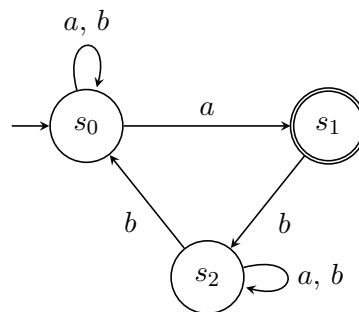


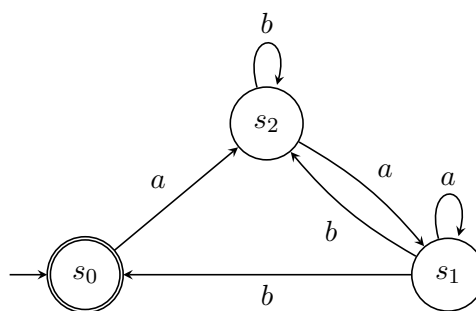
Exercises

[Compiled on September 4, 2017]

- Given an alphabet $\{1, 2, +\}$, draw a finite state automaton such that the automaton accepts words evaluated to 3.
- Apply subset construction to determinize the following automaton.



- Let $M_1 = (Q_1, \Sigma, \delta_1, I_1, F_1)$ and $M_2 = (Q_2, \Sigma, \delta_2, I_2, F_2)$ be two NFAs. Construct an NFA M_3 such that $L(M_3) = L(M_1) \setminus L(M_2)$. Please describe the components of M_3 in detail.
- Write regular expressions to describe the following languages. ($\Sigma = \{a, b\}$)
 - $\{w \mid \text{the length of } w \text{ is even}\}$
 - $\{w \mid w \text{ has at most two } b\text{'s}\}$
 - $\{w \mid \text{every } a \text{ in } w \text{ is followed by } b\}$
- Express the language of the following automaton by a regular expression.



- Write WS1S formulas to describe the following words.
 - Only a 's can occur between any two occurrences of b 's
 - Has an odd length (please start with \exists)
- Draw a Büchi automaton that accepts infinite words where p holds infinitely many times. ($\Sigma = \{p, \neg p\}$)

8. Express the following sentences in LTL formulas.

(a) “ p occurs infinitely often”

(b) “whenever a message is sent, eventually an acknowledgement will be received”