

# Practical Task 9.1

(Pass Task)

Submission deadline: 10:00am Monday, September 23

Discussion deadline: 10:00am Saturday, September 28

## General Instructions

In this task, answer all the following questions and complement each answer with a detailed explanation.

1. Consider the directed graph  $G = \langle V, E \rangle$  represented by the following cost adjacency matrix:

$$A = \begin{bmatrix} \cdot & 3 & \cdot & \cdot & \cdot & 10 & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & 5 & 11 & \cdot & 7 & 1 & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & 2 & \cdot & \cdot & \cdot \\ 6 & \cdot & \cdot & \cdot & \cdot & \cdot & 1 & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 & \cdot & 0 & 3 \\ \cdot & \cdot & \cdot & 3 & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & 2 & \cdot & \cdot & \cdot \\ \cdot & \cdot & 10 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & 5 & \cdot & \cdot & \cdot \end{bmatrix}$$

Assume that element  $a_{ij}$  positioned in row  $i$  and column  $j$  in matrix A stores the distance between node  $i$  and node  $j$  in graph  $G$ . Draw the graph and solve the single-source-shortest path problem by running Dijkstra's algorithm on  $G$ , starting at node 1. What is the order in which nodes get removed from the associated priority queue? What is the resulting shortest-path tree?

2. Let  $P$  be a shortest path from some vertex  $s$  to some other vertex  $t$  in a graph. If the weight of each edge in the graph is increased by one, then will  $P$  be still a shortest path from  $s$  to  $t$ ? Explain your answer.
3. Consider the directed graph  $G = \langle V, E \rangle$  represented by the following cost adjacency matrix:

$$A = \begin{bmatrix} \cdot & 3 & \cdot \\ \cdot & \cdot & 4 & \cdot & 4 & \cdot & \cdot & \cdot & \cdot \\ 2 & \cdot & \cdot & 5 & \cdot & \cdot & \cdot & \cdot & 7 \\ \cdot & 10 & \cdot & \cdot & 6 & \cdot & \cdot & 1 & 1 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & 7 & 8 & \cdot \\ \cdot & \cdot & \cdot & \cdot & 5 & \cdot & \cdot & 6 & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & -4 & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & 2 & \cdot & \cdot \\ 0 & \cdot \end{bmatrix}$$

Assume that element  $a_{ij}$  positioned in row  $i$  and column  $j$  in matrix A stores the distance between node  $i$  and node  $j$  in graph  $G$ . Draw the graph and solve the single-source-shortest path problem by running Bellman-Ford's algorithm on  $G$ , starting at vertex 1. What is the resulting shortest-path tree? Which nodes are get 'infected'?

## Further Notes

- The lecture notes of week 9 should be a good starting point outlining the required shortest path algorithms.
- Reading chapter 14.6 of the course book "Data Structures and Algorithms in Java" by Michael T. Goodrich, Irvine Roberto Tamassia, and Michael H. Goldwasser (2014) will help you with completion of this task. You may access the book on-line for free from the reading list application in CloudDeakin available in

Resources → Additional Course Resources → Resources on Algorithms and Data Structures → Course Book: Data structures and algorithms in Java.

## Marking Process and Discussion

To get this task completed, you must finish the following steps strictly on time:

- Submit your answers to the task via OnTrack submission system. You may submit a hand-written and then scanned document, but ensure that the text and figures are very clear to read. Note that this is a theoretical task, thus **we do not expect you to write any program code**.
- Meet with your marking tutor to explain your solutions. When the solutions are hand-written, do not forget to bring them with you. Cloud students must record a short video explaining their work and use a sort of white-board, e.g. a graphical editor, or a scanned document with the answers.
- Answer all additional (theoretical) questions that your tutor may ask you. Questions are likely to cover lecture notes, so attending (or watching) lectures should help you with this compulsory interview part. Please, come prepared so that the class time is used efficiently and fairly for all the students in it. You should start your interview as soon as possible as if your answers are wrong, you may have to pass another interview, still before the deadline. Use available attempts properly.

Note that we will not check your solution after the submission deadline and will not discuss it after the discussion deadline. If you fail one of the deadlines, you fail the task and this reduces the chance to pass the unit. Unless extended for all students, the deadlines are strict to guarantee smooth and on-time work through the unit.

Remember that this is your responsibility to keep track of your progress in the unit that includes checking which tasks have been marked as completed in the OnTrack system by your marking tutor, and which are still to be finalised. When marking you at the end of the unit, we will solely rely on the records of the OnTrack system and feedback provided by your tutor about your overall progress and quality of your solutions.