	<p style="text-align: center;">Swinburne University of Technology Faculty of Science, Engineering and Technology</p> <p style="text-align: center;">COS10023 Computer Logic and Essentials</p> <p style="text-align: center;">Assignment part 3, Semester 1 2023 Group assignment</p>
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Important dates

Published on	17 th April 2023
Submission Due	21 st May 2023

This is a group Assignment. Carefully read the instructions and the section on plagiarism in the Unit Outline before you proceed (including the section forbidding sharing your work with others).

Submission

Each individual student should submit their assignment via Canvas before the deadline. You can submit several times before the deadline; each new submission will overwrite your previous submission.

Please review the declaration at <https://www.swinburne.edu.au/current-students/manage-course/exams-results-assessment/submit-work/assessment-declaration/>.

Electronic submission of your assignment implies that you agree with this declaration. Please put your name and student ID on the first page.

Group formation

- Students need to join a group using the ‘*people*’ tab in Canvas, or your tutor will assign you to a group (3 to 4 students).
- The group work is supervised by your tutor in your tutorial; hence, you need to be in the same tutorial for this to happen
- A group assignment is the collective responsibility of the entire group, and if one member is temporarily unable to contribute, the group should be able to reallocate responsibilities to keep to schedule. In the event of longer-term illness or other serious problems involving a member of group, it is the responsibility of the other members to notify immediately the Unit Convenor or relevant tutor.

- All group members must be satisfied that the work has been correctly submitted although only one member on behalf of his/her group requires to submit their assignment.
- Any penalties for late submission will generally apply to all group members, not just the person who submitted.

Quality

You can use word processing software to create your submission. Alternatively you can also write on printed paper copy and scan your document as a PDF. You can also submit images of the handwritten responses, however, please make sure those are readable.

Before submitting, please check that your submission contains all your images, working, and text. After submitting, please check that the submitted document is as you expected.

Plagiarism

Please ensure that the work submitted by you/your team is your original work. If this is not the case, then further investigation will take place and a penalty or sanction may be applied. Note this includes:

- sharing your original work with other students either on purpose or by accident – under no circumstances should you show or give your assignment to another student, nor should you ask to see another student's assignment
- soliciting answers from online forums and tutoring sites
- copying answers publicly posted online.

Exceptions

If you have any exceptional circumstances that deter you to submit the assignment by the due date and time, please contact the convenor as soon as is practicable and at latest last Friday *prior to the due date*. Note evidence of circumstances will be required.

Students with EAPs

If you want extension, you are required to make a request for an extension *on or before the Friday before the due date* by emailing the convenor and nominating your ideal due date.

Marking scheme

Marks will be awarded in accordance with the scheme allocated for each sub-part of the problems as indicated in the assignment. Partial marks will be awarded to the extent that the component parts of the question have been correctly answered. Please note that if a problem requires the answer to be justified, no marks will be awarded for simply giving the correct answer.

Stars

The stars suggest the difficulty of the problem:

*Should be straightforward based on lecture and tutorial material.

** Should be more challenging but still based on lecture and tutorial material.

***Might require some further thought or extra research beyond lecture and tutorial material.

Questions

Important

For all parts of the questions, working is required, including combinatoric/factorial notation as needed as well as final answers. An answer consisting of solely an integer will be awarded 0 marks.

Section: Counting (12 marks)

1. *[1 mark] A group of seven students (Harry, Rosa, Ahmad, David and Nancy) has decided to talk with the Computer Science Department chairperson about having the Department offer more courses in object-oriented programming. The chairperson has said that she will speak with three of the students. In how many ways can these seven students choose three of their group to talk with the chairperson?
2. **[3 marks] There is a group of 15 students who are official uni greeters. Ten of them are wearing red shirt and five are wearing black shirts.; they cannot swap shirts. Using combinatoric or factorial notation, answer the following.
 - i. How many ways we can select four students if 2 students are wearing red shirts and 2 of them are wearing black shirts?
 - ii. How many ways we can select four students if no more than 3 are wearing black shirts?
 - iii. If four of the 15 students are waiting in a queue to collect a free meal from a food truck, how many ways could the queue be formed?
3. **[1+1+1= 3 marks] After a year/two of not doing much, everyone has decided to get active. For all parts of this question, working is required, including combinatoric/factorial notation as needed as well as Final answers. An answer consisting of solely an integer will be awarded 0 marks.

During a given day, there are many activities that could be done, such as:

 - go shopping
 - get an immunisation
 - visit a gym
 - go to a tutorial
 - join a virtual student event.

Assume that each activity is undertaken at most once a day (i.e., so once you have visited the gym you don't visit it again). The amount of time spent on each activity is also unimportant, however, for example, shopping before a tutorial and a tutorial before shopping should be considered different. We are interested in working out the different ways people spend their day.

- i. How many different activity patterns can be formed from those five activities?
 - ii. How many patterns contain only three activities (e.g., shop - immunisation - gym)?
 - iii. How many patterns with at least four different activities start with going shopping?
4. ** [1 + 1 = 2 marks] You are going to prepare your pizza at home, and you have six ingredients in your fridge that need to be used up.
- i. How many ways could these be combined? Explain in a sentence how you calculated your answer.
 - ii. How many ways could you use three ingredients only?
5. [1+1+1= 3 marks] You find 18 coloured pencils in your desk drawer, all different colours. You would like to put them in groups for you and 2 friends to use for your next mindfulness colouring session.
- i. How many different ways can the pencils be organised and split evenly amongst you and your friends?
 - ii. Show a second approach to your answer to i.
 - iii. On further inspection, you realise 10 pencils are broken and are beyond saving. How many ways can you split the remaining pencils amongst the 3 of you if you get 2 pencils and your friends get 3 each?

Section: Algorithm (12 marks)

6. [10 marks] You have been given a file with two columns: a name and an integer (whole number) representing how many minutes a student spent playing a particular game in last 25 hours. The file will look something like:

John 10
Gary 52
Sarah 150
Cara 236
...

It is not known at the outset how many rows are in the file, however the file will be terminated by EOF (end of file).

- i. [4 marks] * Draw a flowchart (following the conventions used in class) that reads the file and then calculates and prints the number of students who spent at least 60 minutes playing the game.
- ii. ** [2 marks] What is the likely complexity of your program using big-O notation? Clearly point out what the primary parameters are and define your terms.

- iii. *[4 marks] Rewrite your algorithm using pseudocode. There is one change to be made: this time you should calculate the average time spent in the game instead.
7. [2 marks] Your colleague is working on two algorithms, X and Y, that determines whether two people are a certain distance apart. They use a few different inputs, n . They are seeking your advice.
 - i. *If they tell you that algorithm X has a worst-case runtime complexity of $O(n)$ and algorithm Y has a worst-case runtime complexity of $O(n^2)$, which algorithm would you recommend and why?
 - ii. ** Your colleague then adds that the average-case time complexity for X is $\Theta(n \log n)$ and for Y is $\Theta(n)$. Does this change your advice at all, and why?

Your answers should be no longer than a sentence or two.

Section: Graphs and Trees (12 marks)

8. [2 marks] ** Given the graph as shown below (Figure 1), use Dijkstra's algorithm to determine the cost of the shortest path from **a** to **h** and enumerate the shortest path.

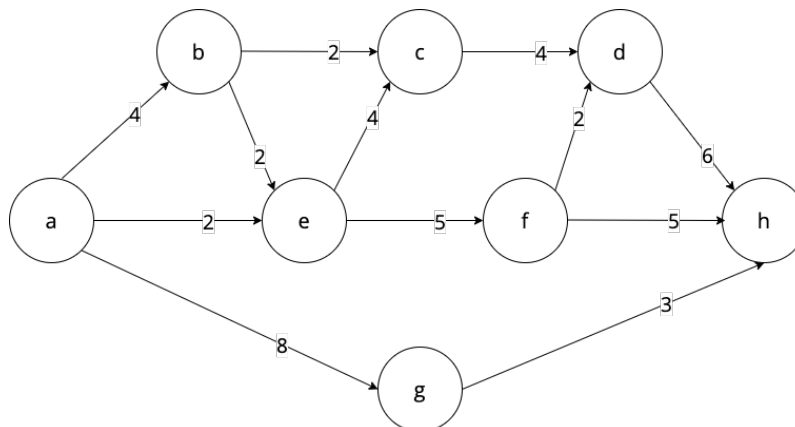


Figure 1: Dijkstra's algorithm (question 8)

9. [2 marks] *If you traverse the following tree in pre-order, in-order and post order what will be the sequence of vertices visited?

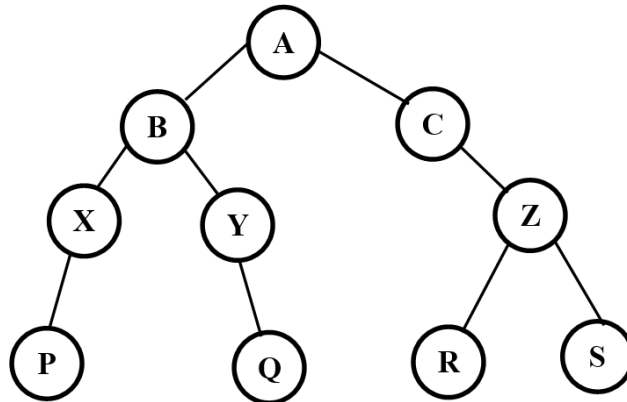


Figure 2: Tree traversal (question 9)

10. [5 marks] Using the following graph representation $(G(V, E, w))$:

$V = \{1, 2, 3, 4, 5, 6, 7\}$

$E = \{\{1, 3\}, \{1, 5\}, \{1, 7\}, \{2, 3\}, \{2, 4\}, \{2, 6\}, \{3, 4\}, \{3, 5\}, \{3, 7\}, \{5, 7\}, \{6, 7\}\}$

$W(1, 3) = 2, W(1, 5) = 6, W(1, 7) = 16$

$W(2, 3) = 11, W(2, 4) = 8, W(2, 6) = 13$

$W(3, 4) = 3, W(3, 5) = 4, W(3, 7) = 18$

$W(5, 7) = 14, W(6, 7) = 10$

a) [1 mark] * Draw the graph including weights.

b) [4 marks] ** Given the following algorithm for finding a minimum spanning tree for a graph:

Given a graph $(G(V, E))$ create a new graph (F) with nodes (V) and no edges

Add all the edges (E) to a set S and order them by weight starting with the minimum weight

While S is not empty and all the nodes V in F are not connected:

Remove the edge s from set S with the lowest weight

When s is added to F :

If it does not cause a cycle to form, keep it

Else discard it from F

Using your graph from a) as G ,

- i. [3 marks] Provide the order of the edges as they are removed from S , and note whether it is kept or discarded.
- ii. [1 mark] Draw the resulting spanning tree F .

11. [2 marks] *Given the graph below (Fig: 3) and starting from node '0': Using breadth-first search (BFS) and depth first search (DFS), write down the nodes visited in order for your BFS and DFS path. In case of a decision between two or more nodes, use ascending alphabetic order (e.g., 0 before 1).

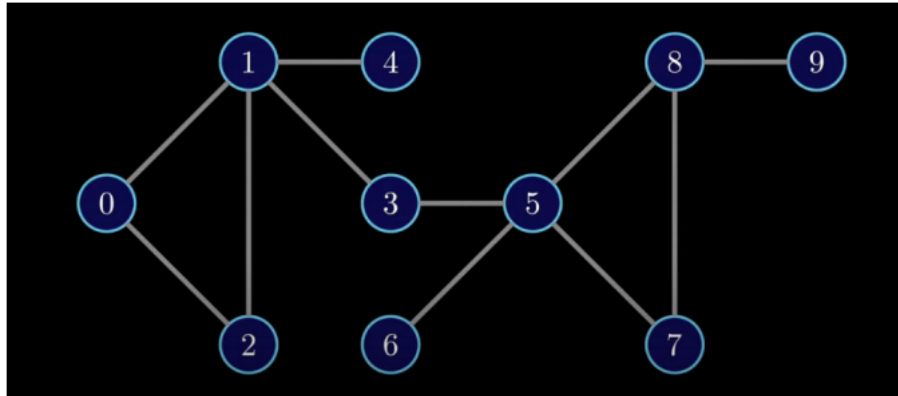


Fig 3: BFS and DFS

12. [2 marks] *Determine whether the following graph contains any Eulerian cycles (and provide an example of a Eulerian cycle if so; do not provide all cycles) and explain briefly how you found them. Please note you need to draw the graph first.

$$V = (p, q, r, s, t, u, v, w)$$

$$E = \{(p, q), (q, r), (r, s), (p, s), (t, u), (u, v), (v, w), (t, w), (p, t), (q, u), (r, v), (s, w)\}$$

Section: Probability (10 marks)

13. [1mark] *A bag contains 4 white, 5 red and 6 blue marbles. Three marbles are drawn at random from the bag. What will be the probability that all of them are red?
14. [3 marks]* A survey of 30 students found that 15 have been swimming at Hawthorn pool, 10 have been swimming at the City Baths and 5 have been swimming at both pools. A person is selected at random. Express the following as fractions and show your working.
- If they have been swimming at Hawthorn pool, then what is the probability that they have been swimming at the City Baths?
 - If they have been swimming at the City Baths, then what is the probability that they have been swimming at the Hawthorn pool?
 - What is the probability that they have been swimming at either pool?
15. [2+1=3 marks] ** There are 3000 tickets in a lottery sold at \$2000 each, with a first prize of \$50,000 and a second prize of \$30,000 and a third prize of \$15,000.
- If you buy a ticket, then what is your expectation in terms of prize money?
 - What should be the price of the ticket to make it fair?
16. [1+2= 3 marks] **A company is suffering from severe quality control problems, resulting in 25% of its products being defective. If six products are randomly chosen, what is the probability that:
- 2 are faulty
 - At least 2 are faulty