**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 = Σ\* for CFL, L ≠ ∅ for CSL

For CFL L, L = L2 ?

For CFL L, ∃n Ln = Ln+1 ?

Post Correspondence Problem

PCP and context free grammars

From any PCP instance, P, can specify CFGs, G1 and G2, such that   
L(G1) ∩ L(G2) ≠ ∅ iff P has a solution

Merging these together to new grammar G with start symbol S and rule

S → S1 | 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) ≠ ∅ 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?