You will submit your solution to this assignment to the Curator System (as `HW04`). Your solution must be either a plain text file (e.g., NotePad++) or a <u>typed</u> MS Word document; submissions in other formats will not be graded.

Credit will only be given if you show relevant work.

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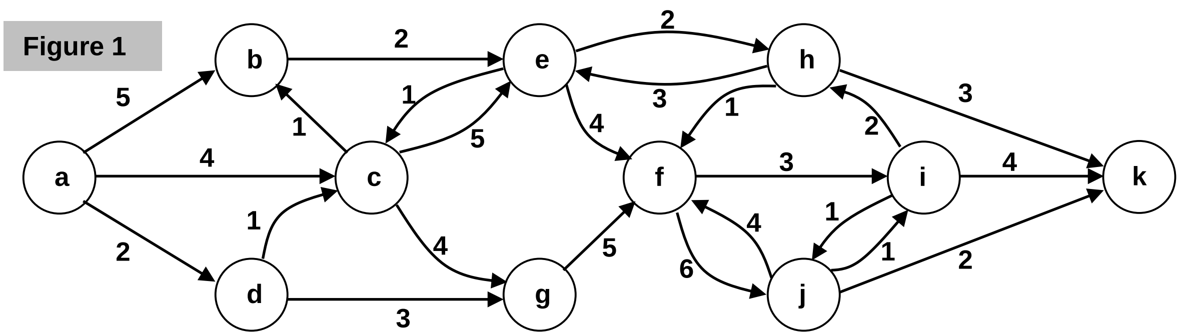
1. [30 points] Apply Dijkstra's SSAD algorithm to find the shortest distance from vertex a to every other vertex in the graph shown in Figure 1 below. For uniformity, when choosing which node to visit next, take them in increasing alphabetic order. You must show supporting work in the form of a table; see the course website for an acceptable format. You do not need to list the paths in your answer, just the minimum distances.

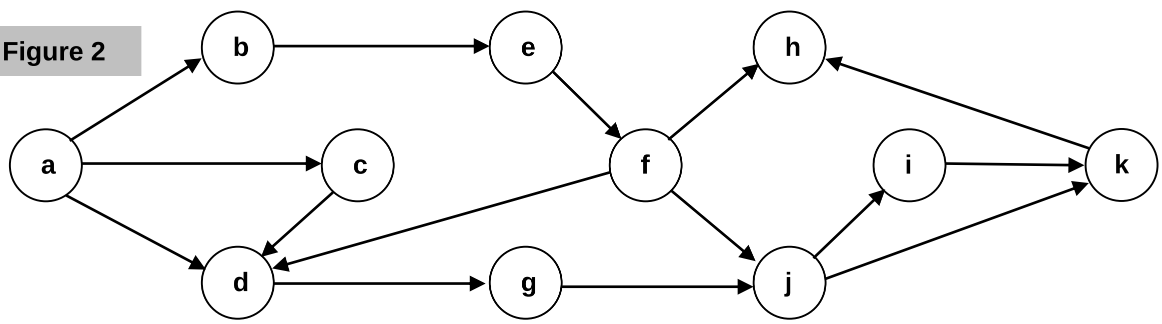
Note: the example in the course notes shows an undirected graph, but the algorithm applies to directed graphs as well, and in the obvious manner.

Figure 1



2. [30 points] Using a depth-first traversal, find a topological ordering of the nodes in the graph shown in Figure 2 below. For uniformity, when choosing which node to visit next, take them in increasing alphabetic order. You must show supporting work; see the course website for an acceptable format.

Figure 2



3. Suppose you are given a collection *S* of $N = 2^{10}$ different, positive integers (which could cover a very large range of values). Explain whether each of the following search problems could be solved more efficiently if the elements in *S* were sorted in ascending order, describing (in words, not code) the most efficient algorithm for solving the problem. Do not consider the cost of sorting the values in *S* as part of the analysis.

a) **[10 points]** Determine whether there is some integer *Z* such that *Z* and $Z + 1$ are both in *S*.

b) **[10 points]** Given a specific integer *X*, which may or may not be in *S*, determine whether there is an integer *Z* in *S* such that *Z* is a multiple of *X*.

c) **[10 points]** Given a specific integer *X*, which may or may not be in *S*, determine whether there are two values in *S* whose sum is *X*.

d) **[10 points]** Given a specific integer *X*, which may or may not be in *S*, determine whether there is an integer *Z* in *S* such that *X* equals $(Z / 10^K) \% 10^M$, for some nonnegative integers *K* and *M*.

Note: what this is saying is that the digits of *Z* contain the digits of *X* as a consecutive subsequence, like $X = 421$ and $Z = 973\underline{421}64$.