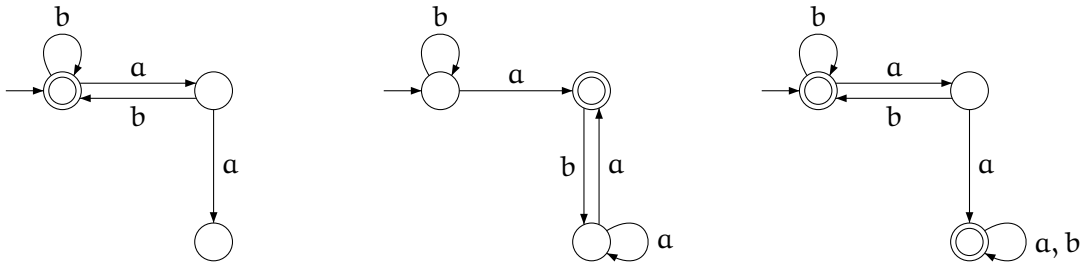# Tutorial 4

Exercise 1: Use regular expressions to describe the languages accepted by the following three automata:

Exercise 2: For each of the following languages determine whether the given language is regular or not. Justify your answers.

a) $\{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0\}$

b) $\{w \in \{a, b\}^* \mid w \text{ starts or ends with a pair of the same symbols}\}$

c) $\{w \in \{a, b\}^* \mid |w|_a < |w|_b\}$

d) $\{w \in \{a, b, c\}^* \mid \text{if } w \text{ does not contain substring } abc \text{ then it ends with } bca\}$

e) $\{w \in \{a, b\}^* \mid |w|_a < |w|_b \text{ or } w \text{ ends with } baa\}$

f) $\{w \in \{a, b\}^* \mid |w|_a < |w|_b \text{ or } |w|_b \geq 2\}$

g) $\{ww^R \mid w \in \{a, b\}^*\}$

h) $\{w \in \{a, b\}^* \mid w = w^R\}$

i) $\{w \in \{a\}^* \mid w = w^R\}$

j) $\{ww \mid w \in \{a, b\}^*\}$

k) $\{ww \mid w \in \{a\}^*\}$

l) $\{w \in \{a, b\}^* \mid |w|_a - |w|_b > 100\}$

m) $\{w \in \{a, b\}^* \mid |w|_a \cdot |w|_b \geq 100\}$

n) $\{w \in \{a\}^* \mid |w| \text{ is a prime}\}$