Tutorial Problem:

1, Create NFA for each of the following

```
( a | b)                    ID_1;

( a (b*) a )                ID_2;

( a b a )+             ID_3;
```

2. Construct a single DFA for the above token specifications. using subset construction

3. Use the DFA to get tokens from the following input strings based on the longest match convention:--

abaabaabbabaaaaabaaaa

Nondeterministic Finite Automata

A nondeterministic finite automaton (NFA) consists of:

1. A finite set of states S.

2. A set of input symbols �, the input alphabet. We assume that E, which stands for the empty string, is never a member of �.

3. A transition function that gives, for each state, and for each symbol in � U {E} a set of next states.

4. A state 80 from S that is distinguished as the start state (or initial state) .

5. A set of states F, a subset of S, that is distinguished as the accepting states (or final states) .

We can represent either an NFA or DFA by a transition graph, where the nodes are states and the labeled edges represent the transition function. There is an edge labeled a from state 8 to state t if and only if t is one of the next states for state 8 and input a. This graph is very much like a transition diagram, except:

Algorithm 3.22 :

Simulating an NFA.

INPUT: An input string x terminated by an end-of-file character eof. An NFA N with start state So, accepting states F, and transition function move.

OUTPUT: Answer "yes" if M accepts x; "no" otherwise.

METHOD:

The algorithm keeps a set of current states S, those that are reached from So following a path labeled by the inputs read so far. If c is the next input character, read by the function nextCharO, then we first compute move(S, c) and then close that set using E-closureO. The algorithm is sketched in Fig. 3.37. o

1) S = E-closure(so);

2) c = nextCharO;

3) while (c != eof) {

4) S = E-closure(move(S, c));

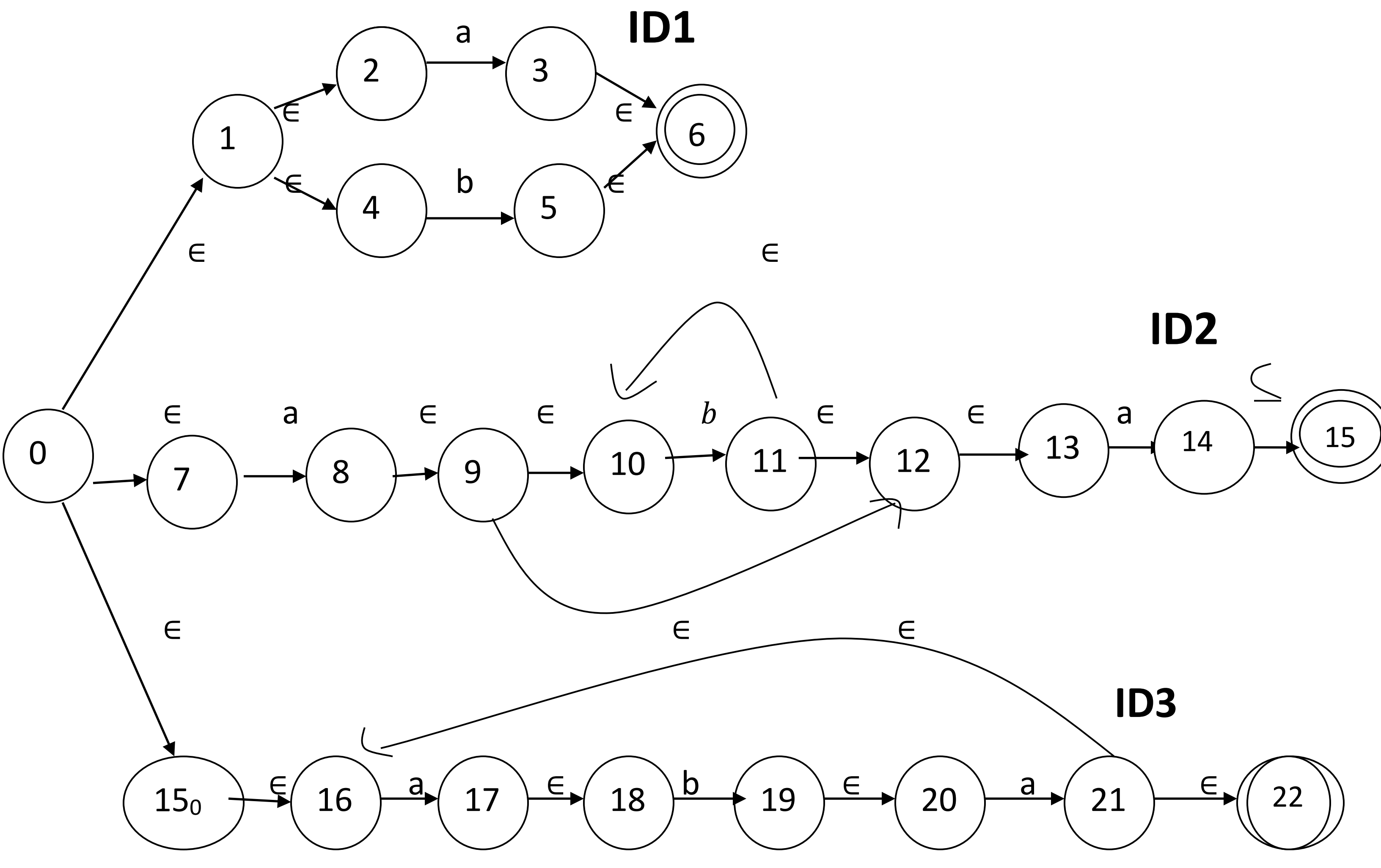
5) c = nextCharO;

6) }

7) if (S n F != 0) return "yes ";

8) else return "no" ;

1.



ID1
ID2
ID3
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
15_0
16
17
18
19
20
21
22
a
b
∈

Conversion of an NFA to a DFA

E-closure(s) :Set of NFA states reachable from NFA state s on E-transitions alone. E-closure(T): Set of NFA states reachable from some NFA state s in set T on E-transitions alone; = Us in T E-closure(s) .

move(T, a) :Set of NFA states to which there is a transition on input symbol a from some state s in T.

```
t-closure(so) is the only state in Dstates, and it is unmarked;
while ( there is an unmarked state T in Dstates )
{
    mark T;
    for ( each input symbol a ) {
        U = t-closure( move(T, a));
        if ( U is not in Dstates )
            add U as an unmarked state to Dstates;
        Dtran[T, a] = U;
    }
}
```

Deterministic Finite Automata

A deterministic finite automaton (DFA) is a special case of an NFA where a E st� b Figure 3.26: NFA accepting aa* lbb*

1. There are no moves on input E, and

2. For each state S and input symbol a, there is exactly one edge out of s labeled a.

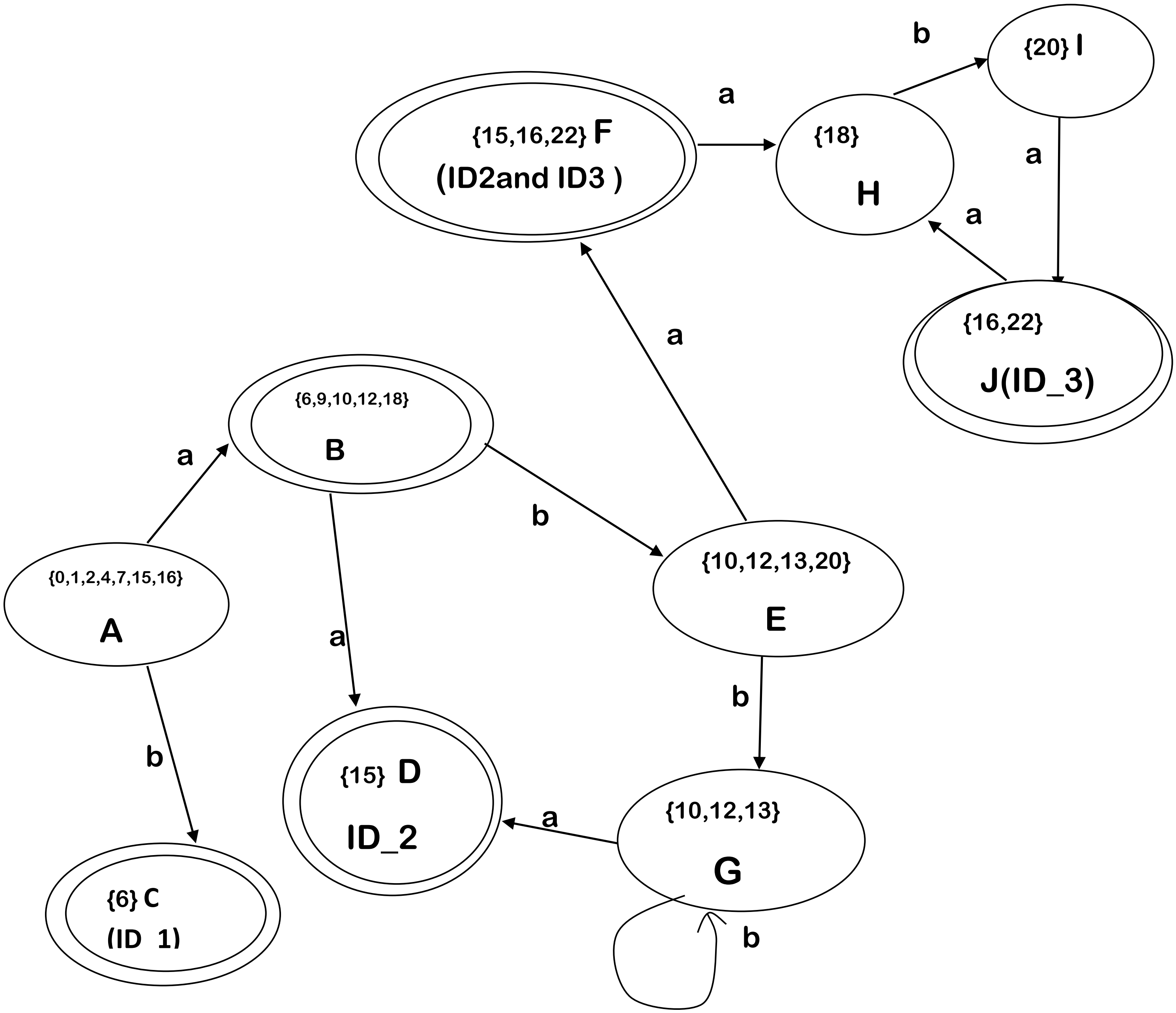
If we are using a transition table to represent a DFA, then each entry is a single state. we may therefore represent this state without the curly braces that we use to form sets

```
s = so;

c = nextCharO;

while ( c != eof)

    {

    s = move(s, c) ;

    c = nextCharO;

    }

    if ( s is in F ) return "yes ";

     else ret urn "no" ;
```

string:str=”abbba”

intial	Iter-2	Iter-3	Iter-4	Iter-5	Final
S=A	S=B	S=E	S=E	S=E	S=D
C=a	C=b	C=b	C=b	C=a	C=eof
C!=eof	C!=eof	C!=eof	C!=eof	C!=eof	
S=>B	S=>E	S=>G	S=>G	S=>D	
C=b	C=b	C=b	C=a	C=eof	

D is final state which is ID_2 so this string accepted by ID_2


{0,1,2,4,7,15,16}
A
{6,9,10,12,18}
B
{6} C
(ID 1)
{15} D
ID_2
{10,12,13,20}
E
{15,16,22} F
(ID2and ID3)
{10,12,13}
G
{18}
H
{20} I
{16,22}
J(ID_3)
a
b

2.Construct a single DFA using subset construction

The start state A of the equivalent DFA is t-closure(O), or

A = {0,1,2,4,7,15₀,16}, sInce these are exactly the states reachable from state 0 via a path all of whose edges have label t. Note that a path can have zero edges, so state 0 is reachable from itself by an t-labeled path.

The input alphabet is {a, b} . Thus, our first step is to mark A and compute Dtran[A, a] = ∈-closure(rriove(A, a))

and Dtran[A, b] = ∈-closure(move(A, b)) . Among the states 0, 1, 2, 4, 7,15 and 16, only 2 , 7 and 16 have transitions on a, to 3, 8 and 17 , respectively.

Thus, move(A, a) = {3, 8,17}.

Also, ∈-closure({3, 8,17}) = {6,9,10,12,18}=B

so we conclude

mov(A,b)={5}

∈-closure(mov(A,b)) =∈-closure({5}) ={6}=C

For state B:

∈-closure(mov(B,a)) =∈-closure(mov({6,9,10,12,18},a)) =∈-closure({14}) ={15}=ID_2=D

∈-closure(mov(B,b)) ==∈-closure(mov({6,9,10,12,18},b)) =∈-closure({11,19}) ={10,12,13,20}=E

For state E

∈-closure(mov(E,a)) =∈-closure(mov({10,12,13,20},a)) =∈-closure({14,21}) = {15,16,22}=F=(ID_2 and ID_3)

∈-closure(mov(E,b)) ==∈-closure(mov({10,12,13,20},b)) =∈-closure({11}) ={10,12,13}=G

For state F

∈-closure(mov(F,a)) =∈-closure(mov({15,16,22},a)) =∈-closure({17}) = {18}=H

∈-closure(mov(F,b)) ==∈-closure(mov({15,16,22},b)) =∈-closure({}) =∅

***For state G*:**

∈-closure(mov(G,a)) =∈-closure(mov({10,12,13},a)) =∈-closure({14}) = $\{15\} = D$

∈-closure(mov(G,b)) ==∈-closure(mov({10,12,13},b)) =∈-closure({11}) ={10,12,13}=G

***For state H*:**

∈-closure(mov(H,a)) =∈-closure(mov({18},a)) =∈-closure({}) =∅

∈-closure(mov(H,b)) ==∈-closure(mov({18},b)) =∈-closure({19}) ={20}=I

***For state I*:**

∈-closure(mov(I,a)) =∈-closure(mov({20},a)) =∈-closure({21}) =$\{16{,}22\}$=J

∈-closure(mov(I,b)) ==∈-closure(mov({20},b)) =∈-closure({}) =∅

***For state J*:**

∈-closure(mov(J,a)) =∈-closure(mov({16,22},a)) =∈-closure({17}) =$\{18\}$=H

$\in$-closure(mov(J,b)) ==$\in$-closure(mov({16,22},b)) =$\in$-closure({}) =$\emptyset$

3. **Use the DFA to get tokens from the following input strings based on the longest match convention:--**

abaabaabbabaaaaabaaaa

string="abaabaabbabaaaaabaaaa"

C=a	**C=b**	**C=a**	**C=a**	**C=b**	**C=a**	**C=a**	**C=b**	**C=b**	**C=a**
S=A	S=B	S=E	S=F	S=H	S=I	S=J	S=H	S=I	
S->B	S->E	S->F	S->H	S->I	S->J	S->H	S->I	S->problem	

Longest match is **abaabaab.**