CSCI3160: Regular Exercise Set 8

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Problem 1. Consider the SCC graph G^{scc} discussed in our lecture. Prove: G^{scc} is a DAG (directed acyclic graph).

Problem 2. Let $G = (V, E)$ be a directed simple graph stored in the adjacency-list format. Define $G^{rev} = (V, E^{rev})$ be the reverse graph of G, namely, $E^{rev} = \{(v, u) \mid (u, v) \in E\}$. Design an algorithm to produce the adjacency list of G^{rev} in $O(|V| + |E|)$ time. You can assume that $V = \{1, 2, ..., n\}$.

Problem 3. Implement the SCC algorithm discussed in our lecture in $O(|V| + |E|)$ time. You can assume that $V = \{1, 2, ..., n\}$.

Problem 4. Let $G = (V, E)$ be a DAG, where each vertex $u \in V$ carries an integer *weight* denoted as w_u. Let $R(u)$ be the set of vertices in G that u can reach (i.e., for each vertex $v \in R(u)$, G has a path from u to v); note that $u \in R(u)$ (i.e., a node can reach itself). Define $W(u) = \min_{u \in R(u)} w_u$. Design an algorithm to compute the $W(u)$ values of all $u \in V$ in $O(|V| + |E|)$ time.
(Hint: dynamic programming).

Problem 5*. Let $G = (V, E)$ be an arbitrary directed simple graph, where each vertex $u \in V$ carries an integer *weight* denoted as w_u. Let $R(u)$ be the set of vertices in G that u can reach; note that $u \in R(u)$. Define $W(u) = \min_{u \in R(u)} w_u$. Design an algorithm to compute the $W(u)$ values of all $u \in V$ in $O(|V| + |E|)$ time.