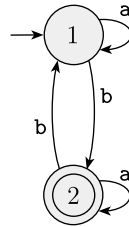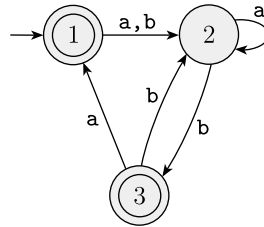# Homework 4

The problems below are from the Sipser textbook.

1.21 Convert the following finite automata to regular expressions.

(a)   (b)

1.28 Convert the following regular expressions to NFAs. In all parts, the alphabet is $\{a, b\}$.

    a. $a(abb)^* \cup b$

    b. $a^+ \cup (ab)^+$

    c. $(a \cup b^+)a^+b^+$

1.47 Let $\Sigma = \{1, \#\}$ and let

$$Y = \{w \mid w = x_1 \# x_2 \# \cdots \# x_k \text{ for } k \geq 0, \text{ each } x_i \in 1^*, \text{ and } x_i \neq x_j \text{ for } i \neq j\}.$$

Prove that Y is not regular.

1.49
    a. Let $B = \{1^k y \mid y \in \{0, 1\}^* \text{ and } y \text{ contains at least } k \text{ 1s, for } k \geq 1\}$.
    Show that B is a regular language.

    b. Let $C = \{1^k y \mid y \in \{0, 1\}^* \text{ and } y \text{ contains at most } k \text{ 1s, for } k \geq 1\}$.
    Show that C isn't a regular language.

1.53 Let $\Sigma = \{0, 1, +, =\}$ and

$$ADD = \{x=y+z \mid x, y, z \text{ are binary integers, and } x \text{ is the sum of } y \text{ and } z\}.$$

Show that ADD is not regular.

6 Consider the languages $A = 0^*1^*$ and $B = \{1^n 0^m 1^m : n, m \geq 0\}$. Prove that $A \cup B$ is a nonregular language.