

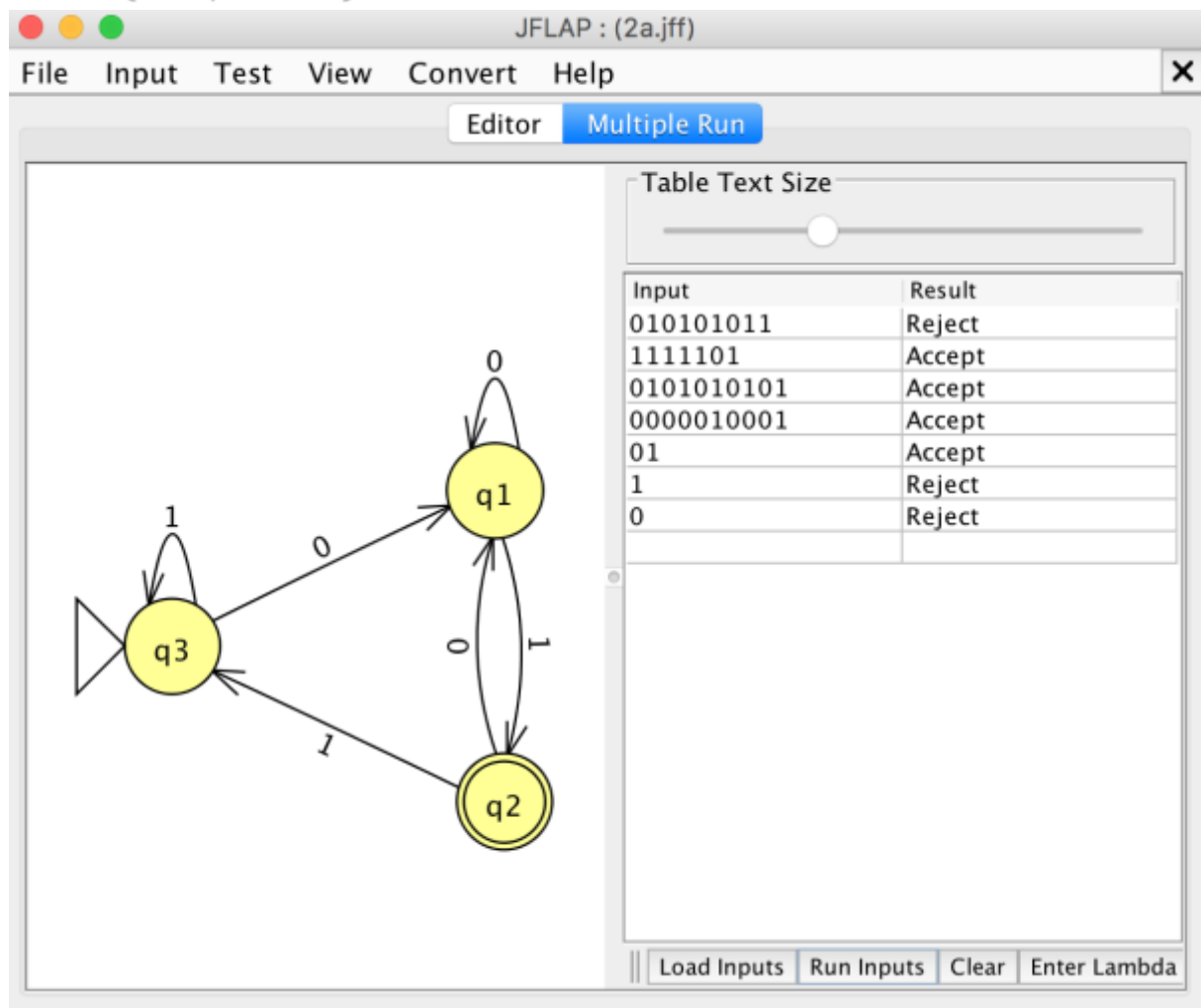
# Konzepte konkreter und abstrakter Maschinen

Übungsblatt 1 20. Oktober 2016

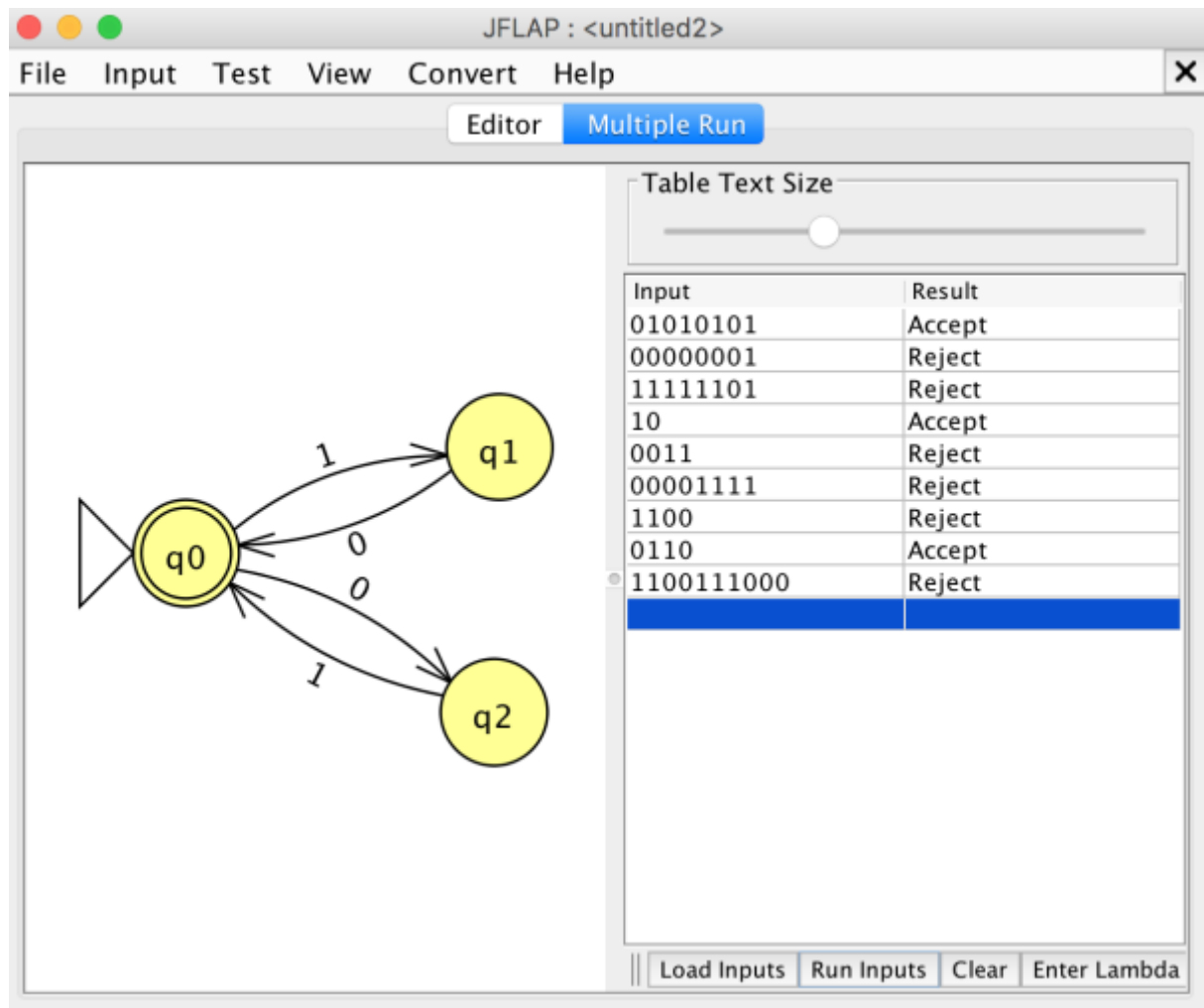
## Aufgabe 1

## Aufgabe 2

$$L_A = \{w01 \mid w \in V^*\}$$



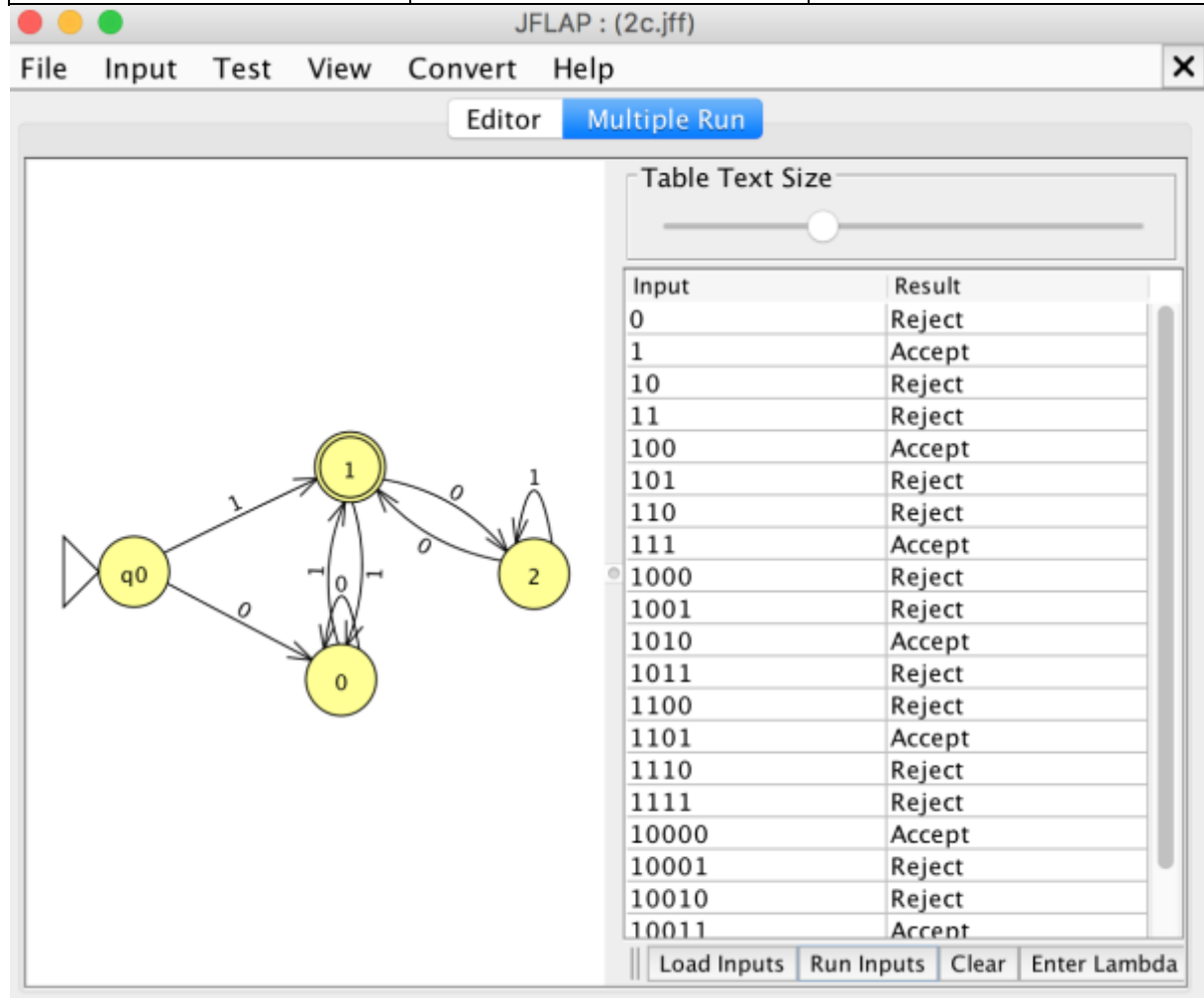
$L_B = \{w \mid w \in V^* \wedge \|w\|_0 = \|w\|_1\}$ , wobei  $\|w\|_x$  die Anzahl des Zeichens  $x$  im Wort  $w$  ist.



nicht möglich => Fälle 000000111111 nicht abbildbar als Automat, da kein Zähler vorhanden

$L_C = \{w \mid w \in V^* \wedge (\|w\|_{dez} \bmod 3) = 1\}$ , wobei  $\|w\|_{dez}$  das dezimale Äquivalent des Wortes  $w$  ist, wenn dieses als Dualzahl interpretiert wird. und  $\bmod k$  der Rest bei Division durch  $k$  ist.

Dez.Wert	Bin.Wert	Mod 3
0	0000	0
1	0001	1
2	0010	2
3	0011	0
4	0100	1
5	0101	2
6	0110	0
7	0111	1
8	1000	2
9	1001	0
10	1010	1
11	1011	2
12	1100	0
13	1101	1
14	1110	2
15	1111	0



$$L_D = \{0^k 1^k \mid k \in \mathbb{N}\}$$

wie bei  $L_B$  fehlt hier ein Zähler, mit dem die Anzahl 0en oder 1en „überprüft“ werden kann

### Aufgabe 3

Wurde das letzte Mal schon abgegeben, dafür dieses Mal zusätzliche Abgabe des DFA Moduls.

#### Modul

##### Question 1.

1. Load the NFA in the file NF-1.jflap.
2. Enter inputs  $w_1$ ,  $w_2$ ,  $w_3$  and  $w_4$  in the discussion above and verify that the first three inputs are accepted and the last is rejected, as shown in the diagram below.
3. List all configurations for the inputs  $w_1$ ,  $w_2$ ,  $w_3$  and  $w_4$ .
4. Enter six more inputs of your own, three of which are accepted and the other three are rejected.

The screenshot shows the JFLAP software window titled "JFLAP : (01\_NFA.jff)". The interface includes a menu bar (File, Input, Test, View, Convert, Help) and a toolbar with buttons for Editor, Multiple Run, Load Inputs, Run Inputs, Clear, and Enter Lambda. On the left, an NFA diagram is displayed with states p, q, r, s, t, and u. State p is the start state, and state u is the final state. Transitions are labeled with 'a', 'b', and 'c'. On the right, a table titled "Table Text Size" shows the results of running inputs. The table has two columns: "Input" and "Result".

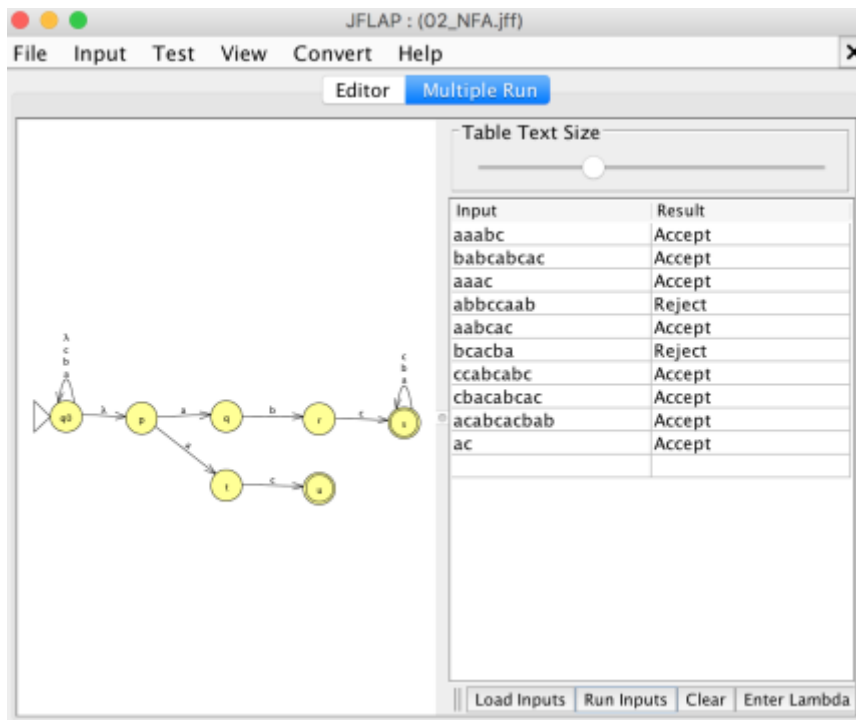
Input	Result
aaabc	Accept
babcbacac	Accept
aaac	Accept
abbccaab	Reject
aabcbac	Accept
bcacba	Reject
ccabcbac	Accept
cbacabcbac	Accept
acabcbabab	Accept
ac	Accept

**Question 2.** Complete the table above by filling out all blank cells in the table. Explain your answers.

	a	b	c	$\lambda$
p	{p,q,t}	{p}	{p}	$\phi$
q	$\phi$	{r}	$\phi$	$\phi$
r	$\phi$	$\phi$	{s}	$\phi$
s	{s}	{s}	{s}	$\phi$
t	$\phi$	$\phi$	{u}	$\phi$
u	$\phi$	$\phi$	$\phi$	$\phi$

**Question 3.**

1. Load the NFA in the file NFA-2.jflap, as shown below.
2. Verify that  $Q = \{q_0, p, q, r, s, t, u\}$ .
3. Which state is the initial state?
4. What is  $F$ ?
5. Verify that  $\delta(p, a) = \{q, t\}$ .
6. What is  $\delta(q_0, \lambda)$ ?
7. What is  $\delta(r, b)$ ?
8. What is  $\delta(t, \lambda)$ ?
9. What is  $\delta(u, b)$ ?
10. What is  $\delta(s, c)$ ?



$q_0$  is the initial state.

$F = \{s, u\}$

$\delta(q_0, \lambda) = \{p\}$

$\delta(r, b) = \{\}$

$\delta(t, \lambda) = \{\}$

$\delta(u, b) = \{\}$

$\delta(s, c) = \{s\}$

**Question 4.** Do NFA-1.jflap and NFA-2.jflap accept the same set of words? Explain your answer in detail.

Yes, because they are the same NFA, except the  $\lambda$  transition in NFA-2.

## Exercise 1

Define an NFA that recognizes the following language  $L$  over  $\Sigma = \{a, b\}$ :

$$L = \{ w \mid w \text{ ends with } aa \}.$$

Recall that an NFA is defined as a 5-tuple  $(Q, \Sigma, \delta, q_0, F)$  where

- $Q$  is a finite set of states
- $\Sigma$  is a finite alphabet
- $\delta$  is the transition function,  $\delta: Q \times \Sigma \rightarrow \text{PowerSet}(Q)$
- $q_0$  is the start state ( $q_0 \in Q$ )
- $F$  is a set of accept states ( $F \subseteq Q$ )

JFLAP : <untitled1>

File Input Test View Convert Help

Editor Multiple Run

Table Text Size

```

graph LR
    start(( )) --> q0((q0))
    q0 -- b --> q0
    q0 -- a --> q1((q1))
    q1 -- a --> q2(((q2)))
  
```

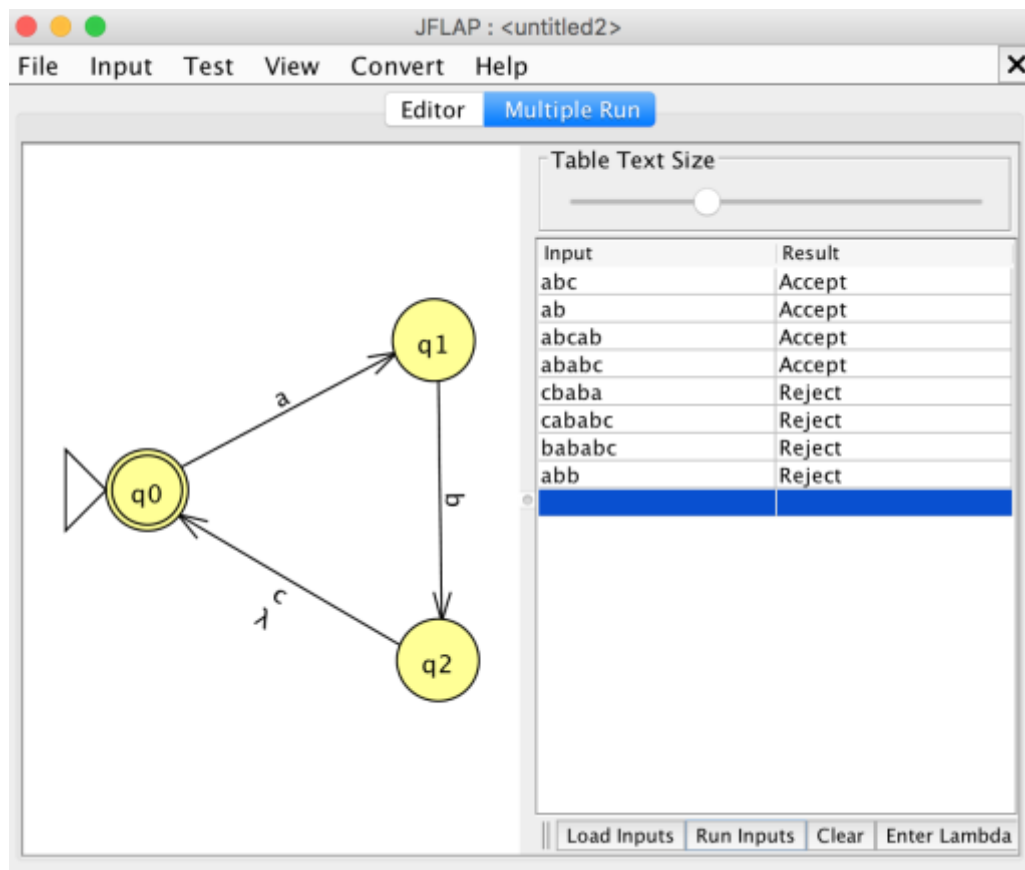
Input	Result
abaa	Accept
aa	Accept
bab	Reject
baba	Reject
aaaabb	Reject
bbbabb	Reject
bbbbbbaaa	Accept
bb	Reject

Load Inputs Run Inputs Clear Enter Lambda

## Exercise 2

**Problem:**

Construct an NFA that accepts the language  $\{ab, abc\}^*$ . This is the set of strings where  $ab$  and  $abc$  may be repeated. Example strings include  $abcb, ababcb, abcabcabc$ , and the empty string.



## Exercise 3

Given the Alphabet  $\{a,b,c\}$  construct a NFA which accepts  $(a|b|c)^*c$

