SIM Global Education

UNIVERSITY OF WOLLONGONG AUSTRALIA

Assignment 3 (15% of total marks)

Due date: 1 March 2024, Friday at 90:00 pm Singapore time

Scope:

The tasks in this exercise consist of activities in the areas of **Data Structures and Algorithms, in particular, algorithm design strategies – Greedy Algorithm, Branch and Bound, backtracking and Divide and Conquer**. The exercises cover the topics discussed in topics 5, 6, and 7.

Marks:

Total mark: 100
Weightage: 15% of total subject mark

Assessment criteria:

Marks will be awarded for:

- Correct,
- Comprehensive, and
- Appropriate

application of the materials covered in this subject.

Assignment Specification:

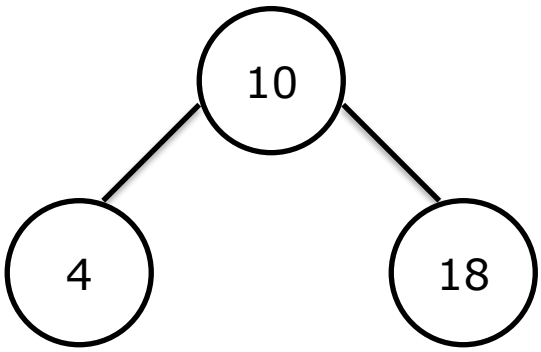
Question 1 (20.0 marks)

Consider a hash table of size 11 with hash function *h(x) = x mod 11*. Draw the table that results after inserting, in the given order, the following values: 33, 13, 32, 8, 55, 37, 43, 74, 103 for each of the three scenarios below:

a) When collisions are handled by separate chaining; **(5.0 marks)**
b) When collisions are handled by linear probing; **(5.0 marks)**
c) When collisions are handled by double hashing using a second hash function $h'(x) = (x \ mod \ 5) + 1$. Hint, the overall (combined) hash function is $H(x) = (\ h(x) + i \times h'(x)\ ) \ mod \ 11$, where *i* = 0, 1, 2, 3, … **(5.0 marks)**
d) When collisions are handled by quadratic probing with a quadratic probe function $h'(x, i) = (h(x) + 0.5\ i + 0.5\ i^2) \ mod \ 11$ where $i = 1, 2, 3, \ldots$. **(5.0 marks)**

Question 2 (20.0 marks)

a. A partially constructed AVL tree is shown below. Insert elements into the tree with the following keys, in that order, into the partially constructed AVL tree **showing each step and any rotations performed**: 7, 8, 3, 9. **(5.0 marks)**



b. Given the following list of numbers in an array:

65, 57, 85, 48, 47, 61, 75, 5, 25, 85, 20, 42

Make the array into a maximum heap. You need to show the required swapping in the process.

(15.0 marks)

Question 3 (15.0 marks)

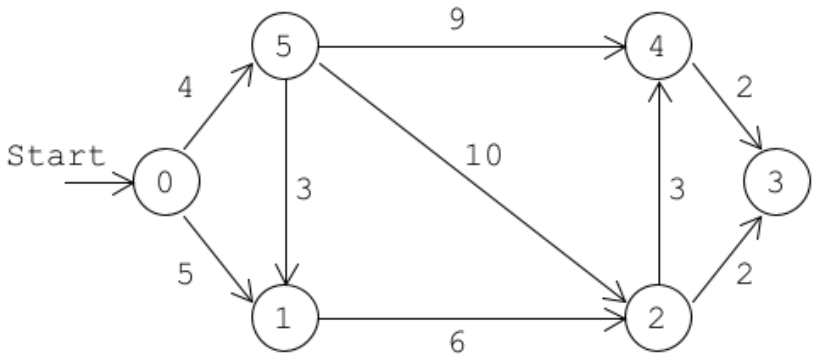
Show the steps that a quicksort with middle-of-three (mean) pivot selection takes when sorting the array in ascending order. **(15.0 marks)**

27	59	50	38	13	91	85	34

Question 4 (15.0 marks)

Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from 0 to all network nodes.

(i) Show how the algorithm works by computing a table (adjacency matrix), like the one discussed in class. **(10.0 marks)**
(ii) Show all the paths from 0 to all other network nodes. **(5.0 marks)**



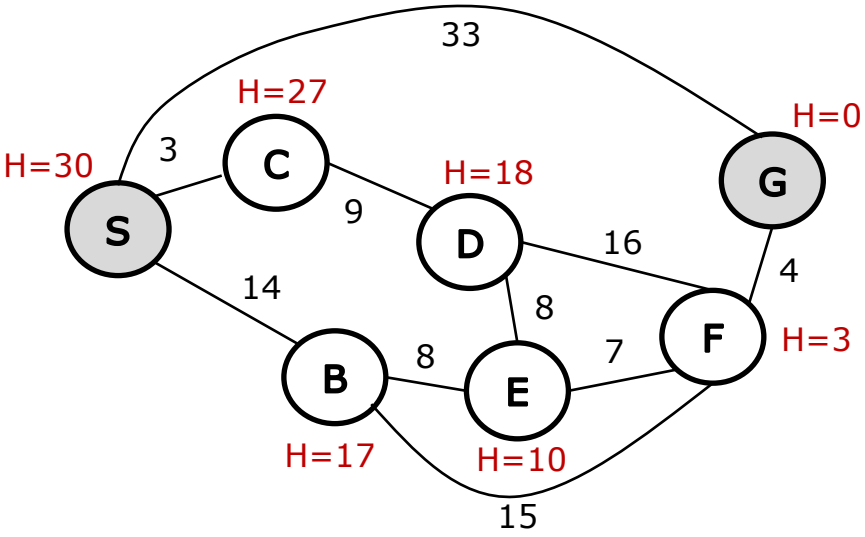
Question 5 (30.0 marks)

Consider the following search problem, represented as a graph. Each node is label by a capital letter and the value of a heuristic function is shown in maroon. Each edge is labelled by the cost to traverse that edge. The start state is 'S' and the only goal state is 'G'. Perform the A* search to find the shortest path from node S to node G.

i. Is the heuristics specified in the problem (shown below) admissible? Justify your answer. If the heuristics is admissible, proceed to answer part (ii). If the heuristics is not admissible, correct it with a sensible value of your choice and proceed to answer part (ii). **(10.0 marks)**

ii. Perform the A* search to find the shortest path from the start state (S) to the goal state (G).

(20.0 marks)



Numbers in maroon are the heuristics for the respective nodes.
Numbers in black are the weight (estimated costs.)

Submissions

This assignment is due by 1 March 2024, Friday at 9:00 pm Singapore time.

- Type or handwritten your answer for each question in a MS Word or equivalent document format and save it in a pdf formatted file, name your file as PUID-A3-Sol.pdf where PUID is your Partner University Identification Number (That is, UOW student number).
- All assignments that do not satisfy the submission requirements listed above will not be evaluated and will be returned to the students with 0 marks.

Submit the files **PUID-A3-Sol.pdf** through Moodle in the following way:

1) Access Moodle at **http://moodle.uowplatform.edu.au/**
2) To login use a Login link located in the right upper corner the Web page or in the middle of the bottom of the Web page
3) When successfully logged in, select a site **CSCI203 (SP421) Algorithms and Data Structures**
4) Scroll down to a section Submissions of Assignments
5) Click at Submit your Assignment 3 here link.
6) Click at a button Add Submission
7) Move a file, for example, **PUID-A3-Sol.pdf** into an area. You can drag and drop files here to add them. You can also use a link *Add…*
8) Click at a button Save changes,
9) Click at a button Submit assignment,
10) Click at the checkbox with a text attached: By checking this box, I confirm that this submission is my own work, … in order to confirm authorship of your submission,
11) Click at a button Continue.

A policy regarding late submissions is included in the subject outline.

Only one submission per student is accepted.

Assignment 3 is an individual assignment, and it is expected that all its tasks will be solved individually without any cooperation with the other students. Plagiarism is treated seriously. Students involved will likely receive zero. If you have any doubts, questions, etc. please consult your lecturer or tutor during lab classes or over e-mail.

********** End of Assignment Specification **********