CS 1511 Exam II

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11 November 2002

Instructions: This is a closed book, note and neighbor exam! You must **show all work** in the space provided on this test.

Name: _____

Question	Points	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

Question 1 (20 points)

a) Prove that the language E_{CFG} is decidable. Be sure to give complete details of the proof in addition to the details of your construction.

b) Is your decider an LBA? Explain.

Question 2 (20 points) Using a *diagonalization argument* prove that the set $\{f \mid f : \Sigma^* \longrightarrow \Sigma^*\}$ is uncountable.

Question 3 (20 points)

a) Give the definition of a *computable function* $f : \Sigma^* \longrightarrow \Sigma^*$.

b) Give the definition of $A \leq_m B$ for languages A and B.

c) Prove that $A_{TM} \not\leq_m E_{TM}$.

Question 4 (20 points) Prove that E_{TM} is not decidable. Be sure to give complete details of the proof in addition to the details of your construction.

Question 5 (20 points)

a) State the fixed-point version of the Recursion Theorem.

b) Let $t : \Sigma^* \longrightarrow \Sigma^*$ be a transformation that reverses every transition in the state transition diagram of a Turing Machine *except* transitions to q_{accept} and q_{reject}. Give an example of a **non-empty** decidable language L over $\{a, b\}^*$ and a Turing Machine decider M for L that is a fixed-point for the transformation t. Explain in detail why M's behavior is immune to this transformation.
(Note: consider M to output "yes" if $w \in L$ and "no" if $w \notin L$.)
(Hint: consider a very simple Turing Machine that behaves like a DFA)