1 Exercise 1

Take $M_1$, a diagram for a deterministic FSA.

![Diagram](image)

Give the formal description of $M_1$, where $M_1 = < Q, \Sigma, \delta, q_0, F >$, where

1. $Q = $  
2. $\Sigma = $  
3. $\delta$ is defined as

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
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<tbody>
<tr>
<td>q1</td>
<td></td>
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<tr>
<td>q2</td>
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<tr>
<td>q3</td>
<td></td>
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<tr>
<td>q4</td>
<td></td>
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</tbody>
</table>

4. The start state is $q_0$.

5. $F = $.

Which of the following strings does $M_1$ accept?

- a. aabbb
- b. baaba
- c. bbba
- d. abab
- e. abaa
- f. a
- g. bab
- h. $\epsilon$
- i. aaaaa
- j. aaabaaa
2 Exercise 2

Draw a diagram for the formal description of \( M_2 \):
\[
M_2 = \langle Q, \Sigma, \delta, q_0, F \rangle, \text{ where}
\]

1. \( Q = \{q_1, q_2, q_3, q_4, q_5\} \)

2. \( \Sigma = \{u, d\} \)

3. \( \delta \) is defined as

<table>
<thead>
<tr>
<th>( q )</th>
<th>( u )</th>
<th>( d )</th>
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</thead>
<tbody>
<tr>
<td>( q_1 )</td>
<td>( q_1 )</td>
<td>( q_2 )</td>
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</table>

4. The start state is \( q_3 \).

5. \( F = \{q_3\} \).

Which of the following strings does \( M_2 \) accept?

a. \( d \)
b. \( du \)
c. \( udu \)
d. \( dudu \)
e. \( uuudu \)
f. \( uuudduddduu \)
g. \( duuuuuddu \)
h. \( \epsilon \)
i. \( duduuddudu \)
j. \( uudduddu \)

3 Exercise 3

Exercise 1 in Partee at al., page 480.
4 Exercise 4

Show that the following languages are regular. That is, construct state diagrams for (deterministic) FSA that recognize the following languages. For each language, assume that $\Sigma = \{1, 0\}$ and use as few states as possible.

i) $\{w: \text{the length of } w \text{ is at most 5}\}$

ii) $\{\epsilon, 10, 01\}$

iii) $\{w : w \text{ contains an even number of } 0\text{s, not necessarily consecutive (and any number of } 1\text{s in any order)}\}$

iv) $\{w : w \text{ contains no } 0 \text{ and contains a total of } n \text{ } 1\text{s, where } n = 4m + 1, \text{ for } m=0 \text{ or } m \text{ is a natural number}\}$

v) $\{w : w \text{ contains the sub-string } 0101\}$

vi) $\{w : w \text{ is any string except } 11 \text{ and } 111 \}$