Name: Gokulnath M Prabhu
Class: CS7B
Roll No: 21

Lab Cycle 3 - Experiment 12

Write a program to convert NFA to DFA.

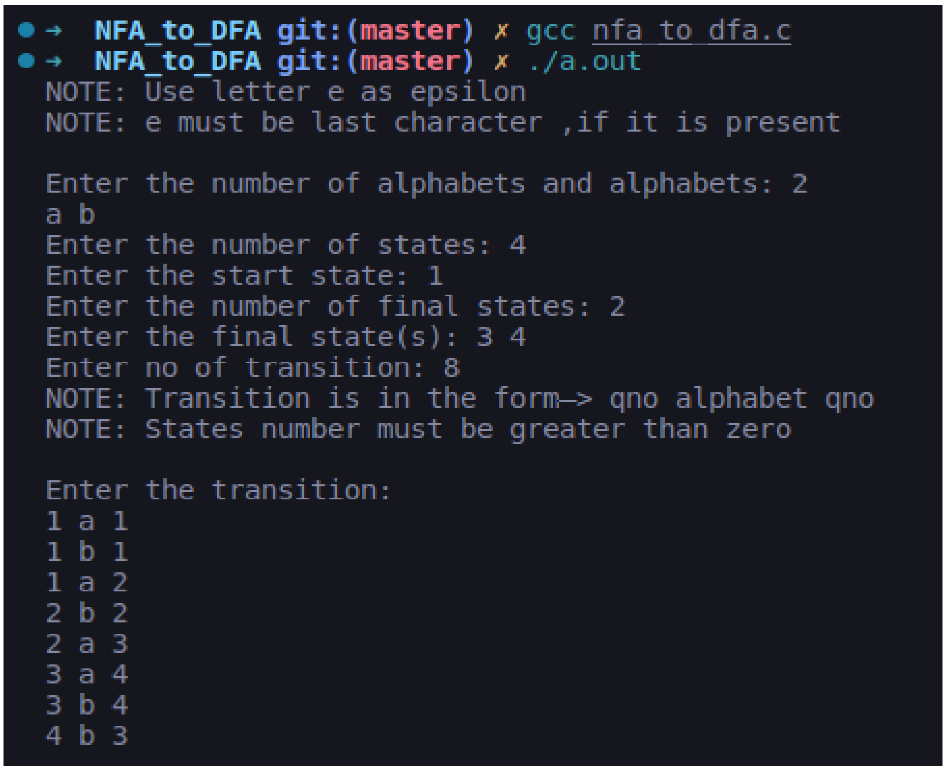
Code:

```c
#include <stdio.h>
#include <stdlib.h>
struct node
{
   int st;
   struct node *link;
};
struct node1
{
   int nst[20];
};

void insert(int, char, int);
int findalpha(char);
void findfinalstate(void);
int insertdfastate(struct node1);
int compare(struct node1, struct node1);
void printnewstate(struct node1);

static int set[20], nostate, noalpha, s, notransition, nofinal, start,
finalstate[20], c, r, buffer[20];
int complete = -1;
char alphabet[20];
static int eclosure[20][20] = {0};
struct node1 hash[20];
struct node *transition[20][20] = {NULL};

void main()
{
   int i, j, k, m, t, n, l;
   struct node *temp;
   struct node1 newstate = {0}, tmpstate = {0};
   printf("NOTE: Use letter e as epsilon\n");
   printf("NOTE: e must be last character ,if it is present\n");
   printf("\nEnter the number of alphabets and alphabets: ");
   scanf("%d", &noalpha);
   getchar();
```

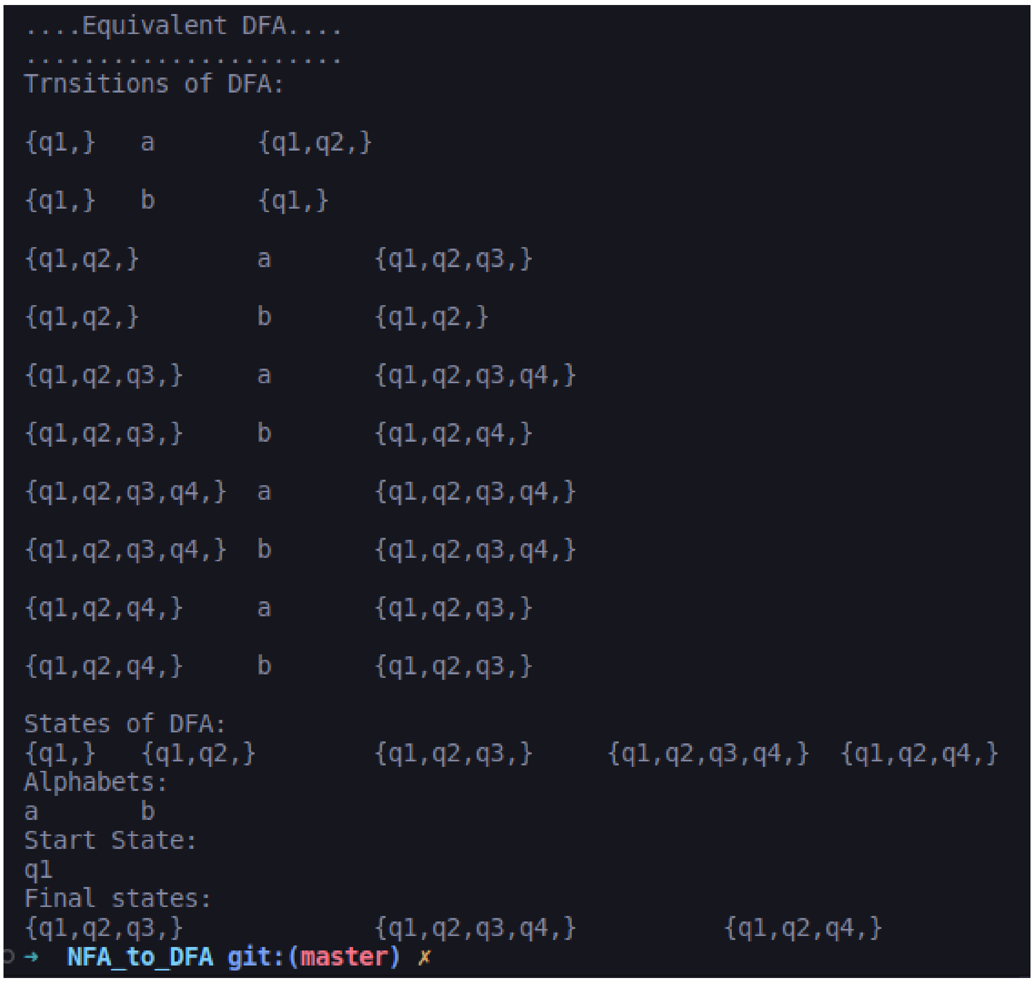
```c
    for (i = 0; i < noalpha; i++)
    {
        alphabet[i] = getchar();
        getchar();
    }
    printf("Enter the number of states: ");
    scanf("%d", &nostate);
    printf("Enter the start state: ");
    scanf("%d", &start);
    printf("Enter the number of final states: ");
    scanf("%d", &nofinal);
    printf("Enter the final state(s): ");
    for (i = 0; i < nofinal; i++)
        scanf("%d", &finalstate[i]);
    printf("Enter no of transition: ");
    scanf("%d", &notransition);
    printf("NOTE: Transition is in the form-> qno alphabet qno\n");
    printf("NOTE: States number must be greater than zero\n");
    printf("\nEnter the transition: \n");
    for (i = 0; i < notransition; i++)
    {
        scanf("%d %lc%d", &r, &c, &s);
        insert(r, c, s);
    }
    for (i = 0; i < 20; i++)
    {
        for (j = 0; j < 20; j++)
            hash[i].nst[j] = 0;
    }
    complete = -1;
    i = -1;
    printf("\n....Equivalent DFA....\n");
    printf(".......................\n");
    printf("Trnsitions of DFA:\n");
    newstate.nst[start] = start;
    insertdfastate(newstate);
    while (i != complete)
    {
        i++;
        newstate = hash[i];
        for (k = 0; k < noalpha; k++)
        {
            c = 0;
            for (j = 1; j <= nostate; j++)
                set[j] = 0;
            for (j = 1; j <= nostate; j++)
            {
                l = newstate.nst[j];
                if (l != 0)
                {
                    temp = transition[l][k];
                    while (temp != NULL)
                    {
                        if (set[temp->st] == 0)
                        {
                            c++;
                            set[temp->st] = temp->st;
                        }
                        temp = temp->link;
                    }
                }
            }
            printf("\n");
            if (c != 0)
            {
                for (m = 1; m <= nostate; m++)
                    tmpstate.nst[m] = set[m];
                insertdfastate(tmpstate);
                printnewstate(newstate);
                printf("%c\t", alphabet[k]);
                printnewstate(tmpstate);
                printf("\n");
            }
            else
            {
                printnewstate(newstate);
                printf("%c\t", alphabet[k]);
                printf("NULL\n");
            }
        }
    }
    printf("\nStates of DFA:\n");
    for (i = 0; i <= complete; i++)
        printnewstate(hash[i]);
    printf("\nAlphabets:\n");
    for (i = 0; i < noalpha; i++)
```

```c
        printf("%c\t", alphabet[i]);
    printf("\nStart State:\n");
    printf("q%d", start);
    printf("\nFinal states:\n");
    findfinalstate();
}

int insertdfastate(struct node1 newstate)
{
    int i;
    for (i = 0; i <= complete; i++)
    {
        if (compare(hash[i], newstate))
            return 0;
    }
    complete++;
    hash[complete] = newstate;
    return 1;
}

int compare(struct node1 a, struct node1 b)
{
    int i;
    for (i = 1; i <= nostate; i++)
    {
        if (a.nst[i] != b.nst[i])
            return 0;
    }
    return 1;
}

void insert(int r, char c, int s)
{
    int j;
    struct node *temp;
    j = findalpha(c);
    if (j == 999)
    {
        printf("error\n");
        exit(0);
    }
    temp = (struct node *)malloc(sizeof(struct node));
    temp->st = s;
    temp->link = transition[r][j];
    transition[r][j] = temp;
}

int findalpha(char c)
{
    int i;
    for (i = 0; i < noalpha; i++)
        if (alphabet[i] == c)
            return i;
    return (999);
}

void findfinalstate()
{
    int i, j, k, t;
    for (i = 0; i <= complete; i++)
    {
        for (j = 1; j <= nostate; j++)
        {
            for (k = 0; k < nofinal; k++)
            {
                if (hash[i].nst[j] == finalstate[k])
                {
                    printnewstate(hash[i]);
                    printf("\t");
                    j = nostate;
                    break;
                }
            }
        }
    }
}
void printnewstate(struct node1 state)
{
    int j;
    printf("{");
    for (j = 1; j <= nostate; j++) {
        if (state.nst[j] != 0)
            printf("q%d,", state.nst[j]);
    }
    printf("}\t");
}
```

Output:



```
● ➜  NFA_to_DFA git:(master) ✗ gcc nfa_to_dfa.c
● ➜  NFA_to_DFA git:(master) ✗ ./a.out
  NOTE: Use letter e as epsilon
  NOTE: e must be last character ,if it is present

  Enter the number of alphabets and alphabets: 2
  a b
  Enter the number of states: 4
  Enter the start state: 1
  Enter the number of final states: 2
  Enter the final state(s): 3 4
  Enter no of transition: 8
  NOTE: Transition is in the form—> qno alphabet qno
  NOTE: States number must be greater than zero

  Enter the transition:
  1 a 1
  1 b 1
  1 a 2
  2 b 2
  2 a 3
  3 a 4
  3 b 4
  4 b 3
```



```
....Equivalent DFA....
......................
Trnsitions of DFA:

{q1,}   a       {q1,q2,}

{q1,}   b       {q1,}

{q1,q2,}        a       {q1,q2,q3,}

{q1,q2,}        b       {q1,q2,}

{q1,q2,q3,}     a       {q1,q2,q3,q4,}

{q1,q2,q3,}     b       {q1,q2,q4,}

{q1,q2,q3,q4,}  a       {q1,q2,q3,q4,}

{q1,q2,q3,q4,}  b       {q1,q2,q3,q4,}

{q1,q2,q4,}     a       {q1,q2,q3,}

{q1,q2,q4,}     b       {q1,q2,q3,}

States of DFA:
{q1,}   {q1,q2,}        {q1,q2,q3,}     {q1,q2,q3,q4,}  {q1,q2,q4,}
Alphabets:
a       b
Start State:
q1
Final states:
{q1,q2,q3,}     {q1,q2,q3,q4,}          {q1,q2,q4,}
○ ➜  NFA_to_DFA git:(master) ✗
```