User Requirements Document
for
Warehouse Product Locating and Routing System (WPLRS)
Release

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Contents

Version History

Revision	Date	Author(s)	Description
1.0	12.04.2019	A. Aksakal, H. Chen, K. Phan, Z. Ning	Initial version
1.5	05.03.2019	A. Aksakal, H. Chen, K. Phan, Z. Ning	Alpha/Beta Pre-Check Version
2.0	05.10.2019	A. Aksakal, H. Chen, K. Phan, Z. Ning	Beta Version • *Alpha to Beta Improvements:* – Map re-oriented to follow absolute North with origin (0,0) at bottom-left corner – User directions are more readable – Output errors resolved – Binary now available for installation • *Beta Features:* – Supports importing order lists of size 1,5, 10, and 15 – Dynamic start location

2.5	05.24.2019	A. Aksakal, H. Chen, K. Phan, Z. Ning	Beta v2 Version • *Beta to Beta v2 Improvements:* – Made path directions consistent and more user friendly – Changed empty spaces character from '0' to '.' for improved visibility – Distances are only calculated once • *Beta Features:* – Supports manual input of order list – Supports loading input file into order list ∗ User can request next unfulfilled order ∗ User can request specific order number/line – Dynamic start and end locations
Release	06.07.2019	A. Aksakal, H. Chen, K. Phan, Z. Ning	Release Version • *Beta to Release Improvements:* – Improved error handling with exceptions for unloaded data, unavailable menu options, etc. – Test document includes input cases and covers wider range for chosen genetic algorithm • *Release Features:* – Error handling without crashing, alerts user instead – Parallelized genetic algorithm for better performance – Timeout feature that limits time taken to compute path and calculate distances

Chapter 1

Front Matter

1.1 Glossary

- *Warehouse Terminology*:
  - **Item/Product:** a warehouse object that has attributes such as ID, name,quantity, and location inside the warehouse.
  - **Location:** an (x,y) coordinate pair representation of where a warehouse object is based on a grid representation of the warehouse. The coordinate is the shelf that it is located on while AccessN, AccessW, AccessS, and AccessE values indicate which direction it is accessible from.
  - **Order:** a compiled list of items/products that need to be retrieved from the warehouse to be sent out. This is represented as a series of Product IDs and can be loaded from a .txt file or inputted manually.
  - **Order List:** a compiled list of orders that can be loaded from a .txt file
  - **Inventory:** a compiled list of all items available in the warehouse. Formatted in .txt file with columns(ProductID, xLocation, yLocation, AccessN, AccessW, AccessS, AccessE)
- *Application Terminology*:
  - **Graphic User Interface (GUI):** the interface which will display relevant information to the user such as list of items in orders or location of items
  - **Map:** A text grid representation of the warehouse where shelves are displayed as "s"'s and empty spaces are .'s. Ticks on the x and y axis indicate the coordinate location occupied or available. Route is distinguished by 0's
  - **Path/Route:** a list of directions that tells workers which direction to go based on the coordinate value of their current location in the warehouse

Chapter 2

Overview of System

2.1 Usage Scenarios

- Warehouse workers aim to improve their throughput when processing orders. Using the WPLRS, the workers use the menu to import inventory and to find the optimal path to a select product and to view the overall map.
    1. Import inventory by inputting '1' for option 1: "Import an Inventory". and inputting the filename including extension
    2. On success, the message "Inventory has been successfully created from the given file! Number of products that are added to the inventory: <number of products>" is outputted
    3. Display map by inputting '2' for option 2: "Display the Map"
    4. Compute path to product by inputting '4' for option 4: "Compute the path to a product"

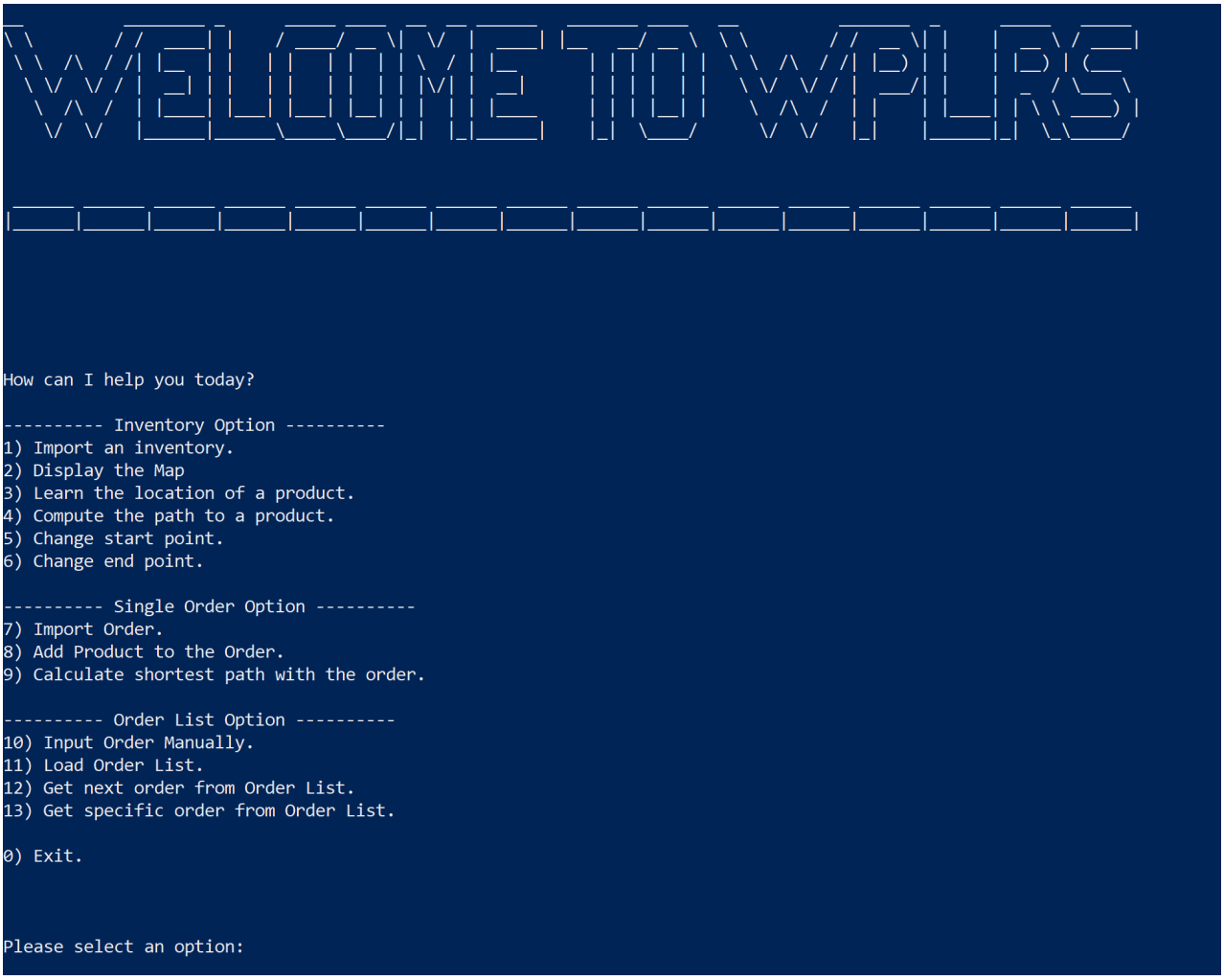

Figure 2.1: Example menu display

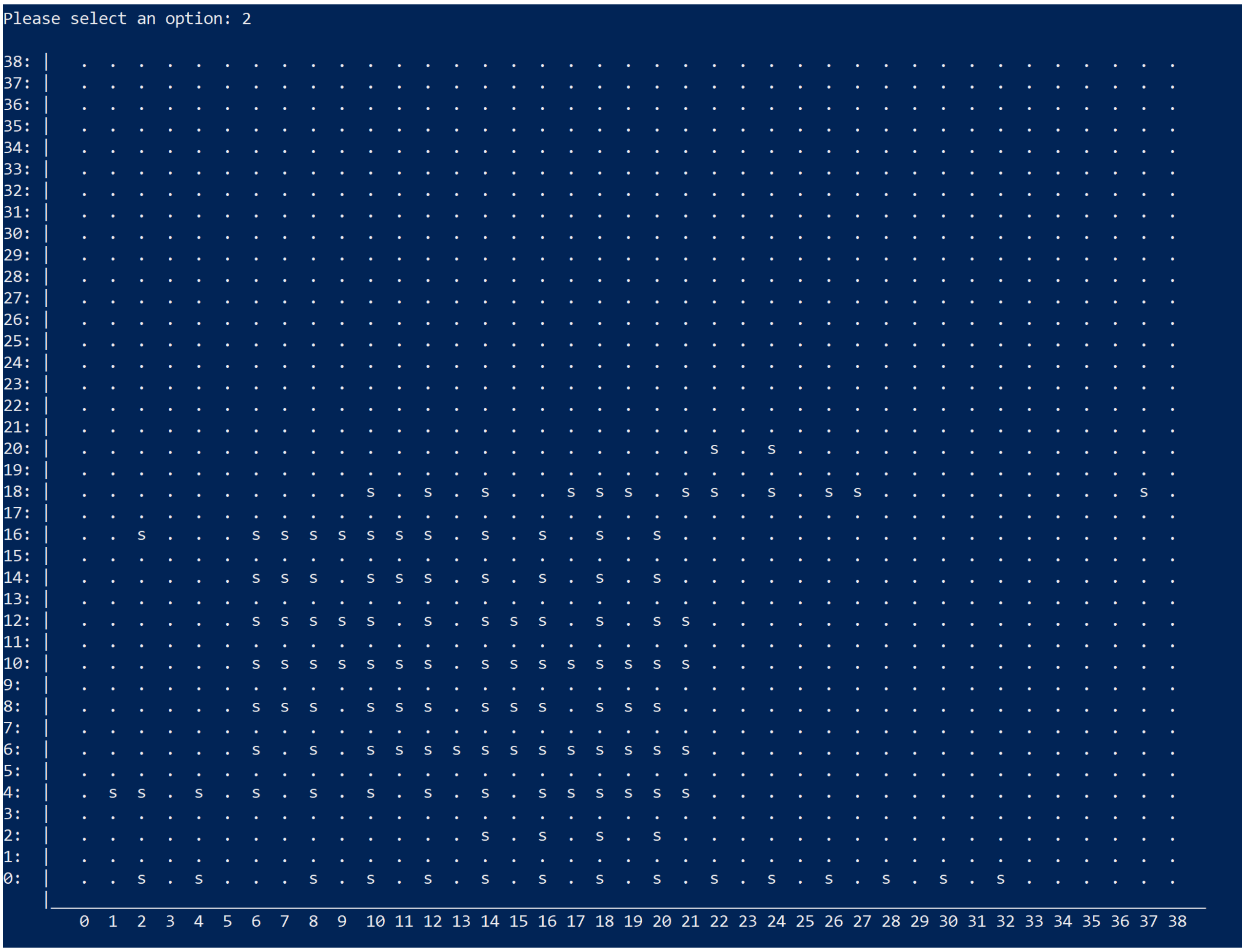

Figure 2.2: Example map display after choosing menu option 2

```
Please select an option: 4

Please enter a product ID: 45
Please follow this instruction to get the product:

Start at (0, 0)
Move Towards North, For 15 Steps, Until You Reach Point (0, 15) and Turn Right to East Direction.
Move Towards East, For 10 Steps and End Your Tour at (10, 15)
```

Figure 2.3: Example path display for reaching Product with ID 45 from (0,0)

- Warehouse workers is at a different starting point and requests the optimal path to a product.
    1. Change start point by inputting '5' for option "Change start point" and input new x coordinate and y coordinate as prompted
    2. Change end point by inputting '6' for option "Change end point" and input new x coordinate and y coordinate as prompted

```
Please select an option: 4

Please enter a product ID: 45
Please follow this instruction to get the product:

Start at (5, 10)
Move Towards North, For 5 Steps, Until You Reach Point (5, 15) and Turn Right to East Direction.
Move Towards East, For 5 Steps and End Your Tour at (10, 15)
```

Figure 2.4: Example path display for reaching Product with ID 45 from (5,10)

- Warehouse workers import order list and want to fulfill next unfulfilled order or specific order
    1. Import order list from file by selecting option '11' for option "Load Order List". Input filename as prompted
    2. Retrieve next unfulfilled order by selecting option '12' for option "Get next order from Order List"
    3. Retrieve specific order by selecting option '13' for option "Get specific order from Order List"

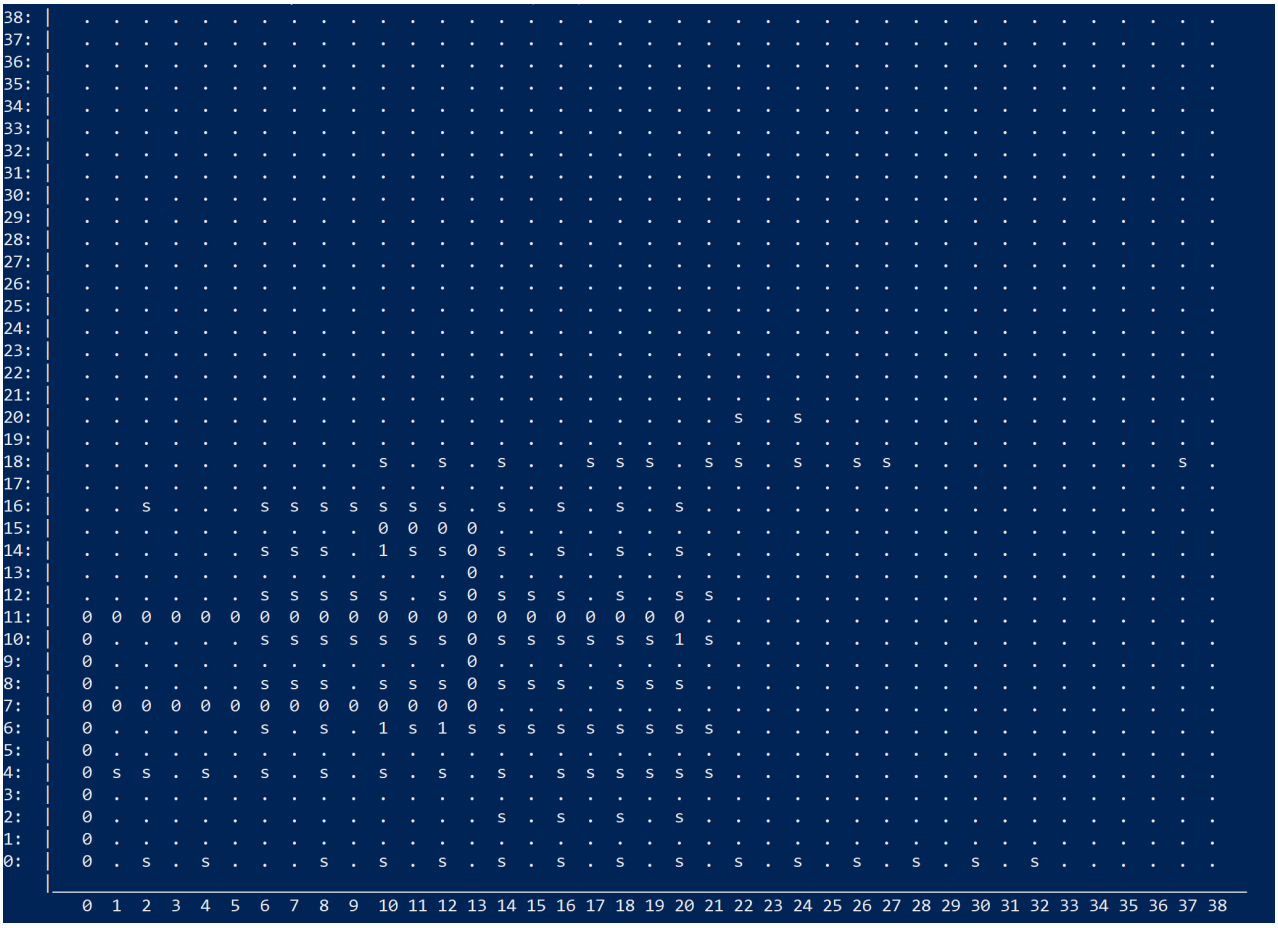

Figure 2.5: Example path display for order

```
Please select an option: 12

Order to fulfill: Order 0001

Items: 108335 391825 340367 286457 661741

The distance is 52.0


Given algorithm has not been implemented yet!


The optimal sequence is the following:
['286457', '661741', '340367', '391825', '108335']


Please follow this instruction to get the products:
Start at (0, 0)
Move Towards North, For 7 Steps, Until You Reach Point (0, 7) and Turn Right to East Direction.
Move Towards East, For 12 Steps, and Pick Up Item: 108335 at (12, 7)
Move Towards East, For 0 Steps, Until You Reach Point (12, 7) and Turn Back to West Direction.
Move Towards West, For 2 Steps, and Pick Up Item: 391825 at (10, 7)
Pick Up Item: 340367 at (10, 7)
Move Towards West, For 0 Steps, Until You Reach Point (10, 7) and Turn Back to East Direction.
Move Towards East, For 3 Steps, Until You Reach Point (13, 7) and Turn Left to North Direction.
Move Towards North, For 8 Steps, Until You Reach Point (13, 15) and Turn Left to West Direction.
Move Towards West, For 3 Steps, and Pick Up Item: 286457 at (10, 15)
Move Towards West, For 0 Steps, Until You Reach Point (10, 15) and Turn Back to East Direction.
Move Towards East, For 3 Steps, Until You Reach Point (13, 15) and Turn Right to South Direction.
Move Towards South, For 4 Steps, Until You Reach Point (13, 11) and Turn Left to East Direction.
Move Towards East, For 7 Steps, and Pick Up Item: 661741 at (20, 11)
Move Towards East, For 0 Steps, Until You Reach Point (20, 11) and Turn Back to West Direction.
Move Towards West, For 20 Steps, Until You Reach Point (0, 11) and Turn Left to South Direction.
Move Towards South, For 11 Steps and End Your Tour at (0, 0)
```

Figure 2.6: Example path display for order

2.2 Goals

The Warehouse Product Locating and Routing System (WPLRS) will be capable of taking in orders, determining the location of all items in the warehouse if it is available, and providing the optimal path to retrieve each item. Furthermore, the system should allow for review of orders and review of items located in a section of the warehouse. It is meant to provide a warehouse worker with the information needed to locate all products in an order and find the most efficient path for retrieving them.

2.3 Basic Features

- *User Interface*: displays menu for warehouse workers including options based on the following categories. **Input number corresponding to feature below to use that option**:
  - **WLPRS Menu**:
    1. *Import an inventory:* Import inventory from .txt file formatted with columns for ProductID, xLocation, yLocation, AccessN, AccessW, AccessS, AccessE.
    2. *Display the map:* Displays text representation of warehouse where 1's are shelves and 0's are empty spaces
    3. *Learn the location of a product:* Input the ProductID of an item and its location is displayed
    4. *Compute the path to a product:* Input the ProductID of an item and the steps to reach it from the start point will be given
    5. *Change the start point:* Input x coordinate and y coordinate to change the start point for path directions
    6. *Change the end point:* Input x coordinate and y coordinate to change the end point for path directions
    7. *Import Order:* Import list of orders from text file

8. *Add Product to Order:* Add product to current order by inputting Product ID of item to add
9. *Calculate shortest path with order list:* Uses current order list to calculate and display shortest paths between products
10. *Input Order Manually:* Add parameters for order to add new order to list
11. *Load Order List:* Input filename of .txt file with list of orders to import orders
12. *Get next order from Order List:* Retrieves next unfulfilled order from current order list and computes path for order
13. *Get specific order from Order List:* Input order/line number to get the associated order and compute path for it

1. *Exit:* Exit program **Option Number is 0 for Exit**

Chapter 3

Installation

3.1 System Requirements

- **Windows,Mac, or Linux**
- Internet access

3.2 Setup and Configuration

1. Open wlprs.zip included in submission
2. Extract files
3. Change directory to wlprs/bin/dist/interactive
4. Run interactive.exe

3.3 Uninstalling

1. Remove wplrs directory and exe file

Chapter 4

Back Matter

4.1 Copyright

4.2 Error Messages

- *Cannot find file:* file used to import orders is an invalid file or is unreadable
- *Please import inventory with option [1] first :* prompts user to load inventory file before using related functions
- *Execution time is over the timeout:* Route calculation has gone over execution time limit of 1 minute
- *Please import order list with option [11] first or input order manually with option [10] :* prompts user to load order file before using related functions
- *All orders are fulfilled :* alerts user that all orders have been filled
- *Does Not Exist:* object with ID does not exist in its relevant database/structure

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