STATE UNIVERSITY OF BANGLADESH (SUB)

Course No: CSE-0408

Course Name: Artificial Intelligence Lab

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```
#include<bits/stdc++.h> using
namespace std;
#define D(x) cerr<<__LINE__<<" : "<<#x<<" -> "<<x<<endl
#define rep(i,j) for(int i = 0; i < 3; i++) for(int j = 0; j < 3; j++)
#define PII pair < int, int > typedef
vector<vector<int>> vec2D;

const int MAX = 1e5+7;
int t=1, n, m, l, k, tc;

int dx[4] = {0, 0, 1, -1}; int
dy[4] = {1, -1, 0, 0};

vec2D init{
   {8, 1, 2},
   {3, 6, 4},
   {0, 7, 5}
};
vec2D goal{
   {1, 3, 2},
   {8, 0, 4},
   {7, 6, 5}
};
//vec2D init{
```

```
//    {1, 2, 3},
//    {8, 6, 0},
//    {7, 5, 4}
//};
//vec2D goal{
//    {1, 2, 3},
//    {8, 0, 4},
//    {7, 6, 5}
//};
//vec2D init{
//    {1, 3, 2},
//    {4, 0, 7},
//    {6, 5, 8}
//};
//vec2D goal{
//    {0, 2, 4},
//    {1, 3, 8},
//    {6, 5, 7}
//};

struct Box {
   vec2D mat{ { 0,0,0 },{ 0,0,0},{ 0,0,0} };
int diff, level;     int x, y;
```

```
   int lastx, lasty;
   Box(vec2D a,int b = 0, int c = 0, PII p = {0,0}, PII q = {0,0}) {
rep(i,j) mat[i][j] = a[i][j];        diff = b;        level = c;        x =
p.first;        y = p.second;        lastx = q.first;        lasty =
q.second;
   }
};

bool operator < (Box A, Box B) {     if(A.diff
== B.diff) return A.level < B.level;     return
A.diff < B.diff;
}

int isEqual(vec2D a, vec2D b) {
int ret(0);
   rep(i,j) if (a[i][j] != b[i][j]) ret--;
return ret;
}

bool check(int i, int j) {
   return i>=0 and i<3 and j>=0 and j<3;
}

void print(Box a) {
```

```
   rep(i,j)
   cout << a.mat[i][j] << (j == 2 ? "\n" : " ");
   D(-a.diff);     D(-
a.level);
   cout << "(" << a.x << "," << a.y <<")\n\n";
}



void dijkstra(int x, int y) {
map < vec2D,  bool > mp;
priority_queue < Box > PQ;
int nD = isEqual(init, goal);
   Box src = {init, nD, 0, {x,y}, {-1,-1}};
PQ.push(src);     int state = 0;
while(!PQ.empty()) {        state++;
       Box now = PQ.top();
       PQ.pop();
       print(now);
if(!now.diff) {
          puts("Goal state has been discovered");
cout << "level : " << -now.level << "\n";
D(state);           break;
       }
```

```
        if(mp[now.mat]) continue;
mp[now.mat] = true;
        for(int i = 0; i < 4; i++) {
int xx = now.x + dx[i];
int yy = now.y + dy[i];
if(check(xx, yy)) {
                if(now.lastx == xx and now.lasty == yy) continue;
Box temp = now;
                swap(temp.mat[temp.x][temp.y], temp.mat[xx][yy]);
temp.diff = isEqual(temp.mat, goal);                temp.level =
now.level - 1;                temp.x = xx;                temp.y = yy;
temp.lastx = now.x;                temp.lasty = now.y;
                PQ.push(temp);
            }
        }
    }
}



signed main() {
puts("Current State:");
    rep(i,j) cout << init[i][j] << (j == 2 ? "\n" : " ");
puts("");     puts("Goal State:");
```

```
   rep(i,j) cout << goal[i][j] << (j == 2 ? "\n" : " ");
puts("\n.....Search Started.....\n");
rep(i,j) if(!init[i][j]) dijkstra(i,j);     return 0;
}
```

Output Clear

```
/tmp/kuWxkyV4qd.o
Current State:
8 1 2
3 6 4
0 7 5

Goal State:
1 3 2
8 0 4
7 6 5
.....Search Started.....

8 1 2
3 6 4
0 7 5
79 : -a.diff -> 6
80 : -a.level -> 0
(2,0)
```

Output Clear

```
8 1 2
3 6 4
7 0 5
79 : -a.diff -> 5
80 : -a.level -> 1
(2,1)

8 1 2
3 0 4
7 6 5
79 : -a.diff -> 3
80 : -a.level -> 2
(1,1)

8 1 2
0 3 4
7 6 5
79 : -a.diff -> 4
80 : -a.level -> 3
(1,0)
```

Output

Clear

```
8 1 2
0 3 4
7 6 5
79 : -a.diff -> 4
80 : -a.level -> 3
(1,0)

0 1 2
8 3 4
7 6 5
79 : -a.diff -> 3
80 : -a.level -> 4
(0,0)

1 0 2
8 3 4
7 6 5
79 : -a.diff -> 2
80 : -a.level -> 5
(0,1)
```

```
7 6 5
79 : -a.diff -> 3
80 : -a.level -> 4
(0,0)

1 0 2
8 3 4
7 6 5
79 : -a.diff -> 2
80 : -a.level -> 5
(0,1)

1 3 2
8 0 4
7 6 5
79 : -a.diff -> 0
80 : -a.level -> 6
(1,1)

Goal state has been discovered
level : 6
101 : state -> 7
```