Homework 2

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CS331 Algorithms and Complexity

Problem Q1(a). What is the number of topological orderings in this directed graph?
Solution: 2^{n+1}

Problem Q1(b). Let T be a tree such that every node in T has either 2 children or 0 children. If T has $n \geq 1$ leaves, prove that the total number of nodes in T is $2n - 1$.

Problem Q2. Let s be the vertex of a connected undirected graph G. Let $T^B_{G,s}$ and $T^D_{G,s}$ respectively be the trees obtained by running BFS and DFS on graph G starting at node s. Prove

$$T^B_{G,s} \equiv T^D_{G,s} \implies G \text{ is acyclic}$$

Problem Q3. Given n images and m unambiguous matches, design an algorithm that runs in $O(m+n)$ time and uniquely labels n images as either A or B, such that two images reported to be the same by ImgComp get the same label, and two images reported to be different by ImgComp get different labels. Prove the algorithm's runtime and correctness.

Problem Q4.