ALL SYMBOLS WORD GENERATED BY REGULAR EXPRESSION

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Abstract. *We show that deciding whether a regular expression generates all symbols word.*

I. PROBLEM STATEMENT

Given an alphabet **A** and a regular expression, we want to check if this regular expression generate word containing all symbols in **A**.

II. PROOF OF HARDNESS

3-SAT can be reduced to this problem. Given a CNF with m clauses (**A, B, C, D, ...**) and n variables $(x_1, x_2, \dots, x_n)$, where each clause contains three literals, we can construct a corresponding regular expression on an alphabet with m symbols; the regular expression will accept a word with all m symbols if and only if the CNF is satisfiable. Specifically, the regular expression consists of n blocks of the form $(a_i | b_i)$, where a_i (resp. b_i) is a string of the symbols corresponding to exactly those clauses that contain x_i (resp. $\neg x_i$). (If a_i is empty, replace this by $b_i?$, and vice-versa.) For example, if the CNF is

$$(x_1 \vee \neg x_2 \vee \neg x_3) \wedge (x_4 \vee x_1 \vee x_2) \wedge (\neg x_4 \vee x_5 \vee \neg x_2)$$

Then the regular expression is

$$(\mathbf{AB})?(\mathbf{B|AC})\mathbf{A}(\mathbf{B|C})\mathbf{C}?$$

Any assignment of truth variables corresponds to a path through the regular expression, making a binary choice for each variable (resp., each block); a satisfying assignment (word) is one that makes every clause true (includes every symbol).

III. CONCLUSION

Garey and Johnson [1] shape their theory based on previous primal works of Cook, Levin and Karp. Johnson [2] moves on with the guide to this theory. As long as we study a mathematical conjecture, we should encourage ourselves to have moderate amount of labor hours on popular mathematics books like these. Then, reading some articles on theory of computing like [3] is a good practice. Having all those done, we could think of the ultimate final for all mathematics sciences.

REFERENCE

1. Michael R. Garey, David S. Johnson, **Computers and Intractability: A Guide to the Theory of NP-Completeness**
2. David S. Johnson, **The NP-Completeness Column: An Ongoing Guide**
3. Phan Dinh Dieu, Le Cong Thanh, Le Tuan Hoa, **Average Polynomial Time Complexity of Some NP-Complete Problems**, Theor. Comput. Sci. 46(3): 219-237 (1986)