AI Tutorial 5

Write a program to Implement A* Algorithm.

Code:-

```
#include <list>

#include <algorithm>

#include <iostream>


class point {

public:

   point( int a = 0, int b = 0 ) { x = a; y = b; }

   bool operator ==( const point& o ) { return o.x == x && o.y == y; }

   point operator +( const point& o ) { return point( o.x + x, o.y + y ); }

   int x, y;

};


class map {

public:

   map() {

      char t[8][8] = {

         {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},

         {0, 0, 0, 0, 1, 1, 1, 0}, {0, 0, 1, 0, 0, 0, 1, 0},

         {0, 0, 1, 0, 0, 0, 1, 0}, {0, 0, 1, 1, 1, 1, 1, 0},

         {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}

      };

      w = h = 8;

      for( int r = 0; r < h; r++ )

         for( int s = 0; s < w; s++ )
```

```
                m[s][r] = t[r][s];
    }
    int operator() ( int x, int y ) { return m[x][y]; }
    char m[8][8];
    int w, h;
};

class node {
public:
    bool operator == (const node& o ) { return pos == o.pos; }
    bool operator == (const point& o ) { return pos == o; }
    bool operator < (const node& o ) { return dist + cost < o.dist + o.cost; }
    point pos, parent;
    int dist, cost;
};

class aStar {
public:
    aStar() {
        neighbours[0] = point( -1, -1 ); neighbours[1] = point(  1, -1 );
        neighbours[2] = point( -1,  1 ); neighbours[3] = point(  1,  1 );
        neighbours[4] = point(  0, -1 ); neighbours[5] = point( -1,  0 );
        neighbours[6] = point(  0,  1 ); neighbours[7] = point(  1,  0 );
    }

    int calcDist( point& p ){
        // need a better heuristic
        int x = end.x - p.x, y = end.y - p.y;
        return( x * x + y * y );
    }
```

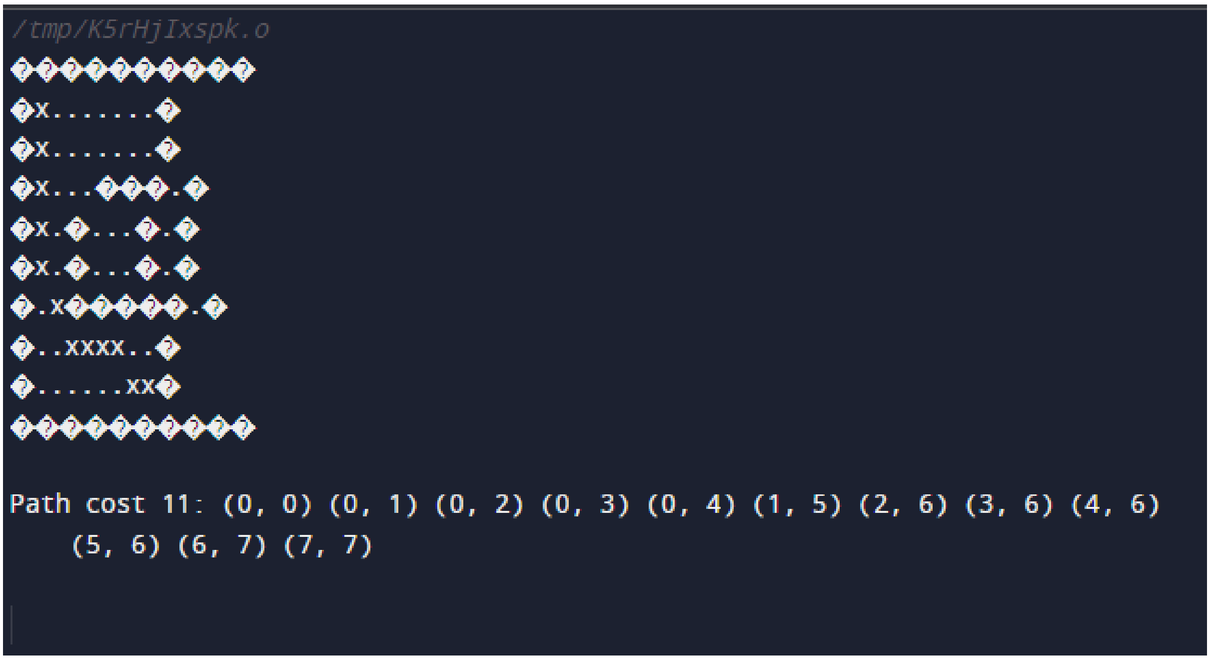
```
bool isValid( point& p ) {
    return ( p.x >-1 && p.y > -1 && p.x < m.w && p.y < m.h );
}

bool existPoint( point& p, int cost ) {
    std::list<node>::iterator i;
    i = std::find( closed.begin(), closed.end(), p );
    if( i != closed.end() ) {
        if( ( *i ).cost + ( *i ).dist < cost ) return true;
        else { closed.erase( i ); return false; }
    }
    i = std::find( open.begin(), open.end(), p );
    if( i != open.end() ) {
        if( ( *i ).cost + ( *i ).dist < cost ) return true;
        else { open.erase( i ); return false; }
    }
    return false;
}

bool fillOpen( node& n ) {
    int stepCost, nc, dist;
    point neighbour;

    for( int x = 0; x < 8; x++ ) {
        // one can make diagonals have different cost
        stepCost = x < 4 ? 1 : 1;
        neighbour = n.pos + neighbours[x];
        if( neighbour == end ) return true;
```

```
        if( isValid( neighbour ) && m( neighbour.x, neighbour.y ) != 1 ) {
            nc = stepCost + n.cost;
            dist = calcDist( neighbour );
            if( !existPoint( neighbour, nc + dist ) ) {
                node m;
                m.cost = nc; m.dist = dist;
                m.pos = neighbour;
                m.parent = n.pos;
                open.push_back( m );
            }
        }
    }
    return false;
}

bool search( point& s, point& e, map& mp ) {
    node n; end = e; start = s; m = mp;
    n.cost = 0; n.pos = s; n.parent = 0; n.dist = calcDist( s );
    open.push_back( n );
    while( !open.empty() ) {
        //open.sort();
        node n = open.front();
        open.pop_front();
        closed.push_back( n );
        if( fillOpen( n ) ) return true;
    }
    return false;
}

int path( std::list<point>& path ) {
```

```
        path.push_front( end );
        int cost = 1 + closed.back().cost;
        path.push_front( closed.back().pos );
        point parent = closed.back().parent;

        for( std::list<node>::reverse_iterator i = closed.rbegin(); i != closed.rend(); i++ ) {
            if( ( *i ).pos == parent && !( ( *i ).pos == start ) ) {
                path.push_front( ( *i ).pos );
                parent = ( *i ).parent;
            }
        }
        path.push_front( start );
        return cost;
    }

    map m; point end, start;
    point neighbours[8];
    std::list<node> open;
    std::list<node> closed;
};

int main( int argc, char* argv[] ) {
    map m;
    point s, e( 7, 7 );
    aStar as;

    if( as.search( s, e, m ) ) {
        std::list<point> path;
        int c = as.path( path );
        for( int y = -1; y < 9; y++ ) {
```

```
            for( int x = -1; x < 9; x++ ) {
                if( x < 0 || y < 0 || x > 7 || y > 7 || m( x, y ) == 1 )
                    std::cout << char(0xdb);
                else {
                    if( std::find( path.begin(), path.end(), point( x, y ) )!= path.end() )
                        std::cout << "x";
                    else std::cout << ".";
                }
            }
            std::cout << "\n";
        }

        std::cout << "\nPath cost " << c << ": ";
        for( std::list<point>::iterator i = path.begin(); i != path.end(); i++ ) {
            std::cout<< "(" << ( *i ).x << ", " << ( *i ).y << ") ";
        }
    }
    std::cout << "\n\n";
    return 0;
}
```

Output:-



```
/tmp/K5rHjIxspk.o
����������
�x.......�
�x.......�
�x...���.�
�x.�...�.�
�x.�...�.�
�.x�����.�
�..xxxx..�
�......xx�
����������

Path cost 11: (0, 0) (0, 1) (0, 2) (0, 3) (0, 4) (1, 5) (2, 6) (3, 6) (4, 6)
    (5, 6) (6, 7) (7, 7)
```