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I have read and agree to the collaboration policy. Davie Truong

Homework Heavy

CMPS 102 – Spring 2017 – Homework 3

Solution to problem 4

Bellman-Ford

For v in V

v.dist = infinity

v.p = none

source.dist = 0

for i from 1 to V – 1

for (u,v) in E:

relax (u,v)

relax (u,v)

if v.dist > u.dist + weight(u,v)

v.dist = u.dist + weight(u,v)

v.p = u

A)

Description: Bellman-Ford algorithm. It is used to handle the negative edge weights that can occur during sequence of increasing edge weights.

Proof of Correctness:

Runtime is dependent on the order of relax, we can achieve a faster runtime than O(VE) if we carefully choose the order in which we relax the edges. We are guaranteed that for all v , a shortest path from s to v has increasing edge weights. Thus, if we sort all edge weights in increasing order and relax all edges in increasing order of weight, that would give every shortest path.

Time Complexity:

O (V + E Log V). The time to sort the edges by weight is O (E log v). Each pass of relax takes O( E), thus the total time is O (V + E Log V).

Space Complexity:

O () for the adjacency matrix.

B)

Description: Bellman-Ford algorithm. It is used to handle the negative edge weights that can occur during the bitonic sequence.

Proof of Correctness:

Since the runtime is dependent on the order of relax, we can achieve a faster runtime than O(VE) if we carefully choose the order in which we relax the edges. In the bitonic sequence, there can be either monotonically increase and then monotonically decrease. Thus, if we relax all edges one time in increasing order of weight, and then another time in decreasing order of weight, that would give every shortest path in the correct order. If the bitonic sequence was only monotonically increasing, then we can relax all edges one time in increasing order of weight, resulting in the correct shortest path.

Time Complexity:

O (V + E Log V). The time to sort the edges by weight is O (E log v). Each pass of relax takes O( E), thus the total time is O (V + E Log V).

Space Complexity:

O () for the adjacency matrix.