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Homework 4

CS 6515: Introduction to Graduate Algorithms

Approach:

a.) To find if a path between s and t is made up of only white or gold edges within a graph, we first make a copy of the original graph, remove all gold edges, and call it G^{white}. We run G^{white} through the DFS algorithm to check if vertices s and t are connected components, if so, return TRUE. If not, we make another copy of the original graph, remove all white edges, and call it G^{gold}. We then run G^{gold} through the DFS algorithm again. If vertices s and t are connected components, return TRUE, if not, return FALSE as there is no path from s to t made up of only white edges or only gold edges.

b.) To find if a path between s and t where all white edges appear before all gold edges within a graph, we first make a copy of the original graph, remove all gold edges, and call it G^{white}. We then run G^{white} through the DFS algorithm to see which vertices are connected components of s. Next, we make another copy of the original graph, remove all white edges from it, and call it G^{gold}. We then run G^{gold} through the DFS algorithm again, seeing which vertices are connected components of t. We then see if there's a vertex reachable from s only using white edges and reachable from t only using gold edges. Return TRUE if such a vertex exists, or FALSE otherwise.

Correctness:

a.) Running G^{white} and G^{gold} through the DFS algorithm will show if a path between s and t containing only white or gold edges exists if s and t are within the same connected component.

b.) Running G^{white} and G^{gold} through the DFS algorithm will show if there's a vertex reachable from s using only white edges, and from t using only gold edges. This vertex would indicate that a path between s and t with only white edges appearing before gold edges exists.

Runtime:

a.) Copying the original graph takes O(n + m) time. Removing either all white or gold edges takes O(m) time. Finally, running DFS as a black box on either modified graph takes O(n + m) time. Making the overall runtime O(n + m).

b.) Copying the original graph takes O(n + m) time. Removing the white and gold edges takes O(m) time. Running DFS as a black box on either modified graph takes O(n + m) time. Finally, scanning vertices takes O(n) time. Making the overall runtime O(n + m).

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