Problem

Problem 8.13 showed that A_{LBA} is PSPACE-complete.

a. Do we know whether A_{LBA} ? NL? Explain your answer.

b. Do we know whether A_{LBA} ? P? Explain your answer.

Step-by-step solution

Step 1 of 3

It is being given and it is being proved in the previous chapter that $A_{LBA} \in PSPACE$.

PSPACE is basically the class of the language, whether the language belongs to deterministic finite automata or non-deterministic finite automata it is decidable in the polynomial time Turing machine.

- A language can be said *PSPACE* complete if that particular language belongs to *PSPACE*.
- For each and every language *PSPACE* hardness is satisfied.

Comment

Step 2 of 3

Here, user needs to prove that $A_{LBA} \in NL$, but as it is being given that $NP \in NPSPACE$ is *PSPACE*- complete.

With the help of space hierarchy theorem it can be proved that $A_{LBA} \in NL$.

It is being known by the Corollary of the Savitch's theorem that *PSPACE=NSPACE*, it implies deterministic space complexity and non-deterministic polynomial space complexity are basically the same.

Space complexity of *PSPACE* is $O(\log n)$ whereas space complexity of the NSPACE is $O(n^k)$ for each and every value of k_i.

So, this implies that language is basically accepted by *NSPACE* but it is not accepted by *NL*.

But, it is being known by the space hierarchy theorem that the language is accepted by PSPACE and also language is accepted by NL.

This implies that $NL \in PSPACE$

As, it is being given that $A_{LBA} \in PSPACE$

Hence, it is proved that $A_{LBA} \in NL$

Comment

Step 3 of 3

Here, user needs to prove that $A_{LBA} \in P$, but as it is being given that $NL \in PSPACE$ is *PSPACE*- complete.

With the help of space hierarchy theorem it can be proved that $A_{LBA} \in P$.

It is being known by the Corollary of the Savitch's theorem that *PSPACE=NSPACE*, it implies deterministic space complexity and non-deterministic polynomial space complexity are basically the same.

Poly-time Turing machine is not able to consume space greater than poly-space.

It implies $P \in PSPACE$ and $NP \in NPSPACE$.

As, it is being given that $A_{LBA} \in PSPACE$

Hence, it is proved that $A_{LBA} \in P$

Comment