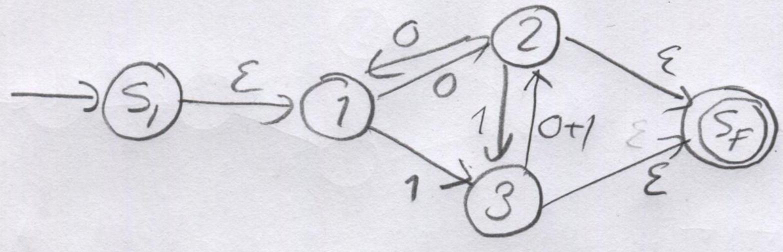
3.5a) Redraw and add new start and final state



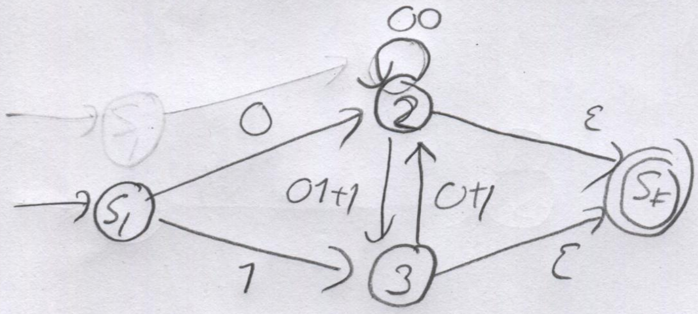
eliminate state 1. There are 4 paths through 1

$S_1 \to 1 \to 2$: $\varepsilon \emptyset^* 0 + \emptyset = 0$

$S_1 \to 1 \to 3$; $\varepsilon \emptyset^* 1 + \emptyset = 1$

$2 \to 1 \to 2$: $0 \emptyset^* 0 + \emptyset = 00$

$2 \to 1 \to 3$: $0 \emptyset^* 1 + 1 = 01 + 1$



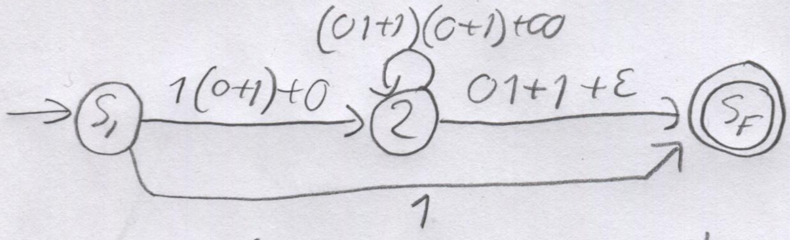
eliminate state 3. There are 4 paths through 3

$S_1 \to 3 \to 2$: $1 \emptyset^* (0+1) + 0 = 1(0+1) + 0 =$

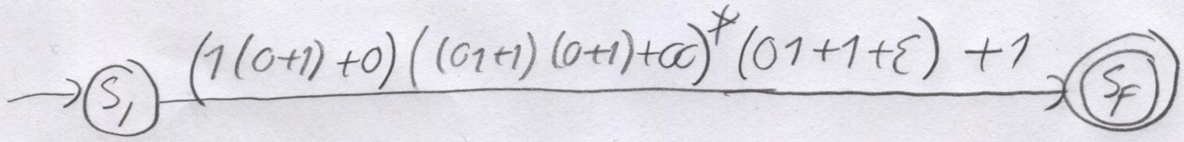
$S_1 \to 3 \to S_F$; $1 \emptyset^* \varepsilon + \emptyset = 1$

$2 \to 3 \to 2$: $(01+1) \emptyset^* (0+1) + 00 = (01+1)(0+1) + 00$

$2 \to 3 \to S_F$: $(01+1) \emptyset^* \varepsilon + \varepsilon = (01+1) + \varepsilon$

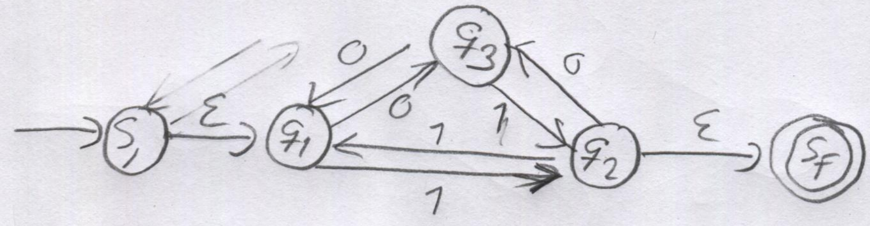


eliminate state 2: There is 1 path: $S_1 \to 2 \to S_F$



This reg. exp. describes the language of the original DFA.

3.5b) Redraw and add new start and final states



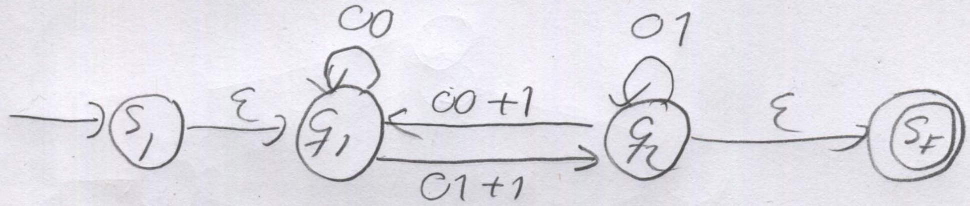
eliminate state q_3. There are 4 paths through q_3:

$q_1 \to q_3 \to q_1$: $0\emptyset^*0 + \emptyset = 00$

$q_1 \to q_3 \to q_2$: $0\emptyset^*1 + 1 = 01 + 1$

$q_2 \to q_3 \to q_1$: $0\emptyset^*0 + 1 = 00 + 1$

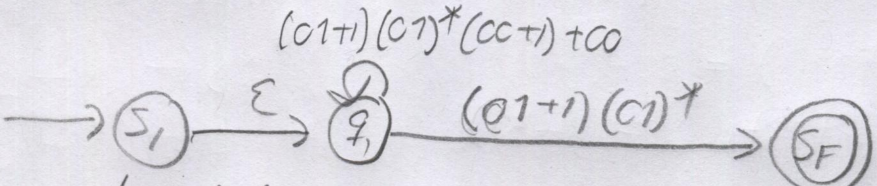
$q_2 \to q_3 \to q_2$: $0\emptyset^*1 + \emptyset = 01$



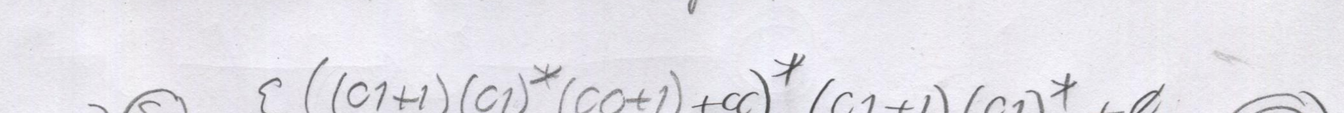
eliminate state q_2: There are 2 paths through q_2:

$q_1 \to q_2 \to q_1$: $(01+1)(01)^*(00+1) + 00$

$q_1 \to q_2 \to s_F$: $(01+1)(01)^*\varepsilon + \emptyset = (01+1)(01)^*$



eliminate state q_1. There is 1 path.



which simplifies to

$$((01+1)(01)^*(00+1)+00)^*(01+1)(01)^*$$