CS3000: Algorithms & Data — Summer 2023 — Laney Strange

Recitation 4
Due Tuesday June 6 @ 9pm Gradescope

Name: Laney Strange
Collaborators: The Algorithmics

- One recitation problem each week is graded; the rest are there for practice. That problem will be graded on completeness – full credit for making an honest effort. It is also closely linked to the upcoming Long Homework, so be sure you read the feedback from your grader!
- Recitations can be written by hand, or typeset if you prefer.
- Put your name on the first page. If you are using the LaTeX template we provided, then you can make sure it appears by filling in the `yourname` command.
- This recitation is due Tuesday June 6 @ 9pm Gradescope. If you miss the in-person recitation, or need to submit your solution later than the end of your section, please fill out this form: https://forms.gle/CLrhrkVauXYzC7U57
- Collaboration is strongly encouraged during recitation! Please list all your collaborators in your solution for each problem by filling in the `yourcollaborators` command.

Problem 1. *Depth-First Search (graded)*

(a) Draw an example of a directed graph G including vertices s, u, and v such that:

- There is a path from u to v in G, and
- There is a DFS traversal starting from s such that u is discovered before v but v is not a descendant of u in the DFS tree.
- (You can assume that ties are broken in alphabetical or numeric order.)

Solution:

(b) Show the $v.s$ and $v.f$ values of every vertex v when we run Depth-First Search on your graph G starting at vertex s.

Solution:

(c) Can your DFS results be used to topologically-sorted the vertices of your graph? If so, give the topological order. If not, explain why.

Solution:

(d) Classify each edge of your graph as a tree edge, back edge, forward edge, or cross edge.

Solution:

Problem 2. *Graph Properties (not graded; for practice)*

For each question below, justify your answer with an argument (if true) or a counterexample (if false).

(a) TRUE or FALSE? If a directed graph G is strongly connected, then G has a simple cycle that contains all the vertices.

Solution:

(b) TRUE or FALSE? A *forest* is an undirected acyclic graph, which is possibly unconnected. The number of edges in a forest with n vertices and k connected components is $n - k$.

Solution:

(c) TRUE or FALSE? In a connected, undirected graph G, suppose D is the highest d value that results from running BFS on G. It must also be true that any two vertices in G are at distance at most $2D$ from one another.

Solution: