Illinois Wesleyan University
Digital Commons @ IWU

John Wesley Powell Student Research Conference

2006, 17th Annual JWP Conference

Apr 8th, 11:00 AM - 12:00 PM

Limits of Diagonalization and the Polynomial Hierarchy

Kyle Barkmeier
Illinois Wesleyan University

Hans-Joerg Tiede, Faculty Advisor
Illinois Wesleyan University

Oral Presentation O13.1

LIMITS OF DIAGONALIZATION AND THE POLYNOMIAL HIERARCHY

Kyle Barkmeier and Hans-Joerg Tiede *
Computer Science Department, Illinois Wesleyan University

The question of P versus NP has long eluded complexity theorists, and has been a major area of research for the past 35 years. There is even a one million dollar bounty to the individual that can prove whether or not P is equal to NP. If the class of "efficiently" solvable languages (P) were equal to NP, a class containing many intuitively "harder" languages, it would imply that all of these "hard" languages have efficient solutions that we have not yet found. In fact, there is an entire hierarchy of increasingly difficult classes above (and containing) P and NP called the polynomial hierarchy. It has also not been proven whether or not the levels contained in it are distinct. This is where diagonalization comes in. Diagonalization is a proof method similar to a proof by contradiction that is frequently used to separate sets. However, there are good indications that diagonalization cannot be used to separate P and NP (or any similar set of classes in the polynomial hierarchy), even though is has been proven that if P and NP can be proved separate, a proof of this can be expressed as a diagonalization proof. The focus of this study is how these two seemingly contradictory statements can be reconciled for P and NP, as well as whether the same applies to higher classes in the polynomial hierarchy.