

Tutorial 1 – Graphs

Instructions: Complete the following questions, check your answers with the sample solutions before the end of the tutorial session. Capture your work (using Office Lens or similar) and upload to the relevant link on Brightspace at the end of the lab session.

1. Draw an undirected graph with 5 vertices $v_1 \dots v_5$ and with edges connecting v_1 to v_2 , v_1 to v_3 , v_2 to v_4 , v_2 to v_5 , v_3 to v_4 and v_4 to v_5 .
2. Draw a directed graph with 3 vertices $v_1 \dots v_3$ and edges from v_3 to v_1 , v_3 to v_2 and v_1 to v_2 .
3. Draw the graphs with the following adjacency matrices:

(a)

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0 1 1 0
1 0 0 1
1 0 0 1
0 1 1 0
    
```

(b)

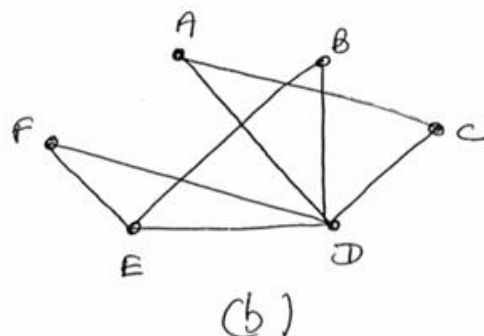
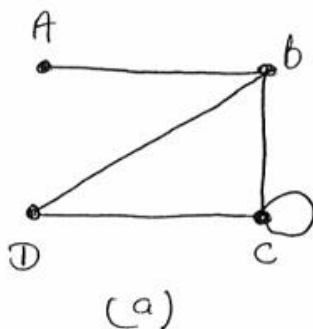
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0 0 1 2 1
0 1 1 1 0
1 1 0 0 1
2 1 0 0 1
1 0 1 1 2
    
```

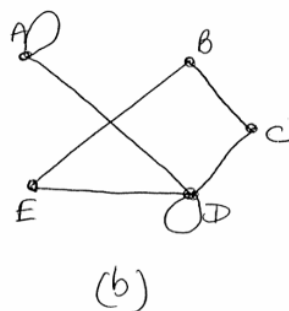
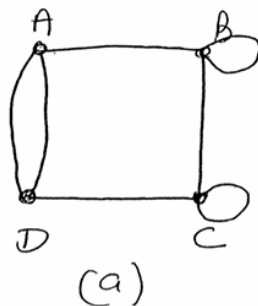
4. Verify for each of the graphs below, that the **sum of the degrees of the vertices equals twice the number of edges i.e.**

$$\sum_{v \in V} \deg(v) = 2|E|$$

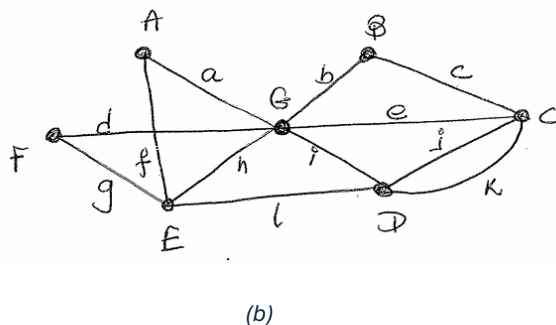
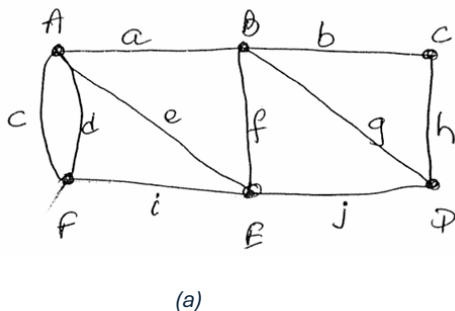
Note: a loop counts as 2 towards the degree but 1 edge



5. Construct the adjacency matrix for each of the graphs shown below in (a) and (b). Note: a loop is one edge.

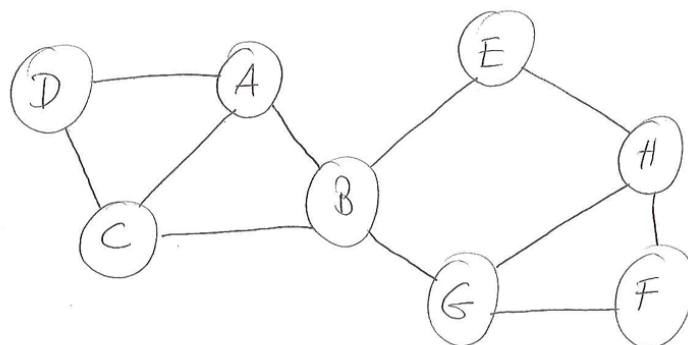


6. For each the graph below, find a Hamiltonian circuit or explain why no Hamiltonian circuit exists. Note: Vertices are labelled with uppercase letters, Edges are labelled with lowercase letters.



What Hamiltonian paths exist for graph (b) above?

7. Consider the following graph. Starting at vertex A



- In what order will the vertices be visited using a Breadth First Search (BFS)?
- In what order will the vertices be visited using a Depth First Search (DFS)?

Note: If there is a decision between multiple neighbour vertices, choose alphabetically.

Complete questions on the Lecture 1 Quiz on Brightspace.