**Spring 2015 COT 4210 Exam #2**

**April 2, 2015**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1) (15 pts) Define EQCFG = { <G1, G2> | G1 and G2 are CFGs with L(G1) = L(G2) }. With proof, determine whether or not EQCFG is decidable.

2) (15 pts) In class we spent time on an example illustrating the proof that the PCP is undecidable. Based on that proof, recreate the matching tiles that correspond to the following accepting computation history:

#q0ab#cq1b#cdq2˽#cd˽qacc#

3) (10 pts) We mentioned in class that ∑\* is a countable set. In order to prove this, we can enumerate the items in this set in lexicographical order (shortest strings first, breaking ties "alphabetically"). Complete the program below so that it prints out all strings in the set ∑3, where ∑ is the lowercase letters, in alphabetical order.

import java.util.\*;

public class enumerate {

public static void main(String[] args) {

printAll(3);

}

public static void printAll(int n) {

char[] res = new char[n];

printAll(res, 0);

}

public static void printAll(char[] prefix, int k) {

if (k == prefix.length)

System.out.println(new String(prefix));

else {

// All added code must go here.

}

}

}

4) (20 pts) A Turing machine with a doubly infinite tape does not have a left end to its tape. Rather, the tape extends infinitely to both the left and the right of the input, with blank spaces. Prove that this type of Turing machine recognizes the class of Turing-recognizable languages.

5) (15 pts) Let FINITEDFA = {<D> | D is a DFA that accepts a finite number of strings}. With proof, determine whether or not FINITEDFA is decidable.

6) (20 pts) Let CANHALTTM = {<M> | M is a TM that halts on at least one input}. Properly categorize CANHALTTM as Turing decidable, Turing recognizable or co-Turing recognizable. (If the language fits in more than one of these categories, list the first one it belongs to.) Prove your result.

8) (5 pts) What shape is a Magic Square? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Scratch Page - Please clearly mark any work on this page you would like graded.**