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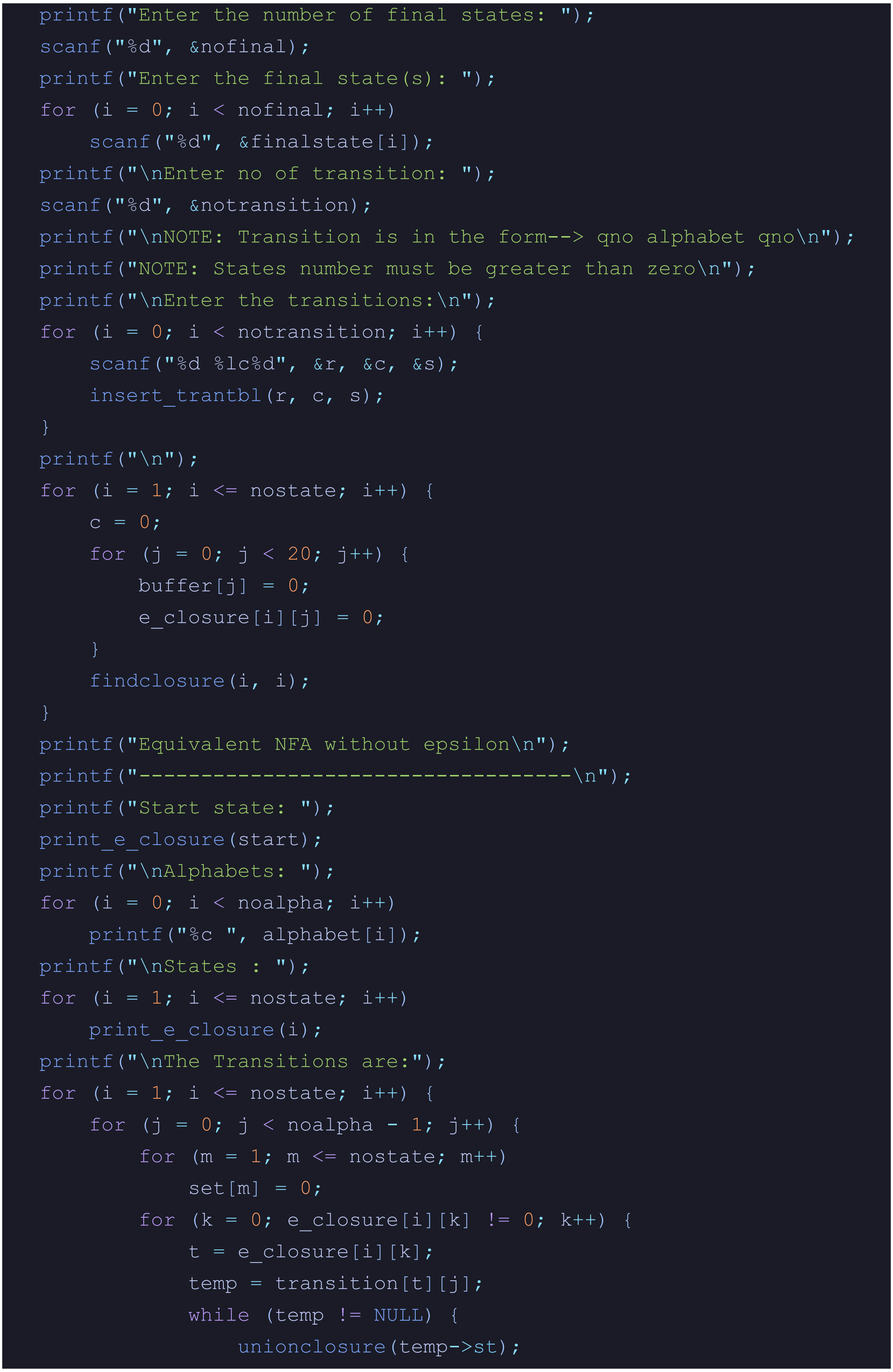
Lab Cycle 3 - Experiment 11

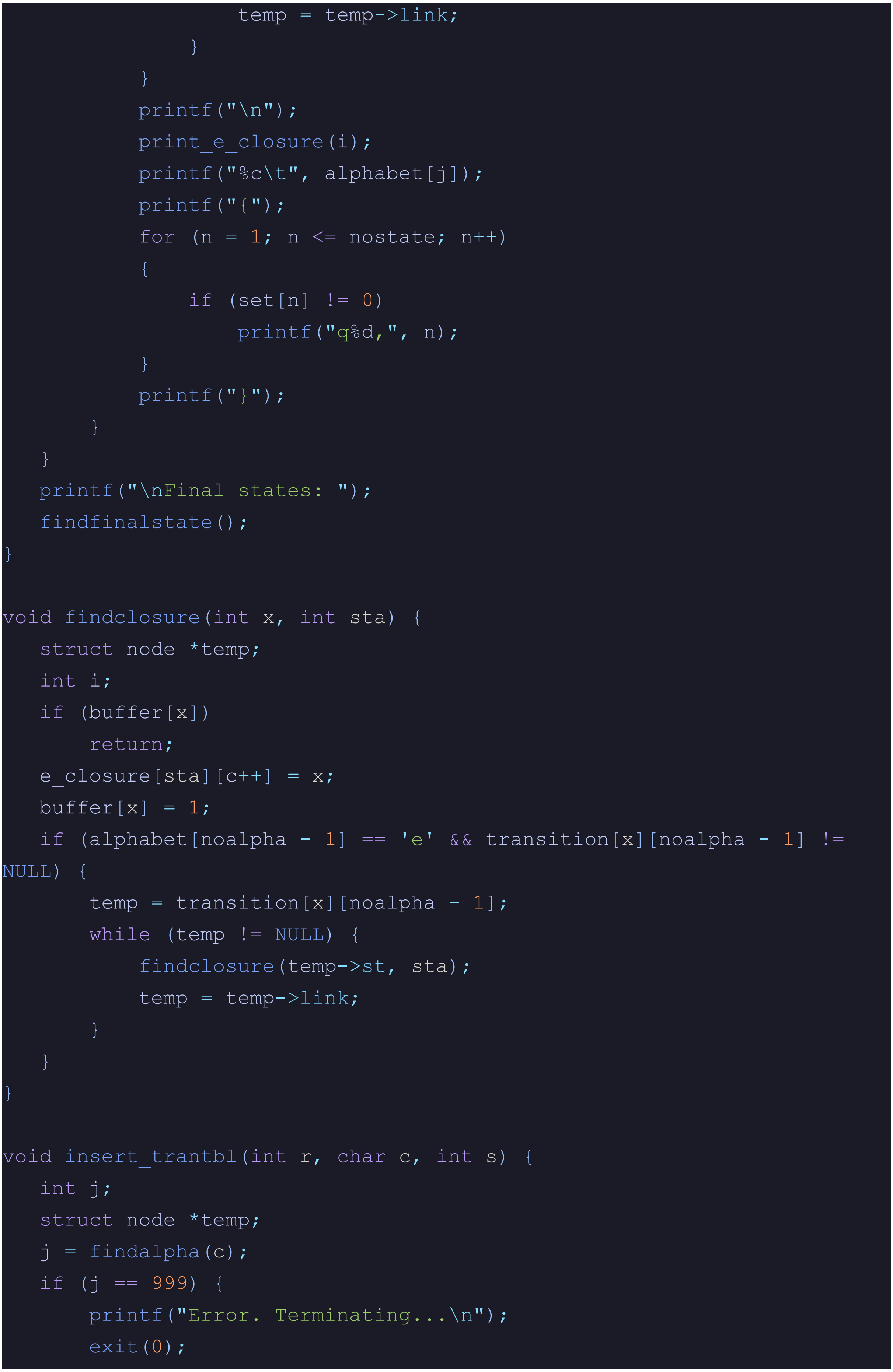
Write a program to convert NFA with ε transition to NFA without ε transition

Code:

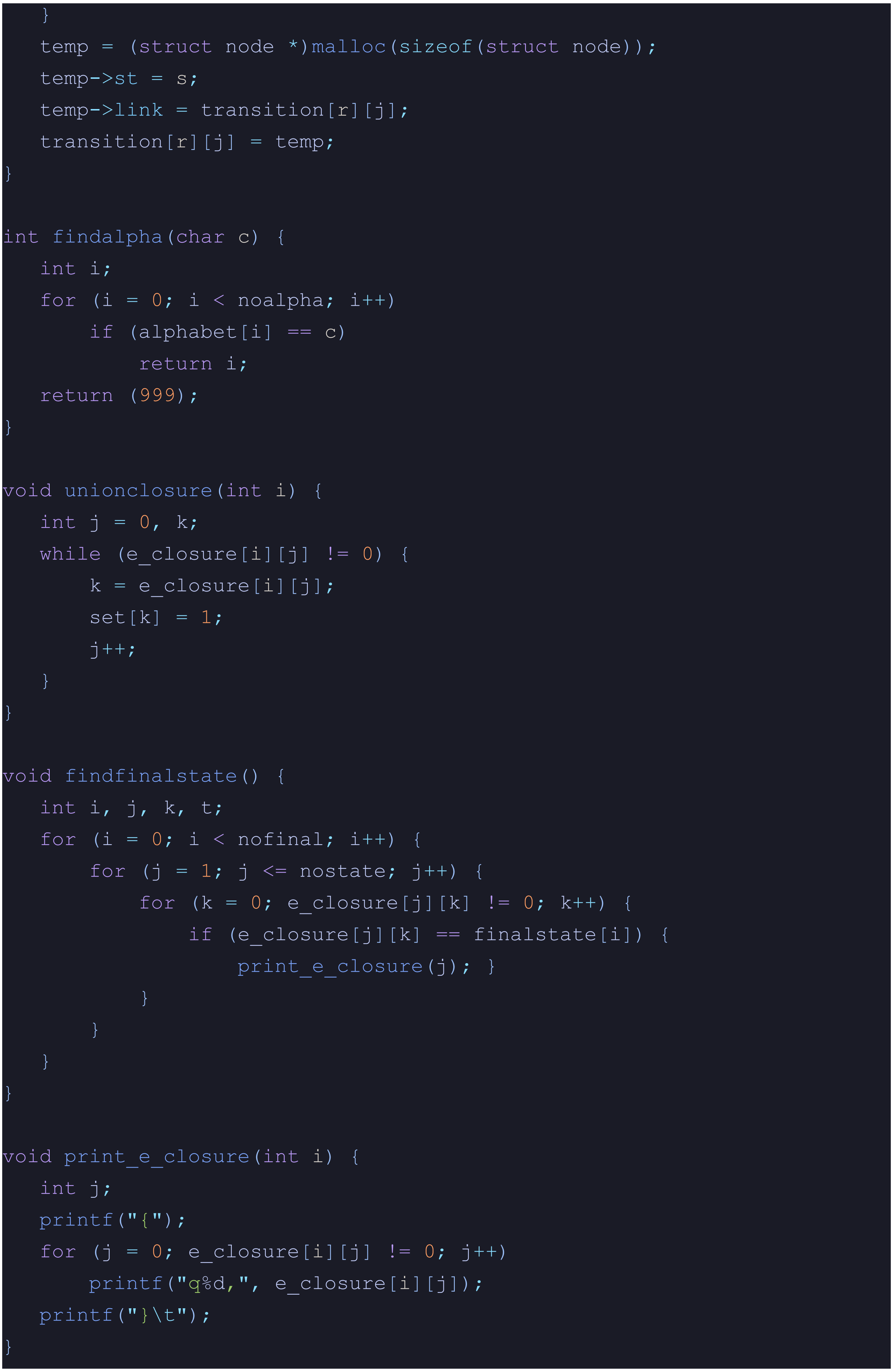
```c
#include <stdio.h>
#include <stdlib.h>
struct node {
   int st;
   struct node *link;
};

void findclosure(int, int);
void insert_trantbl(int, char, int);
int findalpha(char);
void findfinalstate(void);
void unionclosure(int);
void print_e_closure(int);

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

void main() {
   int i, j, k, m, t, n;
   struct node *temp;
   printf("Enter the number of alphabets: ");
   scanf("%d", &noalpha);
   getchar();
   printf("\nNOTE: Use letter e as epsilon\n");
   printf("NOTE: e must be last character, if it is present\n");
   printf("\nEnter the alphabets: ");
   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("\nEnter no of transition: ");
scanf("%d", &notransition);
printf("\nNOTE: Transition is in the form--> qno alphabet qno\n");
printf("NOTE: States number must be greater than zero\n");
printf("\nEnter the transitions:\n");
for (i = 0; i < notransition; i++) {
    scanf("%d %lc%d", &r, &c, &s);
    insert_trantbl(r, c, s);
}
printf("\n");
for (i = 1; i <= nostate; i++) {
    c = 0;
    for (j = 0; j < 20; j++) {
        buffer[j] = 0;
        e_closure[i][j] = 0;
    }
    findclosure(i, i);
}
printf("Equivalent NFA without epsilon\n");
printf("-----------------------------------\n");
printf("Start state: ");
print_e_closure(start);
printf("\nAlphabets: ");
for (i = 0; i < noalpha; i++)
    printf("%c ", alphabet[i]);
printf("\nStates : ");
for (i = 1; i <= nostate; i++)
    print_e_closure(i);
printf("\nThe Transitions are:");
for (i = 1; i <= nostate; i++) {
    for (j = 0; j < noalpha - 1; j++) {
        for (m = 1; m <= nostate; m++)
            set[m] = 0;
        for (k = 0; e_closure[i][k] != 0; k++) {
            t = e_closure[i][k];
            temp = transition[t][j];
            while (temp != NULL) {
                unionclosure(temp->st);
```

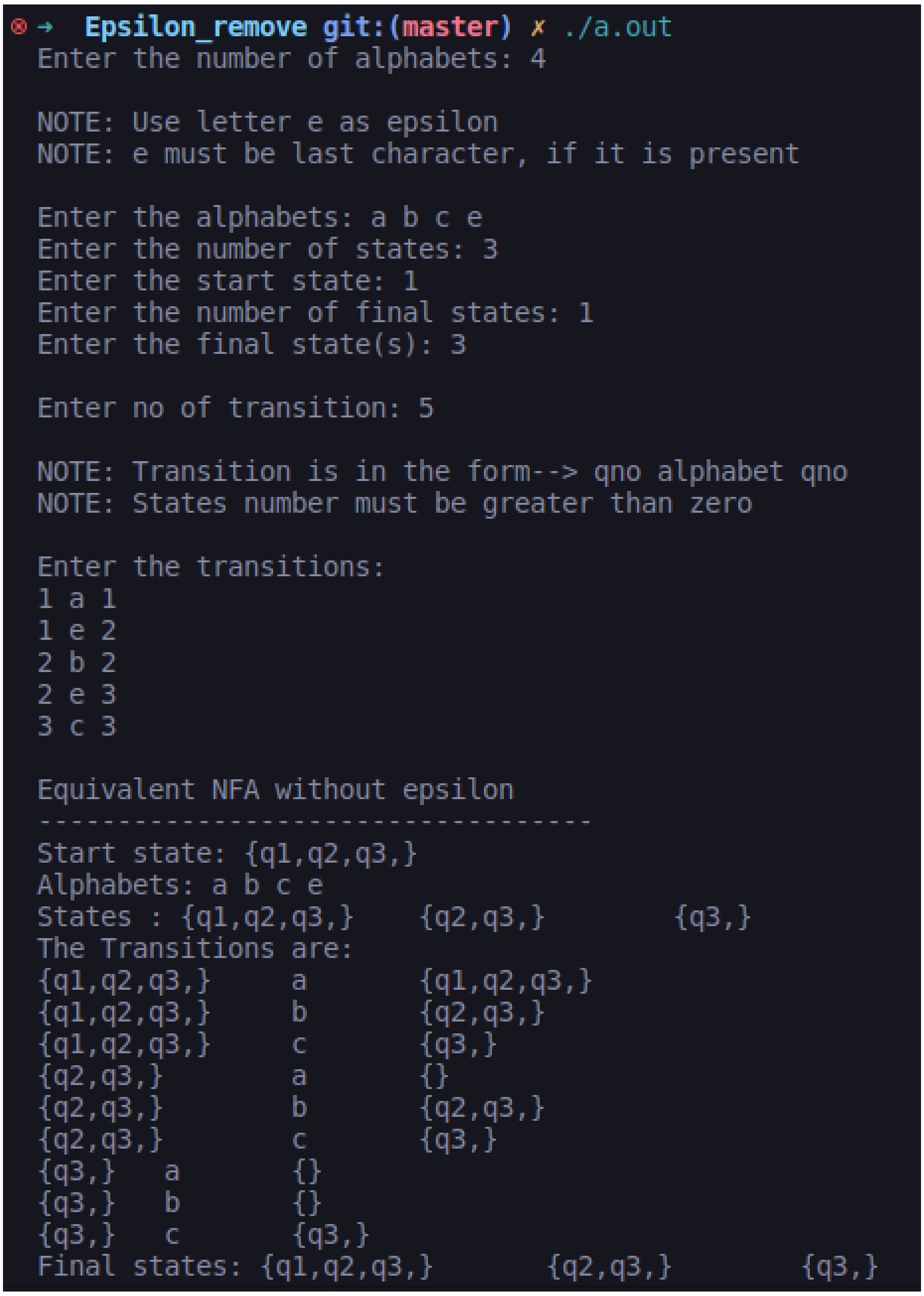


```
                    temp = temp->link;
                }
            }
            printf("\n");
            print_e_closure(i);
            printf("%c\t", alphabet[j]);
            printf("{");
            for (n = 1; n <= nostate; n++)
            {
                if (set[n] != 0)
                    printf("q%d,", n);
            }
            printf("}");
        }
    }
    printf("\nFinal states: ");
    findfinalstate();
}

void findclosure(int x, int sta) {
    struct node *temp;
    int i;
    if (buffer[x])
        return;
    e_closure[sta][c++] = x;
    buffer[x] = 1;
    if (alphabet[noalpha - 1] == 'e' && transition[x][noalpha - 1] !=
NULL) {
        temp = transition[x][noalpha - 1];
        while (temp != NULL) {
            findclosure(temp->st, sta);
            temp = temp->link;
        }
    }
}

void insert_trantbl(int r, char c, int s) {
    int j;
    struct node *temp;
    j = findalpha(c);
    if (j == 999) {
        printf("Error. Terminating...\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 unionclosure(int i) {
    int j = 0, k;
    while (e_closure[i][j] != 0) {
        k = e_closure[i][j];
        set[k] = 1;
        j++;
    }
}

void findfinalstate() {
    int i, j, k, t;
    for (i = 0; i < nofinal; i++) {
        for (j = 1; j <= nostate; j++) {
            for (k = 0; e_closure[j][k] != 0; k++) {
                if (e_closure[j][k] == finalstate[i]) {
                    print_e_closure(j); }
            }
        }
    }
}

void print_e_closure(int i) {
    int j;
    printf("{");
    for (j = 0; e_closure[i][j] != 0; j++)
        printf("q%d,", e_closure[i][j]);
    printf("}\t");
}
```

Output:



```
⊗ →  Epsilon_remove git:(master) ✗ ./a.out
  Enter the number of alphabets: 4

  NOTE: Use letter e as epsilon
  NOTE: e must be last character, if it is present

  Enter the alphabets: a b c e
  Enter the number of states: 3
  Enter the start state: 1
  Enter the number of final states: 1
  Enter the final state(s): 3

  Enter no of transition: 5

  NOTE: Transition is in the form--> qno alphabet qno
  NOTE: States number must be greater than zero

  Enter the transitions:
  1 a 1
  1 e 2
  2 b 2
  2 e 3
  3 c 3

  Equivalent NFA without epsilon
  -----------------------------------
  Start state: {q1,q2,q3,}
  Alphabets: a b c e
  States : {q1,q2,q3,}    {q2,q3,}        {q3,}
  The Transitions are:
  {q1,q2,q3,}     a       {q1,q2,q3,}
  {q1,q2,q3,}     b       {q2,q3,}
  {q1,q2,q3,}     c       {q3,}
  {q2,q3,}        a       {}
  {q2,q3,}        b       {q2,q3,}
  {q2,q3,}        c       {q3,}
  {q3,}   a       {}
  {q3,}   b       {}
  {q3,}   c       {q3,}
  Final states: {q1,q2,q3,}       {q2,q3,}        {q3,}
```