**University of Nevada, Las Vegas Computer Science 456/656 Spring 2021**

**Assignment 1: Due Friday September 9, 2022, 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, Shekhar Singh, telling you how to turn in the assignment.

In each case, the identical problem is in both fifth and sixth editions of our textbook, *An Introduction to Algorithms*, by Peter Linz.

1. *Problems 11(d), 12, 13 on page 38 of the fifth edition, problems 14(d), 15, 16 on page 29 of the sixth edition.*

   Find a grammar for $\Sigma = \{a, b\}$ which generates the set of all strings which contain at least three $a$'s.

   Give a simple description of the language generated by the grammar:

   $S \to aaA$
   $A \to bS$
   $S \to \lambda$

   What language does the grammar with these productions generate?

   $S \to Aa$
   $A \to B$
   $B \to Aa$

2. *Problems 14(a), 14(h) on page 39 of the fifth edition, problems 17(a), 17(h) on page 29 of the sixth edition.*

   Let $\Sigma = \{a, b\}$. For each of the following languages, find a grammar that generates it.

   (a) $L_1 = \{a^n b^m \ : \ n \geq 0, m < n\}$

   (h) $L_1^\star$. (The same $L_1$ defined in (a) above.)

3. *Problem 4 on page 44 of the fifth edition, problem 6 on page 35 of the sixth edition.*

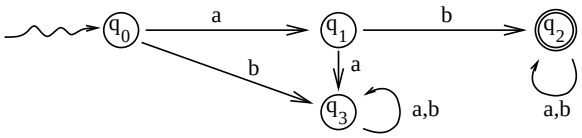
   Suppose a certain programming language permits identifiers that start with a letter, contain at least one but no more than three digits, and can have any number of letters. Give a grammar and an accepter for such a set of identifiers.

4. *Problem 2(a) on page 56 of the fifth edition, problem 4(a) on page 48 of the sixth edition.*

   Construct a DFA which accepts the language of all strings over $\{a, b\}$ which contain exactly one $a$.

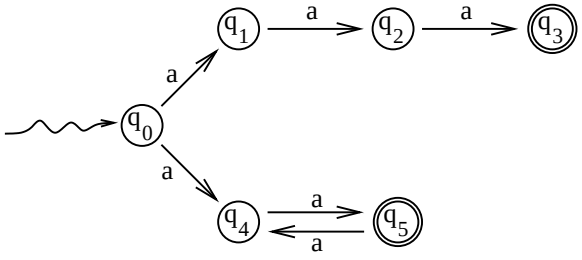
5. *Problem 26 on page 58 of the fifth edition., problem 28 on page 51 of the sixth edition.*

   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?




6. *Problems 6 and 12 on pages 63, 64 of the fifth edition, problems 3, 13 on page 57 of the sixth edition.*

Find a DFA equivalent to the NFA shown below.




Which of the strings 00, 01001, 10010, 000, 0000 are accepted by the following NFA?