

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.

$L_1 \leq L_2$.

alphabet union. words union.

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).

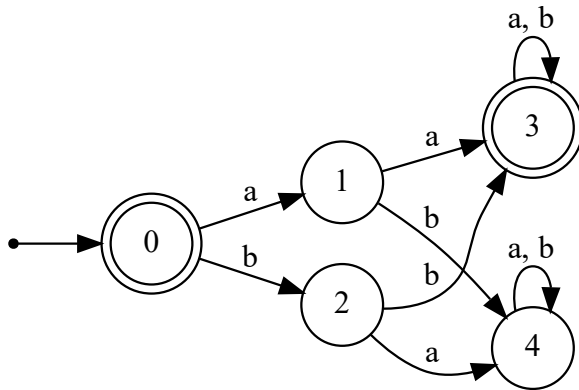
2. (5 marks) Let $\Sigma = \{a, b, c, d\}$ and $L \subseteq \Sigma^*$ be the following language

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

x_1, x_1, x_1, x_1, d
 $x_1 x_1 x_1 d x_2$
 $x_1 x_1 d x_2 x_2$
 $x_1 d x_2 x_2 x_2$

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.)



$aa \{a, b\}^* + bb \{a, b\}^*$

$L(M)^R = \{a, b\}^* + aa/bb$

