COS522: Computational Complexity Fall 2011

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Lecture 6 notes Oct 4. Continuing discussion of circuits.

1. Circuit recap.
2. Equivalence to Straight line programs. Note: different program for each input size.
3. Characterization using TM’s with advice.
4. [KL] If NP has poly size circuits, PH = \Sigma\_2.
5. Proof: Show \Phi\_2 is in \Sigma\_2. \Pi\_2: forall followed by exists. Can hope to replace exists with a deterministic computation if we have the circuit. Guess the SAT circuit at the start? How to check it is the right circuit?
6. Main idea: search reduces to decision for SAT. There is also a poly size circuit that generates the true assignment for every satisfiable formula. Guess that.
7. There exist languages that require circuits of size 2^n/n. Counting argument. Number of circuits of size S (assuming constant degree) is at most 2^{O(S \log S)}. Number of boolean functions on n bits is 2^{2^n}}.
8. Mention Meyer’s theorem.
9. Parallel computation. NC, AC0. Examples: addition, multiplication. Matrix multiplication.
10. Nonuniform hierarchy theorem.
11. Circuits of exponential size. Characterizations of PH.
12. Randomized computation. Simulating arbitrary bias with fair coin and vice versa.
13. Polynomial identity testing. Fingerprinting trick.