Open Problems Column
Edited by William Gasarch

1 This Issue's Column!

This issue's Open Problem Column is by William Gasarch and is P *vs* NP*: Invitation to take a Poll*

2 Request for Columns!

I invite any reader who has knowledge of some area to contact me and arrange to write a column about open problems in that area. That area can be (1) broad or narrow or anywhere in between, and (2) really important or really unimportant or anywhere in between.

P vs NP and Related Questions: Invitation to take a Poll

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By William Gasarch

3 Introduction

There have been two polls asking theorists (and others) what they though of P vs NP (and other questions) [**?**, **?**]. Both were written by William Gasarch and appeared in the Complexity Column of SIGACT News, edited by Lane A. Hemaspaandra. They were in 2002 and 2012. Since William Gasarch is fond of van der Warden's theorem, you would think the next poll would be 2022; however, Lane asked if it could be a bit earlier so as to be the 100th issue of his column. So here we are.

In the past the questions for the poll appeared in Lane's column. This time they appear here in the *Open Problems Column*, which makes sense since, well, P vs NP is indeed an open problem.

In this column I will, in Section **??**, pose the questions for the poll. I invite you to take the poll at surveymonkey:

`https://www.surveymonkey.com/r/PversusNP`

At the site above you can also leave comments on your choices and I urge you to do so! Often the comments are more interesting than the binary YES-NO. Also – do not feel obligated to answer all of the questions.

It would be great if you could do it *now*, while the questions are fresh in your mind. You don't have to think long or hard if you don't wish to: treating it like a TCS Rorschach test and giving your instant, gut answers might surprise me and even you.

This column is about what people *think* the status of P vs NP is and will be. For information on what *is* the status of P vs NP see Scott Aaronson's article [**?**], Lance Fortnow's article [**?**], or (for the layperson) Lance Fortnow's book [**?**].

4 Questions

1. Do you think P = NP?
2. When do you think the question will be resolved?
3. (Answer this one only if you answered P $\neq$ NP above.) Sasha Razborov, Avi Wigderson, and Andy Yao (or three other wise people whose opinions on P vs NP you take seriously) all knocked at your door at 3 a.m. to tell you that P vs NP has been resolved — but after announcing it dashed off to tell Lane the good news — without telling you in which direction or how it had been resolved! Which way do you think it went? (This question measures what is stronger: your belief that P $\neq$ NP or your believe that we are no where near proving P $\neq$ NP.)
4. What kind of mathematics will be used to resolve P vs NP?
5. Do you think the polynomial hierarchy is proper (i.e., does not collapse: $\Sigma_1^p \subset \Sigma_2^p \cdots$)?
6. Do you think that SAT has polynomial-sized circuits?
7. Do you think P = BPP?
8. Do you think that SAT $\in$ BQP (commonly called *Quantum P*) implies that the polynomial hierarchy collapses?
9. Do you think P = NP $\cap$ coNP?
10. Do you think Graph Isomorphism is in P?
11. Do you think factoring is in polynomial time?
12. If you answered P $\neq$ NP above do you believe that an obstacle is "hard instances", for example, for any deterministic Turing machine M accepting the language

    $$L = \{(N, x, 1^t) : \text{Nondeterministic } N \text{ does not halt on input } x \text{ within } t \text{ steps } \}$$

    there exists (N', x') such that the runtime of M on $(N', x', 1^t)$ is not bounded by a polynomial t^c?
13. If someone shows P = NP will this have a big effect on practical computing?
14. If someone shows P $\neq$ NP will this have a big effect on practical computing?
15. Given that SAT-SOLVERS are now quite good, will P vs NP become less relevant?
16. Aside from P vs NP which open problem do you most want to see solved?
17. Anything else you want to comment on, feel free!
18. Do I have permission to print your response with your name? without your name? not at all?
19. What is your highest degree? What is it in? Where is it from? When did you get it? The answer will not appear in the article; however, I want it for statistical use.

References

[1] S. Aaaronson. P=?NP. In J. Nash and M. Rassias, editors, *Open problems in mathematics*. Springer, 2016.

[2] L. Fortnow. The status of the P versus NP problem. *Communications of the ACM*, 86(8):78–86, 2009.

[3] L. Fortnow. *The golden ticket: P, NP, and the search for the impossible*. Princeton University, 2013.

[4] W. Gasarch. Complexity Theory Column 36: The P=NP poll. *SIGACT News*, 33(2):34–47, 2002.

[5] W. Gasarch. Complexity Theory Column 74: The P=NP poll. *SIGACT News*, 43(2):53–77, 2012.