Object-Oriented Software Development Team Project

Logistics Application

Contributors: Ralph Z. & Lanny X.

Overview

Logistics: The process of planning, implementing, and controlling the efficient, effective flow and storage of goods from the point of origin to a destination for the purpose of conforming to customer requirements.

Our application will process orders to move items (products) from one (or more) facilities to a destination facility.

These items must be processed at the source facility (retrieved from stock, packaged, packed into containers).

The container items are then loaded onto transport trucks.

These trucks then transport the ordered items over approved shipping routes.

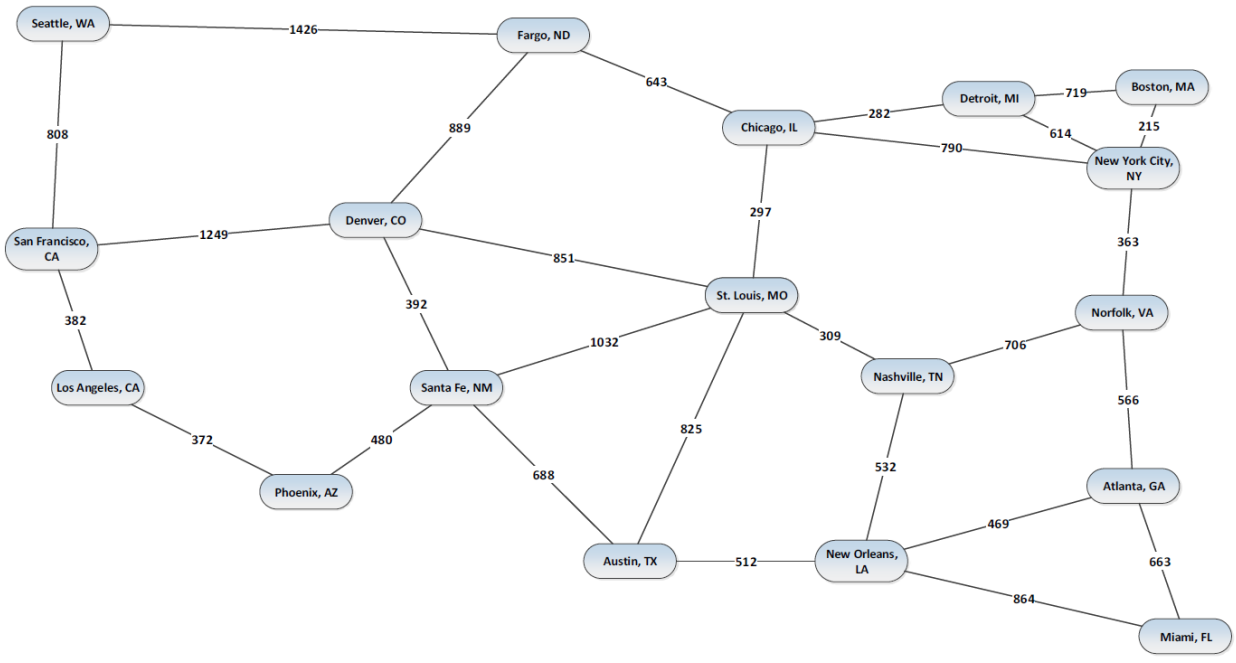
The ordered items are unloaded, unpacked and delivered to their destination facility.

Our project develops an application that performs these Order Processing & Logistics functions – it automatically processes customer orders – a very time-intensive process when done manually. The input of information, order processing, and results generation are all handled by our application.

Application Characteristics

Transportation

Our application works with a network of "facilities". Facilities either act as an order destination (the delivery destination for the items in an order) or an item source (a facility from which the items are taken). Below is a "map" of the facilities (18 of them) that is represented in our application. The available transportation links between facilities are represented by the lines between facilities. The distances between facilities (in miles) are shown on the lines. *Input details for facilities and the transportation network can be found in Facilities.xml file.*



Part of processing an order includes determining the best (i.e., shortest) path between facilities. For example, processing an order with destination "Denver" involves finding the shortest path to one of 3 facilities that have the desired item (assume they are "Chicago", "Miami", and "Norfolk"). While the network has many possible paths between Denver and the 3 listed facilities, the shortest paths would be:

- Chicago, IL to Denver, CO: [Chicago, IL - St. Louis, MO – Denver, CO] = 1,148 mi
- Miami, FL to Denver, CO: [Miami, FL - New Orleans, LA - Austin, TX - Santa Fe, NM - Denver, CO] = 2,456 mi
- Norfolk, VA to Denver, CO: [Norfolk, VA - Nashville, TN - St. Louis, MO - Denver, CO] = 1,866 mi

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Orders

An Order represents a request to have items (products) moved from one or more facilities to a destination facility. An Order consists of the following information:

Order:

- Order Time: An "int" start day number
- Order Id: A String
- Destination: A String (a known destination)
- List of "Order Items":
  - Item ID: A String , Quantity: An int
  - Item ID: A String , Quantity: An int
  - …

*Example input for orders can be found in **Orders.xml** file.*

Schedules

All facilities have limited processing capabilities. The processing refers to packing items and preparing them for shipment. Facilities can process a fixed number of items per day (each facility will have its own processing rate). Once the number of items for a day has been reached at a facility, the next available day must be used to continue processing. The amount of time it will take a facility to process a request is based upon the number of items requested, the facility's items-per-day rate, and the facility's available days.

Order Processing

The Order Processing procedure involves a variety of activities, and is shown below:
Assume an Order has the following 2 Order Items:

1. Item ID: X499E, Quantity 100
2. Item ID: XC670L, Quantity 480

For each of these 2 order items, do the following:

1) Identify all facilities with the desired item.

2) For each identified facility:
   a) Calculate the shortest path (in days) from the facility to the destination.
   b) Determine the days needed to process the items located at the facility.

c) Add the travel time to the previously calculated processing end day to generate the "Arrival Day" of the item for that facility.
d) Save this information as a Facility Record (described later) – a potential solution

3) Sort the records developed in step "2d" above by earliest (lowest) Arrival Day

4) Select the facility with the earliest (lowest) Arrival Day and do the following:
a) Reduce the inventory of the item at that facility by the number of items taken
b) Reduce the quantity of the item that is needed for the order by the amount taken from the selected facility
c) Update the schedule of the selected site (book the days needed to process the items)
d) Save this operation as part of your solution

5) If there is still more quantity of the item needed, go back to step 4 and continue the process. Otherwise proceed with step 6.

6) Compute the total cost of this item.

7) Generate the complete logistics record for this order item

8) If there are more items to process in this order, go back and repeat this process from step 1 with the next order items. Otherwise proceed with step 9.

9) Generate output.

Application Outputs

The output that is generated by our application is dependent upon the orders it processes. For each order, the output summarizes the order and its processing solution. In addition to the order output, our application also includes a summary of the state of all facilities including its current inventory, a list of depleted items (items completely used up), and booking schedule.

Example Order Output

Order #1

- Order Id: TO-001
- Order Time: Day 1
- Destination: Miami, FL
- List of Order Items:

  Item ID: ABC123, Quantity: 180

  Item ID: CR2032, Quantity: 320

Processing Solution:

- Total Cost: $94,355
- 1st Delivery Day: 3
- Last Delivery Day: 16
- Order Items:

Item ID	Quantity	Cost	# Sources Used	First Day	Last Day
ABC123	180	$67,705	4	4	16
CR2032	320	$26,650	1	3	6

Facility Status Output

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Chicago, IL
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Rate per Day: 10
Cost per Day: 300.0

Direct Links:
Detroit, MI (0.7d); Fargo, ND (1.6d); New York City, NY (2.0d); St. Louis,
MO (0.7d);

Active Inventory:
     Item ID    Quantity
     ABC123     60
     CT1928     20
     E241i      64
     RTF110     110
     XTP202     20

Depleted (Used-Up) Inventory: None

Schedule:
   Day: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
   Available: 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
```