COSC 3340/6309 Final Examination

Thursday, July 6, 2017, 11 am – 2 pm

Open Book and Notes   Final grades only through PeopleSoft

<u>YOU MUST USE THE CONSTRUCTIONS GIVEN IN CLASS</u>

1. Construct a regular expression over {a,b,c} for the language accepted by this nfa:

	a	b	c	
→ A	/	B,C	/	0
B	B	/	C	1
C	/	A,B	/	1

2. Prove that the language L(G) is not regular where G is the following cfg:

$G = (\{S,A,B\}, \{a,b\}, \{S \to Abb|B, A \to aS, B \to b\}, S)$.

Note: You <u>must</u> first determine L(G).

3. Construct a reduced dfa for the following extended regular expression over {0,1}:

$[(10^*)^* \cap 0^*10^*]$

Note: You <u>must</u> first determine nfas for (10*)* and 0*10*, then do the intersection. The answer must then be reduced.

4. Construct a **Chomsky** normal form grammar for L(G) for the following cfg G:

$G = (\{S,B\}, \{a,b,c,d\}, \{S \to Sb|Ba, B \to cBdB|S|\varepsilon\}, S)$.

Note: You <u>must</u> first remove all ε- and all unit productions.

5. Construct a **Greibach** normal form grammar for L(G) for the following CNF G:

$G = (\{S,A\}, \{a,b\}, \{S \to ASS|A, A \to SSS|aba\}, S)$.

Note: You <u>must</u> first remove all unit productions. You <u>must</u> derive all the productions for S and A; indicate how the result looks for S' and A'.

6. Prove that the following language L is not contextfree: $L = \{ 0^n1^n0^{n+2} \mid n \geq 1 \}$.

7. Consider the class CF_A of all context free languages over the fixed alphabet A.

(a) Is CF_A countable?

(b) Is the class $NOTCF_A$ countable where $NOTCF_A$ consists of all languages over A that are not context free?

(c) Is the class $CF_A \cap NOTCF_A$ countable?

For each question, you must give a precise argument substantiating your answer.

8. Construct a Turing machine for the language in Question 6, $L = \{ 0^n1^n0^{n+2} \mid n \geq 1 \}$.

Note: Describe first the process in English; then translate this into moves of the Turing machine.

9. Let L_1 and L_2 be arbitrary languages, subject to the specification in either (i) or (ii).

Consider the following four questions:

(Q1) Does $L_1 - L_2$ contain a given fixed word w?   (Q2) Is $L_1 - L_2$ empty?

(Q3) Does $L_1 \cap L_2$ contain a given fixed word w?   (Q4) Is $L_1 \cap L_2$ empty?

For each of these four questions **<u>explain with reasons</u>** whether the general problem is <u>recursive</u>, <u>not recursive but r. e.</u>, or <u>non-r. e.</u>, provided

(i) Both L_1 and L_2 are <u>recursive</u>.

(ii) L_1 is <u>r. e., but not recursive</u> and L_2 is <u>recursive.</u>

Note that there are **eight** different questions to be answered.

Points: 1: 6 2: 8 3: 15 4: 11 5: 12 6: 12 7: 13 8: 8 9:15