October 2: DFA/NFA $\rightarrow$ Regular Expression

**Idea:**

![Diagram of states and transitions]

1. Start with DFA/NFA but introduce edges that will have regular expressions.
2. Eventually, we get $L = L_1 L_2^* L_3 L_4^* L_5 L_6^*$.

Motivation is that all these describe the same class of languages.
Example: \( \text{DIV}_3 = \{0, 3, 6, 9, 12, 15, \ldots\} \)

\[ R_0' = \{0, 3, 6, 9\} \]
\[ R_0' = 3 \times 0, 6, 9 \]
\[ R_1 = 10, 4, 7 \]
\[ R_2 = 2, 5, 8 \]
eliminate

\[ S_2 = R_0' \cup R_2 R_0^* R_1 \quad S_4 = R_0 R_1 R_0^* R_2 \]
\[ S_3 = R_1 R_2 R_0 R_2 = S_1 \quad S_5 = R_1 R_0 R_0 R_2 \]
\[ S_1 = R_1 R_2 R_0^* R_2 \]

\( R_6 = \{0,3,6,9\} \]
\( = 0369 \)
\( R_0' = 369 \)
\( R_1 = 10407 \)
\( R_2 = 2058 \)

\[ T_0 = S_0 \cup S_4 S_5 \]
\[ T_1 = S_0 S_4 S_5 \]
\[ T_0 T_1 \bar{e} = T_0 T_1 \\]
\[ (S_1 u S_3 S_4 S_5) (S_6 \ldots) \]

etc., \( \dagger \)