CSCE 5400 Formal Languages, Automata, and Computability - Fall 2024

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Assignment-6

1. **Show that NP is closed under the star operation. Provide a detailed justification for your answer.**

Ans:

If L is the language that belongs to NP, then we need to prove that L* also belongs to NP.

Given L ∈ NP, to prove L* ∈ NP

If L is an NP language, then a Tuning Machine M should decide on language L in polynomial time.

Let us consider an input string w which belongs to L*.

Now to construct a nondeterministic Tuning machine M* for L*, we use the following steps:

- On input w, machine M* nondeterministically breaks the input string w into parts such that w=w1,w2,w3,....,wn
- Now, check for every wi in wn nondeterministically determines that it belongs to L.
- If all the wi are in L, then M* accepts the string w.
- If M accepts all the substrings, then M* accepts w, otherwise, reject the input.

Algorithm:

Language L belongs to NP.

There is a nondeterministic Tuning Machine M such that the language of M, L(M) = L*

M = "On input w

1. If w = epsilon then accept.

2. Nondeterministically select a number m such that $1 \leq n \leq |w|$.

3. Nondeterministically split w into n pieces such that w = w1w2 . . . wn.

4. For all i, $1 \leq i \leq n$: run M1 on wi . If M is rejected, then reject.

5. Else (M1 accepted all wi , $1 \leq i \leq n$), accept."