C950 Task-1 WGUPS Algorithm Overview

(Task-1: The planning phase of the WGUPS Routing Program)

Student Name

ID #009925209

WGU Email: ajo3484@wgu.edu

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C950 Data Structures and Algorithms II

A. Algorithm Identification

For this program, I will be utilizing the greedy algorithm to optimize the delivery route. This will ensure the truck takes the shortest possible route between packages to maximize speed.

B. Data Structure Identification

I will be using a chained hash table to store all the package details.

B1. Explanation of Data Structure

Using a hash table will make the data readily available and easy to search through. Hashing will be based on the package ID. Each package id will go through a hash function to sort it into an array, giving each item a unique index in the array. To avoid collisions, I will utilize basic chaining in the buckets. What that means in this instance is that if two package ids hash to the same index in the array, then the items will be added to a linked list and the linked list will be stored at that index.

C1. Algorithm's Logic

-Create a hash table for the packages with 5 buckets

-Load each truck that has a driver with the max amount of packages the truck can hold

-Create a list with the packages_per_truck to show what packages each truck has

-Create a list with truck_location to show where all the trucks are at

-Check the packages_per_truck to see if the current truck is empty

-If there are still packages, in a for loop

--Find the next nearest location utilizing the greedy algorithm

---Find the distance between the current location and the delivery addresses of the remaining packages then select the shortest distance

--Set the truck to go that location

--Deliver package

--Update the current truck_location

-If the truck runs out of packages, return to the hub to reload

C2. Development Environment

For this project, I will be using Visual Studio Code IDE in conjunction with Python 3.12.7. As for hardware, I will be using my desktop compute running Windows 10.

C3. Space and Time complexity using Big-O notation

-Opening the CSV file and reading it

Time complexity: O(n)

Space complexity: O(n)

-Creating the hash table

Time complexity: O(n)

Space complexity: O(n)

-Loading the truck

Time complexity: O(n^4)

Space complexity: O(n^4)

-Delivering the packages

Time complexity: O(n^2)

Space complexity: O(n^2)

-Overall

Time complexity: O(n^8)

Space complexity: O(n^8)

C4. Scalability and Adaptability

My solution is scalable to adapt to a growing number of packages in the sense that the average run time will be lower than the space-time complexity would suggest. For example, loading the truck is O(n^4), but n is the max number of packages per truck, which is a relatively small number. The biggest scalability issue is the number of trucks/drivers.

C5. Software Efficiency and Maintainability

The software design is efficient and easy to maintain because of the use of classes and abstraction. Trucks and packages will be kept in classes, making it efficient to write new code for. All functions of those trucks will be abstracted into functions, which makes it very easy to understand and therefore maintain.

C6. Self-Adjusting Data Structures

Strengths:

Efficient insertion and search

Collision resolution options readily available

Weaknesses:

Does not maintain order of elements

Fixed size

Dependent on the quality of hash function

C7. Data Key

For the hash function, I will use the package ID as the key because it will ensure that every number run through the hash function is unique, which should ensure an even spread among the buckets.

D. Sources

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