlined in scenario 1

Scenario 3: Log Input

Part 3 of 3

Transfer Process:

- Jared reads the transfer list and is instructed to load the container called “MonsterEnergy” and unload “RedBullEnergy”
- Jared waits for the software to produce the optimal path for him to follow and the log is updated accordingly:

  2024-09-19 00:40 Container “MonsterEnergy” is onloaded
  2024-09-19 01:00 Container “RedBullEnergy” offloaded

- Jared notices there’s a huge dent in the cargo container named “RedBullEnergy”

Inputting Log Message:

- Jared presses on the “Add a message to the log” button which allows him to type a message regarding the damages
- Jared’s Message in the Log

  2024-09-19 01:02 I saw that the RedBullEnergy container has a large dent on the side but the door is still completely closed. I sent a photo to the head office and will continue with the rest of the cycle.

- Jared completes the cycle and the updated manifest is saved to the desktop as described in scenario 1

Maintenance Plan

On the first day of launching the program, one of our employees will be present in the port all day to help with the program.

Following months we will provide instant support, we can be contacted via email and phone

We will provide support if any changes need to be made to account for new changes in the port, which include but are not limited to...

- Container sizes
- Ship sizes
- New Manifest formats
- New log formats
- New regulations

Training and Documentation

Training

- We will provide a 10 minute or less video of how to use our program, this will be provided in the completion of the program and will be included in the PDF handbook

Reference

- A PDF handbook will also be provided with the features and how to use the program in case an employee would like to reference it while on the job

Compliance with Regulation

- Log file will be in proper format as per government guidelines
- Name of the manifest is displayed at all times to prevent confusion
- Software will not suggest putting more than 1 container on a truck
- Software will not suggest keeping containers stacked over 10 units high on the ship
- Data is kept secure and all privacy protocols are ensured
- Software will log 24/7, 365 days as requested by the client and creating a new log file as needed
- SIFT will be performed in the event balancing is not possible in order to adhere to Maritime Law

Acceptance Testing

Time Efficiency and Algorithm Performance:

- We can efficiently sort and balance a ship with 5 containers in under 5 minutes. For larger quantities, the processing time per container increases linearly.
- The algorithm responsible for generating steps operates at a speed no slower than 5% of the solutions produced by your workers.
- The time to compute an optimal solution will not exceed 15 minutes as requested by the client.

System Reliability and User Operations:

- Our recovery system is fully operational and guarantees no data loss.
- Employees have the flexibility to clock in at any time.
- Operations performed and user inputs are recorded in a hidden log.

Documentation and Downloadable Resources:

- The manifest accurately reflects the state of the ship after processing.
- Operators can download the instructions list and the manifest.

Contract

- We are proposing a software that efficiently sorts and balances containers.
- We will have a final deliverable on or before December 7, 2024.
- We may require up to five hours of your time (or the time of a qualified proxy) to answer any additional questions. Questions should be answered within 48 hours given no unexpected circumstances.
- We will not honor any additional requests or “feature creeps”, at this price point and delivery date.
- Payment must be made on the date of delivery or by the latest, December 7, 2024.
- DockerTechCo. will not be held liable for any loss of data or profits due to erroneous damages.
- We are offering a perpetual software license that is non-transferable.
- Intellectual property rights will be completely transferred and all trademarks and trade secrets will belong to the client. We do not retain the right to access or utilize the software after delivery unless otherwise specified.

DockerTechCo. Signature: _____ Date: _____

Client Signature: _____ Date: _____

References

[a] General Interview with Mr. Keogh on Oct 7th 2024

[b] Elicitation Interview with Mr. Keogh on Oct 18th 2024

[c] General email from Mr. Keogh on Oct 22nd 2024

[d] Information on Intellectual Property

[e] Licensing for Software

[f] International Longshoremen’s Association