



Answer all the questions. Figures are in the right-hand margin indicate full marks.
Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

1. (a) In a road network graph, vertices represent intersections and edges represent roads. If we want to model both one-way and two-way roads, what kind of graph that will be? Why? [1]
- (b) Suppose a graph has 11 vertices and 19 edges. Each of the odd-degree vertices has degree 3 and each of the even-degree vertices has degree 4. Find the numbers of the odd-degree and the even-degree vertices. [2]
- (c) Determine whether the following graph is a bipartite graph. [2]

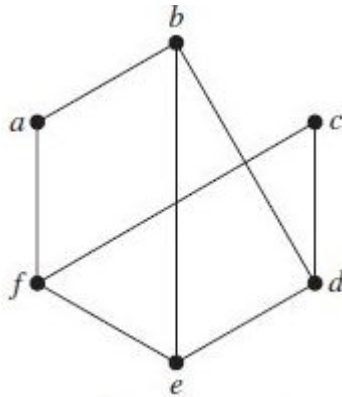


Figure for question 1 (c)

2. (a) Explain why the graph below is not a strongly connected graph. Also, explain why it is weakly connected. Determine the strongly connected components from the graph. [1.5]

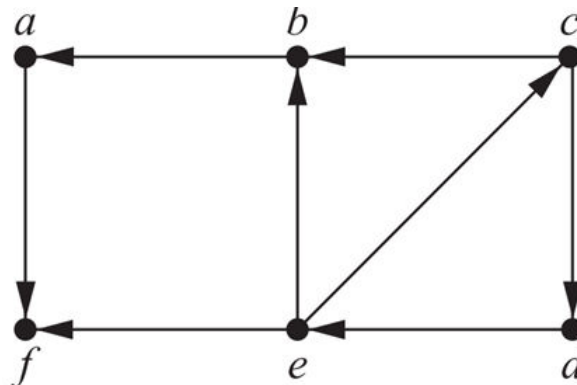


Figure for question 2 (a)

- (b) Draw a directed weakly connected graph of your choice. [1.5]

- (c) The following matrix represents the adjacency matrix of a directed graph consisting of six vertices - a, b, c, d, e and f . [2]

$$A = \begin{matrix} & \begin{matrix} a & b & c & d & e & f \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \\ e \\ f \end{matrix} & \begin{pmatrix} 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 \end{pmatrix} \end{matrix}$$

Draw the graph from the adjacency matrix.

3. (a) Draw a tree using the following information: [0.25 × 12 = 3]
- i The parent of h is g .
 - ii The ancestors of d are (from top to bottom) g, f and l .
 - iii e, k and l are siblings.
 - iv The descendants of h are a, b, i and j .
 - v a, b, c and d are leaves at level 3.
 - vi a and b has no other siblings.
 - vii e, j and k are leaves.
 - viii The tree is balanced.
- (b) A full m -ary tree has 136 vertices. Among them, 109 are leaves. Calculate the values of m , and the number of edges in the tree. [2]
4. (a) Considering the dictionary order, construct a Binary Search Tree from the strings given below. You must follow the order in which the strings are given. [2]

Binary, Search, Tree, Is, A, Very, Efficient, Data, Structure, For, Searching

- (b) Show the result of post-order traversal on the tree you constructed. [2]
- (c) Is the tree you constructed a balanced tree? Explain your answer in one sentence. [1]
5. (a) In a game of UNO, there are cards of 4 colors- red, green, blue and yellow. There are 25 cards for each color [1 + 1 = 2] (there are some special cards, but we will not be considering them now). A player is dealt 7 cards in a round.
- i Explain why there is no guarantee that a player will get at least 2 red cards.
 - ii How many cards should be picked to ensure that he gets at least 2 red cards?
- (b) A coin is tossed 6 times such that every time it can land either on heads or tails. How many possible outcomes contain an odd number of heads? [1]
- (c) There are n_1 computer science courses and n_2 computer engineering courses available at a certain university. A student has to select r_1 courses from computer science courses and r_2 courses from computer engineering courses. If the order of the courses taken are important, then how many ways can a student complete the courses? [2]