

IN-CLASS EXERCISES

Version: 2025-12-28



LEXICAL ANALYSIS 3- FROM RES TO DFAS

Download exercises

1. Go to

<https://ligerlabs.org/compilers.html>

2. Download the file

`lex-3-exercises.zip`

3. Open up a terminal and Unzip the file

`> unzip lex-3-exercises.zip`

`> cd lex-3-exercises`

`> ls`

Task 1

- Use Thompson's Construction to build NFAs from the following regular expressions:

1. $(a \mid b)^* a$

2. $ab^* \mid ba^*$

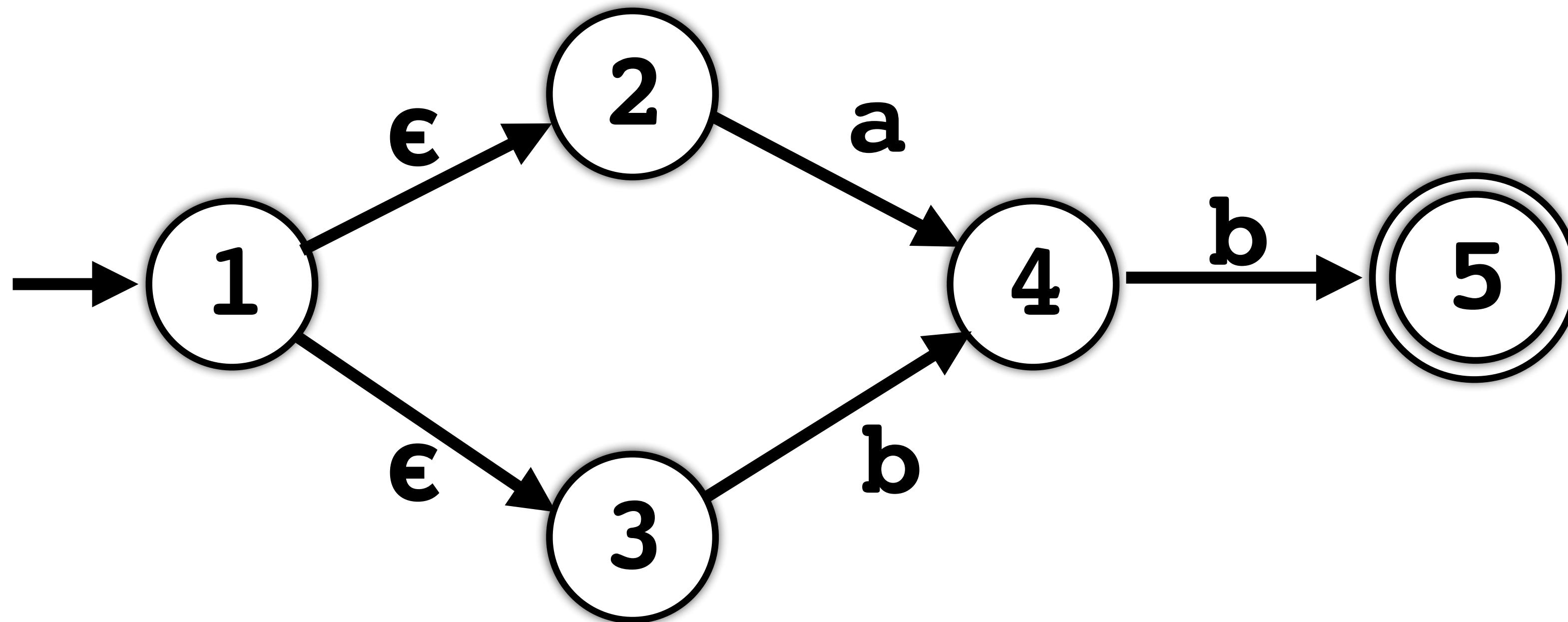
Task 2

- First transform the regular expression below so that it does not use the ? operator.
- Use Thompson's Construction to build the NFA.

- $(a?)^*b^*(a?)^*$

Task 3

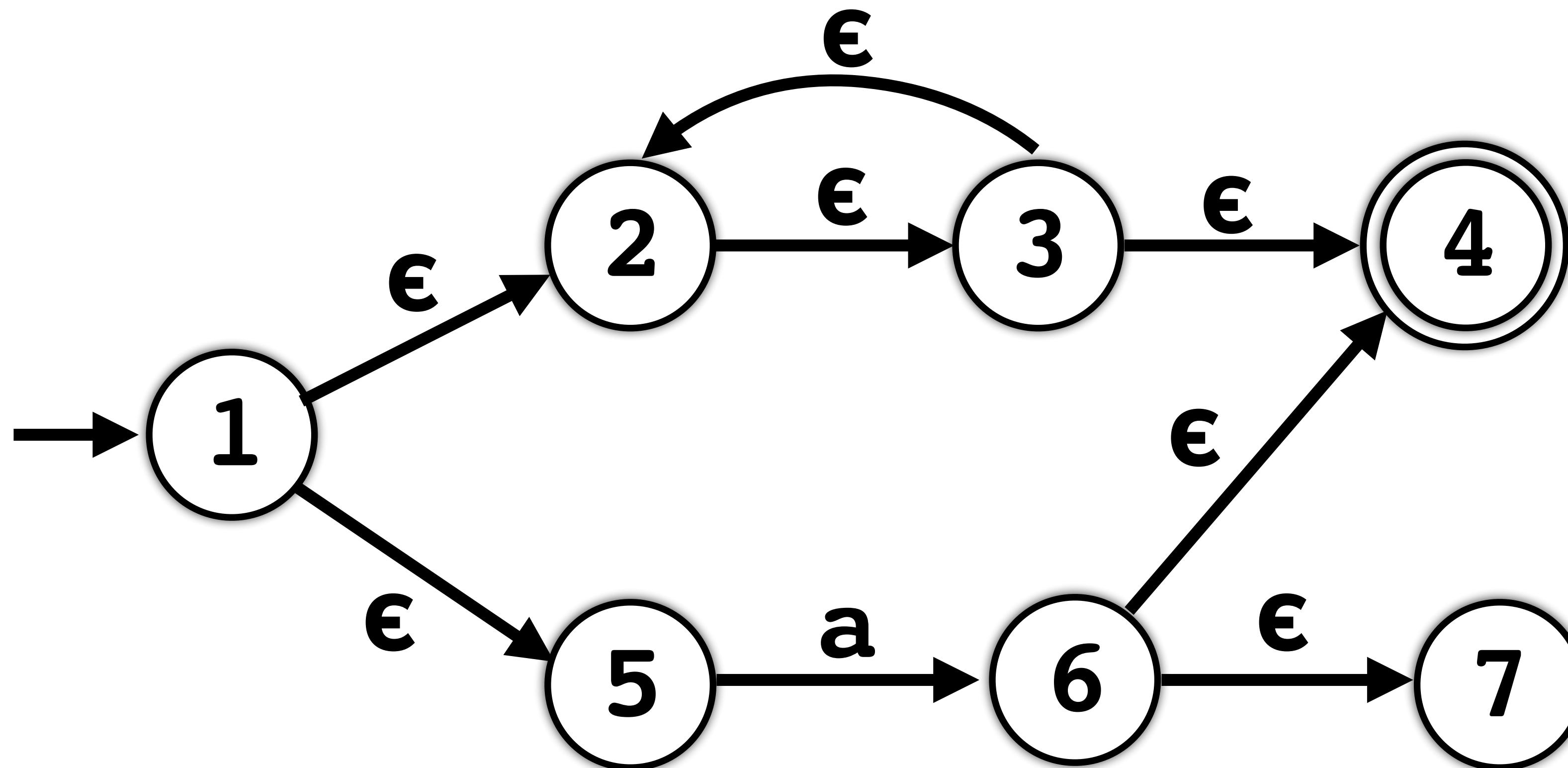
- For each state s in this NFA, compute ϵ -closure($\{s\}$).



Task 4 (a)

- Consider the NFA on the next page.
1. For each state s in the NFA, compute $\epsilon\text{-closure}(\{s\})$.
 2. Compute $\epsilon\text{-closure}(\{2, 5\})$.
 3. Compute $\text{move}(\{5\}, a)$.

Task 4 (b)



Task 5

- Use Thompson's Construction to build the NFA for this regular expression:
 - $(ab \mid c)^*$
- Use the SubsetConstruction algorithm to convert the NFA to a DFA.

Task 6

- Use Thompson's Construction to build the NFA for this regular expression:
 - $(ab) | c^*$
- Use the SubsetConstruction algorithm to convert the NFA to a DFA.

Task 7

- Use Thompson's Construction to build the NFA for this regular expression:

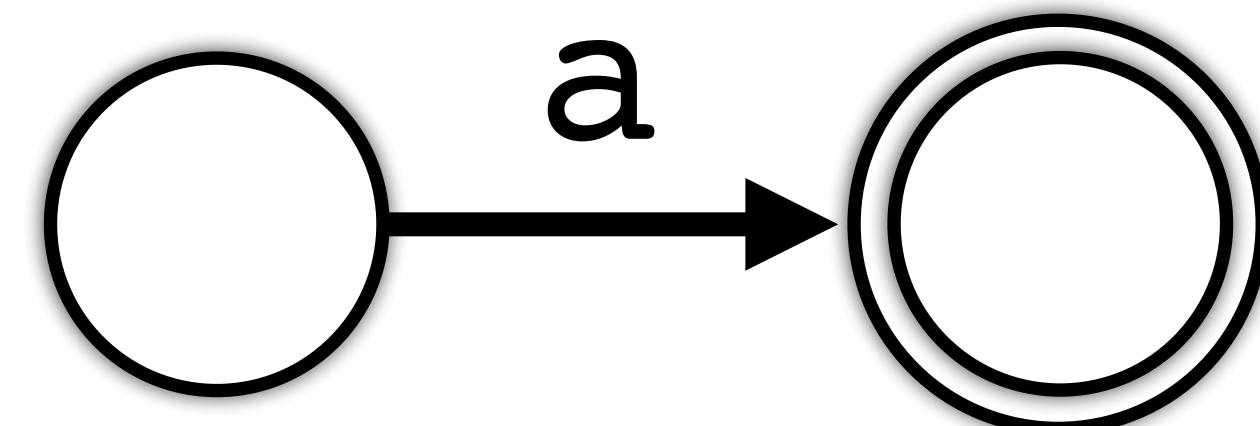
- $(aa \mid b)^* b (a \mid b)$



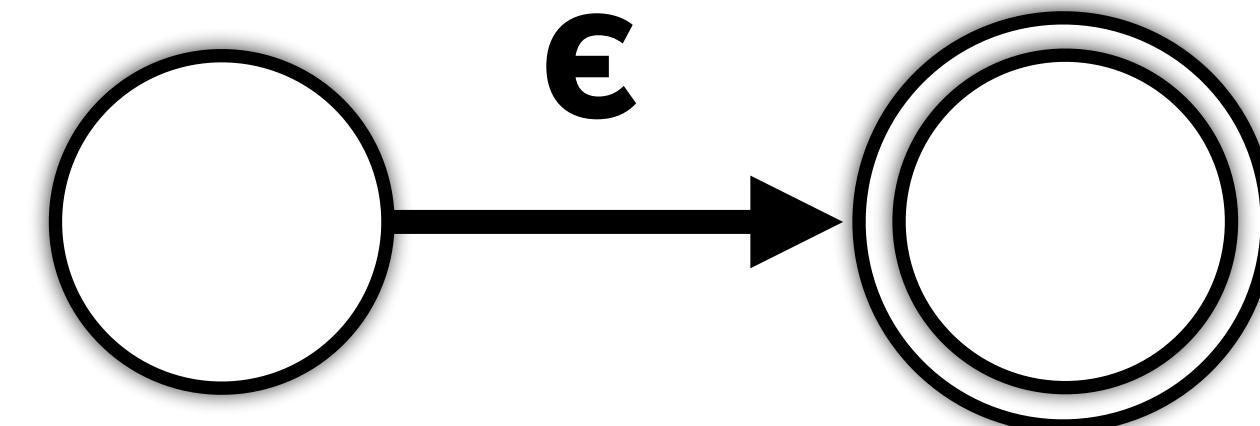
DEFINITIONS AND ALGORITHMS

Thompson's Construction - Characters

The RE matching 'a'

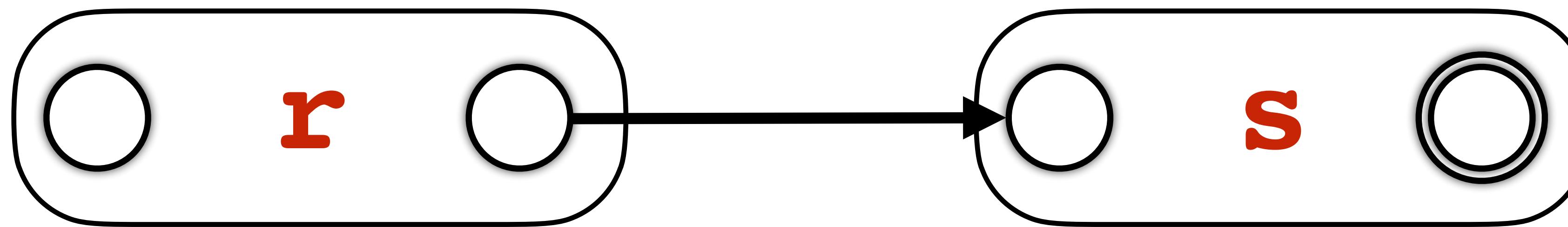


The RE matching ϵ



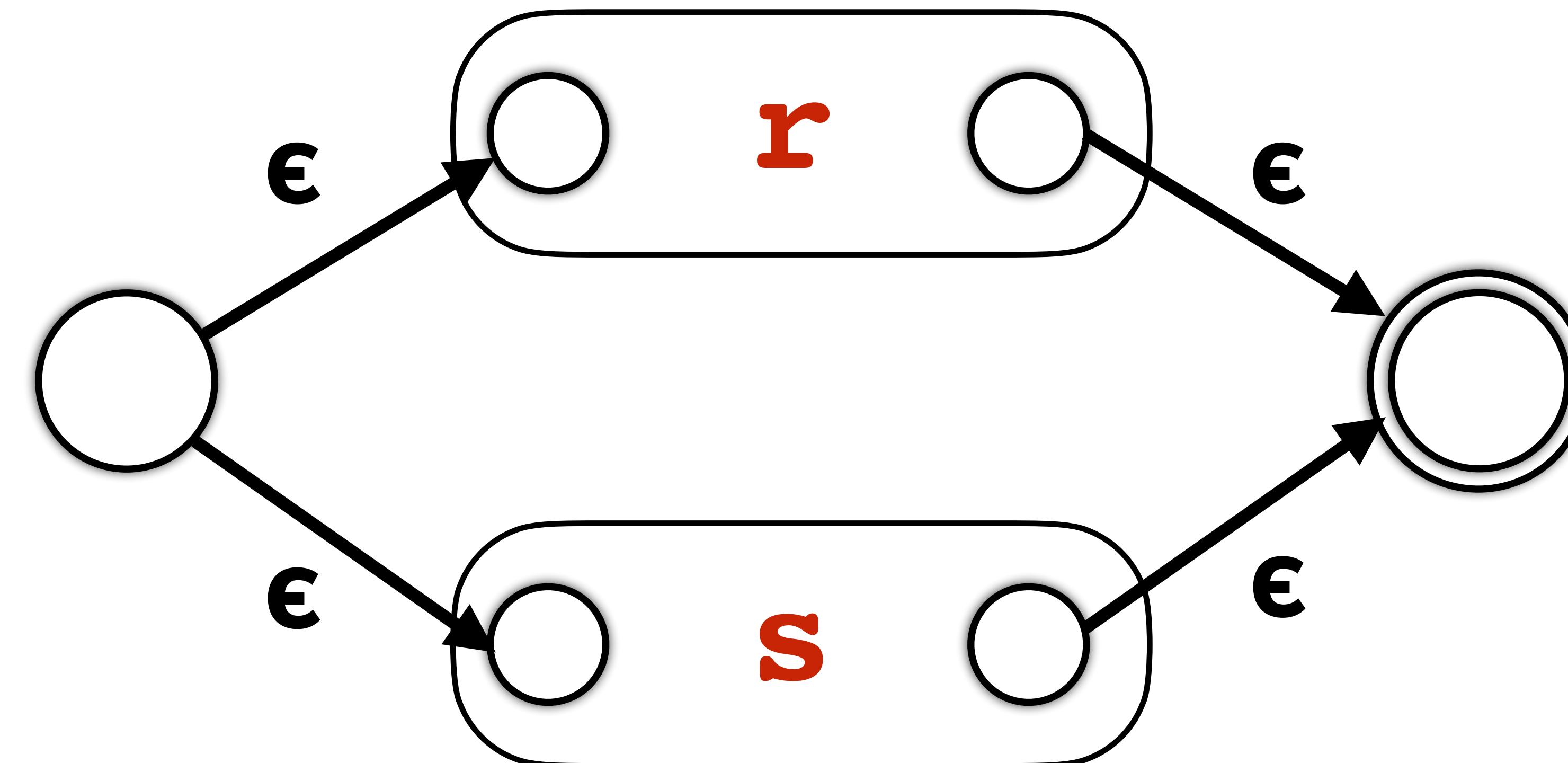
Thompson's Construction - Concatenation

The regular expression **r** followed by **s** translates into



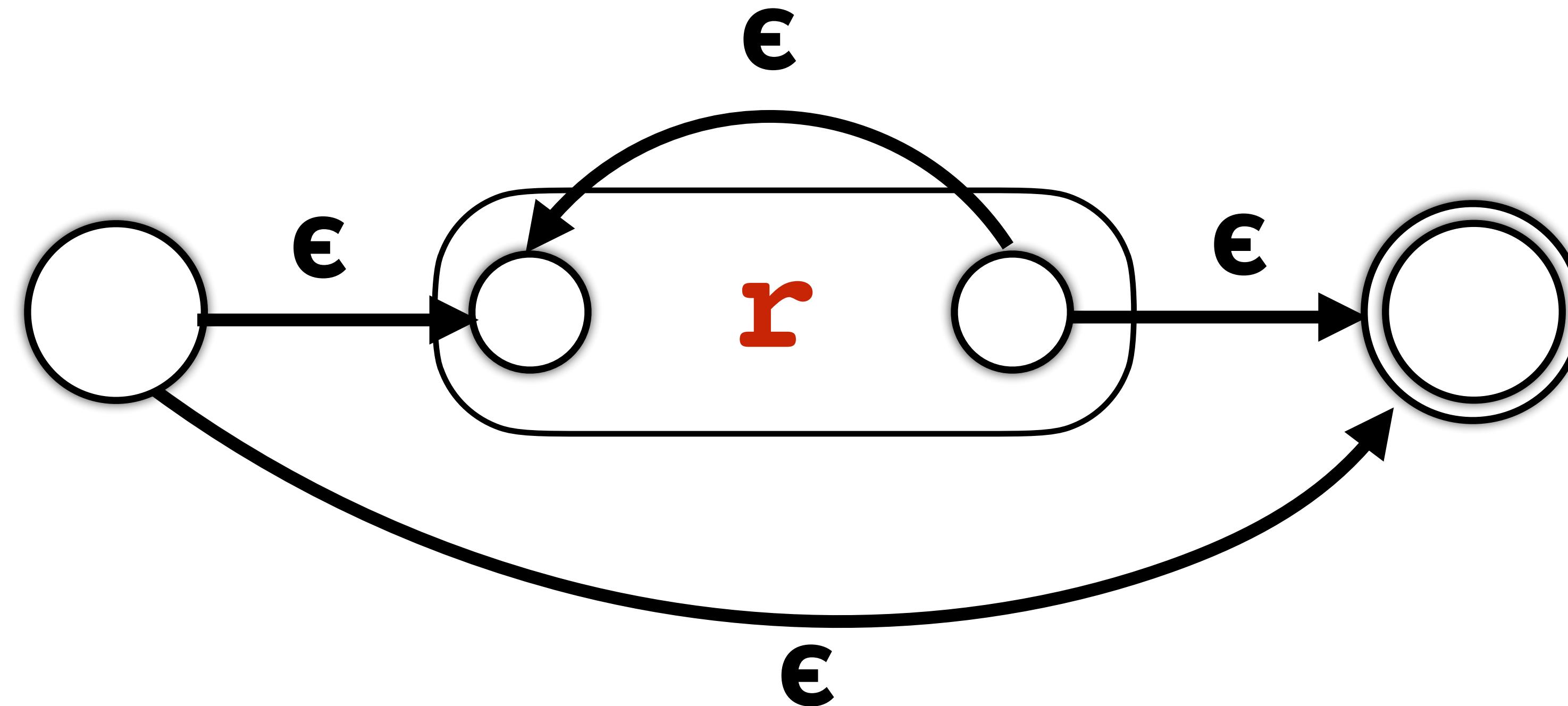
Thompson's Construction - Alternation

The regular expression $r \mid s$ translates into



Thompson's Construction - Repetition

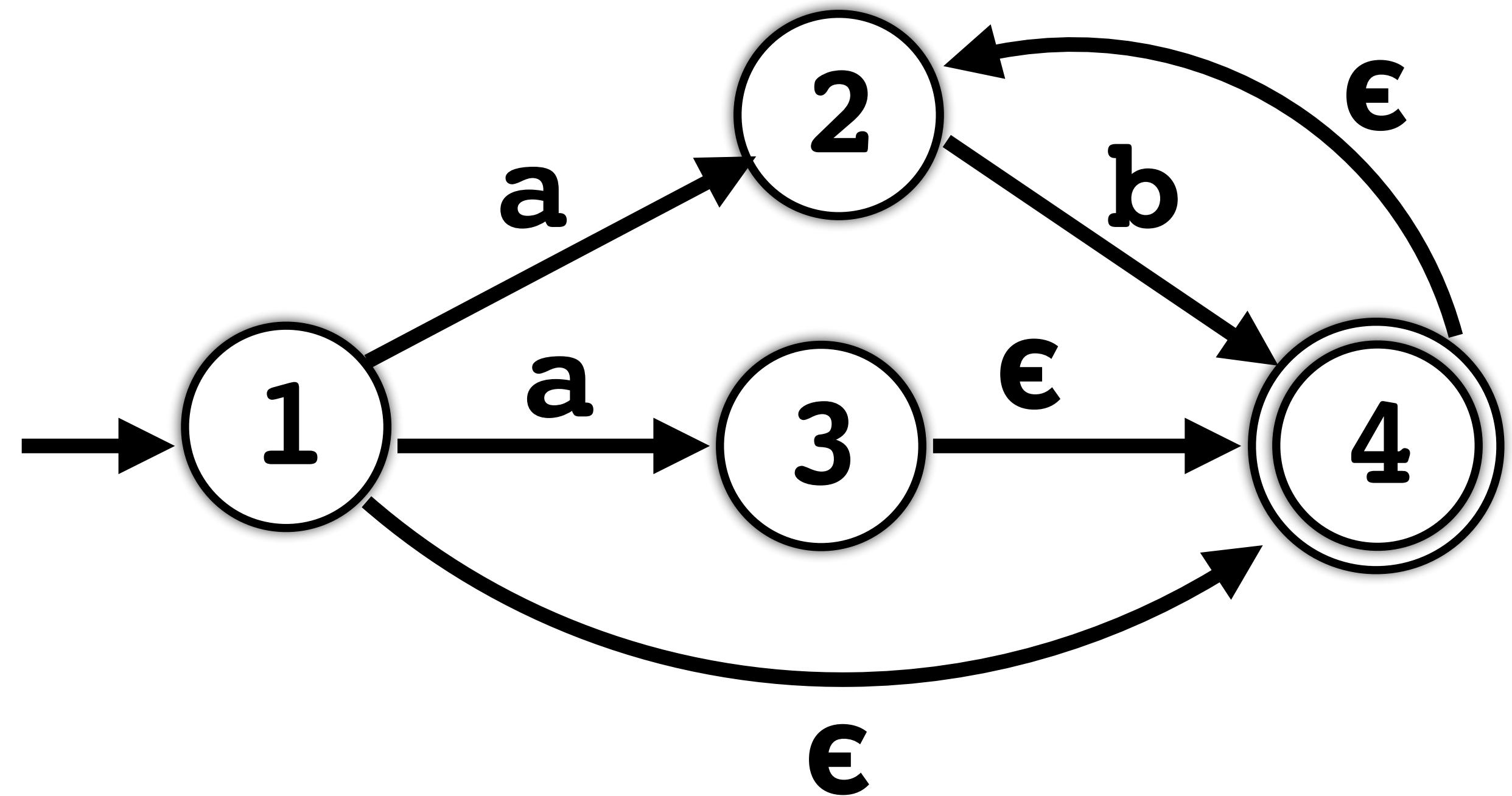
The regular expression r^* translates into



```
procedure  $\epsilon$ -closure( $T$ )
    push all states in  $T$  onto stack
     $C := T$ 
    while stack is not empty do
         $t := \text{pop(stack)}$ 
        for each edge  $t \xrightarrow{\epsilon} u$  do
            if  $u$  is not in  $C$  then
                 $C := C \cup u$ 
                push(stack,  $u$ )
    return  $C$ 
```

$\text{move}(T,a)$

- $\text{move}(T,a)$ is the set of NFA states to which there is a transition on input symbol a from some NFA state $s \in T$.



- $\text{move}(\{1\},a) = \{2,3\}$
- $\text{move}(\{2,3\},b) = \{4\}$

```
procedure SubsetConstruction(NFA N)
    Dstates := {ε-closure(s0)}
    Dtrans := {}
repeat
    T := an unexplored state in Dstates
    for each input symbol a do
        U := ε-closure(move(T, a))
        if U is not in Dstates then
            Dstates := Dstates ∪ U
            Dtrans := Dtrans ∪ (T →a U)
    until all states have been explored
return (Dstates, Dtrans)
```

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