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Question: Prove that $\forall L \in NP, L \leq_p HALT$

Proof:

Consider the language 3SAT.

Consider a non-deterministic turing machine M′ .

Given an expression x , reduce x to (M,x) where M is a machine that runs M' on x in all the possible ways and halts if M′ accepts in at least one of these computations.

If $x \in 3SAT \Rightarrow \exists$ an assignment for which x evaluates to T. so M′ accepts one of the assignments which means that M halts.

If M halts on $x \Rightarrow$ certain assignment was accepted by M′ .so $\exists$ an assignment for which x is true.

Since M is of constant size ,the pairing <M,x> can be done in polynomial time .

Hence, $3SAT \leq_p HALT$

We know that 3sat is NP –complete ,

$\Rightarrow \forall L \in NP, L \leq_p 3sat$ and $3SAT \leq_p HALT$

Hence, that $\forall L \in NP, L \leq_p HALT$