A	B	C	Φ
0	0	0	0
0	0	1	1 ←
0	1	0	0
0	1	1	0
1	0	0	1 ←
1	0	1	0
1	1	0	1 ←
1	1	1	1 ←

$$\Phi = (\bar{A}\bar{B}C) + (A\bar{B}\bar{C}) + (AB\bar{C}) + (ABC)$$

$$\bar{\Phi} = (\bar{A}\bar{B}\bar{C}) + (\bar{A}B\bar{C}) + (\bar{A}BC) + (A\bar{B}C)$$

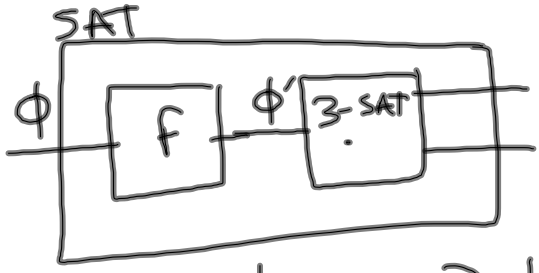
$$\Phi = \overline{(\bar{A}\bar{B}\bar{C})}\,\overline{(\bar{A}B\bar{C})}\,\overline{(\bar{A}BC)}\,\overline{(A\bar{B}C)}$$

$$= (A+B+C)(A+\bar{B}+C)(A+\bar{B}+\bar{C})(\bar{A}+B+\bar{C})$$

3-SAT is NPC

1. show in NP
   - same as SAT
2. show $\forall L \in NP$
   $L \leq_p$ 3-SAT

So show SAT $\leq_p$ 3-SAT



Suppose ϕ is a Boolean formula in CNF

Construct ϕ', a Boolean formula in 3CNF.

(term) clauses in ϕ	convert to ϕ'
3 literals	copy
1 literal x	$(x + x + x)$
2 literals $x+y$	$(x + y + y)$
4 literals $(x_1 + x_2 + x_3 + x_4)$	$(x_1 + x_2 + a) \wedge (\bar{a} + x_3 + x_4)$
5 literals $(x_1 + \ldots + x_5)$	$(x_1 + x_2 + a) \wedge (\bar{a} + x_3 + b) \wedge (\bar{b} + x_4 + x_5)$

$\therefore$ 3 SAT is NPC

CLIQUE is NPC

1. done
2. 3SAT $\leq_p$ CLIQUE

HAMPATH = $\{\langle G, s, t\rangle \mid$ directed graph G has a Hamiltonian path from s to $t\}$

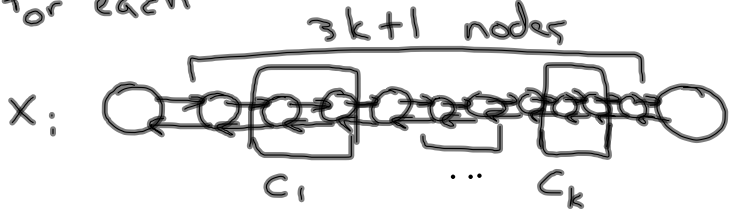
1. Show in NP ✓
2. 3SAT $\leq_p$ HAMPATH

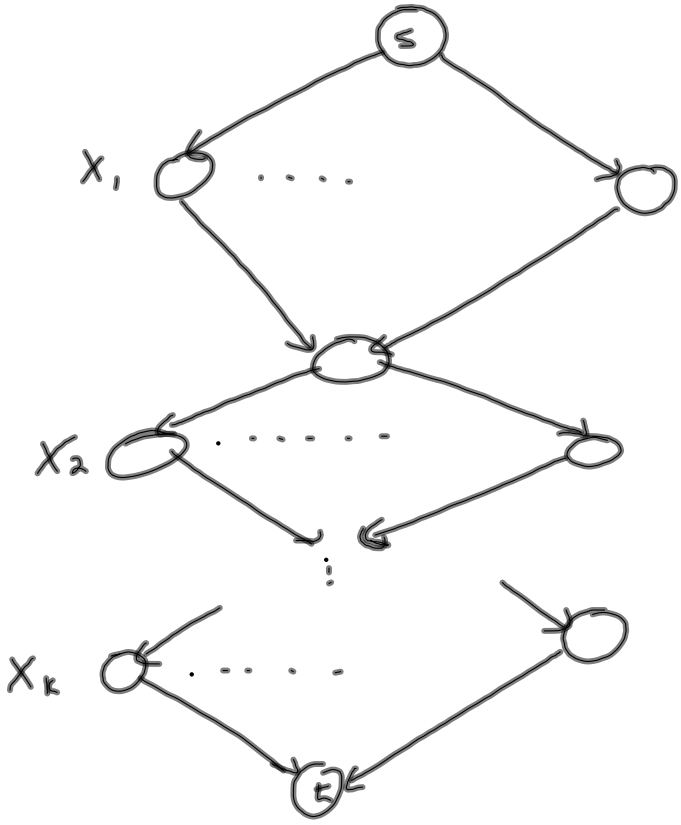
$\phi = (a_1 \vee b_1 \vee c_1) \wedge (a_2 \vee b_2 \vee c_2) \wedge \ldots \wedge (a_k \vee b_k \vee c_k)$

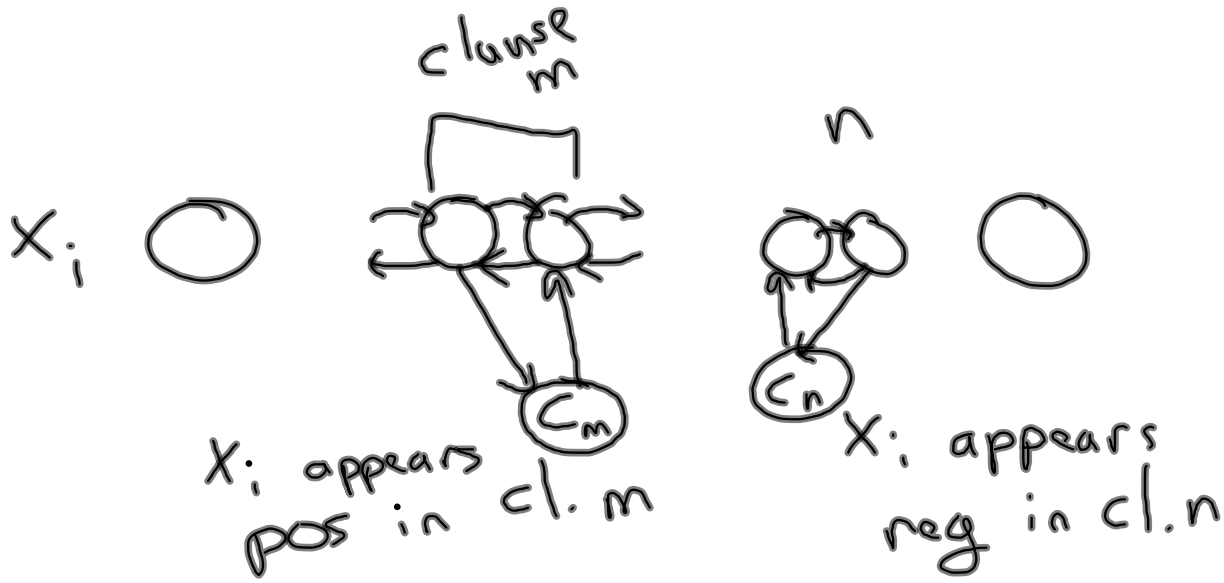
variables: $x_1 \ldots x_l$

1. add nodes to G for each clause $C_1 \ldots C_k$

for each var.






clause
m
n
x_i
C_m
C_n
x_i appears pos in cl. m
x_i appears neg in cl. n