P is equal to NP

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**Abstract.** In this paper, we prove that the complexity classes P and NP are equal by showing that the 3-SAT problem can be solved in deterministic polynomial time.

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**1. Introduction**

The P versus NP problem is one of the most important problems in computer science. In 1971, Stephan Cook proved that the 3-SAT is NP-complete [1], which means that if 3-SAT can solved in polynomial time, we can state that P=NP.

**2. Preliminaries**

See Wikipedia: http://en.wikipedia.org/wiki/Boolean\_satisfiability\_problem

**3. Main theorem**

**Theorem 1**

*3-SAT can be solved in* $O(n)$*.*

**Proof.** Let us denote given 3-SAT $E$ as follows:

$E=\left(a\_{11}∨a\_{12}∨a\_{13}\right)∧\left(a\_{21}∨a\_{22}∨a\_{23}\right)∧…∧\left(a\_{n1}∨a\_{n2}∨a\_{n3}\right)$,

where $a\_{ij}=x\_{k} or ¬x\_{k}$. Since a clause $(a\_{k1}∨a\_{k2}∨a\_{k3})$ is equals to $\left(a\_{k1}∨a\_{k2}\right)∨(a\_{k2}∨a\_{k3})$, we can reform $E$ as follows:

$E=\left(\left(a\_{11}∨a\_{12}\right)∨\left(a\_{12}∨a\_{13}\right)\right)∧…∧(\left(a\_{n1}∨a\_{n2}\right)∨\left(a\_{n2}∨a\_{n3}\right))$.

By replacing clauses with variables (in case some clauses are equal, replace them with the same variables), we can obtain 2-SAT $E^{'}$. The number of clauses of $E'$ is $n$, and the number of variables in $E'$ is at most $2n$. It is known that 2-SAT can be solved in linear time [2]. ■

For instance, for 3-SAT $\left(x\_{1}∨¬x\_{2}∨x\_{3}\right)∧(x\_{1}∨¬x\_{2}∨x\_{4})$, the corresponding 2-SAT is $\left(y\_{1}∨y\_{2}\right)∧(y\_{1}∨y\_{3})$, where $y\_{1}$, $y\_{2}$ and $y\_{3}$ are corresponding to $(x\_{1}∨¬x\_{2})$, $(¬x\_{2}∨x\_{3})$ and $(¬x\_{2}∨x\_{4})$, respectively.

**4. Conclusion**

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**References**

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2. Krom, L. R.: The Decision Problem for a Class of First-Order Formulas in Which all Disjnctions are Binary. eitschrift für Mathematische Logik und Grundlagen der Mathematik 13 (1967) 15-20