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# Online on NP

Proof : let us have a graph G with vertices V and edges E.

Step 1. Clique problem is an NP problem

let ~~us~~ the clique has V', a subset of the V vertices of the graph. For each pair of vertices in this subset we can check whether there is an ~~ed~~ edge between them in O(V+E) time. This is a polynomial time So, the problem belongs to NP class.

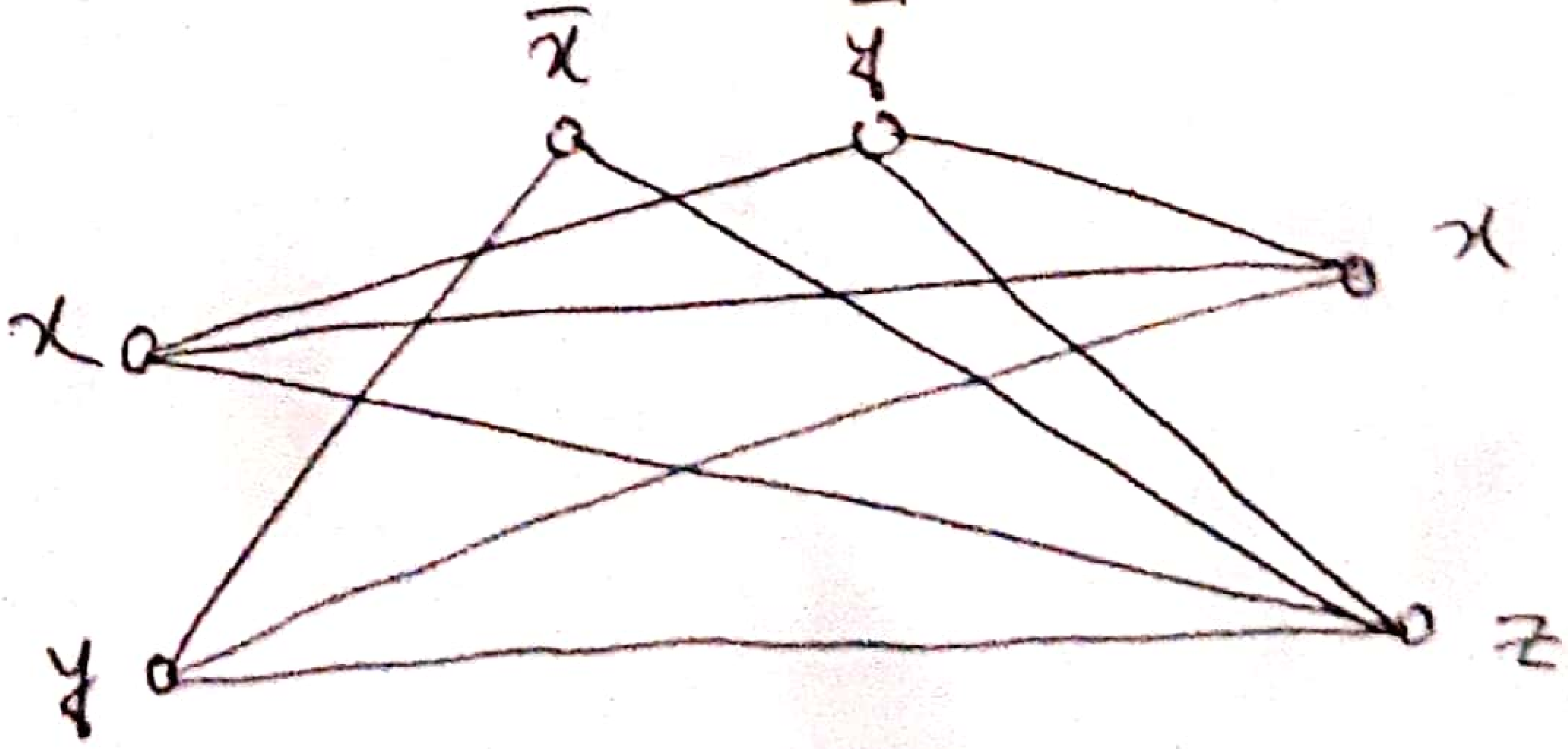
Step 2. Clique problem is an ~~NP-complete~~ NP-hard problem

Let us use the 3-SAT problem to satisfy this condition. If we can reduce the 3-SAT problem to the Clique problem we can prove that the clique problem is an NP-complete problem.

Let us take a boolean expression

$$C = (x \vee y) \wedge (\bar{x} \vee \bar{y}) \wedge (x \vee z)$$

Here,




~~For~~

$V = \{x, y, z\}$

$E = \{(i, j) \mid j \neq i\}$

The number of clauses is 3 and we get a clique of size 3 $(y \bar{x} z)$

Now, for this graph we take a boolean value for each of the vertices, such that the vertices belonging to the clique have a true value.

So, $\bar{x} = 1$, $y = 1$, $z = 1$
$x = 0$, $\bar{y} = 0$, $\bar{z} = 0$

From the Boolean expression we get,

$$C = (x \vee y) \wedge (\bar{x} \vee \bar{y}) \wedge (x \vee z)$$
$$= (0 \vee 1) \wedge (1 \vee 0) \wedge (0 \vee 1)$$
$$= 1 \wedge 1 \wedge 1$$
$$= 1$$

Thus, the 2B-SAT problem is reduced to the clique ~~prove~~ problem which proves that the clique problem is NP-complete.

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