

Thursday
8/30/18

NPC

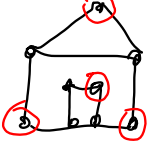
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NP

Independent Set

Input: G, k
 Q: Is there an independent set in G of size $\geq k$

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→ Decision version
 - Optimization version
 - Search version

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NPC

3SAT

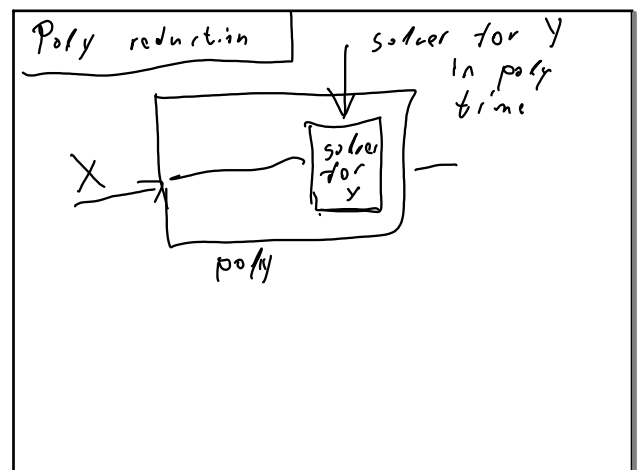
It solve 3SAT in poly time $\Rightarrow \forall$ problems in NP can be solved in polynomial time.

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Polynomial time reduction

$X \leq_p Y$: If we can solve Y in poly time then we can solve X in poly time.

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$O(n^{10}) \iff \leq c \cdot n^{10}$
 $O(n^2)$ $O(n^{7+2}) \Rightarrow O(n^{14})$
 ↑ RT of
 cols block
 to box
 6/acc (T/F)
 box

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$\exists \text{SAT} \leq_p \text{CLIQUE}$
 \geq_p
 $\exists \text{SAT} \equiv_p \text{CLIQUE}$

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CLIQUE (DECISION)
 $P \text{ OPT.} \Rightarrow K$
 CLIQUE Search:

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~~3~~ 3SAT 3 CNF
 SAT CNF
 CSAT circuit satisfiability

CLIQUE
 INDEPENDENT set

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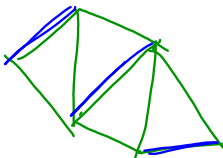
~~3~~ VERTEX COVER =

VC is a subset
 $X \subseteq V(G)$ $|G| = k$
 $\forall u \in E(G)$
 $u \in X$ or $v \in X$

min | VC of size k indep $n-k$

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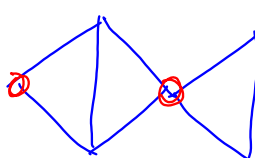
EDGE COVER



Polynomial time solvable!

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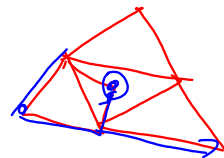
Dominating Set



G, k

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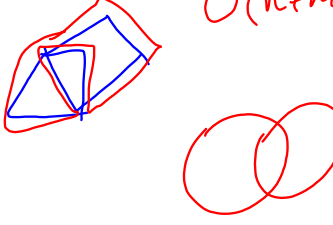
Hamiltonian Cycle/PATH



G
 $3SAT \leq_P HC$

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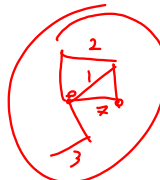
EULERIAN CYCLE # edges



$O(n+m)$

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TSP



G
 $G \times$

Is there a Hamiltonian cycle s.t. the cost of the cycle is at most α .

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SET COVER

$(S, F), k \quad F \subseteq 2^S$

$(\{1,2,3,4\}, \{\{1,2\}, \{2,3,4\}, \{1,3\}, \{1,4\}\})$

$k=2, \{1\}$

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$\{1, 2, 3, 4, 5\}$
 $F = \{ \{4, 5\}, \{2, 3, 4, 5\}, \{1, 5\} \}$

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SET COVER $F(u) = \{uv \in E(G) \mid u=v(a)\}$
 NPQ G, F
 $VC \leq_p SET\ COVER$
 $(E(G), \{F(u)\})$

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SUBSET SUM NPQ
 $S = \{ \text{positive integers, numbers } 7, 16, 34, 500, \dots \}$
 t - target
 Q: $\exists X \subseteq S$ s.t. $\sum_{x \in X} x = t$

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$3SAT \leq_p SUBSET\ SUM$
 n var m clause \Rightarrow $n+m$ numbers
 $O(n+m)$ bits.
 $t \geq 2^{n+m}$
 Thus S set of numbers t $O(nt)$ time **DP**

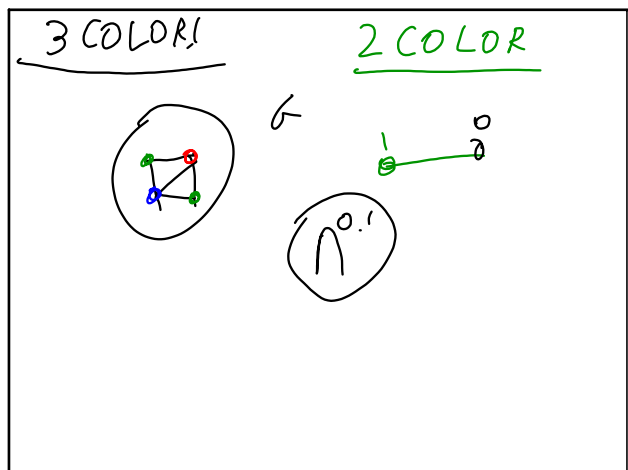
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PARTITION
 S set of numbers
 $S = S_1 \cup S_2$
 $\sum_{s \in S_1} s = \sum_{t \in S_2} t$

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BIN PACKING
 $S = \{s_1, s_2, \dots, s_n\}$
 B : Bin size
 k :

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HITTING SET
 $(S, F), k$
Q: $\exists X \subseteq S \quad |X| = k$
 $\forall f \in F \quad |f \cap X| > 0.$

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