Approximation Algorithms

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1. Basic facts from Probability Theory - Tail bounds.
2. **NP-completeness**. SAT.
   (a) Problems as languages over Σ^*.
   (b) Certificates and the class **NP**.
   (c) Computation tree of a non-deterministic computation.
   (d) Conjectures and theorems.
   (e) Reductions (Turing and Karp) and **NP-completeness**.
   (f) Optimization problem and **NP-hardness**. Why decision problems are strong enough?
   (g) Reductions must be hardness preserving.
   (h) Approximation factor preserving reductions.
   (i) Self-reducibility.
   (j) Weak and strong **NP-completeness**.
   (k) The class **coNP** and the class **P**.
   (l) Randomized complexity classes, **RP**, **coRP** and **ZPP**.
3. Linear Programming - Forms, Duality, Farkas' Lemma. Relaxing a constraint.
4. How to solve: Simplex, Ellipsoid, Karmarkar, Fourier-Motzkin.
5. Integer Programming - Hardness, Modeling tool. Knapsack, Vertex cover, independent set, set cover, Disjunction, Implication, k out of m constraints.
6. Relation between LP and IP.
7. How to solve IPs. Branch and Bound. Cutting planes. Implicit enumeration.