Consider the following figure
Example 1.33 II
For this language, $\Sigma = \{0\}$. This is called unary alphabets.

The only non-deterministic place is at the start state.

What is the language?

\[ \{0^k \mid k \text{ multiples of 2 or 3} \} \]
Example 1.35  

- **Fig 1.36**

Accept
- $\epsilon$, $a$, $baba$, $baa$ can be accepted

But babba is rejected
Example 1.35 II

See the tree below

- This example is later used to illustrate the procedure for converting NFA to DFA
Definition: NFA I

- \((Q, \Sigma, \delta, q_0, F)\)
- \(\delta: Q \times \Sigma_\epsilon \rightarrow P(Q)\)
  - \(P(Q)\): all possible subsets of \(Q\)
- \(\Sigma_\epsilon = \Sigma \cup \{\epsilon\}\)
- \(P(Q)\): power set of \(Q\)
  - “power”: all \(2^{|Q|}\) combinations; \(|Q|\): size of \(Q\)

\[
Q = \{1, 2, 3\}
\]

\[
P(Q) = \{\emptyset, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}
\]
Thus $P(Q)$ is a set of sets
Example 1.38

\[ Q = \{ q_1, \ldots, q_4 \} \]

\[ \Sigma = \{ 0, 1 \} \]

Start state: \( q_1 \)

\[ F = \{ q_4 \} \]

\[ \delta: \]
### Example 1.38 II

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>$\epsilon$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_1$</td>
<td>${q_1}$</td>
<td>${q_1, q_2}$</td>
<td>$\emptyset$</td>
</tr>
<tr>
<td>$q_2$</td>
<td>${q_3}$</td>
<td>$\emptyset$</td>
<td>${q_3}$</td>
</tr>
<tr>
<td>$q_3$</td>
<td>$\emptyset$</td>
<td>${q_4}$</td>
<td>$\emptyset$</td>
</tr>
<tr>
<td>$q_4$</td>
<td>${q_4}$</td>
<td>${q_4}$</td>
<td>$\emptyset$</td>
</tr>
</tbody>
</table>

- Every element in the table is a set
- Note that DFA does not allow $\emptyset$. In NFA, “no link” means the output of $\delta$ is $\emptyset$
- So seriously speaking, a DFA is not an NFA. Need modifications to satisfy the NFA definition
First we have that $w$ can be written as

$$w = y_1 \ldots y_m$$

where $y_i \in \Sigma \epsilon$

A sequence $r_0 \ldots r_m$ such that

1. $r_0 = q_0$
2. $r_{i+1} \in \delta(r_i, y_{i+1})$
3. $r_m \in F$

So $m$ may not be the original length (as $y_i$ may be $\epsilon$)