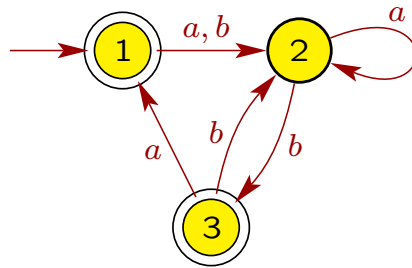


## Homework 4

1. Use the procedure described in Lemma 1.55 to convert the regular expression  $((00)^*(11))^* \cup 01)^*$  into an NFA.
2. Use the procedure described in Lemma 1.60 to convert the following DFA to a regular expression.



3. Prove that the following languages are not regular.
  - (a)  $A_1 = \{www \mid w \in \{a, b\}^*\}$ .
  - (b)  $A_2 = \{w \in \{a, b\}^* \mid w = w^R\}$ .
  - (c)  $A_3 = \{a^{2n}b^{3n}a^n \mid n \geq 0\}$ .
  - (d)  $A_4 = \{w \in \{a, b\}^* \mid w \text{ has more } a\text{'s than } b\text{'s}\}$ .
4. Suppose that language  $A$  is accepted by an NFA  $N$ , and language  $B$  is the collection of strings *not* accepted by some DFA  $M$ . Prove that  $A \circ B$  is a regular language.
5.
  - (a) Prove that if we add a finite set of strings to a regular language, the result is a regular language.
  - (b) Prove that if we remove a finite set of strings from a regular language, the result is a regular language.
  - (c) Prove that if we add a finite set of strings to a nonregular language, the result is a nonregular language.
  - (d) Prove that if we remove a finite set of strings from a nonregular language, the result is a nonregular language.
6. Consider the following statement: “If  $A$  is a nonregular language and  $B$  is a language such that  $B \subseteq A$ , then  $B$  must be nonregular.” If the statement is true, give a proof. If it is not true, give a counterexample showing that the statement doesn’t always hold.