

# FLA (Fall 2024) – Assignment 1

Name: \_\_\_\_\_ Dept: \_\_\_\_\_

Grade: \_\_\_\_\_ ID: \_\_\_\_\_

**Due: Oct. 13, 2024**

## Problem 1

Provide DFAs and REs of the following languages. In all parts, the alphabet  $\Sigma = \{0, 1\}$  and  $|v|_\omega$  denotes the number of occurrences of substring  $v$  in string  $\omega$ .

- $\{\omega \mid \text{Every even position of } \omega \text{ is } 1 \text{ and } |\omega| \text{ is odd.}\}$
- $\{\omega \mid |110|_\omega \geq 1\}$
- $\{\omega \mid |01|_\omega = |10|_\omega\}$
- $\{\omega \mid |0|_\omega \bmod 3 \equiv 0 \wedge |1|_\omega \bmod 2 \equiv 0\}$  (**DFA only**)

**Solution.**

## Problem 2

Let  $R = (\mathbf{a + b + c})^* \mathbf{ab(b + c)^*}$ .

- a. Convert  $R$  to an  $\epsilon$ -NFA. (**You may omit some  $\epsilon$ -transitions.**)
- b. Convert the  $\epsilon$ -NFA to a DFA by subset construction.

**Solution.**

### Problem 3

Consider the following  $\epsilon$ -NFA:

	$\epsilon$	$a$	$b$	$c$
$\rightarrow p$	$\{q, r\}$	$\emptyset$	$\{q\}$	$\{r\}$
$q$	$\emptyset$	$\{p\}$	$\{r\}$	$\{p, q\}$
$*r$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

- Give all the strings of length three or less accepted by the automaton.
- Convert the automaton to an NFA.

**Solution.**

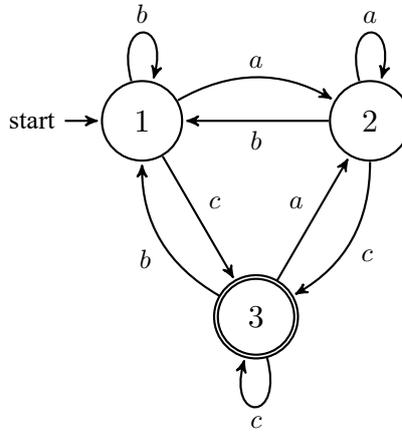
## Problem 4

Give a DFA as figure below, please give the regular expression for the following  $R_{ij}^k$ , and **try to simplify the expressions as much as possible**.

- $R_{11}^0, R_{12}^0, R_{13}^0$ .
- $R_{21}^1, R_{22}^1, R_{23}^1$ .
- $R_{31}^2, R_{32}^2, R_{33}^2$ .
- The RE for this DFA.

**Hint:**

- $(\epsilon + R)^* = R^*$
- $R + SR = (\epsilon + S)R$
- $\epsilon + RR^* = R^*$
- $(R + S)^* = (R^*S)^*R^*$



**Solution.**