# Theoretical and Formal Proof of “P versus NP” Theorem

Mirzakhmet Syzdykov
Satbayev University, Astana, Kazakhstan
mirzakhmets@icloud.com

## ABSTRACT

After making the number of sufficient and successful experiments on account of “P versus NP” theorem, specifically according to the equivalence of complexity classes, we are giving the final and formal theoretical proof by contradiction in this paper summarizing all the results before and giving the definition of our functional hypothesis or conjecture.

**Keywords:** proof, P versus NP, theorem, complexity, class.

## INTRODUCTION

The long-standing question of the relation between intractable or non-polynomial classes of complexity has gained attention more than fifty years ago, since it was first stated by Cook [1], in the letter by John Forbes Nash – he has addressed it to be one of the important questions in mathematics and computer science.

Since that the unsuccessful attempt was done by number of researchers from the past [2, 3]. We have stated that there could be the set of feasible functions according to which the Cook’s equilibrium withholds according to the natural and mathematical notation [4]. We are to address the general breakthrough by seeing the statement of the problem according to which set of tractable polynomial class’ problems is actually a subset of non-polynomials [5].

## CONJECTURE

Let’s define the *NP* as a class of non-polynomial problems and *P* is to be a class of polynomial problems, then there exist the function *f(x)* defined as follows:

$$f(np \in NP) = P \Leftrightarrow O(f(NP)) = O(P).$$

The above conjecture states that according to feasible and existent function *f(x)* both classes are equal, since any NP-complete problem in this class can be solved and approached by applying this function [4]. In the next section we show the proof by contradiction.

## PROOF

Let’s assume that function *f(x)* doesn’t exist and classes “P” and “NP” are unequal:

$$\nexists f(np \in NP) \Rightarrow \nexists f(p \in P) : P \subseteq NP.$$

The above statement is a contradiction as problems in polynomial class are always tractable and feasible, thus, there exist any function which is defined on all its set:

$$\exists f(p \in P) \Leftrightarrow O(P) \in O(f \in F).$$

where *F* is a set of any arbitrary function, since polynomial problems can be solved in any observable amount of time.

Thus, we have that function *f(x)* is defined and exists:

$$\Rightarrow \exists f(NP) \Leftrightarrow O(f(NP)) = O(P) \Rightarrow NP = P.$$

## CONCLUSION

We have given a strict, formal and theoretical proof towards the tractability and solution for any NP-complete problem within the time space and its measurement like big O-notation. The prior results also played the sufficient role, showing that both classes are equal and Cook's equilibrium function exists.

## REFERENCES

1. Cook, S. (2003). The importance of the P versus NP question. *Journal of the ACM (JACM)*, *50*(1), 27-29.

2. Fortnow, L. (2009). The status of the P versus NP problem. *Communications of the ACM*, *52*(9), 78-86.

3. Sipser, M. (1992, July). The history and status of the P versus NP question. In *Proceedings of the twenty-fourth annual ACM symposium on Theory of computing* (pp. 603-618).

4. Syzdykov, M. (2021). Functional hypothesis of complexity classes. *Advanced technologies and computer science*, (3), 4-9.

5. Louiz, A. (2023). A Proof That the Set of NP-problems is Bigger Than the Set of P-problems by Using a Logical Consideration. *WSEAS Transactions on Computers*, *22*, 159-170.