## Problem

Show that if NP = $P^{SAT}$, then NP = coNP.

## Step-by-step solution

**Step 1** of 1

If $NP = P^{SAT}$ is assumed then, there is only need to show that $NP = coNP$. It can be conclude directly from the assumption $NP = P^{SAT}$, that $P^{SAT} \subseteq NP$. As $coNP \subseteq P^{SAT}$ is already known, which result in $coNP \subseteq NP$.

• Now it is known that $P$ is closed under the complement operation, so is $P^{SAT}$, because it can be just swap the reject and accept states. It can be concluded that:

$L \in P^{SAT} \Rightarrow \overline{L} \in P^{SAT}$.

• The given statement can be managed by using the prediction $NP = P^{SAT}$, because if this would be the case any language in $P^{SAT}$ would be in $NP$ and vice versa.

• For which $NP$ also has to be closed under the complement operation $L \in NP \Rightarrow \overline{L} \in NP$, that is just the same as $L \in NP \Rightarrow L \in coNP$ from the definition of $coNP$.

• In other words, from the above explanation it can be said that $NP \subseteq coNP$. Hence $NP = coNP$.

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