Turning FSA into DFSA

• Need to treat all states reachable by a given path as the same
• States of DFSA are sets of states from original FSA
• The $\varepsilon$ closure of a set of state $S$, written here as $S(\varepsilon)$, is the smallest set
  - containing $S$
  - if $s \in S$ and $(s, \varepsilon, t)$ is an edge labeled by $\varepsilon$, then $t \in S$
• The $\alpha$-reachable states from $S$,
  $S(\alpha) = \{ t \mid (s, \alpha, t) \text{ is an edge for some } s \in S \}$

Example 1

New states: {A}
New edges: ({A}, 0, ), ({A}, 1, ),
Example 1

New states: \{A\}, {A,B}
New edges: (\{A\}, 0, \{A\}), (\{A\}, 1, \{A,B\}),
(\{A,B\}, 0, \{A\}), (\{A,B\}, 1, \{A,B\})

New states: \{A\}, {A,B} Final = {{A,B}}
New edges: (\{A\}, 0, \{A\}), (\{A\}, 1, \{A,B\}),
(\{A,B\}, 0, \{A\}), (\{A,B\}, 1, \{A,B\})
Example 2

New states: \{A,B\}
New edges: (\{(A,B), 0, \}, (\{(A,B), 1, \})
Example 2

New states: \{A,B\}, \{B\}
New edges: (\{A,B\}, 0, \{A,B\}), (\{A,B\}, 1, \{B\}),
(\{B\}, 0, \{A,B\}), (\{B\}, 1, \{B\})

Example 2

New states: \{A,B\}, \{B\}
New edges: (\{A,B\}, 0, \{A,B\}), (\{A,B\}, 1, \{B\}),
(\{B\}, 0, \{A,B\}), (\{B\}, 1, \{B\})

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Turning Regular Expressions into NFSAs

- Compose NFAs for pieces of reg exp to get NFA for whole reg exp
- \(\varepsilon\) goes to (\{s_0\}, \{\}, \{s_0\}, s_0)
Turning Regular Expressions into NFSAs - letters

- $\varepsilon$ goes to $\{(s_0, \epsilon), (s_0, s_0)\}$

- $\alpha$ goes to $\{(s_0, s_1), (s_0, \alpha, s_1), (s_1, s_0)\}$

Turning Regular Expressions into NFSAs - Concatenation

- $(S, E, F, s_0)$ FSA for $\sigma$
- $(S', E', F', s_0')$ FSA for $\tau$
- Concatenation: $\sigma \cdot \tau$ goes to $(S \cup S', E \cup E' \cup \{(f, \varepsilon, s_0') | f \in F\}, F', s_0)$

Turning Regular Expressions into NFSAs - Choice

- $(S, E, F, s_0)$ FSA for $\sigma$
- $(S', E', F', s_0')$ FSA for $\tau$
- Choice: $\sigma \lor \tau$ goes to $(S \cup S' \cup \{s\}, E \cup E' \cup \{(s, \varepsilon, s_0), (s, \varepsilon, s_0')\}, F \cup F', s)$ where $s$ is a new state

Turning Regular Expressions into NFSAs - Kleene Star

- $(S, E, F, s_0)$ FSA for $\sigma$
- Choice: $\sigma^*$ goes to $(S \cup \{s'\}, E \cup E' \cup \{(f, \varepsilon, s_0)\} \cup \{(f, \varepsilon, s') | f \in F\}, \{s'\}$

Example: $(0 \mid 1)^* 1$

- $0$: $s_0 \xrightarrow{0} s_1$
- $1$: $s_0 \xrightarrow{1} s_2$

Example: $(0 \mid 1)^* 1$

- $(0 \mid 1)^*$:
Example: \((0 \mid 1)^* 1\)

- \((0 \mid 1)^* 1:\)

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\[
\begin{array}{c}
S_0 \\
S_1 \\
S_2 \\
S_3 \\
S_4 \\
\end{array}
\]
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Edges:
- \((S_0, 0, S_1)\)
- \((S_0, 1, S_3)\)
- \((S_1, \epsilon, S_2)\)
- \((S_2, 1, S_3)\)
- \((S_3, \epsilon, S_3)\)