CS 2200 Homework CNF & TM 1

Due Monday, April 18, 2022 before midnight

Name your machines with your last name and the problem number. For example, the first problem for Jane Doe would be "doe1a". You may submit pdfs or JFLAP saved machines.

Assume: Unless noted, the empty string λ is *not* in the alphabet Σ. 5 points each.

1) Given alphabet $\Sigma = \{a, b\}$, create a grammar to generate the languages:
   a) $L(A) : A = \{w : a^n b^n\}$ where $n \geq 0$ [5 points]
   b) $L(B) : B = \{w : a^n b^{n+1}\}$ where $n \geq 0$ [5 points]
   c) $L(B) : B = \{w : a^n b^{n-1}\}$ where $n \geq 0$ [5 points]

2) Change each of the languages in problem 1 to Chomsky Normal Form. [10 points each]

3) Given the following grammar:

   S $\rightarrow$ aAB
   A $\rightarrow$ bBb
   B $\rightarrow$ A | λ

   a) Convert this grammar to Chomsky Normal Form. [10 points]
   b) Give a possible derivation of *abbbb* [5 points]

Assume an alphabet of $\Sigma = \{0, 1\}$ as binary digits. Create a Turing machine that accepts each language.

4) $L(A) : A = \{w$ where w is an even number.$\}$ [10 points]
5) $L(B) : B = \{w$ where w is a palindrome.$\}$ [15 points]
6) $L(C) : C = \{0^n 1^n\}$ [10 points]
7) $L(D) : D = \{0^n 1^{n+1}\}$ [10 points]
8) $L(E) : E = \{w : w$ has the same number of ones and zeros **in any order.**$\}$
   For example, 0110 is in the language as is 0011. 010111 is not. [20 points]