University of Nevada, Las Vegas Computer Science 456/656 Spring 2021
## Assignment 1: Due Wednesday January 25, 2023, 11:59 PM

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. You will receive a message from the graduage assistant, Sandeep Maharjan, telling you how to turn in the assignment.

There are four handouts on my website, and they should all be posted on Canvas. They are `regular-I.pdf`, `regular-II.pdf`, `finiteAutomata.pdf`, and `NFA-DFA.pdf`. These handouts include all the material of the course on regular languages (except regular grammars) but are somewhat overlapping. Be sure to finish reading them by Wednesday, February 1.

1. Which of the strings 00, 01001, 10010, 000, 0000 are accepted by the following NFA?
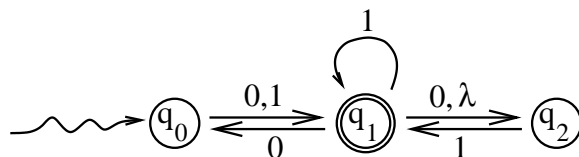
2. Construct a DFA which accepts the language $\{b^i a b^j : i, j \geq 0\}$, the language of all strings over $\{a, b\}$ which contain exactly one a.

3. Can you find a DFA with three states that accepts the language of the figure given below? If not, can you give convincing arguments that no such DFA can exist?
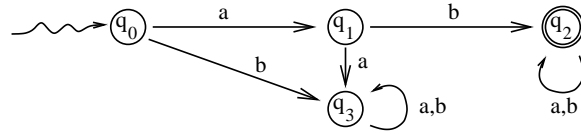
4. Find a DFA equivalent to the NFA shown below.
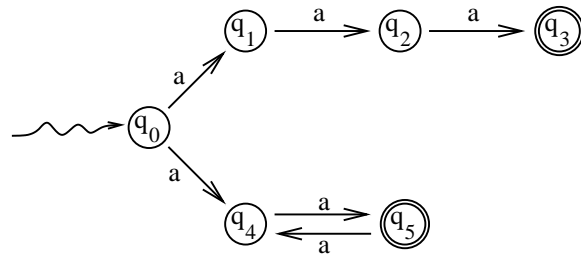
5. Answer the 12 questions on page 3 of the handout *regular-I.pdf*.

   (a) Since $|L_1| = |L_2| = 3$, we would expect that $|L_1 L_2| = 9$. But it's only 8. Why?

   (b) Recall that $\emptyset$ is the empty language. If L is some language, what is the concatenation $\emptyset L$?

   (c) Let $L_1 = \{\lambda\}$. the language consisting of only the empty string. If L_2 is some other language, what is the concatenation $L_1 L_2$?

   (d) Given two languages L_1 and L_2, is the equation $L_1 L_2 = L_2 L_1$ always true?

   (e) What is L^0?

   (f) Is the equation $L_1(L_2 + L_3) = SL_1 L_2 + L_1 L_3)$ always true?

   (g) What is $\emptyset^*$, the Kleene closure of the empty language?

   (h) What is L^{**}?

   (i) Is the union of two regular languages always regular?

   (j) Is the intersection of two regular languages always regular?

   (k) Is the complement of a regular language always regular?

   (l) Is the Kleene closure of a regular language always regular?

6. Solve problems given in the handout `finiteAutomata.pdf` associated with the following figures.

   (a) Figure 1.

   (b) Figure 3.

   (c) Figure 5.

   (d) Figure 11.