Undergraduate Colloquium in Mathematics
Wednesday, March 21, 3:00 PM – 4:00 PM
STV 346

P versus NP, a Millennium Prize Problem

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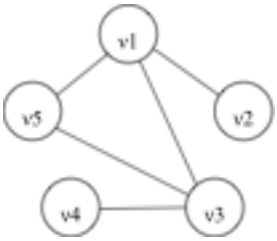
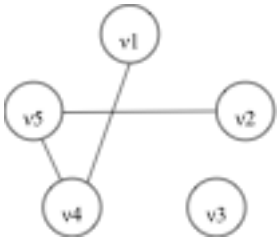
Compared to the long history of mathematics, Computational Complexity is still a very young research area. A theoretical analysis on algorithms gave birth to this study with some results that counter our intuitions, while some concepts are so intuitive but we fail to give rigorous proofs to justify our intuitions. One of the most fascinating open questions in theoretical computer science is whether or not the two intuitively different complexity classes, P and NP, are indeed different?

In this talk, we will explore the concept of nondeterminism and nondeterministic algorithms, which is a commonly misused and misunderstood concept even among computer scientists (including the one who bothered to edit Wikipedia). Then, we examine P, NP and NP-completeness, and argue that problems that cannot be solved efficiently by computers in many cases are not because of the lack of computer power or good programming skills, but because of the intrinsic difficulty of the problems.

Consider the following three problems.
1. What is the maximum clique of Graph A?
2. What is the minimum vertex cover of graph B?



Graph A



Graph B

3. Let S = {1, 4, 16, 64, 256, 1040, 1089, 1108, 1280, 1285}. Can we find a subset of S, its sum is 1706, 2730, or 3754?

How to relate them to each other and argue that if we can solve one efficiently, then we can solve the other two efficiently? Ultimately, does such efficient algorithm exist? If it is a programming assignment due next week, or a real industrial project need to be finished under some time constraints, should we spend time to find an efficient algorithm? If not, how to justify our choice? We need to provide a theoretical framework to characterize computable problems in terms of their hardness.