University of Nevada, Las Vegas Computer Science 477/677 Fall 2024

Answers to Assignment 5: Due Friday October 18, 2024

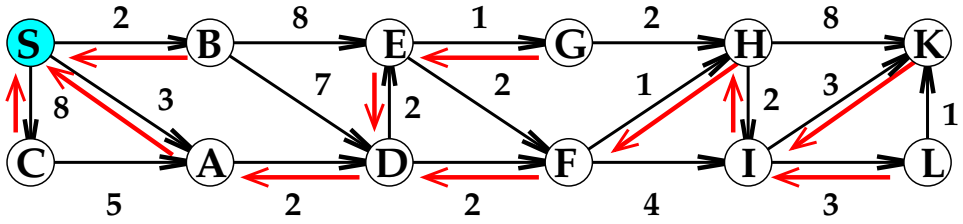
`Wed Oct 9 05:43:24 PM PDT 2024`

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet.
To turn in the homework, follow instructions given by the graduate assistant, Sepideh Farivar. at `farivar@unlv.nevada.edu`.

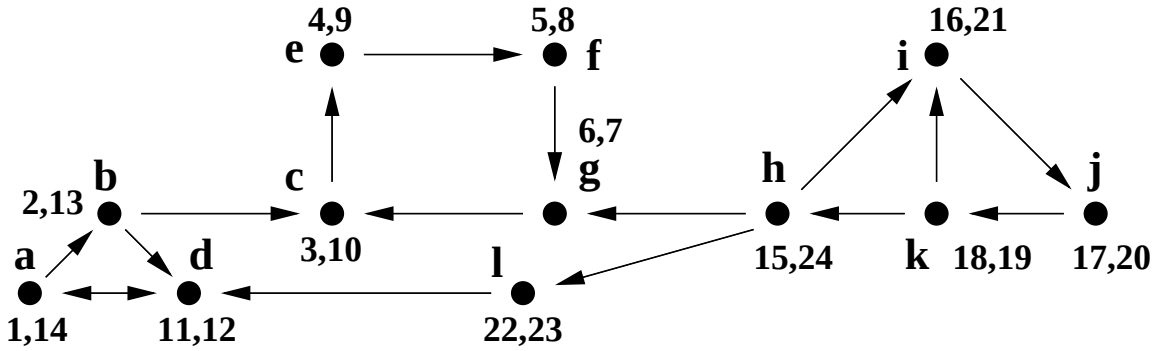
1. Walk through Dijkstra's algorithm for the single source minpath problem for the directed graph illustrated on the next page. Instead of numbering the vertices 0 through 19, I have assigned them letters from A to T. The source vertex is S.

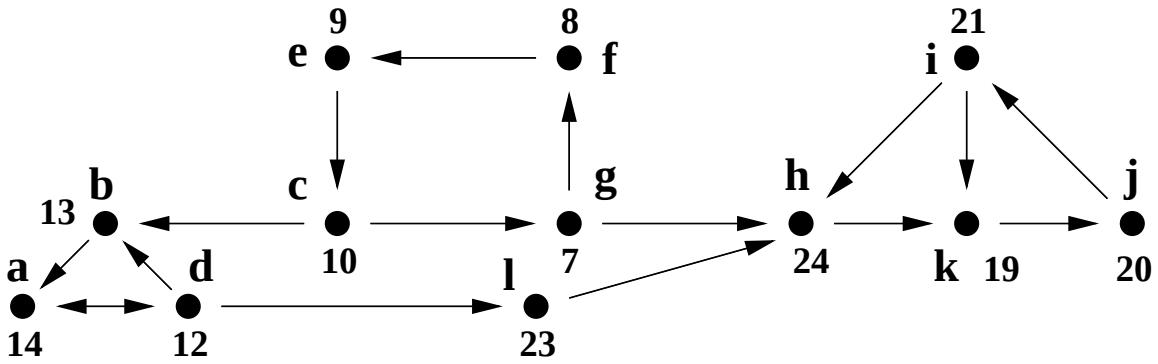
   After each iteration of the main loop, show
   1. The array dist, where dist[x] is the smallest length of any path found so far from S to x. (Initially, dist[x] = ∞ for most x.)
   2. The array back, where back[x] is the next-to-the last vertex on the path of smallest weight found so far from S to x.
   3 The contents of heap. Do not try to show the structure of the heap, simply list its members.

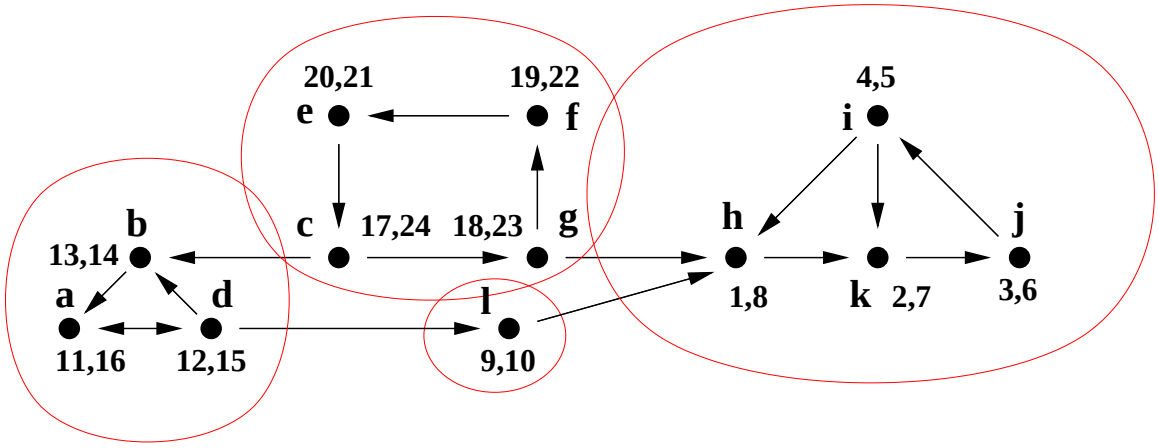


	S	A	B	C	D	E	F	G	H	I	K	L
V	0	3	2	8	~~9~~ 5	~~10~~ 7	7	8	8	~~11~~ 10	~~16~~ 13	13
back		S	S	S	~~B~~ A	~~B~~ D	D	E	F	~~F~~ H	~~H~~ I	I

2. Find the strong components of the directed graph G below. Show your work. The next figure shows ine inverse graph of G, which you will need in your calculations.







3. The following problem is on the website:

   https://www.cs.princeton.edu/courses/archive/fall02/cos226/exercises/maxflow.html

   A bunch of Princeton students are each in need of a unit of blood, and the clinic has more than enough blood, but perhaps not the correct types.

   We will go over maxflow/mincut in class, enabling you to work this problem and others like it. However, for this problem, you might still be able to find a proof that the students cannot all get their transfusions.

One way to do this problem is to work through all the steps. But if you can find it, there is a simpler proof that the students cannot all be treated.

Let $\mathcal{S}$ be the set of students whose type is either B or O. $|\mathcal{S}| = 80$, and none of them is allowed to receive blood of type A or AB. There are only 79 units of that that are neither A nor AB, and thus some member of $\mathcal{S}$ will not be treated.