H A R D

It's too hard.

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1 Hard Problems

Many problems have polynomial $O(n^k)$ time solutions. Some problems haven't had a polynomial time solution.

2 Complexity Classes

P Set of problems we can solve in polynomial time. Sorting, Searching. . .

NP Verifiable in polynomial time. If you can solve in polynomial time, you can verify in polynomial time, but it's not always true in the other direction.

NP-Complete Set of problems that <u>ANY</u> problem in NP can be transformed into in polynomial time. Decision.

NP-Hard At least as hard as hard as hard as hard as any problem in NP. Optimization.

3 P vs NP

P = NP? If you can find a polynomial solution in NP-Complete, then you can transform any NP problem into NP-Complete in polynomial time and then solve it. So if you can prove P = NP you're a genius millionare.

4 NP-Complete Problems

4.1 Boolean Satisfiability

kCNF (k Conjunctive Normal Form) - A way to express a logical statement. Each or has exactly k variables.

- "AND" of many "OR" expressions, each of which contains K variables or their negations.

- (P || !Q) && (R || Q) && (!P || !R) - 2 CNF because each or has 2 variables.

4.2 kSAT

Given an expression in KCNF is there an assignment of vars that makes it evaluate to true.
k = 2 (2SAT) ϵ P
k > 2 ϵ NP-Complete