

CSEN1002 Compilers Lab, Spring Term 2024  
Task 3: Fallback Deterministic Finite Automata

Due: Week starting 02.03.2024

## 1 Objective

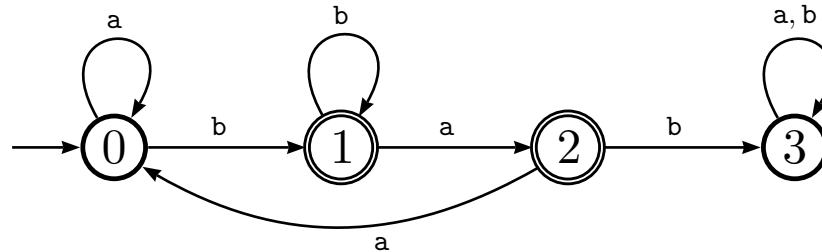
For this task, you need to implement a fallback deterministic finite automaton with actions (FDFA) abstract data type. Recall that an FDFA is a sextuple  $(Q, \Sigma, \delta, q_0, F, \mathcal{A})$ :  $Q$  is a non-empty, finite set of states;  $\Sigma$  is a non-empty, finite set of symbols (an alphabet);  $\delta : Q \times \Sigma \rightarrow Q$  is the transition function;  $q_0 \in Q$  is the start state;  $F \subseteq Q$  is the set of accept states; and  $\mathcal{A}$  is function that maps every state in  $Q$  to an action. Refer to the slides of Lecture 2 of CSEN1003 for more details about the operation of FDFA.

## 2 Requirements

- We make the following assumptions about FDFA for simplicity.
  - a) The set of states  $Q$  is always of the form  $\{0, \dots, n\}$ , for some  $n \in \mathbb{N}$ .
  - b) The alphabet  $\Sigma$  is always a subset of the Latin alphabet, not including **e**.
  - c)  $q_0 \notin F$ .
  - d)  $\mathcal{A}(q)$  is the action which appends the token “*lex,q*” to a list, where *lex* is as indicated in Lecture 2 of CSEN1003, and  $q$  is the state name.
- You should implement a class constructor **FallbackDfa** and a method **run**.
- **FallbackDfa**, a class constructor, takes one parameter which is a string description of an FDFA and constructs an FDFA instance as per the description. A string describing an FDFA is of the form  $Q\#A\#T\#I\#F$ .
  - $Q$  is a string representation of the set of states; a semicolon-separated sequence of sorted integer literals.
  - $A$  is a string representation of the input alphabet; a semicolon-separated sequence of alphabetically sorted symbols.
  - $T$  is a string representation of the transition function.  $T$  is a semicolon-separated sequence of triples. Each triple is a string representing a single transition; a comma-separated sequence  $i, a, j$  where  $i$  is a state of  $Q$ ,  $a$  a symbol of  $A$ , and  $j$  a state of  $Q$  representing a transition from  $i$  to  $j$  on input  $a$ . These triples are sorted by the source state  $i$  and then by the input  $a$ .
  - $I$  is an integer literal representing the initial state.
  - $F$  is a string representation of the set of accept states; a semicolon-separated sequence of sorted integer literals.

- Note that the function  $\mathcal{A}$  is not encoded in the string representation since it is fixed for all FDFA as indicated in the simplifying assumptions above.
- For example, the following string represents the FDFA whose state diagram appears in the figure below.

0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



- **run** simulates the operation of the constructed FDFA on a given string, and returns a semicolon-separated sequence of tokens. For example, running the above FDFA on the string **baababb** produces the output **baaba, 2; bb, 1**.
- Important Details:
  - Your implementation should be done within the template file “**FallbackDfa.java**” (uploaded to the CMS).
  - You are not allowed to change package, file, constructor, or method names/signatures.
  - You are allowed to implement as many helper classes/methods within the same file (if needed).
  - Public test cases have been provided on the CMS for you to test your implementation.
  - Please ensure that the public test cases run correctly without modification before coming to the lab to maintain a smooth evaluation process.
  - Private test cases will be uploaded before your session and will have the same structure as the public test cases.

### 3 Evaluation

- Your implementation will be tested by constructing two FDFAs and running each on five strings.
- You get one point for each correct output of **run**; hence, a maximum of ten points.
- The evaluation will take place during your lab session of the week starting Saturday, March 02.

### 4 Online Submission

- You should submit your code at the following link.

<https://forms.gle/PRghyivArpcgDA2G9>

- Submit one Java file (FallbackDfa.java) containing executable code.
- **Online submission is due by the end of your lab session.**