

Syllabus (Content) CMSC 652- Complexity Theory

We will be covering a subset of the following topics.

1. How can some problems be more undecidable than others? Computability and reductions.
2. Are there problems that take LOTS of time to decide? Time-hierarchy theorems.
3. Why do we think SAT and many other problems are hard? Cook's theorem and reductions.
4. Do we actually know anything? $NSPACE(S(n)) \subseteq NSPACE(S(n)^2)$ (Savitch's Theorem), $NSPACE(S(n)) = co - NSPACE(S(n))$ (Immerman-Szelepcsenyi Theorem.) (NOTE- these will be presentation-assignments.)
5. Sharp P and the Permanent. (NOTE- this will be presentation-assignments.)
6. Why do we think Sparse sets are NOT NP-Complete? Mahaney's theorem, Karp-Lipton theorem, and the Poly Hierarchy.
7. Circuit complexity and Poly time with advice.
8. Why do we think Graph Isomorphism is NOT NP-complete? Interactive Proof Systems.
9. If we KNOW that a formula has ≤ 1 satisfying assignment, then is telling if its in ϕ easy?
10. Why do we think Clique and many other problems are hard to approximate? The PCP theorem
11. $\#P$ and the Permanent. (NOTE- this will be presentation-assignments.)
12. Why do we think $\#P$ is much harder than NP? Sharp-P and Toda's Theorem.