CSE3064 Homework #2 – Due to June 9, 2020.

1. [10 pts] Consider the context-free grammar S → ySx | yySx | ε
   a. Show that the grammar is ambiguous.
   b. Derive an equivalent unambiguous grammar.

2. [15 pts] Design a PDA for the following languages:

   a. $L_1 = \{0^{2k}\ 1^{3k} \mid k \geq 0\}$
   b. $L_2 = \{\ 0^a 1^b 2^c \mid a, b, c \geq 0 \text{ and } a + b = c\ \}$

3. [15 pts] Prove or disprove the following statements:

   a. The class of context-free languages are closed under the union operation.

   b. The class of context-free languages are closed under the intersection operation. Hint: Consider the following two languages:

$$L_1 = \{a^m b^n c^n \mid m, n \geq 0\}$$
$$L_2 = \{a^n b^n c^m \mid m, n \geq 0\}$$

4. [10 pts] Given the following context-free grammar:

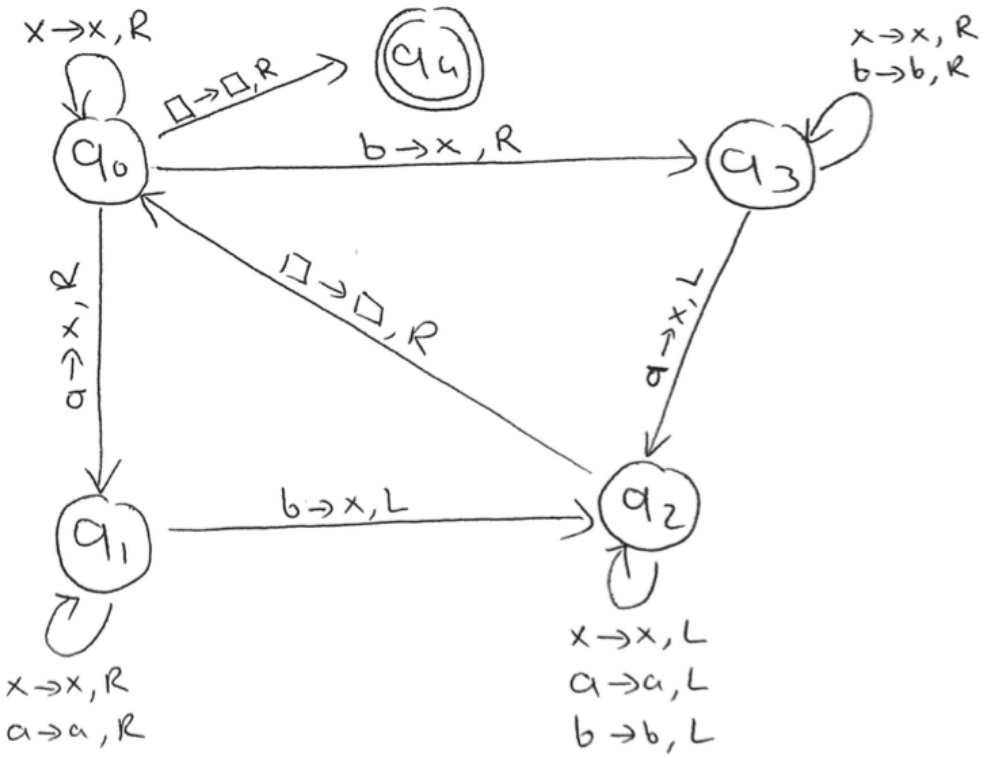
   S → XY | ε
   X → xY
   Y → Sy

   a. What is the language generated by this grammar?
   b. Draw the parse tree for the string xxyyyy.

5. [15 pts] Convert the following context-free grammar to an equivalent grammar in Chomsky Normal Form.

   S → ASA | A | ε
   A → 11 | ε

6. [10 pts] What is the language on {a,b} recognized by the following Turing Machine (a,b,x, and box are the tape symbols where box denotes the empty cell) ?



7. [10 pts] Prove or disprove the following statement:
   Turing-recognizable languages are closed under the intersection operation.

8. [15 pts] Prove that the following languages are decidable (give the deciders for each of the language):

   a. $L_1 = \{ < D, R > \mid D \text{ is a DFA}, R \text{ is a regular expression and } L(D) = L(R) \}$
   b. $L_2 = \{ < N > \mid N \text{ is an NFA and } L(N) = \Sigma^* \}$

Notes:

- You need to create only one pdf file with high resolution. Make sure that your pdf file is readable. (You can use a smartphone application for this purpose)

- Make sure that the pdf file's name contains your number. (yourNumber_HW2.pdf)

- Make sure that the all pages of your pdf file also contain your number. (for example, on upper right corner)

- Note that in case of cheating, all parties involved will get zero grade.

- If you submit your assignment late, for every day after the due date, your grade will be decreased by 10%. (If you submit the day

after the due date, you will get 90% of your actual grade, if you submit 2 days after, you will get 80% of your actual grade, etc.)

- Due date of the assignment is June 9, 2020, 23:59.

- Send your assignments to cse364.projects@gmail.com