# Compiler Design

## Week - 3

## Topic : NFA To DFA Conversion

**AIM:** To write a program for converting NFA to DFA.

**ALGORITHM:**

1. Start
2. Get the input from the user
3. Set the only state in SDFA to “unmarked”.
4. while SDFA contains an unmarked state do:

a. Let T be that unmarked state

b. for each a in % do S = e-Closure(MoveNFA(T,a))

c. if S is not in SDFA already then, add S to SDFA (as an “unmarked” state)

d. Set MoveDFA(T,a) to S

5. For each S in SDFA if any s & S is a final state in the NFA then, mark S an a final state in the DFA
6. Print the result.
7. Stop the program

Code :

```
import pandas as pd

nfa = {}
n = int(input("No. of states : "))
t = int(input("No. of transitions : "))
for i in range(n):
    state = input("state name : ")
    nfa[state] = {}
    for j in range(t):
        path = input("path : ")
        print("Enter end state from state {} travelling through path {} : ".format(state, path))
        reaching_state = [x for x in input().split()]
        nfa[state][path] = reaching_state
print("\nNFA :- \n")
print(nfa)
print("\nPrinting NFA table :- ")
nfa_table = pd.DataFrame(nfa)
print(nfa_table.transpose())
print("Enter final state of NFA : ")
nfa_final_state = [x for x in input().split()]
new_states_list = []
dfa = {}
keys_list = list(
    list(nfa.keys())[0])
path_list = list(nfa[keys_list[0]].keys())
dfa[keys_list[0]] = {}
for y in range(t):
    var = "".join(nfa[keys_list[0]][
                      path_list[y]])
    dfa[keys_list[0]][path_list[y]] = var
    if var not in keys_list:
```

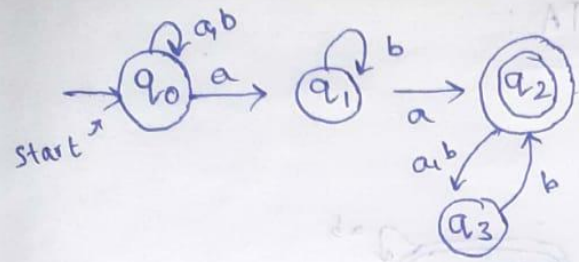
```
            new_states_list.append(var)
            keys_list.append(var)
    while len(new_states_list) != 0:
        dfa[new_states_list[0]] = {}
        for _ in range(len(new_states_list[0])):
            for i in range(len(path_list)):
                temp = []
                for j in range(len(new_states_list[0])):
                    temp += nfa[new_states_list[0][j]][path_list[i]]
                s = ""
                s = s.join(temp)
                if s not in keys_list:
                    new_states_list.append(s)
                    keys_list.append(s)
                dfa[new_states_list[0]][path_list[i]] = s
        new_states_list.remove(new_states_list[0])
    print("\nDFA :- \n")
    print(dfa)
    print("\nPrinting DFA table :- ")
    dfa_table = pd.DataFrame(dfa)
    print(dfa_table.transpose())
    dfa_states_list = list(dfa.keys())
    dfa_final_states = []
    for x in dfa_states_list:
        for i in x:
            if i in nfa_final_state:
                dfa_final_states.append(x)
                break
    print("\nFinal states of the DFA are : ", dfa_final_states)
```

Output :

```
No. of states : 3
No. of transitions : 2
state name : A
path : 0
Enter end state from state A travelling through path 0 :
A
path : 1
Enter end state from state A travelling through path 1 :
A B
state name : B
path : 0
Enter end state from state B travelling through path 0 :
C
path : 1
Enter end state from state B travelling through path 1 :
C
state name : C
path : 0
Enter end state from state C travelling through path 0 :

path : 1
Enter end state from state C travelling through path 1 :


NFA :-

{'A': {'0': ['A'], '1': ['A', 'B']}, 'B': {'0': ['C'], '1': ['C']}, 'C': {'0': [], '1': []}}

Printing NFA table :-
     0       1
A  [A]  [A, B]
B  [C]     [C]
C   []      []
Enter final state of NFA :
C

DFA :-

{'A': {'0': 'A', '1': 'AB'}, 'AB': {'0': 'AC', '1': 'ABC'}, 'AC': {'0': 'A', '1': 'AB'}, 'ABC': {'0': 'AC', '1': 'ABC'}}
```

```
Printing DFA table :-
      0    1
A     A   AB
AB   AC  ABC
AC    A   AB
ABC  AC  ABC

Final states of the DFA are :  ['AC', 'ABC']
```

NFA




It has more than one state for given input.

⑥ Transition table for NFA :

| State | Input | |
|---|---|---|
| | a | b |
| → $q_0$ | $q_0 q_1$ | $q_0$ |
| $q_1$ | $q_2$ | $q_1$ |
| $q_2$ (final) | $q_3$ | $q_3$ |
| $q_3$ | - | $q_2$ |

Transition table for DFA for given NFA

| State | Input | |
|---|---|---|
| | a | b |
| → $q_0$ | $[q_0 q_1]$ = | $[q_0]$ |
| $q_0 q_1$ | $[q_0 q_1 q_2]$ = | $[q_0 q_1]$ |
| $q_0 q_1 q_2$ | $[q_0 q_1 q_2 q_3]$ = | $[q_0 q_1 q_3]$ |
| $q_0 q_1 q_2 q_3$ | $q_0 q_1 q_2 q_3$ | $q_0 q_1 q_2 q_3$ |
| $q_0 q_1 q_3$ | $q_0 q_1 q_2$ | $q_0 q_1 q_2$ |

If we will take the multiple out as new state

∵ $q_2$ is present in both $q_0 q_1 q_2$, $q_0 q_1 q_2 q_3$ these 2 are final states for DFA.

## Transition Diagram for DFA :