Class Number: CPSC 481-04
Project Number and Name: Project 1, A* Search
Team Name: IDK_Guys
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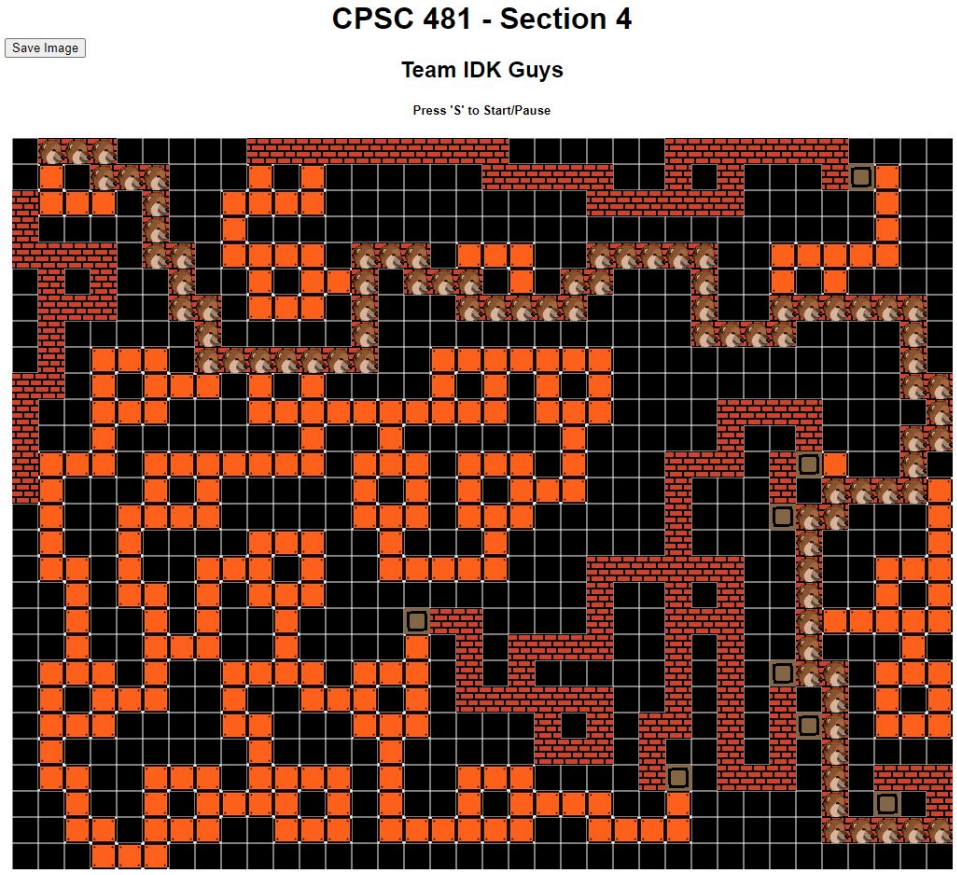
Project Algorithm Report

Step Count:

```
(p5 draw_bot  2 1 0  )                    cs-sketch-paint.js:192
end draw_bot)                             cs-sketch-paint.js:201
(p5 draw_bot  2 35 26  )                  cs-sketch-paint.js:192
end draw_bot)                             cs-sketch-paint.js:201
Step Count = 84                           cs-sketch-paint.js:313
```

The bot goes through several different paths creating several routes in the process. The step count does not count backtracking or other paths to create the true step count. The final step count is decided when the bot reaches the goal tile and then counts backwards and compares it to other finished paths to check for the shortest path. The final step counts for the best path being 84 steps.

Final Board Position:



As shown above, this is the shortest path deemed by the AI with a step count of 84. The orange boxes represent the path the AI Bot has taken and visited, while the Brown boxes indicate the potential paths the bot will eventually visit. The pixel dog represents the bot's current best path eventually leading the end. There is an example of where a path could be taken by the bot, but it deemed it longer than the best path shown, leaving the alternate path as a brown box.

Algorithm:

```
function draw()  // P5 Frame Re-draw fcn, called for every frame.
{
    ++g_frame_cnt;
    if (!g_stop && (0 == g_frame_cnt % g_frame_mod))
    {
        //console.log( "p5 draw" );
        //move_bot_to_mouse( );
        //draw_update( );


        if (openSet.length > 0) {
            // keep going
            var lowestIndex = 0;
            for (var i = 0; i < openSet.length; i++) {
                if (openSet[i].f < openSet[lowestIndex].f) {
                    lowestIndex = i;
                }
            }
            var current = openSet[lowestIndex];
            console.log(current)

            for (var i = 0; i < openSet.length; i++) {
                draw_bot(0, openSet[i].x, openSet[i].y);
            }

            for (var i = 0; i < closeSet.length; i++) {
                draw_bot(3, closeSet[i].x, closeSet[i].y);
            }


            if (current == end) { // end the loop when reach the end
                noLoop();
            }

            removeFromArray(openSet, current);
            closeSet.push(current);

            // calculate the f, g, and h for all the neighbors
            var neighbors = current.neighbors;
            for (var i = 0; i < neighbors.length; i++) {
                var neighbor = neighbors[i];

                if (!closeSet.includes(neighbor)){
                    // Counting the amount of g/steps
                    var tempSteps = current.g + 1;

                    if (openSet.includes(neighbor)) {
                        if (tempSteps < neighbor.g) {
                            neighbor.g = tempSteps;
                        }
                    }
                    else {
                        neighbor.g = tempSteps;
                        openSet.push(neighbor);
                    }

                    neighbor.h = heuristic(neighbor, end);
                    neighbor.f = neighbor.g + neighbor.h;
                    neighbor.previous = current;
                }
            }

            // draw the best path
            var stepCount = 0;
            console.log("DONE!");
            path = [];
            var temp = current;
            path.push(temp);
            while (temp.previous) {
                path.push(temp.previous);
                temp = temp.previous;
                stepCount++;
                draw_bot(2, temp.x, temp.y);
            }
            draw_bot(2, current.x, current.y);
            console.log("Step Count = " + stepCount);
        }
    }
```

For our algorithm, we first set up a 2d array to allow each tile to store information of its location, f, g, h value, neighboring tile, and the previous tile in relation to the current tile. Using the Draw() function, we locate the tile with the lowest f value in the open set. We set the bot to that tile by setting it as the current tile, and we remove it from the open set and push it to the closed set indicating that the tile is visited. We would then check all neighboring tiles of the current tile. First, we have to ensure the neighboring tile is not in the close-set because the close-set indicates that the tile had already been visited. Then we check if the neighboring tile is in the open set, and if it's not in the open set, we have to push it to the open set. We then calculate its f, g, h value and set the previous tile to the current tile, linking up the 2 tiles; this is how the bot creates the paths seen in the program. We then show the current best path at the end of each loop. The draw() function continues looping when there are still tiles in the open set or if the bot reaches the end tile. continues looping when there are still tiles in the open set or if the bot reaches the end tile.

Code References:

C. (2017, January 16). Coding Challenge 51.1: A* Pathfinding Algorithm - Part 1. Retrieved October 16, 2020, from https://www.youtube.com/watch?v=aKYlikFAV4k