Greedy Dijkstra Assignment: Sample Reflection Solutions

November 2025

Part B: Northfield Subsidies

(i) **What outcome did you get from running Dijkstra with negative edge weights?**

When I added the Northfield subsidy (a negative cost edge), Dijkstra still returned the same route and total cost as in Part A. It did not switch to the route that uses the negative edge, even though that route should have been cheaper overall.

(ii) **What does this imply about Dijkstra's assumptions? Why can't the graph here contain negative weights?**

This shows that Dijkstra assumes all edge weights are nonnegative. Once it removes a node from the priority queue, it assumes that node's distance is final and never looks for a cheaper path later. With negative edges, a later path can reduce the cost of an already "finalized" node, so Dijkstra can miss the true cheapest route. That is why the graph cannot have negative weights if we want Dijkstra to be correct.

Part D: Ethical Modification (Sample Answers)

Below are example reflection answers for each possible rule. A student who chose only one rule would answer only the matching pair of questions.

Option 1: Fatigue Rule

(i) **How did the ethical rule you pick account for people?**

The fatigue rule makes very long or back-to-back long drives more expensive, so the route tries to avoid long stretches without breaks. This centers the driver's health and safety instead of only focusing on money or distance.

(ii) **Can you identify more factors to incorporate?**

We could also limit total driving hours per day, add higher costs for late night driving, or add rest-stop requirements after a certain number of miles. We might also include driver health, past accident history, or time between shifts so the algorithm does not push drivers to work in unsafe ways.

Option 2: Fairness / Rural Subsidy Rule

(i) **How did the ethical rule you pick account for people?**

The fairness rule lowers the effective cost for trips to and from rural cities, so the algorithm is more willing to send routes through places that are usually under-served. This helps people in rural areas get more access to rides, instead of always favoring dense, profitable urban trips.

(ii) **Can you identify more factors to incorporate?**

We could vary the subsidy based on how few rides a city usually gets, or on income levels or disability access in each area. We might also add penalties when one neighborhood is skipped too often, or rewards for serving low-income areas or places with poor public transit.

Option 3: Weather Safety Rule

(i) **How did the ethical rule you pick account for people?**

The weather rule makes routes through stormy, snowy, or rainy cities more expensive, so the algorithm prefers safer roads when possible. This protects both the driver and passengers by not treating all roads as equally safe.

(ii) **Can you identify more factors to incorporate?**

We could also include time of day (night driving in storms might cost even more), real-time road closure data, or driver experience with winter roads. We might add extra cost near schools or hospitals to encourage slower, safer routing there.

Part E: Reflections and Responsibilities

(i) **Identify some potential impact of algorithm design. Are they also optimal or objective?**

Our cost formulas decide which cities get fast, cheap service and which ones are skipped or made more expensive. This can change who can afford rides, where drivers earn money, and which areas stay connected or become isolated. These choices are not fully objective or always "optimal" for everyone, because the weights encode human values and trade-offs, not neutral facts.

(ii) **What should computer scientists do to eliminate such impact?**

Computer scientists should first be honest that algorithms carry values, then test their designs for unfair patterns across different groups and regions. They should talk with affected communities, document their assumptions, try alternative weight choices, and adjust models to reduce harm, even if that means giving up a little efficiency or profit.