CS442/542

Lexical Analysis
Part 2
## Example Regular Expressions over the alphabet \{0, 1\}

<table>
<thead>
<tr>
<th>Regular Expression</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>{ 0 }</td>
</tr>
<tr>
<td>0 ( \mid 1 )</td>
<td>{0, 1}</td>
</tr>
<tr>
<td>0 ((0 \mid 1))</td>
<td>{00, 01}</td>
</tr>
<tr>
<td>1*</td>
<td>{ x \mid x is a string of 0 or more 1s}</td>
</tr>
<tr>
<td>((0 \mid 1))*</td>
<td>{ x \mid x is any string of 0s and 1s including the empty string}</td>
</tr>
</tbody>
</table>
RE -> NFA

Regular Expression

\[ \epsilon \]

\[ 0 \]

NFA

\[ S_0 \xrightarrow{\epsilon} S_0 \]

\[ S_0 \xrightarrow{0} S_1 \]
RE -> NFA

Regular Expression (Assume $R$ and $S$ are regular expressions)

$$R \cdot S$$

The start state of the NFA for $R$ is the start state of the new machine. The final state in the NFA for $R$ connects via an epsilon transition to the start state of the NFA for $S$. The final state in the NFA for $S$ is the final state for the new machine.
Regular Expression (Assume $R$ and $S$ are regular expressions)

$R \mid S$

$S_0$ connects to the start states of the NFA for $R$ and the NFA for $S$ by epsilon transitions and the final states of the NFA for $R$ and NFA for $S$ connect to $S_1$ by epsilon transitions.
Regular Expression (Assume $R$ is a regular expressions)

$R^*$

S0 connects to S1 and the start state of the NFA for $R$ by epsilon transitions. The final state of the NFA for $R$ connects to S1 and to the start state of the NFA for $R$ by epsilon transitions.
Example Problems

• Construct NFAs for the following regular expressions.
  – 0
  – 00
  – 0 | 1
  – (0 | 1) *
  – 0*(10*10*)*