Today: §1.3: Every regular language (for which there is an NFA) is described by a regular expression.

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Rem: If L, L' are regular, we ~~know~~ $L \cup L'$, $L \circ L'$, L^* are regular (used NFA). One can show that $L \cap L'$ is regular:

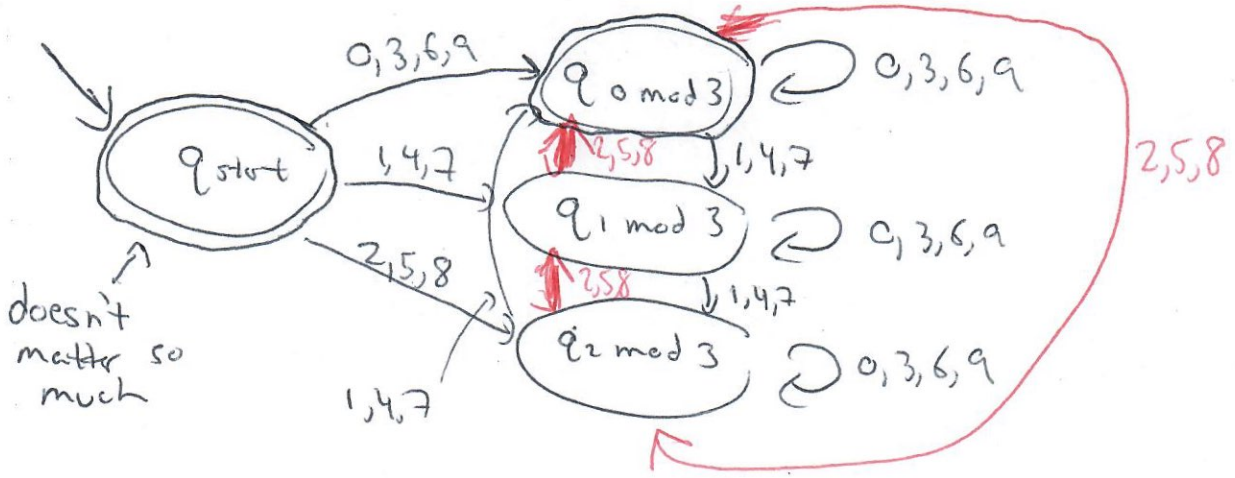
① Take the DFAs for L, L', build DFA for $L \cap L'$ (product of graphs)

② $L \cap L' = (L^{comp} \cup (L')^{comp})^{comp}$

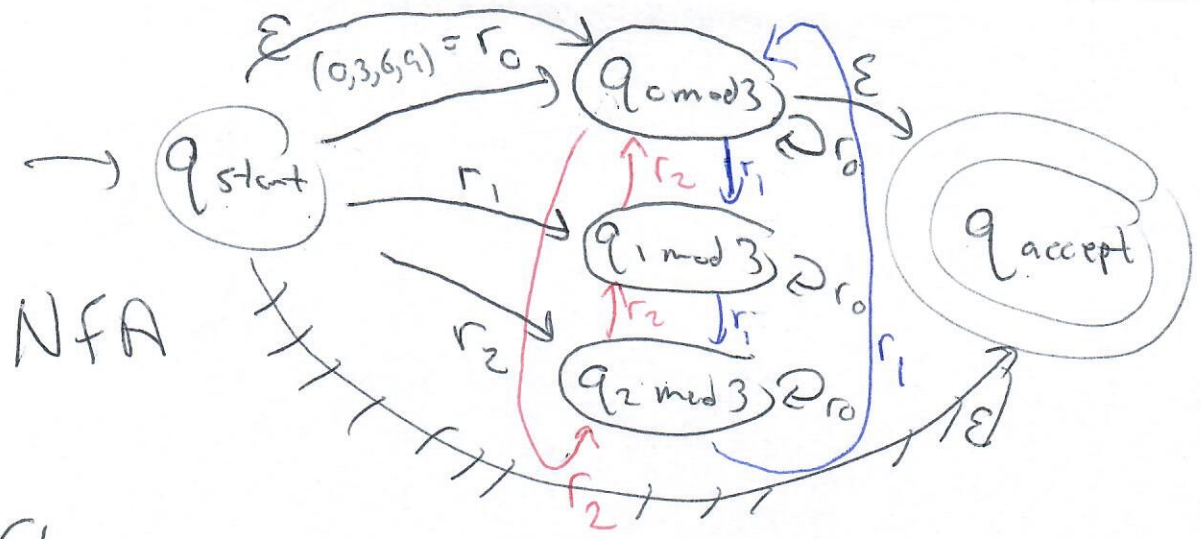
NFA ← comp simple DFA operation

To follow--

$$DIVIS\_BY\_3 = \{ s \in \{0,\dots,9\}^* \mid s \text{ represents in base 10 a number divisible by 3} \}$$



① First: Make an NFA with one ~~start~~ state q_{start} + accept state q_{accept}



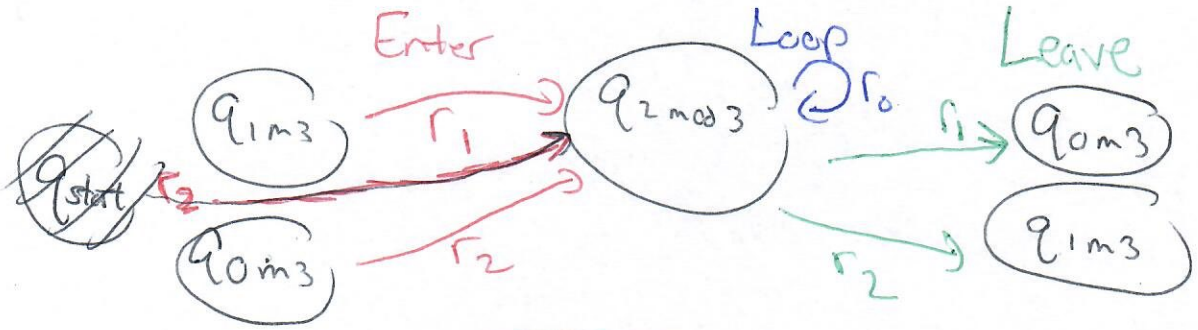
$r_0 = 0, 3, 6, 9$

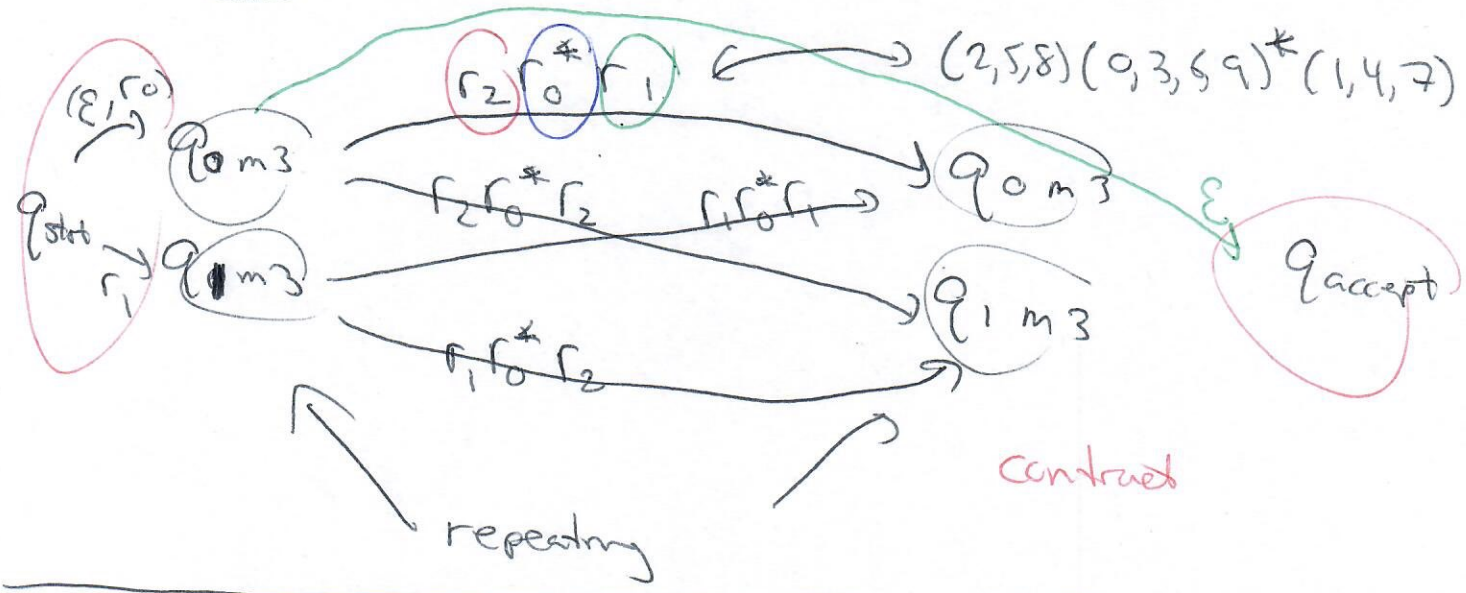
$r_1 = 1, 4, 7$

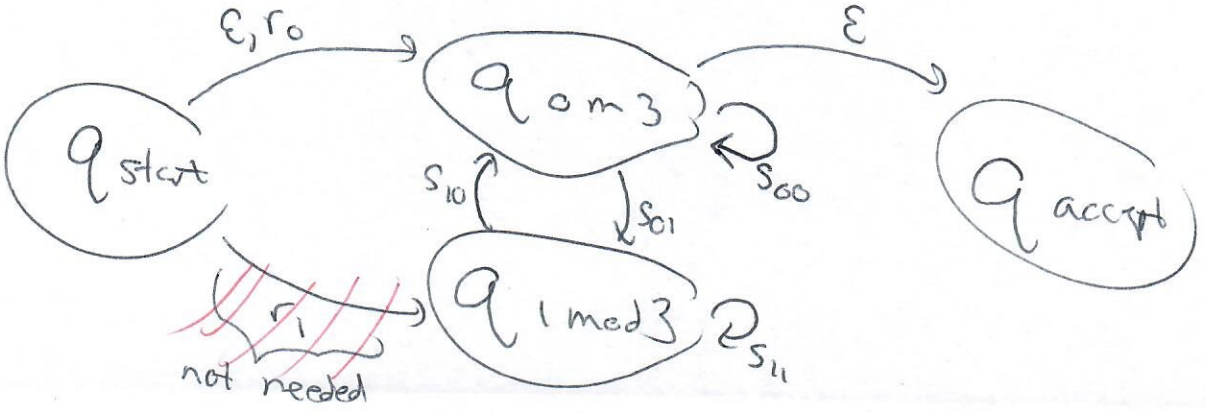
$r_2 = 2, 5, 8$

Allow reg expressions

Eliminate q_{2m3}:





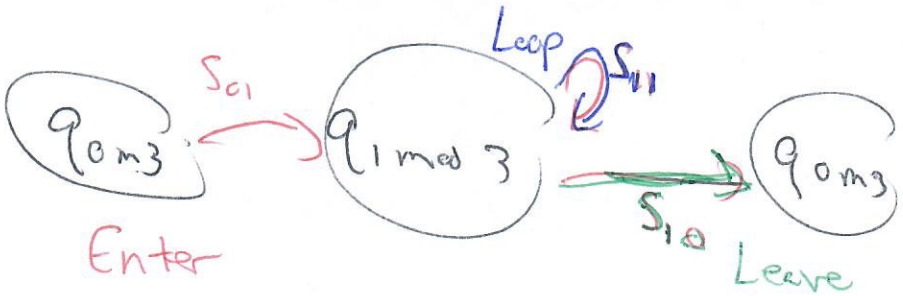


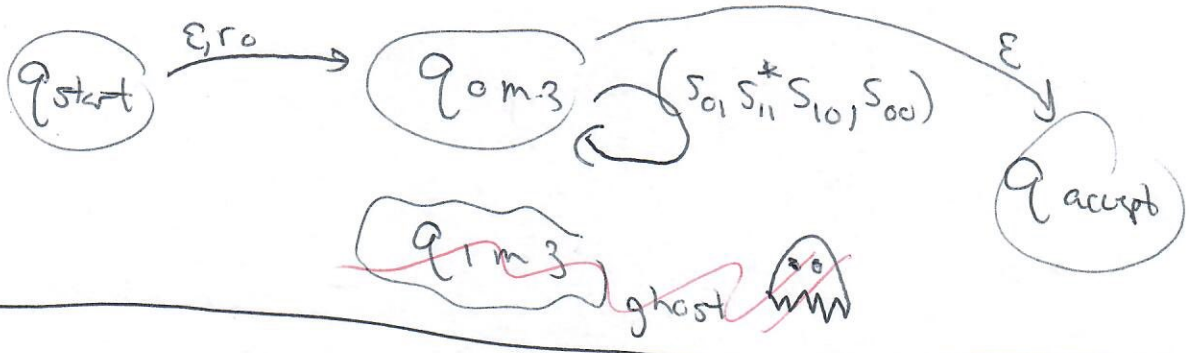
$s_{00} = (r_0, r_2 r_0^* r_1)$

$s_{01} = (r_1, r_2 r_0^* r_2)$

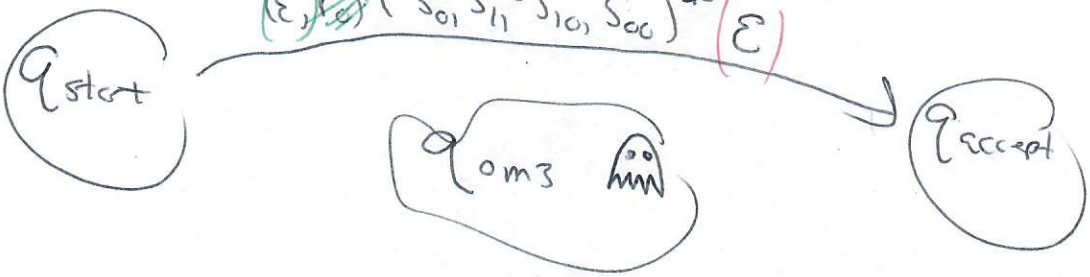
$s_{01} = \ldots$

$s_{11} = \ldots$


Loop
S_{11}
S_{01}
$q_{0 \bmod 3}$
$q_{1 \bmod 3}$
$q_{0 \bmod 3}$
S_{10}
Enter
Leave


q_{start}
$\varepsilon, \varepsilon \to \varepsilon$
$q_{0 \bmod 3}$
$(S_{01} S_{11}^* S_{10}, S_{00})$
ε
q_{accept}

$q_{1 \bmod 3}$
ghost


q_{start}
$(\varepsilon, \varepsilon)(S_{01} S_{11}^* S_{10}, S_{00})^* (\varepsilon)$
$q_{0 \bmod 3}$
q_{accept}