**CSCE 4323 / CSCE 5173 – Formal Languages and Computability**

**Assignment 5 – Due 03/04/2024**

**Instructions:**

The focus of this assignment is on context free grammars and the languages they define. You should derive your CFGs on paper, and them use JFLAP to implement and test your CFGs. Save your CFG in a jff file and an image of the derivation of one string accepted by the language as a jpg image. Copy the questions below into hw5.docx and copy/paste your JFLAP images into the document to show your answers.

**Questions:**

1. [10 points] Consider the context free grammar G below.

S 🡪 A | B | 

A 🡪 B | aAa | a

B 🡪 A | bBb | b

* 1. What are the terminals of G?
  2. What are the non-terminals of G?
  3. What is the starting non-terminal of G?
  4. Give the two strings in L(G)
  5. Give two strings *not* in L(G)

1. [20 points] Give context free grammars that generate the following languages. In all cases, assume that the alphabet  is {a, b}. Test your grammar in JFLAP with one string you know is in the language.
   1. L1 = {w | the string has |w| >=4, and starts and ends with the letters aa, with any sequence of a’s and b’s in between}
   2. L2 = {w | w = wR, hence w is a palindrome}
   3. L3 = {w | w has length greater than two, |w| > 2}
   4. L4 = {w | w = anb2n or bna2n for all n >= 0}
2. [10 points] Use the method discussed in class to convert the following DFA into an equivalent CFG. You may choose any variable names you wish. Test your grammar in JFLAP with one string you know is in the language.

A diagram of a triangle with circles and lines

Description automatically generated

A diagram of a triangle with circles and numbers

Description automatically generated

**Challenge Questions: (optional for undergraduates, required for graduates)**

1. [4 points] Use the method discussed in class to convert the following DFA into an equivalent CFG. You may choose any variable names you wish. Test your grammar in JFLAP with one string you know is in the language.

A yellow circle with black lines and a yellow circle with black text

Description automatically generated

1. [4 points] Give context free grammars that generate the following language. Assume that the alphabet  is {a, b}. Test your grammar in JFLAP with one string you know is in the language.

L5 = {w | w has twice as many a’s as b’s, and the letters can be in any order}

**Assignment Submission:**

Once you have answered all of the questions above, create a document called “hw5.docx” that has a copy of the questions above and copy/paste the “jpg” images you created into this document. Create a folder called “hw5” that contains all of your “jff” and “jpg” files and compress this folder to create “hw5.zip”. Upload “hw5.zip” and “hw5.docx” into the “hw5” link in Blackboard. To receive full credit for each question, the “jff” files must be named correctly (e.g., 3a.jff and 3a.jpg), and they must load and operate correctly in JFLAP. *Points will be deducted for missing or incorrectly named JFLAP files.*

The dates on your electronic submission will be used to verify that you met the due date above. All late assignments will receive reduced credit:

* 10% off if less than 1 day late,
* 20% off if less than 2 days late,
* 30% off if less than 3 days late,
* no credit if more than 3 days late.

**7. Academic Honesty Statement:**

Students are expected to submit their own work on all assignments, unless group projects have been explicitly assigned. Students are NOT allowed to distribute solutions to each other, or copy solutions from another individual or website. Students ARE allowed to use any materials on the class website, or in the textbook, or ask the instructor and/or GTAs for assistance.

Violations of the policies above will be reported to the Provost's office and may result in a ZERO on the assignment, an F in the class, or suspension from the university, depending on the severity of the violation and any history of prior violations.