CSI 2110 Tutorial (Section A)

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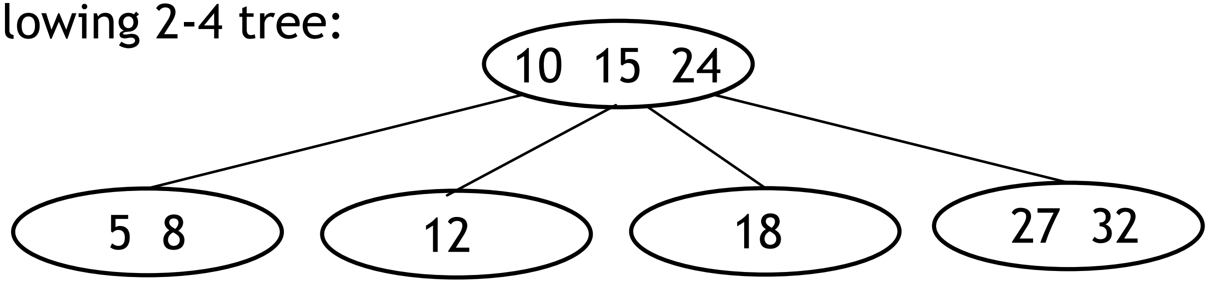
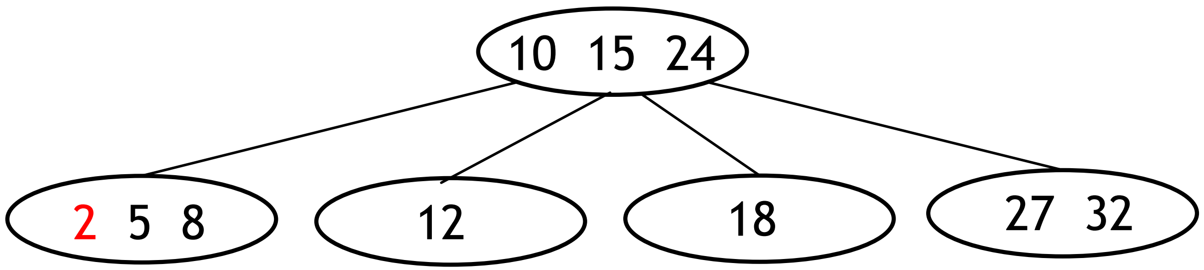
Office Hour: Fri 13:00-14:00
Place: STE 5000G

Previous Exercise

Consider the following 2-4 tree:

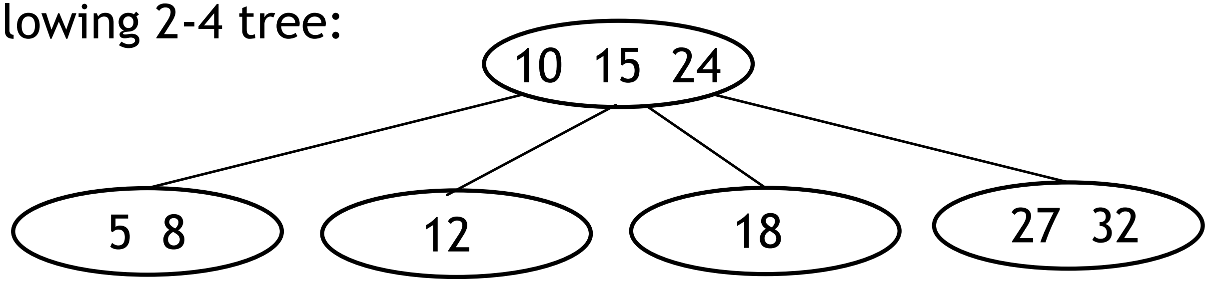


1. Insert 2 into the following 2-4 tree and show the resulting tree beside it.

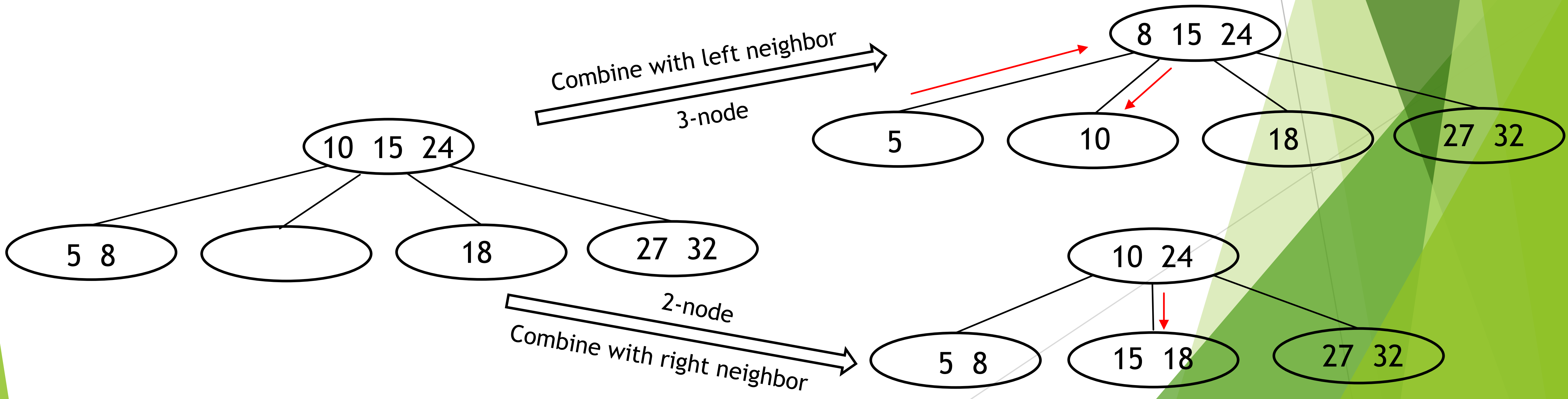


Previous Exercise

Consider the following 2-4 tree:

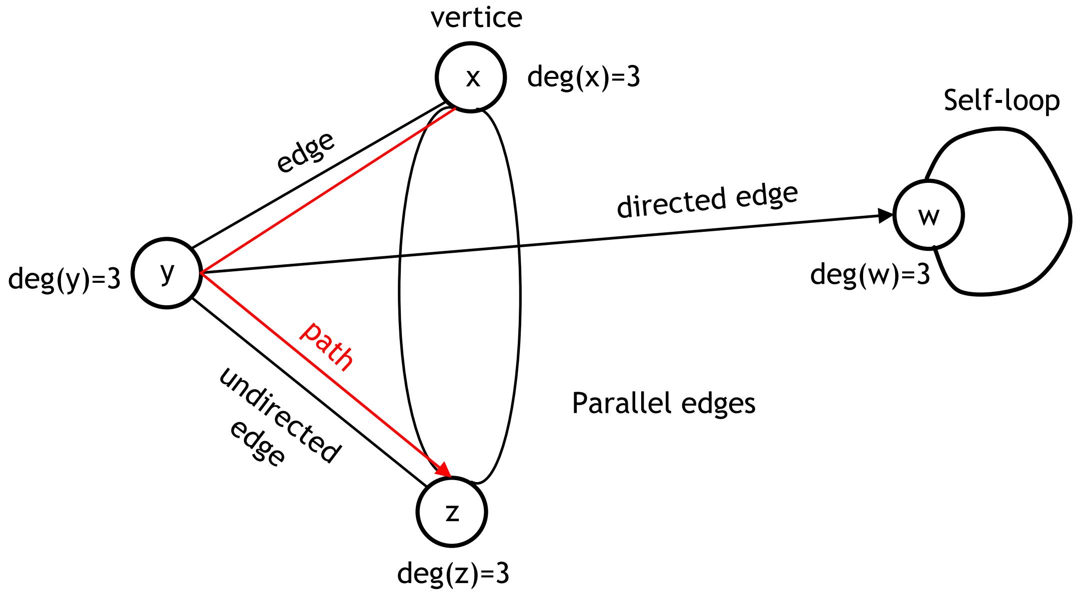


2. Delete 12 from the following 2-4 tree and show the resulting tree beside it.



Review: Graph

A graph G=(V, E) consists of an set V of vertices and a set E of edges, with
E = {(u, v): u, v ∈ V, u ≠ v}



Directed (undirected) Graph: all edges are directed (undirected)

Property:

1) $\sum_v \deg(v) = 2m$

2) $m \leq \frac{n(n-1)}{2}$ if undirected graph without self-loop and parallel edges

Notation:

n: number of vertices

m: number of edges

deg(v): degree of vertex v

Exercise

14.2 If G is a simple undirected graph with 12 vertices and 3 connected components, what is the largest number of edges it might have?

Assume: each component has x, y, z vertices.

Then: $x+y+z=12$, and $num_{edge}=\frac{x(x-1)}{2}+\frac{y(y-1)}{2}+\frac{z(z-1)}{2}$ $(1 \le x, y, z \le 10)$

Merge two equations (replace z by 12-x-y):

$$num_{edge}=\frac{x(x-1)}{2}+\frac{y(y-1)}{2}+\frac{(12-x-y)(11-x-y)}{2}$$
$$=x^2-12x+y^2-12y+xy+66$$

Compute partial derivative of x, and set it equals to 0:

$$\frac{dnum_{edge}}{dx}=2x+y-12=0 \text{ (for extreme points)}$$

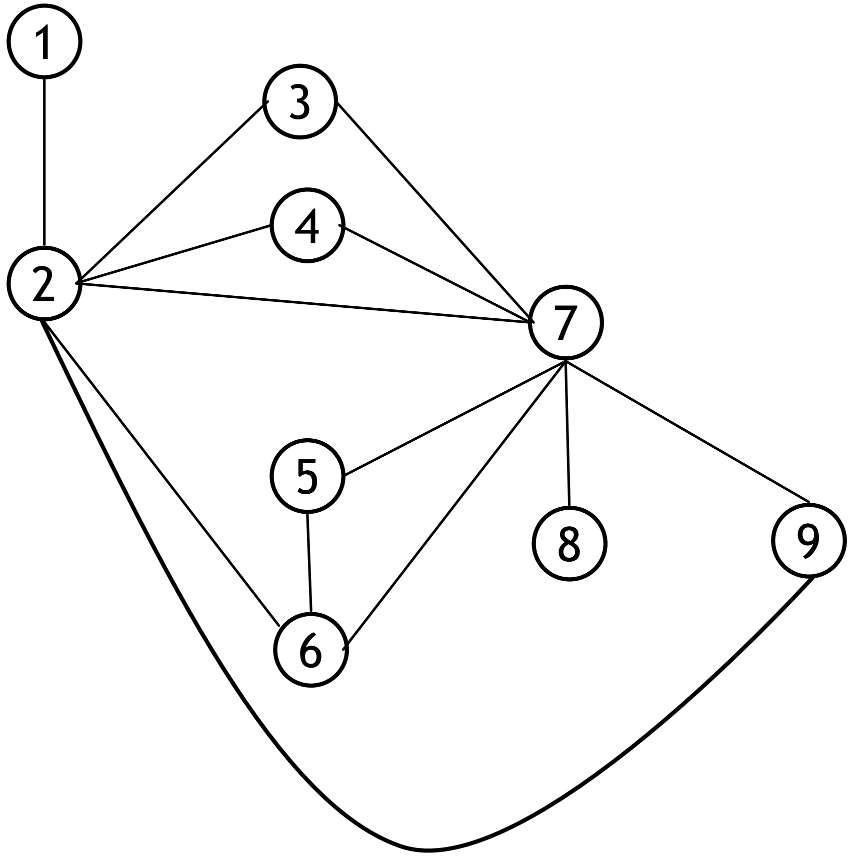
Compute specific values for x, y according to equation above:

x	y	num_{edge}
1	10	45
2	8	30
3	6	21
4	4	18

x	y	num_{edge}
5	2	21

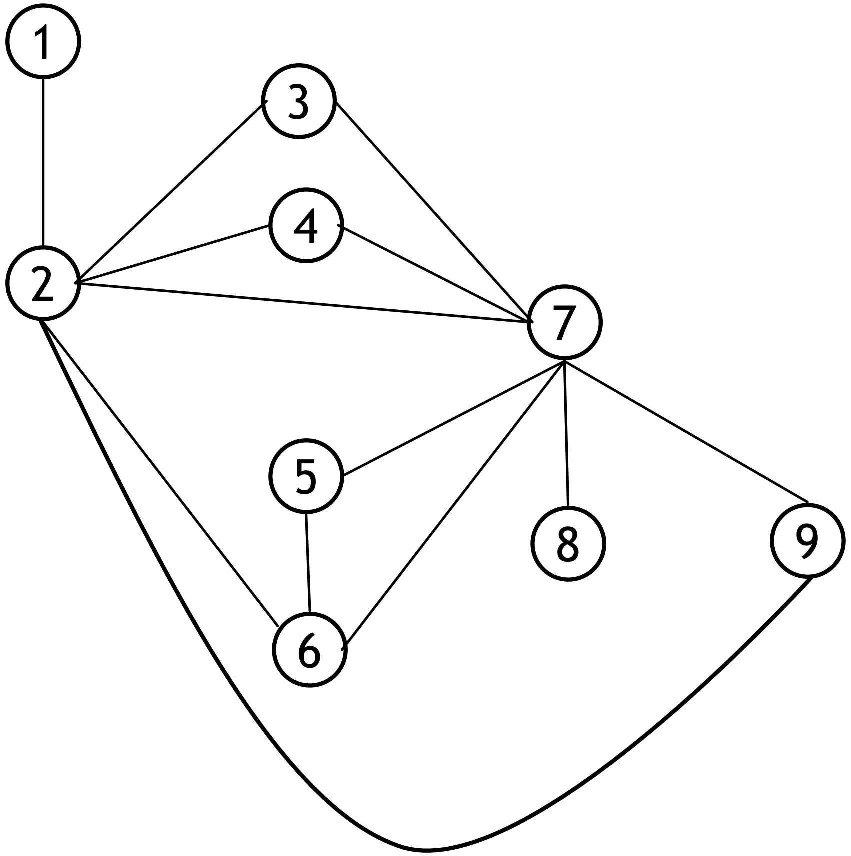
Exercise

14.3 Draw an adjacency matrix representation of the undirected graph



Exercise

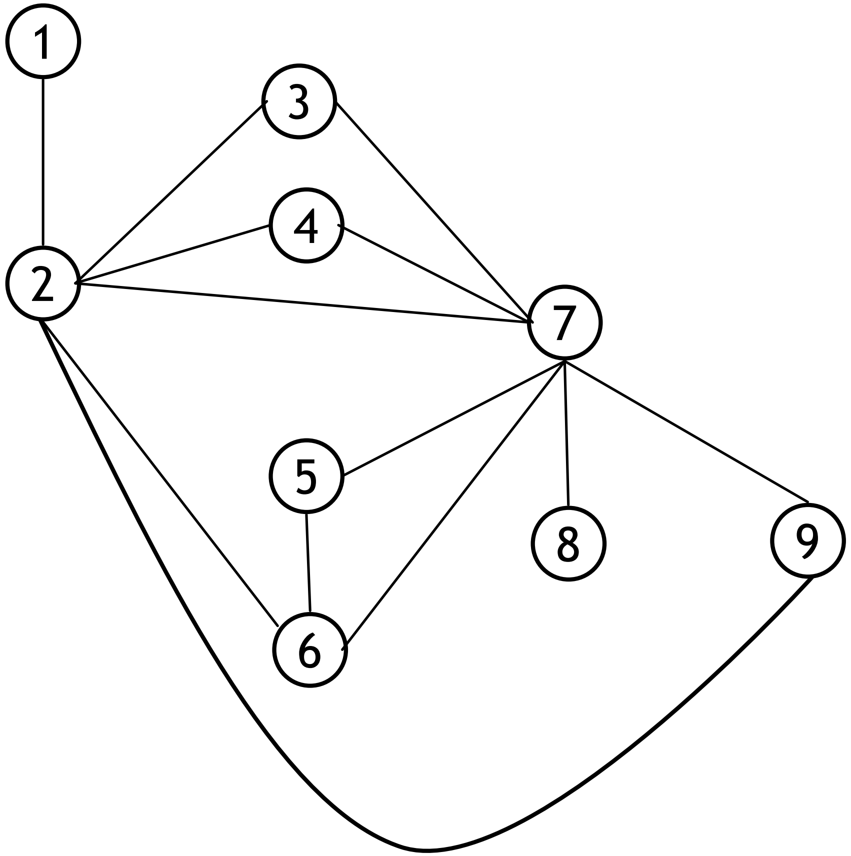
14.3 Draw an adjacency matrix representation of the undirected graph



	1	2	3	4	5	6	7	8	9
1	0	1	0	0	0	0	0	0	0
2	1	0	1	1	0	1	1	0	1
3	0	1	0	0	0	0	1	0	0
4	0	1	0	0	0	0	1	0	0
5	0	0	0	0	0	1	1	0	0
6	0	1	0	0	1	0	1	0	0
7	0	1	1	1	1	1	0	1	1
8	0	0	0	0	0	0	1	0	0
9	0	1	0	0	0	0	1	0	0

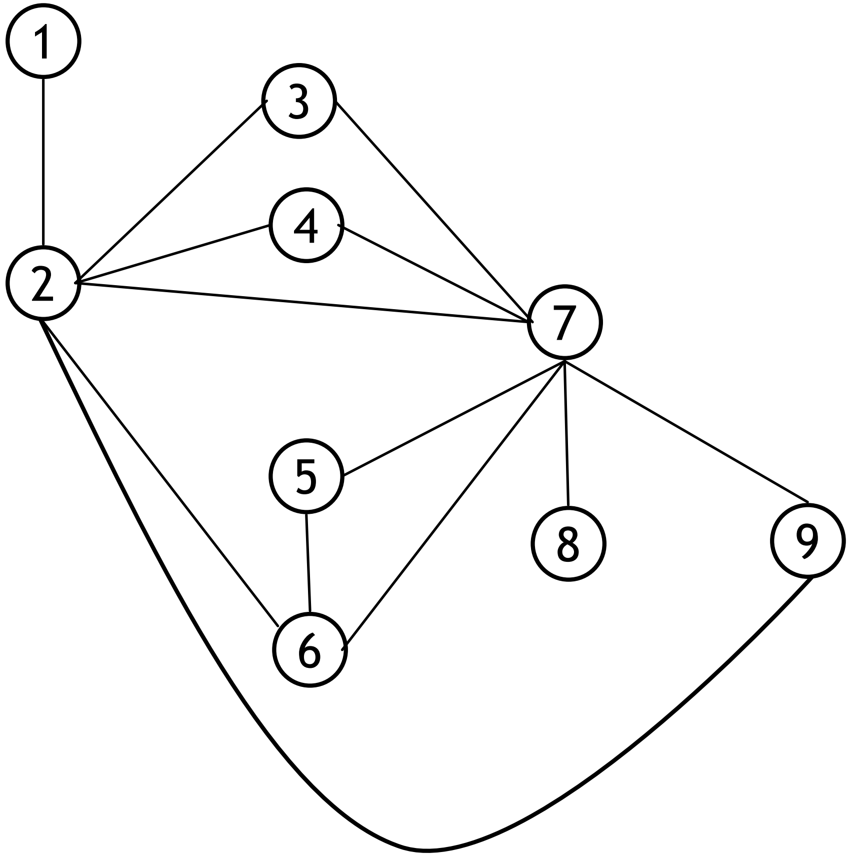
Exercise

14.4 Draw an adjacency list representation of the undirected graph



Exercise

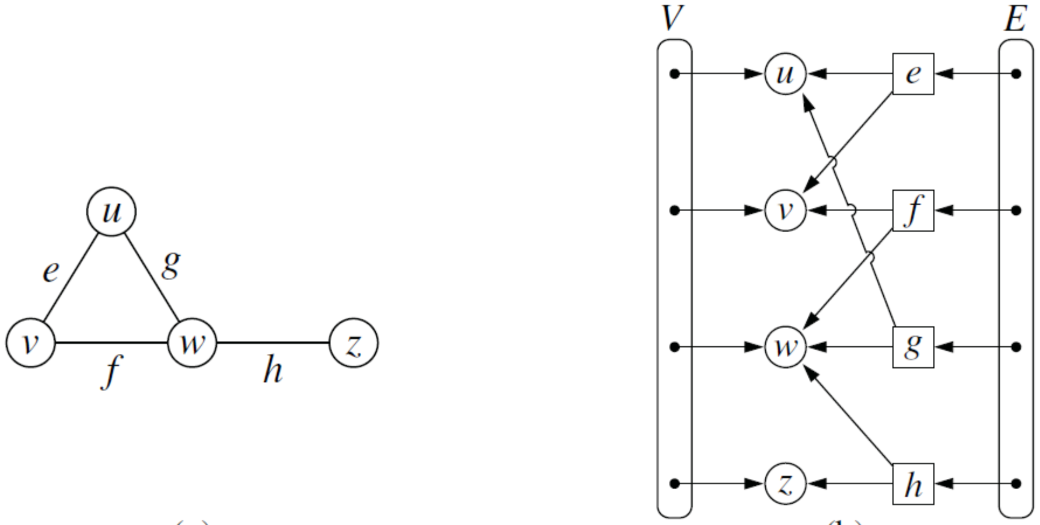
14.4 Draw an adjacency list representation of the undirected graph



1	1	2
2	6	1, 3, 4, 6, 7, 9
3	2	2, 7
4	2	2, 7
5	2	6, 7
6	3	2, 5, 7
7	7	2, 3, 4, 5, 6, 8, 9
8	1	7
9	2	2, 7

Exercise

14.6 Suppose we represent a graph G having n vertices and m edges with the edge list structure. Why, in this case, does the insertVertex method run in $O(1)$ time while the removeVertex method runs in $O(m)$ time?



(a) (b)

For an insertVertex operation, directly insert vertex to the vertex array (no edge)

For a removeVertex operation, we need to scan the edge array to remove the ones that contain removed vertex.

Exercise

14.16 Let *G* be an undirected graph whose vertices are the integers 1 through 8, and let the adjacent vertices of each vertex be given by the table below:

vertex	adjacent vertices
1	(2, 3, 4)
2	(1, 3, 4)
3	(1, 2, 4)
4	(1, 2, 3, 6)
5	(6, 7, 8)
6	(4, 5, 7)
7	(5, 6, 8)
8	(5, 7)

Assume that, in a traversal of *G*, the adjacent vertices of a given vertex are returned in the same order as they are listed in the table above.

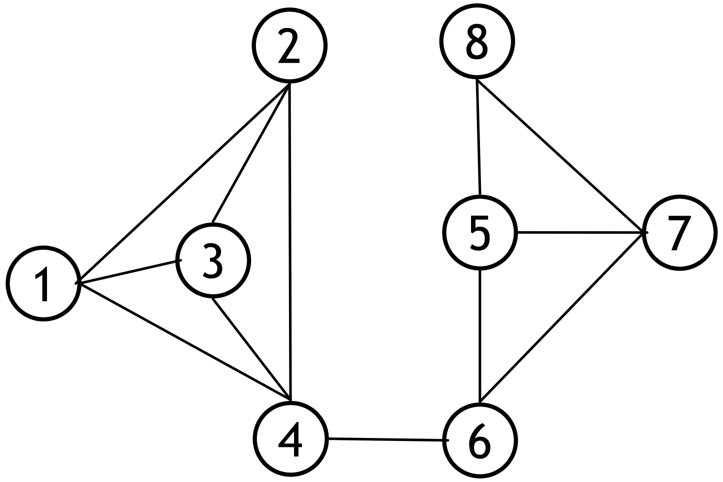
a. Draw *G*.

b. Give the sequence of vertices of *G* visited using a DFS traversal starting at vertex 1.

c. Give the sequence of vertices visited using a BFS traversal starting at vertex 1.

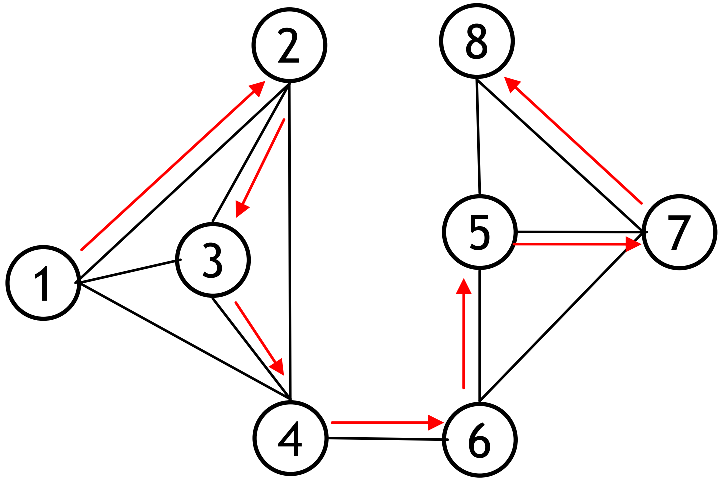
vertex	adjacent vertices
1	(2, 3, 4)
2	(1, 3, 4)
3	(1, 2, 4)
4	(1, 2, 3, 6)
5	(6, 7, 8)
6	(4, 5, 7)
7	(5, 6, 8)
8	(5, 7)

a. Draw *G*



vertex	adjacent vertices
1	(2, 3, 4)
2	(1, 3, 4)
3	(1, 2, 4)
4	(1, 2, 3, 6)
5	(6, 7, 8)
6	(4, 5, 7)
7	(5, 6, 8)
8	(5, 7)

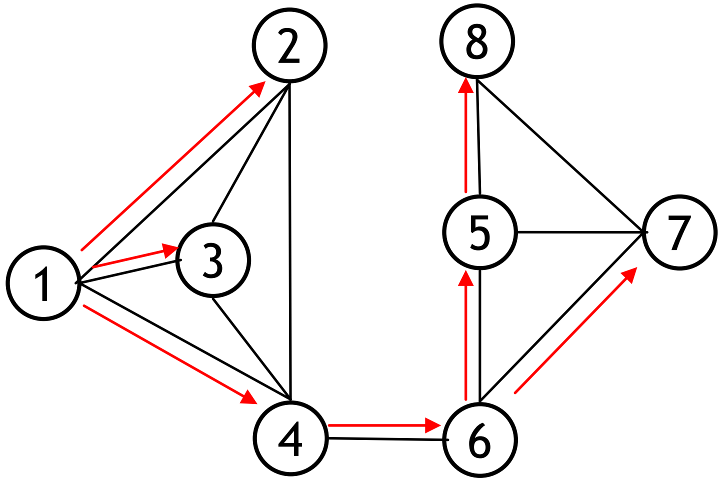
Give the sequence of vertices of *G* visited using a DFS traversal starting at vertex 1



1, 2, 3, 4, 6, 5, 7, 8

vertex	adjacent vertices
1	(2, 3, 4)
2	(1, 3, 4)
3	(1, 2, 4)
4	(1, 2, 3, 6)
5	(6, 7, 8)
6	(4, 5, 7)
7	(5, 6, 8)
8	(5, 7)

Give the sequence of vertices of *G* visited using a BFS traversal starting at vertex 1



1, 2, 3, 4, 6, 5, 7, 8