Assignment 1

COMPSCI 3331

Due: October 11, 2022 at 11:59 PM

General notes:

- Assignments **must** be submitted on gradescope. You must indicate the locations of all answers for questions using gradescope. A video demonstrating how to do this can be found here.
- Assignments can be hand-written or typeset, as long as they are submitted to gradescope as an electronic file (pdf, png or other accepted format). It is your responsibility to submit a file that can be marked (i.e., images of pages are clear and handwriting, if any, can be read).
- Assignments can be submitted up to 48 hours late. A deduction of 1 % (of the total assignment value) will be applied per hour (rounded up) that the assignment is submitted past the deadline.
- You may also use your **once-per-course** 3-day extension on this assignment. Please submit the form on owl to declare that you want to use this extension. (choose "Individual Extension" from the tool menu on owl.) Recall that extensions do not stack – you may either choose the late submission penalty or the individual extension for an assignment, but not both.

1. (5 marks) (a) Let Σ be any finite alphabet with at least one letter. Prove that for all languages $L_1, L_2 \subseteq \Sigma^*$, if $L_1 \subseteq L_2$, then $L_1^* \subseteq L_2^*$.
(b) If $L_1^* \subseteq L_2^*$, is it true that $L_1 \subseteq L_2$? Prove or disprove (by giving a counter-example).

2. (5 marks) Let $\Sigma = \{a, b, c, d\}$ and $L \subseteq \Sigma^*$ be the following language

$$L = \{x_1 d x_2 \ : \ x_1 \in \{a,b\}^*, x_2 \in \{b,c\}^*, |x_1| + |x_2| = 4\}$$

Show that L is regular by giving a DFA that accepts the language. You do not need to formally prove that the language is regular, but you must include some justification that the DFA accepts the language L, such as arguing informally as to the role of the states in your DFA.

3. (5 marks) Consider the DFA M below, over the alphabet $\{a, b\}$. Give both an NFA and a DFA for $L(M)^R$. (*Hint: for the DFA it may be helpful to determine what the language $L(M)$ is, and then construct a DFA for $L(M)^R$ based on that. You are not required to perform the subset construction.*)