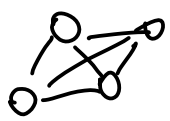
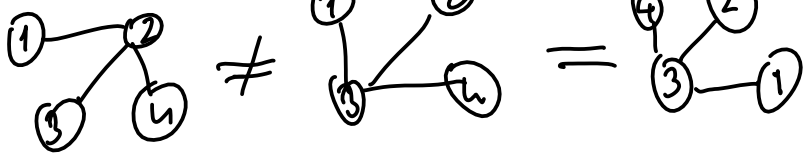
$n = 4$



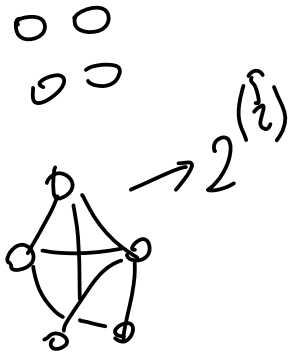
$\binom{4}{2} = 6$

$\binom{n}{2}$ → # of possible edges in graph with n vertices

labelled graph

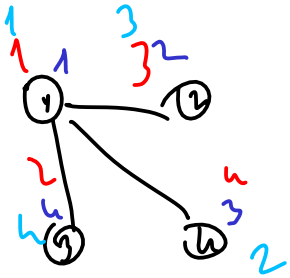


$2^{\binom{4}{2}}$

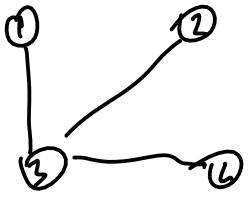


$2^{\binom{4}{2}}$

There are 11 different unlabeled graphs with 4 vertices due to isomorphism.

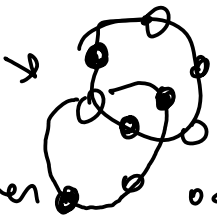


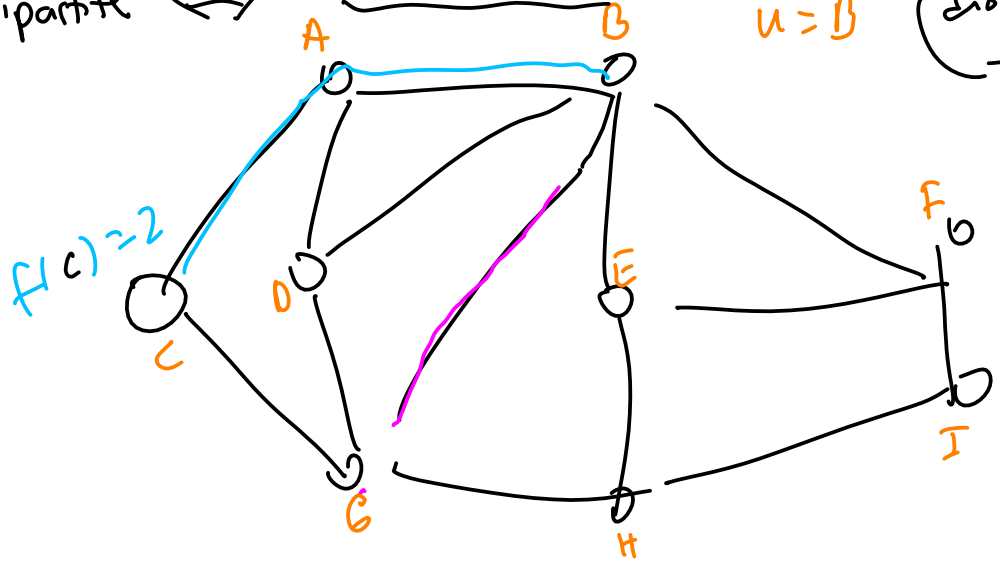
bipartite $\iff$ no odd cycles



$u = B$

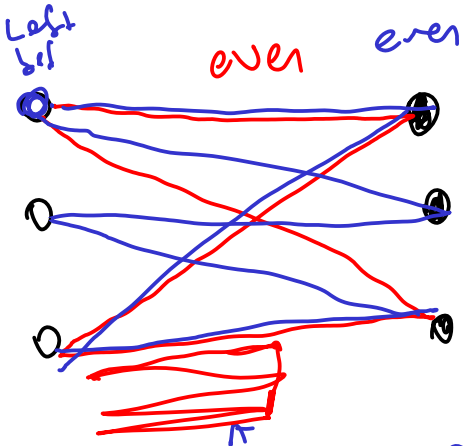
dist to B → even / odd





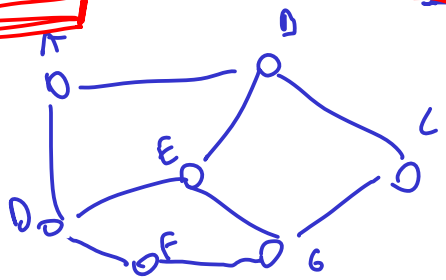
B
C
H
I

A
D
G
E
F



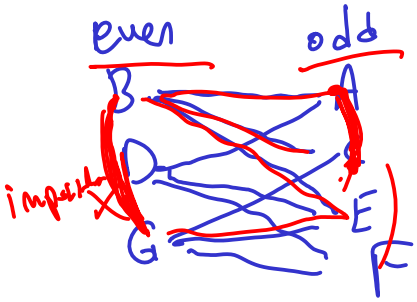
trivial.

bipartite $\Rightarrow$ no odd cycle



no odd cycle $\Rightarrow$ bipartite

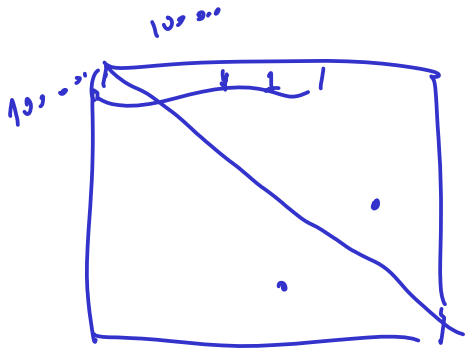
$u = B$

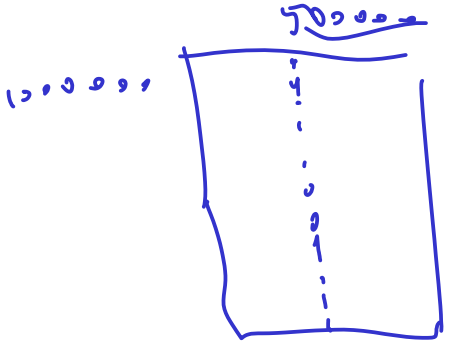


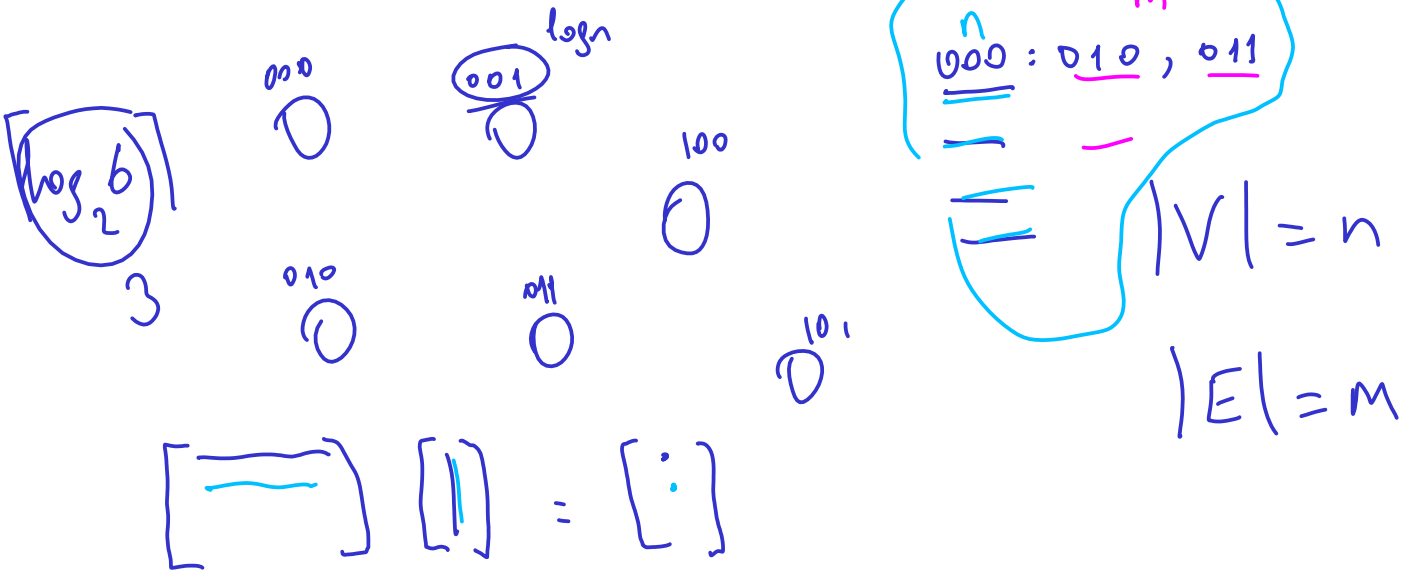
1000000 vertex

500000 edges.

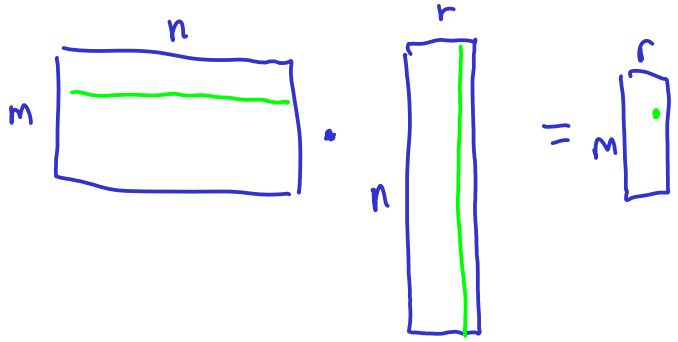
Sparse server or dense? Yogun

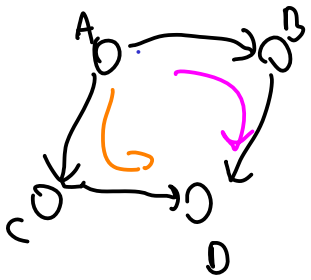






$$\begin{bmatrix} 0&0&1&0 \\ 1&1&0&0 \\ 0&1&0&0 \\ 0&1&1&0 \end{bmatrix}^T = \begin{bmatrix} 0&1&0&0 \\ 0&1&1&1 \\ 1&0&0&1 \\ 0&0&0&0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$



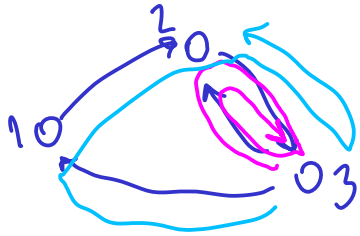


	A	B	C	D
A	0	1	1	0
B	0	0	0	1
C	0	0	0	1
D	0	0	0	0

A-B A-C B-D C-D +1+1 D

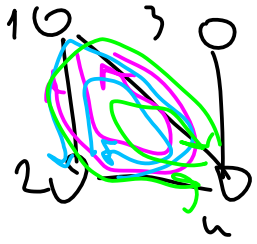
$$\begin{bmatrix} 0&1&1&0 \\ 0&0&0&1 \\ 0&0&0&1 \\ 0&0&0&0 \end{bmatrix} \begin{bmatrix} 0&1&1&0 \\ 0&0&0&1 \\ 0&0&0&1 \\ 0&0&0&0 \end{bmatrix} = \begin{bmatrix} 0&0&0&2 \\ 0&0&0&0 \\ 0&0&0&0 \\ 0&0&0&0 \end{bmatrix} \begin{bmatrix} 0&1&1&0 \\ 0&0&0&1 \\ 0&0&0&1 \\ 0&0&0&0 \end{bmatrix} = \begin{bmatrix} \cdot&\cdot&\cdot&\cdot \\ \cdot&\cdot&\cdot&\cdot \\ \cdot&\cdot&\cdot&\cdot \\ \cdot&\cdot&\cdot&\cdot \end{bmatrix}$$

$$\begin{bmatrix} 0&1&0 \\ 0&0&1 \\ 1&1&0 \end{bmatrix}^2 = \begin{bmatrix} 0&0&1 \\ 1&1&0 \\ 0&1&1 \end{bmatrix} \begin{bmatrix} 0&1&0 \\ 0&0&1 \\ 1&1&0 \end{bmatrix} = \begin{bmatrix} 1&1&0 \\ 0&1&1 \\ 1&1&1 \end{bmatrix} \begin{bmatrix} 0&1&0 \\ 0&0&1 \\ 1&1&0 \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} \begin{bmatrix} \cdot&\cdot&\cdot \\ \cdot&\cdot&\cdot \\ \cdot&2.&\cdot \end{bmatrix} \quad 1\,2\,3$$



3 → 2

length = 4 (2)

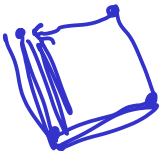


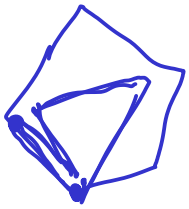
$$\begin{matrix}1\\2\\3\\4\end{matrix}\begin{bmatrix}0&1&0&1\\1&0&0&1\\0&0&0&1\\1&1&1&0\end{bmatrix}\begin{bmatrix}0&1&0&1\\1&0&0&1\\0&0&0&1\\1&1&1&0\end{bmatrix}\begin{bmatrix}\textcircled{2}&1&1&1\\1&\textcircled{2}&1&1\\1&1&\textcircled{1}&0\\1&1&0&\textcircled{3}\end{bmatrix}$$

degrees

$m=4$

$tr(A)=0$





$tr(A^2)=8$

$8/2=4$

$\frac{\sum d(v)}{2}=|E|$ ✓

$$\begin{bmatrix}\textcircled{2}&1&1&1\\1&\textcircled{2}&1&1\\1&1&\textcircled{1}&0\\1&1&0&\textcircled{3}\end{bmatrix}\begin{bmatrix}0&1&0&1\\1&0&0&1\\0&0&0&1\\1&1&1&0\end{bmatrix}=\begin{bmatrix}\textcircled{2}&3&1&4\\3&\textcircled{2}&1&4\\1&1&0&3\\4&4&3&2\end{bmatrix}$$

$6/6=1$