COT6410 Topics for Final Exams

Computability Theory (E1 on Tuesday, April 15)

- Relations between rec, re, co-re, re-complete, non-re/non-co-re
- Proofs about relations, e.g., re & co-re => decidable;
  - union of re and rec is re but can be rec
- Use of quantified decidable predicates to categorize complexity
- Reduction (many-one); degrees of unsolvability (many-one)
- Rice's Theorem (including its proof)
- Applications of Rice's Theorem
- Proof of re-completeness (re and known re-complete reduces to problem)
- Basic decidability results in formal grammars
- Trace languages (CSL) and complement of trace languages (CFL)
  - $L = \Sigma^*$ for CFL, $L \neq \emptyset$ for CSL
  - For CFL L, $L = L^2$?
  - For CFL L, $\exists n\ L^n = L^{n+1}$?
- Post Correspondence Problem
- PCP and context free grammars
  - From any PCP instance, P, can specify CFGs, G1 and G2, such that $L(G1) \cap L(G2) \neq \emptyset$ iff P has a solution
  - Merging these together to new grammar G with start symbol S and rule $S \rightarrow S1 \mid S2$ where S1 is start symbol of G1 and S2 is start symbol og G2 we have that G is ambiguous iff P has a solution
- PCP and context sensitive grammars
  - From any PCP instance, P, can specify CSG, G, such that $L(G) \neq \emptyset$ iff P has a solution; it is also the case that L(G) is infinite if so
  - Note that this is second proof of udecidability of emptiness for CSG
- PSG
  - Given TM, M, can specify PSG, G, such that L(G) = L(M)
  - Every PSL is homomorphic image of a CSL
- Quotient
  - Given TM, M, can specify CFGs, G1 and G2, such that L(G1) / L(G2) = L(M)

Complexity Theory (E2 on Thursday, April 17)

P, NP (verification vs non-det. Solution), co-NP, NP-Complete
FP, FNP, TFNP, NP-Easy, NP-Hard, NP-Equivalent, PSPACE
Problems I will focus on
SAT, 3-SAT
SubsetSum, Partition, Bin Packing, Knapsack
k-vertex cover, k-coloring (3-coloring), Hamiltonian circuit, Travelling Salesman
Deadline scheduling
Scheduling heuristics and anomalies
Unit execution scheduling of tree/forest and of anti-tree/anti-forest
Integer Linear Programming Feasibility
Is there an assignment that satisfies the constraints; 0-1 case?
Relation of ILP to subset sum
Independent set problem for undirected graph
Optimization versions of SubsetSum (closest to goal), Partition (closest to split)
k-coloring (min coloring), k-vertex cover (min vertex cover)
min sum of weights for TS, rather than setting fixed goal
Integer linear programming optimality
What is the solution that minimizes or maximizes some objective function?