Tutorial 02

University of Victoria

CSC 320 - Spring 2023

Foundations of Computer Science

Teaching Team

Learning Outcomes:

- Become familiar with DFAs and NFAs.
- Become familiar with the concept of Closure.
- Become familiar with the concept of Kleene Star.
- An introductory level of understanding of Reduction.

Interesting Article:

"On Theory of Regular Languages with the Kleene Star Operation" [1]

January 24th, 2023

Question 2.01

Give the formal specification of a DFA for the following language:

$$L = \{0\}^* \text{ over } \Sigma = \{0\}$$

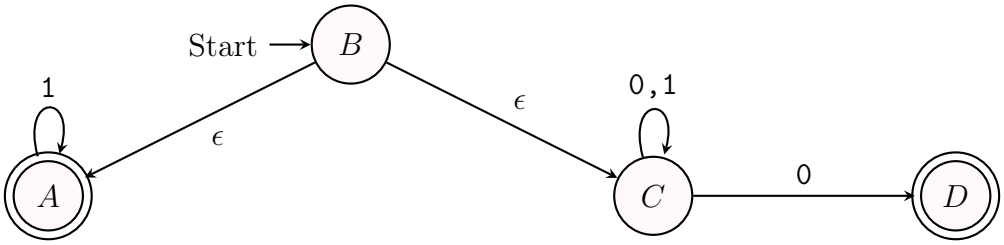
Question 2.02

Give the formal specification of a DFA for the following language:

$$L = \{w \in \{a, b\}^* \mid w \text{ is any string not in } (ab^+)^*\}$$

Question 2.03

Consider the following state diagram:



where the start state is B, and state A and state D are accept states. And can be describe by the following transition table:

δ	0	1	ϵ
A	$\emptyset$	A	B
B	$\emptyset$	$\emptyset$	$\{A, C\}$
C	$\{C, D\}$	C	$\emptyset$
D	$\emptyset$	$\emptyset$	$\emptyset$

Table 1: State Diagram - Transition Table

(a) Is the string 0011 accepted by this state machine? How about 1100?

(b) What is the language of this machine?

Question 2.04

Design an NFA state diagram for the following language:

$$\{w \in \{0,1\}^* \mid w \text{ contains } 00 \text{ or } 11 \text{ as a substring}\}$$

DFA Union Closure

Regular languages are closed under union.

What does "closed" mean?

A set S is closed under operation O if $O(S) \in S$.

Let $S = \{a, b, c\}$. Define O as such: $O(a) = b$, $O(b) = c$, and $O(c) = a$.

Notice that applying O yields elements that are all in set S. So S is closed under O. If O were defined the same but $O(c) = z$, then S is no longer closed under O.

Kleene Star Proof

Prove that regular languages are closed under Kleene star.

Reduction Discussion

Reduction...

Problem A: Will Ammar Brush His Hair?

Problem B: Is Angela Happy?

Reduction:

$$A \longrightarrow B \text{ "A reduces to B"}$$

The outcome of A relies on the outcome of B.

Bibliography

[1] B. Karlov, "On Theory of Regular Languages with the Kleene Star Operation," English, *Lobachevskii journal of mathematics*, vol. 41, no. 9, pp. 1660–1665, 2020, ISSN: 1995-0802. DOI: https://doi.org/10.1134/S1995080220090164.