

Lecture 23 = Sessional.

Lecture 24 = Revision. Complete bipartite -

$K_{2,6}$.



Sub Graph:-

$$G = (V, E).$$

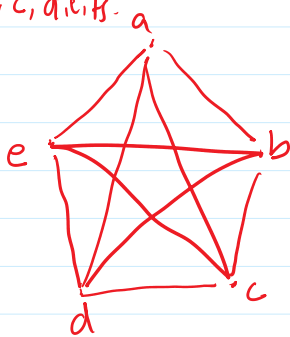
$$H = (W, F).$$

$$W \subseteq V \text{ \& } F \subseteq E.$$

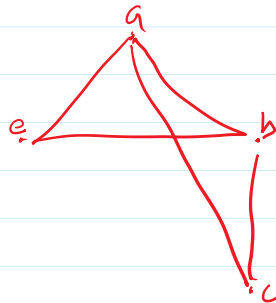
H is a Subgraph of G.

$V = \{a, b, c, d, e\}$.

$E = ?$ HW.



G .



H .

$$F \subseteq E. \checkmark$$

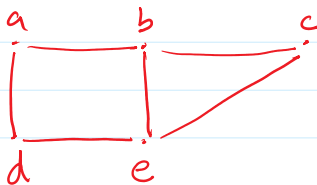
$$F = \{(a,b), (a,c), (a,e), (b,c), (b,e), (b,a), (c,a), (e,a), (c,d), (e,b)\}.$$

$$W = \{a, b, c, e\}.$$

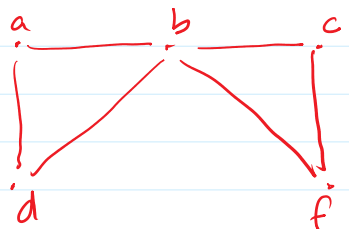
$$W \subseteq V. \checkmark$$

$$H \subseteq G. \text{ HW.}$$

Union & Intersection.



G_1 .

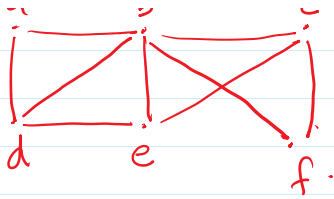


G_2 .



HW.

Ex 546-549.

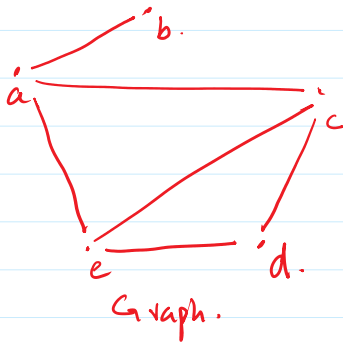


$G_1 \cup G_2$

AW.
Ex 546-549.

Graphs Representation.

1- Adjacency list.

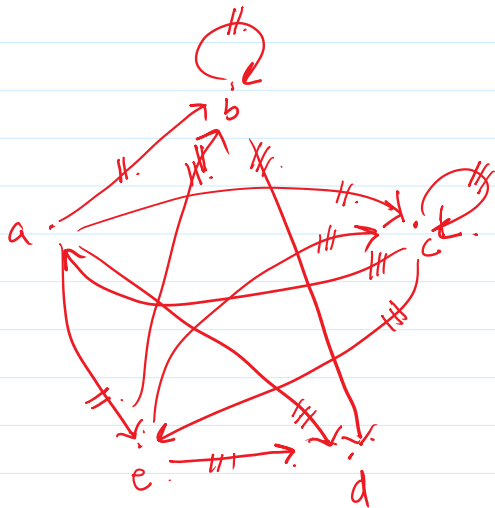


Vertices.

a
b
c
d
e

Adjacent Vertices.

b, c, e
a
a, c, d
c, e
a, c, d.



Vertices.

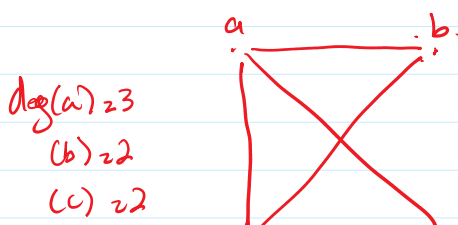
a
b
c
d
e.

Terminal Vertex.

b, c, e, d
b, d
c, a, e
—
b, c, d.

(ASCII) #v.

2- Incidence Matrix.

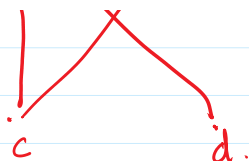


Rows = Columns = |Vertices|.

	1	2	3	4	
	a	b	c	d	
1 a	0	1	1	1	3.
2 b	1	0	1	0	2.
3 c	1	1	0	0	2.
4 d	1	0	0	0	1

(b) 22
(c) 22
(d) 21.

8.



$$\begin{array}{c} 3c \\ 4d \end{array} \left| \begin{array}{cccc} 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{array} \right| \begin{array}{c} 2 \\ 1 \end{array}$$

3 2 2 1.

1- if \exists a non-zero entry on Main diagonal.
Then it is not a Simple Graph.

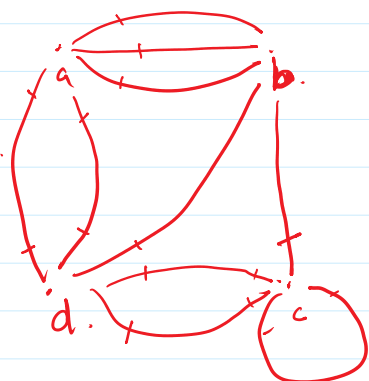
2- if \exists an entry $> 1 \rightarrow$ Not a Simple Graph.

3- The Rowwise / Columnwise Sum gives you
the degree of vertices.

Graph \leftrightarrow Matrix.

Exs
PSS2.

deg(a) 25
(b) 25
(c) 25.



$$\begin{array}{c} a \\ b \\ c \\ d \end{array} \left| \begin{array}{cccc} a & b & c & d \\ 0 & 3 & 0 & 2 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 2 & 1 & 2 & 0 \end{array} \right| \begin{array}{c} 5 \\ 5 \\ 5 \\ 5 \\ \hline 20 \end{array}$$

Sessional II.

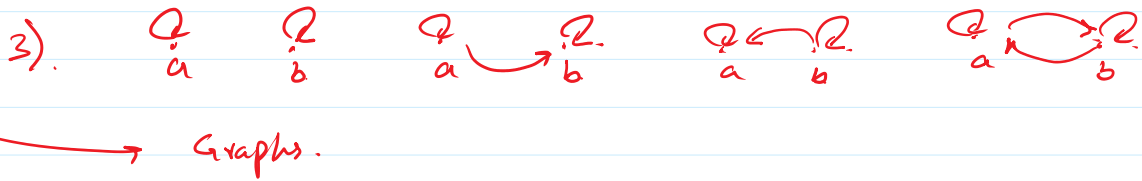
1) $\mathbb{R} \subset \{a|b\} \mid a-b \in \mathbb{Z}^+\} \quad \mathbb{R} \times \mathbb{R}.$

$$\left\{ \frac{1}{2} \right\} \cup \left\{ \frac{1}{2}, -\frac{1}{2}, -\frac{3}{2}, -\frac{5}{2}, \dots \right\}.$$

$$2) \quad \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}.$$

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \quad \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$$

1 0 0 1 0 0 1 1 0 1 1 0 1 0 1 1 1 1



4). $\{ \{a, d, e\}, \{b, c, f\} \}$

$\{a, d, e\} = \{ (a, a), (a, d), (a, e), (d, a), (d, d), (d, e), (e, a), (e, d), (e, e) \}$

$\{ _ \} = _$

5). $R = \{ (a, b) \mid a \cap b = b \cap a \}$

16 elements.

$A = \{ \{a\}, \{b\}, \{a, b\}, \{b, c\} \}$

$A \times A = \{ (\{a\}, \{a\}), (\{a\}, \{b\}), (\{a\}, \{a, b\}), (\{a\}, \{b, c\}), (\{b\}, \{a\}), (\{b\}, \{b\}), (\{b\}, \{a, b\}), (\{b\}, \{b, c\}), (\{a, b\}, \{a\}), (\{a, b\}, \{b\}), (\{a, b\}, \{a, b\}), (\{a, b\}, \{b, c\}), (\{b, c\}, \{a\}), (\{b, c\}, \{b\}), (\{b, c\}, \{a, b\}), (\{b, c\}, \{b, c\}) \}$

$= 14$ elements.

$(\{b, c\}, \{b, c\})$

6). $A = \{a, b, c\}$

$\text{Pow}(A) = \{ \emptyset, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\} \}$

$\text{Pow}(A) \times \text{Pow}(A) = 64$

$= \{ (\emptyset, \emptyset), (\emptyset, \{a\}), (\emptyset, \{b\}), (\emptyset, \{c\}), (\emptyset, \{a, b\}), (\emptyset, \{a, c\}), (\emptyset, \{b, c\}), (\emptyset, \{a, b, c\}), (\{a\}, \emptyset), (\{a\}, \{a\}), (\{a\}, \{b\}), (\{a\}, \{c\}), (\{a\}, \{a, b\}), (\{a\}, \{a, c\}), (\{a\}, \{b, c\}), (\{a\}, \{a, b, c\}), (\{b\}, \emptyset), (\{b\}, \{a\}), (\{b\}, \{b\}), (\{b\}, \{c\}), (\{b\}, \{a, b\}), (\{b\}, \{a, c\}), (\{b\}, \{b, c\}), (\{b\}, \{a, b, c\}), (\{c\}, \emptyset), (\{c\}, \{a\}), (\{c\}, \{b\}), (\{c\}, \{c\}), (\{c\}, \{a, b\}), (\{c\}, \{a, c\}), (\{c\}, \{b, c\}), (\{c\}, \{a, b, c\}), (\{a, b\}, \emptyset), (\{a, b\}, \{a\}), (\{a, b\}, \{b\}), (\{a, b\}, \{c\}), (\{a, b\}, \{a, b\}), (\{a, b\}, \{a, c\}), (\{a, b\}, \{b, c\}), (\{a, b\}, \{a, b, c\}), (\{a, c\}, \emptyset), (\{a, c\}, \{a\}), (\{a, c\}, \{b\}), (\{a, c\}, \{c\}), (\{a, c\}, \{a, b\}), (\{a, c\}, \{a, c\}), (\{a, c\}, \{b, c\}), (\{a, c\}, \{a, b, c\}), (\{b, c\}, \emptyset), (\{b, c\}, \{a\}), (\{b, c\}, \{b\}), (\{b, c\}, \{c\}), (\{b, c\}, \{a, b\}), (\{b, c\}, \{a, c\}), (\{b, c\}, \{b, c\}), (\{b, c\}, \{a, b, c\}), (\{a, b, c\}, \emptyset), (\{a, b, c\}, \{a\}), (\{a, b, c\}, \{b\}), (\{a, b, c\}, \{c\}), (\{a, b, c\}, \{a, b\}), (\{a, b, c\}, \{a, c\}), (\{a, b, c\}, \{b, c\}), (\{a, b, c\}, \{a, b, c\}) \}$

$R = \{ (a, b) \mid a \cap b = \emptyset \}$

27 elements.

7). $(P(\{a, b, c\}), \subseteq)$

$\{a\} / \{b\}$
 $\{b\} / \{c\}$
 $\{c\} / \{a\}$

$\{a, b\} / \{c\}$
 $\{a, c\} / \{b\}$
 $\{b, c\} / \{a\}$

$\{a, b\} / \{b, c\}$
 $\{a, c\} / \{b, c\}$

Q3. $\overline{1, 2, 4, 5}$

CLO :-

Q3.	<u>Q1, 2, 4, 5</u>	}
3,	4.	
<u>6.</u>	<u>15.</u>	

B