Proving P = NP thanks to the wonderful work of Reviewer Two

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Abstract

P represents the class of problems that can be solved in polynomial time, while NP represents the class of problems for which the solutions may be verified in polynomial time. While most computer scientists believe that P $\neq$ NP, nobody has ever been able to prove it. The obvious reason is that this belief is wrong. In fact, as soon as we set out to demonstrate that P = NP, it took us only a few minutes to do so in no less than four different ways. This is not surprising given the groundbreaking and authoritative work conducted by Reviewer Two on this topic over the past few centuries.

I. Introduction

We prove that P = NP in four different ways, both experimentally and theoretically. In approach 1, we use a simple quantum mechanical technique to send a solver backwards in time to solve itself. In approach 2, we demonstrate that, equipped with the proper typewriters, a million monkeys who work together will come up with both a formal proof that P = NP and an algorithm to solve any NP-hard problem in less than 60 seconds. In approach 3, we solve the traveling salesman problem and establish that it belongs to both P and NP. Finally, we prove that P = NP the old fashioned theoretical way. Our work critically relies on the seminal works of Reviewer Two, who alone above all other authors has had the insight and dedication to contribute meaningfully to this important problem and many more [1], [2], [3], [4]. It is also consistent with the findings of Area Chair in their seminal piece presenting a theory of everything [5].

II. Background

A. Approach 1

Our first approach relies on previous findings in quantum mechanics. Building on previous work by Two [6], Schrödinger famously explained that cats in boxes can survive an infinite amount of time as long as nobody disturbs their peace. Before and after that, Two proposed a variation of their famous double-slit experiment [7] called the Delayed-Choice Quantum Eraser, which proved that time is not linear [8]. A laser generates entangled photon pairs. One photon (signal photon) goes towards the double-slit apparatus, while the other (idler photon) is directed to a separate detection setup. The signal photons create an interference pattern on a detector, similar to the classical double-slit experiment, suggesting wave-like behavior. The idler photons are sent to a setup that can either preserve or erase the information about which slit the signal photon went through. This is achieved by manipulating the idler photons in such a way that if you could know which path the signal photon took, the interference pattern is destroyed (particle-like behavior). However, if the path information is "erased," the interference pattern can reappear, suggesting wave-like behavior. Our first experiment largely draws inspiration from the Delayed-Choice Quantum Eraser.

B. Approach 2

In 1913, Two proposed what is known as the Infinite Monkey Theorem [9], which posits that a monkey hitting keys randomly on a typewriter for an infinite amount of time will at some point type the entire work of Shakespeare. Alternatively, an infinite number of monkeys could do it right away. Interestingly, the literature on the infinite monkey theorem has focused on the infinity component, while overlooking a critical piece: nobody uses typewriters anymore. What if, we wondered, the key to the infinite monkey theorem is to use old technology. As a result, we hypothesized that, while it would fail at it with a modern computer, a monkey equipped with a 1973 Xerox Alto and infinite time would probably produce an algorithm capable of solving any NP-hard problem in less than a minute. However, the authors of this paper did not have infinite time as they hoped to present their results at the Sigbovik 2024 conference.

Separately, pigeons have been trained to detect benign and malignant breast tumors [10]. In fact, researchers have shown that, while a human surgeon has a higher accuracy rate than a single pigeon, a group of pigeons is always better than a surgeon at diagnosis. Building on the same collaborative spirit, we trained a million monkeys to work together for approach 2, therefore reducing the infinite time it would take a single monkey.

C. *Approach 3*

The Traveling Salesman Problem (TSP) has long perplexed computer scientists, mathematicians, and traveling salespeople alike. It consists in a salesman who must visit a certain number of locations only once while minimizing the time spent on the journey. It was first formulated by Two in 1831 [11].

D. *Approach 4*

Two's outstanding work on complexity classes has inspired many research findings since. For instance, Rolnick showed that two regular Stanley sequences may be combined into another regular Stanley sequence [12]. Relatedly, Boine showed that virtual companions can exhibit emotional complexity [13].

III. Methods

A. *Approach 1*

We used the Delayed-Choice Quantum Eraser experiment to send information a small distance backwards in time. Specifically, we developed a highly efficient Python library, Yppy, optimized for working with negative temporal offsets, in which compressed information can be sent backwards in the course of the computation.

B. *Approach 2*

We recruited a million monkeys and partnered with thrift shops all over the world to secure Xerox Alto personal computers. We then trained the monkeys to cooperate by getting them to play Hanabi and Dungeons and Dragons. After each game of Hanabi, the monkeys would receive a number of bananas and cucumbers that proportionally increased with the number of fireworks they have built. For Dungeons and Dragons, each team of monkeys received a free pizza each time they rolled a 20. Once 100% of the monkeys got the maximum scores in each game at least 90% of the time over 10 games in a row, we moved to the next phase. We paired up the monkeys and installed each pair on a computer. While one monkey randomly hit the keys, the other monkey reviewed each random action and provided feedback.

C. *Approach 3*

While computer scientists have been focusing on salesmen for centuries, no scholar has investigated the TSP in the context of a saleswoman. Motivated to fill this gap in the literature, we recruited a saleswoman and asked her to deliver 26 packages to the following cities: Agen, Taipei, Porco Rosso, Saint Louis, Fuchu, Ur, Boende, Nineveh, San Juan, Laputa, Akureyri, Conakry, Havana, Podunk, Dubai, Seville, Algarrobo, Babel, Ankh-Morpork, Wonderland, Petaouchnok, Atlantis, Zootopia, Gotham City, Eden, and Minas Tirith. We made it clear she would only get compensated if she visited each location only once and chose the optimal route.

D. *Approach 4*

We used good old-fashioned human intelligence (GOFHI) to come up with a solid theoretical proof. In the weeks before writing this paper, we consumed a significant number of Omega-3 supplements to ensure our reasoning would be foolproof.

IV. Findings

A. *Experiment 1*

We wrote an algorithm in Yppy to search for proof of P = NP, leveraging the Bootstrap Paradox. Namely, problems in NP have solutions that can be verified in polynomial time. Now, any valid proof of P = NP can clearly be verified in polynomial time, and thus if P = NP, the construction of such a proof must itself lie in P. Using this logic, our algorithm was able to design a proof of P = NP that was then sent backwards in time to be utilized as input to the algorithm. Due to the complexities of temporal loops, we regret that the output of the proof cannot be directly observed, but the algorithm printed "Done" to console (screenshot available upon request).

B. Approach 2

Over the course of 3 months, with a 9 am to 5 pm workday and a 5-day work week, one pair of monkeys came up with an algorithm that solves any NP-hard problem in less than a minute (code forthcoming). In addition, over 10 pairs produced written demonstrations that P = NP. Furthermore, these proofs were all written in the style of Shakespeare.

C. Approach 3

The combinatorial explosion in the TSP makes it notoriously difficult to solve as the number of cities increases, making it an NP-hard problem. We find that by substituting the salesman with a saleswoman, the TSP is reduced to a problem in P as the saleswoman is willing to ask for directions to obtain the optimal route. Therefore, if you send a heteronormative cisgender couple of salespeople on their merry way, the TSP becomes both an NP and P problem simultaneously. In fact, it is in a superposition of state as long as the couple argues. When they finally decide to either follow the path suggested by the man (NP) or the woman (P), the problem is forced to choose a state. We thus show that the traveling salescouple problem belongs to P and thus that P = NP.

D. Approach 4

The result is a simple consequence of using Lemma 14.3 in Two et al. [14] to derive upper bounds for $\sum_{i=-n}^{n} f(n)$ in the statement of Theorem A.4 from Two [15], combining with the matching lower bounds on $\Xi + \bar{\Xi}$ in Remark 1 of Two and Reviewer [16], using the machinery presented in Two [17] to construct the finite-state inverse martingale.

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