COMP 4200 - Formal Languages: Homework #5

Due on Wednesday, March 29, 2023, at 10:00 pm
Instructor: Hugh Kwon

Instructions:

- Submit your work as a single PDF through GradeScope (link on Canvas). You will need to mark your solution to each question (click for the instruction).
- Note that it is your responsibility to make your submissions readable by TAs. If your handwriting is not readable by the TA, he may not give you full credits (or any credits at all) for the illegible part.
- You will not only be graded on your mathematics, but also on your organization, proper use of English, spelling, punctuation, and logic.
- Late submissions will NOT be graded unless as specified by the Late Assignment Submission policy in the syllabus.
- For any questions regarding the assignment or grading of the assignment, please email our TAs.

Problem 1

Total: 30 points (15 points each)
Exercise 2.6. Give context-free grammars (CFGs) generating the following languages.

1. The set of strings over the alphabet $\Sigma = \{a, b\}$ with more a's than b's
2. The complement of the language $\{a^n b^n \mid n \geq 0\}$

Problem 2

Total: 15 points
Exercise 2.9. Give CFG generating the following language:

$A = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}$

Is your grammar ambiguous? Why or why not? If yes, please provide an example of two different leftmost derivations that generate the same string.

Problem 3

Total: 15 points
Exercise 2.14. Convert the following CFG into an equivalent CFG in Chomsky normal form using the procedure given in Theorem 2.9.
Please provide all intermediate steps with comments on how you transform from the grammar from one version to another (these steps are critical for your work to be graded).

$$A \to BAB \mid B \mid \epsilon$$
$$B \to 00 \mid \epsilon$$