TA evaluations today; please make sure to give your evaluation to Lirone.

Today: We mull over §9.2 ... Friday: ~~Final~~ incl exam from 2017

§9.2: Oracle machines...

T.m. + (magic button that tests membership in A in one step)

A = specified language, we often write M^A

fixed oracle T.m., A varies

"One line proof", if $A = PSPACE\text{-}SNEAKY$, ← Ch. 8.

then $P^A = NP^A$.

Could we just assert $P^{SAT} \stackrel{??}{=} NP^{SAT}$ ...

Example: $A = CONN\text{-}GRAPHS \in P$

$P^{CONN\text{-}GRAPHS} = P$ ☹ $NP^{CONN\text{-}GRAPH} = NP$ ☹

$$P = \bigcup_{k=1,2,\ldots} TIME(n^k)$$

↑ In deterministic time $O(n^k)$ can decide

$$P^A = \bigcup_{k=1,\ldots} TIME^A(n^k)$$

↑ In deterministic time $O(n^k)$ can decide with oracle calls to A

Warm up, §9.2: How big is P^{SAT}?

$$co\text{-}NP = \{ L, \text{ s.t. } \text{complement}(L) \in P \}$$

$$UNSAT = \{ \langle f \rangle \mid \begin{array}{l} f \text{ Boolean formulas s.t.} \\ \text{there is no satisfying} \\ \text{assignment for } f \end{array} \}$$

$$3\text{-UNCOLOR} = \{ \langle G \rangle \mid \begin{array}{l} G \text{ has no} \\ 3\text{-colouring} \end{array} \}$$

$$f = (x_1 \text{ or } x_2 \text{ or } \neg x_3) \text{ and } x_1 \text{ and } (x_2 \text{ or } (x_3 \text{ and } x_1)) \ldots$$

$$coNP, NP \subset P^{SAT} \leftarrow \text{magic SAT button}$$

q oracle query

q oracle says yes

q ... no

} 1 time step

tells you "yes" or "no" in one step

$NP \subset P^{SAT}$ stronger: $L \in NP$, we can run poly time alg and then at the very last step call the SAT oracle

UNSAT: given $\langle f \rangle$

hit magic SAT button

no → accept

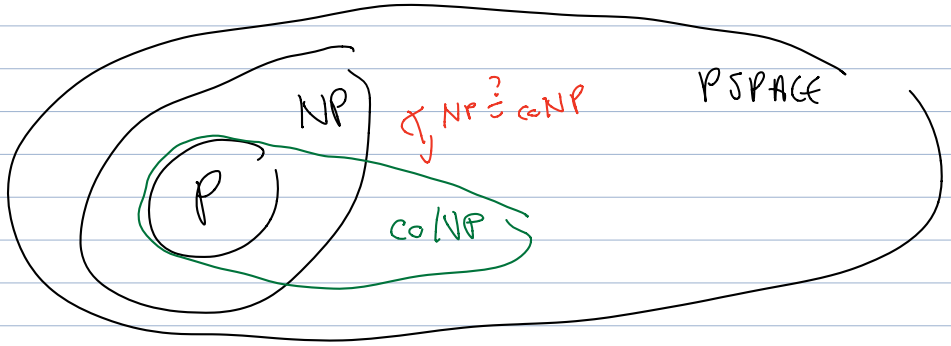
yes → reject

$UNSAT \in P^{SAT}$

Isn't P^{SAT} no more power than NP?? "Probably" not...

Could be $P = NP$, $SAT \in P$, $P^{SAT} = P^{GRAPH\text{-}CONN} = P$

But, if $coNP \neq NP$, then P^{SAT} contains $coNP$



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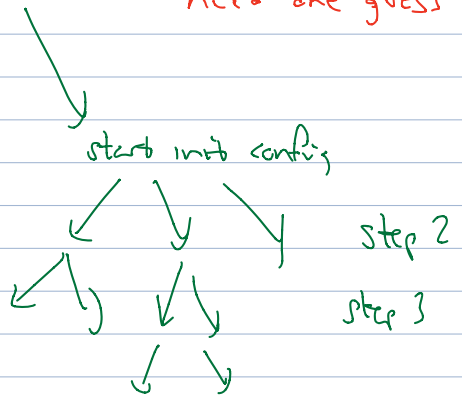
If $L \in P$, $L^{comp} \in P$ deterministic algorithm

SAT in NP since there is a non-det guess & you only need one guess

$\langle f \rangle$ is this not satisfiable ???



(∀ possible configs you reject) v.s. (∃ at least → accepting conf)