COT 6315/CIS 4930 (Spring02,Sitharam)

Sample Test 2(2 hrs–closed book)

Note this is only a rough guide. The structure will be similar. I.e, classification questions.

Individual items need not follow pattern of those given below. You need to work on the HW and other exercises in book – the items can follow the spirit of any of them.

–Please write your name and code legibly on top of your answer sheet.

–**Answer all questions.** Please budget your time so that you spend no more than an average of 17 min on each (sub)question.

1. Classify the following languages are regular, contextfree but not regular; or decidable but not context free. Give a full justification of your classification.

   (a) The set QUITEEQUAL of strings in a 4 letter alphabet, in which the numbers of a's and b's are equal; and the numbers of c's and d's are equal.

   (b) The set WEIRD of strings of 0's and 1's which have: an even number of 0's, a number of 1's that is not a multiple of 5, and end with an odd number of 0's (atleast 3). So, for example 0110110000 is not in the language, but 0011011000 is; 0000, 00100 and 0101010101000 are not in the language but 0100000 is.

   (c) Let L be regular. Classify the language VERYDIFFERENT(L) = $\{z : \forall x, u, v \in \Sigma^* \ \ (xuv = z) \Rightarrow (u \notin L)\}$ I.e, VERYDIFFERENT(L) is the set of all strings of which no substring belongs in L.

   (d) The set BALANCED = $\{a^k b^l c^m d^n : n + k = m + l\}$.

2. (28% of the points) Classify the following languages as recursive (decidable), recursively enumerable but not recursive (r.e. but undecidable); or not recursively enumerable. Assume in all cases a single consistent pseudocode programming language, so that 'one instruction execution step' is a well-defined quantity. In all cases, fully justify your answer.

   (a) The set of tuples (M_1, M_2, x), where M_1 and M_2 are pseudocodes and $x \in \Sigma^*$, such that M_1 and M_2 both halt and accept x in the same number of instruction steps.

   (b) The set of tuples (M_1, M_2, x) of pseudocodes along with a string $x \in \Sigma^*$ such that M_1 and M_2 both halt and accept x in exactly $|x|^2$ instruction steps.

(c) The set of pairs (M_1, M_2) of pseudocodes such that there is some $x \in \Sigma^*$ such that both M_1 and M_2 halt and accept x in the same number of instruction steps.