

CS 1511 Exam I

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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	25	
2	25	
3	25	
4	25	
Total	100	

Question 1 (25 points)

- a) Construct (the state transition diagram for) a deterministic single-tape Turing Machine that is a decider for the language

$$L = \{ww^R : w \in \{a,b\}^*\}$$

[Be sure to include all transitions.]

- b) Give a brief description of how your TM works.
- c) Show (by giving the exact sequence of TM configurations) how your TM works on the input string *ababa*.

Question 2 (25 points)

- a) Construct a Context-Free Grammar that generates the language

$$L = \{a^m b^n c^m : m, n \geq 0\}$$

- b) Give a leftmost derivation for $aabbcc$ with respect to your grammar.
- c) Give the derivation tree for the string $aabbcc$ with respect to your grammar.

Question 3 (25 points)

- a) Construct (the state transition diagram for) a Push-Down Automaton that recognizes the language

$$L = \{a^m b^n : m = n \text{ or } m = 2n\}$$

[Be sure to include all transitions.]

- b) Give a brief English description of how your PDA works.
- c) Show (by means of a detailed step by step trace which includes the state of the input, PDA state, and stack) how it works on the input *aaabb*.

Question 4 (25 points)

a) State the Pumping Lemma for:

- i) Regular Languages
- ii) Context-Free Languages

[Be sure to include all required quantifiers and components of the statements.]

b) Consider the following language

$$L = \{a^{n^2} : n \geq 0\}$$

- i) Is L context-free?
- ii) If L is **not** context-free, then prove this by using the Pumping Lemma for Context-Free Languages. **Otherwise**, prove it is not regular by using the Pumping Lemma for Regular Languages.