

New additional tutoring: 9-10 on Tuesdays (today! In 206)

Due Today: Pset 2 Self-Assessment, Reflection 1

Goals

- Understand NP Definition
- Prove a problem is in NP
- Discuss relationship between creativity and NP
- Place NP in our map

NP

Let $L \subseteq \{0,1\}^*$. Then $L \in \text{NP}$ if \exists a polynomial $p: \mathbb{N} \rightarrow \mathbb{N}$ and a polytime TM M s.t. $\forall x \in \{0,1\}^*$

$x \in L$ iff $\exists u \in \{0,1\}^{p(|x|)}$ s.t. $M(x,u) = 1$.

→ If $x \in L$, then $\exists u \in \{0,1\}^{p(|x|)}$ s.t. $M(x,u) = 1$

→ If $x \notin L$, then $\forall u \in \{0,1\}^{p(|x|)}$, $M(x,u) = 0$

Terminology:

• $M \Rightarrow$ Verifier

• $u \Rightarrow$ witness or certificate

ex:

$L = \{ \langle x \rangle : x \text{ is a solvable sudoku grid} \}$

u ? fill of the rest of the grid

M ? checks each row + col

$L \in \text{NP}$

Proof

Let M be the TM that on input $\langle x, u \rangle$ checks if

then if $x \in L$, x is solvable, so there exists a solution u that satisfies M 's checks.

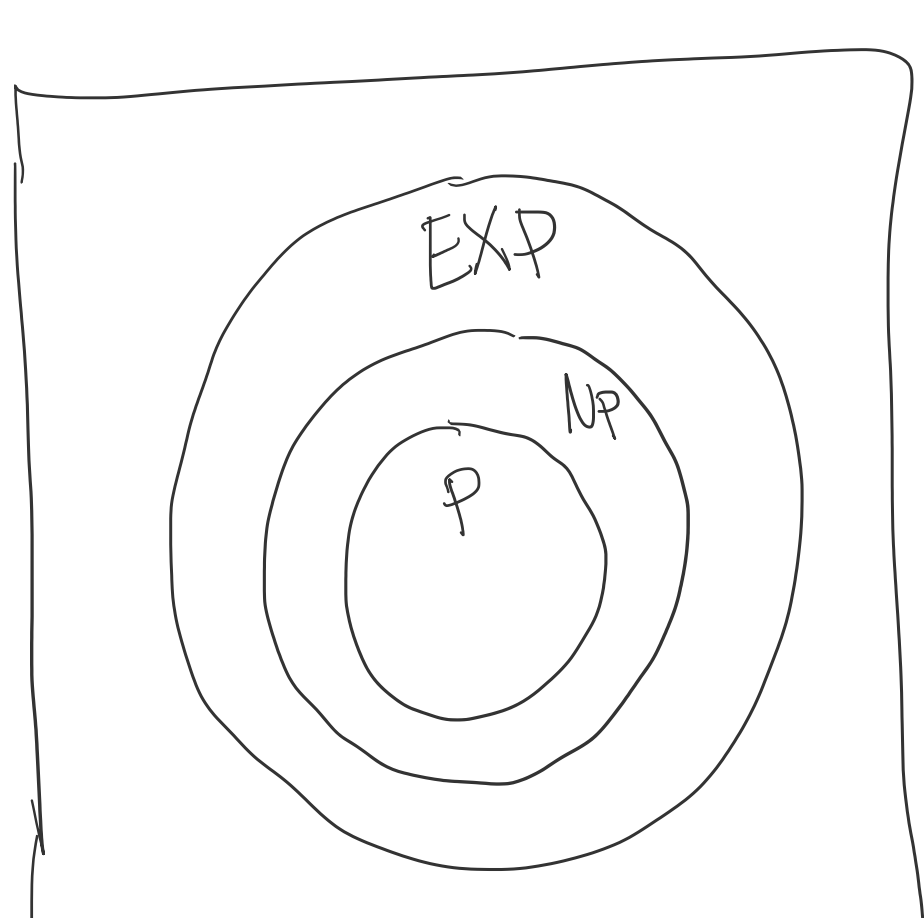
If $x \notin L$, x is not solvable, so no matter what u is given, $\langle x, u \rangle$ will fail one of M 's checks.

Note. $|u|$ is polynomial in $|x|$. M can check u in polynomial time in $|x|$. Thus $L \in \text{NP}$.

Goal: NP tries to capture creativity

Creative	Not Creative

Discuss: Is NP a good way to capture creativity?
(Q's about definition.)



Prove $P \subseteq \text{NP}$

$\text{NP} \subseteq \text{EXP}$

Strategy for $A \subseteq B$

Let $L \in A$, then \exists TM M_A that...

Let M'_B be TM that... then M' decides L , so $L \in B$