

Problem 1 (CO1): DFA and Regular Languages (10 points)

Let  $\Sigma = \{0, 1\}$ . Consider the following languages over  $\Sigma$ .

$$L_1 = \{w : w = 1^m 0^n, \text{ where } m, n \geq 0\}$$

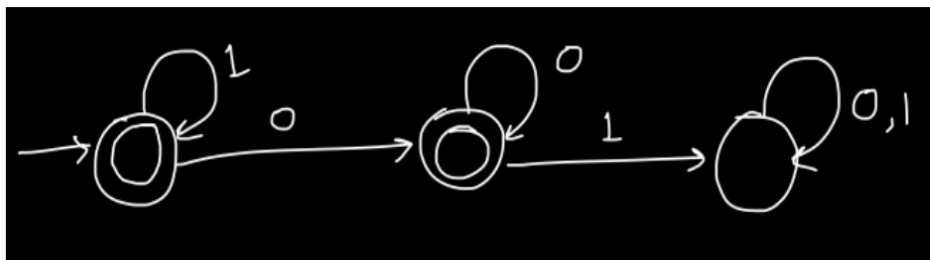
$$L_2 = \{w : 1 \text{ does not appear at any even position in } w\}$$

$$L_3 = L_1 \cap L_2$$

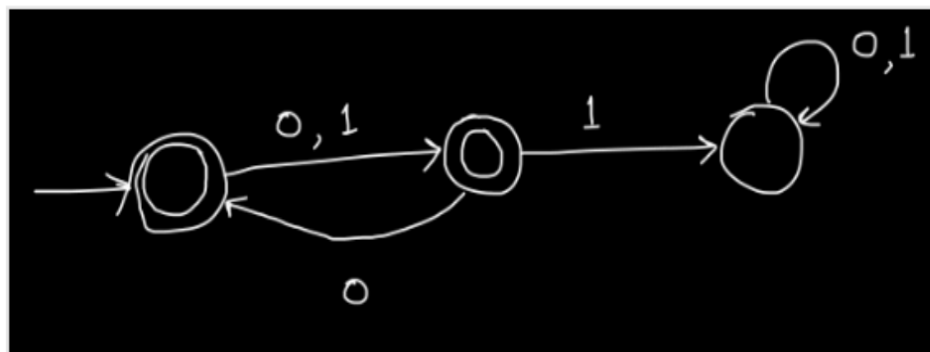
Now solve the following problems.

- (a) **Give** the state diagram for a DFA that recognizes  $L_1$ . (3 points)
- (b) **Give** the state diagram for a DFA that recognizes  $L_2$ . (3 points)
- (c) If you were to use the “cross product” construction shown in class to obtain a DFA for the language  $L_3$ , how many states would it have? (1 point)
- (d) **Find** all four-letter strings in  $L_3$ . (1 point)
- (e) **Give** the state diagram for a DFA that recognizes  $L_3$  using only three states. (2 points)

(a)



(b)



(c) The answer is  $3 \times 3 = 9$

(d) The strings are 0000, 1000.

(e)

