Non-Deterministic Finite Automata Simulation Exercise in JFLAP

Table of Contents

Problem Statement

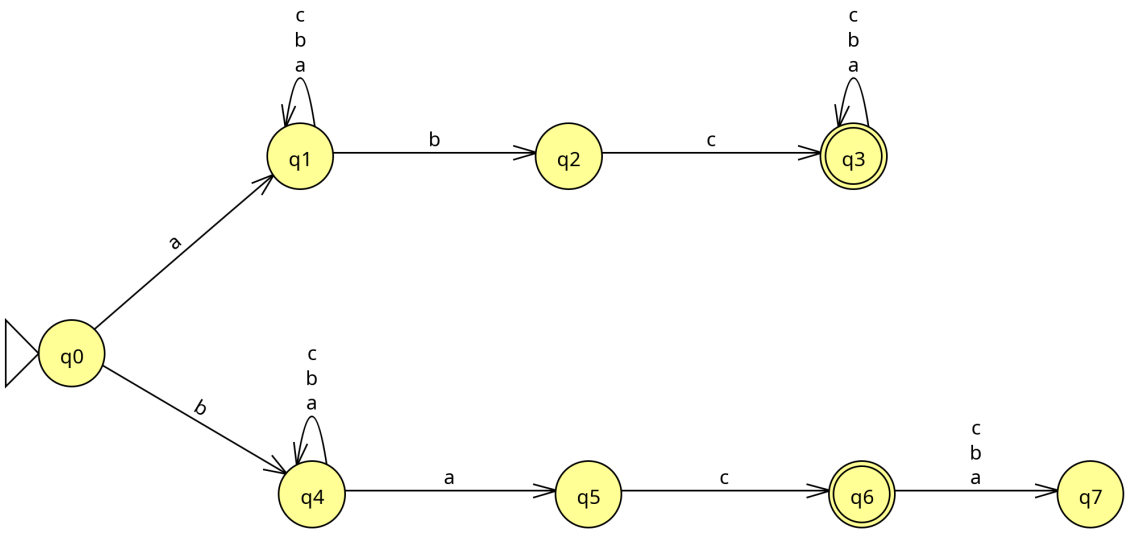
Construct a Non-deterministic Finite Automaton (NFA) for the language (L) over the alphabet ({a, b, c}) where a string (w) belongs to (L) if it satisfies the following conditions:

1. The string starts with an (a) and contains `bc` as a substring.
2. The string starts with a (b) and ends with `ac`.

Design Steps

- **Step 1:** Initial state q_0 with transition `a` to q_1 (to start the string with `a`).
- **Step 2:** From q_1, create transitions for all symbols to stay in q_1.
- **Step 3:** From q_1, add `b` transition to q_2.
- **Step 4:** From q_2, add `c` transition to accepting state q_3.
- **Step 5:** From q_3, add all symbol transitions to stay in q_3
- **Step 6:** From q_0, add `b` transition to q_4.
- **Step 7:** From q_4, add all symbol transitions to stay in q_4.
- **Step 8:** From q_4, add `a` transition to q_5.
- **Step 9:** From q_5, add `c` transition to accepting state q_6.
- **Step 10:** From q_6, add all symbol transitions to move to non-accepting state q_7, so that symbols after encountering `ac` are not accepted.

The final Non-Deterministic Finite Automata constructed is as follows:



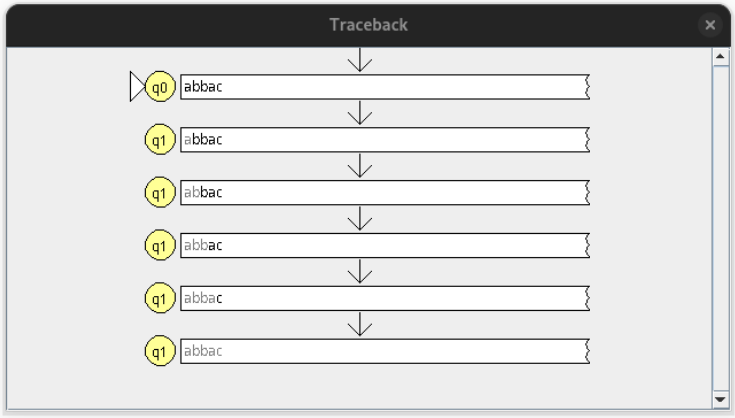
Tracing Strings

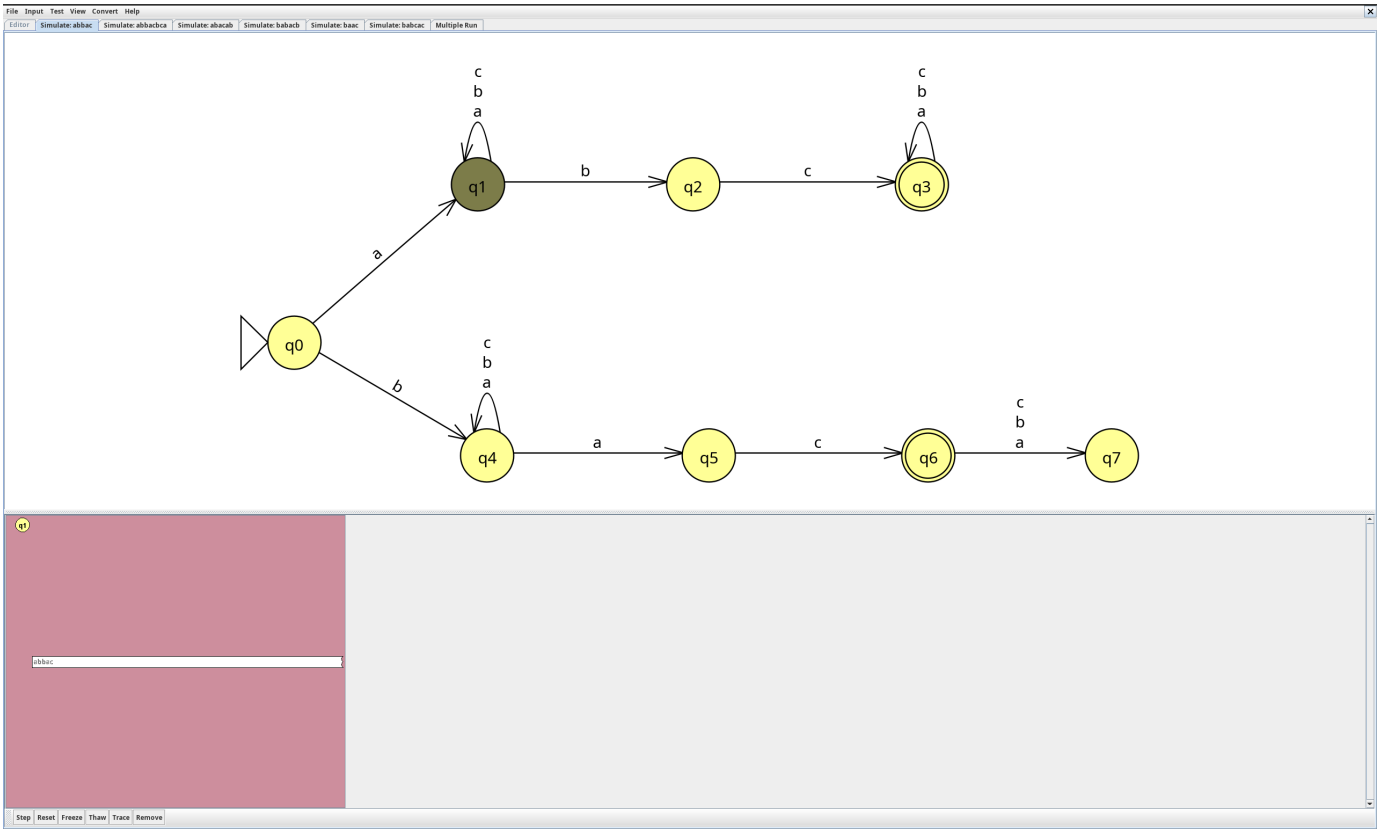
- **String 1:** `abbac`

  1. The machine transitions from q_0 to q_1 on reading `a`.
  2. Then, the machine transitions from q_1 to itself on reading `b`.
  3. Then, the machine transitions from q_1 to itself on reading `b`.
  4. Then, the machine transitions from q_1 to itself on reading `a`.
  5. Then, the machine transitions from q_1 to itself on reading `c`.

  Since q_1 is a non-accepting state, the string `abbac` is invalid.

  Corresponding JFLAP Traceback



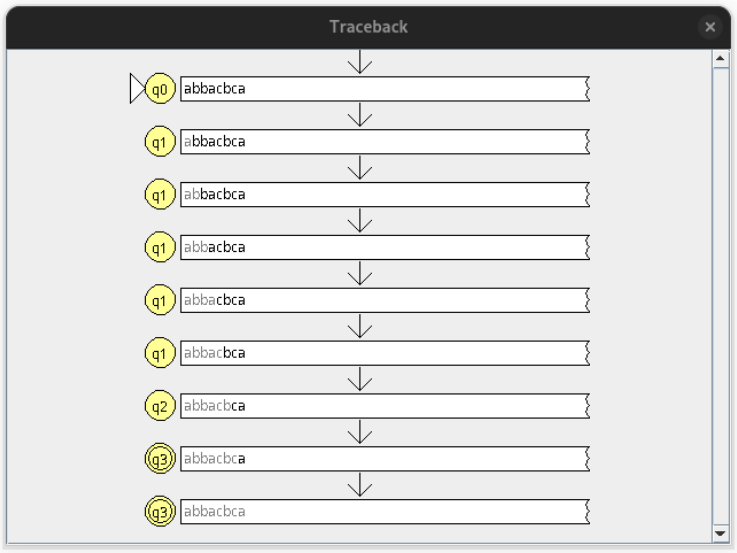


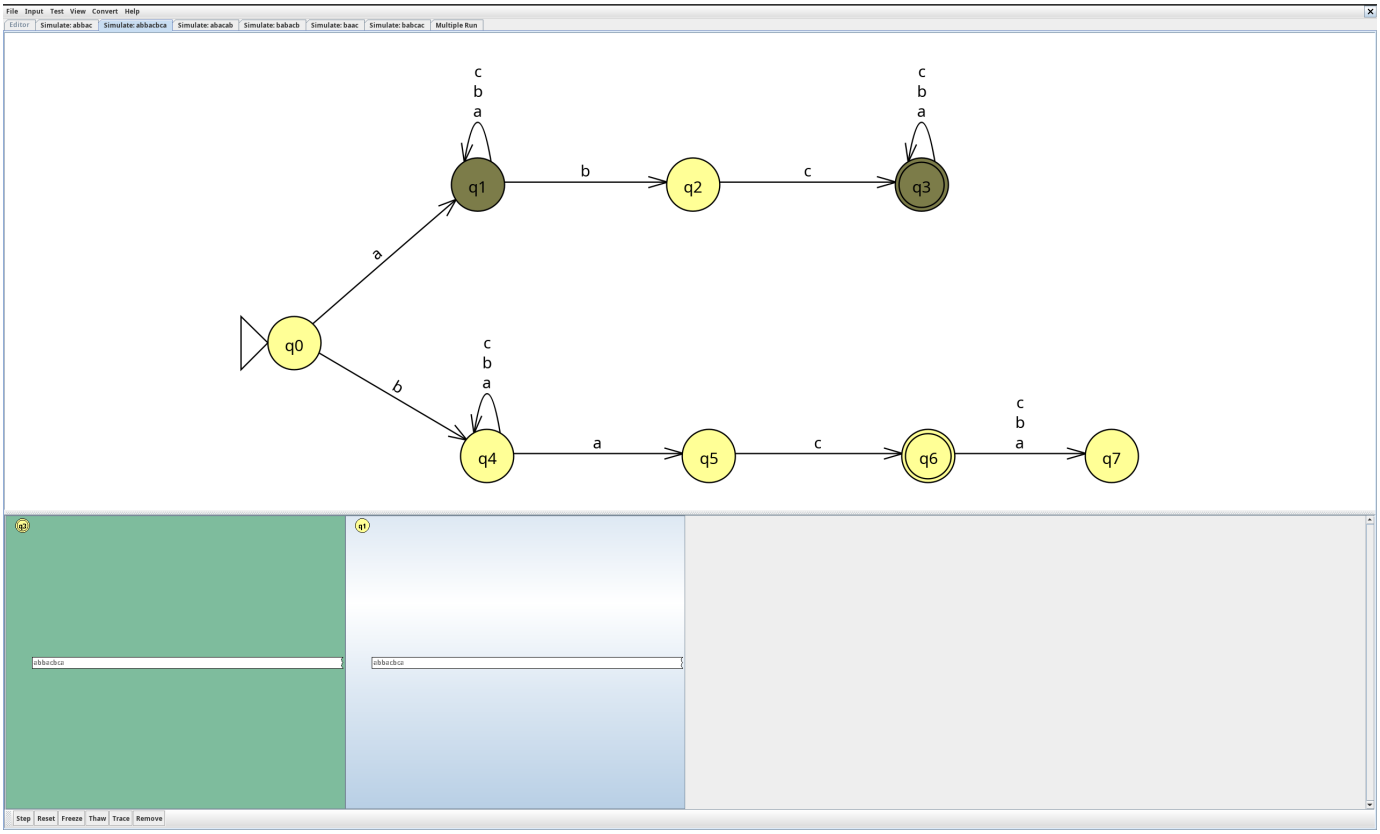
- **String 2:** `abbacbca`

  1. The machine transitions from q_0 to q_1 on reading `a`.
  2. Then, the machine transitions from q_1 to itself on reading `b`.
  3. Then, the machine transitions from q_1 to itself on reading `b`.
  4. Then, the machine transitions from q_1 to itself on reading `a`.
  5. Then, the machine transitions from q_1 to itself on reading `c`.
  6. Then, the machine transitions from q_1 to q_2 on reading `b`.
  7. Then, the machine transitions from q_2 to q_3 on reading `c`.
  8. Then, the machine transitions from q_3 to itself on reading `a`.

  Since q_3 is an accepting state, the string `abbacbca` is valid.

  Corresponding JFLAP Traceback



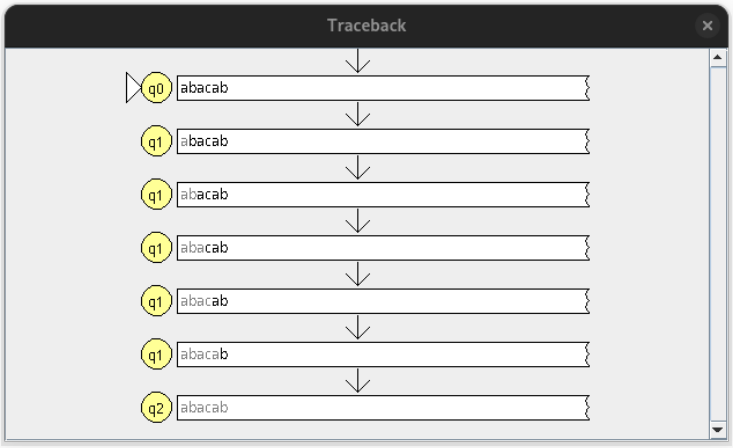


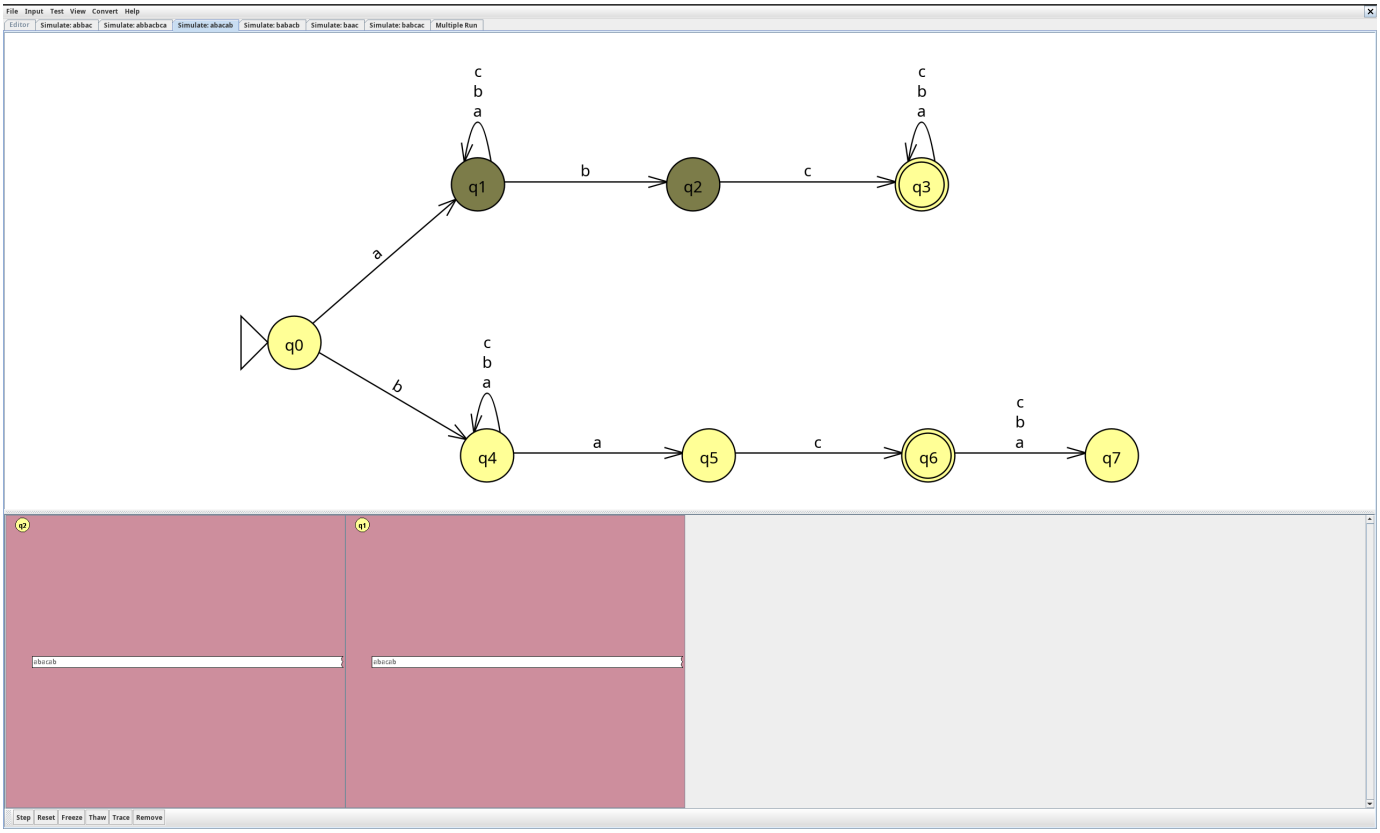
- **String 3:** `abacab`

  1. The machine transitions from q_0 to q_1 on reading `a`.
  2. Then, the machine transitions from q_1 to itself on reading `b`.
  3. Then, the machine transitions from q_1 to itself on reading `a`.
  4. Then, the machine transitions from q_1 to itself on reading `c`.
  5. Then, the machine transitions from q_1 to itself on reading `a`.
  6. Then, the machine transitions from q_1 to q_2 on reading `b`.

  Since q_2 is a non-accepting state, the string `abacab` is invalid.

  Corresponding JFLAP Traceback



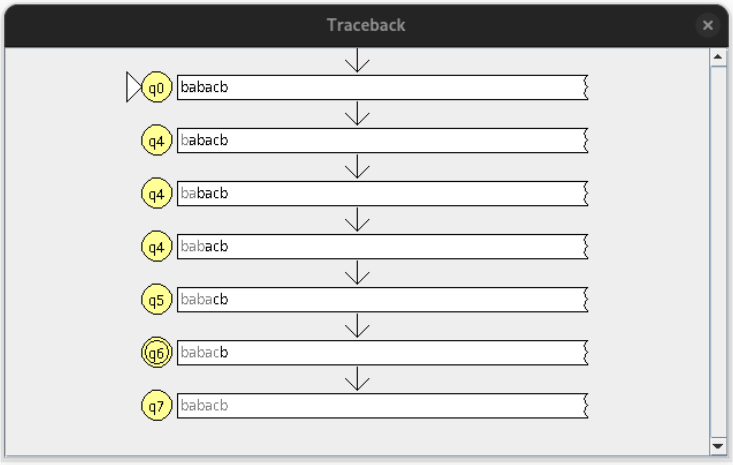


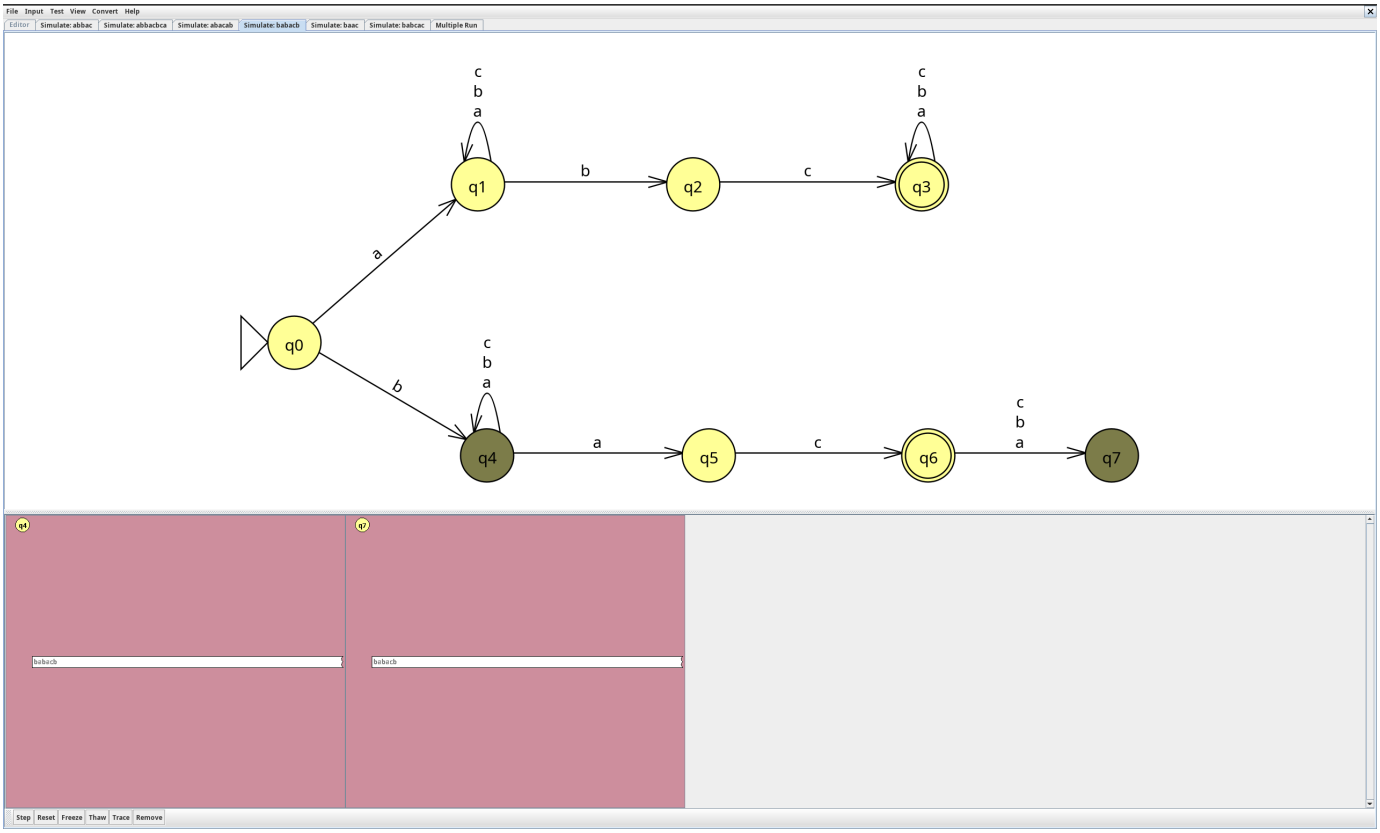
- **String 4:** `babacb`

  1. The machine transitions from q_0 to q_4 on reading `b`.
  2. Then, the machine transitions from q_4 to itself on reading `a`.
  3. Then, the machine transitions from q_4 to itself on reading `b`.
  4. Then, the machine transitions from q_4 to q_5 on reading `a`.
  5. Then, the machine transitions from q_5 to q_6 on reading `c`.
  6. Then, the machine transitions from q_6 to q_7 on reading `b`.

  Since q_7 is a non-accepting state, the string `babacb` is invalid.

  Corresponding JFLAP Traceback



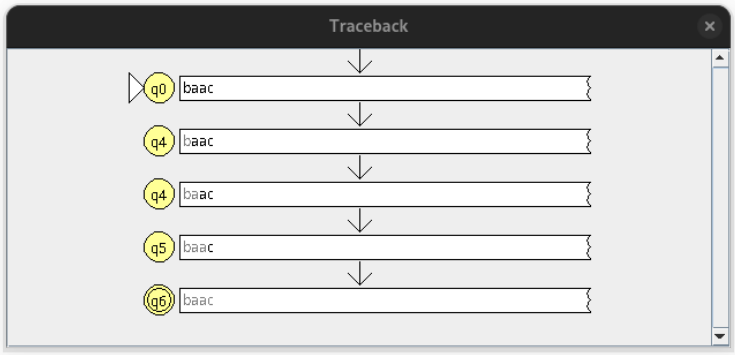


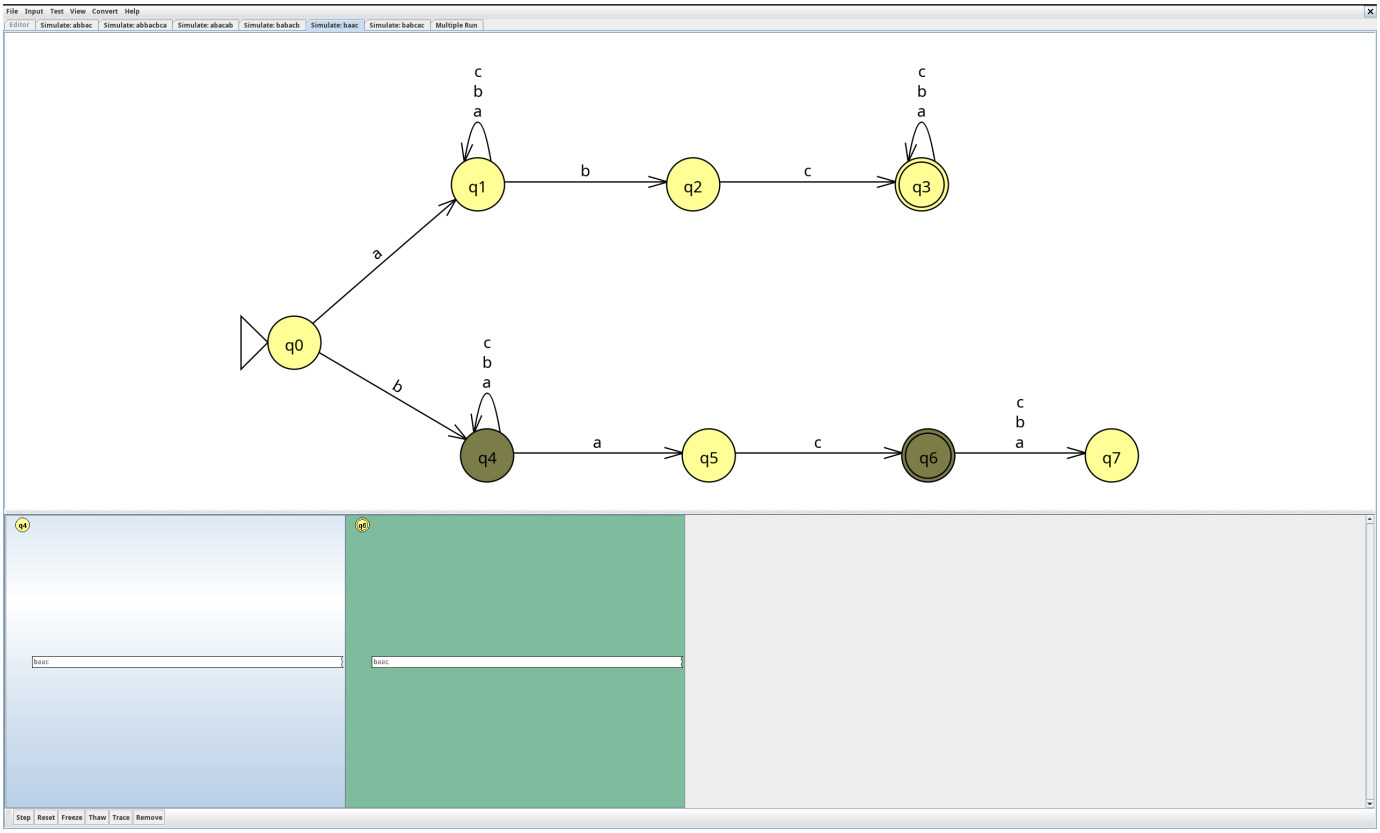
- **String 5:** `baac`

  1. The machine transitions from q_0 to q_4 on reading `b`.
  2. Then, the machine transitions from q_4 to itself on reading `a`.
  3. Then, the machine transitions from q_4 to q_5 on reading `a`.
  4. Then, the machine transitions from q_5 to q_6 on reading `c`.

  Since q_6 is an accepting state, the string `baac` is valid.

  Corresponding JFLAP Traceback



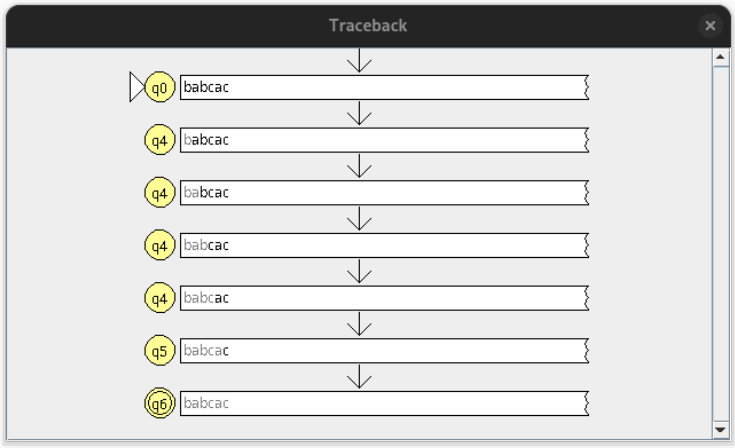


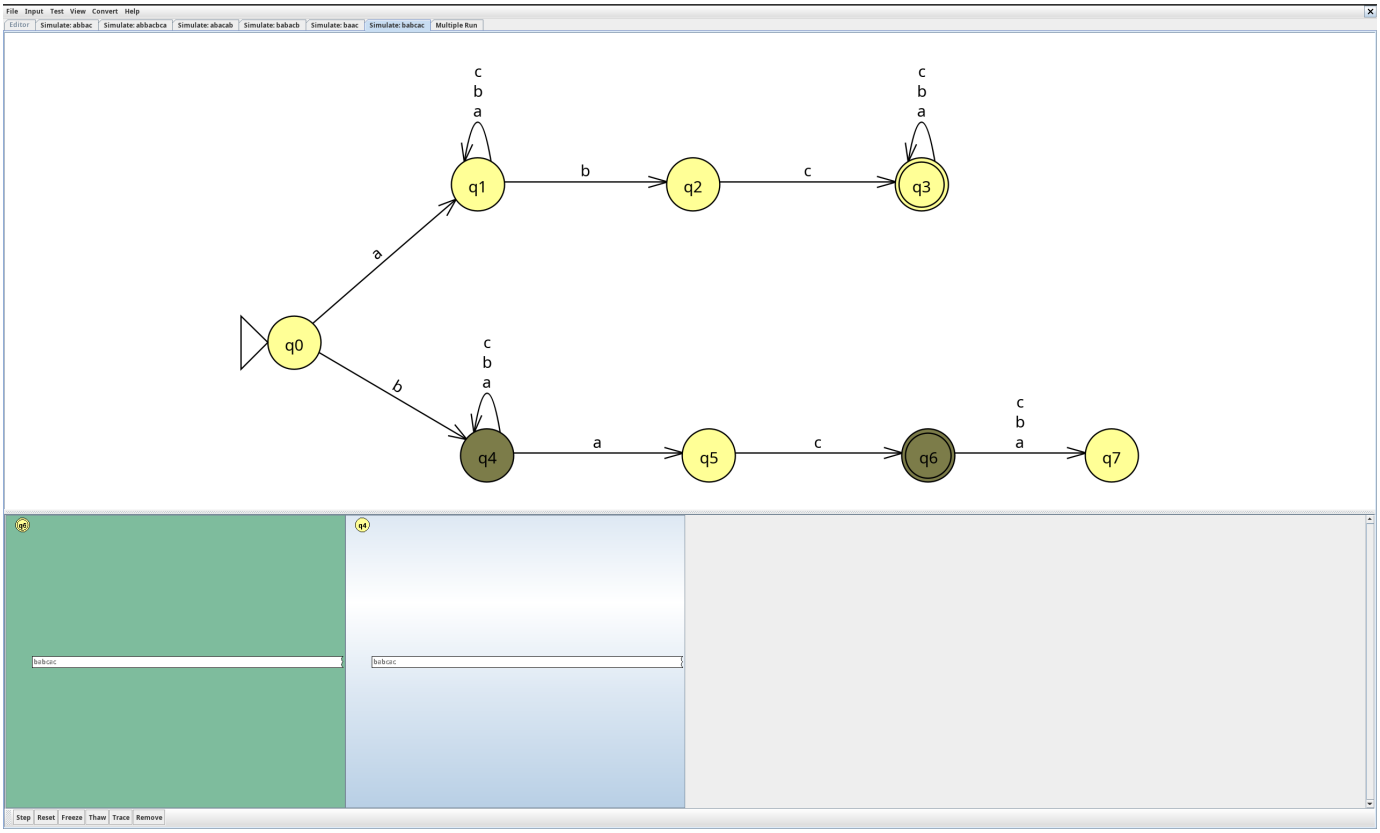
- **String 6:** `babcac`

  1. The machine transitions from q_0 to q_4 on reading `b`.
  2. Then, the machine transitions from q_4 to itself on reading `a`.
  3. Then, the machine transitions from q_4 to itself on reading `b`.
  4. Then, the machine transitions from q_4 to itself on reading `c`.
  5. Then, the machine transitions from q_4 to q_5 on reading `a`.
  6. Then, the machine transitions from q_5 to q_6 on reading `c`.

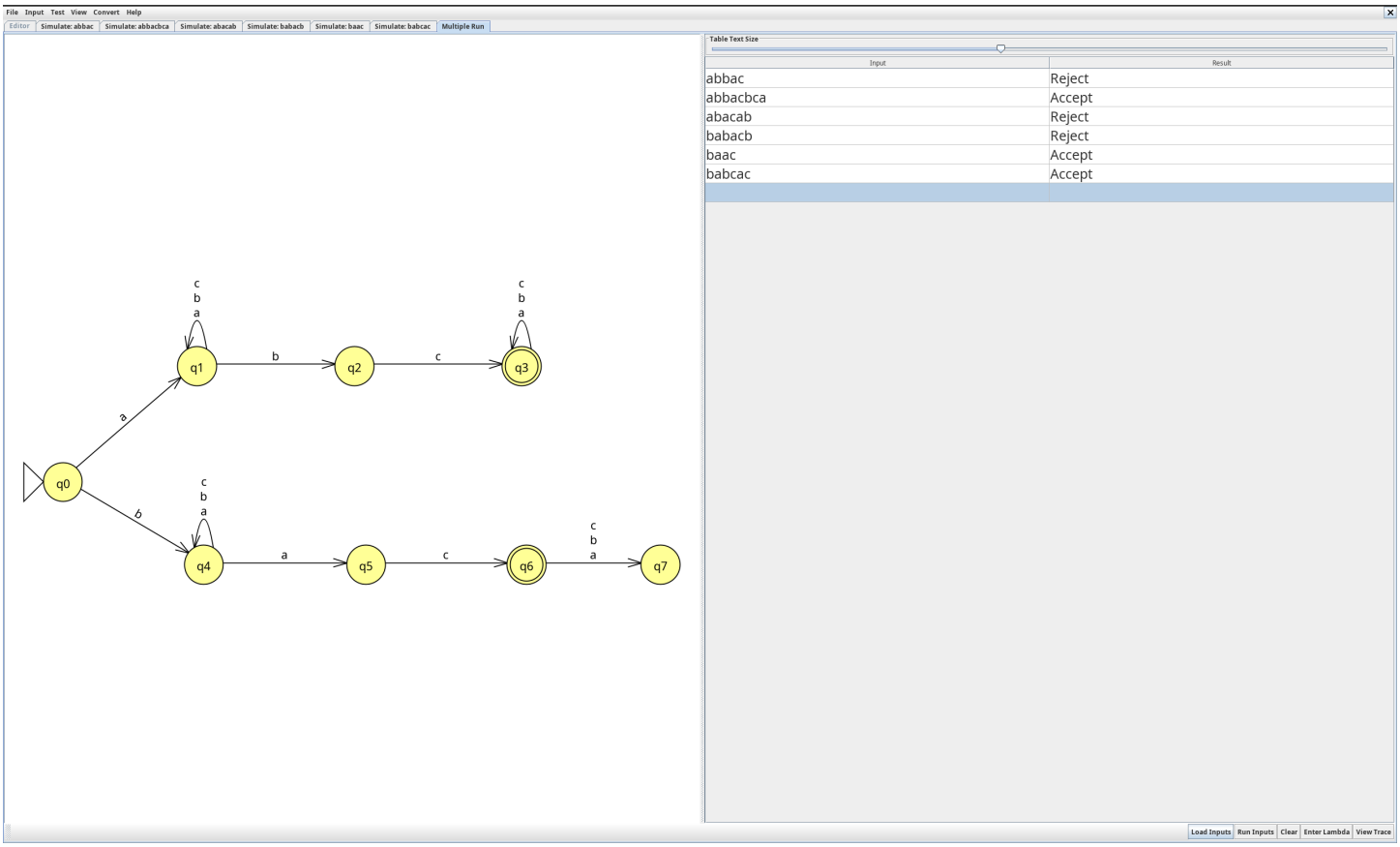
  Since q_6 is an accepting state, the string `babcac` is valid.

  Corresponding JFLAP Traceback





Multiple Run Output in JFLAP



The results of Multiple Run prove that the manual traces for all six strings under the previous heading are correct.
