

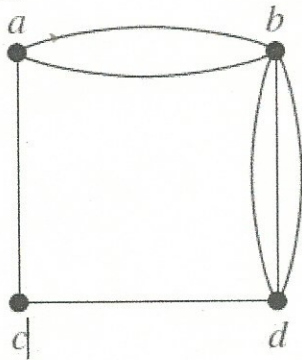
CIS 185  
Practice 15  
Objective:

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ID: \_\_\_\_\_ Date: \_\_\_\_\_

- Be able to construct a graph
- Be able to recognize some special types of graphs
- Be able to understand some graph terminology
- Be able to represent graph by list and matrices.

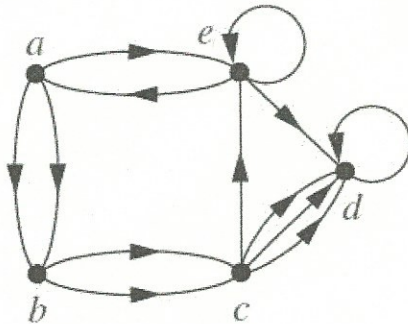
Exercise 1: Determine whether the graph shown has directed or undirected edges, whether it has multiple edges, and whether it has one or more loops. Use your answers to determine the type of graph

a.



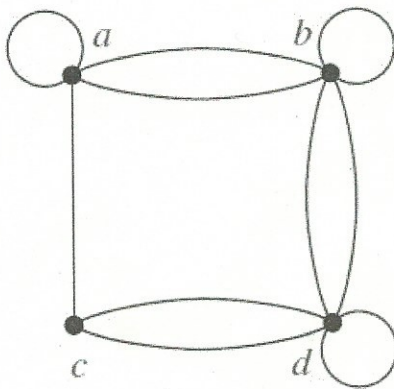
undirected edges  
no loops  
parallel edges  
= multigraph

b.



directed edges  
2 loops  
parallel edges  
directed multigraph

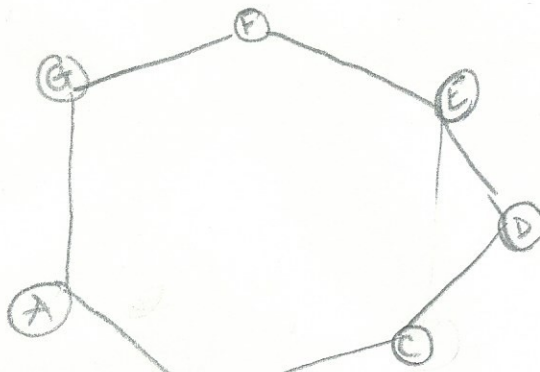
c.



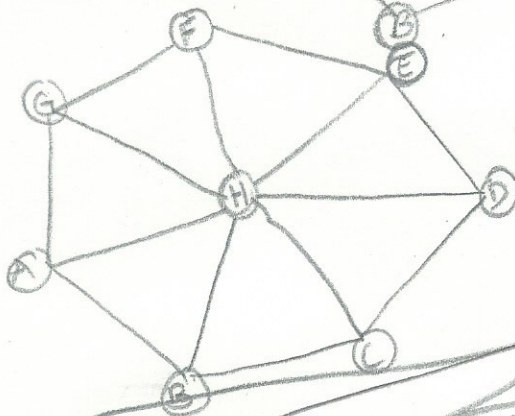
undirected edges  
3 loops  
parallel edges  
= pseudograph

Exercise 2:  
Draw these graphs.

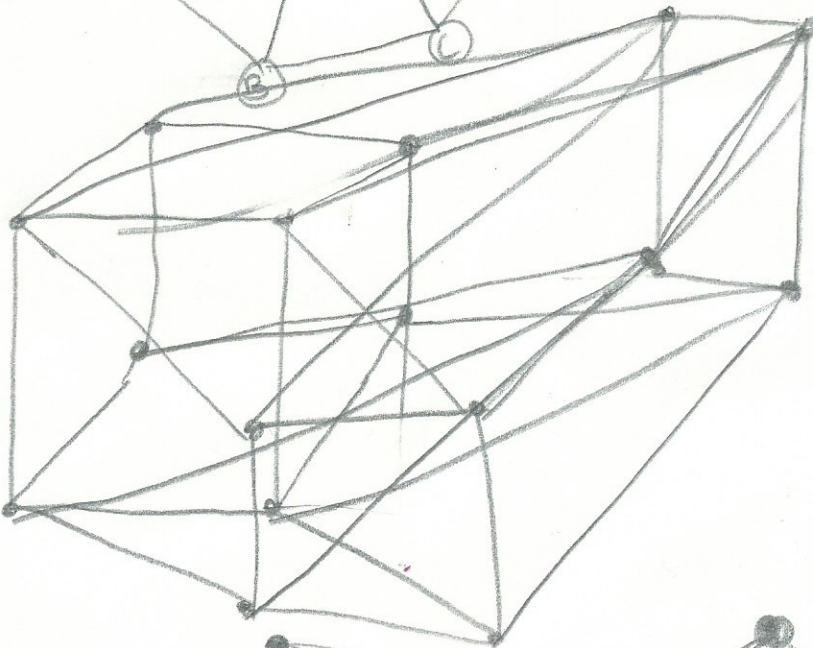
a)  $C_7$



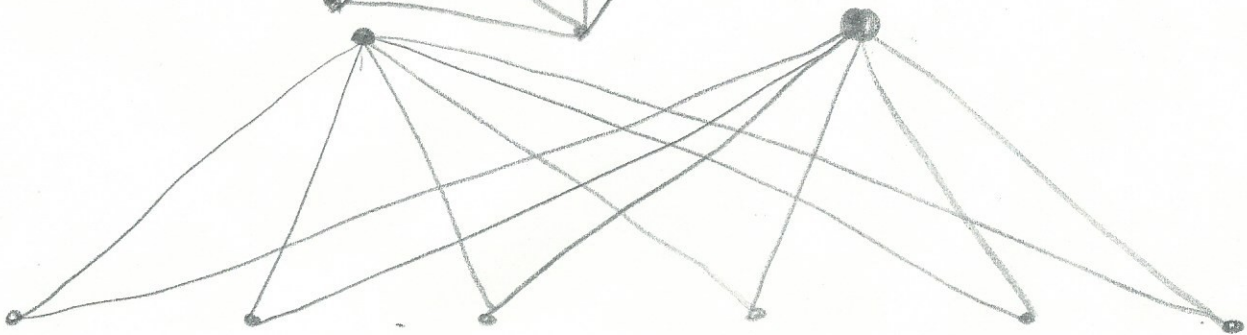
b)  $W_7$



c)  $Q_4$



d)  $K_{2,6}$



Exercise 3:

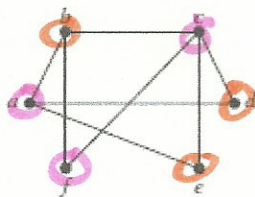
Determine whether the graph is bipartite.

a)



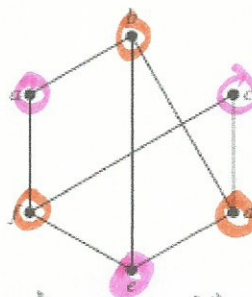
bi partite

b)



not bipartite

c)



not bipartite

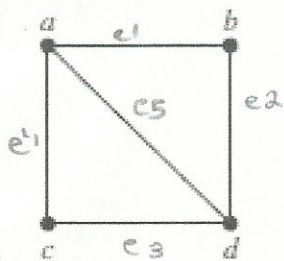
Exercise 4:

Represent the following graphs with

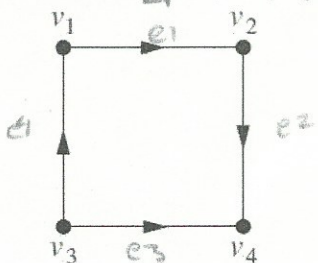
i) an adjacent list

ii) an adjacent matrix

iii) an incidence matrix



	a	b	c	d
a	0	1	1	1
b	1	0	0	1
c	1	0	0	1
d	1	1	1	0



	v1	v2	v3	v4
v1	0	1	0	0
v2	0	0	0	1
v3	1	0	0	1
v4	0	0	0	0

vertex	Adjacent vertex
a	b, c, d
b	a, d
c	a, d
d	a, b, c

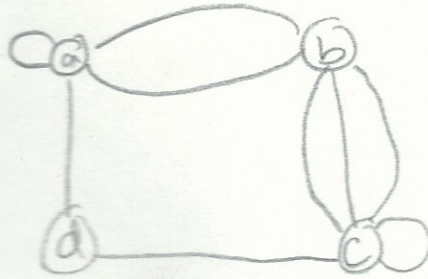
	e1	e2	e3	e4	e5
a	1	0	0	1	1
b	1	1	0	0	1
c	0	0	1	1	0
d	1	1	1	0	1

int. vertex	terminal vertices
v1	v2
v2	v4
v3	v1, v4

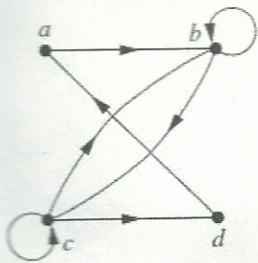
	e1	e2	e3	e4
v1	1	0	0	1
v2	1	1	0	0
v3	0	0	1	1
v4	0	1	1	0



**Exercise 5:** Draw an undirected graph represented by the given adjacency matrix

$$\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$


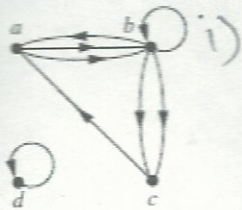
**Exercise 6:** Find the adjacency matrix of the given directed multigraph with respect to the vertices listed in alphabetic order.



$$\begin{matrix} & \begin{matrix} a & b & c & d \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \end{matrix} & \begin{bmatrix} 0 & 2 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

**Exercise 7:**

- Determine the number of vertices and edges and find the in-degree and out-degree of each vertex for the given directed multigraph.
- Determine the sum of the in-degrees of the vertices and the sum of the out-degrees of the vertices directly. Show that they are both equal to the number of edges in the graph.



i) vertices = 4  
edges = 8

degree(a) out = 2

degree(a) in = 2

degree(b) in = 3

degree(b) out = 4

degree(c) in = 2

degree(c) out = 1

degree(d) in = 1

degree(d) out = 1

ii)	out	in
a	2	2
b	4	3
c	1	2
d	1	1
Total	8	8