Theory of Computation, CSCI 438, Spring 2021
Exam 3, ~~March 26~~ March 31st

Name _____

Essay portion of the exam. (10 pts.)

Definition

1. Define what it means for a language to be Turing-recognizable (also called recursively enumerable). (5 pts.)

Short Answer

2. Describe the difference between a language being Turing-recognizable and Turing-decidable. (5 pts.)

3. Give the inputs to each of the following languages: (10 pts.)

$E_{RegExpression}$

$EQ_{RegExpression}$

$A_{RegExpression}$

Problem Solving

4. Let $ALL_{DFA} = \{<A> \mid A \text{ is a DFA and } \mathcal{L}(A) = \Sigma^*\}$.
   Show that ALL_{DFA} is decidable. (10 pts.)

5. Fill out the columns, telling if the language is regular, context-free, decidable and/or Turing recognizable and how you would show this. (15 pts.)

Needs fixing

Language	**The language is regular**	**The language is context free**	**Decidable**	**Turing recognizable**
L={w | w is a palindrome}				
L={w such that w begins and ends with the same symbol }				
$L=\{a^n b^m c^k \mid n=m \text{ or } m=k\}$				

6. Create a Turing machine that recognizes

$L = \{w \mid w \in \{0,1\}^* \text{ and } w \text{ contains twice as many 0s as 1s}\}$.

High-level plan: (10 pts.)

Detailed plan: (10 pts.)

Turing machine: (5 pts.)

Proof

7. Let ADD be the language defined by
ADD={a=b+c | a, b, c are binary integers, and a is the sum of b and c}.

The alphabet for ADD is {0, 1, +, =}. Binary integers are any non-empty combination of 0s and 1s.

If ADD is context-free, create a CFG or a PDA for it. If it is not context-free, prove that it is not using a pumping lemma. (20 pts.)