CIS 315, Intermediate Algorithms
Spring 2019

Assignment 1

due April 15, 2019

1. Suppose you are given the adjacency matrix representation M of a directed graph $G = (V, E)$. Note that the size of M is $\Theta(n^2)$. The goal here is to determine if there is a node of G with in-degree $n-1$ and out-degree 0 (that is, all other nodes point to it and it points to no other node). Give an algorithm to do this which runs in $\Theta(n)$ time (so **not** $\Theta(n^2)$). **[5 points]**

2. Suppose you work for a lab which is studying butterflies. It has a sample of n butterflies, $L_1, L_2, \ldots, L_n$. The researchers have made a series of r determinations determining whether two butterflies belong to different species. A determination is of the form (i, j), and it means that L_i and L_j belong to different species. Your job is to give an $O(n + r)$ time algorithm to decide whether the determinations are consistent with the butterflies belonging to just *two* species. (Note: it is possible that they could belong to three or more species, but that is a separate question.) **[5 points]**

3. exercise 22.3-2, from CLRS text **[5 points]**

4. exercise 22.4-1, from CLRS text **[5 points]**

5. exercise 3-16, from DPV text **[5 points]**

Total: 25 points