STATE UNIVERSITY OF BANGLADESH (SUB)

Course No: CSE-0408

Course Name: Artificial Intelligence Lab

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Submitted to:

Khan Md. Hasib

Lecturer,

Department of CSE, SUB

Main Code:

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

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

intdx[4] = {0, 0, 1, -1};
intdy[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;
intlastx, 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;
}

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

bool check(inti, 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;
intnD = 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(inti = 0; i< 4; i++) {
int xx = now.x + dx[i];
intyy = 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:-

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)
```

Submitted By:

Name: Yeasmin Akter

ID: UG02-48-18-013

Batch:48

Email: yasminepsha@gmail.com