Questions and Exercises to work out and turn in:

Grading Guidelines:

* A right answer will get full credit when:

1. It is right (worth 25%)
2. It is right **AND** neatly presented making it easy and pleasant to read. (worth an **extra** 15%)
3. There is an **obvious and clear link** between 1) the information provided in the exercise and in class and 2) the final answer. A clear link is built by properly writing, justifying, and documenting an answer (worth an **extra** 60%).
4. Calculation mistakes will be minimally penalized (2 to 5% of full credit) while errors on units will be more heavily penalized.

You are welcome/encouraged to discuss exercises with other students or the instructor. But, ultimately, **personal** writing is expected.

* USE THIS FILE AS THE STARTING DOCUMENT YOU WILL TURN IN. **DO NOT DELETE ANYTHING FROM THIS FILE:** JUST **INSERT** EACH ANSWER **RIGHT AFTER ITS QUESTION/PROMPT**.
* IF USING HAND WRITING (STRONGLY DISCOURAGED), **USE THIS FILE** BY CREATING SUFFICIENT SPACE AND WRITE IN YOUR ANSWERS.

FAILING TO FOLLOW TURN IN DIRECTIONS /GUIDELINES WILL COST **A 30% PENALTY.**

Objectives of this assignment:

* to use and manipulate the concepts presented in this module
* to propose and write algorithms in pseudocode
* to analyze the time complexity of algorithms
* to analyze the space complexity of algorithms
* to learn autonomously new concepts

What you need to do:

Answer the questions and/or solve the exercises described below.

Exercise 1 (50 points)

Run the Bellman-Ford algorithm on the directed graph of Figure 1.1, using vertex as the source. In **each pass**, relax edges in the order provided on Figure 1.2, and using the **style/format** of Figure 24.4 (Textbook). A pass is the execution of the *For Loop* Lines 3-4 (Bellman-Ford algorithm). Show the ***d*** and values after **each pass** (over all edges on Figure 1.2)

It is ok to draw by hand the graphs, take picture(s), and insert as long as it is neat (neatness is worth 15%). A pass means that you relax through the list of all edges on Figure 1.2.

Justify in detail the first **two** passes **only** (recall the direct link....**60%**). You must show your results after each pass, but you justify in detail only for the first two passes.

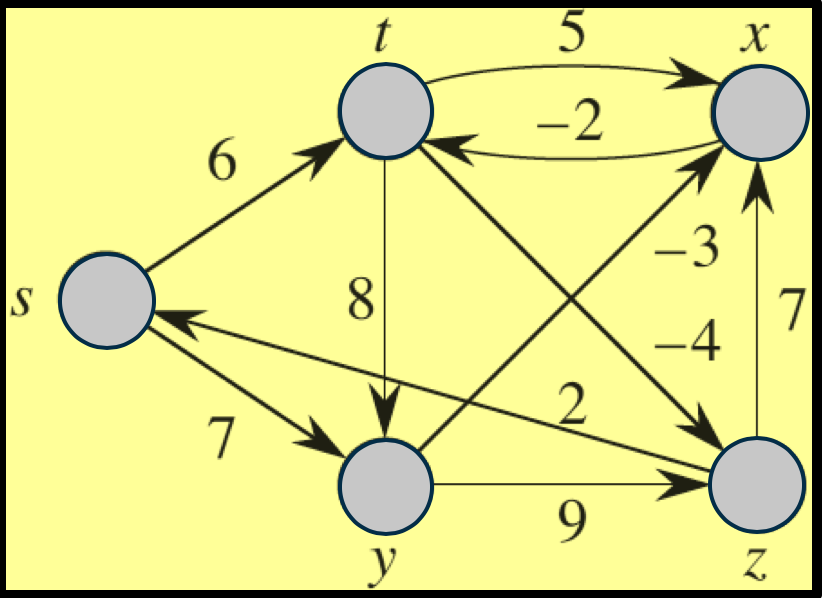


Figure 1.1 Graph

**(t, y), (s, t), (z, s), (y, x), (s, y), (z, x), (t, x), (t, z), (x, t), (y, z)**

Figure 1.2 Edges Order

I used draw.io to make my graphs. To start I am just showing my remade graph within this program.

A graph with circles and lines

Description automatically generated

A group of white circles on a black background

Description automatically generated

The source vertex for this is z. The distance for the source to itself will be set to 0, which can be seen in the initialization. All other distances are set to infinity at this time because they do not have they parent set from NIL.

A diagram of a network

Description automatically generated

There are 2 out going edges from z. The edge (z, s) with a weight of 2 and then (z, x) with a weight of 7. The vertex z will be set as the parent of both y and x. Their updated distance is then saved inside the circle of each vertex.

A diagram of a diagram

Description automatically generated with medium confidence

This is after the second pass. (s, y) has been added with the distance currently at 9 for the vertex y. Its parent is set to s after this step. Also (x, t) is highlighted and added. This edge carries a weight of -2 and this sets the vertex t distance to 5 with the weight of x set at 7 currently. The edge set of (z, s) and then to (s, t) is 8, which is not faster than the current distance set. The parent of t is then set to x.

A diagram of a network

Description automatically generated

**Exercise 2 (50 points)** (**Note**: This exercise uses a different graph than Exercise 1)

Run Dijkstra’s algorithm on the directed graph G = (V, E) of Figure 2.1 using vertex as the source (using a different source will result in no credit awarded). **In the style of Figure 24.6 (Textbook)**, show the and values and the vertices in set S **after each iteration** of the while loop. We expect the vertices to be highlighted the same way as on Figure 24.6.

It is ok to draw by hand the graphs, take picture(s), and insert as long as it is neat (neatness is worth 15%).

**Justify in detail** the first **two** passes **only** (recall the direct link....60%). You must show your results after each pass, but you justify in detail only for the first two passes.

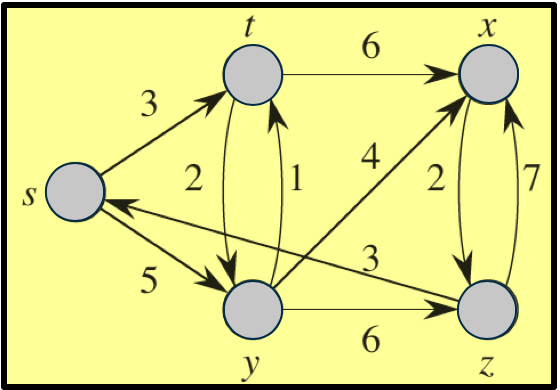


Figure 2 Graph G

Here again simply is the graph recreated in draw.io to start. This should still match the graph above. A graph with circles and lines

Description automatically generated

The first step is the initialization which has y set as the source. All of the other vertexs will be set to infinite again during this step because the parent is currently NIL for each vertex other than the source. The source vertex y has a distance of 0 to itself.

A diagram of a complex network

Description automatically generated with medium confidence

A diagram of a graph

Description automatically generated

At this pass the source vertex y is added to the set S = {y}. The distance from each outgoing edge from the source y is set to its weight as its distance. Then the parent of each t, x, and z are set to y.

A diagram of a graph

Description automatically generated with medium confidence

After this step the set S = {y, t} and the next to be processed will be x. The edge going from t back to the source can not be less than the 0 already set. Also with that in mind the edge (t, x) has a weight of 6, so the path from y to x is already the shortest path at 4 distance. This will remain unchanged through this pass.

A screenshot of a computer game

Description automatically generated

A diagram of a diagram

Description automatically generated with medium confidence

A yellow arrows pointing to different directions

Description automatically generated

What you need to turn in:

* Electronic copy of this file (including your answers) (standalone). Submit the file as a Microsoft Word or PDF file.
* Recall that answers must be well written, documented, justified, and presented to get full credit.
* How this assignment will be graded:
* A right answer will get full credit when:
* It is right (worth 25%)
* It is right AND neatly presented making it easy and pleasant to read. (worth 15%)
* There is an obvious and clear link between 1) the information provided in the exercise and in class and 2) the final answer. A clear link is built by properly writing, justifying, and documenting an answer (worth 60%).
* Calculation mistakes will be minimally penalized (2 to 5% of full credit) while errors on units will be more heavily penalized.
* You are welcome/encouraged to discuss exercises with other students or the instructor. But, ultimately, personal writing is expected.

See appendix below for details about grading.

**Appendix**: Grading: What is an OBVIOUS and CLEAR LINK?

Here is an example to explain what an **obvious and clear link** is and how we grade your work.

Consider the following problem:

"(100 points) John travels from Auburn to Atlanta in his car at a speed of 60 mph. Leaving at 8am, at what time will John reach Atlanta".

Here are the answers of three students and their scores:

* **Student 1** answers: "9:48am". Student 1 will get 25 points.
* **Student 2**answers : "John will reach Atlanta at 9:48am". Student 2 will get 25+15 = 40 points
* **Student 3** answers: "The time t to travel a distance d at speed v is equal to d/v = d/60mph. The problem does not provide the distance d from Auburn to Atlanta. Based on GoogleMaps, the distance from Auburn to Atlanta is approximately 108 miles (**document is attached**).



Therefore, the time t = 108 miles/60mph \* 60 minutes/hour= 108 minutes. Since John left at 8am, he will then reach Atlanta at 8am + 108 minutes = 8 am + 60 minutes + 48 minutes = 9:48".

**Student 3** will get 25 + 15 + 60 = 100 points

Do you see the **direct** **link** going from the data provided in the question to the final answer, using general knowledge/formula and documents?.... Can you now solve the following problem and get 100 points?

"(100 points) Alice travels from Auburn to Atlanta in her car at a speed of 60 mph. Leaving at 8am, at what time will Alice reach Atlanta assuming that she had a flat tire that delayed her 30 minutes".