

# Some Automata Theory Review Questions

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1. (a) Build an NFSA that recognizes the language

$$\mathcal{L}_1 = \{x \in \{0, 1\}^* : x = 0^m 1^n; m, n \in \mathbb{N}\}$$

- (b) Build the equivalent DFSA.

2. (a) Build an NSFA that recognizes the language

$$\mathcal{L}_2 = \{x \in \{0, 1\}^* : x \text{ starts and ends with a } 1\}$$

- (b) Use subset construction to build the equivalent DFSA.

3. Build a DFSA that recognizes

$$\mathcal{L}_3 = \{x \in \{0, 1\}^* : x \text{ contains an even number of } 0\text{'s}\}$$

4. Build a DFSA that recognizes

$$\mathcal{L}_4 = \{a, ab, abe\}$$

Your machine should have no more than 3 states.

5. Build a DFSA that recognizes

$$\mathcal{L}_5 = \{x \in \{a, b, c, d, e\}^* : x \text{ contains the substring "abe"}\}$$

*Hint:* Start from the answer you had in the previous question, and work from there. You should not need more than 3 states, but your accepting states will have to be different.

6. Draw the NFSA that recognizes the language described by the regular expression  $0^*1^*$ .  
7. Draw the NFSA that recognizes the language described by the regular expression  $0^*011^*$ .  
8. Prove or disprove each of the following statements.

- $\mathcal{L}(0^*011^*) \subseteq \mathcal{L}(0^*1^*)$
- $\mathcal{L}(0^*1^*) \subseteq \mathcal{L}(0^*011^*)$
- $\mathcal{L}((a^*b^*c^*)^*) \subseteq \mathcal{L}((ab)^*)$
- $\mathcal{L}((ab)^*) \subseteq \mathcal{L}((a^*b^*c^*)^*)$
- $\mathcal{L}((0^*1^*)^*) \subseteq \mathcal{L}((0+1)^*)$
- $\mathcal{L}((0+1)^*) \subseteq \mathcal{L}((0^*1^*)^*)$
- $\mathcal{L}((xyz)^+) \subseteq \mathcal{L}((xyz)^*)$
- $\mathcal{L}((xyz)^+) \subseteq \mathcal{L}(((x+z)y^*z)^*)$
- $\mathcal{L}((x^+y^+(z+\epsilon)^+)^*) \equiv \mathcal{L}(((x^+y^+z^*)+\epsilon))$
- $\mathcal{L}((xyxy)^*) \equiv \mathcal{L}(((xy)+\epsilon)(xy)^*)$