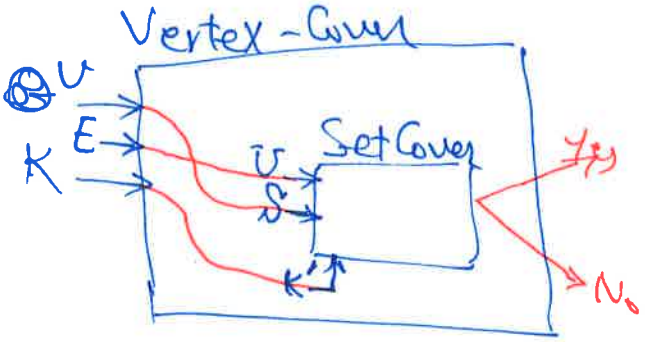
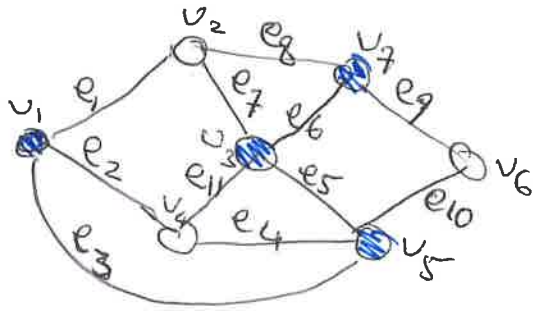
Reduction Strategy #3: designing a gadget





$U = \{e_1, e_2 \ldots, e_{11}\}$

$v_1 = \{e_1, e_2, e_3\}$

$v_2 = \{e_1, e_7, e_8\}$

$v_3 = \{e_7, e_6, e_5, e_{11}\}$

...

$v_7 = \{e_6, e_8, e_9\}$

$S = \{v_1, v_2 \ldots, v_7\}$

e.g. $k = 4$

$\{v_1, v_3, v_5, v_7\}$

Set Cover → Yes

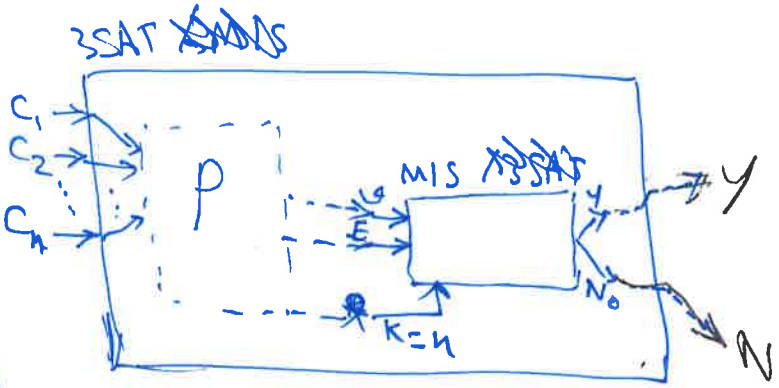
Vertex_Cover is reduced to Set_Cover

$VC \leq_p SC$

3-SAT Problem:

$C_1 \wedge C_2 \wedge \ldots \wedge C_n$

$(\bar{v}_1 \vee v_2 \vee v_5) = C_1$

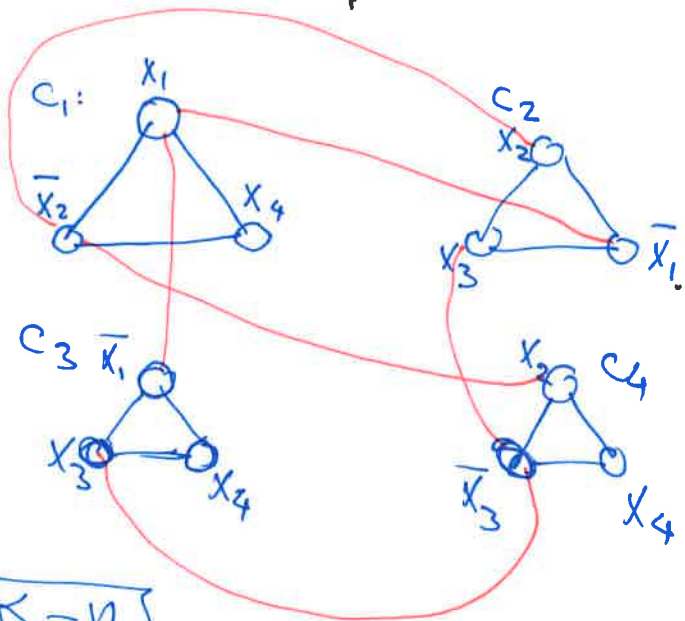


$C_1: x_1 \vee \bar{x}_2 \vee x_4$

$C_2: x_2 \vee x_3 \vee \bar{x}_1$

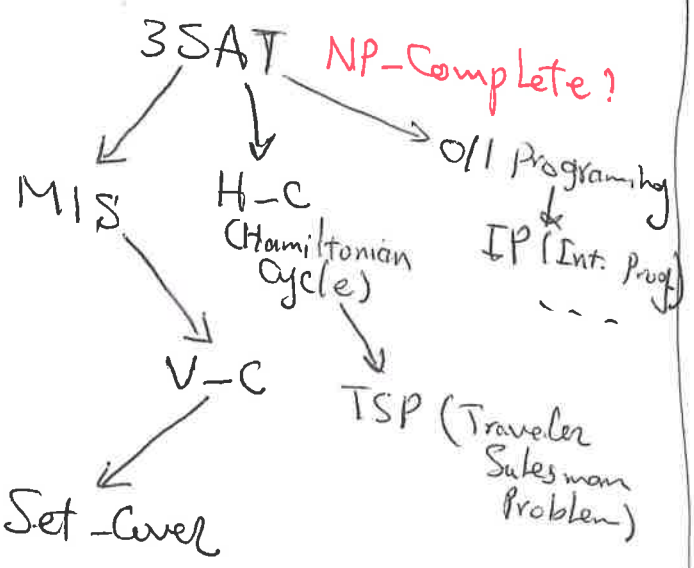
$C_3: \bar{x}_1 \vee x_3 \vee x_4$

$C_4: x_2 \vee \bar{x}_3 \vee x_4$



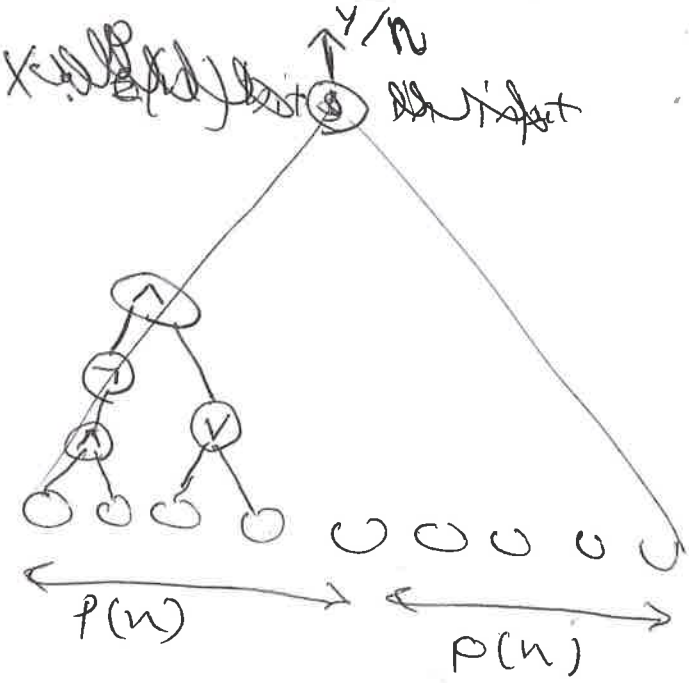
$K = n$

3SAT $\leq_p$ MIS



Circuit SAT

[Cook, Levin]



IS 3SAT NP-Complete?

what does this mean

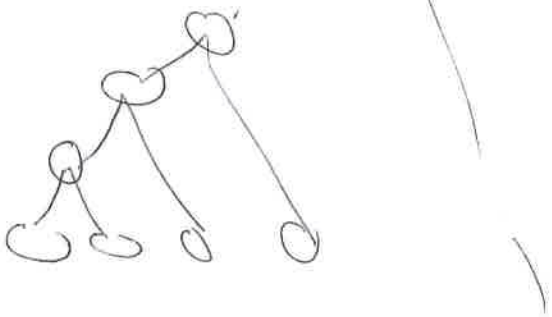
A problem X is NP-Complete if

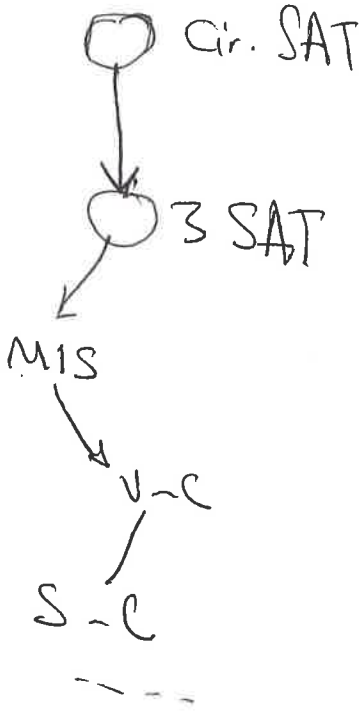
(1) $X \in NP$

* The verification can be done in P.

(2) $\forall Y \in NP$

$Y \leq_p X$





NP-hard:

if Satisfies 2 is NP-hard

NP-hard $\subseteq$ NP ?

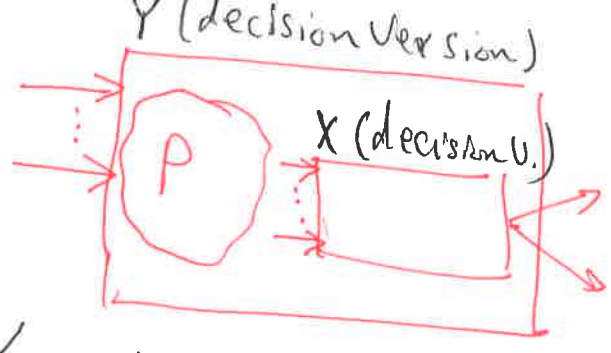
NO

IS Problem X NP-Complete?

(1) Prove $X \in NP$

↳ ? using verification version

(2) Pick a known NP-Complete Problem Y and do the following reduction



$Y \leq_p X$

$X \in$ NP-Complete, ~~set~~