NFA to DFA

Subset Construction

- The *subset construction algorithm* converts an NFA into a DFA using:
  - ε-*closure*(*s*) = Set of NFA states reachable from NFA state s on ε transition alone (T)
  - ε-*closure*(*T*) = Set of NFA states reachable from NFA state s in T on ε transition alone
  - *move*(*T*,*a*) =Set of NFA states to which there is a transition on input symbol a from some NFA state s in T
- The algorithm produces:
  - *Dstates* is the set of states of the new DFA consisting of sets of states of the NFA
  - *Dtran* is the transition table of the new DFA

ε - Closure

push all states in T onto *stack;*

initialize *ε-closure*(*T*) to T;

while *stack* is not empty **do begin**

pop *t*, the top element, off of *stack*;

for each state *u* with an edge from *t* to *u* labeled *ε do*

if *u* is not in *ε-closure*(*T*) **do begin**

add *u* to *ε-closure(T)*;

push *u* onto *stack*;

end

end

Subset Construction Algorithm

Initially, *ε-closure(s0)* is the only state in *Dstates* and it is unmarked

while there is an unmarked state *T* in *Dstates* **do**

    mark *T*

    for each input symbol $a \in \Sigma$ **do**

        U := ε-*closure*(*move*(*T*,*a*))

        if *U* is not in *Dstates* **then**

            add *U* as an unmarked state to *Dstates*

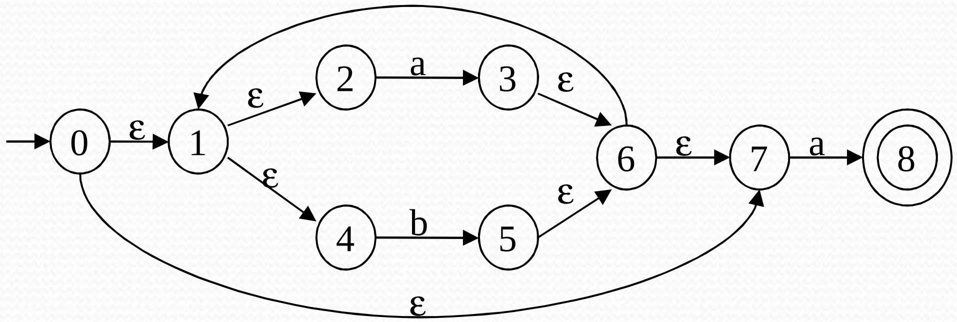
        end if

        Dtran[*T*,*a*] := *U*

    end do

end do

Example



A = ε-closure({0}) = {0,1,2,4,7} A into *Dstates* as an unmarked state

⇓ mark A

ε-closure(move(A ,a)) = ε-closure({3,8}) = {1,2,3,4,6,7,8} = B B into *Dstates*

ε-closure(move(A ,b)) = ε-closure({5}) = {1,2,4,5,6,7} = C C into *Dstates*

Dtran[A,a] 🡐 B Dtran[A,b] 🡐 C

⇓ mark B

ε-closure(move(B,a)) = ε-closure({3,8}) = {1,2,3,4,6,7,8} = B

ε-closure(move(B,b)) = ε-closure({5}) = {1,2,4,5,6,7} = C

Dtran[B,a] 🡐 B Dtran[B,b] 🡐 C

⇓ mark C

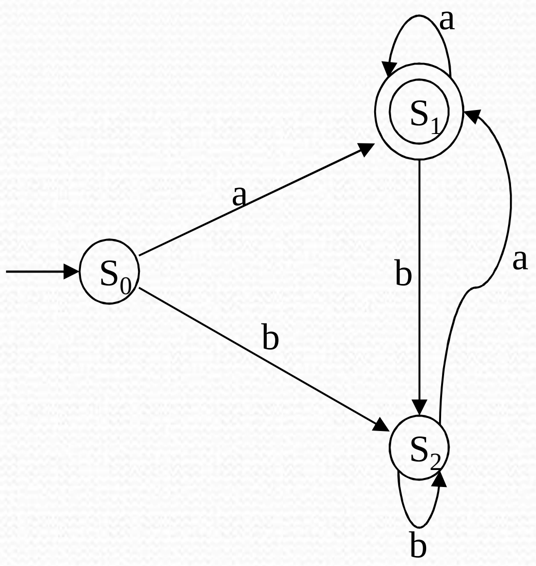
ε-closure(move(C,a)) = ε-closure({3,8}) = {1,2,3,4,6,7,8} = B

ε-closure(move(C,b)) = ε-closure({5}) = {1,2,4,5,6,7} = C

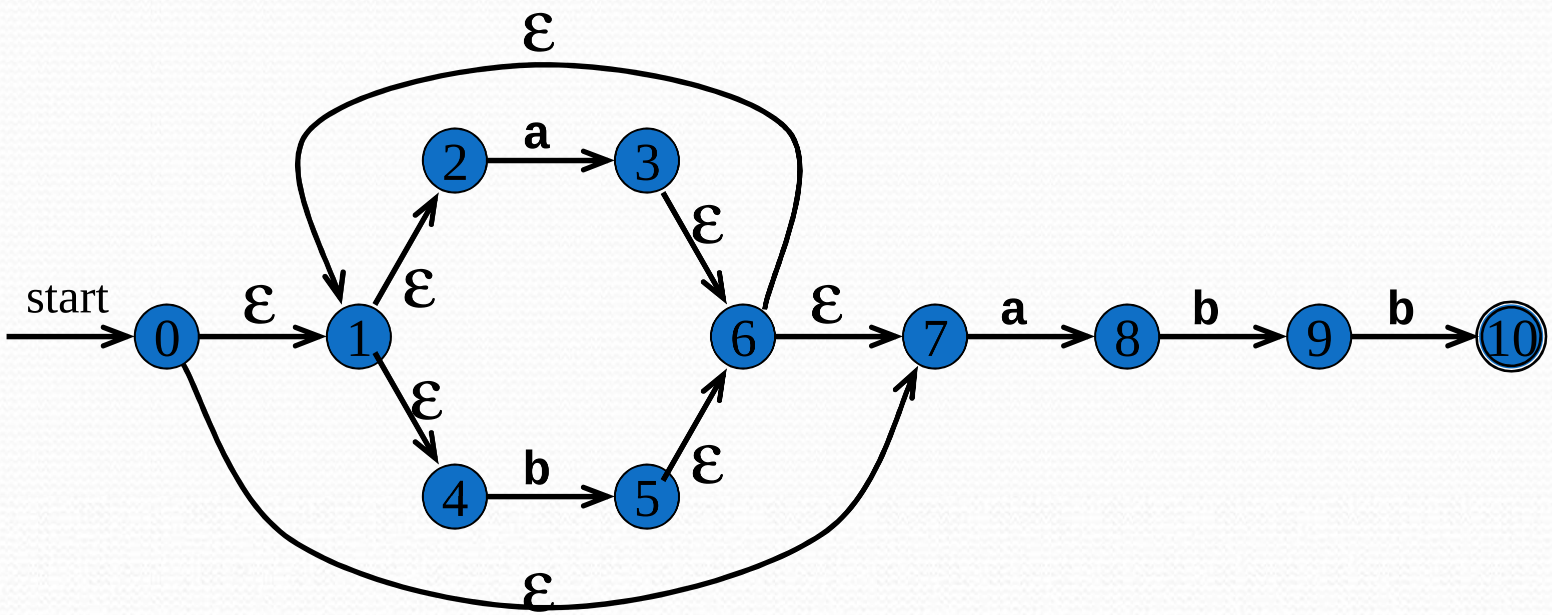
Dtran[C,a] 🡐 B Dtran[C,b] 🡐 C

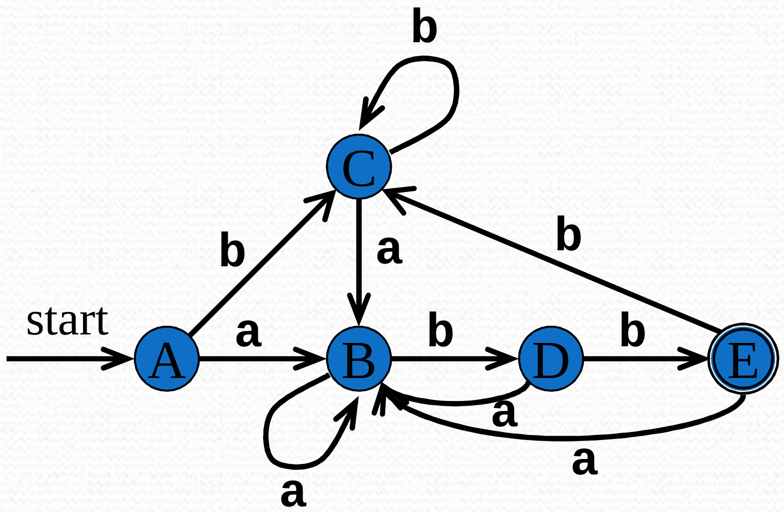
Example Cont…

A is the start state of DFA since 0 is a member of A={0,1,2,4,7}
B is an accepting state of DFA since 8 is a member of B = {1,2,3,4,6,7,8}



Example 2





Dstates

A = {0,1,2,4,7}

B = {1,2,3,4,6,7,8}

C = {1,2,4,5,6,7}

D = {1,2,4,5,6,7,9}

E = {1,2,4,5,6,7,10}

Simulation of an NFA

S := ε-*closure*({*s*0})
a := *nextchar*()
while $S \neq \varnothing$ **do**
    S := ε-*closure*(*move*(S,a))
    a := *nextchar*()
end do
if $S \cap F \neq \varnothing$ **then**
    return "yes"
else return "no"