

CORE ALGORITHM OVERVIEW

THE PROBLEM:

The Western Governors University Parcel Service (WGUPS) needs to determine the best route and delivery distribution for their Daily Local Deliveries (DLD) because packages are not currently being consistently delivered by their promised deadline. The Salt Lake City DLD route has three trucks, two drivers, and an average of 40 packages to deliver each day; each package has specific criteria and delivery requirements.

The program and algorithm should present a solution where all 40 packages will be delivered on time with the least number of miles added to the combined mileage total of all trucks.

- Each truck can carry a maximum of 16 packages.
- Trucks travel at an average speed of 18 miles per hour.
- Trucks have a “infinite amount of gas” with no need to stop.
- Each driver stays with the same truck as long as that truck is in service.
- Drivers leave the hub at 8:00 a.m., with the truck loaded, and can return to the hub for packages if needed. The day ends when all 40 packages have been delivered.
- Delivery time is instantaneous, i.e., no time passes while at a delivery (that time is factored into the average speed of the trucks).
- There is up to one special note for each package.
- The wrong delivery address for package #9, *Third District Juvenile Court*, will be corrected at 10:20 a.m. The correct address is 410 S State St., Salt Lake City, UT 84111.
- The package ID is unique; there are no collisions.
- No further assumptions exist or are allowed.

THE PROGRAM

The entire program is original code, written by me and me alone and runs properly and delivers all packages on time.

Comments are written at each block of code, and also within the blocks of code where necessary to show the intent and decisions made while developing the program.

Identification including first name, last name, and student ID is included. This will be found in the first line of code in every python file.

The program was written with local scope and is not online, so communication protocol is via commands entered into the interface via the python terminal. Data is loaded locally via CSV files, whereas, in a server application scenario, it would be loaded from a SQL or NoSQL database (or equivalent). Connection is obtained by running the program, and disconnection is obtained by entering '0' to exit the program.

The interface for usage is in the entry file for the python application (App.py). Upon opening, the simulation is automatically simulated, and provides a terminal interface for:

- 0: exit the program – self explanatory
- 1: lookup truck route(s) – displays the truck progress, stop by stop
- 2: lookup package by id – lookup package data by its ID
- 3: lookup packages by time – lookup package at a certain time of the day to view its status

THE HASH TABLE

The hash table is located in PackageTable.py has an insertion function that includes, as input, all of the given components. It takes a hash of the package id modulus the size of the bucket for storage. It includes functions for insert, get, get all, remove, available and several other useful functions I used in the program.

The look-up function includes all of the given data elements, completes searches and returns correct data, and lists the status of all packages. The hash table includes all lookup functionality of Package objects (PackageTable.py, Package.py) Each package object contains its own data and status.

DATA STRUCTURES

The primary data structure used for the package table is lists. More specifically a list of (Package) objects. Data is loaded locally via CSV files into a hash table (PackageTable.py) Lists work very well with indices and play nice with lookups in hash

tables. $O(1)$. I don't see any reason why to use any other data structure than this for the hash table. Lookup, add, delete and other functions are almost always $O(1)$.

The secondary data structure used was a graph and dictionary, primarily used in the algorithm. With edges, I am using a combination of two vertices to file each edge in the dictionary. This is a very simplistic approach to lookup something by multiple criteria, for example: *distance = graph.edges[(vertex, next_vertex)]*

There are several other alternatives that could have been used, and I explored each of them. Sequences, queues and tuples to name a few. In the end, the mutability and reliability of the list won outright, as the ability to hash the package key and store/lookup/delete by id/hash was a primary goal.

THE ALGORITHM

The chosen algorithm for this program was Dijkstra's Shortest path algorithm, and it can perform the task and meets all requirements as outlined in the scenario.

ALGORITHM: STRENGTHS AND WEAKNESSES

Dijkstra will always choose the shortest path. In most cases, this is best for company cost. Less miles = less money spent. The worst-case efficiency is $O(N^2)$, making it more than efficient enough to handle large datasets. Google maps uses a variation of Dijkstra and Hamiltonian path, almost immediately validating it as a contender. In contrast, it is not actually the "most" efficient model, time and resource wise, but performs well enough for the given scenario. Another disadvantage is the negative distance issue. In our case, the data is correct, but that may not always be the case. Dijkstra will produce wonky results with errors in data, such as negative numbers in the distance matrix.

ALGORITHM: OTHER POSSIBILITIES

- > Bellman-Ford algorithm (similar to Dijkstra)
- > A* algorithm (Heuristic graph tree)

The Bellman-Ford algorithm is essentially the same algorithm as Dijkstra, but with errors in data handling (negative edges, for instance). It has a similar to slightly better runtime, but not enough to nominate it a clear winner. Nonetheless, the reduction in error possibilities makes it an intriguing option.

A* is another algorithm possibility. It uses a graph and tree breadth first search and features a heuristic estimate. A* has a better runtime than Dijkstra but is more complex. It may not produce the shortest path but will execute in the best time of the three.

ADAPTABILITY, EFFICIENCY AND MAINTAINABILITY

All functions of the program are designed with scalability and adaptability in mind. The number of packages, locations and distance matrix could be changed outside of the program, including increasing from one to one thousand to ten thousand entries. The data only needs to be valid. Several adaptable features need to be changed “in program”, such as size of truck manifest, weight limits, speed of trucks, etc. (Truck.py) The program is only using two trucks per the instructions, but can easily be changed to more trucks in the Trucks class (TruckTable.py)

This program is efficient and easily maintained. As the maximum complexity for the program is $O(N^2)$, it is gated by the truck capacity in real time scenarios. $O(16^2)$ or less. (Dijkstra.py)

SPACE-TIME AND BIG-O (SUMMARY)

The Dijkstra greedy algorithm has a time complexity of $O(N^2 \log(N))$. The reason for this is that when it starts, the time complexity is $O(N^2)$, but gradually decreases as each package is delivered, it is recalculated. The graph is bi-directional. Space complexity is $O(N^2)$, represented by each vertex having edges to every other vertex in the graph. There are additional space time and big-o comments throughout the comments of the program to further explain each function.

Overhead including memory and computation time remain are linear throughout. Bandwidth is not a factor in the current implementation as the application is run and stored on a local machine and does not require network resources in its current form.

CODE EXECUTION

```
***** WGUPS Command Line *****
0: exit the program
1: lookup truck route(s)
2: lookup package by id
3: lookup packages by time
*****
Enter command [0-3]:
[Truck 1] ->20->21->17->4->5->2->19->12->6->1->0 (32.4 miles)
[Truck 2] ->24->26->22->11->18->15->14->13->7->16->3->23->10->0->9->25->19->8->12->0 (51.1 miles)
```

```
***** WGUPS Simulation *****
Truck 1 completed route in 32.4 miles
Truck 2 completed route in 51.1 miles
Full Package Route completed in 83.5 miles
***** WGUPS Command Line *****
0: exit the program
1: lookup truck route(s)
2: lookup package by id
3: lookup packages by time
*****
Enter command [0-3]:
```

FIRST STATUS CHECK (9:00 AM)

```
*****
Enter command [0-3]:3
Enter Time (hh:mm):9:00
[ID] 1 [ADDRESS] 195 W Oakland Ave Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:37:40, ON TIME
[ID] 2 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 3 [ADDRESS] 233 Canyon Rd Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 4 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 5 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 6 [ADDRESS] 3060 Lester St West Valley City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] DELAYED
[ID] 7 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 8 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 9 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] INCORRECT ADDRESS
[ID] 10 [ADDRESS] 600 E 900 South Salt Lake City UT 84105 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 11 [ADDRESS] 2600 Taylorsville Blvd Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 12 [ADDRESS] 3575 W Valley Central Station bus Loop West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 13 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 10:30:00 [STATUS] EN-ROUTE, TRUCK 1
[ID] 14 [ADDRESS] 4300 S 1300 E Millcreek UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:06:20, ON TIME
[ID] 15 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 09:00:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 16 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 17 [ADDRESS] 3148 S 1100 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 18 [ADDRESS] 1488 4800 S Salt Lake City UT 84123 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 19 [ADDRESS] 177 W Price Ave Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:31:20, ON TIME
[ID] 20 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 21 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 22 [ADDRESS] 6351 South 900 East Murray UT 84121 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 23 [ADDRESS] 5100 South 2700 West Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 24 [ADDRESS] 5025 State St Murray UT 84107 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 25 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELAYED
[ID] 26 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 27 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 1
[ID] 28 [ADDRESS] 2835 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELAYED
[ID] 29 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 30 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 10:30:00 [STATUS] EN-ROUTE, TRUCK 1
[ID] 31 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] AT HUB
[ID] 32 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELAYED
[ID] 33 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 34 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 35 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 1
[ID] 36 [ADDRESS] 2300 Parkway Blvd West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 37 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 10:30:00 [STATUS] EN-ROUTE, TRUCK 1
[ID] 38 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 39 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 1
[ID] 40 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] AT HUB
```

SECOND STATUS CHECK (10:00 AM)

```
Enter command [0-3]:
Enter Time (hh:mm): 10:00
[ID] 1 [ADDRESS] 195 W Oakland Ave Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:37:40, ON TIME
[ID] 2 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 3 [ADDRESS] 233 Canyon Rd Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 4 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:42:20, ON TIME
[ID] 5 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 6 [ADDRESS] 3060 Lester St West Valley City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:54:20, ON TIME
[ID] 7 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 8 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 9 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] INCORRECT ADDRESS
[ID] 10 [ADDRESS] 600 E 900 South Salt Lake City UT 84105 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 11 [ADDRESS] 2600 Taylorsville Blvd Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 2
[ID] 12 [ADDRESS] 3575 W Valley Central Station bus Loop West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 2
[ID] 13 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:18:40, ON TIME
[ID] 14 [ADDRESS] 4300 S 1300 E Millcreek UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:06:20, ON TIME
[ID] 15 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 09:00:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 16 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 17 [ADDRESS] 3148 S 1100 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:50:00, ON TIME
[ID] 18 [ADDRESS] 1488 4800 S Salt Lake City UT 84123 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 2
[ID] 19 [ADDRESS] 177 W Price Ave Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:31:20, ON TIME
[ID] 20 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 21 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 22 [ADDRESS] 6351 South 900 East Murray UT 84121 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:17:20, ON TIME
[ID] 23 [ADDRESS] 5100 South 2700 West Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] EN-ROUTE, TRUCK 2
[ID] 24 [ADDRESS] 5025 State St Murray UT 84107 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:27:40, ON TIME
[ID] 25 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:13:00, ON TIME
[ID] 26 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:13:00, ON TIME
[ID] 27 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:24:00, ON TIME
[ID] 28 [ADDRESS] 2835 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:39:00, ON TIME
[ID] 29 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 30 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:04:40, ON TIME
[ID] 31 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:48:00, ON TIME
[ID] 32 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:48:00, ON TIME
[ID] 33 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 34 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 35 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:24:00, ON TIME
[ID] 36 [ADDRESS] 2300 Parkway Blvd West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:59:40, ON TIME
[ID] 37 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:01:20, ON TIME
[ID] 38 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] AT HUB
[ID] 39 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:18:40, ON TIME
[ID] 40 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:42:20, ON TIME
```

THIRD STATUS CHECK (12:15 PM)

```
Enter command [0-3]:
Enter Time (hh:mm):12:15
[ID] 1 [ADDRESS] 195 W Oakland Ave Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:37:40, ON TIME
[ID] 2 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:08:00, ON TIME
[ID] 3 [ADDRESS] 233 Canyon Rd Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:28:00, ON TIME
[ID] 4 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:42:20, ON TIME
[ID] 5 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:24:40, ON TIME
[ID] 6 [ADDRESS] 3060 Lester St West Valley City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:54:20, ON TIME
[ID] 7 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 8 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:30:00, ON TIME
[ID] 9 [ADDRESS] 380 State St Salt Lake City UT 84103 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:24:40, ON TIME
[ID] 10 [ADDRESS] 600 E 900 South Salt Lake City UT 84105 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:18:40, ON TIME
[ID] 11 [ADDRESS] 2600 Taylorsville Blvd Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 10:37:20, ON TIME
[ID] 12 [ADDRESS] 3575 W Valley Central Station bus Loop West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 10:10:00, ON TIME
[ID] 13 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:18:40, ON TIME
[ID] 14 [ADDRESS] 4300 S 1300 E Millcreek UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:06:20, ON TIME
[ID] 15 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 09:00:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 16 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 17 [ADDRESS] 3148 S 1100 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:50:00, ON TIME
[ID] 18 [ADDRESS] 1488 4800 S Salt Lake City UT 84123 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 10:34:00, ON TIME
[ID] 19 [ADDRESS] 177 W Price Ave Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:31:20, ON TIME
[ID] 20 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 21 [ADDRESS] 3595 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:29:40, ON TIME
[ID] 22 [ADDRESS] 6351 South 900 East Murray UT 84121 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:17:20, ON TIME
[ID] 23 [ADDRESS] 5100 South 2700 West Salt Lake City UT 84118 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 10:36:00, ON TIME
[ID] 24 [ADDRESS] 5025 State St Murray UT 84107 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:27:40, ON TIME
[ID] 25 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:13:00, ON TIME
[ID] 26 [ADDRESS] 5383 South 900 East #104 Salt Lake City UT 84117 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:13:00, ON TIME
[ID] 27 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:24:00, ON TIME
[ID] 28 [ADDRESS] 2835 Main St Salt Lake City UT 84115 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:39:00, ON TIME
[ID] 29 [ADDRESS] 1330 2100 S Salt Lake City UT 84106 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:47:00, ON TIME
[ID] 30 [ADDRESS] 300 State St Salt Lake City UT 84103 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:04:40, ON TIME
[ID] 31 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:48:00, ON TIME
[ID] 32 [ADDRESS] 3365 S 900 W Salt Lake City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:48:00, ON TIME
[ID] 33 [ADDRESS] 2530 S 500 E Salt Lake City UT 84106 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:08:00, ON TIME
[ID] 34 [ADDRESS] 4580 S 2300 E Holladay UT 84117 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 08:13:00, ON TIME
[ID] 35 [ADDRESS] 1060 Dalton Ave S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:24:00, ON TIME
[ID] 36 [ADDRESS] 2380 Parkway Blvd West Valley City UT 84119 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:59:40, ON TIME
[ID] 37 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:01:20, ON TIME
[ID] 38 [ADDRESS] 410 S State St Salt Lake City UT 84111 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 11:24:40, ON TIME
[ID] 39 [ADDRESS] 2010 W 500 S Salt Lake City UT 84104 [DUE] 2020-03-01 23:59:59 [STATUS] DELIVERED, TRUCK 1 @ 2020-03-01 09:18:40, ON TIME
[ID] 40 [ADDRESS] 380 W 2880 S Salt Lake City UT 84115 [DUE] 2020-03-01 10:30:00 [STATUS] DELIVERED, TRUCK 2 @ 2020-03-01 09:42:20, ON TIME
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DIFFERENT APPROACH

One thing I would have done differently is to run the algorithm pre-load and add the ability to be able to handle infinite number of trucks. I would have implemented each algorithm and run them all and evaluated the result data (analytics), and possibly used each for different situations.

SOURCES

The only sources used for this application was ZyBooks course material:
Learn.zybooks.com. (n.d.). zyBooks
<https://learn.zybooks.com/zybook/WGUC950AY20182019/>



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