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Recitation: 8

Problem 0

Points:

Acknowledgements

(a) I did not work in a group.

(b) I did not consult without anyone my group members.

(c) I did not consult any non-class materials.

Problem 1 **Points:**

DFS variations

(a) **Algorithm:** It is given that the car can only hold enough gas to cover L miles while any stretch of highway (l_e) $e \in E$ may or may not be greater than L. Therefore, initially we can simply remove edges (e) of a greater value. Now, the next step is to see if the city t is still reachable from s. To check that, we will be using Breadth First Search (BFS) algorithm. So if vertex t is reachable, then the path is feasible otherwise, it is not feasable.

Proof: In order to show correctness of the algorithm, we would have to show two things:
(1) If a solution exists, the algorithm will find it
(2) If the algorithm finds a solution, then it's a valid solution

Runtime: Running BFS will take $O(|V|+|E|)$.

(b) Here, we will modify Dijkstra's algorithm to find paths that minimize the maximum weight of any edge on the path (instead of the path length).

Here, we take minimum of max(visited, not visited adjacent).

Algorithm:

```
ModifiedDijkstra(G = (V,E))
    for all u ∈ V do
        dist(u) = ∞
        prev(u) = nil
    end
    dist(s) = 0
    Let H be a priority queue constructed with all nodes in V using dist as the key
    while H is not empty do
        u = deleteMin(H)
        for all edges (u,v) ∈ E do
            if dist(v) > max(dist(u),l(u,v))
                dist(v) = max(dist(u),l(u,v))
                prev(v) = u
                decreaseKey(H,v)
            end
        end
    end
end
```

Runtime: Time complexity is same as Dijkstra's algorithm i.e. $O((|V|+|E|)log|E|)$.

Problem 2

Points:

Shortest bitonic paths

(a)

(b)

Problem 3

Points:

Dijkstra's on negative

(a)

(b)