Tutorial 3

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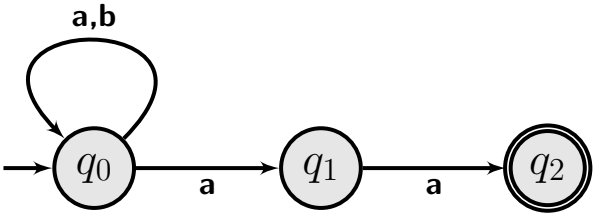
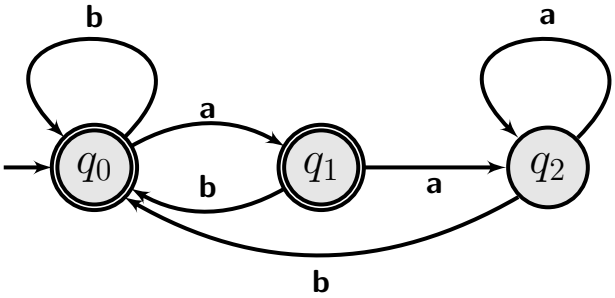
1. Give a regular expression, over the alphabet $\{a, b\}$, that recognises the language of all strings that contain the substring bb and end in a.
2. Given the following finite automaton, give a regular expression that recognises the same language.



3. **Challenge:** Given the following finite automaton, give a regular expression that recognises the same language.



4. Assume the following grammar. Give the abstract syntax tree for the string (3+3)+(2*3). You can use either RDP or shift-reduce methods.

$$\begin{array}{ll} \langle \texttt{E} \rangle & \rightarrow \langle \texttt{F} \rangle \mid \langle \texttt{F} \rangle \times \langle \texttt{F} \rangle \mid \langle \texttt{F} \rangle / \langle \texttt{F} \rangle \\ \langle \texttt{F} \rangle & \rightarrow \langle \texttt{T} \rangle \mid \langle \texttt{T} \rangle + \langle \texttt{T} \rangle \mid \langle \texttt{F} \rangle - \langle \texttt{F} \rangle \\ \langle \texttt{T} \rangle & \rightarrow [0-9] \mid (\ \langle \texttt{E} \rangle\ ) \end{array}$$